

Transformation of Hexagonal Cells into Auxetic in Core Honeycomb Furniture Panels

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Abstract : Structures with negative Poisson's ratios are called auxetic. They are characterized by better mechanical properties than conventional structures, especially shear strength, the ability to better absorb energy and increase strength during bending, especially in sandwich panels. Commonly used paper cores of cellular boards are made of hexagonal cells. With isotropic facings, these cells provide isotropic properties of the entire furniture board. Shelves made of such panels with a thickness similar to standard chipboards do not provide adequate stiffness and strength of the furniture. However, it is possible to transform the shape of hexagonal cells into polyhedral auxetic cells that improve the mechanical properties of the core. The work aimed to transform the hexagonal cells of the paper core into auxetic cells and determine their basic mechanical properties. Using numerical methods, it was decided to design the most favorable proportions of cells distinguished by the lowest Poisson's ratio and the highest modulus of linear elasticity. Standard cores for cellular boards commonly used to produce 34 mm thick furniture boards were used for the tests. Poisson's ratios, bending strength, and linear elasticity moduli were determined for such cores and boards. Then, the cells were transformed into auxetic structures, and analogous cellular boards were made for which mechanical properties were determined. The results of numerical simulations for which the variable parameters were the dimensions of the cell walls, wall inclination angles, and relative cell density were presented in the further part of the paper. Experimental tests and numerical simulations showed the beneficial effect of auxeticization on the mechanical quality of furniture panels. They allowed for the selection of the optimal shape of auxetic core cells.

Keywords : auxetics, honeycomb, panels, simulation, experiment

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