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ROBUST ANISOTROPIC VISCO-DAMAGE MODELING FOR IMPACT APPLICATIONS

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ABSTRACT

Anisotropic damage is quite relevant to describe the cracking pattern and the failure conditions of quasi-brittle materials and structures. In concrete, a state of micro-cracks orthogonal to the loading direction in tension and parallel to it in compression is easily described by a second order damage variable. Based on Mazars and coworkers [1, 2] idea of a damage rate governed by the positive extensions, an anisotropic damage model has been proposed, in either a local or a nonlocal formulations [3]. The low number of material parameters introduced (5 including the elasticity parameters) and the model abilities for computations of 3D concrete, reinforced (RC) and pre-stressed concrete structures [4] makes it potentially efficient for impact applications.

The anisotropic damage modeling is extended here to high loading rates by introducing visco- or delay-damage in the tensile loading cases only. Different delay-damage laws are considered (power, exponential, Weibull) and directly identified from the tensile strain rate effect. Computations on Hopkinson bars dynamic tension are performed in both the local and the nonlocal formulations. The validity domain of the different regularizations (viscosity only, nonlocal only, combined viscosity/nonlocal) is discussed. Applications on impacted RC-beams illustrate the model ability to describe the different dynamic failure modes usually encountered.

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