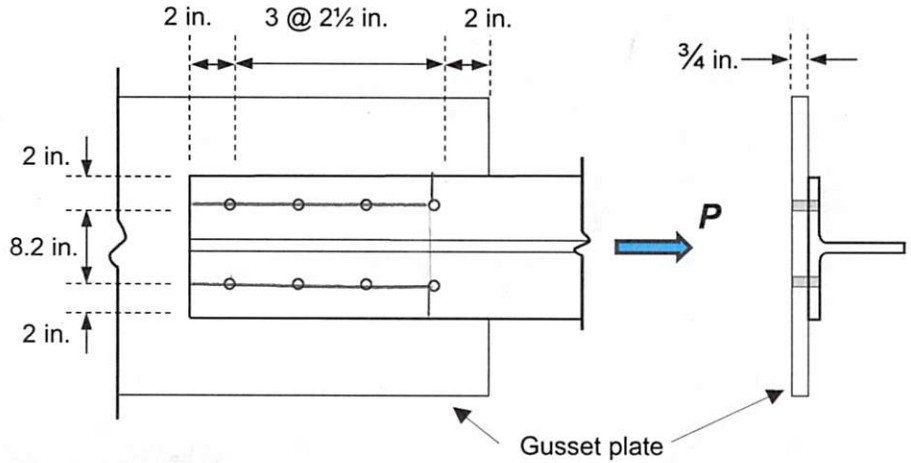
Classroom Problem 3.5-3: Compute the design strength for **WT6 x 53** bolted to a **PL24 x ¾** gusset plate with eight ⅞-in. diameter bolts. **A572 Grade 50** steel (F_y = 50 *ksi*, F_u = 65 *ksi*) is used for the WT shape.



FROM 1-8 (1-68)

$A_g = 15.6 in^2$ $b_f = 12.2 in$ $t_f = 0.990 in$

$\bar{x} = 1.19 in$

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

YIELD - GROSS AREA $\phi P_n = \phi F_y A_g = 0.90(50 ksi)15.6 in^2 = \underline{702^k}$

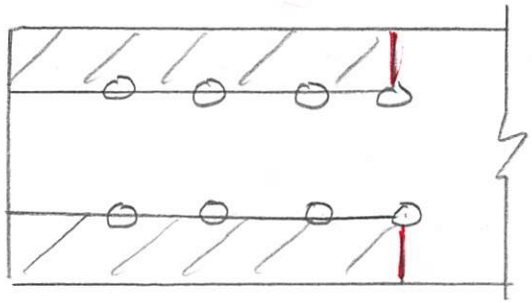
RUPTURE - NET AREA $\phi P_n = \phi F_u U A_n$ $U = 1 - \frac{\bar{x}}{\ell} = 1 - \frac{1.19 in}{7.5 in} = 0.841$

$A_n = A_g - 2 Holes$

$= 15.6 in^2 - 2(1 in)(0.99 in) = 13.62 in^2$

$\phi P_n = 0.75(65 ksi)(0.841)13.62 in^2 = \underline{558.4^k}$

BLOCK SHEAR – FLANGE



$$A_{gv} = 2(9.5\,in)(0.99\,in) = 18.81\,in^2$$

$$A_{nv} = A_{gv} - 7\,Holes = 18.81\,in^2 - 7(1\,in)(0.99\,in) = 11.88\,in^2$$

$$A_{nt} = 2(2\,in)(0.99\,in) - 1in(0.99\,in) = 2.97\,in^2$$

$$P_n = MIN\left[0.6F_uA_{nv},\ 0.6F_yA_{gv}\right] + F_uA_{nt}$$

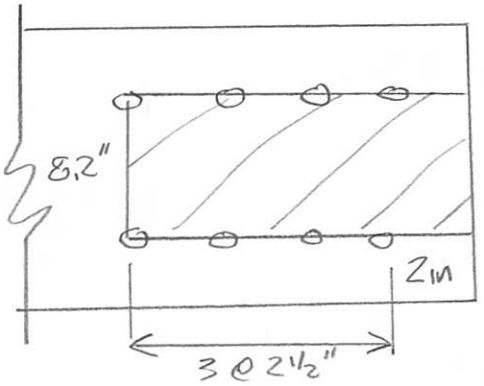
$$= MIN\left[0.6(65ksi)11.88in^2,\ 0.6(50ksi)18.81in^2\right] + 65ksi(2.97in^2)$$

$$= MIN\left[\underline{463.3^k},\ 564.3^k\right] + 193.05^k = \underline{656.4K}$$

$$\phi P_n = 0.75(656.4^k) = \underline{492.3^k}$$

EXAMPLE 3.5-3

BLOCK SHEAR PLATE



$A_{gt} = 8.2in(3/4in) = 6.15in^2$

$A_{nt} = A_{gt} - 1\,HOLE = 6.15in^2 - 2\left[\frac{1}{2}(1in)(3/4in)\right] = 5.40\,in^2$

$A_{gv} = 2\left[3(2.5in) + 2in\right](3/4in) = 14.25in^2$

$A_{nv} = A_{gv} - 7\,HOLE = 14.25in^2 - 7(1in)(3/4in) = 9in^2$

$P_n = MIN(0.6F_uA_{nv};\ 0.6F_yA_{gv}) + F_uA_{nt}$

$= MIN(0.6(65ksi)9in^2;\ 0.6(50ksi)14.25in^2) + 65ksi(5.40\,in^2)$

$= MIN(\underline{351.0^k};\ 427.5^k) + 351.0^k$

$= 702.0^k$

$\phi_t P_n = 0.75(702.0^k) = \underline{526.5^k}$

** BLOCK SHEAR IN WT CONTROLS $\therefore$ $\underline{\phi P_n = 492.3^k}$