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SINGLE-CYCLE AND FATIGUE STRENGTHS OF ADHESIVELY BONDED LAP JOINTS

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Abstract

This study considers a composite-to-steel tubular lap joint in which failure typically occurs when the adhesive debonds from the steel adherend. The same basic joint was subjected to compressive and tensile axial loads (single-cycle) as well as bending loads (fatigue). The purpose of these tests was to determine whether failure is more dependent on the plastic strain or the peel stress that develops in the adhesive. For the same joint, compressive and tensile loads of the same magnitude will produce similar plastic strains but peel stresses of opposite signs in the adhesive. In the axial tests, the tensile strengths were much greater than the compressive strengths - indicating that the peel stress is key to predicting the single-cycle strengths. To determine the key parameter(s) for predicting high-cycle fatigue strengths, a test technique capable of subjecting a specimen to several million cycles per day was developed. In these bending tests, the initial adhesive debonding always occurred on the compressive side. This result is consistent with the single-cycle tests, although not as conclusive due to the limited number of tests. Nevertheless, a fatigue test method has been established and future tests are planned.