Review

This introduction to advanced modelling techniques will likely be of interest to senior engineers seeking background knowledge on the use of analysis software for specialised structural design, writes **John Lyness**.
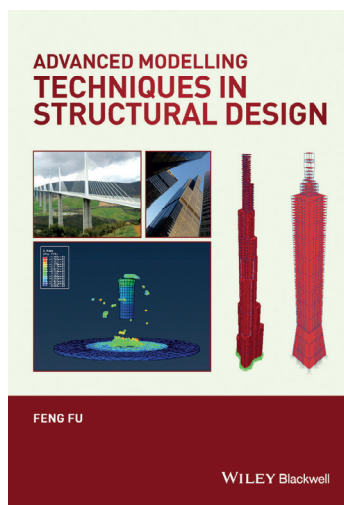
Advanced Modelling Techniques in Structural Design

Author: Feng Fu
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This book covers the analysis, for design purposes, of more unusual structural forms, load cases and material behaviours. The book seeks to describe the use of upstream geometrical modellers as an efficient source of geometric data for the analysis model.

The book contains 10 chapters. Two are introductory chapters and then eight follow that cover the use of geometric and computer-aided design (CAD) modellers with different proprietary finite-element (FE) and other analysis packages. The objective of the use of the geometric and analysis modellers is to provide information on predicted stresses and displacements for different, generally extreme scenarios and load cases due to static, dynamic, environmental and thermal loadings.

The analysis and scenario chapters cover tall buildings, earthquake analysis, progressive collapse, blast and impact loading, structural fire analysis, space structures, bridge structures and foot-induced vibrations.

The author is obviously an analysis practitioner who has been engaged in ensuring the appropriate data and data preparation needs for the effective use of analysis software, and who has been faced with the practicalities of optimising the use of file exchange between the upstream geometric (CAD) modellers and the analysis modellers.

The introductory chapters list the proprietary geometric modellers, CAD software and FE software that are described, later, in the applications. The proprietary analysis software that is listed covers most of the popular software currently in use for "one-off" structures and scenarios. The widespread routine design office use of structural analysis, design and detailing software for more common structural forms is not described.

Within each chapter a "nutshell" introduction is given describing the appropriate mechanics theory and the theory for the analysis method, together with some useful references. The preparation of the geometrical data, using geometric modellers, is followed by use of an appropriate numerical analysis method. The use of the selected proprietary analysis software is outlined by describing the design load cases, constraints, material properties etc. The set-up procedure for the analysis is written up as a sequence of sentences with some commentary. The selection of the appropriate analysis output and its useful format (graphical, vector etc.) for the structural design process is illustrated and discussed.

The written English is variable in parts. Several of the screenshot diagrams are illegible and most of the diagrams would have benefited from annotations.

For the use of the output in design, which must comply with Eurocode or other standards, several conditions must be satisfied by the geometric data, material property data and load data. References are provided at the end of each chapter that go some way to provide this. However, many questions remain, for this reviewer, about proving the suitability of the FE analysis techniques and software that have been chosen. For such structural forms, load cases and material behaviours, involving the use of proprietary analytic software, the quality assurance (QA) compliance sequences and procedures are surely paramount. For more completeness it would have been useful if a description of the appropriate design QA procedures relevant to these modelling steps in real-life structural design could have been included. I am thinking of competence certification, software certification, ISO compliance, design standard compliance, error bounds, tolerances, statistical confidence, risk assessment etc.

Perhaps citing references to the QA for the relevant FE techniques, the QA for the relevant proprietary FE software and the possible assessments of accuracy, following adaptive re-meshing, error bounds, etc., could be considered by the author in future.

I think that this book's principal users will be senior engineers who want speedy access to topical background knowledge on the use of currently accepted analysis software for specialised structural design, and information on using their upstream 2D and 3D CAD modellers. I also think that the book will be of interest to specialised structural analysis practitioners who would like to broaden their practical knowledge of the scope of other providers of currently available acceptable analysis software for more specialised structural analyses and scenarios.

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John is a Reader in Civil Engineering at The University of Ulster. He previously worked as a structural engineer in Northern Ireland and in offshore engineering in London.