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Prediction and Measurement of the Damping Ratios of Laminated Polymer Composite Plates

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Abstract: Laminated composites materials are mostly used in dynamically loaded structures. The design of these structures with finite element packages is focused on vibrations, elastic deformations and failure control. Damping is often neglected because of its assumed secondary importance and also because of dearth of information on relevant material properties. This trend is prone to change as it is now realised that damping plays an increasingly important role in vibration comfort, noise radiation and crash simulations. This paper shows in a first step how to identify the orthotropic elastic and damping properties of single layer fibre-reinforced composite material sheets using a new extended version of the Resonalyser procedure. The procedure is based on the elastic-viscoelastic correspondence principle and uses a mixed numerical experimental method. In a subsequent step, the complex laminate stiffness values are computed using the identified single layer material properties. To validate this approach, the modal damping ratios of arbitrary laminated plates of different materials at several resonance frequencies are predicted and experimentally verified.

Keywords: composite materials; laminated plates; Resonalyser procedure; elastic-viscoelastic correspondence principle; complex stiffness