

A novel high-strength friction stir welding process for butt joints made of different materials and thicknesses

A new process and a new welding tool have been developed to realize friction stir welded butt joints on plates of different material and thickness with significantly increased strength characteristics (99.4%).

- A method for friction stir welding of butt joints made of different materials and thicknesses
- Optimized cross-section connection at the joint line to provide: Higher strengths and higher bending moments
- Eliminating corrosion problems at the joining points/lines

Fields of application

High-strength joining of steel and aluminum sheets of different thicknesses in the automotive and metal processing industries

Background

Particularly in the automotive industry, using a combination of aluminium-steel sheets for fabrication is quite common, as aluminium reduces weight of the structure significantly. This novel friction stir welding process makes it possible to join different metals such as steel and aluminium with different thicknesses to each other, ending to a higher strength.

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Service

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Problem

Traditionally, joints between dissimilar materials with different thicknesses are produced by overlap welding, as higher bending moments and strengths can be achieved through this process. However, overlap welding has the disadvantage of visually disturbing finish, ragged and uneven edges. In addition, direct contact between different materials and the gaps resulting from the overlap, increases the risk of corrosion dramatically. At the moment, butt joints made by friction stir welding process have reliable strength characteristics, if and only if the steel and aluminium sheets have the same thickness.

Solution

Researchers at the University of Stuttgart, Germany, have developed a process and a stir welding tool that can be used to produce friction stir welded butt joints with smooth finish, even edges, improved strength, while still using different materials and thicknesses. For this purpose, the cross-section of the thinner / stronger sheet (e.g. steel) is locally increased at the butt joint. For example, the steel can be folded, bevelled or fold-flanged at the edge to be welded to the aluminium sheet until the thickness at the joint corresponds to that of the aluminium sheet. In addition, a specially shaped friction stir welding tool that is designed for this process, can improve any incomplete fold for better look and advanced strength.

The geometry of the welding pin shall be adapted to the geometry of the wrapping of the stronger material. This enables the aluminium sheet to be completely bonded to the steel sheet with a higher strength in the area of the fold. Joint strengths of up to 99.4% of the steel sheet have been achieved to date.

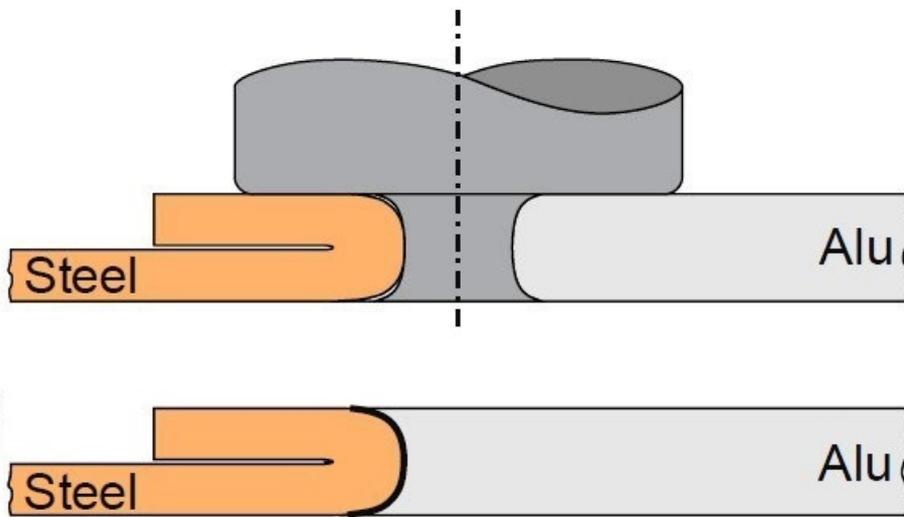


Fig: A schematic illustration of the procedure: Top: A stir welding tool joints two different sheets with different material properties and thicknesses Bottom: Cross section of the butt weld, the lower surface (finish) is even. [Fig. Martin Werz, MPA, University of Stuttgart]