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Book Reviews

Finite Elements for Structural Analysis. By William Weaver Jr. and Paul R. Johnston. Prentice-Hall, Inc., Englewood Cliffs, N.J., 1984. 404 Pages. Price $38.95.

REVIEWED BY A. S. DOUGLAS[1]

The authors have provided another basic text on the use of the finite element method in structural mechanics. The reader is assumed to be familiar with the basic mathematics usually included in undergraduate engineering curricula (including matrix algebra) and is not required to have any previous exposure to elasticity. The principle of virtual work is used as the basis of the finite element procedure but while the potential energy basis is also given, no mention is made of variational calculus.

After a brief discussion on discretization of the solid continuum, the principle of virtual work is stated and used to develop the finite element method for the one-dimensional elastic beam element. This is followed by an introduction to generalized stresses and strains and to axis transformations. The first chapter is completed by brief comments on the potential energy basis for the finite element method and elementary criteria required for convergence.

Subsequent chapters develop the method for the basic structural systems beginning with plane stress and strain. All the details of the matrices are presented for linear strain elements. The calculation of the right-hand side vector is well presented. While the authors comment briefly on their choice of a mesh in an example, they do not give adequate attention to mesh characteristics, such as element aspect ratios and discontinuous changes in element size, which can adversely affect results.

Isoparametric elements for two-dimensional elements are clearly introduced and the authors explanation of their implementation is enhanced by macroflow charts. Only passing mention is made of super and subparametric elements. This development is extended to the general three-dimensional solid.

Attention is then given to those systems pertinent to the structural engineer. This begins with the details of axisymmetric solids which includes a useful discussion of nonaxisymmetric loads. (Uncharacteristically, the details of axisymmetric elements which have nodes on the axis of revolution are omitted.) Subsequent development includes plate and shell elements.

The authors now turn their attention to two important aspects of the behavior of the structural system, namely those of vibration analysis and stability analysis. While the presentation of the physical and mathematical basis for the existence of natural frequencies is terse, the construction of consistent and lumped mass matrices is well developed. For stability analysis, the authors return to the potential energy formulation, but their mathematical basis is again brief.

The text concludes with useful appendices covering integration formulas, Gaussian quadrature, and some computer methods for solving linear equations (including detailed flow charts). Each chapter is followed by examples, a macroflow chart (which clarifies the procedures developed), a number of problems, and a few important references. The problems are directed primarily at developing facility with the basic steps. Few of them are designed to entertain a critical analysis of the finite element method.

Overall, the authors have provided an excellent text for engineering students and practitioners who want to learn the basic procedures involved in the finite element method. The book contains much detail not found in other introductory texts, but, as the title implies, it is strictly limited to structual applications. This book has not attempted to foster a critical appraisal of the finite element method, nor does it address some important practical issues, such as the appropriate choice of elements and the rational prescription of meshes.

Numerical and Physical Aspects of Aerodynamic Flows II. Edited by Tuncer Cebeci. Springer-Verlag, New York, 1984. 416 Pages. Price $58.00.

REVIEWED BY S. WIDNALL[2]

This book contains a portion of the proceedings of a symposium by the same name held at California State University in January 1983. Exclusive of a keynote address by A. M. O. Smith, all of the papers are devoted to two-dimensional aerodynamic calcuations. The focus is on viscous-inviscid interactions in both subsonic and transonic flows. The papers deal with the development and evaluation of calculation methods for flows around airfoils, especially with regions of separated flow, and for downstream wakes. Subjects discussed include Navier–Stokes methods, interactive methods, and analytical methods. A review paper on the calculation of two-dimensional flow past airfoils by Cebeci, Stewartson, and Whitelaw opens the proceedings. The volume is dedicated to Keith Stewartson.

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