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Experimental and finite elements analysis of the vibration behaviour of a bio-based composite sandwich beam

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Abstract

This paper presents the results of experimental and numerical analyses of the flexural vibration behaviour of bio-based sandwich structures and their composite faces, and particularly their damping properties. The material studied is made up of two skins made of a thermoplastic matrix reinforced by flax fibres and a balsa wood core. The faces and the whole sandwich structures were produced by liquid resin infusion. First, experimental tests were performed on the skins. Free vibration tests were carried out on unidirectional and cross-ply laminates in a clamped free configuration to investigate the influence of the fibre orientation and stacking sequence on the dynamic stiffness and loss factors. Then, the damping behaviour of the balsa core was studied through several free vibration tests. In addition, the damping properties of sandwich beams with different thicknesses were measured and discussed. Finally, a finite elements model was used to calculate the resonance frequencies and modal loss factors of different sandwich beams. Close correlation between the numerical and experimental results was observed. Finally, a modal strain energy method was used to evaluate the contribution of the skins and of the core to the damping properties of the different sandwich beams.

Keywords: D. Mechanical Testing, B. Vibration, C. Finite element analysis (FEA)