



SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai



DEPARTMENT OF AGRICULTURE ENGINEERING

R2019-MACHINE DESIGN

II YEAR III SEM

UNIT 2–Design of Fasteners

TOPIC –Stress Concentration Factor & Fillet Welds Problems



Stress Concentration Factor



The reinforcement provided to the weld produces stress concentration at the junction of the weld and the parent metal. When the parts are subjected to fatigue loading, the stress concentration factor as given in the following table should be taken into account.

Table 10.6. Stress concentration factor for welded joints.

Type of joint	Stress concentration factor
1. Reinforced butt welds	1.2
2. Toe of transverse fillet welds	1.5
3. End of parallel fillet weld	2.7
4. T-butt joint with sharp corner	2.0

Note: For static loading and any type of joint, stress concentration factor is 1.0.



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.

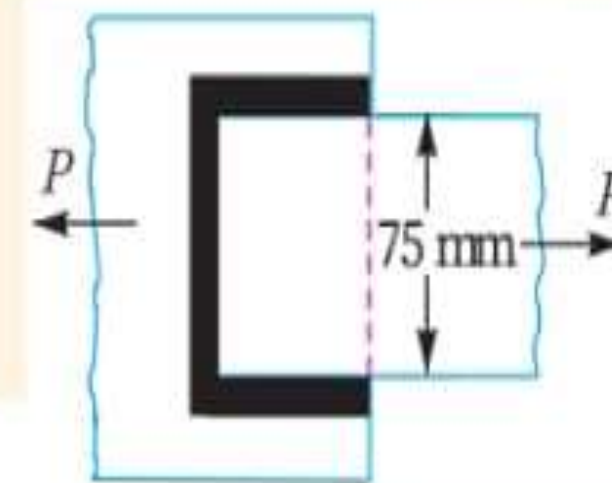


Fig. 10.15



∴ Load carried by the joint (P),

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

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

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

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.

∴ 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,

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

∴ Load carried by the joint (P),

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

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

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



Example 10.6. Determine the length of the weld run for a plate of size 120 mm wide and 15 mm thick to be welded to another plate by means of

1. A single transverse weld; and
2. Double parallel fillet welds when the joint is subjected to variable loads.

Solution. Given : Width = 120 mm ; Thickness = 15 mm

In Fig. 10.16, AB represents the single transverse weld and AC and BD represents double parallel fillet welds.

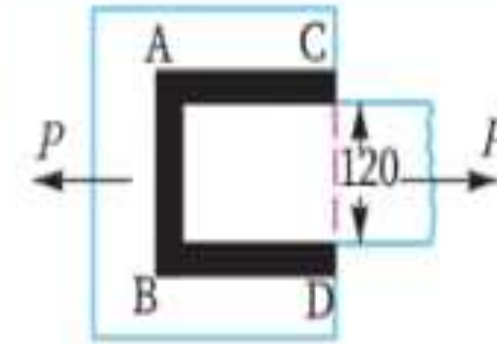


Fig. 10.16

1. Length of the weld run for a single transverse weld

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

$$\therefore l_1 = 120 - 12.5 = 107.5 \text{ mm Ans.}$$

2. Length of the weld run for a double parallel fillet weld subjected to variable loads

Let l_2 = Length of weld run for each parallel fillet, and
 s = Size of weld = Thickness of plate = 15 mm

Assuming the tensile stress as 70 MPa or N/mm^2 and shear stress as 56 MPa or N/mm^2 for static loading. We know that the maximum load which the plate can carry is

$$P = \text{Area} \times \text{Stress} = 120 \times 15 \times 70 = 126 \times 10^3 \text{ N}$$

From Table 10.6, we find that the stress concentration factor for transverse weld 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,

$$P_1 = 0.707 s \times l_1 \times \sigma_t = 0.707 \times 15 \times 107.5 \times 46.7 = 53\,240 \text{ N}$$

and load carried by double parallel fillet weld,

$$P_2 = 1.414 s \times l_2 \times \tau = 1.414 \times 15 \times l_2 \times 20.74 = 440 l_2 \text{ N}$$

∴ Load carried by the joint (P),

$$126 \times 10^3 = P_1 + P_2 = 53\,240 + 440 l_2 \text{ or } l_2 = 165.4 \text{ mm}$$

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

$$l_2 = 165.4 + 12.5 = 177.9 \text{ say } 178 \text{ mm} \quad \text{Ans.}$$



Thank You