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BOOK REVIEWS

PASSIVE VIBRATION CONTROL, 1998, by Denys J. Mead. Chichester: John Wiley & Sons, Ltd., xiv + 540 pp. Price £150.00 (hardback). ISBN 0-471 94203-0.

As stated by the author in the Preface, this book serves as a bridge between standard vibrations textbooks and books that deal with specialized methods of passive vibration control. While there has been significant recent progress in the areas of active and semi-active vibration control, passive techniques continue to be of at least equal importance, primarily due to cost and simplicity considerations. Also, as pointed out by the author in the Introduction, designers of active vibration control systems can "always benefit from sound understanding of passive control principles".

The book covers a lot of material, with a good balance between basic concepts, instructive examples, and applications. The emphasis is on analysis and general methods for passive vibration control by using techniques from linear vibration theory. The treatment is uniformly consistent in the level of technical sophistication, which assumes that the reader has completed an introductory course in vibration analysis. The titles of the chapters are: Introduction, The Response of Structures to Harmonic Force, Receptance and Dynamic Stiffness, The Response of Structures to Prescribed Harmonic Motion, The Response of Structures to Non-harmonic Excitation, Factors Controlling Beam and Plate Vibration, The Control of Vibration by Structural Design, The Control of Vibration by Localized Additions, The Control of Vibration by Added Damping, The Control of Vibration by Resilient Isolation, and The Control of Vibration by Combined Methods.

The first chapter provides motivation for the subject at hand by describing several application areas where vibration control is important. It also reviews vibration measures and specifications for structures and humans, and gives an overview of the remainder of the book.

Chapters 2–6 deal with basic vibration concepts and analysis tools. The author's goal here is to "impart physical understanding" and to introduce the techniques that are used throughout the book. These tools are grounded in the theory of receptance and dynamic stiffness, which is given a textbook-like treatment. The range and organization of topics here is refreshingly different from that of the typical intermediate book in vibrations. In addition to the usual subjects, such as frequency response, modal analysis, force and displacement transmissibility, and response to base motion, the coverage includes random vibration, statistical energy analysis, a description of experimental techniques for measuring modal damping, the wave approach to vibration transmission in structures, the interesting cases of periodic and nearly periodic structures (including localization phenomena), the response of infinite and semi-infinite beams, a detailed development of receptance theory, and the response of structures to fluctuating pressure fields.

The last five chapters of the book deal with various approaches to passive vibration control. The first of these deals with structural design issues. Covered here are several approaches for reducing vibration levels at a given point on a structure to different types of loading conditions. The techniques described include detuning structural resonances, reducing the number of excited modes, redistribution of nodes, decoupling, and geometric alterations, such as stiffening. Localized additions are the subject of the next chapter, which

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covers a range of topics related to the addition of auxiliary systems, such as tuned absorbers and dampers. The author begins this discussion with a general definition of the effectiveness of an auxiliary system, and uses it to derive quite a general result expressed in terms of the dynamic stiffnesses of the component subsystems. Specific auxiliary systems considered include masses, springs, dampers, single frequency tuned dampers, wide-band tuned dampers, and torsional vibration absorbers. Optimization issues are addressed, as are the application to multiple degree-of-freedom systems. Practical matters such as rattle space and fatigue are also discussed.

The third technique covered is that of adding damping. Here the focus is on determining a system's inherent damping and suggested means of increasing structural damping with distributed elements. A discussion of inherent damping is presented, with appropriate emphasis on joint damping and acoustic radiation, topics that are typically not given sufficient treatment. Detailed results for unconstrained and constrained layer damping are provided, including suggested design procedures. Boundary damping and friction elements are also briefly covered. Resilient isolation is the final general category of techniques described, wherein the objective is to design subsystems that fit between the structure of interest and the source of excitation. The standard base isolation topics are covered for both translational and rocking motions of machines, including a discussion of optimizing isolators for the case of a general rigid machine with six degrees of freedom. Two-stage isolators, in which the mass of the isolator is included in the design, are considered, as is the design of isolators placed between two flexible structures. The book concludes with a short chapter that demonstrates some examples of combined methods.

As in-depth reading of some selected topics revealed appropriate levels of technical detail and useful, accurate information, with one minor exception. When discussing centrifugal pendulum vibration absorbers (used for neutralizing torsional vibration), the author indicates that the tautochronic absorber configuration is complicated and expensive when compared with the standard absorber, whereas in actual implementations it is virtually identical in terms of cost and complexity.

A book of this scope must inevitably omit some relevant topics, and each reader can make his or her own list of important missing subjects. However, the author has done an outstanding job of organizing the material into a coherent volume that will serve as a valuable resource to anyone working in the field of mechanical vibration.

S. W. Shaw

APPLICATIONS OF NONSTANDARD FINITE DIFFERENCE SCHEMES, 2000, (R. E. Mickens, editor). World Scientific Publishing Co., xii + 250pp. Price £30.00. ISBN 981-02-4133 X.

This book contains five chapters written by different people on topics related to non-standard finite difference (NSFD) schemes. These schemes are introduced in the first chapter (by Mickens) in the context of ordinary differential equations from initial-value problems whose general solutions are known. A "difference scheme" is constructed in the same pattern as a standard finite difference scheme but with the time step replaced by a formula and non-linear terms replaced by products such that the resulting difference equation is linear in the unknown forward value. The difference scheme is made such that its solution is the same as the exact solution of the differential equation for any value of the time step. Large time steps can thus be taken without affecting the accuracy. This approach is extended to types of partial differential equations with known solutions which are also suitable for the construction of NSFD schemes.