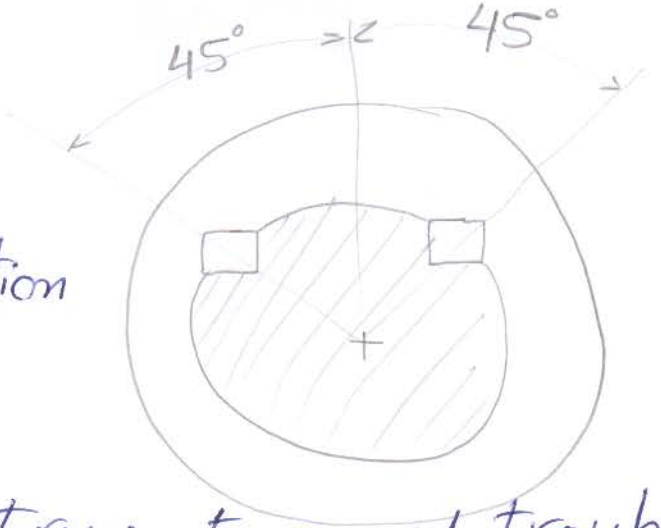
Final ME142 (11-12)

Q1

a)-Kennedy Key:

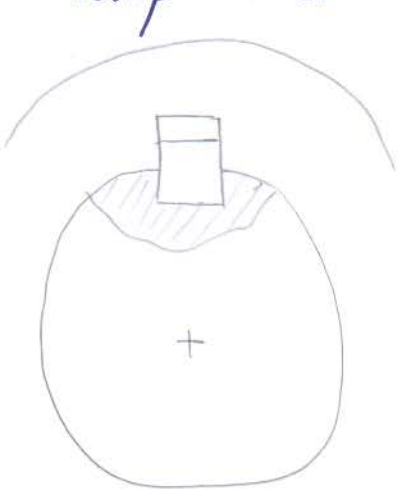


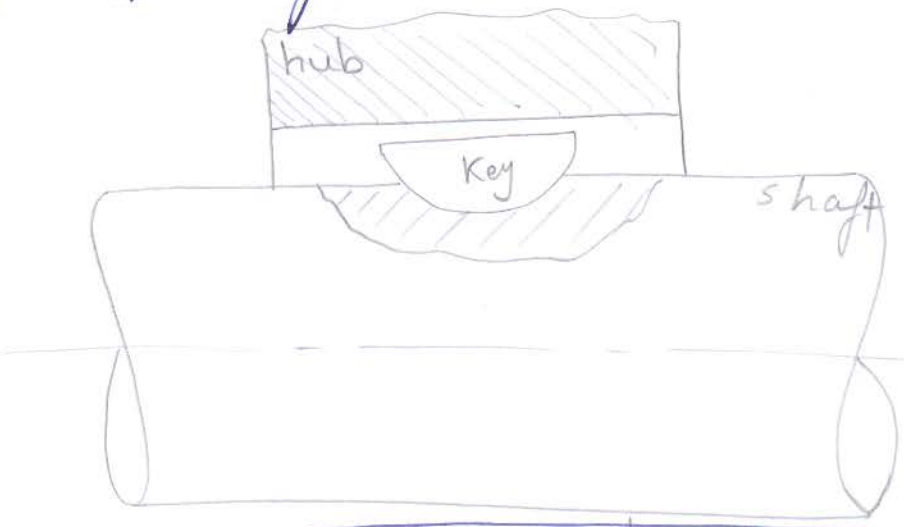
For heavy duty installation

- woodruff Key:

suitable for very small torque to avoid troublesome fitting. It does no tipping or rolling.

well adapted to tapered shafts.



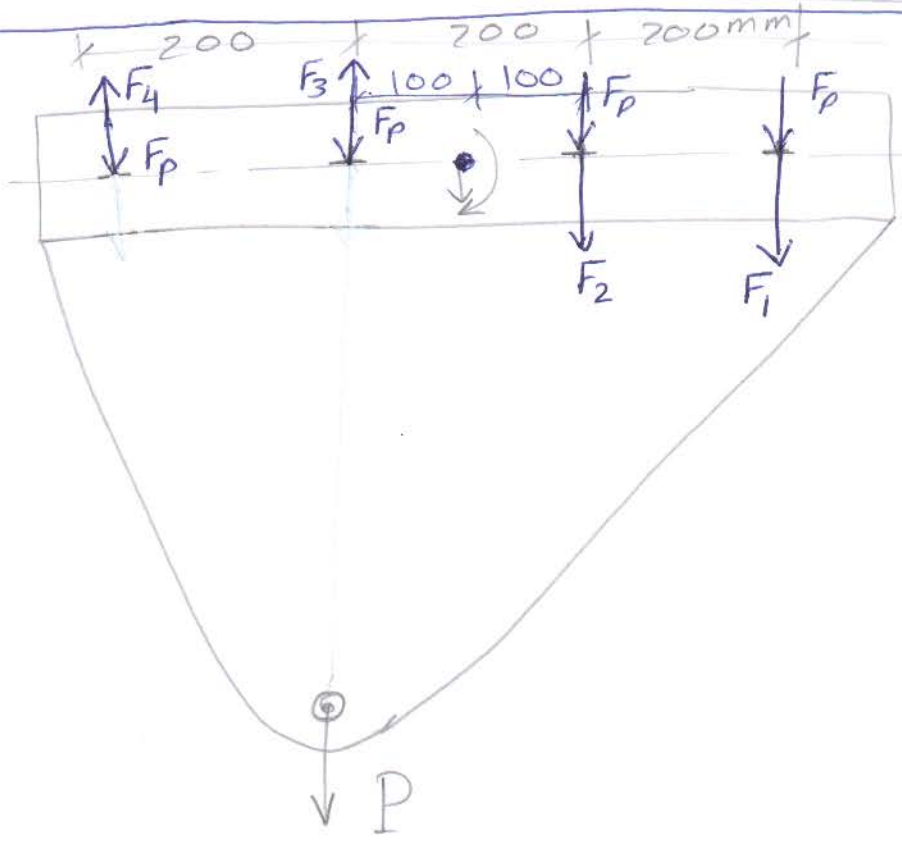


b)

P=??

τ = 100MPa

d = 20mm



$T = F * l = F * 100 \quad N.mm$

$F_p = \frac{F}{4}$

مسألة

$r_1 = 300mm \quad r_2 = 100\ mm$

$r_4 = 300mm \quad r_3 = 100\ mm$

$\theta_1 = \theta_2 = 180^\circ \qquad \theta_3 = \theta_4 = 0^\circ$

the worst rivet is rivet 1 $\quad r_1 = 300\ mm$, $\theta_1 = 180^\circ$

$$F_1 = \frac{T r_1}{\sum_{i=1}^{n} r_i^2} = \frac{F * 100 * 300}{2(300)^2 + 2(100)^2} = 0.15F$$

$$F_{s1} = \sqrt{F_p^2 + F_1^2 - 2 F_p F_1 \cos\theta_1}$$

$$= \sqrt{\left(\frac{F}{4}\right)^2 + (0.15F)^2 - 2 * \frac{F}{4} * 0.15F \cos 180}$$

$$= 0.4F$$

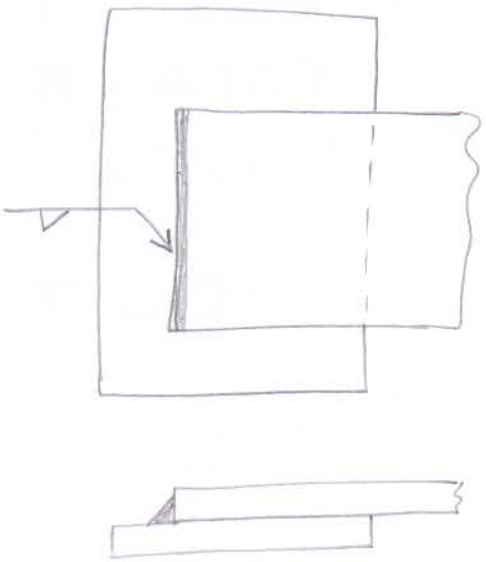
$$\tau = \frac{F_{s1}}{A}$$

$$100 = \frac{0.4F}{\frac{\pi}{4}(20)^2} \qquad \therefore F = 78539.82\ New.$$

Q2

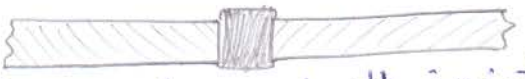
a) Types of fillet welding

① Lap joint



② Butt joint

a) square butt joint



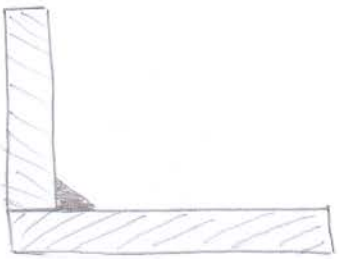
b) single V-butt joint

c) single U-butt joint

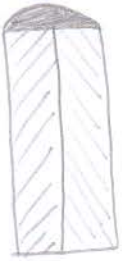
d) double V- ~ ~

e) double U- ~ ~

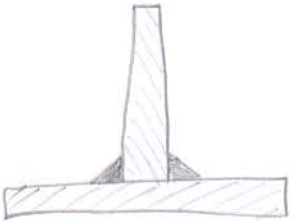
③ Corner joint

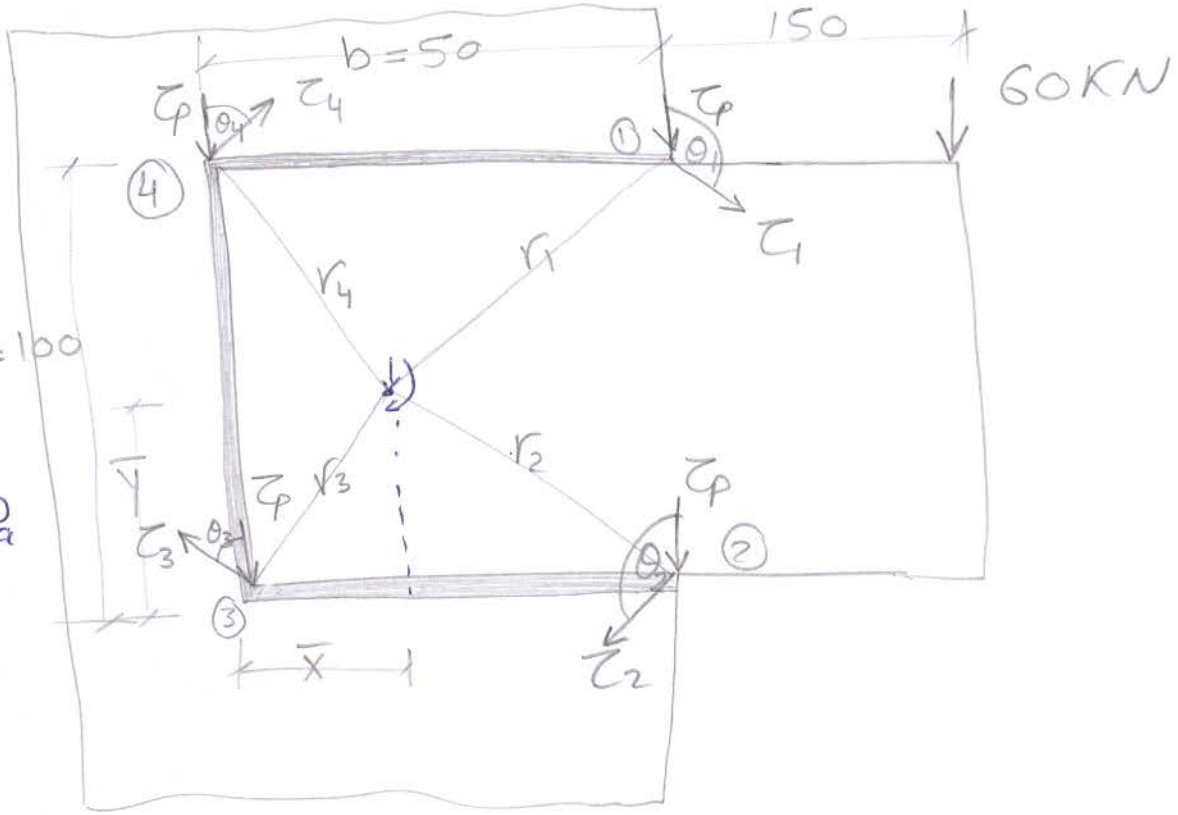


④ Edge joint



⑤ T-joint





مراجعة

$$\bar{x} = \frac{b^2}{2b+d} = \frac{(50)^2}{2*50+100} = 12.5 mm$$

$$\bar{y} = \frac{d}{2} = \frac{100}{2} = 50 mm$$

$$A = 0.707h(2b+d)$$

$$= 0.707h(2*50+100) = 141.4h \ mm^2$$

$$J_u = \frac{8b^3 + 6bd^2 + d^3}{12} - \frac{b^4}{2b+d}$$

$$= \frac{8*(50)^3 + 6*50*(100)^2 + (100)^3}{12} - \frac{(50)^4}{2*50+100}$$

$$= 385416.667 \ mm^3$$

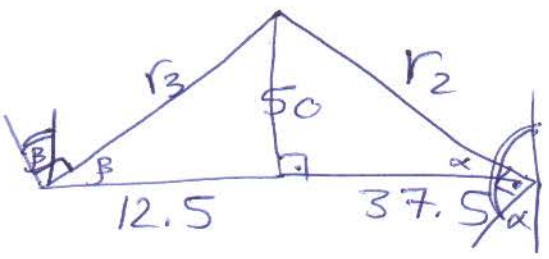
$$T = F * \ell = 60*10^3*(150+50-12.5)$$

$$= 11250000 \ N.mm = 11.25*10^6 \ N.mm$$

$$\tau_\varphi = \frac{F}{A} = \frac{60*10^3}{141.4h} = \frac{424}{h}$$

$$r_1 = r_2 = \sqrt{(50)^2 + (37.5)^2}$$

$$= 62.5 \ mm$$



$$r_3 = r_4 = \sqrt{(50)^2 + (12.5)^2}$$

$$= 51.54 \ mm$$

$$\alpha = \tan^{-1}\frac{50}{37.5} = 53.13^\circ$$

$$\theta_1 = \theta_2 = 180 - \alpha = 126.87^\circ$$

$$\beta = \tan^{-1}\frac{50}{12.5} = 75.96^\circ$$

$$\theta_3 = \theta_4 = 75.96^\circ$$

the worst point is 1 or 2

for point ①

$$\tau_{s1} = \frac{T r_1}{J} = \frac{11.25 * 10^6 * 62.5}{0.707h * 385416.667}$$

$$= \frac{2580.37}{h}$$

$$\tau_{max} = \sqrt{\tau_p^2 + \tau_{s1}^2 - 2\tau_p \tau_{s1} \cos\theta_1} \leq \tau_{all}$$

$$\sqrt{\left(\frac{424}{h}\right)^2 + \left(\frac{2580.37}{h}\right)^2 - 2\left(\frac{424}{h}\right)\left(\frac{2580.37}{h}\right)\cos 126.87}$$

$$\frac{2854}{h} \leq 140$$

$$mm \quad 20.39 \leq h$$

Q3

a) The disadvantages of using belt drive are:-

① limited power range (compared with gears).

② short life.

③ Can't withstand high temperature.

b) V-belt

$N = ??$ power = 2000 watt $n_1 = 900$ rpm

$C = 1500$ mm $d_2 = 400$ mm $d_1 = 200$ mm

$\mu = 0.3$ $W = 11 * 10^3 \frac{N}{m^3}$ $A = 140$ mm^2

$\beta = \frac{38}{2} = 19^\circ$ $K_s = 1$ $\sigma_{all} = 2.5$ MPa

Soln

$$\theta_1 = 180 - 2 \sin^{-1} \frac{d_2 - d_1}{2C}$$

$$= 180 - 2 \sin^{-1} \frac{400 - 200}{2 * 1500} = 172.35^\circ$$

$$V = \frac{\pi d_1 n_1}{60} = \frac{\pi * 200 * 900}{60} * 10^{-3} = 9.42 \text{ m/s}$$

$$F_1 = \sigma_{all} A = 2.5 * 140 = 350 \text{ N}$$

$$F_c = \frac{W}{g} V^2 = \frac{11 * 10^3 * 140 * 10^{-6}}{9.8} * (9.42)^2 = 13.94 \text{ N}$$

$$\frac{F_1 - F_c}{F_2 - F_c} = e^{\mu_e \theta} \quad \text{for V-belt} \quad \mu_e = \frac{\mu}{\sin \beta}$$

$$F_2 = F_c + \frac{F_1 - F_c}{e^{\mu_e \theta}} = 13.94 + \frac{350 - 13.94}{e^{\frac{0.3 * 172.35 * \pi}{\sin 19 \ 180}}} = 34.96 \text{ N}$$

$$\text{power} = K_s (F_1 - F_2) * V * N$$

$$2000 = 1 * (350 - 34.96) * 9.42 * N$$

$$N = 0.6739$$

$$\simeq 1$$