POPULAR SCIENTIFIC ABSTRACT

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Fatigue Properties of a Laser-Welded Thin-Walled T-Joint

The fatigue assessment of a construction is a crucial part of the design phase. There are various approaches available to estimate the fatigue strength or fatigue life of a construction. Some of these are still under discussion in the research on fatigue and form part of this thesis.

The fatigue properties of a single-side laser-welded T-joint were investigated. Due to their essential role for the fatigue strength, the weld shape was a main focus. Data of three-dimensional laser scans were analysed to obtain statistically based weld shapes for the 5%, 50% and 95% fractiles of the measurements.

Moreover, extensive fatigue tests were conducted for the T-joint using different stress ratios. The generated data allowed the creation of novel nominal stress S-N curves, which can be used for the design of similar T-joints. The S-N curves were compared to those S-N curves recommended in the guidelines of the International Institute of Welding (IIW). For the nominal stress S-N curve it was found that the recommended S-N curves by the IIW provided a conservative estimation of the fatigue life. Thus, modifications of the size effect and the mean stress effect on the fatigue strength could be considered.

Studies from literature showed that notch stress approaches with different recommended reference radii can provide uncertain results for welded joints with a material thickness below 5 mm. The experimental data were combined with the calculated notch stresses to evaluate the fatigue assessment quality of notch stress approaches with reference radii of 0.05 mm and 0.3 mm. The notch stresses were derived from FE-simulations, which included the aforementioned weld shapes. The examined approaches provide an adequate estimation of the fatigue life if the notch opening angle is considered in the recommended S-N curves from guidelines and literature. For some cases, the fatigue life estimations are non-conservative, especially in the notch stress approach with a reference radius of 0.05 mm. If a larger reference radius is used, the fatigue life estimations are more conservative. Contrary to expectation, the

assessment based on 50% fractile weld shapes is related to the best fit of experiments and recommendations from literature.