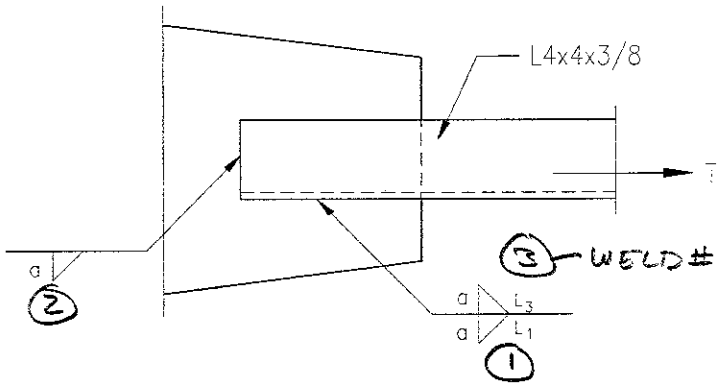
Example Problem 5.2



Given: The single angle connection shown. A992 steel and E70 electrodes are used. The gusset plate is 3/8 inch thick. The Tension load is 25 k Dead Load and 40 k Wind Load. Use LRFD.

Wanted: Determine the size and required lengths of the welds so as to minimize the lap of the connection.

a) All fillet welds are the same size
b) Fillet welds may be different sizes

Solution:

DETERMINE THE DESIGN LOAD, P_u (LRFD LC4 CONTROLS)

$P_u = 1.2(25^k) + 1.6(40^k) = 94.0^k$

DETERMINE WELD SIZE:

SCM J2.2b: $a \le 3/8" - 1/16" = 5/16"$ (FOR WELDS ② & ③)

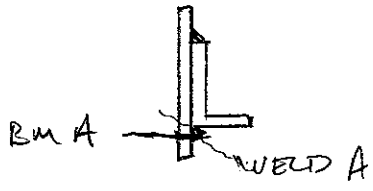
$a \le 4" - 1/16"$ (FOR WELD ①)

SCM TABLE J2.4: SINCE $t_{MAX} = 3/8"$ $\Rightarrow a \ge 3/16"$

LARGEST EFFECTIVE SIZE:

$.707a = \frac{F_{BM}}{F_{EXX}} t_{BM} = \frac{65 ksi}{70 ksi} (3/8")$

$a \doteq .493"$



∴ USE $a = 5/16"$ ← MEETS ALL ABOVE CRITERIA

WELD METAL STRENGTH CONTROLS @ THIS SIZE

(FOR PART (a) & FOR WELDS ② & ③ OF PART (b)

USE $a = 1/2"$ FOR WELD ① OF PART (b)

PROBLEM 5.2 (CONTINUED)

PART (a)

$$\text{WELD STRENGTH} = \min\left[F_{BM}A_{BM}, F_W A_W\right]\phi$$

$$= \min\left[.6(65\text{KSI})(3/8"), .6(70\text{KSI})(.707)(5/16")\right].75$$

$$= \min\left[10.97\text{K/IN}, 6.96\text{K/IN}\right]$$

$$\phi r_N = 6.96\text{K/IN}$$

$$\text{REQ'D WELD LENGTH} = 94.0\text{K}/6.96\text{K} = 13.5\text{ IN}$$

LET $L_2 = 4"$ (WIDTH OF ANGLE LEG)

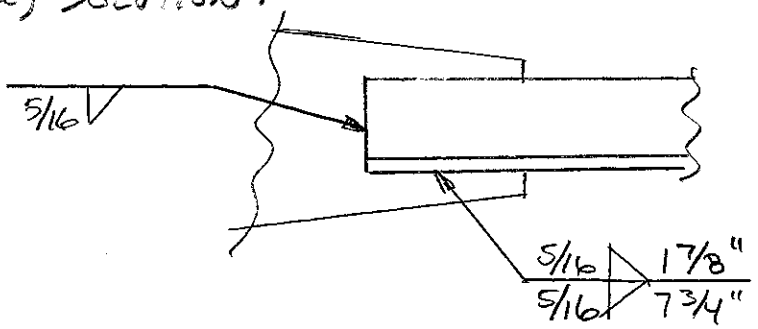
$\bar{y} = 1.13"$ FOR L4x4x3/8" FROM SECTION PROP. TABLES

FORCE REACTION CENTROID TO COINCIDE WITH P_u CENTROID

$$1.13" = \frac{L_1(0) + 4"(2") + L_3(4")}{13.5"} \Rightarrow L_3 = 1.82"$$

$$L_1 = 13.5" - 4" - 1.82" = 7.69"$$

PART (a) SOLUTION:



PART (b)

$$\sum F = 0 = \cancel{P_u}^{94\,K} - \phi r_{n1} L_1 - \phi r_{n2} L_2 - \phi r_{n3} L_3$$

$\phi r_{n1} = 10.97\ K/in$ (WELD IS $\frac{1}{2}$" ≥ MAX EFF. SIZE ∴ BASE METAL CONTROLS)

$\phi r_{n2} = \phi r_{n3} = 6.96\ K/in$ (WELD IS $\frac{5}{16}$")

$$94.0^K = (10.97\ K/in) L_1 + (6.96\ K/in)(L_2 + L_3)$$

CENTROID:

$$\bar{y} = 1.13" = \frac{(0)L_1 + (6.96)(4)(2) + (6.96)(L_3)(4)}{10.97 L_1 + (6.96)(4) + (6.96) L_3}$$

SOLVE THE TWO EQUATIONS ABOVE FOR L_1 & L_3

$L_1 = 4.88"$ $L_3 = 1.816"$

SCM J2.2b REQUIRES $L \geq 4a$ ⇒ FOR $a = \frac{5}{16}$", $L \geq 1.25"$ ∴OK

PART (b) SOLUTION: