

Low-cycle Fatigue of Welded Steel Components for Offshore Structures

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ABSTRACT

The present work investigates the low-cycle fatigue performance of welded steel components, using advanced numerical methods supported by physical testing. The research work is part of an extensive national research program, which aims at improving the structural performance of an offshore floating platform, installed in deep-water locations. The current study extends the work performed in previous European research projects (Mavrakos et al., 2020) for developing a hybrid tension-leg-platform (TLP), suitable for combined offshore wind and wave energy exploitation. The current work presents an effective and robust numerical methodology for predicting the structural response of welded T-joint specimens, commonly used in offshore tubular steel structures, subjected to severe repeated loading. A coupled cyclic plasticity-damage model is employed for simulating low-cycle fatigue in metal components (Chatziioannou et al., 2021). Constitutive relations account for J_2 -flow theory with non-linear kinematic/isotropic hardening, coupled with isotropic continuum damage mechanics. The algorithm is implemented in a user-subroutine into ABAQUS/Standard finite element software. The numerical results are compared with experimental testing results, in terms of global structural response, local strains at the weld vicinity and the number of cycles for crack initiation and propagation along the weld toe.

References

- Chatziioannou, K., Karamanos, S. A., and Huang, Y. Coupled numerical simulation of low-cycle fatigue damage in metal components. *Engineering Structures*, 229:111536, 2021.
- Mavrakos, S. A. et al. Life-Cycle Assessment of a Renewable Energy Multi-Purpose Floating Offshore System: Final report of REFOS project. Brussels, European Commission, 2020.