NON-UNIFORM DISTRIBUTIONS OF INITIAL POROSITY IN METALLIC MATERIALS AFFECT THE GROWTH RATE OF NECKING INSTABILITIES IN FLAT TENSILE SAMPLES SUBJECTED TO DYNAMIC LOADING

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Abstract

In this work we assess, using finite element calculations performed with ABAQUS/Explicit, the influence of porosity in the development of necking instabilities in flat metallic samples subjected to dynamic tension. The mechanical behaviour of the material is described with the Gurson—Tvergaard—Needleman [1-3] constitutive model pre-implemented in the finite element code. The novelty of our methodology is that we have included in the gauge of the specimen various non-uniform distributions of initial porosity which, in all cases, keep constant the average porosity in the whole sample. This has been carried out assigning random values of initial porosity (within specified bounds) to some nodes and zero to the others. Therefore, the larger the percentage of nodes with non-zero initial porosity, the smaller their initial value of porosity. The idea is to replicate the heterogeneous microstructure of (most) metals which have a finite number of voids non-uniformly distributed in the bulk. The key point of this work is that, following this methodology, we reproduce the experimentally-observed asymmetric-growth of the pair of necking bands which define the localization process in flat tensile samples subjected to dynamic loading [4].

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