

Book of Abstract

Characterisation of Crack/Notch Tip Fields

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7th of June (Day 3)

Session VIII – Chairman: Thierry Palin-Luc

- 9.00-9.20 **Aleksandar Sedmak, Srdja Perkovic, Zijah Burzic, Zoran Radakovic.**
Notch vs. crack effects on impact toughness of a duplex steel p. 61
- 9.20-9.40 **Giovanni Meneghetti, Alberto Visentin, Alberto Campagnolo.**
Implementation of the Peak Stress Method for the automated FEA-assisted design of welded structures subjected to variable amplitude multiaxial fatigue loads p. 43
- 9.40-10.00 **Paolo Livieri, Roberto Tovo.**
Review of the design fatigue strength for steel butt welded joints: influence of geometrical factors and shape defects p. 33
- 10.00-10.20 **Paolo Livieri.**
Simplified analysis of stress intensity factors at weld toe p. 31
- 10.20-10.50 Coffee break

10.50-11.50 Discussion Session & Closure – Chairman: Michael Vormwald & Youshi Hong

End of Day 3

Review of the design fatigue strength for steel butt welded joints: influence of geometrical factors and shape defects

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During last two decades, the studies on fatigue strength of welded joint progressively moved from the nominal and structural stress approaches to the local stress methods, by acknowledging the dominating position of the notch effects at toes, roots or other stress raisers related to defects or geometrical irregularities.

The peculiarity of the weld geometry is the significant presence of sharp stress concentrations, compared to other structural details, and the related problems in estimating the actual notch sensitivity. The local stress investigations proposed several methods to address and overcome such criticality. The most largely used local method is the “1 mm fictitious radius”; however, even different methods have been used in the literature as well as the Strain Energy Density SED, the Peak Stress Method, the Critical Distance or the Implicit Gradient approaches. Similarly, even the Fracture Mechanics based approaches, by investigating the crack thresholds or propagating condition in the weldments, deal with the stress field affected by the overall local weld geometry.

The proposed methodology, somehow, determine an effective stress value by averaging the local stress field at the tip of the stress raisers. Each method has its advantages and overcomes. At this stage, several investigations have been carried out and it is not convenient to focus on which method could be more effective, but it is more practical to take advantage of the evidence coming out from the investigations and to develop updated design guidelines more accurately considering the effects of weld geometry parameters and properties. Also the actual decrease caused by defects and irregularities can be conveniently be included in a comprehensive approach. The “FAT Categories” suggested in design standards, consider a reduced number of influencing parameters and the proposed corrections can now probably been improved according with the scientific literature.

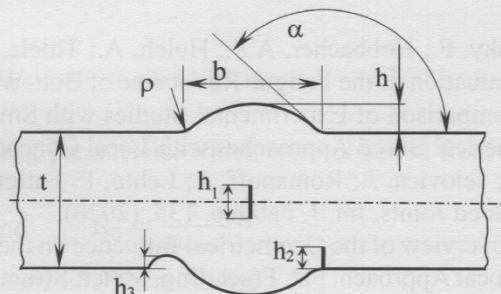


Figure 1. definition of the weld geometrical parameters and of main defect dimensions: inner lack of penetration, crack like defect at toe, rounded undercuts.

This paper focuses on butt weldment made of steel under cyclic tensile loading. It aims to take advantage of the local stress methods and to summarise main outcomes in a reformulation of influencing factors as a contribution for upcoming design guidelines.

In this direction, a representing contribution has been recently given in [1] where parametrical formulas for design curve assessment are proposed. Other contributions, for butt welds are, for instance in [2]. In this paper, starting from the outcomes [3], a larger comparison with the literature is given, by suggesting new criteria and formulation of the geometrical parameters influence. Even the acceptability of common defects is addressed. Used reference geometry and parameter definitions are shown in fig. 1.

The main effort is to order the principal influencing parameter starting from the most affecting ones. According to the literature they are the size effect and the h/b value. In this paper, considering the size effect, the fundamental role of the weld angle “ α ” is highlighted, so that, the influence of the h and h/t values, are mainly associated to their relationship with “ α ”.

In figure 2, the new formulated size effect, based on main plate thickness, is given. In the same figure also the usual Fat categories definition of the size effect is shown together with some confirming data taken from the literature, obtained with the fictitious radius approach.

In the second part of the figure 2, an example of the effect of a lack of fusion is proposed. Other crack like or notch like defects, are considered in the paper.

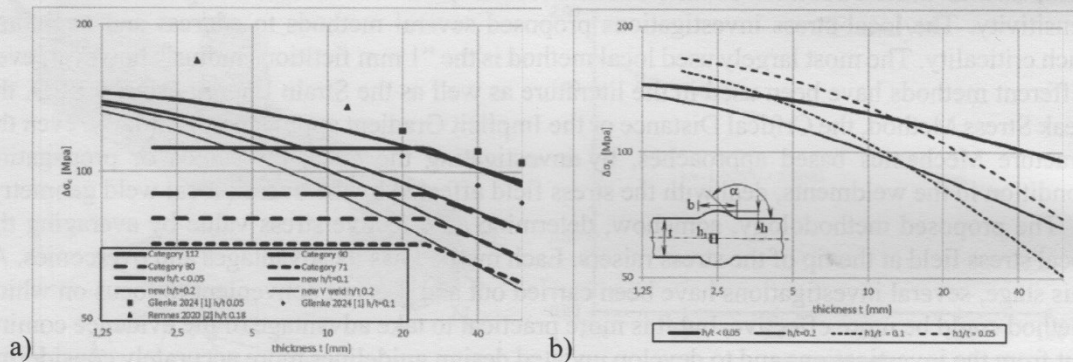


Figure 2. a) new formulation of the size effect compared to FAT categories and data from literature; b) the influence of the inner lack of penetration.

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