Fatigue Strength of Welded Thin Steel Structures

A PhD Project by Tobias Pawlowitz

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Introduction

The prediction of the fatigue life of a machine part or a steel structure is an essential part of the design work. The fatigue strength is related to a complex system of influencing factors [1]. Therefore the calculation of the fatigue strength always contains some uncertainty. In order to minimise the uncertainty different approaches have been developed to assess the fatigue strength.

This project will concentrate on the nominal stress approach, the hot spot stress approach, and the notch stress approach [2]. The investigated construction detail is a laser welded connection between relatively thin steel plates with a wall thickness less than 5mm.

Methods

The research is divided into two segments. The calculations of the fatigue strength are performed according to the above mentioned approaches. These calculations are supported by extensive finite element simulations, see Figure 1.

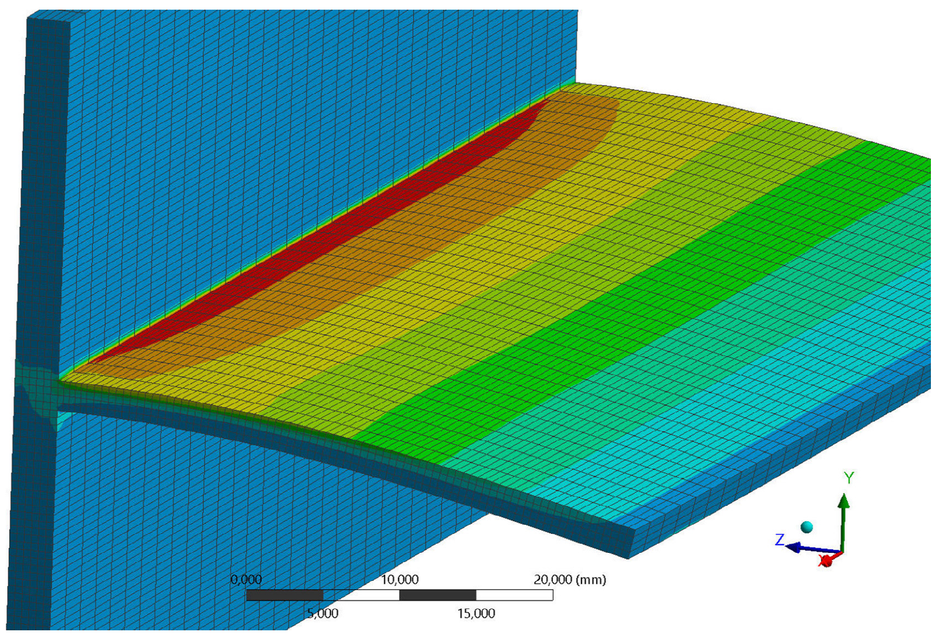

Figure 1: Distribution of maximum principle stresses in a specimen

Figure 2: Test bench at Kiel UAS

The experiments will be conducted using a test bench for fatigue tests. The tests shall reveal the actual fatigue life of the specimens.

The test results will be compared to the calculation results. The outcome of the comparison will be analysed to verify the approaches chosen.

Objectives

- Investigation of the fatigue strength of welded steel structures with a wall thickness less than 5mm
- Creation of experimental data about a specific weld seam
- Verification of input parameters and settings of finite element calculation of this investigated structure
- Comparison of the calculation results and experimental results and thereby improvement of the prediction accuracy of the notch stress approach for thin-walled steel structure.
- Enhancement of research data base by application of the hot spot stress approach and the nominal stress approach to this specific weld detail

Project Information

Project period:
June 2018 – May 2021

Project partner:
University of Southern Denmark (SDU)
Kiel University of Applied Sciences (Kiel UAS/FH Kiel)

References

[1] D. Radaj and M. Vormwald, Ermüdungsfestigkeit: Grundlagen für Ingenieure, 3rd ed. Berlin, Heidelberg: Springer-Verlag Berlin Heidelberg, 2007.
[2] A. Hobbacher, "Recommendations for Fatigue Design of Welded Joints and Components," International Institute of Welding, Paris XIII-2460-13/XV-1440-13, May. 2014.

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