Influence of geometric parameters and material properties of the reinforcing core on the modal properties of vibrating beam structures.

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The occurrence of unwanted phenomena, which arise in various mechanical structures, cause in them unwanted vibrations, in many cases have fatal consequences for their functionality and, in extreme cases, for their structural integrity. Very dangerous states occur when these structures are exposed to an inappropriate dynamic load, which in unfavorable cases causes a resonance state of the structures. There is necessary to eliminate these undesirable states arising during operation, and one of the ways is to create conditions and possibilities for modifying the modal properties [1], [2] of the relevant structural elements of the mechanical system.

The beam structures are considered as fundamental structural elements that are widely used in mechanical and building structures. One of the important tasks in the structural design of beam structures should be the ability to prevent or reduce the level of unwanted vibrations. It is obvious that the dynamic properties of beam structures depend on their shape structure, i.e. from their geometric parameters and material properties. Usually, the beam structures have constant cross-section and made of homogeneous material. However, these structures in many cases do not have the required dynamic properties. The design and analysis of the beam structures that will allow its spatial properties (mass and stiffness) to be redistributed using the sliding core inserted into the beam structure is investigated in this paper.

The change of modal properties of beam structures [3], which are closely related to their resonance behavior, depending on the redistribution of spatial properties (material properties, dimensions and position of the reinforcement core) is investigated. By changing the above-mentioned spatial parameters of beam structures, it is possible to achieve a suitable modification of the natural frequencies and mode shapes of the beam structure. The presented design modifications in the beam structure provide possibilities for redistribution of spatial properties, which can be used to "tune"the modal properties of the beam structures to the desired values and thus eliminate the emergence of resonance states.

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[1] Avitable, P., Twenty years of structural dynamic modification - A review, (based on a paper presented at IMAC-XX), Sound and Vibration, 2003.

[2] Naď, M., Modification of Modal Characteristics of Vibrating Structural Elements. Scientific Monographs, Köthen, (2010), 92 p.

[3] Rolník, L., Structural dynamic modification of lathe tool body. PhD. thesis, Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology, 2015.