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High-Frequency Mechanical Impact Effect on High-Cycle Fatigue of Welded Steel Connections for Offshore Structures

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ABSTRACT

The present paper presents the fatigue performance of twelve (12) full-penetration welded T-joint specimens commonly used in offshore tubular steel structures. The research work is part of an extensive Greek national research program with the acronym SIRENES, focusing on the structural integrity of offshore structures for renewable energy production. It is the continuation of the European REFOS project for developing hybrid tension-leg-platforms (TLP) installed in deep water locations for combined wind and wave energy production. The study focuses on the effect of High-Frequency Mechanical Impact (HFMI) post-weld treatment on welded joints fatigue life. The full-penetration welds represent the brace-to-chord connections of the offshore structure. The specimens are made of either mild steel S355 or high-strength steel S700, and are subjected to four-point bending cyclic loading under a constant load amplitude with a load ratio (R=0.5). Two welding techniques for the connection have been employed: (a) manual (semi-automatic) weld; (b) manual weld with HFMI post-weld treatment. Crack initiation and propagation along the weld toe is monitored during testing using magnetic particle inspection. A three-dimensional numerical model of the welded connections is also developed using ABAQUS/Standard FE software to support the experiments accounting for material properties based on uniaxial tests of coupon specimens extracted from the same steel sheet used for specimens fabrication.

References

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