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NUMERICAL SIMULATION OF THE RUPTURE OF A CONICAL SHELL BY THE EXPLOSION OF A TAPE CHARGE

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This paper considers the problem of the destruction of a thin closed truncated conical shell loaded along the generatrix with a tape explosive charge. The problem simulates rocket head separation. The total stress and strain field in the shell under nonstationary loading is determined by the finite-element method and used as initial conditions for the analysis of the destruction of the maximum loaded strip situated along the generatrix. For the strip, a plane initial-boundary problem of inelastic plastic deformation is solved. The mathematical model uses a constitutive equation, which includes the plastic flow of the material and is formulated in terms of inelastic strain rates in the form of strain hardening, and a kinetic equation for a damage parameter. The dynamic constants of the material were determined from data of complex-stress experiments. Using finite-element simulation, macrodefect initiation sites are determined, and macrodefect initiation times are estimated. To implement the proposed mathematical model, software was developed. The software allows one to refine finite-element schemes with the extraction of the destroyed parts and to determine crack development times for different loading conditions. The proposed method is verified by comparing the calculated results with experimental curves of explosive deformation and with a solution to this problem obtained in the ANSYS finite-element analysis program system based on the Cooper–Symonds hardening model for a 3D geometric model.

Keywords: truncated conical shell, tape explosive charge, inelastic plastic deformation, strain hardening, damage parameter, Cooper–Symonds hardening model, finite-element method, shell rupture.

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