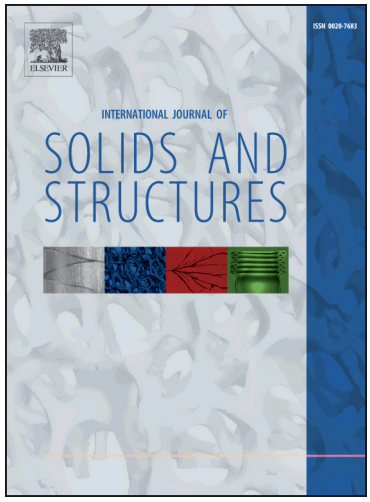

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Validation of metal plasticity and fracture models through numerical simulation of high velocity perforation

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Abstract

Perforation of circular 2024-T3(51) aluminum alloy plates of various normalized thicknesses by a rigid spherical projectile is considered as a benchmark problem to validate material plasticity and fracture models. A new set of experiments with circular 2024-T3(51) aluminum alloy plates and AISI 52100 alloy steel spheres was conducted in order to augment available in literature experimental data and to form more precise reference solution for the benchmark problem. Numerical simulations of a plate perforation using Johnson-Cook plasticity model with two sets of parameters, Johnson-Cook fracture criterion with one set of fitting parameters and pressure and Lode dependent ductile fracture criterion with three sets of material constants are performed. Problem formulation, types of plasticity and fracture models and their parameters are estimated independently in the context of their effect on the accuracy of numerical solution. Ballistic limit velocity and residual velocity tests are employed for validation procedure. With one of the considered formulation-models combination quantitative discrepancy of less than 10% and good and physically sound qualitative agreement with the experiment were obtained.

Keywords

Plasticity model, fracture criterion, plate perforation, numerical simulation, experiment.

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