Book review

STRUCTURAL DYNAMICS AND VIBRATION IN PRACTICE: AN ENGINEERING HANDBOOK

Douglas Thorby. Butterworth-Heinemann, 2008. ISBN 978-0-7506-8002-8, £23.74, 401 pp.

As soon as I started reading Douglas Thorby's textbook, I felt it was different compared to the plethora of existing textbooks on structural dynamics focused on mechanical and aerospace engineering disciplines. The first two paragraphs of the textbook introduce the difference between *dynamics* (elastic bodies in motion) and *vibrations* (oscillatory behaviour), and the term 'coordinate', which means more 'movement' than 'location of a point' on a structure. Many other run-of-the-mill textbooks on structural dynamics and vibrations do not have this kind of clarity, and so it was good to see similar articulation with regard to other usual 'slippery' points (where other authors have failed to deliver much needed clarity). At the University of Sheffield, the module on Vibration Engineering, which I deliver to postgraduate students and industrialists, commences in a similar way by explaining the difference between dynamics and vibrations and introducing the changing nature of a 'coordinate' in a moving structure.

The textbook is presented in 13 chapters, covering: Chapter 1: Basic concepts; Chapter 2: The linear single degree of freedom system: classical methods; Chapter 3: The linear single degree of freedom system: response in the time domain; Chapter 4: The linear single degree of freedom system: response in the frequency domain; Chapter 5: Damping; Chapter 6: Introduction to multi-degree-of-freedom systems; Chapter 7: Eigenvalues and eigenvectors; Chapter 8: Vibration of structures; Chapter 9: Fourier transformation and related topics; Chapter 10: Random vibration; Chapter 11: Vibration reduction; Chapter 12: Introduction to self-excited systems; and Chapter 13: Vibration testing.

These section titles indicate that the material is primarily theoretical and there is very little material related to practice, in particular concerned with civil and structural engineering, which is my field. Indeed, this book, as its author notes in the preface, is heavily biased towards the aerospace industry. However, the theory covered is very much applicable to all branches of engineering, including structural civil engineering. With regard to this, I like the intelligibility of Thorby's writing, his superb mastery of the rather complex technical English

used in the structural dynamics and vibrations world. Although Thorby, whenever possible, tries to explain things quite effectively using his own perspective, the key terminology used is precise and correct, which is quite hard to achieve. This is particularly so, considering Thorby's understandable despair with the inconsistent and ever-changing terminology often used quite loosely by the structural dynamics and vibrations community. For example, he notes:

Unfortunately, the term 'structural damping' has acquired a special meaning: it now appears to mean 'hysteretic damping', and cannot be used to mean the damping in a structure, whatever its form, as the name would imply.

There are plenty of similar informative insights throughout the book, indicating deep understanding and knowledge of the field.

Having said this, there are some weaknesses. Whenever I get a new textbook on structural dynamics and/or vibrations, I check the following areas, which modern textbooks on the subject should cover: (1) introduction to damping; (2) Laplace and Fourier transforms and what is written about the relationship between them, if anything is written; and (3) dynamic testing. These areas are usually neither explained nor written well in textbooks, and – alas – this one is no exception.

In Thorby's textbook, physical sources of damping are mixed with their mathematical modelling, which is what is usually and quite confusingly done in other textbooks. In principle, there is only dispersion and dissipation of vibration energy, and nothing else physically happening in real structures, which dampens them. Everything else is mathematical modelling of those two phenomena, and I am yet to see a textbook dealing with damping in this way explicitly. Laplace and Fourier transforms are, as usual, linked only by a highly mathematical and physically non-intuitive approach assuming that the real part of the Laplace variable (and not 'Laplace operator', which is a typo on p. 48) is zero. So what? Finally, the section on dynamic testing has almost no graphics and does not describe any practical activity required to do the testing, which is – surprise, surprise – all about hands-on work with some real structures.

It was refreshing to see that the graphics in the textbook are clear and consistently presented. Figures and illustrations are not the usual hotchpotch of inconsistent plots and drawings

featuring many different sizes and styles (in the same textbook), which are so common now in modern textbooks written by overbusy authors and commissioned by editors with overstretched publishing budgets. Well done!

The book contains rather few references. Although the textbook is written very clearly and it may be argued that a comprehensive list of references is necessary as a supplement, I feel that an opportunity has been lost here to provide further reading material. Personally, I would love to see what Douglas Thorby considers to be the seminal publications that inform the various topics he so nicely and confidently writes about.

Finally, a subtitle 'An Engineering Handbook' is, I think, misleading. This is not a handbook, defined by Collins dictionary as 'a reference manual giving practical information on a subject'. Rather, this is a well-written standard textbook on the theory of structural dynamics and vibrations offering better than usual explanations of many key concepts that will serve its reader for many years to come.

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