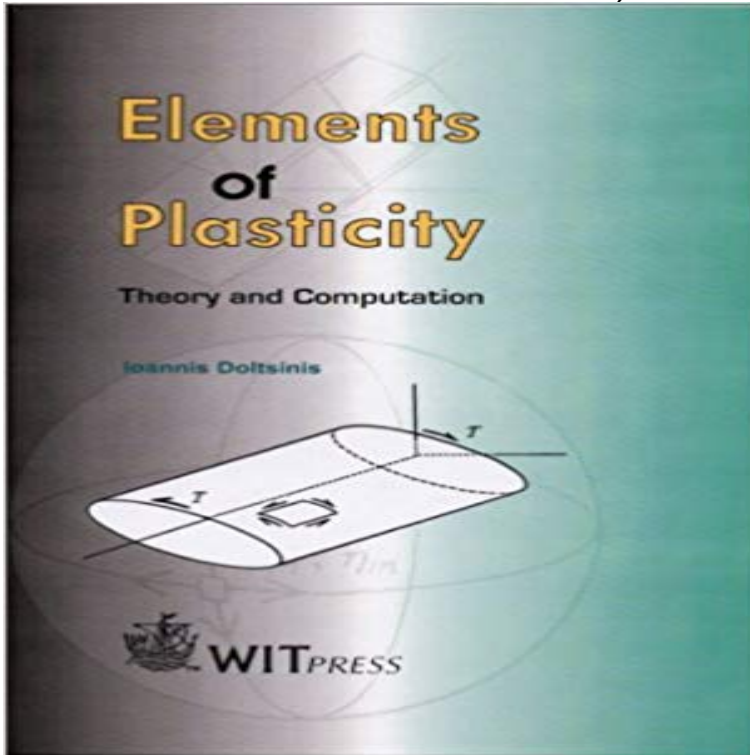


Elements of Plasticity : Theory and Computation (High Performance Structures and Materials Vol. 1)



The book addresses the subject of elastoplastic solids and structures undergoing infinitesimal deformations. Problems of this class are associated with the design of structures in civil, mechanical, and aerospace engineering. In this connection, the interest lies in the stress analysis rather than in the process of deformation. The purpose of the book is two-fold: to present essential elements of the theory of elastoplastic systems, and to introduce modern computational techniques for elastoplastic analysis. The text on the theory of plasticity refers to the course on elastoplastic structures taught by the author at the University of Stuttgart. The parts dealing with computational finite element methods reflect the authors research and development work on the subject. It has been imparted to commercial finite element software for large-scale systems. In the theoretical part, the reader is introduced to the characteristics of elastoplastic materials and systems, and their mathematical description. Appropriate space is provided to the description of the material behavior as the key issue for understanding the elastoplastic response of solids, and for its significance in developing computational solution algorithms. The characteristic response of elastoplastic structures is considered, and is followed by the presentation of the equations governing elastoplastic continua. Some specific cases are discussed. The remainder of the theoretical part is devoted to the subject of load-carrying capacity and the behavior under time-variant loading condition. The part on the computational stress analysis starts with an outline of the finite element systematic and demonstrates the elastic algorithm as a reference for the elastoplastic case. Computational procedures accounting for incremental plastic flow are presented next, and are followed by a discussion on the numerical properties of various approaches. Theory

and algorithms are extended to other aspects of inelastic material behavior as well. They include the influence of temperature and time, and touch the subject of pressure-sensitive materials. In conclusion, the application of finite element techniques is demonstrated for a number of representative problems from engineering practice. The book is mainly educational in nature. The subject is gradually developed from classical theory towards modern computational techniques, introducing the respective notation and systematic. Throughout the text, simple examples accompany the theory either for an introduction to the matter under consideration, or for subsequent elucidation. Where appropriate, an attempt is made to present plasticity by pointing out differences to customary elastic response. Rather than providing specific analytical solutions to engineering problems, the book develops the essential theoretical framework required for understanding elastoplastic behavior, global finite element computational

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