Crack Path in Compact Tension Cracked Specimens: Experiments vs. Phase Field model and Finite Fracture Mechanics

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ABSTRACT

Depending on the specimen geometrical features and crack initial length, the crack in Compact Tension specimen can propagate collinearly or branch, eventually following a curved path. Several approaches have been proposed in the literature to study this phenomenon under certain simplifying assumptions, with different complexity depending on the number of involved parameters, including T-stress [1] and Generalized Strain Energy Density (GSED) criteria [2].

The present work is devoted to the prediction of crack growth in brittle precracked Compact Tension geometries under Mode I loading using Phase Field (PF) model. The numerical approach combines a hybrid method that first employs a quasi-static analysis to capture the elastic phase of the tensile test, followed by a dynamic analysis to catch the nature of unstable fracture phenomena [3].

Accounting for the transition from stable to unstable propagation, a comprehensive analysis of the Energy Release Rate during the propagation phase is also conducted to verify that crack propagates in accordance with Griffith's energy criterion. Numerical outcomes are compared with experimental results reported in the literature [2]: PF analysis reveals to be able to predict the crack path deflection for the analysed geometries with sufficient accuracy.

Lastly, PF numerical results are compared with Finite Fracture Mechanics predictions [1] to assess the consistency and validity of the proposed model.

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