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NUMERICAL STUDYING OF THE STATIONARY DYNAMICAL PROCESS IN ANISOTROPIC INHOMOGENEOUS CYLINDRICAL BODIES

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Cylindrical bodies are widely used in aircraft building, shipbuilding, space technology, oil and gas industry, in civil and industrial building as well as in many other fields of modern machine and instrument-making industries. Strength and reliability assurance of these structures assume that the stress-strain state and dynamical characteristics of relevant cylindrical systems, which are the components of structural members, are known. At the same time, experimental studying of such problems encounters considerable economical and technical difficulties. Thus, development of effective numerical methods for defining mechanical behavior of hollow cylindrical bodies is the actual complicated problem due to necessity in solving systems of partial differential equations and in satisfying boundary conditions at bounding surfaces. If the structural elements have complicated shape and made of anisotropic inhomogeneous materials, these difficulties increase appreciably. The present report addresses the natural vibrations of anisotropic inhomogeneous bodies both with circular and noncircular cross section. As initial mechanical models, the Kirchhoff-Love classic shell theory, the Timoshenko-Mindlin-Reissner refined theory, and the spatial elasticity theory are used. To solve the problems under consideration, we employ the numerical analytical approach based on the spline- approximation of model partial differential equations. Currently the spline-functions are widely used for solving problems of computation mathematics, mathematical physics, and mechanics owing to advantages of a spline-approximation apparatus in comparison with others. The main advantages include stability of splines with respect to local disturbances since behavior of the spline in the neighborhood of a point does not influence on the behavior of the spline as a whole (such situation is encountered at polynomial approximation), good convergence of spline-interpolation unlike polynomial one, simplicity and convenience in computer-aided realizing algorithms for constructing and calculating splines. Use of spline-functions in various variational, projective and other discrete continual methods makes it possible to obtain appreciable results in comparison with classical apparatus of polynomials, to simplify considerably their numerical realization, and to find the searched solution with high accuracy. Using the proposed numerical analytical approach, the natural vibrations of a wide class of anisotropic inhomogeneous cylindrical bodies are studied within the frames of classical, refined, and accurate models. The influence of character of structural inhomogeneity of cylindrical bodies, of variation in geometrical and mechanical parameters, and of boundary conditions are analyzed. Reliability of the results obtained is estimated.