Fatigue fracture and probabilistic assessments of a cone and pipe welded structure of stainless steels

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Abstract

Using thin-walled cone-pipe welded joints of stainless steels, fatigue tests under bending loads were carried out. The test data were statistically analyzed with the Benard's approximation, Gaussian, 2P-Weibull, and 3P-Weibull distributions. Stress–life curves at different failure probabilities by a constant strength scatter band model were obtained. The metallographic structures were investigated, and the stress concentration states were analyzed to elucidate the causes of the strengths and scatters. In the high-cycle fatigue regime, the 2P-Weibull distribution was mostly in agreement with the Benard's approximation, and the coefficient of determination was 0.9666. The microstructure of the weld metal with a high weld opening angle was mainly ferrite phase with 20% austenite distribution. The crack initiation point was close to the weld interface, but the propagation direction was at a right angle, and initially penetrated the heat affected zone of the cone, leading to the high fatigue strength. The stress concentration factors depended on the weld opening angles, indicating the main factor which affected strengths and scatters.

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