Accepted Manuscript

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PII: S1359-8368(16)00074-3

DOI: 10.1016/j.compositesb.2015.12.050

Reference: JCOMB 4012

To appear in: *Composites Part B*

Received Date: 5 October 2015

Revised Date: 8 November 2015

Accepted Date: 24 December 2015

Please cite this article as: Rezaei AS, Saidi AR, Application of Carrera Unified Formulation to study the effect of porosity on natural frequencies of thick porous-cellular plates, *Composites Part B* (2016), doi: 10.1016/j.compositesb.2015.12.050.

Application of Carrera Unified Formulation to study the effect of porosity on natural frequencies of thick porous-cellular plates

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Abstract

Carrera Unified Formulation (CUF) is used for free vibration analysis of Levy-type thick rectangular porous-cellular plates. The variation of porosity through the thickness causes mechanical properties to change along the thickness. Properties are modeled by a simple cosine rule. The equations of motion are solved analytically for Levy-type rectangular porous-cellular plates using state space method. The correctness of this approach is confirmed through comparison studies with published results based on highly accurate approaches. Different orders of model are used to enhance the accuracy of the method in order to obtain the exact frequencies of thick and very thick porous-cellular plates. The effects of the coefficient of plate porosity and the thickness-length ratio as well as the aspect ratio, on the frequencies are investigated for Levy-type boundary conditions. It is found that natural frequencies of the porous-cellular thick plates decrease as the coefficient of plate porosity increases in all studied boundary conditions.

Keywords: Plates; Vibration; Analytical modelling; Porosity; Cellular and porous materials.

1. Introduction

A non-homogeneous frame of material consisting interconnected network of pores is called porous material. This network can be free or saturated by fluid. Foams and other highly porous materials with a cellular structure are known to have many interesting combinations of physical and mechanical properties, such as high stiffness in conjunction with very low specific weight. For this reason, nature frequently uses cellular materials for constructional

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