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MODELING CRACK TIP FLIPPING IN FULL SCALE PLATE TEARING USING THE GURSON MODEL

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Naturally occurring crack tip flipping, where a slant crack reorients it-self by flipping the crack face roughly 90 degree about its growth direction, has received little attention in the open literature. It is typically disregarded as transitional or ascribed randomness in the microstructure. However, recent years effort in getting to the bottom of this intriguing phenomenon has shown that it is far from random, but rather is it a largely overlooked propagation mode where multiple scales interact to create a highly three dimensional tearing mechanism [1, 2]. The interaction of scales, combined with the three dimensional evolution of damage near the crack tip, makes crack tip flipping a challenge to model and the authors have been inching forward, through various models, to hone in on a set-up that yields flipping. As in experiments, the flipping mechanism rarely engages but clearly sets it-self apart once it evolves. In a first attempt, Felter and Nielsen [3] focused on so-called assisted crack tip flipping, where a slight mode III is overlaid the dominating mode I. The set-up limited the parameter space to be investigated, along with the computational effort, and yielded a first flip ever predicted by the Gurson model. Moreover, the set-up allowed the pursue of parametric understanding of the mechanics involved. The present work transfers this insight to the modeling of naturally occurring flipping in full scale plates subject to mode I far field loading. No artificial forcing of the flip is applied and still the Gurson model displays the transition from one shear band to another.

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