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Modeling of FSW butt welds and its applications for vehicle bumper crash box assemblies made from dissimilar aluminum alloys extrusions (AA6082-T6 AND AA6063-T6)

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The demand for better structural performance in the joining of components in road vehicles prompts the implementation of aluminum alloy friction stir welding technology in the automotive industry. The objective of this study is to develop and correlate a three-dimensional thermal model of friction stir welding (FSW). Thermo mechanical simulations and analysis are performed to understand the thermal behavior in the FSW weld zones. The developed models are correlated against other published experimental results in terms of temperature profile of the weld zone. The developed models are then implemented for fabricating vehicle bumper parts to illustrate the performance of FSW welded components during an impact. Traditional sled testing for low-speed bumper requirements is performed using a friction stir welded test fixture in the National Institute for Aviation Research (NIAR) at Wichita State University (WSU). Several bumper assemblies are then attached to the test fixture using FSW and GMAW methods. Numerical models are also developed where finite element analysis is used to compare the predicted damage to the actual damage sustained by both of the FSW and GMAW fabricated bumpers. In this study, a new FSW weld model is developed that allows for a better representation of the desired progressive crack propagation. The FSW fabricated bumper based on the Johnson-Cook failure model yields better failure prediction and is in good agreement to the test. The results from this study provide a guideline for an accurate finite element modeling of a FSW fabricated component and its application in the crashworthiness of structure.

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