

Effect of structural modification of rotor with a flexible shaft on its modal properties

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The rotor structures are basic systems that realize the transfer of rotary motion in technical devices and systems. The structure and the mass distribution of the rotor have a fundamental influence on the dynamic properties of the rotor. Improper geometry of the rotor structure cause the emergence of various unacceptable phenomena. These phenomena are usually caused by the rotational inertia effects of the rotor, as well as the stiffness of bearings [1] and they affect the rotor resonant states. Unfavorable phenomena arising during rotor operation [2] can be eliminated or minimize already by appropriate modification of the rotor structure. The rotor modifications can be performed mainly by modifying the rotor's rotational mass, increasing the rotor's stiffness, or changing the stiffness of bearings. As a result of these modifications, it is possible to achieve such values of natural frequencies, i.e. critical rotor speeds that are outside the operating speed range. It is obvious that in the case of a change in the operating regime, the undesirable conditions may occur, i.e. the rotor operates at operating speeds that were not taken into account in the design process of the rotor. For this operating condition, the rotor has unsuitable dynamic parameters, and therefore it is necessary to eliminate undesirable dynamic effects and their transmission to the production equipment, or to the work environment. One of the possibilities of eliminating these undesirable conditions is the design of such a rotor structure [3] that will allow the redistribution of mass and stiffness properties of the rotor during operation. The aim of the study is the analysis of the influence of mass and stiffness parameters of the rotor on the dynamics of selected types and structures of rotors. The solution and analyzes of the modal properties of the rotors are performed for two rotor structures - a rotor with a rigid disc between the bearings and a rotor with an overhanging disc. The following modifications of the structural elements of the rotor and their influence on the modal properties of the considered types of rotors are investigated - geometry and material properties of the binding layers in which the bearings are inserted; - the influence of the reinforcing core position and length inserted into the rotor shaft.

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- [1] Adams, M. L. Jr., Rotating Machinery Vibration-From Analysis to Troubleshooting, Marcel Dekker, Inc. New York-Basel. 386 p., ISBN 0-8247-0258-1. 2001.
- [2] Lalanne, M., Ferraris, G. Rotordynamics Prediction in Engineering, Lyon, France: John Wiley & Sons, 1991, 252 p., ISBN 0-8247-2399-6.
- [3] Nad', M. Modification of Modal Characteristics of Vibrating of Structural Elements. Scientific Monographs, Hochschule Anhalt, Koethen, 2010, ISBN 978-3-86011-029-4.