EVALUATION OF NOVEL JOINING TECHNIQUES FOR CHASSIS & SUSPENSION

Ed Carter

Swansea University

1 KEY WORDS:

Fatigue, Finite element analysis, automotive chassis, boron steel, laser welding

2 TOPIC GROUP THE PAPER BELONGS TO:

- Welding, Joining & Fastening
- Vehicle Performance Development
- Development of CAD/CAE/CAM and CFD Methods in Automotive Practice
- Advanced Chassis, Body Structure and Design
- New Materials and Structures
- Simulation and Experimental Validation

3 RESEARCH AND/OR ENGINEERING QUESTIONS/OBJECTIVE:

New requirements in EU legislation stipulate a 20-25% reduction in emissions for small-medium vehicles by 2015, with extensive work already carried out on the body-in-white, there is a growing trend towards lightweight, high strength chassis components for the automotive industry. The key challenges initially preventing a market-wide movement to thinner gauges are the formability, weldability, and the fatigue resistance of components. This paper evaluates novel joining and material applications, such as laser welding of boron steel products less than 2mm thick, for automotive chassis and suspension components, using finite element based fatigue analysis techniques.

4 METHODOLOGY:

The geometry used for the analysis is from a 2008 W204 Mercedes C-Class front subframe; this is scanned using a LiDAR 3D laser scanner. CAD geometry is then built up from the scanned geometry cloud. The quality of this data is then improved to increase the accuracy of the model. This model is then transferred into both Abaqus and HyperMesh to create 3D meshes of the CAD model; both Abaqus and HyperMesh are used for comparison. Finite Element analysis is then undertaken in Abaqus and MSC Nastran respectively, for both a MIG welded and Laser welded subframe. Post processing of this information is undertaken to perform fatigue analysis using FEMFAT's seam weld, nCode's DesignLife and MSC Fatigue, forming a comparison of the differing fatigue calculation methods.

5 RESULTS:

The results show the change in fatigue life of a single component, relative to the method of prediction for fatigue life used. This provides a comparison of each computation method used, highlighting limitations and accuracy. The results obtained are verified by hand calculation of simplified geometries, and experimentally to ensure an acceptable accuracy margin between the prediction methods.

6 LIMITATIONS OF THIS STUDY:

The methods used for this investigation can be widely applied to multiple components; in this case however, the analysis methods are only applied to a single grade of boron steel, the specific joining techniques used in manufacture, and to an industry relevant geometry. Fatigue prediction databases incorporated in the software is experimentally verified to ensure reliability.

7 WHAT DOES THE PAPER OFFER THAT IS NEW IN THE FIELD IN COMPARISON TO OTHER WORKS OF THE AUTHOR:

This paper offers the evaluation of novel joining and material applications in the manufacture of a vehicle front subframe(s). Two welding techniques are compared, laser welding and MIG welding of boron steel, on gauges less than 2mm thick.

8 CONCLUSIONS:

In conclusion the paper offers an evaluation of some of the novel joining and material applications currently in use within the automotive industry. This gives a useful insight into the developments and designs of the front subframe(s), which points towards future possible adaptations and or advancements to the design of this component. A deeper understanding of component(s) fatigue life is provided.