Ciarlet, Philippe G.

Mathematical elasticity. Vol. 3: Theory of shells. (English) Zbl 0953.74004
Studies in Mathematics and its Applications. 29. Amsterdam: North-Holland. 666 p. (2000).

Shell theory can be regarded as the highest form of modelling in structural analysis. Thus, this third volume in a series of monographs on mathematical elasticity by the same author [Mathematical elasticity. Volume I: Three-dimensional elasticity. Studies in Mathematics and its Applications, 20. Amsterdam etc.: North-Holland. xi (1988; Zbl 0648.73014); Mathematical elasticity. Vol. 2: Theory of plates. Amsterdam: Elsevier. lxi (1997; Zbl 0888.73001)] can be looked upon as a highlight and consistent completion of the work. The preface comprises at a glance differential geometry relations, three-dimensional elasticity in curvilinear coordinates, and two-dimensional shell equations. Elasticity is restricted to homogeneous, isotropic material, mainly of St.Venant-Kirchhoff type, and in some cases of a more general class of hyperelastic materials. In its first two thirds, the book treats linear shell theories, whereas the remainder deals with nonlinear ones. Starting from three-dimensional elasticity in curvilinear coordinates, sound mathematical procedures are applied to derive two-dimensional relations. As an essential step to prove existence and uniqueness of solutions, an inequality of Korn type is set up in curvilinear coordinates. After scaling with the shell thickness, convergence is assured through a formal asymptotic analysis. Therewith, equations of membrane and flexural shells are obtained. Special attention is paid to the theories of Koiter, Naghdi, and Budiansky and Sanders. Each chapter starts with a short introduction sketching the procedure followed in the text and ends with useful exercises to strengthen the acquired knowledge. The effort to write each chapter as self-contained as possible makes the book most enjoyable to those interested in the mathematical foundation of shell theory.

Reviewer: K.Rohwer (Braunschweig)

MSC:

74-02	Research exposition (monographs, survey articles) pertaining to mechanics of deformable solids
74K25	Shells
74G10	Analytic approximation of solutions (perturbation methods, asymptotic methods, series, etc.) of equilibrium problems in solid mechanics
74B05	Classical linear elasticity
35Q72	Other PDE from mechanics (MSC2000)

Keywords:

nonlinear shell theories; Korn-type inequality; Koiter theory; Naghdi theory; Budiansky-Sanders theory; differential geometry; three-dimensional elasticity; curvilinear coordinates; two-dimensional shell equations; homogeneous isotropic material; hyperelastic materials; linear shell theories; existence; uniqueness; convergence; asymptotic analysis; membrane; flexural shells