rectangular element plus an improved twelve-degree-of-freedom element are considered. This progresses to elements based on extra nodal freedoms (16 degrees of freedom) and elements based on subregion approach, i.e., subdividing the individual element into a number of subregions with separate displacement fields. With another lunge, we meet the widely used triangular elements. A considerable number of triangular elements have been developed over the years. This consists of nonconforming elements employing higher degreees of freedom using only the basic 9 degrees of freedom, subregional and conforming elements enlisting higher degrees of freedom (18 degrees of freedom constrained quintic element with only vertex modes). Numerical results of triangular elements are given. Plane finite elements can be extended to solid brick elements. In many cases, this is required for analysis. A while ago, the reviewer applied a 20 node brick element in determining the stress concentration of an oblique hole in a rectangular plate. This was employed in extending the curve in Peterson's book for oblique hole stress concentrations. Brief mention is made of the use of single face shell elements using triangular elements. The concluding chapter points out the problems associated with vibration and buckling. The initial part of this chapter solves the free undamped vibration of a spring mass system. This projects into the FE formulation used in vibration problems. Next, lateral vibration of beams and plates are studied accompanied by vibration of bars and frameworks. Lumped and concentrated mass matrices and Guyan reduction method are used in condensed eigenvalues problems. The chapter concludes with the buckling of struts and plates using the FE method.

The reviewer would have preferred sections on shear deformation included in the beam matrix, tables of nomenclature and abbreviations, and application and use of isoparametric elements in fracture mechanics. Additional topics of interest are the node loading in 8 and 20 node isoparametric solid elements plus the employment of dynamic condensation in vibration problems. Nevertheless, the reviewer highly recommends this book to those interested in acquiring a good foundation in FE analysis.

Applied Finite Element Analysis, 2nd edition, L. J. Segerlind, John Wiley & Sons, New York, NY, 1984, 427 pages.

This book hits the mark! The author intends the book to be a primer on finite elements (FE) and hits it right on the head. Starting with beginning elements in FE analysis, he proceeds to the more advanced topics. At all times, he never strays from the path and always guides the readers in an orderly fashion using care and finesse. As stated by the author, "This is an introductary textbook covering the basic concepts of (FE) method and then application to the analysis of plane structures, and two-dimensional continuum problems in heat transfer, irrotational flow and elasticity." The book, consists of 4 parts. Twenty-eight short chapters and 3 appendices. The latter are (a) matrix notation, (b) differentiation of matrix equation, and (c) modifying the system of equations.

Part I describes the basic concepts and should be read and understood prior to reading the following chapters in the book.

Chapter 1 introduces the book and continues with the integral formulations for numerical solutions. They are (a) variational methods, (b) collocation method, (c) subdomain method, and (d) least square method. This follows with potential energy formulations plus an introduction to FE method. Chapter 2 forges ahead and considers one-dimensional elements, division of the region into elements, and the linear element equation for the shape function. Chapter 3 discusses weighting functions, weighted residual, integrals, and its evaluation plus the solution of a simply supported (ss) beam. A good illustrative example!

Chapter 4 reports on element matrices and their incorporation in the equation for the direct stiffness matrix. This is applied to an ss beam. The next topics are the global stiffness matrix and Galerkin formulation. Chapter 5 follows with two-dimensional grids, linear triangular and bilinear rectangular elements. Chapter 6 concludes this part by explaining local and natural coordinate systems. This follows with the discussion of the rectangular and triangular element coordinates.

Part II reports on field problems.

Chapter 7 covers two-dimensional field equations. This begins with the governing partial differential equation and leads into integral equations for element matrices. The concluding section details the element matrices for triangular and rectangular elements. Chapter 8 points out the different constituents required in solving the torsion of a noncircular section. This embraces shear stress components, evaluation of twisting of a square bar, twisting torque, and computer solution for the square bar. Chapter 9 encompasses derivative boundary conditions and assessment of element integrals plus point sources and sinks. Examples are steam within the earth and groundwater problems, respectively. Chapter 10 focuses upon irrotational flow. Illustrated examples are streamline and potential formulation plus flow around a cylinder and groundwater flow. The next chapter delves slightly into heat transfer by conduction and convection. Beginning with one-dimensional fin and a composite wall, this extends to convection heat flux in two-dimensional bodies.

Chapter 12 reports on the application of Helmholz's equation in acoustical vibrations for one and two dimensions. The chapter is too concise and should be expanded to include acoustic flow through pipes over cylinders and applications to room acoustics.

Chapter 13 refers to axisymmetric field problems. Beginning with partial differential equations in cylindrical coordinates, the author proceeds with the derivative boundary conditions. He stresses Galerkin's weighted residual integral method. Chapters 14 and 15 develop time dependent field problems with emphasis on Galerkin's method. Fingered are the consistent and lumped formulation plus the two-dimensional elements, i.e., rectangular and triangular elements. Concluding sections comment on finite difference solutions in time with mention of forward, backward, constant difference, and Galerkin's method. A good example illustrates the heat flow in a rod. Chapter 16 stresses the computer program written in FORTRAN IV for the two-dimensional field problems entitled TD FIELD plus its four subroutines.

Part III studies the application of the FE method to structures and solid mechanics. Chapter 17 introduces the reader to the axial force member. The strain energy and minimum potential energy representatives and formulation of the axial force matrix are applied to a bar. Chapter 18 derives the element matrices employing potential energy equation. Chapter 19 delves into the simple truss problem with an example of a pinned truss. This chapter is too concise and should have been expanded to include supports at an angle to the horizontal.

Chapter 20 explains the formulation of the beam element employing strain energy and displacement equation and results in the determination of the element stiffness matrix. This applied to a statically indeterminate beam. Chapter 21 continues with the plane frame element and the derivative of the element stiffness matrix and its internal forces. Chapter 22 speaks about the elementary aspects of the theory of elasticity, i.e., strain, stress, and Hooke's law. This follows with the strain displacement equation, element matrices, and strain components. Chapter 23 lunges ahead into two-dimensional elasticity covering plane stress and strain, the displacement equations and the corresponding element matrices and stresses. Chapter 24 follows with the derviation of element matrices in axisymmetrical elasticity with demonstrations of the solution of an axisymmetrical body containing applied surface loads. Chapter 25 concludes this part with the computer program FRAME. This analyzes one- and two-dimensional plane structures. It contains 5 subroutines: MODFRM, DCMPD, SLVBD, CONVERT, and INVERT. The final program in this chapter is STRESS which is used in analyzing two-dimensional plane stress elasticity problems.

Part IV dwells upon linear and quadratic elements.

Chapter 26 reports on element shape functions. Introducing this chapter is the proper numbering of the local nodes and evaluation of the shape functions for the following elements: (a) one-dimensional, (b) triangular, (c) linear quadrilateral, (d) eight node quadrilateral, and (e) Lagrangian 9 node. Chapter 27 discusses the numerial techniques applied in evaluating the integrals that provide the element matrices. This comprises one- and two-dimensional integrals, Gauss-Legendre quadrative for the various integrals of the elements. The chapter concludes with surface integrals which occur in element matrices.

The final chapter presents isoparametric computer programs which were the subject of the previous two chapters. The computer progtam ISOFLD uses the quadrilateral element to solve the general field equation with the previously discussed boundary conditions. This driver program utilizes eight subroutines of which three (MODIFY, DCMPD, and SLVBD) were previously used in programs STRESS and DFIELD. The new subroutines are ELSTMX, ELGRAD, INGPTS, PDERV, and ODSHEN. They evaluate (a) gradient related quantities at the eight element node points, (b) Jacobian transformation matrix, (c) stiffness matrix and element force vector using Gauss-Legendre integration technique, and (d) corresponding weighting coefficient for a nine point Gauss-Legendre integration of the area integrals.

In summary, this is an excellent book. The reviewer would have preferred a table of nomenclature for the various programs including their symbolic notation, introduction to vibration as used in FE analysis plus an introduction to brick elements employed in three-dimensional studies. Nevertheless, the reviewer does recommend this book to those interested in acquiring a solid foundation in elementary and preliminary stages of advanced FE methods.

Microcomputer Aided Engineering—Structure Dynamics, M. Paz, Van Nostrand and Reinhold Co., New York, NY, 1986, 321 pages, $49.95.

Wow! This is a very good book. Structural dynamics progresses, with computer programs playing an important role in solving problems in vibration in a comparatively short time. This book is one of the very few which incorporates modern methods of analysis and techniques applicable to computer programming.

The reviewer recently reviewed an excellent sister book in this journal entitled, *Structural Dynamics—Theory and Computation, 2nd Edition,* which contained 16 computer programs written in FORTRAN. This book contains 20 computer programs written in BASIC and coded for an IBM-PC employing an advanced BASIC (BASICA) interpreter. In order to employ the computers some small changes are required. Both books should be in attendance, since *Microcomputer Aided Engineering* relies a great deal upon the theory and analysis of *Structural Dynamics.*

The book is organized in primary parts comprising a total of 20 chapters. Beginning with the simple computer programs for simple vibrations, it forges ahead to the Fast Fourier Transform (FFT) program. Included are programs determining the response to certain impulse excitation programs. This covers response of inelastic behavior and development of response spectra. Part II models the structure as shear buildings, beams, plane, and spare frames, grid frames, plane space trusses. Part III reports on a collection of computer programs for analyzing the design of multi-degree-of-freedom (MDOF) systems. By employing the programs in this part, one may solve for the natural frequencies and mode shapes of MDOF by readily employing static and dynamic condensation in reducing the size of the dynamic problems. Additional programs furnish the response of dynamic systems by engaging model superposition or step by step integration method. The 20 programs are illustrated in the accompanying table. These computer programs are put together in a software package for interactive use on the microcomputer. These programs introduce MENUS in order to pick out the desired programs. Program 1, "MASTER" chains in an automatic fashion to any program in the package. The book includes a *diskette of all the programs in the package.*

The reviewer stresses that *Structural Dynamics* should be used as a meaningful reference. The reviewer would have preferred a chapter on random vibration plus its computer program. Additional topics which would be considered are Houbolt's method, Newmark's method applied to step integration plus employment of the condensation method applied to vibration of turbine blades. The reviewer recommends this book along with *Structural Dynamics.* Both make a powerful combination.

The author further states that any correspondence relative to the programs can be directed to the diskette source. This allows the sender to receive new developments related to this publication and corrections and changes in the programs.