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STUDY OF ALTERNATIVE MANUFACTURING PROCEDURES FOR AN ALUMINIUM RAILWAY CAR PASSENGER UNDERFRAME

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ABSTRACT

The LighTRAIN project aims at the development of novel solutions for the underframe/floor of passenger railway cars, seeking to obtain improved life cycle costs through light-weighting and/or reduced fabrication costs, whilst ensuring compliance with the applicable design requirements.

The Al alloys are materials with great potential in this context, given their high strength and low weight. However, the use of these alloys implies the need for research on the more efficient and applicable welding technologies. Among the technologies to be considered are laser beam welding (LBW) and friction stir welding (FSW).

This paper presents and discusses the experimental results in characterization of the mechanical behaviour of dissimilar joints among the aluminum alloys AA 6060 and AA 5754, welded using LBW and FSW, as part of the development of the railways car floor panel.

Tensile, bending and fatigue tests on welded joints were performed in order to access improved joint strength for both FSW and LBW welds. Lap joint configuration was chosen since it reproduces the floor panel geometry.

In this work results obtained testing details of connections at coupon level are presented and discussed, aiming at the subsequent manufacture and test of a representative prototype.

Keywords: friction stir welding, laser beam welding, aluminium alloy, lap joints.

INTRODUCTION

After preliminary studies focused on weight and manufacture cost reduction, a new concept for the under-frame was developed where a weight saving of 40% could be achieved. Specimen tests now performed aim at the characterization of the necessary welded joint details, which are based on the joining of H profiles with the outer skins. This solution is in accordance with stiffness requirements for this type of structures. A 3D view of the profile array is presented in Figure 1.

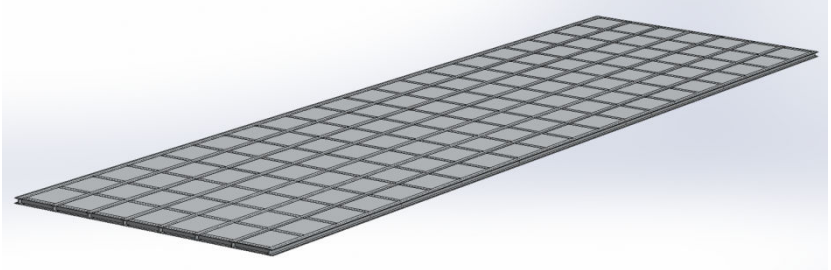

Fig. 1 - CAD model of the under-frame.

Lap-joint specimens joined with friction stir welding (FSW) and laser beam welding (LBW) were manufactured using aluminum alloys of two different series, AA 5754 and AA 6082.

The geometry of the specimens used for tensile and fatigue tests are presented in Figures 2 to 4, including specimens for the less common assessment of the resistance to shear stresses parallel to the weld line, Figure 4. Fatigue curves for $\tau_{\perp}$ and $\tau_{//}$ are presented in the paper.

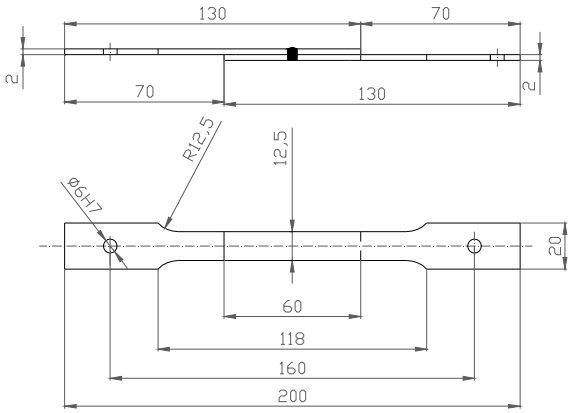

Fig. 2 - Tensile specimen.

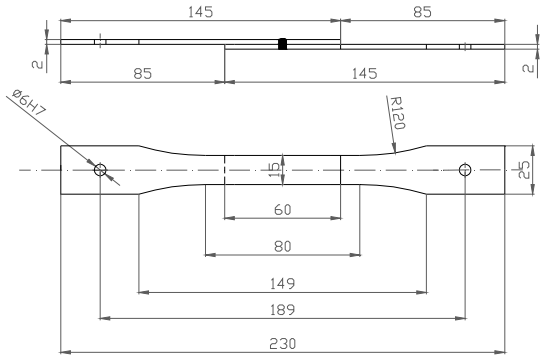

Fig. 3 - Fatigue specimen for generation of $\tau_{\perp}$ *vs.* N plots.

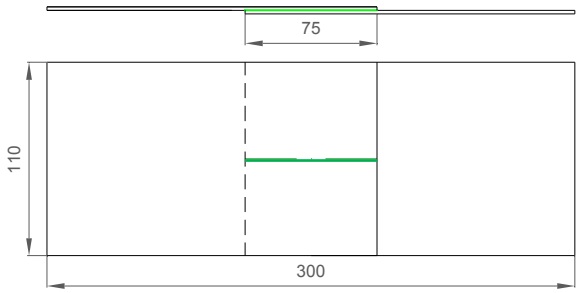

Fig. 4 - Fatigue specimen for generation of $\tau_{//}$ *vs.* N plots.

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