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Fatigue strength of longitudinal fillet welded attachments and joints in steels under axial loading

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THE PREPARATION OF THIS DATA ITEM

The work on this particular Data Item was monitored and guided by the Stress Analysis and Strength of Components Committee. This Committee first met in 1964 and now has the following membership:

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Dr C.E. Turner	—	Imperial College of Science and Technology.

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The person with overall responsibility for the work in this subject area is Mr M.E. Grayley, Head of Strength Analysis Group.

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FATIGUE STRENGTH OF LONGITUDINAL FILLET WELDED ATTACHMENTS AND JOINTS IN STEELS UNDER AXIAL LOADING

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1. NOTATION

a	throat depth (see Sketch 2.5)	m	in
d	distance of weld end from end of loaded plates	m	in
E	modulus of elasticity of plate material	N/m^2	lbf/in^2
l	length of weld run of loaded plate	m	in
N	endurance		
P	load applied to joint	N	lbf
S_a	nominal alternating stress (half range) in loaded plate	N/m^2	lbf/in^2
s	weld leg length (see Sketch 2.5)	m	in
t	thickness of loaded plate	m	in
w	width of loaded plate	m	in

Both SI and British units are quoted.

2. NOTES

This Item presents data on the fatigue strength of longitudinal fillet welded attachments and joints between steel members of the types shown in Sketch 2.1 to 2.4 tested in the *as-welded* condition. The data are obtained from specimens welded in the laboratory. The range of sizes of the test specimens is quoted on the relevant figure.

Provided that the welds are sound and free from major defects, the fatigue strength of longitudinal fillet welds in the untreated and unmachined condition is independent of the properties of the plate and weld materials (except in the low cycle fatigue region, that is, when $2S_a$ is greater than about 85 per cent of the material tensile strength, at which the endurance is about 4×10^3 cycles). The fatigue strength is also independent of the applied mean stress. This is because as-welded longitudinal joints contain a system of highly localised residual stresses in the direction of loading which result from the internal constraints applied during cooling of the weld, and which are of the order of the material yield strength. Hence, any applied loading will cause local yielding in the region of the end of the weld run during the first few load cycles. The actual stress experienced in the critical region will thereafter cycle between the yield strength and the yield strength less the applied stress range, irrespective of applied mean stress, except in cases of high compressive mean stress.

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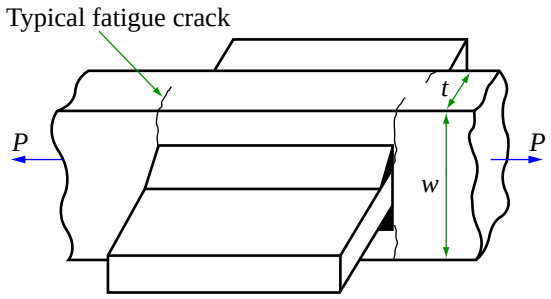
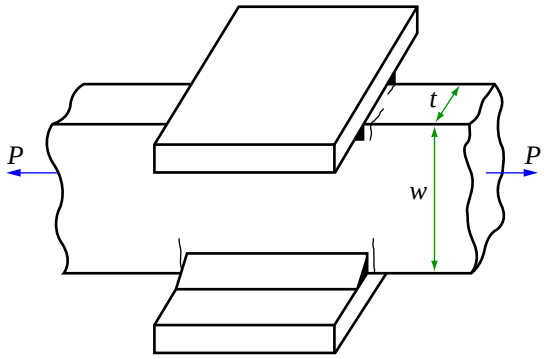
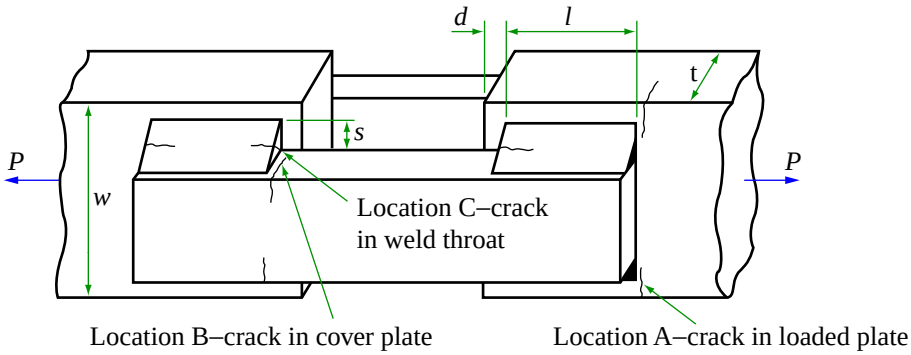


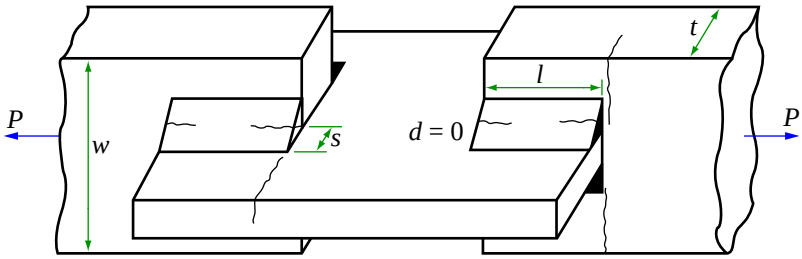
Sketch 2.1 Non-load-carrying joint (stiffener type)



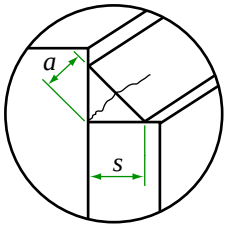
Sketch 2.2 Non-load-carrying joint (flange type)



Sketch 2.3 Load-carrying joint (double strap type)



Sketch 2.4 Load-carrying joint (egg-box type)



Sketch 2.5 Illustrating the assumed throat depth of a fillet weld and showing a type C failure

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