Rezensionen / Reviews

Kurrer, K.-E.:
The History of the Theory of Structures
Ernst & Sohn, Berlin, 2008
848 Seiten, 500 Abbildungen, Hardcover
ISBN-10: 3-433-01838-3
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119,00 €

This voluminous book is the English edition of Kurrer's *Geschichte der Baustatik* (Berlin, 2002). However, it is not only the translation of the original, but has been essentially enlarged by more than 300 pages. These enlargements contain, among others, more recent topics like numerical methods, and in particular the Finite Element Method, and a very interesting chapter "Twelve scientific controversies in mechanics and theory of structures".

The book starts with a chapter on the "history of the history", i. e., with an overview over works on the history and its reception.

Naturally the mechanics of structures of modern times was inspired by the need of challenging constructions like bridges, where already complicated parts under tension, pressure, and even torsion are involved. Such constructions have a long and fascinating history, with all ups and downs, i. e., with constructions almost like memorials, but also catastrophic failures.

Even more challenging are two-dimensional structures like plates and shells, membranes and vaults, where the analysis is already rather demanding, so that the history of their design is a long zigzag path with many deviations and dead-end branches besides the trunk.

Of course, when studying the history of structural mechanics, also the influence of the mathematical methods becomes evident. While in those old days graphical methods played an important role for the design of structures, the introduction of modern computers put an immediate end to most of these methods, now favouring matrix methods appropriate for computers. So much of the work of our ancestors seems to be almost forgotten, while the analytic basis of strength of materials became a firm ground in science hardly without any alteration and of quasi eternal validity.

A very helpful part of the book consists of brief biographies of hundreds of men and women, each of them with more or less important contributions to our subject. Many of these names are strongly connected with formulae or theories, but only for a few of them some knowledge about the persons and fates behind the names is prevalent.

Eventually the author adds personal remarks about his adventures when detecting and discovering the history of science. This is rather unusual for such textbooks. However, it gives the reader an impression of the joy and enthusiasm of gathering this knowledge and, thus, includes the reader into this passion.

The book is equipped by a great number of pictures and figures. Many of them, however, have only the size of a thumbnail and banned to the margin, unfortunately.

All in all, Kurrer offers us a highly interesting work on a fascinating subject, carefully and detailed explained, which may help all engineers and scientist to find the historical roots of science. In particular, this book will be highly welcome to all teachers in the field of mechanics.

A. Bertram

Ahrens, T.; Hettrich, F.; Karpfinger, C.; Lichtenegger, K.; Stachel, H.:
Mathematik
Spektrum Akademischer Verlag, 2008,
1498 S., 1181 Abb.
ISBN 978-3-8274-1758-9, 69,95 €
Mathematik zum Mitnehmen
Spektrum Akademischer Verlag, 2010, 224 S.
ISBN 978-3-8274-2494-5, 17,95 €

Das Lehrbuch soll den Leser vom Studium bis ins Berufsleben begleiten und dabei die gesamte praxisrelevante (Ingenieur)mathematik bis hin zu numerischen Verfahren abdecken. Ein Farbleitsystem sorgt dafür, dass Definitionen, Anwendungen, Übersichten, Vertiefungen und Beispiele im gesamten Buch schnell gefunden werden. Das Buch ist bei einem Umfang von fast 1400 Seiten und einer Masse von mehr als vier Kilogramm nichts für unterwegs, jedoch ein didaktisch gut aufgebautes, verständliches und anschauliches Werk für den Schreibtisch. Es zeigt, dass Mathematik keine trockene Wissenschaft sein muss. Im Gegensatz zu reinen Nachschlagewerken, wie zum Beispiel dem Bronstein, enthält das Buch neben Beispielrechnungen auch Aufgaben und Kontrollfragen zu den einzelnen Kapiteln. Die Lösungen dazu findet man am Ende des Buches. Das Buch ist durchgängig mehrfarbig, wodurch u.a. die Grafiken sehr anschaulich werden. Dem Techniker bekannte praxisrelevante Beispiele aus unterschiedlichen Gebieten, u.a. der Mechanik, tragen zum Verständnis bei. Interessant sind zum Beispiel die Ausführungen in der beschreibenden Statistik, wo gezeigt wird, wie durch unterschiedliche Darstellungen die (optische) Wahrnehmung von Sachverhalten manipuliert werden kann.

Der Inhalt des Buches gliedert sich in sechs Teile, die in insgesamt 41 Kapitel unterteilt sind. Dies sind die Teile Einführung und Grundlagen, Analysis mit einer reellen Variablen, Lineare Algebra, Analysis mehrerer reeller Variablen, Höhere Analysis sowie Wahrscheinlichkeitsrechnung und Statistik. Die Nennung aller Kapitel würde an dieser Stelle zu weit führen. Deshalb sei auf die Internetseite www.matheweb.de verwiesen.

Der Preis des Buches erscheint auf den ersten Blick hoch. Vergleicht man jedoch mit anderen, mehrteiligen Lehrbüchern, so sind die Kosten vergleichbar und auch für Studenten akzeptabel. Im Internet ist Bonusmaterial zum Buch verfügbar. Als Dozentenservice gibt es alle Aufgaben und Grafiken auf einer (kostenpflichtigen) DVD.

Das Buch ist gleichermaßen für Studenten, Dozenten und Praktiker auf den Gebieten Mathematik, Physik, Chemie sowie Ingenieurwissenschaften interessant, da es eine neuartige und gelungene Kombination aus Lehrbuch und Nachschlagewerk darstellt.

Auf Anregung von Nutzern des Lehrbuches erschien eine Zusammenstellung der Übersichten und Zusammenfassungen als (leichtes) handliches Taschenbuch zur Nutzung in Lehrveranstaltungen. Dieses Taschenbuch geht über den Umfang einer reinen Formelsammlung hinaus und ist eine sicherlich sinnvolle Ergänzung zum Lehrbuch.

W. Lenz

Nicholson, D. W.:
Finite element analysis:
thermomechanics of solids
CRC Press, 296 pp, Hardcover, 129,95 $
ISBN-10: 084930749X
ISBN-13: 978-0849307492

The second edition of "Finite element analysis: thermomechanics of solids" by David W. Nicholson, is meant to address both students and people from industry. The book consists of eighteen chapters with a focus on thermal, mechanical and thermo-mechanical problems for small and finite strains.

My review of this book comes to the following. Unfortunately the Introduction fails to present neither the structure nor the intention of the book. Rather than being an introduction to the content of the book, the Introduction instead is more like a resume of the author's experience. As early as the first chapter where finite elements are introduced difficulties arise: the terms elements, mesh, and nodes are applied, but not explained. Only a practitioner, who has already worked with commercial finite element programs, might be able to follow; a student, who is just at the beginning of a course, is left out.
The author applies the Kronecker product notation to vectors and matrices. Tensors are introduced as quantities subjected to orthogonal transformations, not as linear mappings, i.e. tensors are formulated as matrices and the Kronecker product notation is applied to particular tensor operations. Kronecker notation might be considered as an elegant notation, but such formalism here does not really help for understanding the subsequent ideas of finite elements in view of the notation commonly applied in other finite element books. Accordingly, only a very few practitioners and students are addressed.
In the mode of a standard treatment the weak formulations of the principle of virtual displacements as well as virtual temperatures are introduced before the discretization of linear mechanical and thermal problems for one-, two-, and three-dimensions. Yet, the compact notation, on the one hand, helpful for a fast reading, leads, on the other hand, to the omission of a number of necessary explanations. For example, the variation of a functional is not explicitly defined. Thus, for students without any background, the variation of a functional becomes incomprehensible.

In the following chapters, too much space is given to a large number of compactly handled problems. More space instead should have been given to other topics. The proposed solution methods for linear systems of equations, time integration, modal analysis or contact problems do not represent modern methods. Moreover, the representation is too compact. A more non-classical approach is presented proposing an Adams-Moulton-type implementation for dynamic problems. Here, the analysis, although detailed, unfortunately does not consider energy-preservation. Sections of thermodynamics, thermo-elasticity, coupled thermo-elasticity, buckling, contact formulations, and constrained bodies, all very briefly treated, follow.

Further the book deals with non-linear problems such as the kinematics of finite strains and constitutive models of hyper-elasticity for incompressible, nearly-incompressible, and compressible (Blatz and Ko) models. Where a careful investigation of the relation between the strain-energy parts depending on volume-changing and –preserving deformation are required for the nearly incompressible hyper-elasticity formulations, accompanying remarks and analysis were dropped. It is worth noting that the applied plasticity formulation is based on the additive decomposition of the spatial strain-rate tensor commonly applied in commercial finite element programs. In view of the numerical treatment the weak formulations are approached in incremental form so that the time-

integration cannot be clearly identified but instead is mixed-in with the entire solution procedure. In particular, the tangent operator relations to the Multilevel-Newton algorithm, as standard in modern presentations, are not demonstrated.
Several symbols do not remain consistent throughout the book: sometimes δ_{ij} is the Kronecker-symbol, sometimes a relative displacement. Or, $\in$, commonly defined as a mathematical symbol, is chosen for representing a tensor. Many more examples of improper notation can be found.

In conclusion, I can not recommend the book as a textbook for my undergraduate, graduate, or doctoral students. Much of the treatment does not follow modern finite elements and the representation is too compact. However for those investigating the application of the Kronecker symbol notation for finite elements, the book could be of interest.

S. Hartmann