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NUMERICAL SIMULATION OF MISSILE PAYLOAD OPERATION

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This paper considers the features of numerical simulation of the predicted destruction of the fastening elements of a special rocket structure under a given gas-dynamic impulse load. The structure under consideration is a composite one; its components are fastened with bolts and ties. The stress and strain field and the destruction time of an assembled missile payload are investigated. The problem is solved numerically using the ANSYS universal program system for finite-element analysis. The proposed technique for numerical simulation of fastening element destruction includes three stages and in comparison with the standard one offers a faster computational speed and a better convergence for the essentially nonlinear problem. The proposed three-stage approach to simulating the missile payload operation accounts for all loading factors. At the first stage, the static stress and strain field of the whole structure produced by its assembly (bolt tightening) is investigated. At the second stage, the dynamic stress and strain field of the whole structure under impulse loading is investigated with account for the bilinear law of plastic flow and the sliding speed dependence of the friction factor. The objective of the third stage is to investigate the destruction of the statically loaded fastening elements of the structure under the action of the total pressure of a gas-dynamic impulse load and the action of the payload flying apart. The plastic flow of the material is described using the Cowper–Symonds hardening model. The destruction criterion is the maximum plastic strain. The estimated time is synchronized with the actual structure loading time, which allows one to predict the fastening element destruction point. The use of the proposed technique at the development stage allows one to replace full-scale experiments with numerical studies.

Keywords: *composite structure, fastening element, gas-dynamic impulse load, elastoplastic deformation, Cowper–Symonds hardening model, element destruction.*

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