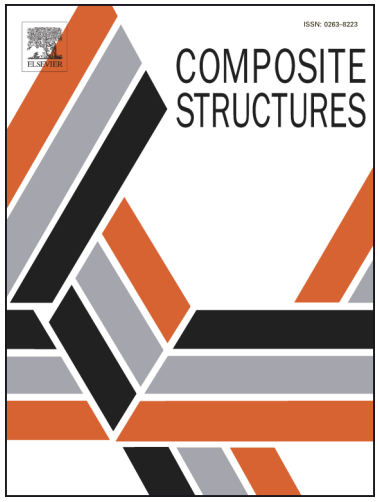

Experimental and Simulation Investigation of Temperature Effects on Modal Characteristics of Composite Honeycomb Structure

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Experimental and Simulation Investigation of Temperature Effects on Modal Characteristics of Composite Honeycomb Structure

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Abstract: Modal analysis is the basis of the structural dynamics design and optimization. When operating in a thermal environment, the structure may be affected by the temperature in diverse aspects. In this paper, a sandwich structure composed of carbon fiber woven skins and a Nomex honeycomb core is taken as the research object. Temperature effects on its modal characteristics are investigated by experiments and simulations. During the test, natural frequencies and modal damping ratios of the specimen change with temperature dramatically, while each mode exhibits a particular trend. Although the temperature-dependent material property of the skin is identified as the essential factor of the variations in the modal parameters, the modulus components of the skin material have different sensitivities to the temperature change. As a result, correlations between the natural frequencies and modulus components are related to the corresponding mode shapes. And these correlations are studied by the finite element analysis.

Keywords: Composite honeycomb structure; Thermal modal experiment; Structural modal characteristics; Glass transition; Modal analysis

1 Introduction

In many industrial fields, structures are required to operate under different temperature conditions, and effects of temperature on structures have been concerned for a long time[1-10]. As we know, the structure generally expands when heated. Once the thermal expansion is constrained, such as boundary conditions, materials with different thermal expansion coefficients or non-uniform temperature fields, thermal stress or even nonlinear deformation will be induced[1,9,10]. Together with the temperature-dependent properties of the material, these factors affect the stiffness of the structure and then alter its dynamic features. In terms of structural dynamics,