Journal of Applied Mechanics

Book Reviews

Dynamic Stability of Suddenly Loaded Structures, by George J. Simitses. Springer-Verlag, New York, 1990. 290 pages.

REVIEWED BY R. H. PLAUT[1]

Until recently, there has been a dearth of books on the stability of structures subjected to suddenly applied loads. Happily, this situation is being remedied. Two recent books, *Dynamic Pulse Buckling* by H. E. Lindberg and A. L. Florence, and *Structural Impact* by N. Jones, concentrate on the elastic and plastic response of structures to intense loads of very short duration. They are complemented nicely by this new book written by Prof. G. J. Simitses.

Simitses considers conservative elastic systems subjected to impulse loads, step loads (i.e., suddenly applied loads with constant magnitude and infinite duration), and rectangular pulse loads (i.e., suddenly applied loads with constant magnitude and finite duration). Dynamic instability here means that the system exhibits a large-amplitude response. Throughout the book, critical values of the dynamic loads are compared to those for the case of quasi-static loading.

A "total potential energy approach" is applied, which has been developed by Simitses. (A similar method, used by C. S. Hsu and his collaborators, is also described in the book.) The energy imparted to the system by the dynamic load is compared to the potential energy of the system at all unstable equilibrium points. One can then determine lower and upper bounds on the critical loads. For one degree-of-freedom systems, these bounds are identical and exact critical loads are obtained.

Following an introductory chapter, three simple rigid-bar models are treated in Chapters 2–4. Two of them have one degree-of-freedom, while the third is a snap-through model with two degrees-of-freedom. The effect of static preloading is analyzed, and some problems are given at the ends of these chapters. For the case of rectangular pulse loading, the influence of small viscous damping is discussed in an appendix.

In Chapter 5, the application of the energy approach to continuous elastic systems is described. Impulse and step loads are considered. Simple two-bar frames are treated in Chapter 6. A step load is applied and lower bounds are obtained for various boundary conditions, eccentricities, and slenderness ratios.

Chapter 7 deals with shallow arches having a half-sine-wave initial shape. The first example is a pinned arch with the load distributed spatially in a half sine wave. Lower and upper bounds are computed for impulse, step, and rectangular pulse loads. In the second example, a clamped arch is subjected to a concentrated load at its apex, applied as an impulse or step load. The response is represented approximately as a combination of two symmetric modes and one antisymmetric mode.

Thin, shallow, clamped, spherical caps under uniform lateral pressure are treated in Chapter 8. Axiymmetric deformations are considered. Lower bounds for a two-term approximation are determined for the cases of impulse and step loading. In Chapter 9, thin cylindrical shells are analyzed. Laminated shells and stiffened shells are included, with geometric imperfections and various boundary conditions. An approximation procedure is utilized, and lower bounds on critical conditions are computed for axial step loading. Finally, conditions based on a prescribed maximum response amplitude are discussed in Chapter 10, and parametric resonance and brachistochrone problems are described in the appendices.

This book is a welcome addition in the field of structural stability. It presents an energy approach which can be used to obtain bounds on critical conditions for suddenly loaded elastic structures. The book is written clearly and covers the basic work carried out by Simitses in this area. It may be used as a textbook for part of a graduate course on dynamic stability of structures, and should be read by researchers in this field.

Introduction to Optimization of Structures, by N. V. Banichuk. Springer-Verlag, New York, 1990. 300 pages. Price: $89.00.

REVIEWED BY BHSHAN L. KARIHALOO[2]

Introduction to Optimization of Structures by Professor N. V. Banichuk is a translation of the original Russian book of the same name, published in 1986. The book is divided into two parts: Part 1 gives an introduction to the theory and techniques of optimization, whereas Part 2 demonstrates the application of theoretical concepts on several examples of beams, plates, shells, trusses, etc.

Chapter 1 gives a general overview of the optimization problem under statical and dynamical conditions, introducing the necessary objective and constraint functionals. This chapter also introduces the reader to multipurpose and multicriteria design problems. Chapters 2 and 3 give the derivation of optimality conditions using classical variational calculus. Chapters 4 and 5 are devoted to the solution of the optimization problems using several analytical and numerical approaches.

Chapters 6–8, which form Part 2 of the book, apply the optimization concepts to beams, plates, shells, trusses, etc. with a view to designing these structures, such that they use the least amount of material in fulfilling their mechanical function.

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The classical variational approach and the analytical solution techniques are described thoroughly and authoritatively. The reader will be well rewarded by Chapters 2, 3, and the first half of Chapter 4. The treatment of numerical optimization techniques, on the other hand, is cursory and superficial, and the interested reader will have to turn to more authoritative sources.

The book concentrates on the work of the author and his research group. While this brings to the attention of the English-speaking audience some very important and interesting Russian-language work, it results in poor coverage of certain topics. Thus, for instance, Sections 4.2–4.4 could have greatly benefitted from additions from English-language literature.

Part 2 of the book gives a well-balanced selection of examples illustrating the various analytical techniques from Part 1. The interested reader will find a wealth of useful hints in these examples on how best to approach optimization problems. For a complete overview of the application of analytical optimization techniques, this part of the book should be read in conjunction with the author's previous book *Problems and Methods of Optimal Structural Design*, Plenum Press, New York 1983.

The book thankfully has not suffered in translation. The translation reads well, with hardly any "non-English" technical terms. I was able to pick up just one; "torsioned" instead of the accepted terminology "twisted."

All in all, this is a thoroughly readable introduction to the optimization techniques and applications well worth acquiring.

BOOKS RECEIVED

July–September 1991

1. **Adhesive Bonding**, edited by L.-H. Lee. Plenum, New York, 1991. 476 pages. Price: $95.00.
2. **Automatic Control of Aircraft and Missiles**, 2nd ed., by J. H. Blakelock. John Wiley and Sons, New York, 1991. 646 pages. Price: $74.95.
3. **Computational Aspects of Contact, Impact, and Penetration**, edited by R. F. Kulak and L. E. Schwer. Elmepress International, Lausanne, 1991. 308 pages.
4. **Design of Control Systems for DC Drives**, by A. Buxbaum, K. Schierau, and A. Straughen. Springer-Verlag, New York, 1991. 237 pages. Price: $79.50.
5. **Disorder and Fracture**, edited by J. C. Charmet, S. Roux, and E. Guyon. Plenum, New York, 1991. 305 pages. Price: $75.00.
6. **Electroslag Technology**, edited by B. I. Medovar and G. A. Boyko. Springer-Verlag, New York, 1991. 270 pages. Price: $79.00.
7. **Handbook of Expert Systems in Manufacturing**, edited by R. Maus and J. Keyes. McGraw-Hill, New York, 1991. 561 pages. Price: $54.95.
8. **Handbook of Incineration Systems**, by C. R. Brunner. McGraw-Hill, New York, 1991. 512 pages. Price: $68.00.
9. **Introduction to Linear, Parametric, and Nonlinear Vibrations**, by M. Cartmell. Chapman and Hall, New York, 1991. 242 pages. Price: $75.00.
10. **Mechanisms and Mechanical Devices Sourcebook**, by N. P. Chironis. McGraw-Hill, New York, 1991. 447 pages. Price: $55.00.
11. **Modern Research Topics in Aerospace Propulsion** (In Honor of Corrado Casci), edited by G. Angelino, L. De Luca, and W. A. Sirignano. Springer-Verlag, New York, 1991. 375 pages.
12. **Nonlinear Fracture Mechanics**, edited by M. P. Wnuk. Springer-Verlag, New York, 1991. 451 pages. Price: $68.00.
13. **Practical Plumbing Engineering**, by C. M. Harris (Editor-in-Chief). McGraw-Hill, New York, 1991. 496 pages. Price: $24.95.
14. **Structural Plasticity Theory, Problems, and CAE Software**, by W. F. Chen and H. Zhang. Springer-Verlag, New York, 1991. 250 pages. Price: $39.00.
15. **Structural Steel Design: LRFD Approach**, by J. C. Smith. John Wiley and Sons, New York, 1991. 570 pages. Price: $57.95.
16. **Theory of Vibration: An Introduction**, Vol. 1, by A. A. Shabana. Springer-Verlag, New York, 1991. 289 pages.
17. **Theory of Vibration: Discrete and Continuous Systems**, Vol. 2, by A. A. Shabana. Springer-Verlag, New York, 1991. 335 pages. Price: $49.50.
18. **Total Quality Control**, 3rd ed., rev., by A. V. Feigenbaum. McGraw-Hill, New York, 1991. 863 pages. Price: $62.00.
19. **Turbulence and Coherent Structures**, by M. Lesieur. Kluwer Academic Publishers, Dordrecht, The Netherlands, 1991. 620 pages. Price: $155.00.
20. **Turbulence in Fluids**, by M. Lesieur. Kluwer Academic Publishers, Dordrecht, The Netherlands, 1991. 412 pages. Price: $70.00.
21. **Valve and Actuator Technology**, by W. Ulanski. McGraw-Hill, New York, 1991. 304 pages. Price: $46.95.
22. **Vector Control of AC Machines**, by P. Vas. Oxford University Press, New York, 1990. 332 pages. Price: $98.00.