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Book Reviews

Finite Element Methods in Dynamics

Y. K. Cheung and A. Y. T. Leung, Kluwer Academic Publishers, Dordrecht, The Netherlands, 1991, 295 pp., $109.00.

Although brief, this book provides a rather comprehensive treatment of the computational aspects of using the finite element method in problems in structural dynamics. Modal methods are emphasized and only viscous damping is considered. An adequate knowledge of classical methods is presumed; e.g., the reader is presumed familiar with the solution of single-degree-of-freedom systems, conversant with the eigenvalue problem, capable of formulating the strain energy of a system, and able to model boundary conditions.

The division of attention is approximately as follows: 15% to a summary of discrete vibrations and the development of shape functions for discretizing continuous systems, 35% to the development of element and system matrices, 20% to solution techniques, 10% to dynamic response and advanced topics, and 20% to a microcomputer package (1000 elements) for the natural vibration and dynamic substructure analysis of frames.

Throughout, the book goes well beyond the introductory level, including, for example, 21 DOF plate elements; three-dimensional isoparametric elements; constant, lumped, continuous and average mass elements; and storage techniques (skyline array). FORTRAN subroutines for stiffness and consistent mass matrices of higher order plane, three-dimensional, and plate elements are given.

The chapter on solution techniques discusses difficulties in root-extraction and treats a number of methods (Gauss, power, and inverse iteration, subspace iteration, and the Lanczos method). Among other computer listings given (all in FORTRAN) are routines for Jacobi rotations, Householder transformations, and a routine for eigenvalues and eigenvectors of a symmetric tridiagonal matrix by Cholesky algorithms.

The final chapter briefly mentions time-step integration and introduces Ritz vector, Lanczos vector, and direct methods for finding the steady-state response. An approach applicable to a heavily, non-proportionally, damped system is also given. Several methods for substructure analysis are developed.

Although probably not well suited as a first introduction to the finite element method, for which a number of suitable texts are available, this book should prove useful as a reference for engineers having some familiarity with structural dynamics and the finite element method who find a need to "get into the details" of structural dynamics analysis. It also might well be considered as a text for a course to be given to students with some knowledge of discrete and continuum vibrations and finite element methods, in which the intent is to focus on the computational aspects of structural vibrations.

A few small weaknesses in the preparation of the volume detract slightly, especially in consideration of the price/size ratio; e.g., the typewriter print face, marginally legible reproductions of computer printouts, and a major section heading found on the page previous to the first line of text. This reviewer never did find Table 5.4.1.

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The Universal Man: Theodore von Kármán's Life in Aeronautics

Michael H. Gorn, Smithsonian Institution Press, Washington, D.C., 1992, 202 pp., $24.95.

Von Sköllöskislaki Kármán Todor was born in Budapest on May 11, 1881. Todor, meaning gift of God in Hungarian, was the third son to Maurice de Kármán and Helen Kohn (spelled Konn in several other publications). His father was a prominent philosopher and educator in the Austro-Hungarian Empire, and his cultured mother descended from a long line of distinguished scientists, theologians, and scholars. Theodore von Kármán, as he became known around the world, was educated as a mechanical engineer in the Royal Joseph University of Polytechnics and Economics, Budapest, and earned his doctoral degree in solid mechanics at the prestigious Georgia Augusta University in Göttingen, where he worked under the supervision of Ludwig Prandtl.

Theodore von Kármán, along with William Prager, Ludwig Prandtl, and Geoffrey I. Taylor, represent perhaps the four greatest applied mechanists of the 20th century. Although he thought of himself as an engineer first, von Kármán was much more than that. As William R. Sears remarked during a 1964 address to the Society for Industrial and Applied Mathematics and again while reviewing the present book for *Physics Today*, von Kármán, the engineer, physicist, mathematician, rocketeer, teacher, businessman, organizer on an international