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Book Review

Shear Deformable Beams and Plates

C. M. Wang, J. N. Reddy, and K. H. Lee, Elsevier Science, Amsterdam, 2000, 312 pp., $99.00

The objective of this book is to study the effects of transverse shear strains for beam and plate structural elements and compare classical theory with shear deformation theory. To discuss each of the structural elements, the book includes an introductory chapter, followed by two separate parts. The first part, which includes Chapters 2–5, covers beams, and Chapters 6–13 cover plates.

In Part I, Chapter 2 includes a discussion of various beam theories, including the classical Euler–Bernoulli beam theory (EBT), the first-order shear deformation theory of Timoshenko (TBT), and the third-order beam theory of Reddy and Bickford (RBT). The governing equilibrium equations and boundary conditions are derived for each theory based on kinematic assumptions of the associated beam theories. Chapter 3 presents a unified element stiffness matrix that includes element stiffness matrices for the EBT, TBT, and RBT theories, respectively. Chapter 4 presents an analytical approach for the derivation of the exact relationship between the elastic buckling loads of columns based on the EBT, TBT, and RBT theories. The resulting RBT buckling solutions are found to be different from those obtained using the EBT solutions. Chapter 5 examines the development of the EBT and TBT equations for the case of isotropic tapered beams for both statically determinate and indeterminate beams. An extension of the work to laminated beams is also discussed.

Part II of the book begins with Chapter 6 and a presentation of the various plate theories, including classical plate theory and first-order shear deformation theory, followed by the third-order plate theory of Reddy. Chapter 7 examines the three plate theories for the case of simply supported, polygonal plates subjected to transverse loads. Chapter 8 discusses solutions of the respective plate equation formulations for the case of rectangular plates simply supported on two edges, with the other two edges subject to general boundary conditions. In Chapter 9, circular and annular geometric plates are examined for the case of the three plate theories introduced in Chapter 6. Chapter 10 examines the development of the governing equations for the case of sectorial plates (e.g., pie-slice shapes) for the case of the classical and first-order plate theories. In Chapter 11, the buckling loads of classical, first-order, and third-order plate theories are examined for polygonal, circular, and sectorial geometry plates. Chapter 12 includes a discussion of the free-vibration equations for the three plate theories for the case of rectangular and regular polygonal geometric plate configurations. The final chapter of Part II is dedicated to the development of the governing equations for inhomogeneous plates. Included in the discussion are the relationships for predicting the deflection of sandwich plates, functionally graded plates, the buckling load of sandwich plates, and the vibration of sandwich plates.

This book is a concisely written treatise on beam and plate theory considering both classical and shear deformable theories. An extremely valuable contribution is the worked example problems in each chapter as well as the inclusion of sample problems to be worked at the end of each chapter. Also included is a useful reference list of publications. This reviewer believes the book to be extremely useful to instructors teaching beam and plate theory in an entry-level graduate course in solid mechanics. It is also a useful reference for the practicing engineer who requires insight on the importance of shear deformation to the response of beam and plate structural elements.

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