18. $P_L = 49.5\,K$ $\qquad$ $P_u = 1.2\,(16.5) + 1.6\,(49.5) = 99\,K$

$P_D = 16.5\,K$ $\qquad$ $P_u = 1.4\,D < 99\,K$

A36 steel

a) <u>LRFD:</u> $\quad P_u = \phi F_y A_g$

$$\Rightarrow A_g = \frac{P_u}{\phi F_y} = \frac{99}{0.9(36)} = 3.06\,in^2$$

try L 5x5x3/8 ⇒ $A_g = 3.61\ in^2$

assume 3/4" bolt

$\Rightarrow A_n = 3.61 - 1\left(\frac{3}{4} + \frac{1}{8}\right) \times \frac{3}{8} = 3.28\ in^2$

$U = 0.6 \Rightarrow A_e = U \cdot A_n = 1.97\ in^2$

Check Rupture: $P_n = F_u A_e = 58 \times 1.97 = 114.26K$

$\Rightarrow P_u = \phi P_n = 85.7\ K < 99K$

⇒ Not good.

try L 6x6x3/8 ⇒ $A_g = 4.38\ in^2$

3/4" bolt ⇒ $A_n = 4.38 - 1\left(\frac{3}{4} + \frac{1}{8}\right) \times \frac{3}{8} = 4.05\ in^2$

$U = 0.6 \Rightarrow A_e = 2.43\ in^2$

check rupture: $P_n = F_u A_e = 58 \times 2.43 = 140.94K$

$\Rightarrow \phi P_n = P_u = 105.71\ K$ ⇒ OK

check slenderness limit

This is MISSTATED in Problem. It should be $\frac{L}{r_z} < 300$

$$\frac{L}{r_z} = \frac{10(12)}{1.19} = 100 < 300 \therefore OK$$

∴ USE L6x6x3/8

21. WT, A992, 7/8 bolts. wind = 380 K

4 bolts / sect $\Rightarrow A_n = A_g - 4\left(\frac{7}{8}+\frac{1}{8}\right) t_f$

only the flange is connected (Assumption).

Assume $U = 0.85$ (3 or more fasteners). and $b_f < \frac{2}{3} d$ (conservative)

$P_u = 1.6 \times 380 = 608K$.

a) LRFD: $A_g = \frac{P_u}{\phi F_y A} = \frac{608}{0.9(50)} = 13.51 in^2$

$A_n = \frac{P_u}{\phi F_u (0.85)} = \frac{608}{0.75(65)(0.85)} =$ ~~[illegible] in²~~ $14.67 in^2$

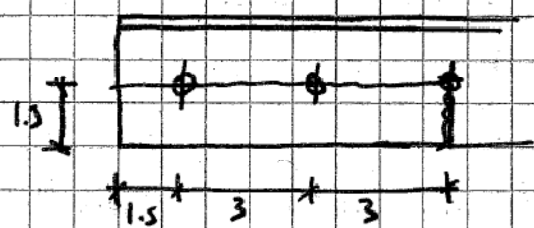
Try WT 6 x 68 $\Rightarrow A_g = 20.0 in^2 > 13.51 in^2$

$A_n = 20.0 - 4\left(\frac{7}{8}+\frac{1}{8}\right) \times 1.25 = 15 in^2 >$ ~~[illegible]~~ $14.67 in^2$

$\Rightarrow$ OK

23. L 4 x 3 x 3/8

3 x 3/4" bolts



$A_{gv} = 7.5 \times \frac{3}{8} = 2.813\ in^2$

$A_{nv} = \left[7.5 - 2.5\left(\frac{3}{4} + \frac{1}{8}\right)\right] \times \frac{3}{8} = 1.99\ in^2$

$A_{nt} = \left[1.5 - \frac{1}{2}\left(\frac{3}{4} + \frac{1}{8}\right)\right]\frac{3}{8} = 0.40\ in^2$

$0.6\ F_u A_{nv} = 0.6 \times 58 \times 1.99 = 69.25$

$0.6\ F_y A_{gv} = 0.6 \times 36 \times 2.813 = \underline{60.76\ K}$

$U_{bs} F_u A_{nt} = 1.0 \times 58 \times 0.4 = 23.2\ K$

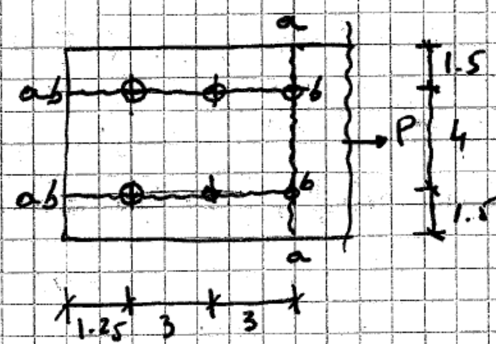
$\Rightarrow R_n = 60.76 + 23.2 = 83.96\ K$

a) **LRFD**: $\phi R_n = 0.75(83.96) = \underline{62.97\ K}$

24. PL 7 × 3/4

3/4" bolts.

A 36 steel



2 failure shapes are possible:

aa - aa : ①

bb - bb : ②

The only difference between the two is the net tension area, the smallest will control

① $A_{nt} = \left[1.5 \times 2 - 1\left(\frac{3}{4} + \frac{1}{8}\right)\right] \times \frac{3}{4} = 1.594 \text{ in}^2$

② $A_{nt} = \left[4 - 1\left(\frac{3}{4} + \frac{1}{8}\right)\right] \frac{3}{4} > ①$

$A_{gv} = 7.25 \times 2 \times \frac{3}{4} = 10.875 \text{ in}^2$

$A_{nv} = \left[7.25 \times 2 - 5\left(\frac{3}{4} + \frac{1}{8}\right)\right]\frac{3}{4} = 7.594 \text{ in}^2$

$0.6\, F_y\, A_{gv} = 0.6 \times 36 \times 10.875 = \underline{234.9}\ K$

$0.6\, F_u\, A_{nv} = 0.6 \times 58 \times 7.594 = 264.27\ K$

$\Rightarrow R_n = 234.9 + 1.0\,(58 \times 1.594) = 327.35\ K$

a) LRFD: $\phi R_n = 0.75 \times 327.35 = 245.51\ K$