Bolts-2

1/

- Investigate the capacity of tension Member. shear plane threads থের বাইরে।

Bolt dia = $\frac{7}{8}$", $F_y = 50$, $F_u = 65$ ksi

A325 bolts, $F_u^b = 120$, $F_y^b = 90$ ksi

① Bolt shear Limit state:

$$R_n = m F_{nv} A_b$$

$$= 1 \times (0.5 \times F_u^b) \times \frac{\pi}{4} d^2$$

$$= 1 \times (0.5 \times 120) \times \frac{\pi}{4} \times \left(\frac{7}{8}\right)^2$$

$$= 36.10 \text{ k}$$

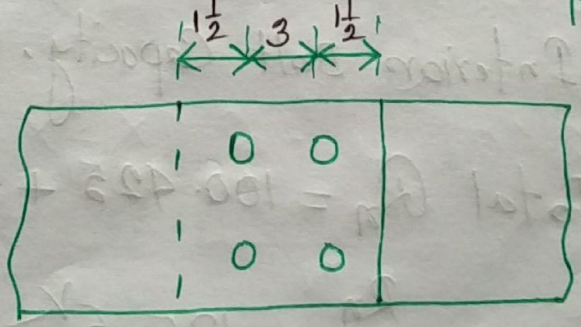
No. of bolt, 4; so; $R_n = 4 \times 36.10^k = 144.4$

In ASD $\longrightarrow$ $\frac{R_n}{\Omega} = \frac{144.4}{2} = 72.2^k$

② Bolt Bearing Limit state:

$$R_n = 1.2 L_c t F_u \leq 2.4 d t F_u$$

PL $\frac{5}{8} \times 6$



Here, $2.4 d t F_u = 2.4 \times \frac{7}{8} \times \frac{5}{8} \times 65 = 85.3^k$

ⓐ যেখানে exterior এবং interior Bolt এর জন্য clear distance L_c vary করে তাহলে R_n এর মান Upper ও lower plate এর জন্য ভিন্ন থাকবে। এই অংশে same থাকবে।

ⓐ For Exterior Bolt

$R_n = 1.2 L_c t F_u$

$L_c = 1\frac{1}{2} - \frac{1}{2}\left(\frac{7}{8} + \frac{1}{16}\right)$ inch

$R_n = 1.2 \times 1.03 \times \frac{5}{8} \times 65 = 50.21 < 2.4 d t F_u$

No. of Ext. Bolt = 2; $R_n = 2 \times 50.21 = 100.425$

ⓑ For Interior Bolt:

$L_c = 3'' - \left(\frac{7}{8} + \frac{1}{16}\right) = 2.063$

$R_n = \times \frac{5}{8} \times 65 = 100.6^k > 2.4 d t F_u$

No. of Int. Bolt = 2; $R_n = 2 \times 100.6 = 201.2^k \rightarrow 2$

So; Interior Bolt Capacity, $R_n = 2 \times 85.3 = 170.6^k$

Total $R_n = 100.425 + 170.6 = 271.03$

ASD $\longrightarrow \frac{R_n}{\Omega} = 135.5^k$

So, Capacity $= 72.2^k$

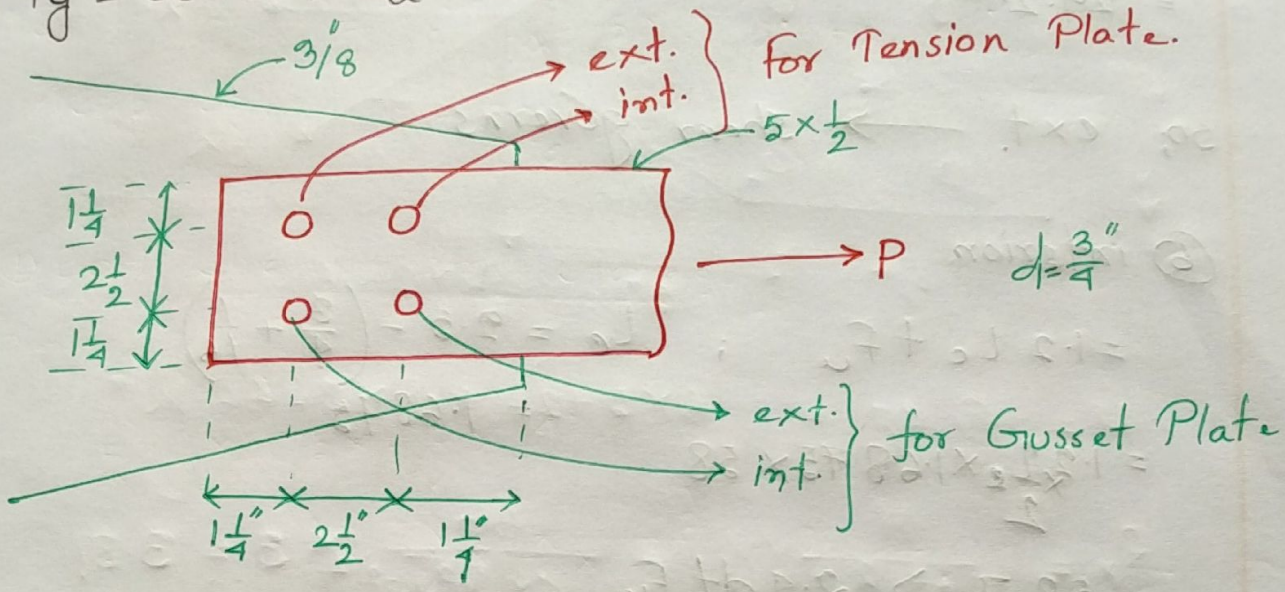
Bolts-3

1/

- Determine the design Load:

$F_y^b = 130\ ksi$; $F_u^b = 150\ ksi$

$F_y = 36\ ksi$; $F_u = 58\ ksi$



① Bolt shear limit state:

$$R_n = m F_{nv} A_b$$

$$= 1 \times (0.4 \times F_u^b) \times \left(\frac{\pi}{4} \times d^2\right)$$

$$= 1 \times 0.4 \times 150 \times \frac{\pi}{4} \times \left(\frac{3}{4}\right)^2 = 26.51^k$$

② Bearing Limit state (For Tension Plate)

ⓐ exterior Bolt

$$1.2 L_c t F_u \leq 2.4 d t F_u$$

$$2.4 d t F_u = 2.4 \times \frac{3}{4} \times \frac{1}{2} \times 58 = 52.2^k$$

$= 1.2 L_c t F_u$ • $L_c = 1.25 - \frac{1}{2}\left(\frac{3}{4} + \frac{1}{16}\right)$

$= 0.84$ inch

$= 1.2 \times 0.84 \times \frac{1}{2} \times 58$

$= 29.2^k$

so; ext. ⟶ shear governs

⑥ interion

$= 1.2 L_c t F_u$; $L_c = 2.5 - \left(\frac{3}{4} + \frac{1}{16}\right)$

$= 1.6875$

$= 1.2 \times \frac{1}{2} \times 1.6875 \times 58$

$= 58.7 > 2.4 dt F_u$

so, int ⟶ shear govent.

so, Capacity (Main Plate and Shean state)

$= 4 \times 26.57 = 106.04^k$

② Bearing Limit state (Gusset plate)

$2.4 dt f_u = 2.4 \times \frac{3}{4} \times \frac{3}{8} \times 58 = 39.2^k$

(a) exterior

$= 1.2 L_c t F_u$

$= 1.2 \times 0.89 \times \frac{3}{8} \times 58 = 21.9^k$

ext ⟶ Bearing Governs.

(b) Interior

$= 1.2 L_c t f_u$

$= 1.2 \times 10875 \times \frac{3}{8} \times 58 = 44 > 2.4 d t F_u$

int ⟶ Shear governs

Capacity $= 2 \times 21.9 + 2 \times$

$R_n = 96.82^k$ (Gusset plate and shear)

So; $R_n = 96.82^k$

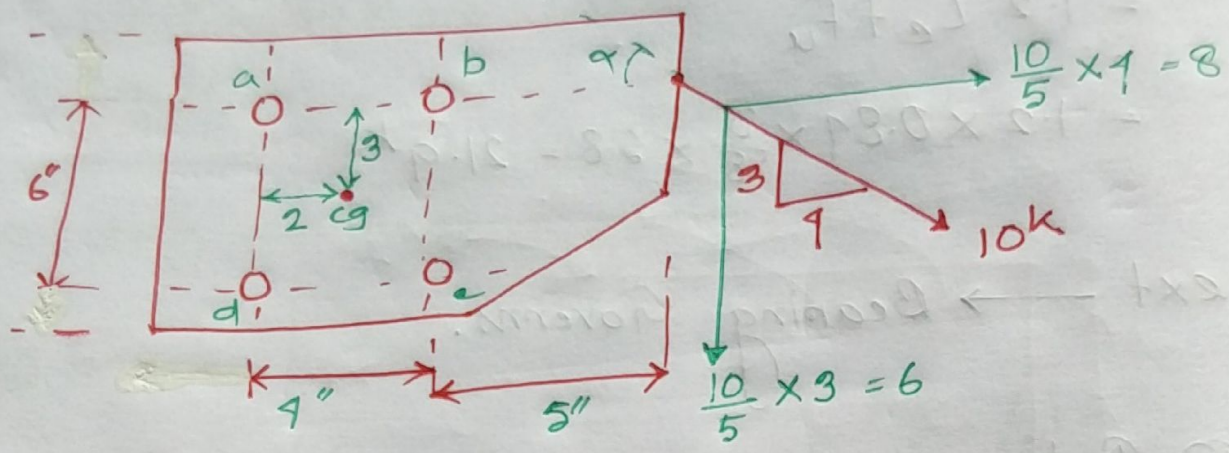
ASD ⟶ $\frac{R_n}{\Omega} = 96.82/2 = 46.4^k$

LRFD ⟶ $R_n \times \phi = 9 \cdot 82 \times 0.75 = 72.62^k$

(Ans)

2/

• Find Max^m Bolt Shear:



$$M = @\ cg = 6\times(5+2) + 8\times 3 = 66\ k''$$

$$R_x = \frac{M}{\Sigma d^2} \times y = \frac{66}{4\times(\sqrt{2^2+3^2})^2} \times 3 = 3.81$$

$$R_y = \frac{M}{\Sigma d^2} \times x = \frac{66}{4\times(2^2+3^2)} \times 2 = 2.54$$

Shear at x-direction $R_{vx} = \frac{8}{4} = 2^k$

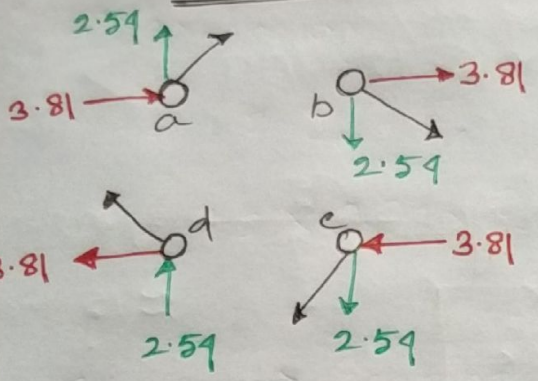
" " y-" $R_{vy} = \frac{6}{4} = 1.5^k$

Or;

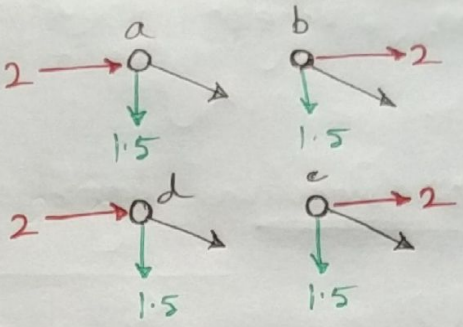
$$R_{vx} = \frac{P\cos\alpha}{N} = \frac{10\times\cos(36.87)}{4} = 2^k$$

$$R_{vy} = \frac{P\sin\alpha}{N} = \frac{10\times\sin(36.87)}{4} = 1.5^k$$

Moment



Shear



At - (a)

$$\text{Shear} = \left\{(3.81+2)^2 + (2.54-1.50)^2\right\}^{\frac{1}{2}} = 5.91^{K}$$

At - (b)

$$\text{Shear} = \left\{(3.81+2)^2 + (2.54+1.50)^2\right\}^{\frac{1}{2}} = \boxed{7.1^{K}}$$ (Ans)

At - (c)

$$\text{Shear} = \left\{(3.81-2)^2 + (2.54+1.5)^2\right\}^{\frac{1}{2}} = 4.43^{K}$$

At - (d)

$$\text{Shear} = \left\{(3.81-2)^2 + (2.54-1.5)^2\right\}^{\frac{1}{2}} = 2.10^{K}$$