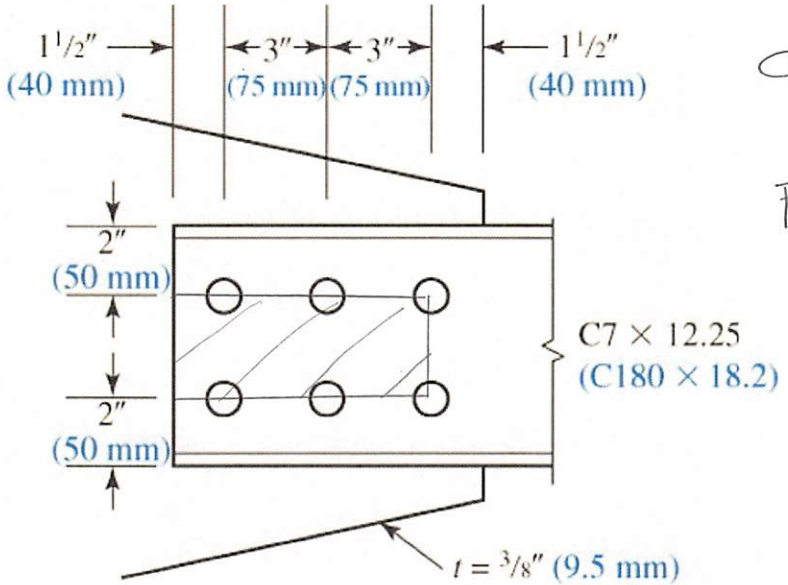
3.5-4 In the connection shown in Figure P3.5-4, ASTM A572 Grade 50 ($F_y = 50$ ksi (345 MPa); $F_u = 65$ ksi (450 MPa)) steel is used for the tension member, A36 ($F_y = 36$ ksi (250 MPa); $F_u = 58$ ksi (400 MPa)) steel is used for the gusset plate, and the holes are for $^3/_4$-inch bolts (M20).



$d_{Hole} = 3/4\,in + 1/8\,in = 7/8\,in$

FROM TABLE 1-5 (1-38)

$t_w = 0.314\,in$

$A_g = 3.59\,in^2$

$\bar{x} = 0.525\,in$

$A_{gv} = 2(0.314\,in)(7.5\,in) = 4.7100\,in^2$

$A_{nv} = 2(0.314\,in)(7.5\,in - 2\,1/2(7/8\,in)) = 3.3363\,in^2$

$A_{nt} = (0.314\,in)(3\,in - 7/8\,in) = 0.6673\,in^2$

① IN MEMBER

$R_n = 0.6F_u A_{nv} + U_{BS} F_u A_{nt}$

$= 0.6(65\,ksi)(3.3363\,in^2) + (1)(65\,ksi)(0.6673\,in^2)$

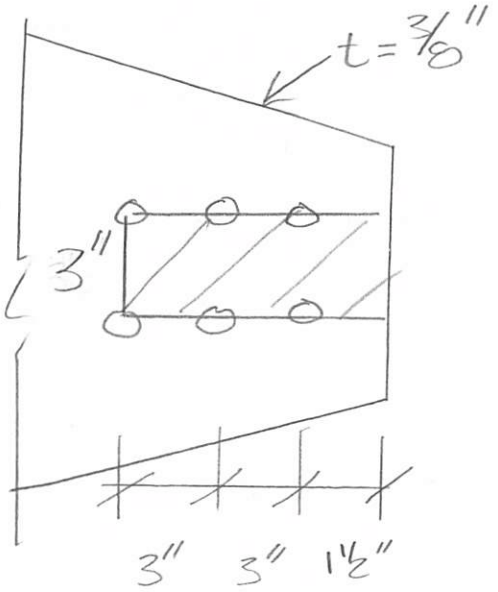
$= \underline{173.49^k}$

UPPER LIMIT $= 0.6F_y A_{gv} + U_{BS} F_u A_{nt}$

$= 0.6(50\,ksi)(4.7100\,in^2) + (1)(65\,ksi)(0.6673\,in^2)$

$\underline{184.67^k}$

(2) IN GUSSET PLATE



$F_y = 36\,ksi$
$F_u = 58\,ksi$
} IN PLATE

$A_{gv} = (3/8\,in)(2)(7.5\,in) = 5.6250\,in^2$

$A_{nv} = (3/8\,in)(7.5\,in - 2\,1/2(7/8\,in))(2) = 3.9844\,in^2$

$A_{nt} = (3/8\,in)(3.0\,in - 1(7/8\,in)) = 0.7969\,in^2$

$R_n = 0.6F_u A_{nv} + U_{bs} F_u A_{nt}$

$= 0.6(58ksi)(3.9844\,in^2) + (1)(58ksi)(0.7969\,in^2)$

$= \underline{184.88^k}$

UPPER LIMIT $0.6F_y A_{gv} + U_{bs} F_u A_{nt}$

$= 0.6(36ksi)(5.625\,in^2) + (1)(58ksi)(0.7969\,in^2)$

$= \underline{\underline{167.72^k}}$

(3) GROSS SECTION

$A_g = 3.59\ in^2$

$A_n = A_g - A_{HOLES} = 3.59 in^2 - 2(0.314 in)(7/8 in) = 3.0405 in^2$

$A_e = U A_n$

$U = 1 - \frac{\bar{x}}{\ell} = 1 - \frac{0.525 in}{Gn} = 0.9125$

$P_n = F_u A_e = 65 ksi (0.9125)(3.0405 in^2) = \underline{180.34^k}$

$P_n = F_y A_g = 50 ksi (3.59 in^2) = \underline{179.5^k}$

LRFD GROSS TENSION $0.9 P_n = 0.9(179.5^k)$

$= \underline{161.55^k}$

NET TENSION $0.75 P_n = 0.75(180.34^k)$

$= \underline{135.25^k}$

BLOCK SHEAR $0.75 R_n = 0.75(167.72^k)$

$= \underline{125.79^k}$ *

* BLOCK SHEAR GUSSETT PLATE CONTROLS *

3.5-4 | ASD

GROSS SECTION $\frac{P_n}{1.67} = \frac{179.5^k}{1.67} = \underline{107.49^k}$

NET SECTION $\frac{P_n}{2} = \frac{180.34}{2} = \underline{90.17^k}$

BLOCK SHEAR $\frac{R_n}{2} = \frac{167.72^k}{2} = \underline{\underline{83.86k}}$

* BLOCK SHEAR IN PLATE CONTROLS *