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Proposal of an alternating bending technique for evaluating low-to-high cycle fatigue of structural steels

Abstract

This paper proposes an alternating bending technique for evaluating fatigue life in the low-to-high cycle fatigue regime. A method was developed for estimating the stress, elastic strain, and plastic strain ranges of a plastically deformed specimen subjected to alternating bending with consideration of stress and strain distributions. To evaluate its effectiveness, fatigue testing was conducted using a specimen made of a steel used for pressure vessels. The stress, elastic strain, and plastic strain ranges could be obtained during cyclic bending. The elastic strain amplitude life and plastic strain amplitude life curves were linear in a log–log plot in the low-to-high cycle fatigue regime. Hence, the fatigue life under alternating bending could be evaluated using the proposed strain-based approach. However, these curves could not be predicted using equations with parameters obtained from tensile testing, such as the universal slope method, due to the strain gradient in the specimen.

Keywords

Bending; Elastically/plastically dominant fatigue; Fatigue testing; Local strain concepts