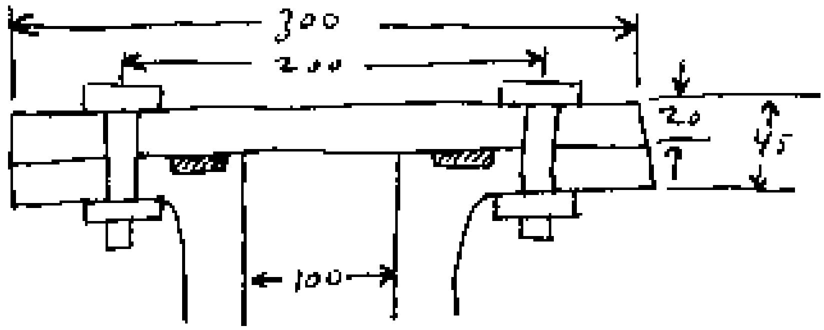
(8.11)



10 bolts

150 class 8.8 $d = 12$ mm $\quad P_i = 6$ MPa

effective sealing diameter is 150 mm.

$$\frac{K_b}{K_b + K_m} = C = 0.213 \quad \text{Find: } n \text{ (Load Factor)}$$

eq. 8-23: $n = \dfrac{S_p A_t - F_i}{CP}$ with (eq. 8.25) $F_i = 0.75 F_p$

8-26: $F_p = A_t S_p$

$$\rightarrow n = \frac{S_p A_t - 0.75 S_p A_t}{CP} = \frac{0.25 S_p A_t}{CP}$$

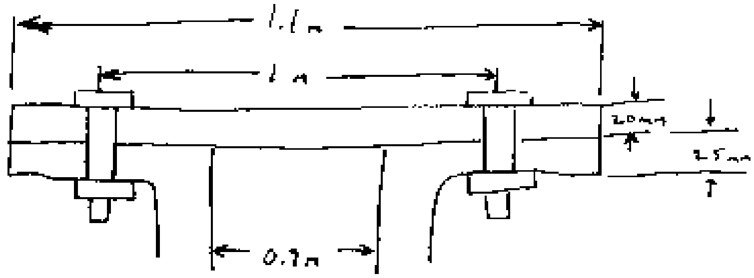
$$P = \frac{1}{10} \pi \left(\frac{150}{2}\right)^2 (6)(10^{-3}) = 10.6 \text{ KN}$$

Table 8-6 $S_p = 600$ MPa

Table 8-1 $A_t = 84.3$ mm^2

$$n = \frac{0.25(600)(84.3)(10^{-3})}{(0.213)(10.6)} = \underline{5.6}$$

(8.21)



Cylinder : ASTM No. 30 cast iron

Head : ...

36 M10 x 1.5 ISO 10.9 bolts at 75% of Proof Load

P_i : 0 ⟷ 550 kPa $C = 0.213$

Find n (factor of safety) against fatigue

Table 8-17 $S_e = 162$ MPa

Table 8-6 $S_p = 830$ MPa

$S_{ut} = 1040$ MPa

Table 8-1 $A_t = 58\ mm^2$

$$n = \frac{S_a}{\sigma_a}$$

$$S_a = \frac{S_{ut} - \frac{F_i}{A_t}}{1 + \frac{S_{ut}}{S_e}}$$

$$\sigma_a = \frac{CP}{2}\left(\frac{1}{A_t}\right) = \frac{CP}{2A_t}$$

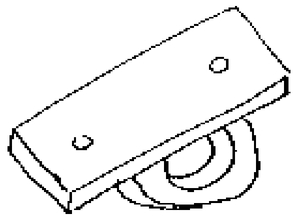
$F_i = 0.75\, A_t\, S_p = 0.75(58)(830) = 36.1$ kN

$$P = \frac{pA}{N} = \frac{(550)\,\pi \left(\frac{0.9}{2}\right)^2}{36} = 9.72\ \frac{kN}{bolt}$$

$$S_a = \frac{1040 - (36.1/58)(10^3)}{1 + 1040/162} = 56.28\ MPa \qquad \sigma_a = \frac{(0.213)(9.72)}{2\ (58)}(10^3) = 17.85\ MPa$$

$$n = \frac{56.28}{17.85} = \underline{3.15}$$

(8.24)



Bolted to ceiling beam.

bolts: $\frac{1}{2}$ in. coarse threads

SAE grade 5

$k_b = 4.94 \frac{Mlb}{in}$ $k_m = 15.97 \frac{Mlb}{in}$

(a) Find P if design factor = 2

(b) Compute load factors based on P

(a) $A_t = 0.1419 \text{ in}^2$ $F_i = 0.75\, A_t\, S_p = 0.75(0.1419)(85) = 9.046$ kip

$S_p = 85$ Kpsi

$S_{ut} = 120$ Kpsi $C = \frac{4.94}{4.94+15.97} = 0.236$

$S_e = 18.6$ Kpsi $\sigma_a = \frac{CP}{2A_t} = \frac{(.236)P}{2(.1419)} = 0.832\,P$ Kpsi

$$S_a = \frac{S_{ut} - F_i/A_t}{1 + S_{ut}/S_e} = \frac{120 - 9.046/0.1419}{1 + 120/18.6} = 7.55 \text{ Kpsi}$$

$n = \frac{S_a}{\sigma_a} = 2 = \frac{7.55}{0.832\,P}$ $\underline{P = 4.537 \text{ kip}}$

(b) $\sigma_a = (0.832)(4.537) = 3.775$ Kpsi

$$n = \frac{S_p A_t - F_i}{CP} = \frac{85(.1419) - 9.046}{(.236)(4.537)} = \underline{2.82}$$

$$n = \frac{F_i}{P(1-C)} = \frac{9.046}{(4.537)(1-0.236)} = \underline{2.61}$$

8-30/. Find tensile shear load F.

SAE 1040 steel, $S_y = 71$ kpsi

SAE Grade 5 bolts, $S_y = 92$ kpsi

$$S_{sy} = 0.577 S_y = 53.08 \text{ kpsi}$$

For shear of bolt,

$$\frac{F_s}{A} = \frac{S_{sy}}{n}$$

(2 bolts)

$$\Rightarrow F_s = \frac{A S_{sy}}{n} = \frac{2 \times \left(\frac{7}{8 \times 2}\right)^2 \pi \, (53.08 \times 10^3 \text{ lb/in}^2)}{1.8}$$

$$= 35.39 \text{ kip}$$

For bearing on bolts,

$$F_b = \frac{A S_y}{n} = \frac{(0.75)(7/8)(2)(92 \times 10^3 \text{ lb/in}^2)}{2.2}$$

$A = td$ (8-41) For bearing stress

$$= 54.78 \text{ kip}$$

For bearing on members

$$F_b = \frac{A S_y}{n} = \frac{(0.75)(7/8)(2)(71 \times 10^3 \text{ lb/in}^2)}{2.4}$$

$$= 38.75 \text{ kip}$$

For Tension of members

$$F_t = \frac{A S_y}{n} = \frac{(16.04)(71 \times 10^3 \text{ lb/in}^2)}{2.6} = 438.22 \text{ kip}$$

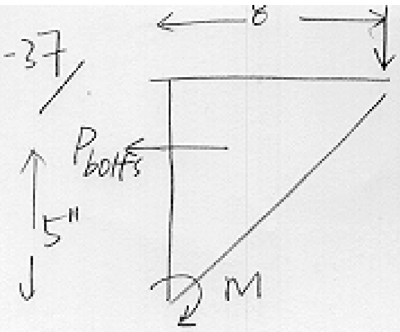
A = areas of plates − areas of holes (see 8-40)

$$= (5.75)(3) - \left(\frac{7}{16}\right)^2 (\pi)(2)$$

$$= 16.04$$

∴ Choose the smallest one, thus $F = 35.39$ kip

8-37/



(a) $\Sigma M = 0$ ← 2 bolts

$$F(8'') = P_{bolts}(5'')(2)$$

$$P_{bolts} = 1000\, lb/bolt$$ //

(b) SAE Grade 5, $A_t = 0.0775\ in^2$, $S_p = 85\ kpsi$, $C = 0.173$

90% preload.

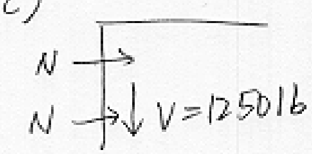
$$\therefore F_i = 0.9 A_t S_p = 0.9(0.0755\ in^2)(85\ kpsi)$$
$$= 5.93\ kip$$

$$\sigma_i = 0.9(85\ kpsi) = 76.5\ kpsi$$

Eq 8-23,

$$n = \frac{S_p A_t - F_i}{CP}$$
$$= \frac{(85\ kpsi)(0.0755\ in^2) - (5.93\ kip)}{(0.173)(1000\ lb)}$$
$$= 3.8$$ //

(c)



Total clamping load is

$$N = 4(5.93) = 23.72\ kip$$ /

↑ 4 bolts

$$n = \frac{\mu N}{V} = \frac{0.25(23.72)\ kip}{1 \times 10^3\ psi}$$
$$= 4.74$$ //.

(d) lower pair carries the entire shear load.

$A_s = 0.221 \text{ in}^2$ for each bolt.

$$\tau = \frac{F}{A} = \frac{1250 \text{ lb}}{0.221} = 5660 \text{ psi}$$

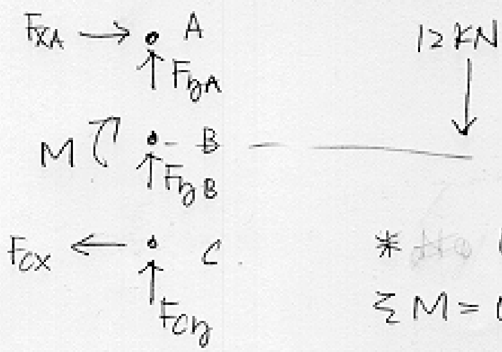
$$S_y = 92 \text{ kpsi} \Rightarrow S_{sy} = 0.577 S_y$$
$$= 0.577(92) = 53.08 \text{ kpsi}$$

$$n = \frac{53.08 \text{ kpsi}}{5.66 \text{ kpsi}} = 9.38$$ //

8-34 / (a) Find total shear load on each [illegible]
bolts.

(b) Find second moment of area.

(c) Find maximum bending stress in plate.



$F_{yA} = F_{yB} = F_{yc}$

$\Sigma F_y = 0$.

$3 F_{yA} = 12 KN$

$F_{yA} = F_{yB} = F_{yc} = 4 KN$.

* No X-component force at B.

$\Sigma M = 0$

$M = 12 KN (0.2) = 2400 Nm$.

By symmetry, $F_{cx} = F_{xA}$.

Sum moment at point B,

$M = 2 \times 32mm \times F_{cx}$

$F_{cx} = F_{xA} = 37.5 \text{ KN}$.

For bolt A & bolt C,

$F_A = F_C = \sqrt{4^2 + (37.5)^2} = 37.7 KN$

bolt B, $F_B = 4 KN$,

Bolt shear on A & C, $A_s = \frac{\pi (12)^2}{4} = 113 mm^2$

$\tau_{A,B} = \frac{37.7 \times 10^3 N}{113 mm^2} = 334 MPa$,

Bolt shear on C,

$\tau_c = \frac{4 \times 10^3 N}{113 mm^2} = 35.4 MPa$,

} bolt shear stress.

bearing stress for A & C

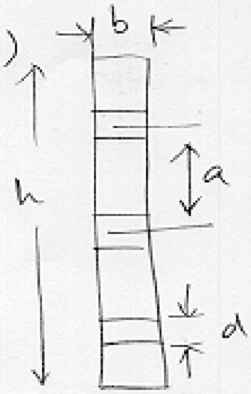
$$A_b = 12(8) = 96\,mm^2$$

$$\sigma = \frac{37.7 \times 10^3 N}{96\,mm^2} = 393\,MPa \quad \text{, (bearing stress)}$$

For bolt B,

$$\sigma = \frac{4 \times 10^3 N}{96\,mm^2} = 41.67\,MPa \quad \text{, (bearing stress)}$$

(b)



moment of inertia,

$$I = \frac{1}{12}bh^3 - \frac{1}{12}bd^3 - 2\left(\frac{1}{12}bd^3 + a^2bd\right)$$

$$= \frac{1}{12}(8)(136)^3 - \frac{1}{12}(8)(12)^3 - 2\left\{\frac{8(12)^3}{12} + (32)^2(8)(12)\right.$$

$$= 1.48 \times 10^6\,mm^4 \;//$$

(c) maximum stress

$$\sigma = \frac{Mc}{I}$$

$$= \frac{2400\,Nm\,(68\,mm)}{1.48 \times 10^6\,mm^4}$$

$$= 110\,MPa \;//$$