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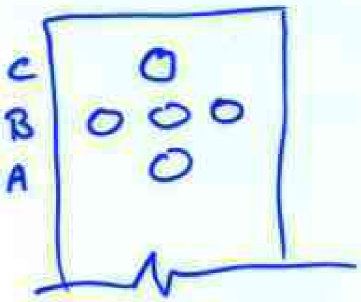
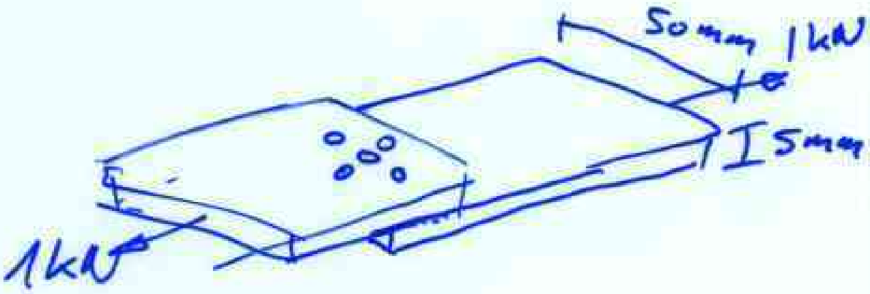
TRIPLE RIVETED LAP JOINT

look @ joint

⇓



ϕ of rivets 4mm



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

(a) find avg force first

$$\frac{1kN}{5} = 200N$$

$$\tau = \frac{F}{A} = \frac{200N}{\left(\frac{4\times10^{-3}}{2}\right)\pi} = \underline{\underline{16MPa}}$$

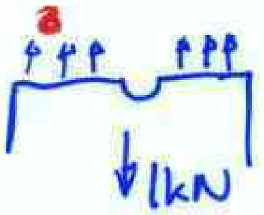
(b) F = 200N again

$$\sigma = \frac{F}{A_{projected}} = \frac{200}{(4\times10^{-3})(5\times10^{-3})} = \underline{\underline{10 MPa}}$$

plate thickness

(c) look @ each row separately.

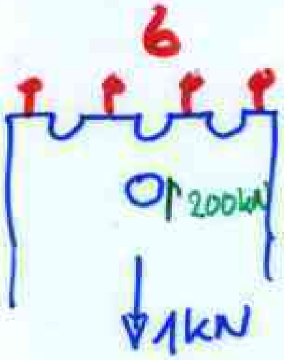
A)



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

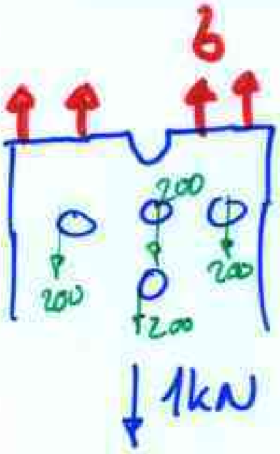
$\rightarrow (w - d)\ (t)$

B/



$$\sigma = \frac{800\ N}{\underbrace{(50\ mm - (3)(4mm))}_{(0.038}\underbrace{(5mm)}_{)(0.005)}} = 4.21 MPa$$

C/



$$\sigma = \frac{(1000 - 4(200))}{(0.046)(0.005)} = \cancel{0.9 MPa}$$

$$1.09\ MPa$$

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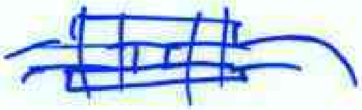
Boiler cylinder $\phi = 1.25$ m

plate is 20mm thick

double riveted butt joint using 2×14mm cover plate

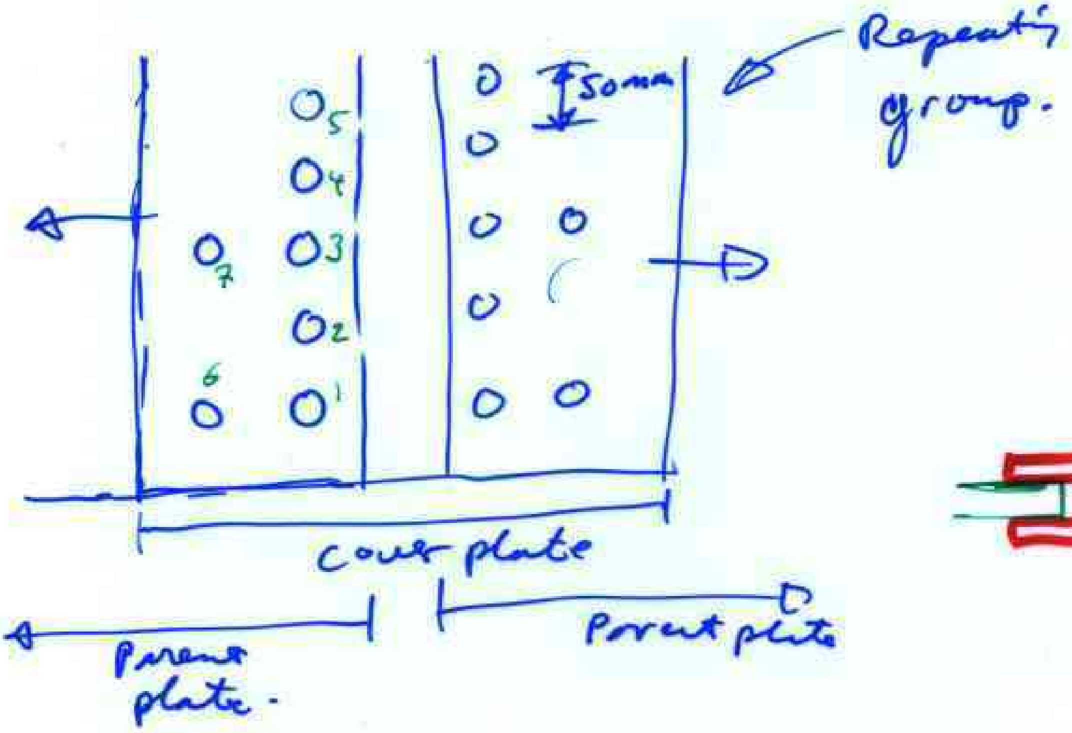


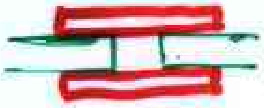
<u>Rivets</u> have ϕ 24mm

max stresses allowed are

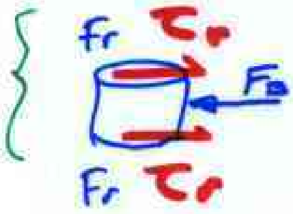
$$\tau_{rivet} = 62 \text{ MPa}$$

$$\text{Plate} \begin{cases} \sigma_{bearing} = 124 \text{ MPa} \\ \sigma_{tensile} = 95 \text{ MPa} \end{cases}$$





look at rivets first



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

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

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

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

$\Rightarrow$ joint can carry

$$\underset{(7)(2)}{(14)}(28) = \cancel{400}\ 392 \quad \text{approx}$$

Bearing force

$$F_B = (\sigma_B)\overline{(d)(t)} = (124\times10^6)(0.024)(0.02)$$
$$= 59.5\,\text{kN}$$

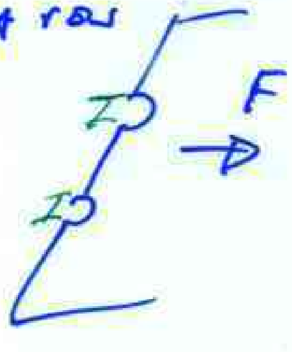
for rivet shear failure $\rightarrow$ $2\times28 = \underline{56}$ kN

Bearing overload $\rightarrow$ 59.5

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

Now consider tensile failure

first row

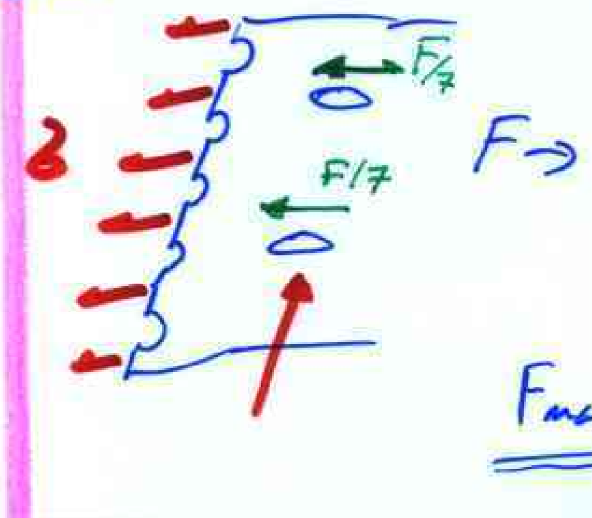


$$F_{max} = (\sigma_{max})(\text{Area})$$
$$= \overline{(95\times10^6)(\underset{t}{20\times10^{-3}})}\,(250-2\times24)\times10^{-3}$$

length of repeated unit

$$= \underline{384\ \text{kN}}$$

2nd row



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

$$F = \left(\frac{7}{5}\right)(95\times10^6)(250-5(24))\times10^{-3} \times (\underset{\text{thickness}}{20\times10^{-3}})$$

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

failure will occur due to tensile failure in plate.

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

strength of joint = 346 kN

$$\text{strength of plate} = (\sigma_{\substack{max\\plate}})(t)(\ell)$$
$$= (95\times10^6)(20\times10^{-3})(250\times10^{-3}) = \underline{475\,kN}$$

$$\text{Efficiency} = \frac{346}{475}\times100 = \boxed{\underline{\underline{72.8\%}}}$$

Max Pressure allowed.

max force per Repeating group = 346 kN

F_x due to pressure $= (P)(d)(\ell)$

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

equate & solve

$$F_{\substack{\text{tension in}\\\text{Boiler wall}}} = (2)(F_{max}) = (2)(346\times10^3)$$

$$P = \frac{(2)(346\times10^3)}{(1.25)(0.250)} = \boxed{\underline{\underline{2.21\,MPa}}}$$