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Book Reviews

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Mechanics of Solids and Shells: Theories and Approximations

G. Wempner and D. Talaslidis, CRC Press, Boca Raton, FL, 2002, 552 pp., $119.95

As science and technology mature, the need for unification of concepts appears. Thus, in elasticity, the classic treatise of A.E.H. Love comes to mind. Even broader unification is represented by the continuum mechanics monographs, e.g., those by Truesdell and Noll and by Fung. Theoretically, these mentioned books have been well received, yet their demand on the mathematical background of the reader has limited their dissemination to practicing engineers; besides, they are out of print. The stated goal of the present book is to be useful to practicing engineers. Therefore, rather than consider all continua, both solids and fluids, the authors limit the presentation to solids only. Consequently, their deformation description is limited to material (Lagrangian) coordinates rather than both Lagrangian and Eulerian coordinates. Also, only quasi-static behavior is considered.

In a sense, the authors compensate for the limitation to a Lagrangian description by including shell geometry rather than just bar (rod) and plate geometry. The combination of foundations of both solids and shells is unique in a textbook. However, in keeping with simplicity, the shell theory used is based on only one kinematic assumption: normals remain straight under deformation. This includes what is known these days as first-order shear deformation shell theory (Chap. 9) as well as Kirchhoff–Love thin shell theory (Chap. 10) but not the various higher-order shear deformation shell theories.

Chapters 1 and 2 present the necessary mathematical preliminaries, including vectors and tensors in curvilinear coordinates. These chapters could be skipped by those with sufficient mathematical background. The "meat" of the subject begins with Chap. 3 on deformation and Chap. 4 on stress. Thermodynamic considerations and application to selected classes of elastic materials and to isotropic plastic and viscoelastic behavior are contained in Chap. 5. Of special note is the inclusion of the modern endochronic form of ideal plasticity.

Chapter 6 presents the principles of work and energy without any kinematic limitation except the small-deformation limitation in the case of the Castigliano theorem. This chapter also introduces the topic of structural stability, including Koiter's concepts for stability near the critical load. The body of knowledge known as the linear theories of isotropic elasticity and viscoelasticity is presented concisely in Chap. 7. From here on, the subject changes from general solids to shells.

As mathematical background to shell theory, Chap. 8 provides an introduction to differential geometry of surfaces. Shell theory is presented in Chaps. 9 and 10. Chapter 9 covers shells subject only to the straight normals hypothesis, whereas Chap. 10 includes the other two facets of the Kirchhoff–Love hypothesis: normals are unstretched and remain normal to the deformed reference surface. This includes elastic–plastic behavior of such shells and several simplifying "models" for describing it.

The concluding chapter discusses approximation concepts from a fundamental viewpoint, with emphasis on finite elements. As in many of the chapters, brief glimpses of the rich history of the topics are presented and a total of nearly 300 references are included at the end of the book. Appropriate and well-drawn figures are dispersed throughout the book.

The stated goal of the authors is reasonably well met. However, it is cautioned that the book is not an easy read, and few worked-out, detailed results are presented. Despite these limitations, this book is recommended as a useful introduction to the foundations of quasi-static analysis of solids and shells.

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Computational Heat Transfer, 2nd edition

Yogesh Jaluria and Kenneth E. Torrance, Taylor and Francis, New York, 2002, 544 pp., $135.00

The second edition of *Computational Heat Transfer* is, as the authors state, an updated and extended version of the first edition of 1986. The second edition at 544 pages has 178 more pages due to the addition of 55 end-of-chapter exercises, 180 references, some examples, and some discussions. The character of the book remains a survey of numerical methods, primarily finite difference and finite element, for solution of heat transfer problems. The coverage is distributed as follows: Chap. 1 Introduction, 16 pp.; Chap. 2 Governing Equations, 16 pp.; Chap. 3 Finite Differences, 48 pp.; Chap. 4 Finite Elements, 33 pp.; Chap. 5 Numerical Methods for Conduction Heat Transfer, 95 pp.; Chap. 6 Numerical Methods for Convection Heat Transfer, 137 pp.; Chap. 7 Numerical Methods for Radiation Heat Transfer, 61 pp.; and Chap. 8 Applications of Computational Heat Transfer, 69 pp. The emphasis is on conduction and convection, although radiation is treated in its own chapter and there are interesting case studies of multimode processes, some of importance in manufacturing. The presentations are good, and the references from the literature are well selected to direct independent readings for those who wish to delve deeper.

Some numerical methods and topics are either little discussed or not mentioned. Mesh refinement studies are not illustrated, and so there is no guidance on how to discretize a problem domain. The special treatment accorded the central control volume in cylindrical and spherical coordinates is stated, but no basis for it is given. The insight that the stability criterion for an explicit finite difference method for conduction is merely that the time interval be no greater than the smallest control-volume time constant is suggested in only a veiled manner in the penultimate sentence on p. 76. Boundary element methods have only one paragraph and one reference in Chap. 1 and two paragraphs and two references in Chap. 4. A Monte Carlo method for heat conduction is not mentioned. For convection, use of a commercially available computer program, Maple for example, for solution of the laminar boundary-layer equation is not illustrated. The SIMPLE algorithm based on the finite volume method has only five pages. Only 11 pages are devoted to turbulent convection. Because only one- and two-dimensional cases are treated, no appreciation is provided of the large increase in computer resources and computational time needed to solve three-dimensional cases, especially for convection.

Because of the outline nature of the coverage, extensive supplementation is likely to be needed for this book to be useful to a first-year graduate student or, especially, a senior undergraduate student. A more knowledgeable reader could obtain useful extension of prior insights and understandings from this book, better suiting it to the needs of an instructor or a professional engineer. The book is of good physical size (6×9 in.) for either bookcase or backpack.

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