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Space Structures II - Development and Verification (Deployable and Dimensionally Stable Structures) (2)

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DEVELOPMENT OF CALCULATION MODEL OF LARGE-SIZE THERMO-DIMENSIONALLY STABLE STRUCTURE OF COMPOSITE MATERIALS

Abstract

This work describes the method of calculation and choosing of optimal parameters for thermo-dimensionally stable optical structures made of composite materials. Development of the satellite high resolution optical devices requires from a designer to create relatively large and, at the same time, light structures. Strong requirements are posed to these structures to achieve requested durability, rigidity and temperature deformations of a design. Composite materials are used to maintain the required parameters of the optical systems and to minimize the impact of space environment to their operation. The proposed method of calculation is based on the finite element analysis for designing and development of the structure of the high-resolution scanner. The main problems, related to design, analyzing and application of this kind of structures include: complexity to ensure the required parameters of temperature on the removed parts of the structure; irregularity of temperature distribution; complexity to ensure the required displacements and rotation angles of mounting places of optical devices; taking into account of orthotropic mechanical and thermal data; complexity of determination of mechanical and thermal data for different schemes of reinforcement of composite materials; complexity of taking into consideration glutinous connections in design models and also determining mechanical and thermal data of the binding glue. Ensuring the stability of the optical part of the structure can be achieved by choosing the composite material with the required mechanical and thermal properties, or by choosing optimal parameters for different schemes of reinforcement. The choice and updating of optimal parameters of calculation model is an iterative process, which is carried out in several stages. The first is the stage of preliminary design, and the second is the stage of detailed design. The criterion of optimal design is an indicator of minimum temperature deformations of the mounting places of optical devices. The proposed method allows to develop the thermo-dimensionally stable structures of various complexity, configuration and destination, and also to find the optimal input data of calculated models for admissible values of thermal deformations. It considerably reduces the amount of the required experimental testing of the structures.