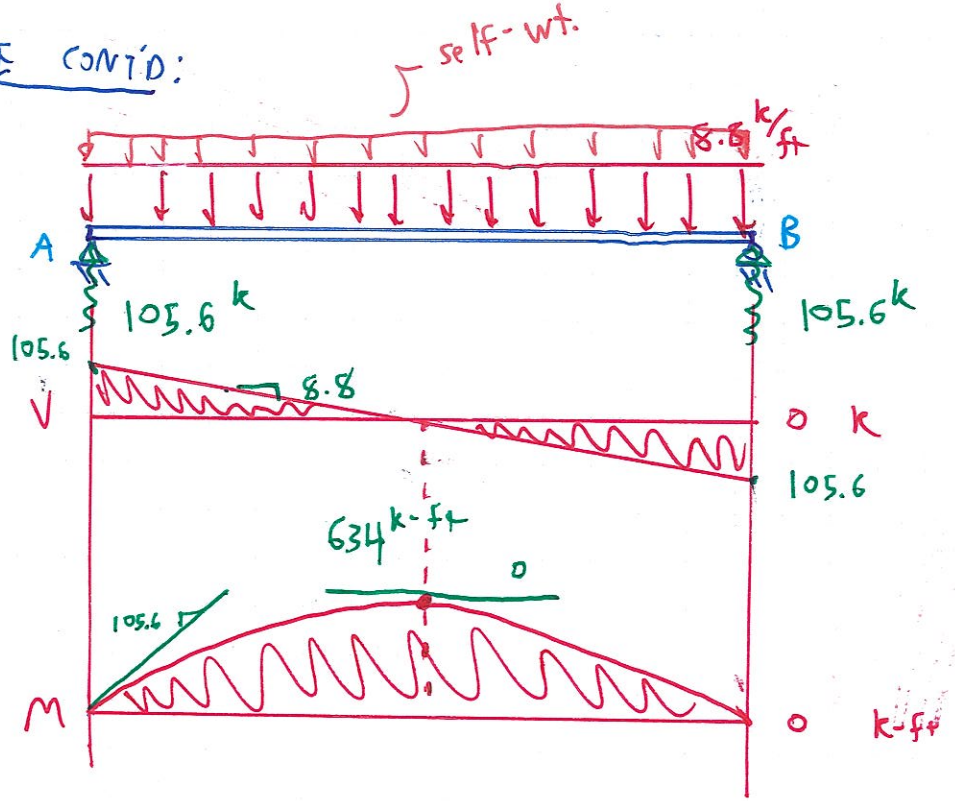
$\frac{220,000}{330,000,000} \times 100 = 0.066$ $\frac{17,000}{29,000,000} \times 100 = 0.0586$

EXAMPLE CONT'D:



$V_{max} = 105.6^{k}$

$M_{max} = 634^{k\text{-}ft}$

$= \frac{WL^2}{8} = \frac{(8.8)(24')^2}{8}$

"PART A" → BASIC STRENGTH

$$\phi_b M_n = \phi_b M_p = \phi_b f_y Z_x$$

$$\phi_b M_n \geq (M_u)_{max} = 634^{k\text{-}ft}$$

$$(Z_{req'd}) = \frac{(M_u)_{max}}{\phi_b f_y} = \frac{(634^{k\text{-}ft})(12)}{0.9(50\ ksi)} = 169\ in^3$$

try W24X68
$\phi_b M_p = 664^{k\text{-}ft}$
pg 3-24

*First Bold Section

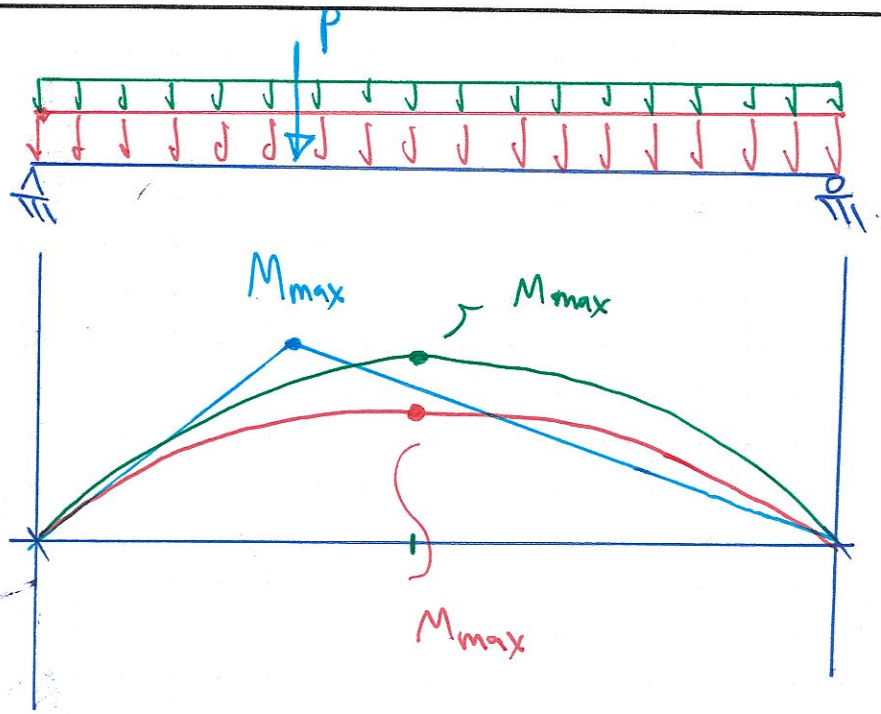
VERIFY CAPACITY

- no notation ∴ compact → no local buckling issues
- $\phi_b M_n = \phi_b M_p = 664^{k\text{-}ft} \geq (M_u)_{max} = 634^{k\text{-}ft} + 1.2\frac{(0.068^{k/ft})(24^{ft})^2}{8} = 640^{k\text{-}ft}$ ✓

VERIFY SHEAR CAPACITY

$$\phi_v V_n = 295^k \geq (V_u)_{max} = 106^k + 1.2\frac{(0.068^{k/ft})(24^{ft})}{2} = 106.6^k \quad \checkmark$$

self-weight of beam



$(0.068\ ^{k}/_{ft})(1.2)$

$8.8\ ^{k}/_{ft}$

CHECK DEFLECTION

Use LL only, steel beams are chambered to cancel DL defl.

$$\Delta_{max} = \frac{5wl^4}{384EI} = \frac{5\left(4\ ^{k}/_{ft}\right)\left(\frac{1}{12}\right)\left(24\ ft \times 12\right)^4}{384\left(29000\ ksi\right)\left(1830\ in^4\right)}$$

(AISC p 3-208)

$= 0.563''$

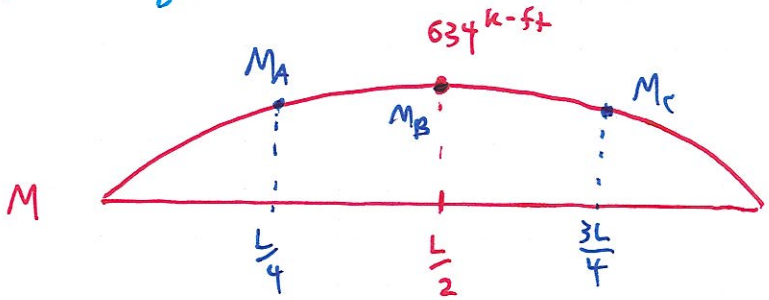
↑ Sect prop

$$\Delta_{ALLOW} = \frac{L}{360} = \frac{(24\,ft)(12)}{360} = 0.8\ in$$ ← Segui pg 221

$\Delta_{max} < \Delta_{allow}$ ✓

USE W24X68, A992 STEEL, 24 ft

PART 2: $L_b = 24\ ft$



ABS VALUES

$$C_b = \frac{12.5 M_{max}}{2.5 M_{max} + 3M_A + 4M_B + 3M_C}$$

$C_b = 1.14$, p 3-18 Table 3-1

$(M_u)_{max} = 634\ k\text{-}ft$ (add bm. wt. at check)

$$M_{eq} = \frac{(M_u)_{max}}{C_b} = \frac{634\ k\text{-}ft}{1.14} = 556\ k\text{-}ft \text{ @ } L_b = 24\ ft$$

TRY W18X97: p 3-116 (solid line) ST $\phi_b M_n = 583$ k-ft @ $L_b = 24$ ft

$\geq M_{eq} = 556$ k-ft @ 24 ft

p 3-24: $\phi_b M_p = 791$ k-ft

$\phi_b M_r = 494$ k-ft

$L_p = 9.36'$

$L_r = 30.4'$

$I_x = 1750$ in^4

$\phi_v V_n = 299$ k

$\phi BF = 14.1$ k

VERIFY CAP.

MOMENT: $\phi_b M_p = 791$ k-ft $\geq (M_u)_{max} = 634$ k-ft $+ 1.2 \frac{(0.097 \text{ k/ft})(24 \text{ ft})^2}{8} = 642$ k-ft ✓

"BASIC STRENGTH"

LTB: $L_p = 9.36' < L_b = 24$ ft $< L_r = 30.4'$

∴ Inelastic LTB

$$\phi_b M_n = \phi_b C_b \left[M_p - BF\left(L_b - L_p\right) \right] \le \phi_b M_p$$

$$= 1.14\left[791^{k\text{-}ft} - 14.1^{k}\left(24^{ft} - 9.36^{ft}\right) \right] \le 791^{k\text{-}ft}$$

$$= \underline{665}^{k\text{-}ft} \le 791^{k\text{-}ft}$$

LTB Controls

$$\phi_b M_n = 665^{k\text{-}ft} \ge (M_u)_{max} = 642^{k\text{-}ft} \quad \checkmark$$

SHEAR:

$$\phi_v V_n = 299^{k} \ge (V_u)_{max} = 106 + 1.2\left(0.097^{k/ft}\right)\left(24^{ft}\right)\left(\tfrac{1}{2}\right) = 107^{k} \quad \checkmark$$

DEFL:

$$\Delta_{max} = \frac{5wL^4}{384EI} = \frac{5\left(\frac{4}{12}\right)\left(24 \times 12\right)^4}{384\left(29000^{ksi}\right)\left(1750^{in^4}\right)} = 0.588'' \quad \checkmark$$

$$\Delta_{ALLOW} = 0.8''$$

USE W18X97, A992 STEEL, 24 FT LONG