IIW Collection

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IIW Guidelines on Weld Quality in Relationship to Fatigue Strength

INTERNATIONAL INSTITUTE OF WELDING
A world of joining experience

Springer

IIW Collection

Series editor

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The IIW Collection of Books is authored by experts from the 59 countries participating in the work of the 23 Technical Working Units of the International Institute of Welding, recognized as the largest worldwide network for welding and allied joining technologies.

The IIW's Mission is to operate as the global body for the science and application of joining technology, providing a forum for networking and knowledge exchange among scientists, researchers and industry.

Published books, Best Practices, Recommendations or Guidelines are the outcome of collaborative work and technical discussions-they are truly validated by the IIW groups of experts in joining, cutting and surface treatment of metallic and non-metallic materials by such processes as welding, brazing, soldering, thermal cutting, thermal spraying, adhesive bonding and microjoining. IIW work also embraces allied fields including quality assurance, non-destructive testing, standardization, inspection, health and safety, education, training, qualification, design and fabrication.

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ISSN 2365-435X ISSN 2365-4368 (electronic)
IIW Collection
ISBN 978-3-319-19197-3 ISBN 978-3-319-19198-0 (eBook)
DOI 10.1007/978-3-319-19198-0

Library of Congress Control Number: 2016936442

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG Switzerland

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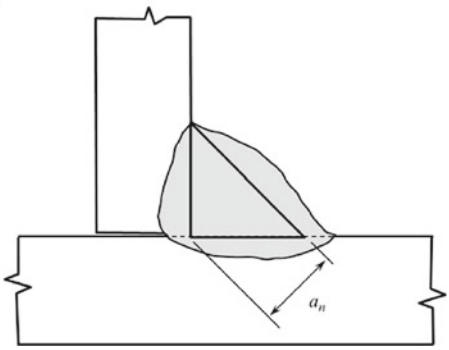
Nomenclature

Cold lap	A region of non-fused overlap between the weld metal and base plate which results in an imperfection parallel to the base plate
Effective notch stress	Elastic notch stress calculated for a notch with a certain assumed notch radius
FAT	All fatigue resistance data including the FAT classes are given as characteristic values, which are assumed to represent a survival probability of at least 95 %, calculated from mean value on the basis of a two-sided 75 % tolerance limits of the mean. Other existing definitions, e.g., a survival probability of 95 % on the basis of 95 % one-sided limit of the mean or means minus two standard deviations corresponding to a survival probability of 97.7 %, are practically equal for engineering applications. Levels are arranged in steps
Geometric stress	See structural stress
Improved welds	Welds for which the weld toe is treated after welding by a grinding, re-melting, or peening operation. IIW Guidelines for select post-weld treatment methods have been published
Inclusion	Non-metallic material entrapped in molten metal during solidification
High quality weld	Welds with a lower level of imperfections such that it has fatigue strength greater than that defined in the IIW Guidelines and Recommendations with respect to nominal stress, hot spot stress, or effective notch stress. The improvement in fatigue strength is normally two FAT classes
Hot spot stress	See structural stress
k_m	Stress magnification factor for misalignment
Micro lack of fusion	Same as cold lap, used in some standards

Normal quality weld	Welds for which the level of imperfections is such that it satisfies the fatigue strength requirement defined in the IIW Guidelines and Recommendations with respect to nominal stress, hot spot stress, or effective notch stress
Notch stress	See effective notch stress
Overlap	A protrusion of weld metal beyond the weld toe or weld root. An overlap may be fused or non-fused. A toe overlap without fusion between the weld metal and base plate is the same as a cold lap
Porosity	Porosity is used to describe cavities or pores caused by gas entrapment in molten metal during solidification
N_f	Cycles to failure
Slag inclusion	See inclusion
Structural stress	A stress in a component, resolved to take into account the effects of a structural discontinuity on the surface of a hot spot, consisting of membrane and shell-bending stress components
Undercut	An unfilled groove along the fusion line between weld metal and base plate
ΔS or $\Delta\sigma$	Nominal stress range
ΔS_c or $\Delta\sigma_c$	Characteristic nominal stress range in MPa (see FAT above), but is a continuous variable when FAT are given in steps

Throat Thicknesses

Term	IIW terminology	Figure
Throat thickness	Thickness of a fillet weld	
Design throat thickness	Throat thickness specified by the designer	*Note* See Fig. 13 in ISO 17659
Nominal throat thickness	Design value of the height of the largest isosceles triangle that can be inscribed in the section of a fillet weld	 convex weld profile

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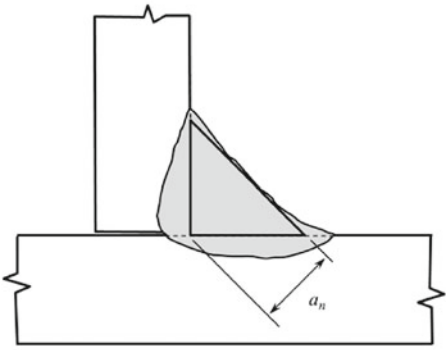
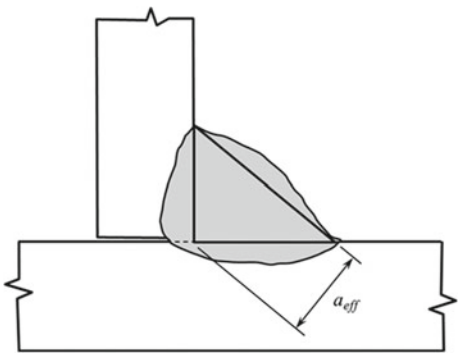
Term	IIW terminology	Figure
		 concave weld profile
Actual throat thickness	Throat thickness of the finalized weld measured according to the design throat thickness	The actual throat thicknesses will depend on whether the nominal throat thickness or effective throat thickness is used in design
Effective throat thickness	Design value of the height of the largest triangle that can be inscribed in the section of a fillet weld	

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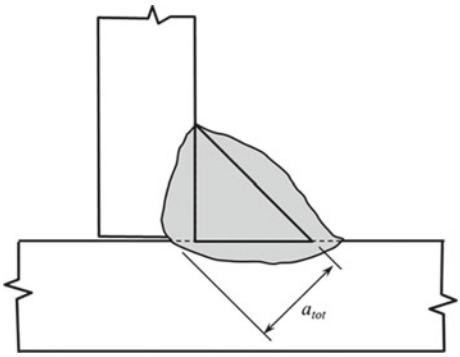
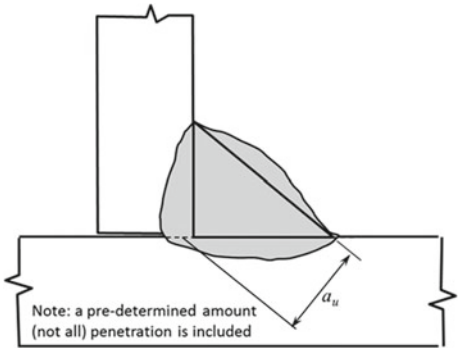
Term	IIW terminology	Figure
Maximum throat thickness	Nominal throat thickness to which a maximum amount of fusion penetration is added	
Utilized throat thickness	Effective throat thickness to which a certain amount of penetration is added	

Note that other definitions may exist, the above-given are according to IIW, Commission VI