# Crack Propagation-Based Fatigue Evaluation of Rib-to-Deck Welded Joints of Orthotropic Steel Bridge Deck by Using Schwartz-Neuman Alternating Method

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The efficient and high performance orthotropic steel decks have been widely used in long span bridges over the world. The initial defects at welded joints of orthotropic steel bridge decks will undergo fatigue failure under the action of live load of moving vehicles on the bridge decks. And the fatigue cracks at the rib-to-deck welded joints are the most dangerous cracks for the orthotropic steel bridge decks. Therefore, the fatigue life evaluation of the rib-to-deck welded joints is very important for the safety of orthotropic steel bridge decks. This paper presents a crack propagation-based model for the fatigue life prediction of the rib-to-deck welded joints, which is based on a local 3D fracture mechanics analysis model of the rib-to-deck welded joints and Schwartz-Neuman alternating method. The crack propagation of the surface cracks at the weld toe and weld root of the rib-to-deck welded joint are simulated based on the local 3D fracture mechanics analysis model. The results show that: (1) fatigue cracks at rib-to-deck welded joints are of the mixed mode cracks of Model I, II and III, but dominated by Model I; (2) the crack at the weld toe of a rib-to-deck welded joint is more dangerous than that at weld root; (3) the fatigue life of the rib-to-deck welded joints is determined by the crack propagation along the deck thickness at the weld toe. The present numerical predictions are in good agreement with the experimental observations. It can be concluded that the fracture mechanics model based on Schwartz-Neuman alternating method is an efficient and powerful approach for the fatigue evaluation of the rib-to-deck welded joints of orthotropic steel bridge decks.

**Keywords:** Fatigue life evaluation; rib-to-deck welded joints; fatigue crack; local 3D fracture mechanics model; crack propagation simulation; schwartz-Neuman alternating method