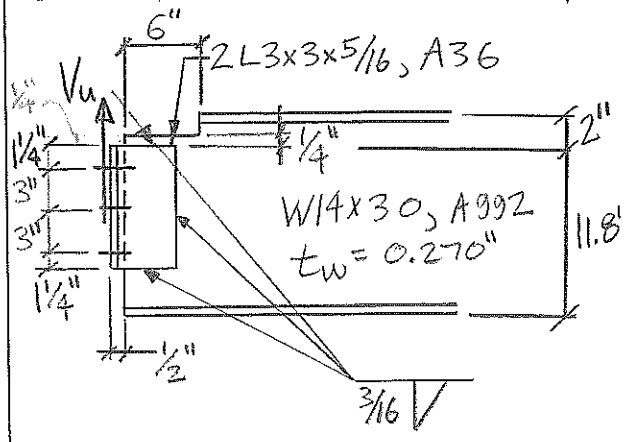
EXAMPLE: COMPUTE ϕV_n



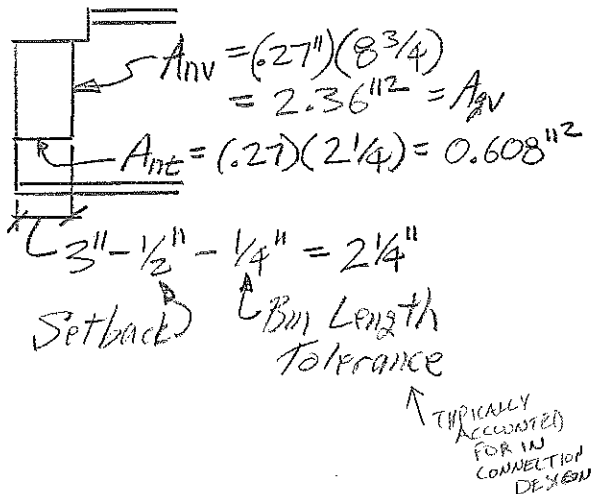
BOLTS: 3/4" A325-X

COLUMN FLG: t_f = 0.65" A992

Shear Yielding @ Cope: $\phi V_n = \phi\, 0.6 F_y A_{gv}$ (ϕ = 1.0)

$= (1.0)(0.6)(50)(0.27)(11.8) = 95.6^k$

Block Shear:



$R_n = \min \begin{cases} 0.6 F_u A_{nv} + U_{bs} F_u A_{nt} \\ 0.6 F_y A_{gv} + \text{"} \end{cases}$

$= \min \begin{cases} 0.6(65)(2.36) + (1)(65)(.608) \\ 0.6(50)(2.36) + \text{"} \end{cases}$

$= \min \begin{cases} 132^k \\ 110^k \end{cases} = 110^k$

$\phi R_n = 82.7^k$

Coped Beam Flexure:

$c = 6"$ $e = 6\,1/2"$ $d_c = 2"$ $h_o = 11.8"$ $d = 13.8"$

$c/d = 6"/13.8" < 1 \Rightarrow f = 2c/d = 2(6)/13.8 = 0.870$

$c/h_o = 6"/11.8" < 1 \Rightarrow k = 2.2(h_o/c)^{1.65} = 2.2(11.8"/6")^{1.65} = 6.72$

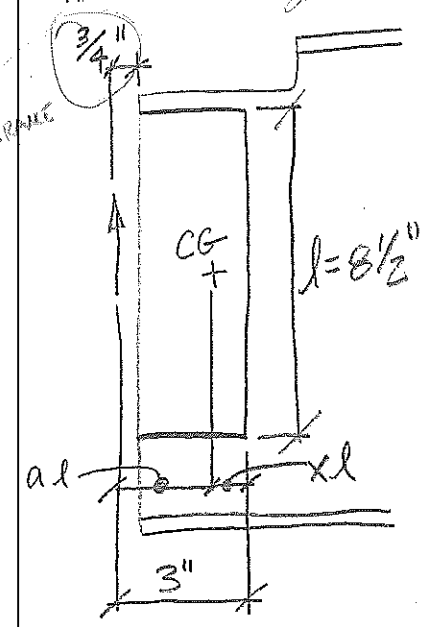
$F_{cr} = 26210(t_w/h_o)^2 f k = 26210(.27/11.8)^2(.870)(6.72)$

$= 80.1^{ksi}$ (> 50ksi) $\therefore$ Use $F_{cr} = 50^{ksi}$

W14x30 w/ 2" Cope: $S_{net} = 9.88^{in^3}$ (Table 9-2)

$\phi M_n = \phi F_{cr} S_{net} = (.9)(50)(9.88) = 445^{k\cdot in} = \phi V_n e \Rightarrow \phi V_n = 68.4^k$

Weld Strength:



Note: J2.2b(1) doesn't apply.

Weld Eccentrically Loaded ⇒ Table 8-8 p 8-90

$\phi R_n = \phi C C_1 D l$

$\phi = 0.75$ $C_1 = 1.0$ for E70XX

$D = 3$ sixteenths $l = 8\frac{1}{2}"$

$k l = 2\frac{1}{4}" \Rightarrow k = 0.265$

$x = 0.0466$ (Bott. Row of Table)

$xl = 0.396"$

$al = 3" - .396" = 2.6" \Rightarrow a = 0.306$

INTERPOLATE: $C = 2.62$

$\phi V_n = \phi R_n = (.75)(2.62)(1.0)(3)(8\frac{1}{2})(2 \text{ SIDES})$

$= 100K$

Web Strength @ Weld:

RATIO PER INCH STRENGTH OF Web Shear RUPT AND WELD STRENGTH.

$$\phi V_n = (\phi V_n)_{weld} \frac{\text{Rupt Str. of 1" of PL}}{\text{Rupt Str of 1" of Weld}} = (\phi V_n)_{weld} \frac{\phi 0.6 F_u A_{nv}}{\phi 0.6 F_w A_w}$$

$$= 100K \frac{0.75(0.6)(65)(.27)(1")}{(1.392)(1.5)(3)(1")(2 \text{ SIDES})} = 63.0K$$

→ CONSERV. Assume $\theta = 90°$ @ least one location.

Angle Shear Yielding: $\phi V_n = \phi 0.6 F_y A_{gv} = (1.0)(.6)(36)(5/16)(8\frac{1}{2})(2)$ ← 2 angles

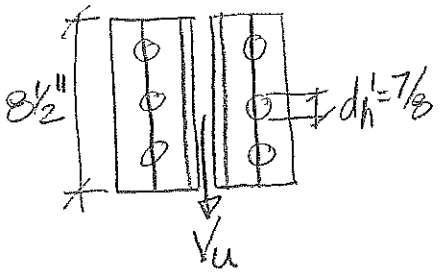
$= 115K$

Angle Str. @ Weld:

$$\phi V_n = 100K \frac{.75(.6)(58)(5/16)(1")(2)}{1.392(1.5)(3)(1")(2)} = 130K$$

← 2 angles

Angle Shear Rupture @ OSL:

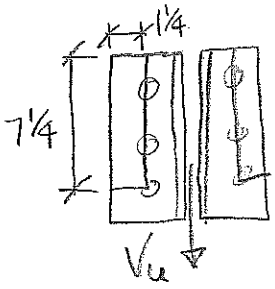


$\phi V_n = \phi\, 0.6 F_u A_{nv}$ ($8\frac{1}{2} - 3(\frac{7}{8})$)

$= (.75)(.6)(58)(5/16)(\quad)(2)$ ← 2 angles

$= \cancel{139}$ K

Angle Block Shear:



$A_{nv} = (5/16)(7\frac{1}{4} - 2.5(7/8))$ (2 angles) $= 3.16^{in^2}$

$A_{gv} = (5/16)(7\frac{1}{4})(2) = 4.53^{in^2}$

$A_{nt} = (5/16)(1\frac{1}{4} - 0.5(7/8))(2) = 0.508^{in^2}$

$R_n = \min \begin{cases} 0.6(58)(3.16) + (1)(58)(.508) = 139\text{K} \\ 0.6(36)(4.53) + \quad " \quad = 127\text{K} \Leftarrow \phi R_n = 95.5\text{K} \end{cases}$

Angle Brg / TO:

END BOLT: $r_n = \min \begin{cases} 1.2 L_c t F_u = \min \begin{cases} 1.2(1\frac{1}{4} - 13/32)(5/16)(58) \\ 2.4 d t F_u \end{cases} \\ 2.4(3/4)(5/16)(58) \end{cases}$

$= \min \begin{cases} 18.4 \text{ K/bolt} \Leftarrow \\ 32.6 \text{ K/bolt} \end{cases}$

Other Bolt: $r_n = \min \begin{cases} 1.2(3 - 13/16)(5/16)(58) = 47.6\text{K/bolt} \\ 32.6\text{K/bolt} \Leftarrow \end{cases}$

$\phi R_n = 0.75(18.4(2) + 32.6(4)) = 125\text{K}$

Bolt Shear

$\phi R_n = \phi F_{nv} A_b$ ← X bolts $= (.75)(60\text{ksi})(.442)(6) = 119\text{K}$

Overall:

$\phi V_n = 63\text{K}$ (Web Str. @ Weld)