$\phi R_n = (0.6)(1.2)(3in - \frac{7/8in + 1/16in}{2})(3/8in)(58ksi) \leq (0.75)(2.4)(7/8in)(3/8in)(58ksi)$

$\phi R_n = 49.55k \leq 34.26k$

Total

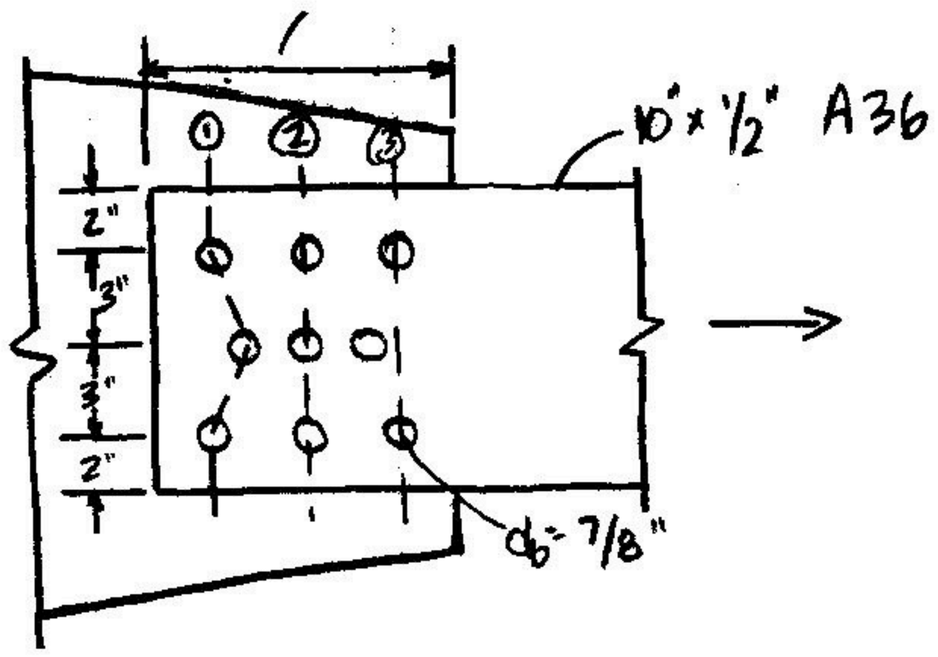
$\phi R_n = (6)(10.8\frac{k}{bolt}) \leq (0.487in)((4)(102\frac{k}{in}) + (2)(89.6\frac{k}{in}))$

$\leq (34.26k)(2) + (4)(3/8in)(91.4k/in)$

$\phi R_n = 64.8k \leq 285.97k \leq 205.62k$

$\boxed{\phi R_n = 64.8k}$

100



$W_g = 10in$ $\quad W_n = W_g - \Sigma d + \Sigma \frac{s^2}{4g}$

$W_{n_1} = 10in - 3(1in) + 2\left[\frac{(2in)^2}{4(3in)}\right] = 7.67in$

$\rightarrow W_{n_2} = 10in - 3(1in) = 7.00in$ ← CONTROLS $\quad W_n = 7.00in$

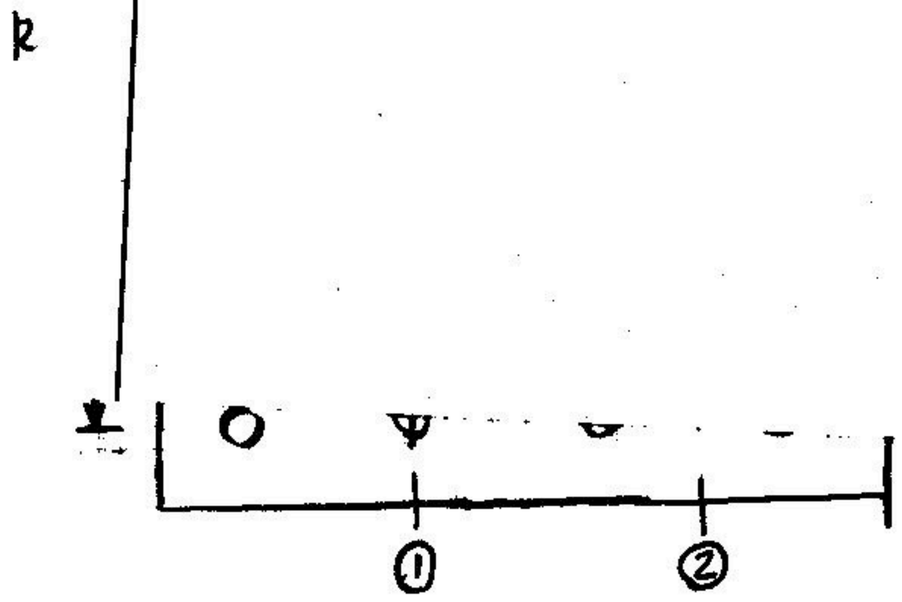
$W_{n_3} = 10in - 2(1in) = 8in$

$A_n = t W_n = (1/2in)(7.00in) = 3.5in^2$

$A_e = UA_n \quad U = 1.0$ CASE 1 $\quad \therefore \quad A_e = 3.5in^2$

NET FRACTURE DESIGN STRENGTH:

$\phi_t A_e F_u = (0.75)(3.5in^2)(58ksi) = \underline{\underline{152.25 kip}}$



V

A36 steel

$A_g = 3.31\ in^2$

$d = 3/4" + 1/8" = 7/8\ in = 0.875 in$

$w_g = 4 + 4 - 7/16 = 7.56\ in$

SECTION 1

$$w_n = w_g - 2d + \frac{s^2}{4g} = 7.56\,in - 2(0.875\,in) + \frac{(2\,in)^2}{4(4.56\,in)} = 6.03\ in$$

SECTION 2

$$w_n = w_g - d = 7.56\,in - 0.875\,in = 6.68\ in$$

SECTION 1 CONTROLS

$$A_n = t(w_n) = (7/16\,in)(6.03\,in) = 2.64\ in^2$$

BOTH LEGS CONNECTED $\therefore A_e = A_n = 2.64\ in^2$

FRACTURE STRENGTH

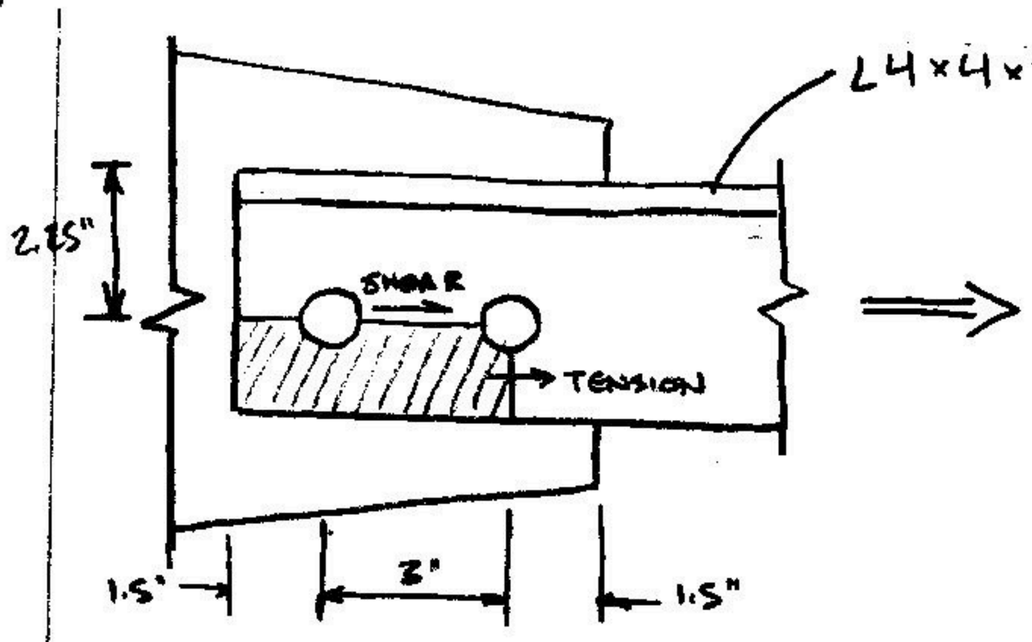
$$\phi_t P_n = 0.75 F_u A_e = (0.75)(58)(2.64) = 114.8\ kip$$

YIELDING STRENGTH

$$\phi_t P_n = 0.90 F_y A_g = (0.90)(36)(3.31) = 107.2\ kip$$

YIELDING STRENGTH CONTROLS

DESIGN STRENGTH = 107 kip



ASTM Gr. 50

$A_{gv} = (7/16)(4.5) = 1.97\ in^2$

$A_{nv} = (7/16)[4.5 - 1.5(7/8 + 1/8)] = 1.31\ in^2$

$A_{nt} = 7/16\,[1.75 - 0.5\,(7/8 + 1/8)] = 0.55\ in^2$

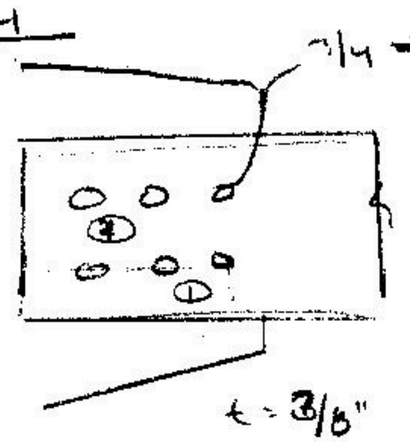
$U_{bs} = 1.0$

$R_n = 0.6 F_u A_{nv} + U_{bs} F_u A_{nt}$
$= 0.6(65)(1.31\ in^2) + 1.0(65)(0.55\ in^2) = 86.8\ kip$ ← CONTROLS

$R_n = 0.6 F_y A_{gv} + U_{bs} F_u A_{nt}$
$= 0.6(50)(1.97) + 1.0(65)(0.55) = 94.8\ kip$

BLOCK SHEAR STRENGTH = 86.8 kip

Problem 4



$A_g = 3.60\ in^2$ $\quad \bar{x} = 0.525$

$t_c = 0.314\ in$

$U = 1 - \bar{x}/L = 1 - \frac{0.525}{6} =$

$U = 0.9125$

Tension: (column)

$A_n = 3.60\ in - (2)(7/8)(0.314) = 3.05\ in^2$

$A_e = A_n \cdot U = (3.05\ in^2)(0.9125) = 2.78\ in^2$

$\phi P_n = \phi F_y \cdot A_g = (0.9)(50000)(3.60)$ $\quad \phi P_n = \phi F_u \cdot A_e = 0.75 \cdot 65000 \cdot 2.78$

$\phi P_n = 162\ k$ $\quad \phi P_n = 135.5\ k$

$\underline{\phi P_n = 135.5\ k}$

Block Shear (column)

$A_{nt} = (0.314)(3) - (1)(7/8)(0.314) = 0.67\ in^2$

$A_{nv} = 2\left((0.314)(7.5) - (2.5)(0.314)(7/8)\right) = 3.34\ in^2$

$U_{bs} = 1.0$

$R_n = 0.6 F_u \cdot A_{nv} + U_{bs} \cdot F_u \cdot A_{nt}$

$\phi R_n = 130.1$

$\phi R_n = (0.6)(65000)(3.34) + (1.0)(65000)(0.67) \Rightarrow \quad R_n = 174\ k$

$R_n = (0.6)(F_y)(A_{gv}) + U_{bs} \cdot F_u A_{nt}$

$\phi R_n = 132.7$

$\phi R_n = (0.6)(50000)(2)(0.314)(7.5) + (1.0)(65000)(0.67) \Rightarrow \quad R_n = 184.9\ k$

Block Shear (beam)

$A_{nt} = (0.375)(3) - (1)(7/8)(0.375) = 0.80\ in^2$

$A_{nv} = 2\left((0.375)(7.5) - 2.5(0.375)(7/8)\right) = 3.98\ in^2$

$R_n = 0.6(58000)(3.98) + (1.0)(58000)(0.80) = 184.9k$

$R_n = 0.6(36000)(2)(0.375)(7.5) + (1.0)(58000)(0.80) = 167.9\ k$

$\phi R_n = 0.75(167.9k) = 126\ k$

$\underline{\phi R_n = 126k}$ (controls)

Total

$R_n = (2)(34.45k) + (4)(47.35k)$

$\boxed{R_n = 357.9\ k}$

L12FD

$P_u = 1.4D = 1.4(30k) = 42$ kip

$P_u = 1.2D + 1.6L = 1.2(30k) + 1.6(90k) = 180\ k$ ← CONTROLS

$P_u \le \phi P_n \rightarrow \phi P_n = 180\ k$

REQ'D $A_g = \dfrac{P_u}{\phi_t F_y} = \dfrac{180k}{(0.90)(50)} = 4.00\ in^2$

REQ'D $A_e = \dfrac{P_u}{\phi_t F_u} = \dfrac{180k}{(0.75)(65)} = 3.69\ in^2$

MIN. RAD. GYRATION: $r = \dfrac{L}{300} = \dfrac{(25)(12)}{300} = 1\ in$

CHOICE 1: 2L2½ × 2½ × ½ $A_g = 4.50\ in^2$ $r = 1.23$

$A_n = A_g - A_{holes} = 4.50 - 2(7/8 + 1/8)(1/2) = 3.50\ in^2$

$U = 1.0 \rightarrow$ CASE 1

$A_e = UA_n = 3.50\ in^2 < 3.69\ in^2$

CHOICE 2: 2L3 × 2½ × 7/16 $A_g = 4.44\ in^2$ $r = 1.16$

$A_n = 4.44 - 2(7/8 + 1/8)(7/16) = 3.56\ in^2$

$U = 1.0 \rightarrow$ CASE 1

$A_e = UA_n = 3.56\ in^2 < 3.69\ in^2$

CHOICE 3: 2L3 × 2½ × ½ $A_g = 5.01\ in^2$ $r = 1.18$

$A_n = 5.01 - 2(7/8 + 1/8)(1/2) = 4.01\ in^2$

$U = 1.0 \rightarrow$ CASE 1

$A_e = UA_n = 4.01\ in^2 > 3.69\ in^2$ ✓

USE A <u>2L3 × 2½ × ½</u>