HÖGSKOLAN VÄST

# Laser welding of ultra-high strength steel and a cast magnesium alloy for light-weight design

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AKADEMISK AVHANDLING

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# Abstract


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There is a strong industrial need for developing robust and flexible manufacturing methods for future light-weight design. Better performing, environmental friendly vehicles will gain competitive strength from using light- weight structures. In this study, focus has been on laser welding induced distortions for ultra-high strength steel (UHSS) where trials were performed on single hat and double hat beams simulating A-pillar and B-pillar structures. Furthermore, also laser welding induced porosity in cast magnesium alloy AM50 for interior parts were studied.

For UHSS, conventional laser welding was done in a fixture designed for research. For cast magnesium, single-spot and twin-spot welding were done. Measurements of final distortions and metallographic investigations have been performed.

The results show that the total weld metal volume or the total energy input were good measures for predicting the distortions within one steel grade. For comparing different steel grades, the width of the hard zone should be used. The relation between the width of the hard zone, corresponding to the martensitic area of the weld, and the distortions is almost linear. Additionally, compared with continuous welds, stitching reduced the distortions.

For cast magnesium, two-pass (repeated parameters) welding with single-spot gave the lowest porosity of approximately 3%. However, two-pass welding is not considered production friendly. Twin-spot welding was done, where the first beam provided time for nucleation and some growth of pores while reheating by the second beam should provide time for pores to grow and escape. This gave a porosity of around 5%.

Distortions and porosity are the main quality problems that occur while laser welding UHSS and cast magnesium, respectively. Low energy input seems to generally minimize quality issues. Laser welding shows high potential regarding weld quality and other general aspects such as productivity in light-weight design for both high strength steel and cast magnesium.