National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Experimental and Numerical Study on Flexural and Free Vibration Characteristics of Laminated Composite Sandwich Plates.
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Venue	: Seminar Room, Mechanical Engineering Department (Room No: ME-001)
Date and Time	: 09 Jul 2025 (11.00AM)
Abstract	: Vibration suppression in structural components is a critical aspect of engineering design due to its profound influence on performance, safety, and durability. In aerospace engineering, reducing vibrations is essential to ensure aircraft integrity, as excessive vibrations can lead to fatigue, structural damage, and diminished passenger comfort. Similarly, in automotive engineering, effective vibration control enhances ride quality, reduces noise, and prevents premature component wear, thereby improving vehicle safety and reliability. The present study focuses on the flexural and free vibration characteristics of sandwich plates composed of natural and synthetic fibre-reinforced hybrid laminated composite face layers and PET foam cores. These materials combine to create lightweight, robust structures with superior vibration-damping properties. Natural fibres like basalt, abaca-sisal, soy, and hemp enhance stiffness and damping, while PET foam cores contribute to overall vibration attenuation and weight reduction. This sustainable material combination also supports environmental goals, offering biodegradable, renewable, and low-carbon alternatives to synthetic materials. Sandwich plates were fabricated using the open mold hand layup technique, combining natural fibre face layers and PET foam cores with Araldite adhesives. Tensile tests on laminated face layers and compression tests on PET cores provided engineering constants for numerical simulations in ABAQUS, using C3D8R solid elements for free vibration analysis. Experimental modal analysis via the roving impact hammer technique validated these simulation results, and found highly consistence. Later, the influence of different parameters such as aspect ratio, core thickness ratio, top-to-bottom face layer thickness ratios, and fibre-angle orientation on the natural frequencies of the sandwich plates under boundary conditions like CFFF, CFCF, CCCF, and CCCC are investigated. An Adaptive Neuro-Fuzzy Inference System (ANFIS model, combining Artificial Neural Networks (ANNs) and Fuzzy Inference Systems (FIS) was developed to predict the natural frequencies of sandwich plates. This approach offers precise predictions, adaptability to new data, and robustness across diverse conditions. The ANFIS model, trained with simulation results, accurately forecasted frequencies for untested input conditions, demonstrating consistency with ABAQUS simulations. This integrated approach of experimental, numerical, and predictive modelling provides a comprehensive framework for designing efficient, sustainable vibration suppression systems for various engineering applications.