Dynamic Finite Fracture Mechanics

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Abstract The development of robust failure criteria applicable to both quasi-static and dynamic loading conditions arouses interest in the scientific community as for the impact it poses in the reliability of failure predictions for critical structural applications. Consequently, different quasi-static failure criteria have already been modified to account for the effect of non-negligible loading rates, although limitations in their applicability and physical soundness still remain.

The extension of the well-established Finite Fracture Mechanics failure criterion to the dynamic loading regime is herein addressed. To that end, some general requirements to be fulfilled by any proper dynamic failure criterion are first shortlisted. Upon these, the definition of the Dynamic Finite Fracture Mechanics (DFFM) is proposed, compared against the main existent failure criteria, and proven to be more robust. Finally, the introduced DFFM approach is validated with suitable experiments from the literature, which were performed on rock specimens that contained three differentiated stress distributions, namely constant, stress concentration (non-singular) and stress intensification (singular). In all of them, DFFM is able to capture the rate dependence of the failure load with reasonable accuracy.