KIRIGAMI INSPIRED NATURAL FIBRE CELLULAR STRUCTURES FOR FUTURE VIBROACOUSTICS APPLICATIONS

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ABSTRACT

The aerospace segment makes large use of cellular structures in sandwich panels, which are known to possess good stiffness while saving weight. Metallic cores are currently being replaced by different classes of composites, especially because of their poor vibration transmissibility. The inclusion of vibroacoustics constraints in the design process gives the opportunity to obtain multifunctional structures that still provide mechanical efficiency while introducing absorption, tunable vibration transmissibility or damping capabilities. In this work, natural fibre prepregs are turned into periodic panels using the ancient Japanese art technique of cutting and folding paper, known as Kirigami. Flax fibre with Polypropylene matrix was used to obtain a cellular structure with improved absorption properties and therefore, thermoforming was adopted due to its compatibility with Kirigami and thermoplasticity of the matrix. A dedicated mould and numerically controlled cutters as well as adhesive were adopted to complete the Kirigami procedure. Numerical simulations were carried out in order to identify the best performing candidates in terms of the properties mentioned above and through-the-thickness vibration transmissibility. Consequently, the selected configurations were manufactured and tested. This natural fibre composite cellular platform will be used for further improving the vibroacoustic properties of the manufactured cores by embedding periodic inclusions of various type and materials within the core, and by analysing different cell topologies.

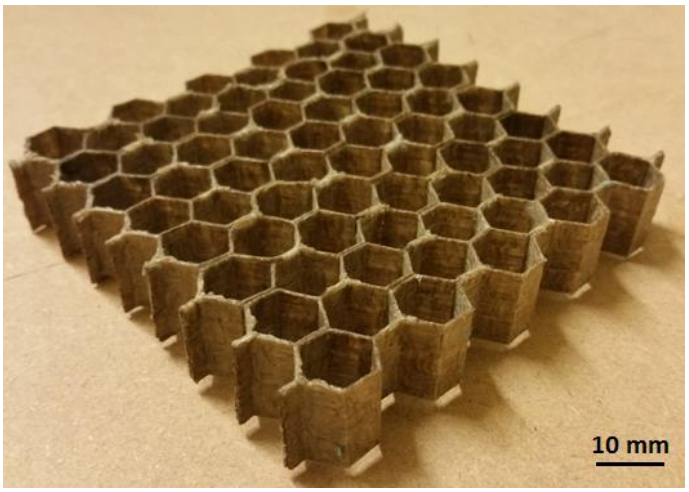

Fig1. *Flax/PP Kirigami hexagonal core*

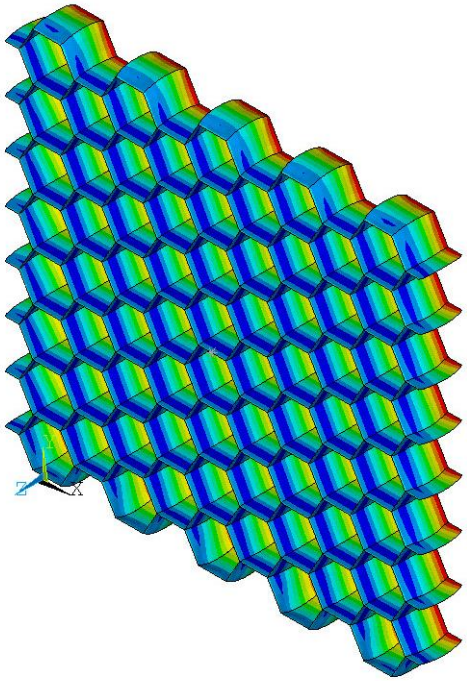

Fig2. *Honeycomb deformed shape and relative displacements at f=1832 Hz.*

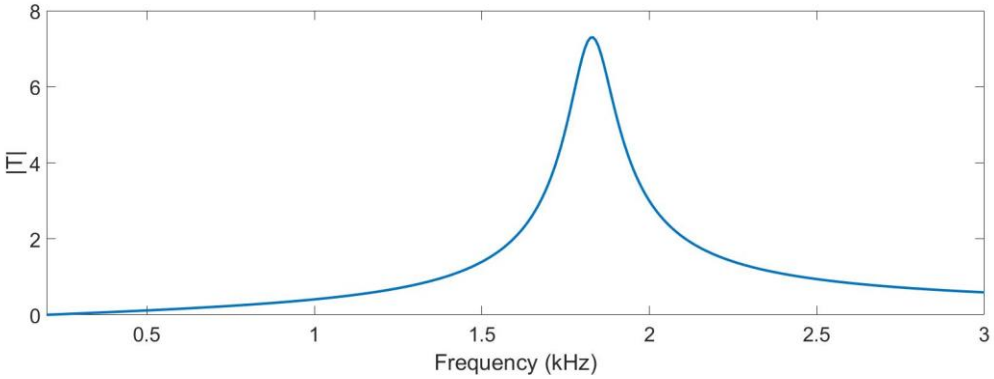

Fig3.Through-the-thickness *transmissibility analysis, 4% damping.*