Large scale validation of the Barcelona plastic damage model with a new hardening law under ULCF conditions

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ABSTRACT

Ultra Low Cycle Fatigue (ULCF) can occur in materials such as structural steel and in modern steel devices that are designed to absorb seismic energy by sustaining large inelastic deformations under cyclic loads. Pipelines installed in seismic or permafrost regions must have sufficient strength against buckling or fracture caused by large ground deformation of buried pipeline.

This paper presents finite element simulations made on a bent pipe subjected to an in-plane variable cyclic displacement combined with a cyclic internal pressure. The results of the numerical analyses will be compared to the experimental ones obtained in the framework of the ULCF project (ultra low cycle fatigue of steel under cyclic high strain loading conditions). The loading scheme is in accordance with the ECCS procedure ECCS-Nr. 45-1986 *Recommended Testing Procedure for Assessing the Behaviour of Structural Steel Elements under Cyclic Loads* [1]. The constitutive model used for the simulation of ULCF loading and the exact expression of the hardening-softening law can be found in Martinez et al. [2] where the validation of the constitutive model is developed for small scale specimens.

The material characteristics for the numerical simulations have been obtained by conducting a calibration analysis with the experimental results obtained on small scale specimens by Pereira et al. [3]. The exact calibration procedure will be described.

The behaviour of a large diameter pipe subjected to an imposed traction followed by monotonically increasing internal pressure until burst, as obtained from the proposed constitutive model, is also shown and compared with experimental results. This simulation has been included in order to analyse the capabilities of the constitutive model for assessing monotonic behaviour.

REFERENCES

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