

EXPERIMENTAL AND NUMERICAL ANALYSIS OF THE STRESS STATE OF HONEYCOMBS MADE BY ADDITIVE TECHNOLOGIES

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This paper proposes an approach to the experiment-and-calculation analysis of the tension of honeycombs made by FDM additive technologies. The approach includes experimental tension analysis. Tension tests of honeycombs were conducted on a certified TiraTest 2300 universal tension testing machine. To do this, sets of honeycomb samples were prepared. The method of honeycomb manufacturing by FDM additive technologies is described. The vertices of a honeycomb cell row are fixed in the vise-type clamps of the tension testing machine. The experimental analysis is accompanied by a numerical finite-element simulation of tension tests. To simulate honeycomb tension, nine mechanical characteristics of the material in material axes must be known. These nine parameters are considered in the paper. A direct finite-element simulation of a honeycomb with account for the deformation of all its cells was performed. To provide the uniformity of sample deformation in a physical experiment, the sample is loaded by setting the displacement of one of its ends to a constant value. In doing so, the other end is clamped. As follows from the experimental analysis, before failure the honeycomb cell end displacements are comparable with the honeycomb cell thickness. Because of this, the geometrically nonlinear deformation of the honeycomb cells in tension is accounted for in the calculations, and a nonlinear problem is solved using ANSYS. The direct simulation of honeycombs and the analysis of their homogenized model give different results. In the direct simulation of honeycombs, they are considered as thin-walled beams working in bending. In this case, the geometrical nonlinearity contributes significantly to the structural deformation. For plate tension (homogenized model), the contribution of the geometrical nonlinearity is very small. Because of this, the stress-strain response is close to linear.

Key words: honeycomb structure, additive technologies, tension, stress-strain response.

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