

Identification of a Phase-Field Model for Brittle Fracture in Transversely Isotropic Elastic Materials with Application to Spruce Wood Specimens under Compression

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Predicting cracking-induced failure mechanisms in complex heterogeneous anisotropic materials (such as wood-based and other composite materials) is of major interest for the design and optimization of structures in mechanical and civil engineering. Among the smeared or diffusive crack approaches, the phase-field method for fracture is one of the most robust and efficient numerical tools for simulating the brittle, ductile and cohesive fracture of materials under quasi-static and dynamic loading conditions. In recent years, a few works have been devoted to model fracture in wood-based and other transversely isotropic or orthotropic elastic materials using a phase-field regularized approach (see [1] for example). The present work focuses on the validation of a phase-field model for brittle fracture of anisotropic elastic materials [2] and the inverse identification of fracture properties in wood-based materials from experimental measurements. Several experimental compression tests have been performed upon failure on spruce wood specimens containing a hole and analyzed by digital image correlation for the acquisition of experimental displacement field measurements and the identification of critical force values (at which crack initiation occurs). The transversely isotropic elastic properties of spruce wood specimens are first identified by solving a nonlinear least-squares optimization problem involving the displacements fields measured experimentally and simulated numerically in the elastic regime (before crack propagation occurs). The fracture properties (fracture toughness) of spruce wood specimens are then identified by solving a nonlinear least-squares optimization problem involving the critical force values obtained by means of phase-field numerical simulations and experimental measurements. The identification results show that the considered phase-field model for brittle fracture is able to correctly reproduce the crack nucleation in spruce wood specimens subjected to compression.

REFERENCES

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