
Reviewed by H. Saunders

This is a gem of a book! It contains a vast amount of material. The authors present an impressive volume which is an outgrowth of the previous text entitled, “Solid Mechanics: A Variational Approach,” which was previously reviewed. This text contains a great deal of that material plus finite elements (FE). Starting from the preliminaries, i.e., foundation of solid mechanics and variational methods, it progresses through various aspects of structural mechanics (beams and plates) and culminates with a thorough introduction to FE. As stated by the authors, “It is our purpose to give students who go through the entire text a balanced and correct exposure to certain key aspects of modern structural and solid mechanics. . . . The goal is to make FE more understandable in terms of the fundamentals and also to provide the student with the background needed to extrapolate the FE method to areas of study other than solid mechanics.” The book consists of three main parts supplemented by six lucid appendices. They cover (a) cartesian tensor, (b) Lagrange multiplier, (c) mesh generation, (d) computer program for plate, (e) solution of system of linear equations, and (f) program to invert a matrix.

Part I reports on foundation of solid mechanics and variational methods. Chapter 1, subpart A, discusses various aspects of stress, i.e., force distribution, equations of motion, principal stresses, and transformation of stress equations. Subpart B recounts the various considerations of strain. They are strain and physical interpretation of strain terms, rotation tensor, transformation equation for strain and compatibility equation. Subpart C focuses upon energy consideration (constitutive laws), Hooke’s Law boundary value problems for linear elasticity and St. Venant’s principle. Subpart D encompasses plane stress, its equation, and delves into the problem of a cantilever beam with an end tip load.

Chapter 2 introduces calculus of variations. Beginning with simple functionals, first variation and delta operator, it journeys ahead into Euler-Lagrange equations, isoparametric problems, and first variation with several dependent variables. The next set of topics probe into functional constraints, simple boundary conditions, and functionals involving higher order distribution. With this under our belt, we consider variational principles of elasticity. Chapter 3 talks about virtual work method of total potential energy, complimentary virtual work, principles of total complimentary energy plus Reissner’s principle and then continues with Castigliano’s 1st and 2nd theorems. Subpart C talks about self-adjustment and positive definite operations, quadratic functionals with homogeneous and nonhomogeneous boundary conditions involving variational principles. This part concludes with Dirichlet and von Neumann boundary value problems. The next subpart responds to approximate methods. This entails the Ritz method, Galerkin method with proper examples explaining these methods.

Part II interprets the subject of structural mechanics. Starting with the deflection equations and its proper justification, chapter 4 forges ahead into Timoshenko beam theory which includes shear deformation and Cowper’s factors for various cross sections and the Ritz method used in a series solution. The applicability of Reissner’s principle ameliorates the problem of the Ritz method (too few functions) and adjusts the several variables independent of each other. The chapter concludes with application of Castigliano’s theorem to beam analysis.

Chapter 5 investigates torsion. The initial topic presents equations for torsion using total energy as a starter. This jumps ahead into the application of total complimentary energy functional and leads us to approximate solutions employing Ritz and Trefftz methods. The Kantorovich method, seldom mentioned in other texts, tends to alleviate the strong dependence on the chosen coordinate functions and causes the approximate process to be more effective. The approximate methods are a forerunner for later chapters.

Chapter 6, one of the lengthiest, states the classical theory of plates. It covers definition and kinematics of plates, stress resultant intensity equations, principles of virtual work, and minimum total potential energy. This is applied to rectangular plates (simply supported) and follows with Levy’s method and approximate methods of clamped rectangular plates (Galerkin, Ritz, and Kantorovich). This leads to solution of elliptical and circular plates using the Ritz method. The chapter concludes with the employment of the Hencky method which contains shear deformation and is an improvement over the previous approximate methods for the clamped circular plate. No mention is made of Prof. Reddy’s work using a refined higher order theory which satisfies free boundary conditions.

Chapter 7 derives and points out the various aspects of dynamics of beams and plates. Hamilton’s equation introduces the subject and leads to beam analysis. The equations of a simply supported beam and cantilever beam are the initial topics. This moves ahead to the use of Rayleigh’s method, refined Rayleigh-Ritz method, and ends with the Timoshenko beam. No mention is made of Macauley’s method and Dunkerly’s rule. The next part starts off with equations of motion for plates and continues with free vibration of a simply supported plate. Our next topics are Rayleigh and Rayleigh-Ritz methods used in vibration analyses of plates. The concluding topic is the vibration analyses accompanied by a thorough discussion of transverse shear and rotary inertia us-
This book holds your interest. It is full of informative material and covers a large range of subjects in a small number of pages. As stated by the authors, "The noise level produced by engineering equipment is growing in importance with increasing emphasis on the reduction of noise pollution to increase the quality of life. The authors' intention...has been to provide soundly based advice for their fellow engineers who are not noise experts." The book begins with the basic definitions in acoustics and extends to the description of noise measurement and noise measuring equipment. This little volume contains 4 appendices. They are (a) room constant and reverberation time, (b) student's t distribution, (c) derivation of standard deviation of total error in mean sound pressure, and (d) international and national standards on machinery noise measurements.

Chapter 1 introduces the subject and defines sound pressure and sound power levels, sound intensity, relationship between sound power level and sound pressure level. This follows with A-weighted sound and sound power levels plus the use of octave and one-third-octave band sound pressure levels. Chapter 2 reports on noise and its relation to man. The loudness level, noise induced hearing damage, and perceived noise level are the starters. This extends to traffic noise index, equivalent continuous sound level, and noise pollution level. For evaluating loudness of complex noises, two test methods are recommended. They are (a) Stevens (explained in the text), and (b) Zwicker (referred to in the text).

Chapter 3 inaugurates the measurement section. It concerns itself with noise field around a machine, sound power measurement in free field (spherical surface measurement), hemispherical surface measurement and conformal and other measurement surfaces. The important topic of sound power measurements in semi-reverberant spaces (ordinary room) is the next important topic. The machine sound power in a semi-reverberant space can be accomplished by the following methods (a) reference sound source substitution, (b) closed-field measurement, (c) reflective correction, (d) room constant, and (e) various small sources employed by oil companies. Additional possible methods are large source, composite, and linear sources. Machinery noise measurements can be made in a reverberant room. It has its advantages and disadvantages (not possible to measure directivity of noise source and difficulty in obtaining accurate pure tone components). The chapter concludes with the procedure of averaging sound pressure levels.

Chapter 4 questions the accuracy in sound-power results.