ASSIGNMENT #1
ANSWER KEY

9.3A W27 X 94 A36

1. UNBRACED LENGTH : 5'

SINCE $L_b \leq L_p$ $(5' \leq 8.83')$ THEN:

$$M_N = M_p = F_y \times Z_x$$

$$= 36\,k \times 278\,in^3$$

$$= \frac{10,008\ k\cdot in}{12} = \boxed{834\ k\cdot ft}$$

2. UNBRACED LENGTH : 15'

SINCE $L_p < L_b \leq L_r$ $(8.83' < 15' \leq 25.9')$

$$M_N = M_p - (M_p - M_r) \times \left(\frac{L_b - L_p}{L_r - L_p}\right)$$

$$= 834 - (834 - 527) \times \left(\frac{15' - 8.83'}{25.9' - 8.83'}\right)$$

$$= 834 - 307 \times .361$$

$$= \boxed{723\ k\cdot ft}$$

3. UNBRACED LENGTH: 30'

SINCE $L_b > L_r$ (30' > 25.9') THEN:

$$M_N = \left(\frac{S_x * X_1 * \sqrt{2}}{L_1/r_y} \right) \times \sqrt{1 + \frac{(X_1)^2 \times X_2}{2 \times (L_b/r_y)^2}}$$

$S_x = 243\ IN^3$

$X_1 = 1740\ KSI$

$X_2 \times 10^6 = 19{,}000\ KSI = X_2 = .019$

$$M_N = \left(\frac{243\ IN^3 \times 1740 \times \sqrt{2}}{(30' \times 12\ IN/ft)/2.12"} \right) \times \sqrt{1 + \frac{(1{,}740)^2 \times .019}{2 \times \left(30' \times 12\ IN/ft / 2.12"\right)^2}}$$

$$= \left(\frac{597957.8}{169.8} \right) \times \sqrt{1 + \frac{57524.4}{57671.8}}$$

$$= 3521.5 \times 1.413$$

$$= \frac{4975.9\ K \cdot IN}{12} = \boxed{414.6\ K \cdot ft}$$

9.4A

TEST FORMULAS FOR LARGEST FACTORED LOAD

$W_U = 1.4\,DL$ OR $W_U = 1.2\,DL + 1.6\,LL$

1. CONVERT LOADS TO K/ft

DL = 13.2 K / 14 ft = 0.94 K/ft

LL = 26.4K / 14ft = 1.89 K/ft

FACTOR:

$1.2(0.94) + 1.6(1.89) = 4.2$ K/ft

$$M_U = \frac{wl^2}{8} = \frac{(4.2\,K/ft)(14\,ft)^2}{8} = \boxed{102.9\ K\cdot ft}$$

2. $$M_N = \frac{M_U}{\phi_b} = \frac{102.9\ K\cdot ft}{0.9}$$

$$= \boxed{114.3\ K\cdot ft}$$

3. REQUIRED SECTION MODULUS:

$$Z_x = \frac{M_N}{F_y} = \frac{114.3\ K\cdot ft\ (12\ in/ft)}{36} = \boxed{38.1\ in^3}$$

4. CHOOSE LIGHTEST W SECTION

W14 X 26

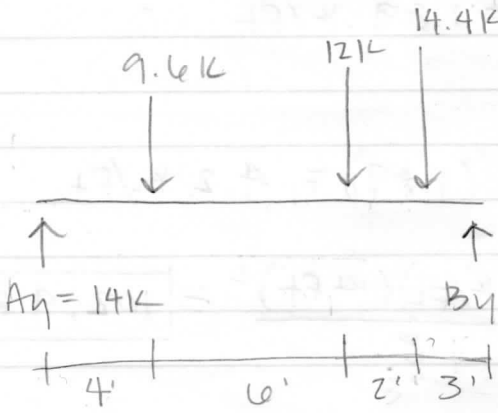
9.4c

(1.) FACTOR LOADS:

$6K(1.6) = 9.6K$

$7.5K(1.6) = 12K$

$9K(1.6) = 14.4K$

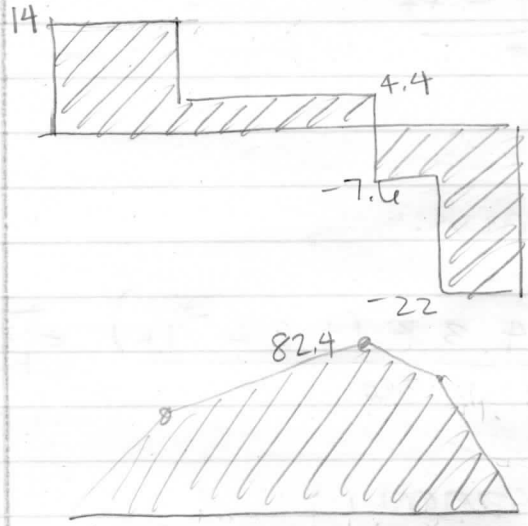


$\Sigma M_A = 9.6(4) + 12(10) + 14.4(12) - By(15)$

$By(15) = 38.4 + 120 + 172.8$

$By = 22K$

$Ay = 14K$



$M_U = 82.4 \text{ K·ft}$

(2.) REQ'D BENDING RESISTENCE:

$M_N = \frac{82.4}{0.9} = 91.6 \text{ K·ft}$

(3.) REQUIRED SECTION MODULUS

$Z_X = \frac{M_N}{F_y} = \frac{91.6(12)}{36}$

$= 30.5 \text{ IN}^3$

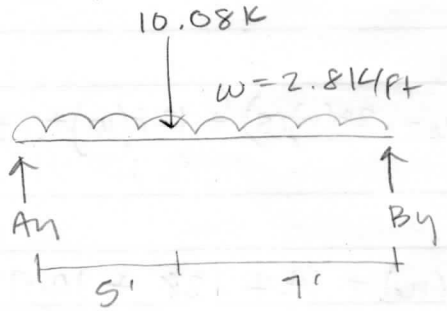
(4.) CHOOSE W10X26

9.4e

1. FACTOR LOADS:

$P_U = 1.2(8.4\,K) = \boxed{10.08\,K}$

$W_U = 1.2(1\,K/ft) + 1.6(1\,K/ft) = \boxed{2.8\,K/ft}$



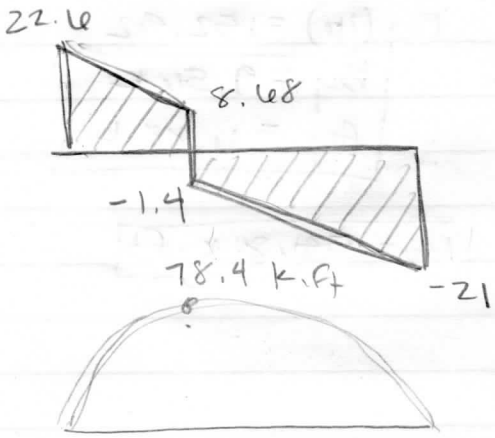
$\Sigma M_A = 10.08(5) + 2.8(12)(6) - By(12)$

$By(12) = 50.4 + 201.6$

$By(12) = 252$

$\boxed{By = 21}$

$\boxed{Ay = 22.68\,K}$



$\boxed{M_U = 78.4\,K\cdot ft}$

REQUIRED BENDING RESISTENCE:

$$M_N = \frac{M_U}{\phi_b} = \frac{78.4}{0.9} = \boxed{87.1\,K\cdot ft}$$

SECTION MODULUS:

$$Z_X = \frac{M_N}{F_y} = \frac{87.1 \cdot 12}{36} = \boxed{29\,IN^3}$$

$\boxed{12 \times 22} \rightarrow Z_X = 29.3\,IN^3$

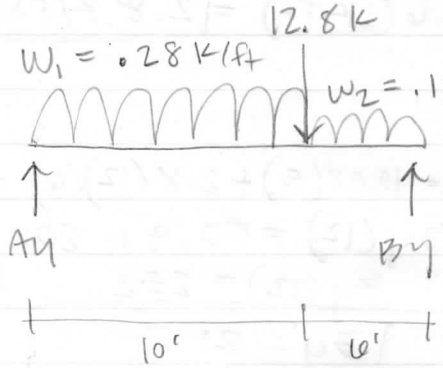
9.4G

1. FACTOR LOADS

$P_U = 8K(1.6) = \boxed{12.8K}$

$W_{U_1} = 1.2(.1K/ft) + 1.6(.1K/ft) = \boxed{.28K/ft}$

$W_{U_2} = 1.2(0.1K/ft) = \boxed{.12K/ft}$



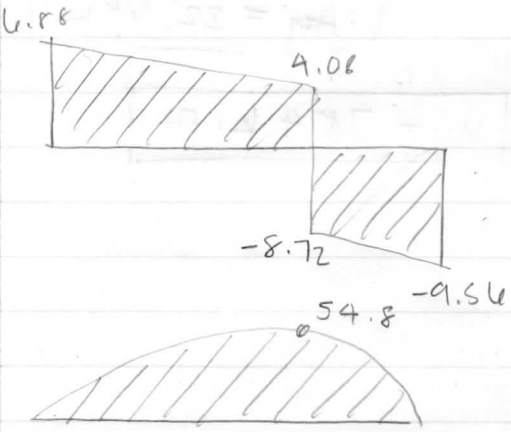
$\sum M_A = .28(10)(5) + 12.8(10) + .14(6)(13) - B_y(16)$

$B_y(16) = 14 + 128 + 10.92$

$B_y(16) = 152.92$

$\boxed{B_y = 9.54K}$

$\boxed{A_y = 6.88K}$



$\boxed{M_U = 54.8 K \cdot ft}$

REQ'D BENDING: $M_N = \frac{M_U}{\phi_b} = \frac{54.8}{0.9} = \boxed{60.9 K \cdot ft}$

REQ'D SECTION MODULUS:

$Z_x = \frac{M_N}{F_y} = \frac{60.9 K \cdot ft (12)}{36 KSI} = \boxed{20.3 IN^3}$

CHOOSE BEAM $\boxed{W\ 10 \times 19}$

9.6A W24 X 84

$d = 24.1''$

$t_w = 0.515''$

$A_w = t_w \cdot d = \boxed{12.52 \text{ IN}}$

$V_N = (0.6 F_y) A_w = 0.6(36)(12.52) = \boxed{270.4 \text{ K}}$

$\phi_v \cdot V_N \geq V_u$

$0.9(270.4\text{K}) > V_u$

$\boxed{V_u \leq 243.36 \text{ K}}$ ✓

9.6C W10 X 33

$d = 9.73$

$t_w = .29$

$A_w = t_w \cdot d = \boxed{2.82 \text{IN}}$

$V_N = (0.6)(36)(2.82) = \boxed{60.9 \text{ IN}}$

$\phi_v \cdot V_N \geq V_u$

$.9(60.9) \geq V_u$

$\boxed{54.81 \text{ K} \geq V_u}$ ✓

9.7A

$$\Delta = \frac{5wL^4(1.6)}{384\,EI}$$

W10 X 33

$w = 1.07$ K/ft

$L = 18$ ft

$E = 29{,}000$

$I = 170$

$$\Delta = \frac{5(1.07)(18)^4(12)^3}{384(29000)170}$$

$$\boxed{\Delta = 0.80 \text{ IN}}$$

FIND Δ FROM FIGURE 9.11

$$\boxed{\Delta \approx 0.9 \text{ IN}}$$

9.7C

W 18 X 46

$w = 2.29$ K/ft

$L = 24$ ft

$E = 29{,}000$

$I = 712$

$$\Delta = \frac{5(2.29)(24)^4(12)^3}{384(29000)(712\,IN^4)}$$

$$\boxed{\Delta = 0.83 \text{ IN}}$$

FIND Δ FROM FIGURE 9.11

$$\boxed{\Delta \approx 0.8 \text{ IN}}$$