

TRANSIENT DYNAMIC RESPONSE OF A NANOCOMPOSITE CONICAL SHELL WITH A RING STIFFENER UNDER THE ACTION OF AN IMPACT LOAD

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This work is devoted to the study of transient processes occurring in a nanocomposite shell with a ring stiffener under the action of an impact load. Nanocomposites are promising new materials for the aerospace industry. However, the analysis of dynamic processes in nanocomposite structures requires the development of new methods due to the anisotropic, functional-gradient nature of these materials. The problem is further complicated if a composed structure is to be analyzed.

This paper proposes a model of deformation of a functionally graded composite conical shell reinforced with carbon nanotubes with an isotropic ring stiffener. The deformation of the functionally graded nanocomposite conical shell is described by Reddy's high-order shear theory, and the deformation of the ring stiffener is described by the Euler-Bernoulli hypotheses. The Rayleigh-Ritz method is used to study the natural vibrations of the composite structure. The main variables are the displacements and angles of rotation of the conical shell.

A mathematical model of the transient response of the structure under the action of an impact load is obtained in the form of a linear dynamic system in generalized coordinates. To obtain this system, the prescribed form method is used.

Numerical studies of the free dynamics and transient response of a nanocomposite conical shell with an isotropic ring stiffener of rectangular section under the action of an impact load were carried out. The results of the numerical modeling of the transient process in the shell showed a close agreement with the results of finite element modeling in the ANSYS package.

The effect of the ring stiffener on the amplitudes of the transient response of the nanocomposite shell is investigated. It is shown that the ring-stiffener significantly reduces the amplitude of the transient response of the composite conical shell when it is subjected to an impact load. The proposed method and the conclusions drawn may be used in the aerospace industry in the design of nanocomposite units for multistage launch vehicles.

Keywords: functionally graded nanocomposite, prescribed form method, linear dynamic system, transient response, compound shell.

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