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Finite cylinder vibrations with different end boundary conditions

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Abstract

Utilizing the infinite circular cylinders solution based on the technique of variables separation, a general solution is developed to analyze the vibration of finite circular cylinders. The vibration of finite circular cylinders with different end boundary conditions as well as the curved panels can be analyzed by the semi-analytical method developed in the present study. In the present paper two different boundary conditions are considered, namely the free-end and fixed-end hollow cylinders. Convergence and precision of the method are determined to calculate the natural frequencies of various geometrical configurations. It is shown that the results obtained from the present semi-analytical method are in good agreement with those obtained using the previously developed methods. Generality, high accuracy and good convergence with a small sized of coefficient matrix are the merits of the present method.

1. Introduction

Finite length hollow cylinders are indispensable in many industries such as marine structures, necessitating the thorough comprehension of their vibration with different boundary conditions. These understanding may be used to analyze the sound transmission through the single and multilayered finite cylinders. The earliest investigation concerning the vibration of cylinders was performed by Pochhamer [1] and Chree [2]. The Pochhamer–Chree solution was developed for an infinitely long solid cylinder. Greenspon [3], Gazis [4] and Armenakas [5] studied the vibration of infinitely long traction free hollow cylinders using linear three dimensional (3D) theory of elasticity. McNevin et al. [6] developed a three-mode theory for axisymmetric vibrations of rods and hollow cylinders. Gladwell and Tahbildar [7] investigated axisymmetric vibrations of cylinders using the finite-element method. The vibration of free finite length circular cylinders using the finite-element method was analyzed by Gladwell and Vijay [8]. Hutchinson [9,10] developed a semi-analytical highly accurate method to solve the vibrations of finite length rods and solid cylinders on the basis of linear 3D elasticity. Hutchinson and El-Azhari [11] investigated the vibrations of free hollow finite length circular

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