Comparison analysis of asymptotic theory of multilayer composite plates and three-dimentional theory of elastisity

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The main relations of novel theory of thin multilayer anisotropic composite plates having been developed on the base of equations of the general three-dimensional theory of elasticity with introducing asymptotic expansions in terms of a small parameter being a ratio of a thickness and a typical length of the plate without any hypotheses on a type of distribution of displacements and stresses versus thickness, are presented. It has been shown that the global (averaged according to the certain rules) problem of the plate elasticity theory developed is similar to the Kirchhoff-Love plate theory but differs from this theory by the presence of three-order derivatives of longitudinal displacements of a plate. The method developed allows us to calculate by analytical formulas (having found previously displacements of the middle surface of a plate and its deflection) all the six components of a stress tensor including cross normal stresses and stresses of interlayer shear.
Comparison of the analytical solutions for stresses in the plate with finite-element three-dimensional solution computed by complex ANSYS has shown that in order to achieve a solution accuracy compared with the accuracy of the method developed we need using very fine finite-element grids and sufficiently high-capacity hardware. It is shown that the developed method allows us to calculate all the six stresses in a plate with a very high accuracy; and finite-element three-dimensional solving may approximate this result only with using very fine grids with a great number of finite elements through the plate thickness, that is a strong restriction for calculations of thin-walled plates and shells.

Keywords: *multilayer composite plates, asymptotic averaging method, asymptotic multilayer plates theory, finite-element method.*

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