8.4 Joining

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS fillet weld • throat • heat input • adhesive bonding

Objective

Size fillet welds through their throat, find the heat input of an arc weld, and estimate the strength of a bonded lap joint and its limits.

1 Key knowledge and worked examples

■ Welds and bonds

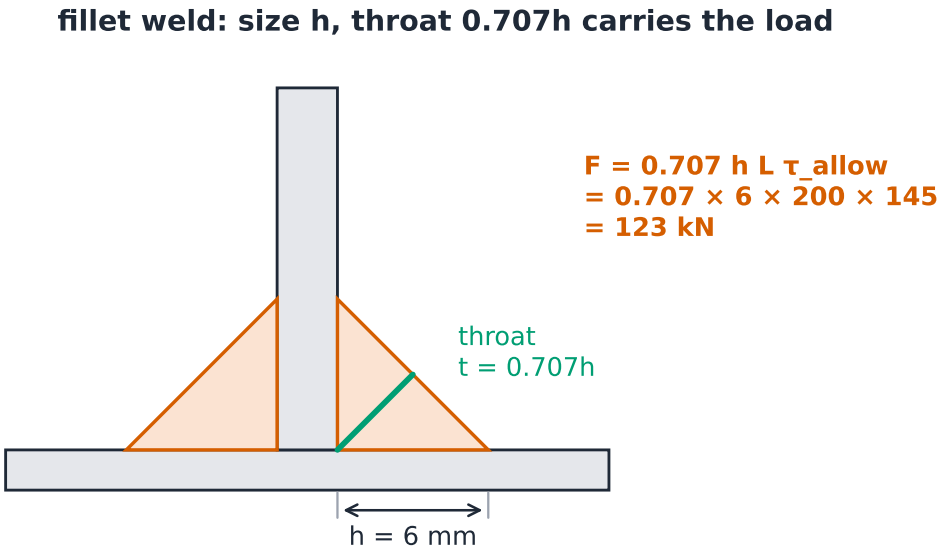
- A **fillet weld** fails through its **throat** : $t = 0.707h$ for leg size h.
- Weld strength in shear: $F = 0.707\,h\,L\,\tau_{allow}$, with $\tau_{allow} = 0.3S_{ut}$ (145 MPa for E70).
- Arc **heat input** : $H = \eta V I / v$ (J/mm).
- **Adhesive bonding** : average strength $F = \tau A$, but the stress peaks at the overlap ends.

■ Worked example. The bracket welds

Two fillets, each $L = 100$ mm, leg $h = 6$ mm, E70 electrode.

- Throat area $= 0.707hL = 0.707 \times 6 \times 200 = 848$ mm^2.
- $F = 0.707hL\tau_{allow} = 848 \times 145 = \mathbf{123}$ kN.
- Heat input at 25 V, 200 A, 5 mm/s, $\eta = 0.8$: $H = \eta V I / v = 0.8 \times 25 \times 200 / 5 = \mathbf{800}$ J/mm.

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2 Practice

E70 electrode, $\tau_{allow} = 145$ MPa.

2.1 Find the throat of an 8 mm fillet weld (two decimals, mm). [2]

2.2 Two 8 mm fillets, each 80 mm long, hold a bracket in shear. Find the allowable load (one decimal, kN). [3]

2.3 The welder runs at 28 V and 220 A, travelling 4 mm/s, with $\eta = 0.8$. Find the heat input (nearest J/mm). Is it higher or lower than the 800 J/mm of the worked example, and what does more heat do to the zone beside the weld? [3]

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3 Exam-style questions

3.1 A 90 kN shear load is to be carried by two equal 6 mm fillet welds. Find the total and the per-weld length (round up to 5 mm). As an alternative, a single-lap epoxy bond 30×20 mm with average shear strength 20 MPa is proposed for a 12 kN cover. Find its average strength and explain why doubling the overlap would not double it. [6]

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Solutions

2.1

- $t = 0.707h = 0.707 \times 8 = \mathbf{5.66}$ mm.

2.2

- $F = 0.707hL\tau_{allow} = 0.707 \times 8 \times 160 \times 145 = \mathbf{131.2}$ kN.

2.3

- $H = \eta VI/v = 0.8 \times 28 \times 220/4 = \mathbf{1232}$ J/mm.
- Higher: a wider, slower-cooling heat-affected zone, with more grain growth and distortion.

3.1

- $L = F/(0.707h\tau_{allow}) = 90\,000/(0.707 \times 6 \times 145) = 146.3$ mm in total.
- Per weld $146.3/2 = 73.2$, so **75** mm each.
- Bond: $F = \tau A = 20 \times 30 \times 20 = \mathbf{12.0}$ kN on average, just enough.
- The load transfers near the overlap ends, where the stress peaks; the middle carries little, so a longer overlap adds less than its area.

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