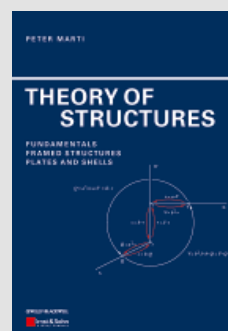


Book reviews

Marti, P.: Theory of Structures – Fundamentals, Framed Structures, Plates and Shells. Ernst & Sohn, Berlin, 2013.
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Is it still appropriate to publish a classic textbook on a conventional subject like “Theory of Structures” in the age of the Internet with its mine of information? Yes, it definitely is appropriate, and in this case many reasons speak in favour of a comprehensive publication in particular. First of all, excellent textbooks will never die out; secondly, it is not a question intensively discussed in the media: printed or digital? Maybe one day we may order an eBook as well anyway.

The current book has some unique features in addition to the classical canon of theory of structures. This has something to do with author’s professional background in the environment of the Swiss Federal Institute of Technology (ETH) Zurich. According to the tradition of the department, a professor for theory of structures was never “only” a structural mechanics expert; *Peter Marti*’s position at ETH also includes structural design with an emphasis on structural concrete, which means he is very much engaged in practical design projects, too. This is reflected in the book through the many examples inspired by real structures, but especially in the sound summary of all the phases in the lifetime of a building,

from the conceptual design phase to structural analyses, construction, use and conservation up to final deconstruction. This part, stressing the holistic view of the subject, is afterwards more detailed, bringing together basic elements of structural analysis and dimensioning and describing the underlying design philosophy, namely emphasizing the necessity of using elastic and plastic methods in the design process. This concept can be traced back to *Marti's* predecessor at ETH, *Bruno Thürlimann*, and is a central building block in the respective Swiss standards, SIA (Swiss Engineers & Architects Association), to a great extent influenced by *Peter Marti*. It became a leading theme in the entire book, in so far as plastic analyses are added to the usual elastic calculations in several places, an unparalleled feature in a textbook on theory of structures.

This valuable introduction is followed by four chapters on applied mechanics, essentially representing the content of a strength of materials course. They describe the three fundamental issues of statics, kinematics and constitutive relations and are complemented by corresponding energy methods.

A central part of the book is devoted to linear analyses of beams, columns and frames, mostly covering traditional subjects such as calculations of stress resultants and deformations, influence lines plus force and displacement methods. It is good to see that the force method is not abandoned, as in the meantime it forms part of the curricula in several universities in other countries. Even if the force method is seldom used anymore in practice, it is still the ideal didactical tool describing the meaning of indeterminacy and different loading conditions. An especially valuable chapter, misleadingly denoted "continuous models", deals with special systems and problems, e.g. stringers, residual stresses, bond, shear, elastic foundations, arches and cables to mention just a few. Matrix notation is used where appropriate, but fortunately does not dominate the mechanical content. On the other hand, the

relatively short section on discretized models seems a bit isolated.

The parts on the non-linear analyses of frames are core elements in the book. The sections on elastic-plastic methods and limit analyses as well as stability of structures are excellent introductions to these subjects and go beyond the usual description of elastic-ideal plastic material behaviour. Topics such as multi-parameter loading, reinforced concrete, masonry, shakedown, minimum weight and general optimum design are dealt with. Buckling refers to elastic and elastic-plastic cases, and also includes three-dimensional phenomena.

According to the subtitle of the book, the last part concentrates on plates and shells. It has to be said that the notion of plates is not unique in the English-speaking world. Although the book refers to plates, this notion is used in the text only for plane structures under in-plane loading; they are distinguished from the bending-oriented slabs. Both are treated at great length. The chapter on plates not only discusses analytical solutions; strut-and-tie models and failure mechanisms are also introduced as typical design elements for reinforced concrete. Classic methods of solution for slabs are described – for circular and rectangular geometry and several support conditions; these methods are supplemented by the application of plastic models based on different yield conditions and the yield line method, mainly in the context of reinforced concrete. A short excursion into folded plates as a combination of plate and slab actions concludes this subject.

The last chapter, on shells, is confined to special cases accessible to analytical solutions, such as membrane analyses of shells of revolution, cylindrical vaults and shells on rectangular plans, bending theory of shallow shells and cylindrical shells under symmetric and asymmetric loading. A short reference is made to the buckling problems of shells. The entire section gives an initial insight into the main phenomena of shell structures.

The book gives us an almost complete presentation of what is called "Theory of Structures". However, we may ask the question: Is there something missing? In the age of sophisticated and powerful software, a profound introduction to numerical solution methods, the finite element method in particular, would have been a great supplement. The knowledge of classic structural analyses on the one hand and numerical solution schemes on the other can help substantially our understanding of the application of sophisticated computer simulations. Another remark may also be important: The original German edition of the book refers to statics in the title ("Baustatik"); as is customary, this has been translated as "Theory of Structures", a term which may, however, suggest that structural dynamics is also covered. This in turn would probably overload the book and could anyway be a subject of another volume.

"Theory of Structures" is an excellent textbook. It is very rich in the individual topics covered. One special and important feature that should be mentioned is the many excellently prepared examples and exercises. Also particularly appealing are the final statements at the end of each chapter, summarizing the key elements of the respective topic. The reader notices on every page the enormous experience of the author gained over many years in academia and practice. This once again answers the question raised at the beginning: The book is a great enrichment for the respective market, in terms of both content and layout. Certainly, we may be doubtful as to whether the Internet-oriented generation is still willing to read books; nevertheless, this is a wonderful textbook for undergraduate and graduate courses. There is also no question that it will be of great interest to teaching staff. In addition, it could be of immense value to those practicing engineers who wish to deepen their background knowledge or refresh fundamental issues.

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