

Example 10.5. A plate 75 mm wide and 12.5 mm thick is joined with another plate by a single transverse weld and a double parallel fillet weld as shown in Fig. 10.15. The maximum tensile and shear stresses are 70 MPa and 56 MPa respectively.

Find the length of each parallel fillet weld, if the joint is subjected to both static and fatigue loading.

Solution. Given : Width = 75 mm ; Thickness = 12.5 mm ; $\sigma_t = 70 \text{ MPa} = 70 \text{ N/mm}^2$; $\tau = 56 \text{ MPa} = 56 \text{ N/mm}^2$.

The effective length of weld (l_1) for the transverse weld may be obtained by subtracting 12.5 mm from the width of the plate.

$$\therefore l_1 = 75 - 12.5 = 62.5 \text{ mm}$$

Length of each parallel fillet for static loading

Let $l_2 =$ Length of each parallel fillet.

We know that the maximum load which the plate can carry is

$$P = \text{Area} \times \text{Stress} = 75 \times 12.5 \times 70 = 65\,625 \text{ N}$$

Load carried by single transverse weld,

$$P_1 = 0.707 s \times l_1 \times \sigma_t = 0.707 \times 12.5 \times 62.5 \times 70 = 38\,664 \text{ N}$$

and the load carried by double parallel fillet weld,

$$P_2 = 1.414 s \times l_2 \times \tau = 1.414 \times 12.5 \times l_2 \times 56 = 990 l_2 \text{ N}$$

* Superfluous data.

\therefore Load carried by the joint (P),

$$65\,625 = P_1 + P_2 = 38\,664 + 990 l_2 \text{ or } l_2 = 27.2 \text{ mm}$$

Adding 12.5 mm for starting and stopping of weld run, we have

$$l_2 = 27.2 + 12.5 = 39.7 \text{ say } 40 \text{ mm } \mathbf{Ans.}$$

Length of each parallel fillet for fatigue loading

From Table 10.6, we find that the stress concentration factor for transverse welds is 1.5 and for parallel fillet welds is 2.7.

\therefore Permissible tensile stress,

$$\sigma_t = 70 / 1.5 = 46.7 \text{ N/mm}^2$$

and permissible shear stress,

$$\tau = 56 / 2.7 = 20.74 \text{ N/mm}^2$$

Load carried by single transverse weld,

$$P_1 = 0.707 s \times l_1 \times \sigma_t = 0.707 \times 12.5 \times 62.5 \times 46.7 = 25\,795 \text{ N}$$

and load carried by double parallel fillet weld,

$$P_2 = 1.414 s \times l_2 \times \tau = 1.414 \times 12.5 \times l_2 \times 20.74 = 366 l_2 \text{ N}$$

\therefore Load carried by the joint (P),

$$65\,625 = P_1 + P_2 = 25\,795 + 366 l_2 \text{ or } l_2 = 108.8 \text{ mm}$$

Adding 12.5 mm for starting and stopping of weld run, we have

$$l_2 = 108.8 + 12.5 = 121.3 \text{ mm } \mathbf{Ans.}$$

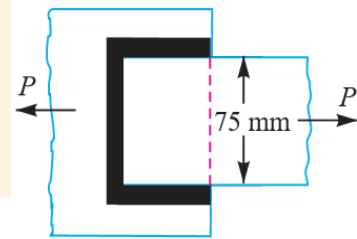


Fig. 10.15

Example 10.10. A 50 mm diameter solid shaft is welded to a flat plate as shown in Fig. 10.25. If the size of the weld is 15 mm, find the maximum normal and shear stress in the weld.

Solution. Given : $D = 50 \text{ mm}$; $s = 15 \text{ mm}$; $P = 10 \text{ kN}$
 $= 10\,000 \text{ N}$; $e = 200 \text{ mm}$

Let $t =$ Throat thickness.

The joint, as shown in Fig. 10.25, is subjected to direct shear stress and the bending stress. We know that the throat area for a circular fillet weld,

$$\begin{aligned} A &= t \times \pi D = 0.707 s \times \pi D \\ &= 0.707 \times 15 \times \pi \times 50 \\ &= 1666 \text{ mm}^2 \end{aligned}$$

\therefore Direct shear stress,

$$\tau = \frac{P}{A} = \frac{10000}{1666} = 6 \text{ N/mm}^2 = 6 \text{ MPa}$$

We know that bending moment,

$$M = P \times e = 10\,000 \times 200 = 2 \times 10^6 \text{ N-mm}$$

From Table 10.7, we find that for a circular section, section modulus,

$$Z = \frac{\pi t D^2}{4} = \frac{\pi \times 0.707 s \times D^2}{4} = \frac{\pi \times 0.707 \times 15 (50)^2}{4} = 20\,825 \text{ mm}^3$$

\therefore Bending stress,

$$\sigma_b = \frac{M}{Z} = \frac{2 \times 10^6}{20\,825} = 96 \text{ N/mm}^2 = 96 \text{ MPa}$$

Maximum normal stress

We know that the maximum normal stress,

$$\begin{aligned} \sigma_{t(max)} &= \frac{1}{2} \sigma_b + \frac{1}{2} \sqrt{(\sigma_b)^2 + 4 \tau^2} = \frac{1}{2} \times 96 + \frac{1}{2} \sqrt{(96)^2 + 4 \times 6^2} \\ &= 48 + 48.4 = 96.4 \text{ MPa} \quad \text{Ans.} \end{aligned}$$

Maximum shear stress

We know that the maximum shear stress,

$$\tau_{max} = \frac{1}{2} \sqrt{(\sigma_b)^2 + 4 \tau^2} = \frac{1}{2} \sqrt{(96)^2 + 4 \times 6^2} = 48.4 \text{ MPa} \quad \text{Ans.}$$

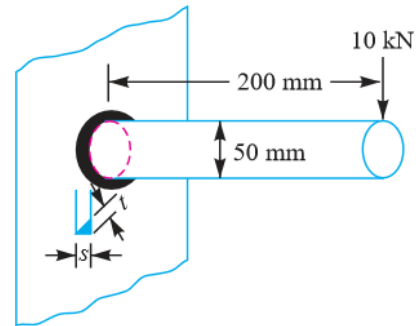


Fig. 10.25