MANUFACTURING ERRORS OF THERMOSTABLE
COMPOSITE PANELS

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SUMMARY
Problems of influence of manufacturing errors on
thermomechanical properties of a composite laminate have
been produced. Also in this paper preliminary stretching of
fibers for shape distortions of thermostable epoxy-carbon in
manufacturing and operation have been analyzed.

1. Thin wall multilayer panels manufactured from high
strength and high modulus carbon fibers have found their
applications in modern large thermostable composite structures [1].
The problems are connected with the manufacturing of
precise and thermostable structures which exclude
distortions caused by thermal stresses during their
manufacturing and meet the requirements for strength and
stress-strain behavior in operational conditions .
Theoretical analysis of stress-strain state makes it
possible to obtain standards of working surfaces
deformation for an antenna both at the production stage and in the conditions of operation taking into account some errors and irregularities during manufacture.

Equation for the components of stress in k-th layer, according to the theory of laminated plates, considering temperature and preliminary tension of fibers is written as

\[ \langle \sigma_{ij} \rangle^{(k)} = [Q_{ij}]^{(k)} ([E_{ij}]^{0} + [K_{ij}]^{0} - [\sigma_{ij}]^{(k)} \Delta T - [E_{ij}]^{(k)}); \]

\[ \text{for } i, j = x, y, xy(1, 2, 6) \]

Correspondingly the governing equation for the laminated plates is taken as follows [2]

\[ \begin{bmatrix} E_{ij}^{0} \\ K_{ij}^{0} \end{bmatrix} = \begin{bmatrix} A_{ij} \\ B_{ij} \\ C_{ij} \end{bmatrix}^{-1} \begin{bmatrix} N_{ij} \end{bmatrix}^{0} \begin{bmatrix} T_{ij}^{0} \end{bmatrix}^{x, y}; \]

\[ i, j = x, y, xy(1, 2, 6) \]

The displacement \( W \) of a middle surface in Z-direction is taken as follows

\[ W = \frac{1}{2} K_{xy} X^2 + K_{xy} X Y + K_{xy}^0 Y^2; \]

Stress-strain of a laminated panel in operation is determined under the conditions of hinged longitudinal edges and free fixing on transversal ones. Corresponding boundary conditions with \( y = 0 \) and \( y = 1 \) will thus take the form of

\[ W(x, 0) = M_y(x, 0) = U_0(x, 0) = N_y(x, 0) = 0, \]

\[ W(x, 1) = M_y(x, 1) = U_0(x, 1) = N_0(x, 0) = 0. \]

The solution satisfying boundary conditions (4) will be represent as the following series:

\[ \phi(x, y) = \sum_{n=1}^{\infty} \phi_n(x) \cdot \sin(n \pi y); \]

where \( \phi_n(x) \) is to be defined.

Considering the task which is symmetric relative to transversal edges we retain only even functions in solving

\[ \phi(x, y) = \sum_{n=1}^{\infty} [B_{n} \cdot \chi(x) \cdot \phi_n(x)] \cdot \sin(n \pi y); \]

In this case \( \phi_n(x) \) is an integral of an ordinary nonuniform linear differential equation, but \( \lambda_{nl} \) are roots