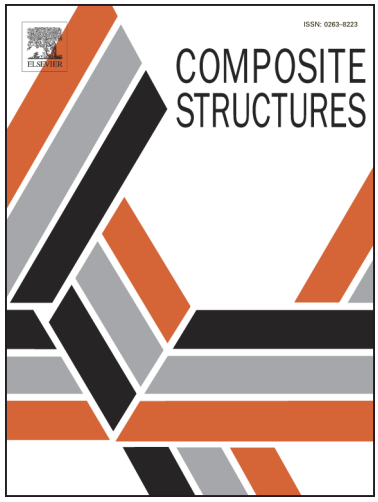

Laminated composite plates in contact with a bounded fluid: Free vibration analysis via unified formulation

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Laminated composite plates in contact with a bounded fluid: Free vibration analysis via unified formulation

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Abstract The effects of the hydroelastic coupling are pronounced on composite structures due to the low composite density. This paper presents an analytical solution for the free vibration analysis of thick rectangular composite plates in contact with a bounded fluid. The plate displacement field is analyzed using Carrera Unified Formulation in order to consider displacement theories of arbitrary order. The displacement variables are approximated using the Ritz method. Analysis considering any of the classical boundary conditions is performed using suitable functions in the Ritz series. The fluid kinetic energy is obtained by considering an inviscid and incompressible fluid, and thus the velocity potential is applicable. The kinetic and potential energy of the plate are also obtained, and the energy functional is used to derive the eigenvalue problem. Validation is performed with results in the open literature and by using 3D finite element software. The influence of the fiber orientations on the natural frequencies is discussed, as well as the influence of the plate and fluid domain geometry. Certain natural frequencies are seen to be independent of the fluid domain height, depending on the symmetric or antisymmetric nature of the normal mode.

Keywords: Plate; Composite; Vibration; Fluid-structure interaction; Hydroelastic; Carrera Unified formulation (CUF).

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Nomenclature