Constitutive Relationships of Fiber-Reinforced Composites Having Different Resistance to Tension and Compression

Sadovskii V.M., Sadovskaya O.V.

Institute of Computational Modeling SB RAS, Krasnoyarsk, Russia

A general approach for constructing constitutive relationships of unidirectional fiber composites, different resisting to tension and compression, is developed. It is assumed that in compression the brittle reinforcing fibers lose their stability and disintegrate at sufficiently small stresses without significant contribution to the strength characteristics of a material, which are determined by the properties of matrix. Hence, Hooke's law for a homogeneous isotropic medium describes the behavior of a composite in compression. The anisotropy of a material in tension is taken into account within the framework of the theory of transversely isotropic elasticity, where elastic parameters are calculated by means of a standard homogenization procedure. Combination of the equations for describing the joint tension and compression is based on a generalized rheological method [1], in which along with traditional elements, modeling elastic, viscous and plastic properties, a new element, simulating the behavior of a flexible inextensible thread, is used. In order to justify the necessity of taking into account different resistance to tension and compression of the composite materials, reinforced with rigid fibers, the problem on bending of a hinged beam under the action of concentrated force and concentrated moment is analyzed.

This work was supported by the Complex Fundamental Research Program no. II.2P "Integration and Development" of Siberian Branch of the Russian Academy of Sciences.

References

1. Sadovskaya O., Sadovskii V. Mathematical Modeling in Mechanics of Granular Materials. Ser.: Advanced Structured Materials, Vol. 21, Ed.: H. Altenbach. Heidelberg – New York – Dordrecht – London, Springer, 2012.