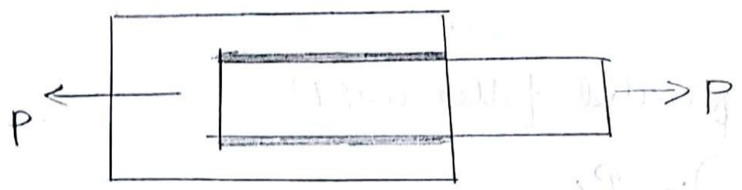
Design of Welded Joints

Process of joining two similar metals with or without application of Pressure

Types of welds.

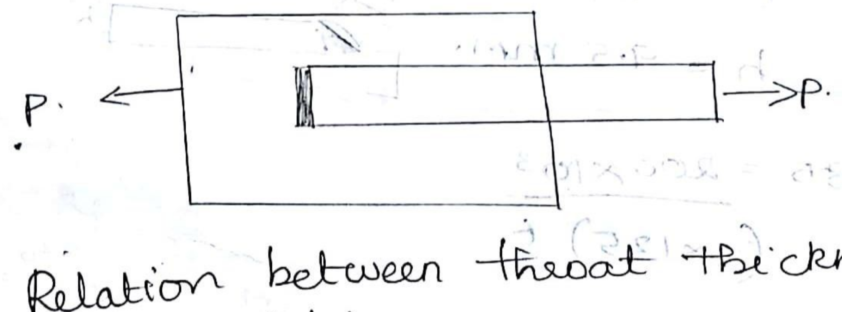
- Butt - Joint
- T - Joint
- Lap - Joint

Parallel Fillet Weld :-

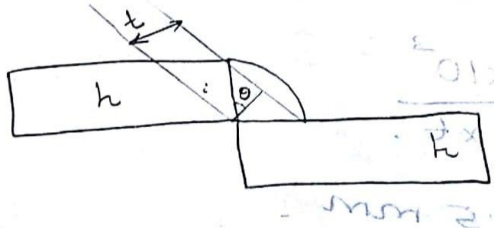


Load & Weld directions are parallel to each other is called Double parallel Fillet Weld.

Transverse Fillet Weld.



Relation between throat thickness and size of welding.



$$\cos 45^\circ = t/h$$

$$\frac{1}{\sqrt{2}} = t/h$$

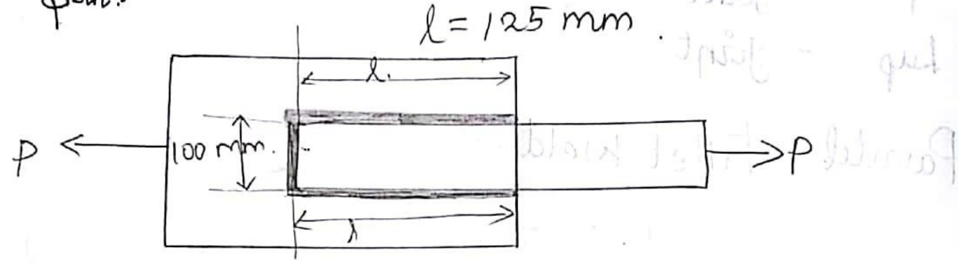
$$t = h/\sqrt{2}$$

$$= 0.707\,h$$

Problems :

1. Two plates joined by fillet weld and are subjected to tensile force of 200 kN if allowable shear stress of weld is 85 MPa. Calculate the size of the weld ?

Soln:-



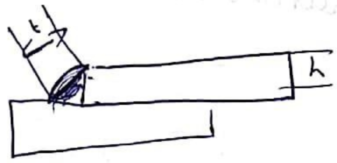
Double parallel fillet weld!

$$\tau_A \, (\sigma_t) = P/A$$

$$85 = \frac{200 \times 10^3}{(100 + (2 \times 125))t}$$

$$t = 6.72 \text{ mm}$$

$$h = 9.5 \text{ mm}.$$



II

$$85 = \frac{200 \times 10^3}{(2 \times 125)\, t}$$

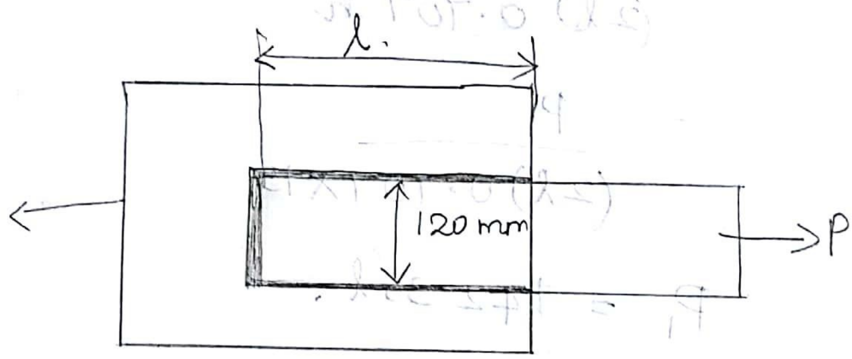
$$t = 9.4 \text{ mm}$$

III

$$85 = \frac{200 \times 10^3}{100 \times t}.$$

$$t = 23.5 \text{ mm}.$$

1. Plate of 120 mm wide and 15 mm thickness is welded to another plate by means of single transverse weld and double parallel fillet weld. Joint is subjected to static loading as well as variable loading. Determine the length of weld. Assume stress concentration factor for transverse weld is 1.5 and parallel weld is 2.7. $\sigma_t = 95\ N/mm^2$ $\tau = 35\ N/mm^2$.



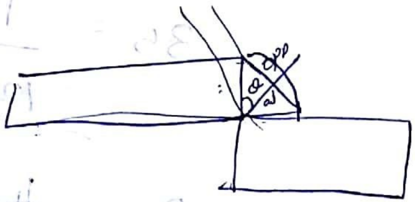
$h = 15\ mm$

$\sigma_t = 95\ N/mm^2$

$\tau = 35\ N/mm^2$

$K_t = 1.5$

$K_p = 2.7$

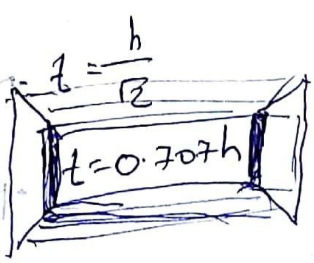


$\frac{1}{\sqrt{2}} = \frac{t}{h}$

Static loading

$\sigma_t = P/A$

$95 = \frac{P}{b(\ldots)\,15}$



$R = 1425\,(120 + 2l)$

$= 171000 + 2850\,l$

$95 \times 120 \times 15 = P$

$P = 171$ kN.

Double Parallel Fillet Weld.

$$\tau = \frac{P_1}{(2l)t}.$$

$$35 = \frac{P_1}{(2l)\, 0.707\, h}$$

$$= \frac{P_1}{(2l)\, 0.707 \times 15}$$

$P_1 = 742.35\, l$.

Transverse weld.

$$\tau = P_2 / b \times t$$

$$35 = \frac{P_2}{120 \times 0.707 \times 15}$$

$P_2 = 44.5$ kN.

$= 44541$ N.

$P = P_1 + P_2$

$171000 = 742.35\, l + 44541$

$l = 170.34$ mm

Case (ii)

Variable loading.

Double parallel fillet weld.

$$\tau = \frac{P_1 \times 2.7}{2l \times t}$$

$$35 = \frac{P_1 \times 2.7}{2l \times 0.707 \times 15}$$

$$P_1 = 274.9\, l$$

Transverse Weld.

$$\tau = \frac{P_2 \times 1.5}{b \times t}$$

$$35 = \frac{P_2 \times 1.5}{120 \times 0.707 \times 15}$$

$$P_2 = 29694$$

$$P = P_1 + P_2$$

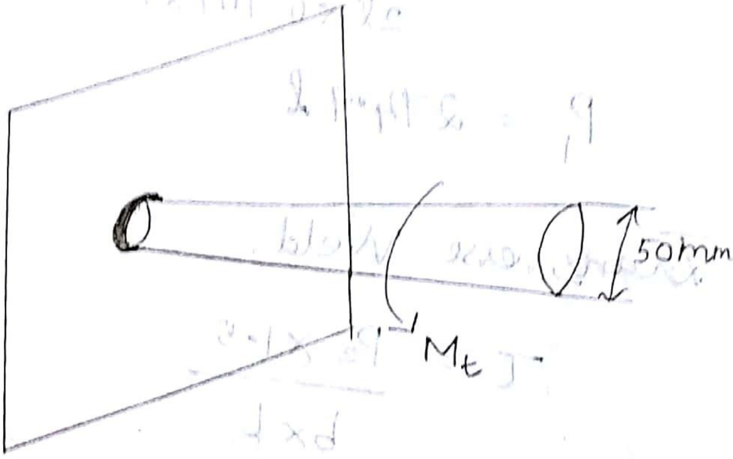
$$171000 = 274.9\,l + 29694$$

$$l = 514.09 \text{ mm}$$

Material property should be changed.

Welding subjected to Bending moment (or) Bending Stress

1. A 50 mm diameter solid shaft is welded a flat plate by 8 mm fillet weld. Determine the maximum torque that the weld can sustain. The permissible stress intensity in the weld material is not to exceed 70 M Pascal?



Given :-

$D = 50$ mm

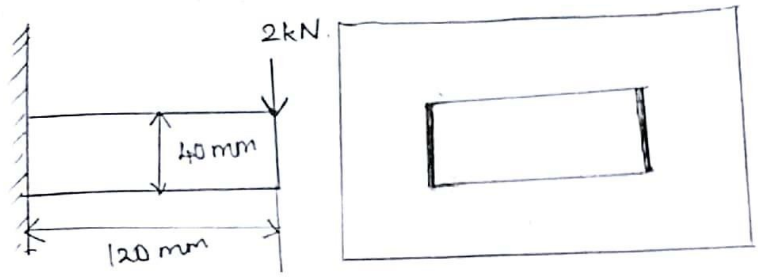
$h = 8$ mm.

$$\tau = \frac{2.83\, M_t}{h D^2 \pi}$$

$$70 = \frac{2.83\, M_t}{8 \times 50^2 \times \pi}$$

$M_t = 1554.1 \times 10^3$ N·mm

2. A welded joint subjected to eccentric loading of 20kN. Maximum shear stress in the weld is 25 MPas. Determine the size of the weld?



$$\tau_{max} = \frac{1}{2}\sqrt{(\sigma_x)^2 + 4(\tau_{xy})^2} \qquad \sigma_x = \sigma_b$$

$$\sigma_b = \frac{M}{Z}$$

$$= \frac{2\times10^3 \times 120}{\frac{(40)^2}{3} \times t}$$

$$\sigma_b = \frac{450}{t} \ N/mm^2$$

$$\tau = P/A$$

$$= \frac{2\times10^3}{(2d)t}$$

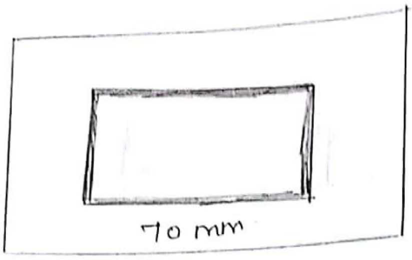
$$\tau = \frac{2\times10^3}{2\times40\times t}$$

$$\tau = \frac{25}{t}$$

$$25 = \frac{1}{2}\sqrt{\left(\frac{450}{t}\right)^2 + 4\left(\frac{25}{t}\right)^2}$$

$$(50)^2 = \frac{202500}{t^2} + \frac{2500}{t^2}$$

$t = 9.05 mm$



$$\sigma_b = \frac{M}{Z}$$

$$= \frac{2 \times 10^3 \times 120}{\left(bd + \frac{d^2}{3}\right) t}$$

$$= \frac{2 \times 10^3 \times 120}{\left((120 \times 40) + \frac{40^2}{3}\right) t}$$

$$= \frac{240000}{5333.3\, t}$$

$$= \frac{45}{t}$$

$$\tau = P/A$$

$$= \frac{2 \times 10^3}{(2d + 2b)\, t}$$

$$= \frac{2 \times 10^3}{(2 \times 120 + 2 \times 40)\, t}$$

$$= \frac{2000}{(240 + 80)\, t}$$

$$= \frac{6.25}{t}$$

$$\tau_{max} = \frac{1}{2} \sqrt{(\sigma_b)^2 + 4 (\tau_{xy})^2}$$

$$50 = \sqrt{\left(\frac{45}{t}\right)^2 + 4\left(\frac{7.5}{t}\right)^2}$$

$$2500 = \frac{2025}{t^2} + \frac{225}{t^2}$$

$$t = 0.94 \text{ mm}$$