

Description for the general public

The aim of the study is to determine the elastic properties of new, lightweight, laminated wood materials with auxetic or rib cores, designed for the furniture and construction industry. The project aims to develop analytical models of the elastic properties of the cell cores as a function of: a linear elastic modulus of the material, modulus of rigidity, the dimensions of the cells, the cell wall thickness, the angle of the cell walls and the dimensions of the ribs. Models will allow to select the most suitable shapes and cell dimensions of the cores. For each type of core cells FEM calculations will be conducted, to determine the elastic properties of orthotropic cores made of wood. These results will be compared with the results of experimental research, and then used in the homogenization of sandwich panels. Next step is the development of numerical models and physical models of sandwich panels with cellular or rib cores. The results of laboratory tests and numerical calculations will allow to select the most favorable models of layered, lightweight cellular composites. That step also will enable verification of homogeneous models and indicate the possibility of their use in the finite element calculation method of the large-size constructions. Physical models of multilayer structures of synclastic curvature and auxetic core will be built. Experimental research and numerical calculations of the construction capable of carrying bending loads will allow to select the most favorable outer layers and auxetic core cells. Research includes influence of high temperature and air humidity on the elastic properties of new materials.

This research will fill the gap in the field of lightweight, laminated furniture panels and building panels with auxetic or rib cores, designed properties and made of wood. Moreover, the scope of the project is part of the National Smart Specialisation, Innovative Products of Wood and Wood based composites and Individualization of furniture production. Project accomplishment will allow to: use of wood for the production of substitute to other non-renewable materials; prepare the offer of new designs achieved by glued elements for furniture and wooden buildings industry; the use of wood and wood-based materials as renewables, wood biocomposites; the development of wood-based materials for applications in modern furniture and construction; production of new generation materials, which exhibit better performance, lower emissions, biodegradability, and in typical usage, resistance to weathering. The proposed scope of the study fulfills the area of multidisciplinary and transdisciplinary research. The scientific field will be enriched by knowledge of the properties of the new layered wood composites with auxetic and rib cores, also under varying climatic conditions.