Hill, R.

The mathematical theory of plasticity. Reprint. (English) Zbl 0923.73001

Oxford Classic Texts in the Physical Sciences. Oxford: Oxford University Press. ix, 355 p. (1998).

The first edition of this book [*R. Hill*, The mathematical theory of plasticity. London: Geoffrey Cumberlege, Oxford: At the Clarendon Press (1950; Zbl 0041.10802)] was certainly considered as a significant point in the development of plasticity theory, the other nine editions which followed, the last in 1989, prove the role which this book played in the education of several generations of students in continuous mechanics, from all the world, and this republication of the book is a notable cultural event crowning the undeniable value of this Hill's work.

The book is a clear, rigorous, and comprehensive guide to the mathematical theory of plasticity, as it stood in 1949. The material of the book is organized into 12 chapters: I. Introduction; II. Foundations of the theory; III. General theorems; IV. The solution of plastic-elastic problems I; V. The solution of plastic-elastic problems II; VI. Plane plastic strain and the theory of the slip-line field; VII. Two-dimensional problems of steady motion; VIII. Non-steady motion problems in two dimensions I; IX. Non-steady motion problems in two dimensions II; X. Axial symmetry; XI. Miscellaneous topics; XII. Plastic anisotropy. Three appendices, an author index, and a subject index conclude the book.

The first three chapters are devoted to a general presentation of plasticity theory and its general theorems which were known in 1949, by the means and on the level of that time. We point out the following features of these chapters: a) A clear specification of the subject and objects of the mathematical theory of plasticity, and its experimental and physical bases; b) A necessary and very instructive historical outline which makes evident the landmarks in plasticity theory from 1870 to 1949; c) A rigorous introduction of concepts of plasticity theory such as the ideal plastic body, the criterion of yielding, and the stress-hardening; d) A brief presentation of the fundamental stress-strain relations, the Levy-Mises and Reuss equations, and the Hencky stress-strain relations; e) Formulations of extremum and variational principles; f) Uniqueness of stress distribution under given boundary conditions for work-hardening material, non-hardening material, and plastic-rigid material. At present, this part of the book is particularly interesting from historical viewpoint.

Chapters IV–XII are devoted to solving analytically problems chosen to illustrate the application of the theory, including the slip-line theory in rigid-plastic body. "Many of these (applications) relate to processes for the shaping of metals, such as rolling and drawning, not only an account of my own interests but also because it is here that the plasticity of a metal is demonstrated most strikingly" (from the author's preface). There are at least 30 applications, which became classical now and which are treated "as complete and factual as present knowledge appears to warrant".

"I have written the book" – says the author – "in the hope that it will attract engineers and applied mathematicians to a field which is well rewarding study and research, and which is finding an increasing application in metal technology". In the reviewer's opinion, this remarkable work still remains a fundamental reference book for designers, engineers, and researchers in continuum mechanics.

Reviewer: Gh.Gr.Ciobanu (Iaşi)

MSC:

74-02	Research exposition (monographs, survey articles) pertaining to mechanics of deformable solids
74Cxx	Plastic materials, materials of stress-rate and internal-variable type
74Axx	Generalities, axiomatics, foundations of continuum mechanics of solids

Keywords:

theory of the slip-line field; axial symmetry; non-steady motion; plastic anisotropy; plastic-elastic problems; plastic strain; steady motion; criterion of yielding