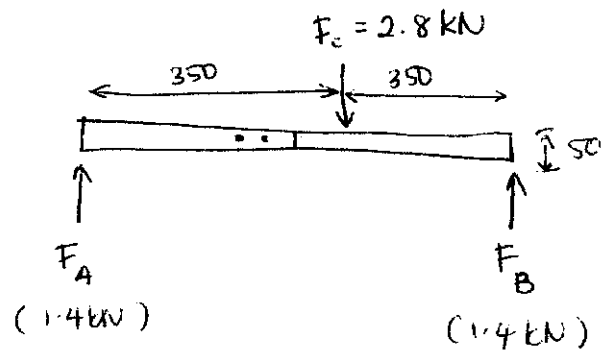
QUESTION 8.44:



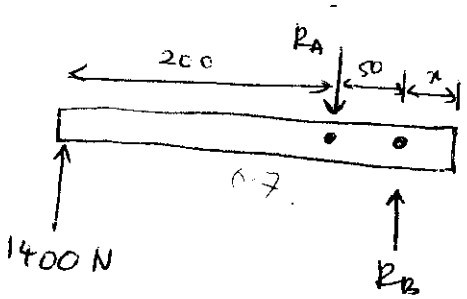
$(\uparrow)\sum F = 0$

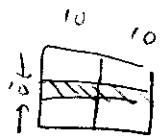
$0 = 2.8 - F_A - F_B$

$(F_A = F_B)$

$0 = 2.8 - 2F_A$

$F_A = \frac{2.8}{2} = 1.4\ kN = F_B$





(M10 x 1.5)

$\circlearrowleft \sum M_B = 0$

$0 = 1.4(0.25) - R_A(0.05)$

$R_A = 7\ kN$ ✱

$\uparrow \sum F_y = 0$

$0 = 1.4 - 7 + R_B$

$R_B = 5.6\ kN$ ✱

Members:

AISI 1018. Dau Table A-18:

$S_y = 370\ MPa$

Bolts:

ISO 5.8: Dau Table 8-11:

$S_y = 420\ MPa$

Shear yield strength: $S_{sy} = 0.577\ S_y = 242.34\ MPa$

Bearing in bolts:

$\sigma = \frac{F}{2td} = \frac{S_p}{n_d}$

Dau Table 8-11:

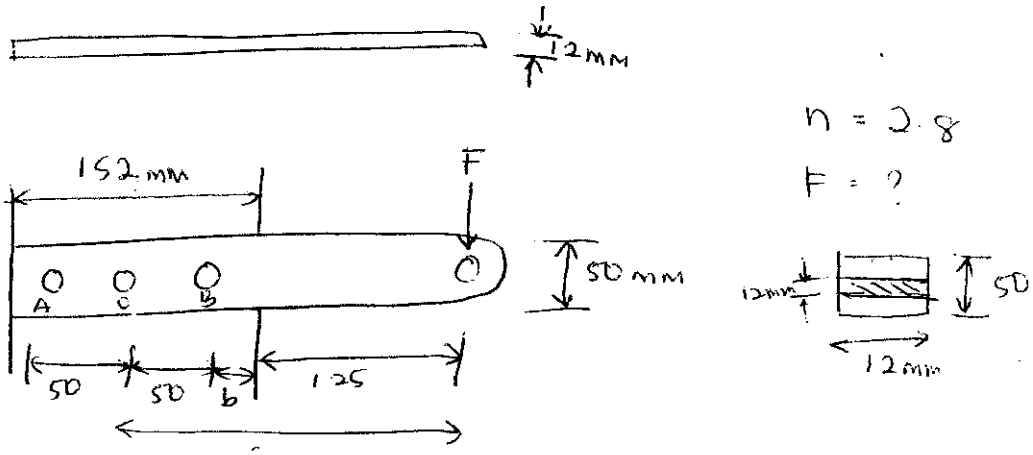
$S_p = 380\ MPa$

$\tau = \frac{F}{\pi d^2/4} = \frac{S_{sy}}{n_d}$

$n_d = \frac{S_{sy}\pi d^2}{4F} = \frac{242.34 \times 10^6 \times \pi \times 0.01^2}{4 \times 7000}$

$= 2.72$

QUESTION 8-48 :



Channel :

AISI 1006 HR

$S_{ut} = 300\ MPa$

$S_y = 170\ MPa$

Bar :

AISI 1015 HR

$S_y = 190\ MPa$

$S_{ut} = 340\ MPa$

Bolts :

M12 X 1.75

$S_p = 380\ MPa$

$S_{ut_{min}} = 520\ MP$

$S_{y_{min}} = 420\ MP$

Direct force on each bolt :

$$F' = \frac{F}{3} = \frac{1}{3}F = 0.333F$$

Centroid, O :

$$b = \frac{152 - 50}{2} = 26$$

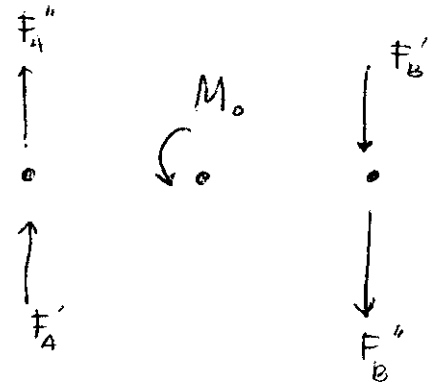
$$M_O = F(0.125 + 0.05 + 0.026)$$

$$= 0.201F$$

$$F'' = \frac{Mr}{r_A^2 + 0 + r_B^2}$$

$$= \frac{(0.201F)(0.05)}{0.05^2 + 0 + 0.05^2}$$

$$= 2.01F$$



$$F_{total} = F' + F''$$

$$= 0.333F + 2.01F$$

$$= 2.342F$$

Dari ①

$F_{total} = F' + F''$

$13.84 = 2.343\,F$

$\therefore F = 5.91\ kN$ ※

Bearing on channel :

$\sigma = \frac{S_y}{n} = \frac{170\ MPa}{2.8} = 60.71\ MPa$

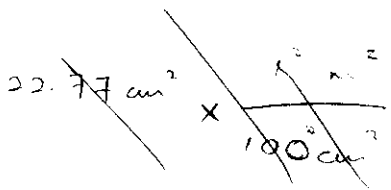
$\sigma = \frac{F}{A_b}$ $\quad A_b = td$, d = dia. bolt

t = tebal channel dari Table A-7.

$F = \sigma A$

$= (60.71 \times 10^6)(0.0064)(0.012)$

$F_{total} = 4.66\ kN$ ↓ Dari Table A-7.

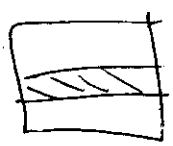


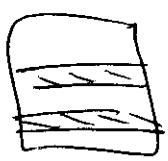
Dari ① :

$F_{total} = F' + F''$

$4.66 = 2.343\,F$

$\therefore F = 1.99\ kN$ ◇





Bearing on cantilever :

$\sigma = \frac{S_y}{n} = \frac{190\ MPa}{2.8} = 67.86\ MPa$

$F_{total} = \sigma A$ $\quad (A = td)$ tebal cantilever

$= 67.86 \times 10^6 \times (0.012) \times 0.012$ (dia. bolts)

$= 9.78\ kN$

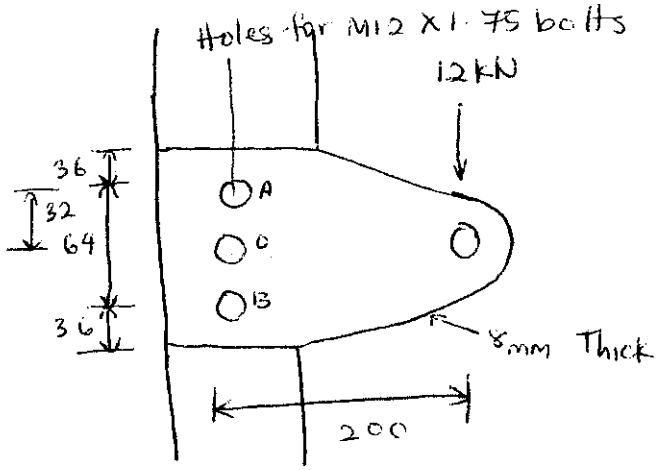
Dari ① : $9.78\ kN = 2.343\,F$

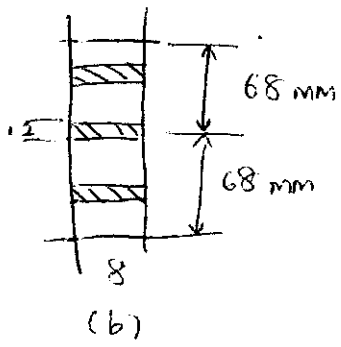
$\therefore F = 4.17\ kN$

$\therefore$ F terendah pada channel,

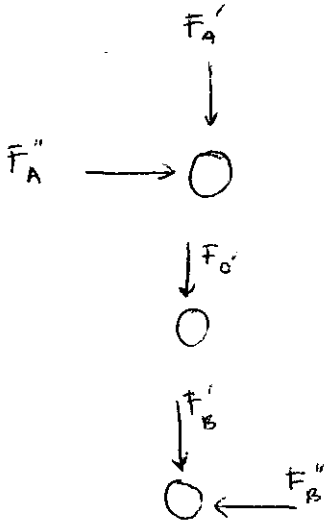
→ $F = 1.99\ kN$ ※

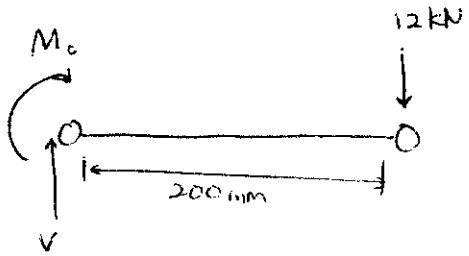
QUESTION 8.49.





(b)

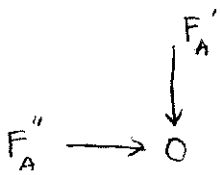


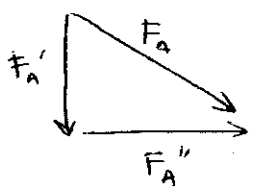


$$M_C = Fl = 12 \times 0.2$$
$$= 2.4\ kNm \ \ast$$

$$F_C' = F_A' = F_B' = \frac{V}{3} = \frac{12}{3} = 4\ kN \ \ast$$

Bolt A:

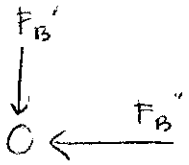


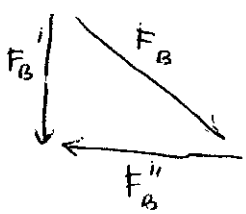


$$F_A'' = \frac{M_C r_A}{r_A^2 + r_B^2 + r_C^2}$$

$$= \frac{2400 \times 0.032}{0.032^2 + 0 + 0.032^2} = 37.5\ kN$$

Bolt B:





$$F_B'' = \frac{M_O r_B}{r_A^2 + r_B^2 + r_C^2}$$

$$= \frac{2400 \times 0.032}{0.032^2 + 0 + 0.032^2} = 37.5\ kN \ \ast$$

$$F_A = \sqrt{F_A'^2 + F_A''^2}$$
$$= \sqrt{4^2 + 37.5^2}$$
$$= 37.71 \text{ kN} \quad \#$$

$$F_B = \sqrt{(F_B')^2 + (F_B'')^2}$$
$$= \sqrt{4^2 + 37.5^2}$$
$$= 37.71 \text{ kN} \quad \#$$

Bolt shear:

$$\therefore \tau = \frac{F}{A} = \frac{37.71 \times 10^3}{\left(\frac{\pi \times 0.012^2}{4}\right)} = 333.43 \text{ MPa} \quad \#$$

(M12)

Bearing stress on member:

$$\sigma = -\frac{F}{A_b}, \quad A_b = td = 0.008 \times 0.012$$
$$= 9.6 \times 10^{-5} \text{ mm}^2$$

$$\therefore \sigma = -\frac{37.71 \times 10^3}{9.6 \times 10^{-5}}$$
$$= -392.8 \text{ MPa} \quad \#$$

Bending stress on plate:

$$I = I_{bar} - I_{holes(C)} - 2\left[I_{holes(A/B)} + \bar{d}^2 A\right]$$
$$= \frac{bh^3}{12} - \frac{bh^3}{12} - 2\left(\frac{bh^3}{12} + \bar{d}^2 A\right)$$
$$= \frac{(0.008)(0.136)^3}{12} - \frac{(0.008)(0.012)^3}{12} - 2\left[\frac{(0.008)(0.012)^3}{12} + (0.008 \times 0.012 \times (0.03$$
$$= (1.677 \times 10^{-6}) - (1.152 \times 10^{-9}) - 2(9.9456 \times 10^{-8})$$
$$= 1.477 \times 10^{-6}$$

$$\therefore \sigma = \frac{My}{I} = \frac{2400 \times 0.068}{1.477 \times 10^{-6}} = 110.5 \text{ MPa} \quad \#$$

Shear on bolt :

$n = 2.8$

$$\tau = \frac{S_p}{n} = \frac{380\ MPa}{2.8} = 135.7\ MPa$$

$$\tau = \frac{F_{total}}{A_s} \longrightarrow \text{Dan table 8-1 (minor, } A_s = A_r)$$

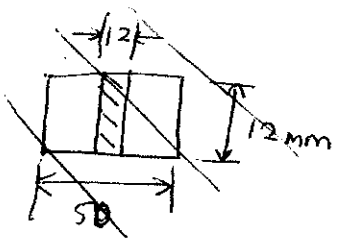
$$F_{total} = \tau A_s$$
$$= 135.7 \times 10^{6} \times 76.3 \times 10^{-6}$$
$$= 10.35\ kN$$

$$F_{total} = 2.343F = 10.35 \times 10^{3}$$

$$F = 4.42\ kN \ \text{✱}$$

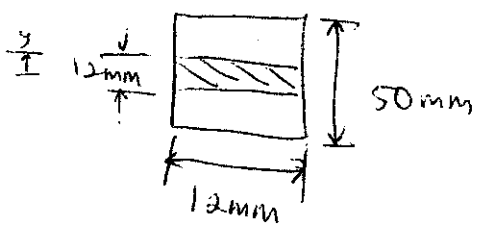
Bearing on bolt :

$$\sigma = \frac{My}{I}, \quad I = ?$$



$$I = \frac{0.012(0.05)^3}{12} - \frac{0.012^4}{12}$$

$$= 1.23 \times 10^{-7}$$



$$\sigma = \frac{My}{I} = \frac{0.201F(0.006)}{1.23 \times 10^{-7}}$$

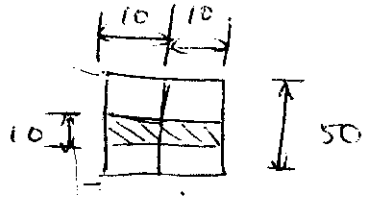
$$= 9805F\ N \ \text{✱}$$

$$\sigma = \frac{S_p}{n}$$

$$9.805F = \frac{380}{2.8}$$

$$\therefore F_{total} = 13.84\ kN$$

Bearing on member :



$$n = \frac{S_y}{\sigma} = \frac{S_y}{P/A}$$

$$n = \frac{A \times S_y}{P} = \frac{370 \times 10^6 \times 0.01 \times 0.01}{7000}$$

Ans = 5.29

$$= 5.29$$

$$\sigma = \frac{F}{2td} = \frac{S_y}{n_d}$$

$$n_d = \frac{370M \times 2 \times 0.01 \times 0.01}{7000}$$

Strength on member :

At A, $\sigma_A = \frac{M_A y}{I} = \frac{1400 \times 0.2 \times 0.025}{1.033 \times 10^{-7}}$

$$\sigma_A = 67.76 \text{ MPa}$$

At C, $\sigma_c = \frac{M_c y}{I} = \frac{1400 \times 0.35 \times 0.025}{1.042 \times 10^{-7}}$

$$\sigma_c = 117.56 \text{ MPa}$$

$$\rightarrow n_A = \frac{S_y}{\sigma_A} = \frac{370}{67.76} = 5.46$$

$$n_c = \frac{S_y}{\sigma_c} = \frac{370}{117.56} = 3.15$$

$$I_A = \frac{bh^3}{12} - \frac{bh^3}{12}$$

$$= \frac{(0.01)(0.05^3)}{12} - \frac{(0.01)(0.01^3)}{12}$$

$$= 1.033 \times 10^{-7}$$

Therefore, the minimum n at the bolt shear :

$$\therefore n = 2.72$$