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The influence of boundaries on sound insulation of the multilayered aerospace poroelastic composite structure

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Abstract

Acoustic analysis of the four-sides simply supported doubly curved composite shell interlayered with porous material used in aerospace applications is considered based on Third order Shear Deformation Theory (TSDT). The focus is specifically placed on presenting the effect of boundaries on Sound Transmission Loss (STL) of the poroelastic structure. Then, the results are compared with those of infinite shell. In order to calculate the STL, the displacement and pressure terms are derived in the form of double Fourier series for a simply supported boundary condition doubly curved shell. A new approach is made to consider the number of modes for the finite composite structure treated with porous material. In addition, the simultaneous solution of the equations of porous and composite layers along with acoustic wave equations is performed. This process leads to obtain the unknown constants in all parts of the structure including upper and bottom composite shells as well as porous core which results in presenting the STL of the structure in the logarithmic scale. Since, the solution is provided in the form of modal infinite series which should be terminated at the sufficient modes, the convergence checking is prepared in 3D configurations with respect to various frequencies and shell dimensions to present the number of the appropriate modes for this process. Moreover, the results are validated with the aid of other researches including experimental as well as analytical models available in literature. Finally, some new results including Sound Pressure Level (SPL) in both of global view and contour map, transverse displacement configurations and the effects of various shell dimensions on STL, are presented for this finite structure.

Keywords

Doubly curved composite shell, Simply supported, Porous material, Sound pressure level, Sound Transmission Loss

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