NUMERICAL AND EXPERIMENTAL MODAL ANALYSIS OF ALUMINIUM AND COMPOSITE PLATES

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Abstract

The paper presents the comparative analysis of the dynamic behaviour of two rectangular plates of different material, aluminium and composite. While their global geometric dimensions (length, width and thickness) are identical, their inner structures are quite different. Whereas aluminium plate can be considered isotropic, composite plate is a unidirectional carbon-epoxy laminate.
Modal characteristics of the two plates were determined both numerically and experimentally and a comparative analysis of the obtained results was performed. Responses of the plates were documented by an optical, contactless 3D digital image correlation (DIC) system that contains a set of high-speed cameras capable of recording the movement of the white-and-black stochastic pattern applied to the upper surfaces of the plates. Numerical simulations were performed by the finite element method (FEM) in the commercial software package ANSYS. The plates were excited by a modal hammer and allowed to freely oscillate. In order to determine the natural frequencies of the plates the recorded time-domain responses were post-processed, i.e. converted to frequency domain by fast Fourier transform (FFT). The first three natural modes were successfully experimentally established and compared to the corresponding numerical values. Since the differences between the two sets of results are less than 5%, the applied experimental technique can be considered valid and suitable to a wide range of engineering problems involving vibrations.

Keywords

Aluminum plate, Composite plate, DIC, FEM, FFT.

Acknowledgement

The research work is funded by the Ministry of Education, Science, and Technological Development of Republic of Serbia through Technological Development Project no. 35035.