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EXPERIMENTAL ANALYSIS OF THE MECHANICAL CHARACTERISTICS OF LAUNCH VEHICLE PARTS MANUFACTURED BY FDM ADDITIVE TECHNOLOGIES

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Additive manufacturing is very promising for aerospace engineering and aircraft construction. Using these technologies, light structures with preset strength properties can be made. For lack of tables of the mechanical properties of materials made by additive technologies, any calculation must be accompanied by the experimental determination of their mechanical properties.

This paper presents an experimental approach to the determination of the mechanical characteristics of parts printed by FDM technologies. Parts manufactured from polymers by FDM technologies are shown to be orthotropic. Therefore, their elastic properties are described by nine constants: three Young's moduli, three shear moduli, and three Poisson ratios. A cube is printed for the experimental determination of these constants. Six specimens are cut out from the cube. Three specimens are cut parallel to the cube edges, and the other three are cut at an angle of 45° to them. Each such specimen is manufactured in five pieces. This makes it possible to average the tensile stress–strain diagrams obtained for all the components of the stress tensor. The mechanical properties of the material are determined from these diagrams. The three Young's moduli and the three Poisson ratios are determined from the three specimen types parallel to the cube edges. The three shear moduli are determined from the specimens cut at an angle of 45° to the cube edges. To determine these constants, tensile stress–strain diagrams are obtained experimentally.

A technology is presented for manufacturing specimens on a Stratasys FORTUS 900 MC 3D printer. The mechanical properties of two polymer materials (ULTEM 9085 and PLA) are determined and compared. PLA has higher Young's moduli and shear moduli and lower Poisson ratios than ULTEM 9085.

Keywords: *FDM technology, orthotropic polymer material, mechanical properties, 3D printer.*

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