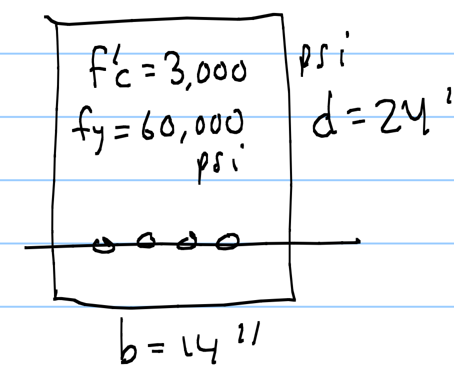
Note Title 4/24/2007

HW # 7 Due

HW # 8 8.8, 8.22 Concrete Text

Shear Design Due 5/1 (Tuesday)

Ex. 8.2 (modified)



(a) V_u = 10,000 lb no

(b) V_u = 25,000 lb 12"

(c) V_u = 50,000 lb 10"

(d) V_u = 100,000 lb 3"

(e) V_u = 150,000 lb

(b)–(d): need stirrups

#3 Stirrups

$A_s = 0.11 in^2$

Do we need stirrups ?

And if so, what spacing ?

$$V_c = 2\sqrt{f'_c}\, b_w d = 2\sqrt{3000}\,(14)(24) = 36{,}807 \text{ lb}$$

$$\phi V_c = (.75)\, V_c = 27{,}605 \text{ lb} \qquad 2V_c = 73{,}614 \text{ lb}$$

$$\tfrac{1}{2}\phi V_c = 13{,}803 \text{ lb} \qquad 4V_c = 147{,}228 \text{ lb}$$

(a) $\underset{}{\overset{V_u}{10{,}000}} < \tfrac{1}{2}\phi V_c$ No Stirrups

(b) – (e) need stirrups

(b) $V_u > \tfrac{1}{2}\phi V_c$ need stirrups

$25{,}000 > 13{,}803$

$$V_s = \left(\frac{V_u - \phi V_c}{\phi}\right) = \frac{25{,}000 - 27{,}605}{(.75)}$$

$$V_s = -3{,}473 \text{ lb}$$

$$S_{max} \le \frac{A_v f_y}{(0.75)\sqrt{f'_c}\, b_w} = \frac{(2\times 0.11)(60{,}000)}{(.75)\sqrt{3000}\,(14)} = 22.95''$$

$$\le \frac{A_v f_y}{50 b_w} = \frac{(2 \times 0.11)(60{,}000)}{50 \underset{(14)}{b_w}} = 18.86''$$

$\rightarrow$ $V_s < 2V_c$ ✓ $\quad d/2 =$ [redacted]

$-3473 < 73{,}614$

$$\boxed{S_{max} = 12''}$$

$S = 12''$

$$V_{s_{12''}} = \frac{A_v f_y d}{S} = \frac{(2 \times 0.11)(60000)(24)}{12} = 26{,}400\ lb$$

$$\phi V_{s_{12}} = (.75)(26{,}400) = 19{,}800\ lb$$

$$\phi V_c + \phi V_{s_{12}} = \underline{27{,}605} + 19{,}800 = 47{,}405\ lb$$

$> 25{,}000$ ✓

(c) $V_u = 50{,}000$ need stirrups

$$V_s = \frac{V_u - \phi V_c}{\phi} = 29{,}860 \text{ lb} < 2V_c$$

$73{,}000$

$S_{max} = d/2 = 12''$

$$S = \frac{A_v f_y d}{V_s}$$

$$S = \frac{(0.11 \times 2)(60000)(24)}{29{,}860} = 10.61''$$

$10'' = S$

(d) $V_u = 100{,}000$

$V_s = 96{,}527 > 2V_c$

$2V_c < V_s = 96{,}527 < 4V_c$

$147{,}228$

$d/4 = 24/4 = 6''$

S_{max}

$$S = \frac{A_v f_y d}{V_s} = \frac{(2 \times 0.11)(60{,}000)(24)}{96{,}527} = 3.28''$$

$$\boxed{S = 3''}$$

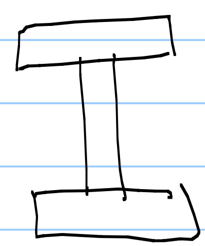
(e) $V_u = 150{,}000$

$V_s = 163{,}193 \text{ lb} > 4V_c$ (147,228) ✗

Steel Beams - Intro (Ch. 8 and Ch 9, steel)

- **Sections used for steel beams**

$M \rightarrow \sigma = \frac{My}{I} \rightarrow$ to get lower σ, want higher I



I-shaped section, gives max moment of inertia with min. area.

- **Standard Rolled Shapes**

W-sections → most commonly used for beams, generally most efficient

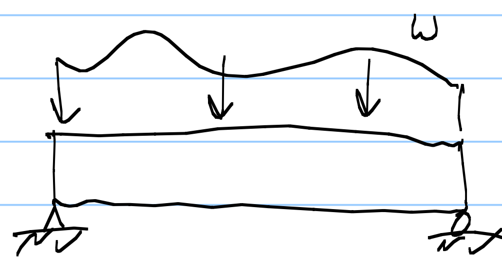
S-sections, M-sections } narrower flanges, may be used to satisfy construction tolerances

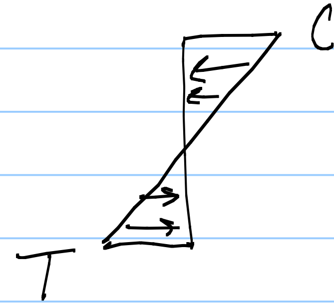
HP-sections → not generally used for beams

Plate Girders

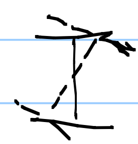
used when need a larger section than rolled shapes

- **Limit States for Steel Beams, Flexural**





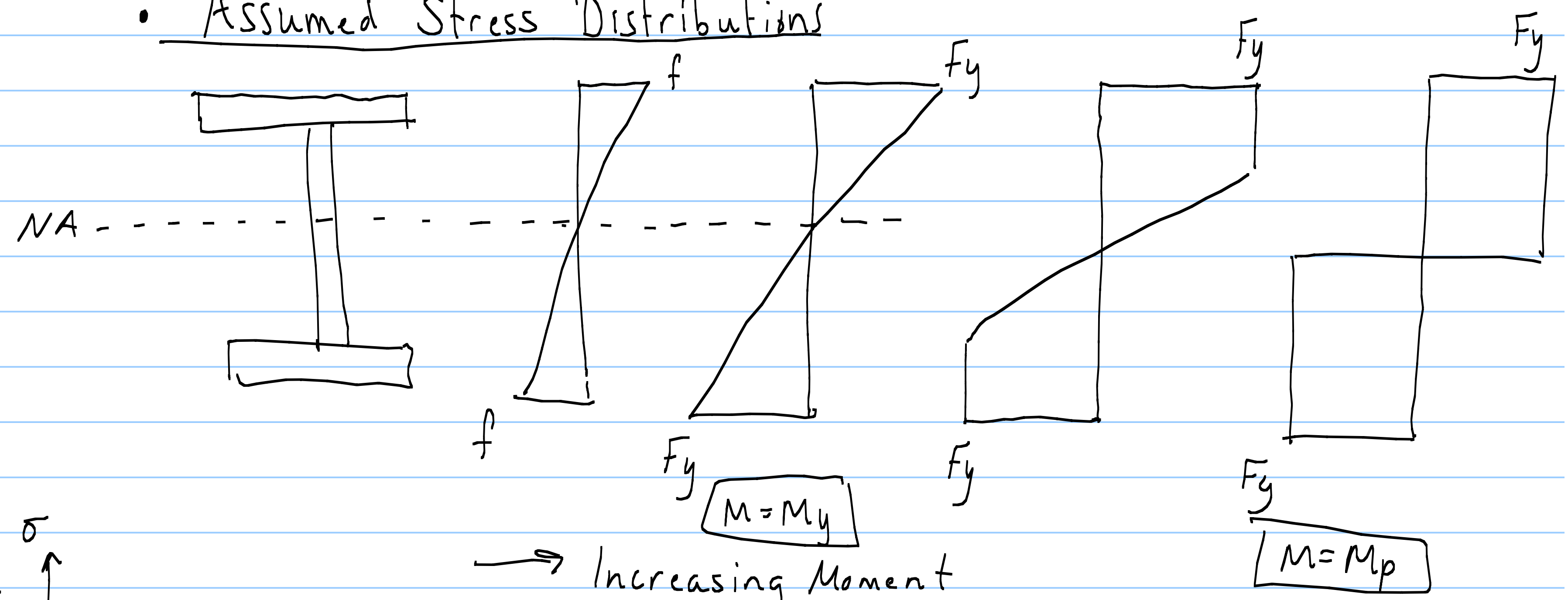
- Flange Local Buckling } prevent by having
- Web Local Buckling } low slenderness ratios ($\frac{b_f}{2t_f}$, $\frac{h}{t_w}$)
- Global Buckling → Lateral Torsional Buckling

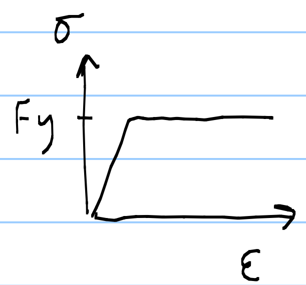


prevent by having continuous bracing or braces at short intervals

- Yielding

- **Assumed Stress Distributions**





M_p = plastic moment
all fibers in cross-section have yielded

- Calculating M_y

$$\sigma = \frac{Mc}{I}$$

$$F_y = \frac{M_y \cdot c}{I} = \frac{M_y \cdot \bar{y}}{I}$$

$$M_y = \frac{F_y \cdot I}{\bar{y}} \qquad \left(S_x = \frac{I}{\bar{y}} \right)$$

$$\boxed{M_y = F_y \cdot S_x}$$

$S_x \Rightarrow$ tables