Numerical analysis of the fatigue behaviour of friction stir welded joints in aluminum bridge decks

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Abstract

Friction stir welding (FSW), a relatively new welding technique, has been widely used in the aerospace and manufacturing industries, showing superior mechanical and durability properties. However, its application in civil engineering is very limited due to the absence of appropriate standards and quality control guidelines. FSW appears to be a promising welding solution for the fabrication of vehicular bridge decks made from aluminum extrusions, with a potential to reduce distortions and improve fatigue properties. The fatigue behaviour of common FSW joint types such as the butt FSW has extensively been investigated and documented in literature. However, certain practical configurations such as the butt-lap joint used in the fabrication of extruded aluminum bridge decks have rarely been studied, especially in the area of fatigue performance. In this context, the present research provides first an overview on the welding process of typical aluminum friction stir welded bridge deck extrusions presenting the butt-lap configuration. Then, the fatigue behaviour of butt-lap FSW joints is assessed using the effective notch stress (ENS) approach. The effect of geometrical features on the fatigue behaviour of butt-lap FSW joints is numerically investigated also by the ENS approach.

Keywords: aluminum bridge deck, fatigue, friction stir welding, butt-lap joint, effective notch stress

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