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Micromechanics-based variational phase-field modeling of Brazilian tests on mortar samples

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The phase-field approach for fracture of quasi-brittle materials like mortar and concrete has received a lot of attention in the past few years, due to its capability to capture the complex crack paths, including crack initiation, propagation and branching. In this context, micromechanics-based phase-field models, such as the model proposed by Ulloa et al. [1], could overcome some limitations of classical phase-field approaches, creating a link between the field variables and physical mechanisms at the microcrack level.

This presentation deals with the phase-field modeling, calibration and validation of Brazilian tests on mortar samples under monotonic loading. The numerical modeling using (micromechanical-based) phase-field fracture models is complicated by the presence of stress concentrations near the applied loads (at the top and bottom of the specimen), which could lead to numerical problems and convergence issues. These issues are addressed through a viscoplasticity regularization within the variational framework. The parameters of the model are calibrated using the experimental results from the work of Deresse et al. [2]. The numerical simulations show that the fracture may initiate either from mode II shear cracks at the load points or mode I fracture at the center of the specimen, depending on the sample properties and boundary conditions. The computed failure modes are compared to the crack pattern observed from experimental results, which include both load-displacement curves and digital image correlation (DIC) measurements during monotonic loading on various mortar samples.

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