Parameter window for assisted crack tip flipping: Studied by a shear extended Gurson model - DTU Orbit (03/11/2019)

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Assisted flipping of a slant mode I dominated tearing crack, where the crack tip flipping mechanism is made to engage by imposing a slight mode III, has recently been studied in Felter and Nielsen (2017) [Assisted crack tip flipping under Mode I thin sheet tearing, Europ. J. Mech. A/Solids, 64, 2017: 58–68]. In the previous study, the Gurson–Tvergaard–Needleman model was used in its original form to limit the model parameter space and facilitate a search for a set of parameter that allows flipping of the slant crack face to occur. It is well known that the adopted version of the Gurson model can predict the shear bands that travel in front of a mode I tearing crack and these are essential features to slant crack propagation — let alone the experimentally observed crack tip flipping phenomenon. In fact, assisted crack tip flipping was achieved with this numerical model set-up, but only within a very narrow parameter window. The present work adopts a phenomenological shear extended Gurson model that allows for a study of the J3 dependency in ductile fracture at engineering scale in an attempt to widen this parameter window. By running series of large-scale computations, where a ductile tearing crack propagates multiple plate thicknesses, the authors can demonstrate tearing modes for various combinations of strain hardening, initial void volume fraction, and shear parameter. The shear damage contribution is found to shift the engagement of the crack tip flipping mechanism toward lower values of the initial void volume fraction for all levels of strain hardening considered.

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