BOLTS = 7/8 DIAMETER

NOMINAL HOLE SIZE = $d_b + 1/16" = 15/16"$

AREA EFFECTED BY FABRICATION = $d_h + 1/16" = 1"$

GROSS AREA OF C 8 x 11.5 = $3.37\ in^2$ $t = 3/8"$

YIELD CALCULATION:

$P_n = F_y A_g \rightarrow \phi_t = 0.9$ F_y A572 Gr. 50 = 50 Ksi

$P_n = (50\ Ksi)(3.37\ in^2) = 168.5$

$\phi P_n = (0.9)(168.5\ kip) = 151.65\ kip$

NET AREA = GROSS AREA − AREA EFFECTED BY FABRICATION

$= 3.37\ in^2 - 2(1" \times 3/8") = \cancel{2.62}\ 2.92\ in^2$

(0.22)

$A_e = U\ A_n$

$U = 1 - \bar{x}/L$ $\bar{x} = 0.572"$ $L = 6"$ -2

$U = 1 - \frac{0.572}{6} = 0.905$

$A_e = \cancel{2.37}\ 2.62\ in^2$

$P_n = F_u A_e = (65\ Ksi)(2.37\ in^2) = 154.05\ kip$

$P_n \phi_t = 0.75\ (154.05\ kip) = 115.5\ kip$

$T_u = P_{n_{ult}} \phi_t = 115.5\ kip$

$D/L = 1/3$ $S = D + L$ $D = 1/4\ S$ $L = 3/4\ S$

$T_u = (1.2)(1/4\ S) + (1.6)(3/4\ S)$

$\frac{115.5\ kip}{1.5} = S = \frac{\cancel{77}\ Kips}{86.1}$

W 16 x 45 A992 steel

7/8" DIAM. BOLTS DIAMETER EFFECTED BY FABRICATION = 1"

FROM WT 8 x 22.5 $\bar{y} = 1.86"$

$A_g = 13.3\ in^2$ $t_f = 0.565\ in.$ $f_y = 50\ ksi$ $f_u = 65\ ksi$

NET AREA = $13.3\ in^2 - 4(1")(0.565") = 11.04"$

$\phi P_n = \phi f_y (A_g) = 0.9(50\ ksi)(13.3\ in^2) = 598.5\ kips$

EFFECTIVE NET AREA = 11.04" $L = 9"$

$U = 1 - \frac{\bar{x}}{L} = 1 - \frac{1.86"}{9"} = 0.79$

$U_{assumed} = 0.85$ from 16.1-29

$A_e = A_n \cdot U_{assumed} = (11.04")(0.85) = 9.38\ in.^2$

$\phi P_n = \phi f_u \cdot A_e = 0.75(65\ ksi)(9.38\ in.^2) = \underline{457.5\ kips}$

A) $L 5 \times 5 \times 5/8$ $\ell = 5''$ parallel to force

GROSS AREA = $5.86\ in^2$ $\bar{x} = 1.47''$ $A_G = A_N$ for welded connection

$U = 1 - \frac{\bar{x}}{\ell} = 1 - \frac{1.47''}{5''} = 0.706$

$A_e = U \cdot A_N = (0.706)(5.86\ in^2) = \underline{4.14\ in^2}$

B) PL $3/8 \times 4$ $\ell = 5''$ longitudinal to force

GROSS AREA = $3/8'' \times 4'' = 1.5\ in^2$.

$\ell = 5''$ $W = 4''$ $U = 0.75$

$A_e = A_g \cdot U = (1.5\ in^2)(0.75) = \underline{1.125\ in^2}$

C) PL $5/8 \times 5$ $\ell = 5''$

$A_g = A_e = (5/8'')(5'') = \underline{3.125\ in^2}$

d) PL $1/2 \times 5\ 1/2$ $d_b = 3/4''$

Effect. $d_{ho} = d_b + 1/8'' = 3/4'' + 1/8'' = 7/8''$

$A_e = A_n = (5.5'' \times 0.5'') - (7/8'' \times 0.5'') = \underline{2.3125\ in^2}$

2 L3x2x1/4 LLBB of A36 steel

D = 12 kip L = 36 kip d_b = 3/4" ASSUME SPACING = 3" spacing

$A_g = 1.19\ in^2$ $\bar{X} = 0.487$ in.

$U = 1 - \frac{0.487}{6} = 0.92$

$A_n = 2(1.19) - (3/4" + 1/8")(2x1/4) = 1.94\ in^2$

$A_e = (0.92)(1.94\ in^2) = 1.78\ in^2$

1.4 (12 kips) = 16.8 kips 1.2 (12 kip) + 1.6 (36 kip) = 72 kip

$(0.9) f_y \cdot A_g = (0.9)(36\ ksi)(2(1.19\ in^2)) = 77.11$ kip

$0.75 f_u \cdot A_e = 0.75 (58\ ksi)(1.78\ in^2) = 77.43$ kip

77.11 kip > 72 kip

YES IT PASSES