Exact solution to the problem of computing strains and stresses for a conical composite fairing subjected to temperature and force loads

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Problems connected with analysis of temperature fields, stresses, and critical force loads arise during the process of designing structural elements for aircraft of various designations. Employing contemporary finite element software to solve such problems involves a labour-intensive process of selecting the right type of finite element, preparing and inputting initial data, and analysing the result obtained. However, analytical computation techniques are still valid. This article presents an analytical technique for calculating parameters of a fairing, one of the most widespread structural elements. A fairing is a thin-walled conical rotational shell. This structural element is subjected to force and temperature loads, the heat field varying along the generatrix and across the thickness of the shell. The analytical solution for the problem of computing the parameters of a fairing made out of a composite material amounts to solving an inhomogeneous Bessel equation with respect to a complex function, the order of which is determined by the elastic moduli ratio of the material in two perpendicular directions. The method of finding a solution to this equation that involves using a solution based on momentless theory as a particular solution is approximate. Therefore the question arises if the solutions found by this method are acceptable. This article presents an exact solution to the Bessel equation, obtained by the method of variation of parameters. We analyse the exact solution for a specific case and compare the approximate and exact solutions. Studying the exact solution helps to avoid errors related to employing the momentless theory. The method under consideration may be used to increase the correctness of estimating the components of the stress-strain state of the fairing.

Keywords*: composite, conical shell, non-uniform heating, exact analytical solution, fairing, inhomogeneous Bessel equation.*

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