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The Numerical and Experimental Analysis of Compressed Composite Plate in Asymmetrical Arrangement of Layers

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Abstract : The work focused on the original concept of a thin-walled plate element with a cut-out, for use as a spring or load-bearing element. The subject of the study were rectangular plates with a cut-out with variable geometrical parameters and with a variable angle of fiber arrangement, made of a carbon-epoxy composite with high strength properties in an asymmetrical arrangement, subjected to uniform compression. The influence of geometrical parameters of the cut-out and the angle of fiber arrangement on the value of critical load of the structure and buckling form was investigated. Uniform thin plates are relatively cheap to manufacture, however due to their low bending stiffness; they can carry relatively small loads. The lowest form of loss of plate stability, which is the bending form, leads to its rapid destruction due to high deflection increases, with a slight increase in compressive load - low rigidity of the structure. However, the stiffness characteristics of the structure change significantly when the work of plate is forcing according to the higher flexural-torsional form of buckling. The plate is able to carry a much higher compressive load while maintaining much stiffer work characteristics in the post-critical range. The calculations carried out earlier show that plates with forced higher form of buckling are characterized by stable, progressive paths of post-critical equilibrium, enabling their use as elastic elements. The characteristics of such elements can be designed in a wide range by changing the geometrical parameters of the cut-out, i.e. height and width as well as by changing the angle of fiber arrangement The commercial ABAQUS program using the finite element method was used to develop the discrete model and perform numerical calculations. The obtained results are of significant practical importance in the design of structures with elastic elements, allowing to achieve the required maintenance characteristics of the device.

Keywords : buckling mode, numerical method, unsymmetrical laminates, thin-walled elastic elements
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