and stress components for a cylinder with closed ends and radial displacement at constant temperature are the next important topics. Chapter 3 jumps ahead into the topic of autofrettage and solution of a cylinder where only the temperature change occurs.

Chapter 12 reports on basic concepts of stress concentration and nature of the problem. The derivation of the stress concentration factor for circular and elliptical holes, grooves and notches plus stress gradients due to concentrated loads provide information for this section. A short but refreshing discourse on experimental techniques follows with stress concentrations due to a blunt crack. This introduces crack propagation. The resulting equations relate stress intensity factor and stresses for various types of cracks. The next chapter studies applications of effective stress concentration factors. Beginning with combined loads, this steps up gently to stress concentration at a groove in a circular shell. The various aspects of effective stress concentration concern itself with (*a*) impact or energy loading, (*b*) significance of stress gradient, (*c*) residual stresses, (*d*) repeated loads, (*e*) corrosion fatigue, and (*f*) inelastic strains including Neuber's theory. Chapter 14 develops the story of contact stresses. This results from the pressure of one solid over another in limited areas of contact. The prime problem rests on the determination of the contact stresses. The main assumptions rely on the properties of the material and shape of surfaces near points of contact before and after loading. The expressions for principal stresses are unravelled and the methods required to compute contact stresses is demonstrated. The previously mentioned maximum shearing stress, maximum octahedronal and/or orthogonal stress equations are derived and applied to this problem. This follows with deflections of bodies in point contact, stress for two bodies in line contact over narrow rectangular area. The loads can be normal and tangent or just normal to the contact area.

Chapter 15 focuses upon finite element methods (FEM). This is a new addition. The initial topic is FEM for beams with a side diversion to the plane problems of elasticity. This introduces triangular and rectangular FE containing the boundary tractions. Assembly of both triangular and rectangular elements are accomplished with a proper interpolation of element boundary stresses. Coordinate transformations are interposed with a journey into refined triangular elements having midside nodes. Examples of triangular elements include (*a*) circular disc subjected to diametrically directed forces, (*b*) cantilever beam with parabolic end load, (*c*) axially symmetric states of stress (cylinder, toroidal elements, solids of revolution), and (*d*) cylindrical bar with central spheroidal cavity in tension. The concluding section encompasses torsion of prismatic beams. Topics considered are torsion of bars of varying cross section, torsion of square prismatic bars, and torsional stresses in shafts having fillets.

This is an excellent book. Computer progams add an additional personality to this book. The reviewer would have preferred more information on FEM with special reference to isoparametric elements. An additional chapter on random functions would be a definite plus. The reviewer heartily recommends this book and salutes the authors' efforts.

Analysis and Design of Foundations for Vibration, P. J. Moore, Ed., A. A. Balkema Publishers, Rotterdam, Netherlands, Distributed by International Publishers Service, Accord, Mass., 1985, 512 pages.

Foundation engineering reaches new heights. Previously, a "seat of the pants" approach was adequate. Today large-size steam and gas turbine foundations require great thought and concentration. Dynamic considerations dictate the use of vibration analysis in the proper design of the foundations. Fortunately, the designers can utilize a great deal of vibration analysis developed in other disciplines. By successfully marrying vibration techniques and proper foundation analysis, a safe and sturdy offspring emerges. The editor of this book accomplishes these ideas by assembling a number of authors well versed in foundation and vibration design. The book consists of 12 meaty chapters containing a uniform list of symbols plus an adequate number of references.

The initial section in Chapter 1 discusses the various terms used in vibrations and refers to a number of standards. Vibration severity is considered and based on the German standard (DIN 4150) supplemented by findings of a number of knowledgeable people. Continuing with structural damage, the caution limits for blasting, transient effects on buildings and people plus the consequence of vibration on machinery are detailed. This is particularly pointed to turbine alternators. The effects of human sensitivity to vibration accompanied by a number of charts and graphs conclude the chapter. The different modes of vibration of blocks and beams are the theme of the next chapter. Since foundations are considered to be rigid blocks directly in contact with the soil, the generalized 3-D equations of motion are derived and applied to blocks resting and supported by springs. This is for both damped and undamped systems. Approximate methods of analysis conclude the chapter. Studied are (*a*) Rayleigh's method, (*b*) beams with lumped mass models, and (*c*) Dunkerly's method.

Chapter 4 analyzes beams and frames. Starting with the equation for flexural vibration of beams, the frequency functions, i.e., natural frequencies of a continuous beam and longitudinal vibration of beams are covered. This proceeds ahead to the analysis of single bay frames accompanied by the proper analysis. The final section of this chapter reports on the influence of axial force, shear deformation, and rotary inertia (Timoshenko beam) on transverse vibrations.

Chapter 5 analyzes vibration records. The book introduces the various terms employed in stochastic theory. This includes probability density functions (normal and Weibull distribution), studies of extremes (Gumbel distributions, upcrossing theory). Fourier analysis plays an important role in data analysis. Digital time series emerges from this theory. The properties of a pair of traces are pondered upon with analyses by means of covariance functions and power spectrum. Nyquist frequency, which is the highest observable frequency in the power spectra, is mentioned. This is half the sampling frequency. This chapter closes with the concept of linear filtering and means of obtaining suitable records for analysis. The author barely mentions fast Fourier transform (FFT). This is the heart of present day digital time series analysis and should have been covered.

Chapter 6 presents theoretical solutions for foundation vibration problems and draws upon the findings of a number of masters in vibration theory. The initial subjects are vertical vibration utilizing half space approach, lumped parameter approach and effect of rotary mass excitation. This progresses ahead to horizontal, rocking and torsional vibrations. Coupled rocking-sliding vibration are additional important factors. Vertical, torsional and coupled rocking-sliding vibrations play important roles in affecting foundation embedment. The final section in this chapter speaks about layering and nonhomogeneity. The increase in shear modulus with soil depth play important roles since large amplitude magnification dictates a profound effect on resonant frequencies for small mass ratios. This lays the ground work for the next chapter on design of shallow foundations.

Chapter 7 studies machine foundation subjected to dynamic

loading. Our thinking must change since conventional consideration of bearing capacity and allowable settlement are insufficient to insure a good design. Consideration must be given to the dynamic loads of crank mechanisms and proper balancing of rotating machinery, so as to minimize any induced vibratory load. Approximate empirical methods for determining natural frequencies (Tschabotarioff) and techniques considering the concept of an apparent mass are additional thoughts on this subject. The author recommends a number of methods for evaluating the resonant frequencies and amplitude at the operating frequency. Spring constants are furnished for (*a*) circular footing, (*b*) rectangular footing, and (*c*) damping ratios for rigid circular footing. All are based on the analysis for rigid footings on an elastic half space. The chapter ends with clues to the proper design of turbine foundations, reciprocating machine foundations, rod and ball mill foundations, and forge hammer foundations.

Chapter 8 continues with the design of deep foundations. With due consideration to design criteria, the author draws upon previous methods employing lumped parameter models with a very brief mention of finite elements (FE). The next important subject is the proper design of piles. This includes the effects of stiffness, damping, slenderness ratio, Poisson's ratio and group interaction of piles. Approximate group interaction coefficients are tendered for a few ranges of parameters used in vertical and horizontal vibration of a group of piles.

Chapter 9 concentrates on measurement of dynamic soil properties. This covers the important changes in shear modulus with increasing shear strain, stress-strain loop, and effective damping ratios. Laboratory techniques encompass resonant column device, wave propagation tests, cyclic tests (shear, torsion and compression). Field techniques include (*a*) seismic refraction surveys, (*b*) seismic cross-hole survey, (*c*) seismic down-hole survey, (*d*) seismic wave techniques, (*e*) standard penetration test, (*f*) resonant footing using half-space analogy, and (*g*) frequency domain measurements using FFT. There still is a difference between laboratory and field measurements. Corrections must be made to the former to agree with the latter.

Chapter 10 relates the instrumentation used in measuring machine foundation vibration. They are the usual piezoelectric accelerometers, displacement transducers, and displacement transducers (seisometers). The measuring systems consist of a charge amplifier, filters, frequency analyzers, accelerometer, vibration exciter, oscilloscope or tape and digital recorder.

Chapter 11 expands the isolation technique described in the initial chapter. Active isolation (elastic layer support) is stated and then applied to rotating mass excitation and machines placed on upper floors of buildings. This follows with passive isolation where the mass is located on a rigid support. A prime example is the isolation of machine tools. The chapter concludes with a short discourse on isolators and isolating materials. An appendix contains the approximate solution for transmissibility of a damped one degree of freedom system and natural frequencies for various rubber and spring mountings.

The final chapter talks about the different aspects of computer modelling. The capabilities of NASTRAN, STRUDL, PAFEC, etc. are stated with application to vibration and dynamics analysis, shock spectrum and proper modelling of soil structures.

This is a good book. The designers would have preferred seeing a more elaborate chapter on FE. Designers of machine foundations should have this book at their disposal. It covers a great deal of material and could be used in the petroleum and nuclear power plant design.

Proceedings of 5th International Modal Analysis Conference (IMAC), D. J. DeMichele, Ed., Union College, Wells House, 1 Union Ave., Schenectady, N.Y. 12308, 1987, 1730 pages.

This international conference reaches new exalted heights in modal analysis methods and theory. As in previous IMAC conferences, the zest and flavor still abounds in the symposium. The editor and his staff amassed many papers from a number of countries. Each of these papers makes great contributions to modal analysis and its allied topic. From IMAC's birth until the present, references are constantly being made in the literature and knowledgeable texts of the many published papers. As stated by the editor, "These papers reflect the advancements made in linking powerful new and analytical tools with the physical testing of structures to achieve design optimization or to predict the behavior of structures in a dynamic environment . . . . These proceedings will serve as a guide to those who must cope with the creative, structural design or structural failure analysis and up avenues of new research." A dynamic subject, modal analysis will always open the minds of individuals desiring to learn or to further their knowledge in this subject. This and the previous conferences will engender deep thought concerning its application to present day dynamic topics. The book consists of an excellent and well-stocked keynote address on the present and future requirements necessary to make modal analysis a household name. There are 22 different topics containing 264 submitted papers.

Dr. Paul Sas opened the keynote address with the comment that nonlinear structures cannot be properly handled by modal analysis. Structural modification techniques require good accuracy of the modal parameters. Modal analysis is actively researched by government organizations, universities and to a limited extent by industry, both here and abroad. The speaker states that experimental modal analysis is a "black box" or input-output approach. The present trends turn towards research efforts in areas of dynamic analysis instrumentation, measurement methods and parameter estimation. Instrumentation for primary input and output requires good calibration prior to testing. This important step reduces any possibility of cross-directional sensitivities, environmental inputs, electromagnetic interference, and unmeasured lateral forces. Commercial instruments are not flexible enough in the problem area of nonlinearities; front end data acquisition and signal generation are important. Measurement methods (burst random, burst sine sweep) improve the signal-to-noise ratio. Even with these excitation methods, there exists the traditional drawback of limited resolution. Automating the complete measurement system and employing multipoint excitation, one obtains consistent, better data and more uniform energy distribution. In the analytical department, global estimation methods produce one set of global parameters which minimizes the error function. This is defined over a whole set of PRF's. The multiple input testing permits a confidence factor between the different modal parameter estimates. In reality, modal participation factors are independent of response location. Mode shapes are independent of input location. The present applications of modal analysis are (*a*) trouble shooting (*b*) design optimization (limited by inaccuracies in modal parameters) (*c*) modal updating, modal verification (use and updating of FE models by iterative or noniterative methods) (*d*) response prediction (stress and strains are important) plus fatigue life calculation, and (*e*) condition monitoring (detect and predict structure failures in an early stage and also in quality control). Dr. Sas states the demands of the modal analysis community are as follows (*a*) reliable and easy to operate, flexible measurement and analysis systems, (*b*) warning for poor measurement conditions of nonlinearities, (*c*) u-