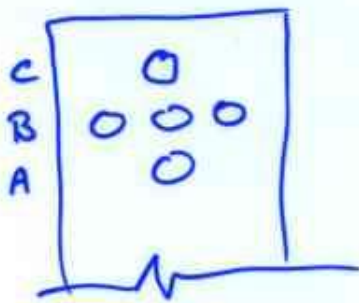
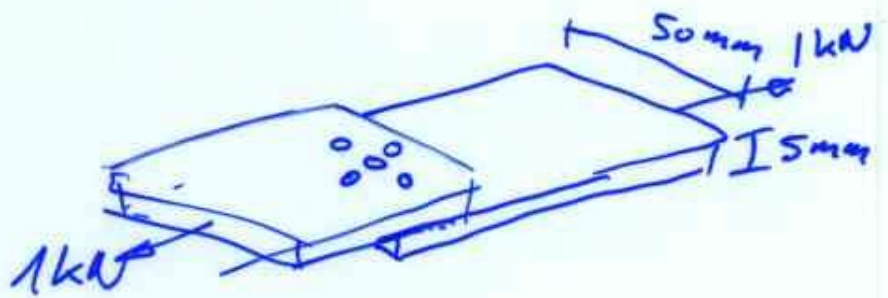


# TRIPLE Riveted LAP JOINT

look @ joint  

$\phi$  of rivets  
 4mm

- (a) find avg stress in rivets
- (b) " bearing stress
- (c) " tensile stresses in plate.

(a) find avg force first

$$\tau = \frac{F}{A} = \frac{2000 \text{ N}}{\left(\frac{4 \times 10^{-3}}{2}\right) \pi} = \underline{\underline{16 \text{ MPa}}}$$

(b)  $F = 2000 \text{ N}$  again

$$\beta = \frac{F}{A_{\text{projected}}} = \frac{2000}{(4 \times 10^{-3})(5 \times 10^{-3})} = \underline{\underline{10 \text{ MPa}}}$$

$\uparrow$   
 plate thickness

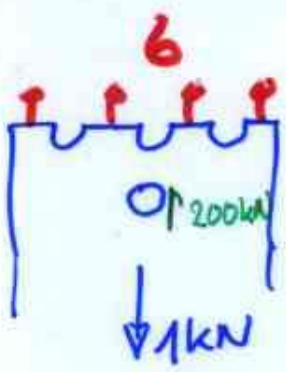
(c) look @ each row separately.



$$\beta = \frac{1000}{(0.05 - 0.004)(0.005)} = 4.35 \text{ MPa}$$

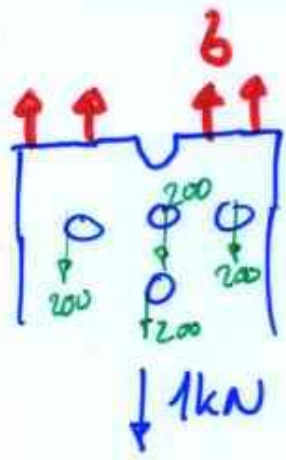
$\rightarrow (w - d) (t)$

B/



$$\delta = \frac{800 \text{ N}}{\underbrace{(50 \text{ mm} - (3)(4 \text{ mm}))}_{(0.038)} \underbrace{(5 \text{ mm})}_{(0.005)}} = 4.2 \text{ MPa}$$

C/

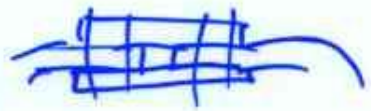


$$\delta = \frac{(1000 - 4(200))}{(0.046)(0.005)} = \cancel{0.9 \text{ MPa}} \quad 1.09 \text{ MPa}$$

Boiler cylinder  $\phi = 1.25 \text{ m}$

plate is 20mm thick

double riveted butt joint  
using 2x 14mm cover plates

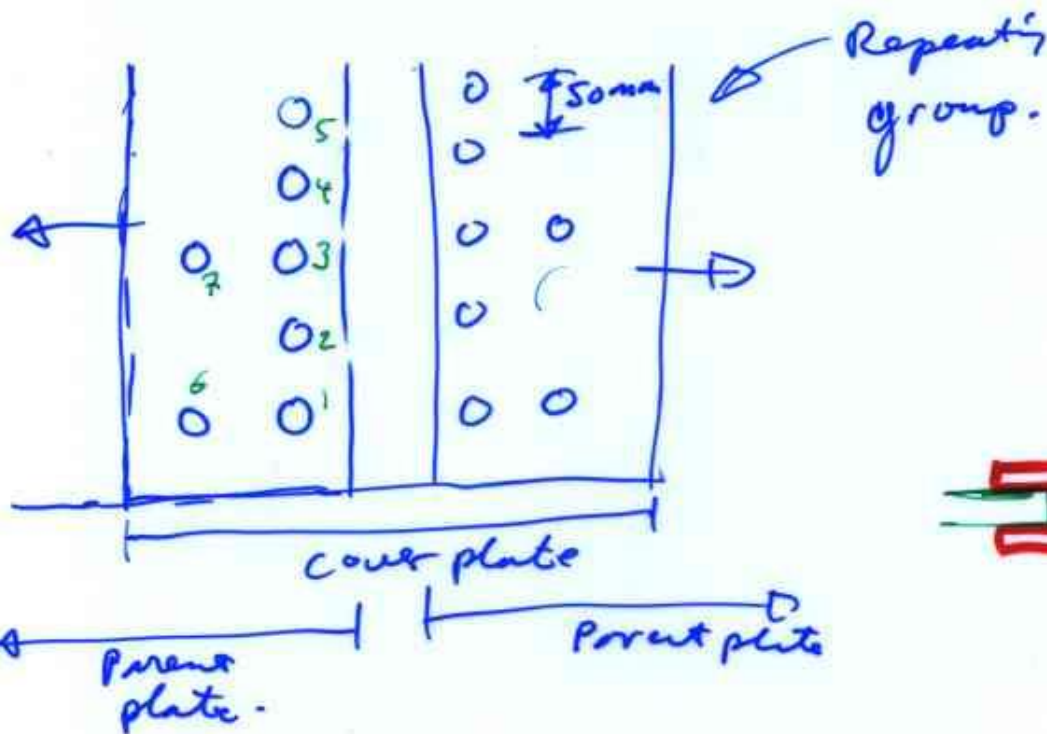


Rivets have  $\phi 24 \text{ mm}$

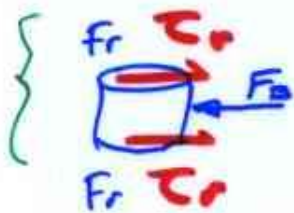
max stresses allowed are

$$\tau_{\text{rivet}} = 62 \text{ MPa}$$

$$\text{Plate } \left\{ \begin{array}{l} \sigma_{\text{bearing}} = 124 \text{ MPa} \\ \sigma_{\text{tensile}} = 95 \text{ MPa} \end{array} \right.$$



look at rivets first



$$\tau_{\text{max}} = 62 \text{ MPa}$$

$$\text{Area} = \left[ \frac{\pi (0.024)^2}{4} \right]$$

$$F_r = (\tau_{\text{max}}) (A)$$

$$= \frac{\pi (0.024)^2}{4} 62 \text{ MPa} = 28 \text{ kN}$$

⇒ joint can carry

$$\frac{(14)(28)}{(7)(2)} = \frac{402}{392} \text{ approx}$$

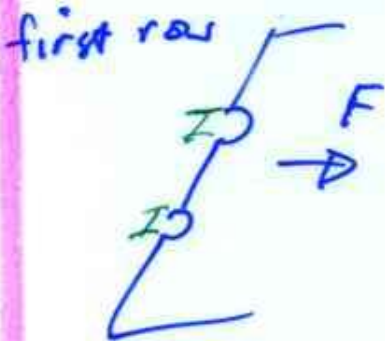
Bearing force

$$F_B = (\sigma_B)(d)(t) = (124 \times 10^6)(0.024)(0.02) = 59.5 \text{ kN}$$

for rivets shear failure →  $2 \times 28 = \underline{56}$  kN  
 bearing overload → 59.5

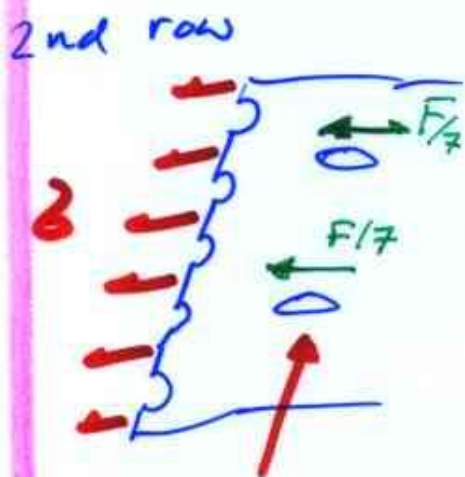
$$(7)(56) = (14)(28) = \underline{\underline{392 \text{ kN}}}$$

Now consider tensile failure



$$F_{max} = (\sigma_{max})(Area) = (95 \times 10^6)(20 \times 10^{-3})(250 - 2 \times 24) \times 10^{-3} = \underline{\underline{384 \text{ kN}}}$$

length of repeated unit



$$(\sigma_{max})(A) = (F - \frac{2F}{7}) = (\frac{5F}{7})$$

$$F = (\frac{7}{5})(95 \times 10^6)(250 - 5(24)) \times 10^{-3} \times (20 \times 10^{-3})$$

thickness

$$\underline{\underline{F_{max} = 346 \text{ kN}}}$$

failure will occur due to tensile failure in plate.

$$\text{Efficiency of Joint} = \frac{\text{Strength of joint}}{\text{Strength of parent plate}}$$

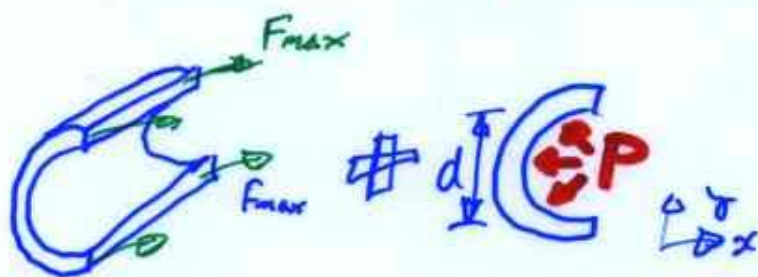
$$\text{Strength of joint} = 346 \text{ kN}$$

$$\begin{aligned} \text{Strength of plate} &= (\sigma_{\text{max plate}})(t)(l) \\ &= (95 \times 10^6)(20 \times 10^{-3})(250 \times 10^{-3}) = \underline{475 \text{ kN}} \end{aligned}$$

$$\text{Efficiency} = \frac{346}{475} \times 100 = \underline{\underline{72.8\%}}$$

Max Pressure allowed.

$$\text{max force per repeating group} = 346 \text{ kN}$$



$$\begin{aligned} F_x \text{ due to} \\ \text{Pressure} \\ &= (P)(d)(l) \end{aligned}$$

$$F_{\text{pressure}} = (P)(1.25)(0.250)$$

$$F_{\text{tension in boiler wall}} = (2)(F_{\text{max}}) = (2)(346 \times 10^3)$$

↙ equate  
↘ & solve

$$P = \frac{(2)(346 \times 10^3)}{(1.25)(0.250)} = \underline{\underline{2.21 \text{ MPa}}}$$