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Book Review

Isaac Elishakoff, Eigenvalues of Inhomogeneous Structures, CRC Press, Boca Raton, ISBN 0-8493-2892-6, 2005 (729pp.)

This book is a collection of a surprisingly large number of closed form solutions, by the author and by others, involving the buckling of columns and beams, and the vibration of rods, beams and circular plates. The structures are, in general, inhomogeneous. Many solutions are published here for the first time.

The text starts with an instructive review of direct, semi-inverse, and inverse eigenvalue problems. Unusual closed form solutions of column buckling are presented first, followed by closed form solutions of the vibrations of rods. Unusual closed form solutions for vibrating beams follow. The influence of boundary conditions on eigenvalues is discussed. An entire chapter is devoted to boundary conditions involving guided ends. Effects of axial loads and of elastic foundations are presented in two separate chapters. The closed form solutions of circular plates concentrate on axisymmetric vibrations.

The scholarly effort that produced this book is remarkable. Historical references are extensive. Connections to other areas such as functionally graded materials are discussed. Actually, as pointed out in the text, many of the solutions that are in this collection could be interpreted as describing “axially graded” structures.

It might be asked why such a collection is necessary in the age of easily accessible finite element solutions and programs. The answer is that we need solutions that we can trust to be exact, so that finite element programs can be verified. Secondly, closed form solutions often give an immediate insight into the importance of design parameters, which a finite element program can only furnish by way of running numerous parameter variations, which then have to be plotted in a, hopefully, meaningful way to extract the same information that a closed form solution can give at a glance. As a matter of fact, design directions gleaned from an examination of closed form solutions of relatively simple models often provide guidance to the users of finite element models, because they may narrow the sets of parameters that need to be investigated.

This book will prove to be a valuable addition to the library of every researcher or designer who deals with either the buckling or the vibration of inhomogeneous structures.

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