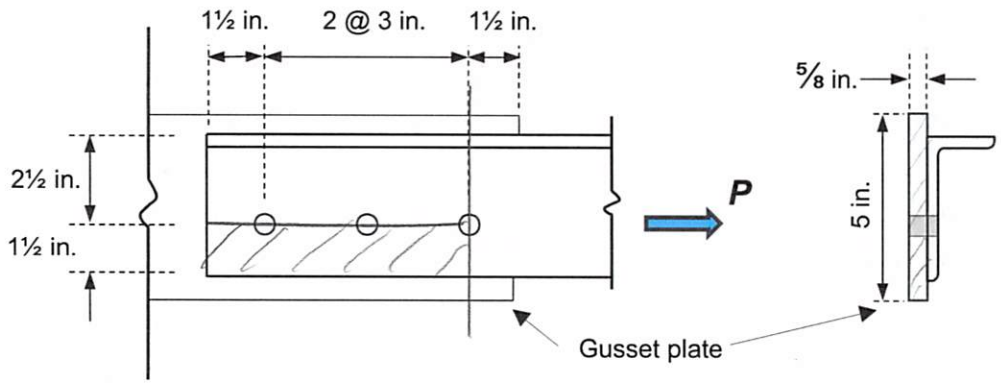
Classroom Problem 3.5-2: An angle **L4 × 3 × ⅜** tension member is connected to a gusset plate by three ⅞-in.-diameter bolts in the standard holes. **A572 Grade 50** steel (F_y = 50 *ksi*, F_u = 65 *ksi*) is used. Compute the design strength.



FROM TABLE 1-7 (1-48)

$A_g = 2.49 in^2$ $\quad \bar{x} = 0.775 in$

$d_{HOLE} = \frac{7}{8} in + \frac{1}{8} in = 1 in$

YIELD - GROSS AREA $\quad \phi P_n = \phi F_y A_g$

ANGLE $2.49 in^2$ **

PLATE $5 in (\frac{5}{8} in) = 3.125 in^2$

$\phi P_n = 0.90 (50 ksi) 2.49 in^2 = 112.1^k$

RUPTURE - NET AREA

$\phi P_n = \phi F_u A_e = \phi F_u U A_n$

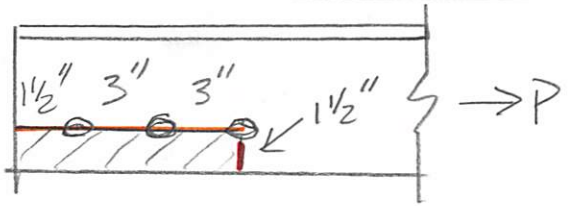
$U = 1 - \frac{\bar{x}}{\ell} = 1 - \frac{0.775 in}{6 in} = 0.871$

ANGLE: $A_g - 1 HOLE = 2.49 - 1(1 in)(\frac{3}{8} in) = 2.12 in^2$ **

PLATE: $A_g - 1 HOLE = 3.125 in^2 - 1(1 in)(\frac{5}{8}) = 2.5 in^2$

$\phi P_n = 0.75 (65 ksi)(0.871) 2.12 in^2 = 90.0^k$

BLOCK SHEAR – ANGLE



$$A_{gv} = (3in + 3in + 1\tfrac{1}{2}in)(\tfrac{3}{8}in) = 2.81\,in^2$$

$$A_{nv} = A_g - 2\tfrac{1}{2}\,Holes = 2.81\,in^2 - 2\tfrac{1}{2}(1in)(\tfrac{3}{8}in) = 1.87\,in^2$$

$$A_{nt} = \left(1\tfrac{1}{2}in - \tfrac{1}{2}(1in)\right)\tfrac{3}{8}in = 0.375\,in^2$$

$$\phi P_n = \phi\left[MIN\left(0.6F_uA_{nv};\ 0.6F_yA_{gv}\right) + F_uA_{nt}\right]$$

$$= 0.75\left[MIN\left(0.6(65ksi)1.87in^2;\ 0.6(50ksi)2.81in^2\right) + 65ksi(0.375in^2)\right]$$

$$= 0.75\left[MIN\left(72.93^k;\ 84.3^k\right) + 24.4^k\right] = 72.98^k$$

** BLOCK SHEAR CONTROLS

$$\phi P_n = 72.98^k$$