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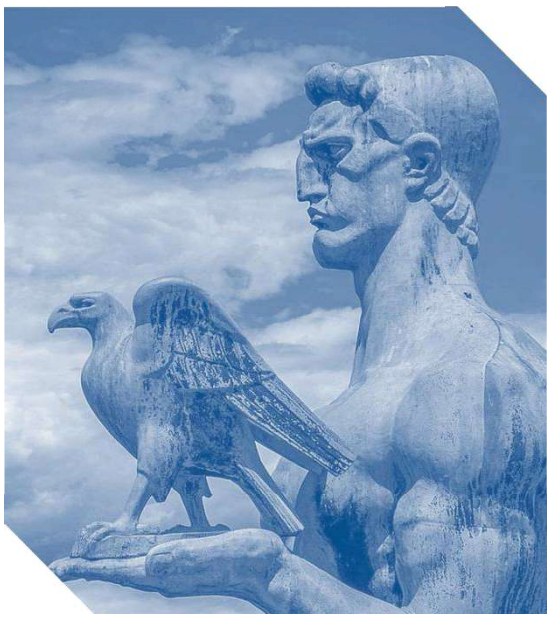

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COMPARATIVE EVALUATION OF EXPERIMENTAL AND PHASE-FIELD MODELING APPROACHES IN THE TENSILE RESPONSE OF S1100QL STEEL

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Abstract

Phase-field Damage Modeling (PFDM) has gained considerable attention as a robust framework for representing material degradation and failure. Its capacity to describe the progressive evolution of damage has led to increasing integration into finite element method (FEM) codes, establishing PFDM as a promising tool for structural assessment. In this study, an axisymmetric PFDM formulation is implemented and validated through comparison with experimental tensile tests on high-strength S1100QL steel specimens.

Cylindrical specimens were machined from the base material using CNC lathes to determine its tensile properties. The tensile tests were subsequently performed on a universal testing machine, ZWICK ROELL Z/100 (ZWICKROELL GmbH, Ulm, Germany) (Fig. 1a).

The critical-total strain-based PFDM implemented into the software PAK-DAM v25 is used for numerical analysis of tensile tests. For numerical simulation, an FE model was created using 2D axisymmetric finite elements. The simulation was performed using the large strain von Mises plasticity constitutive model and logarithmic strain measure. The created FE model consists of 970 elements and 1078 nodes. The FE model, boundary conditions, and loading of the specimen are given in Fig. 1b.

In Fig. 1c, a comparison of the stress-strain diagram for the numerical simulation and the experiment is given. The results show good agreement between the experiment and the numerical simulation results.

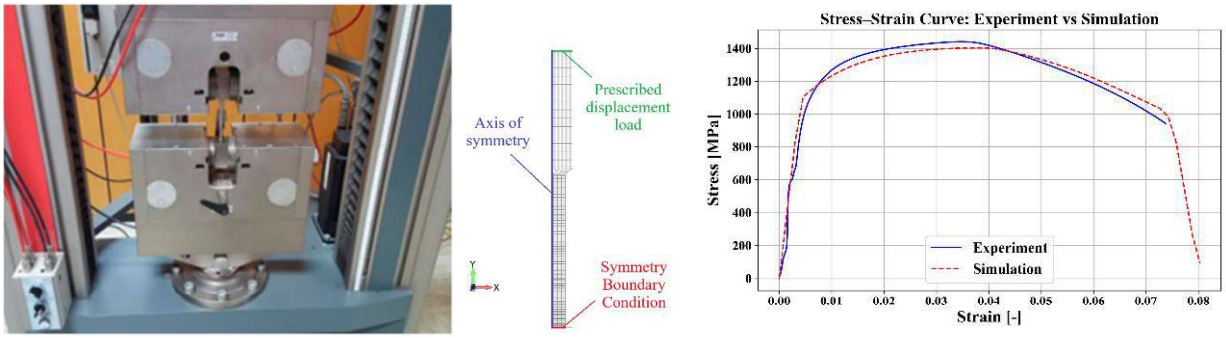

Figure 1. a) ZWICK ROELL Z/100 testing machine; b) FE Model with boundary conditions and loads; c) comparison of stress-strain diagram for experiment and numerical analysis

Keywords: Finite Element Method; Phase-Field Damage Model; S1100QL Steel; PAK-DAM

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