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Book review

Hydraulic Modelling - An Introduction: Principles, Methods and Applications by Pavel Novak, Vincent Guinot, Alan Jeffrey & Dominic E Reeve. January 2010. 616 pages. Hardback ISBN: 978-0-419-25010-4, £100.00; Paperback ISBN: 978-0-419-25020-3, £34.99

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This is a timely book: it is one of the rare books (possibly the only one) that, by definition, makes no difference between numerical simulation and laboratory scale modelling in engineering practice. Indeed, the last 50 years introduced within the engineering community at large, with commercial software available on the market, many false ideas. The two most widely spread are (i) that scale models belong to an extinct (or nearly) species; (ii) that any civil engineer whose company bought simulation software, or who downloaded software from the web, can carry out modelling studies (often using "default values" of parameters found in the user's manual). Both are wrong. Actually the consultants that are leaders in numerical simulation applications and who own scale model laboratories have seen during the last decade a considerable increase in orders for scale model studies in parallel to numerical ones. As for the second idea, there is an analogy between a family car driver and a bus or a freight lorry driver. Most often the former drives some forty thousand kilometres a year and a couple of hours a day without even knowing why his car goes on. For the latter to drive is his *professional activity*. It is the same with modelling: in the water sector in general and in hydraulics specifically there is such a specialty as "modeller" and this is a *profession* like reinforcing concrete structures or foundations or steel bridge design or project execution are, all belonging to civil engineering, engineering *professions*. This means also that an engineer who is working with numerical modelling but knows nothing about reduced scale modelling will never be a good modeller. The inverse is true for a scale model expert. Because both types of modelling are tools to study the same type of problems, often alternative tools and to know nothing of one of them while pretending to be a specialist of another most often means also to ignore much about hydraulics, and to be unable to advise or decide which one (or both) should be used for a given problem. And for both the knowledge of physics, i.e. hydraulics, is essential.

So how does this book answer the problem? The authors write in their preface "The text is not a research monograph, but a textbook aimed at final-year undergraduate and postgraduate students; at the same time we hope that practitioners in the field will find it a useful source of reference, and that for all of them it can serve as a basis for further study and development".

This definition is very accurate. A reader without minimum background in the subjects involved (hydrodynamics, applied mathematics, hydraulics, similarity) certainly cannot *learn* these subjects from the book. Some chapters (namely "*Theoretical backgrounds- mathematics & hydraulics"*) can be considered either as refreshers or as structured guides to what should be learned. Others address readers who know the basics. Indeed the subject is too rich and too wide to be presented as a "course" on 600 pages. In other words: reading the book asks for intellectual effort and time, not because the presentation is unclear but because the text is a serious one: there are no simplifications or "holistic" presentations of the problems. Dealing with both types of modelling (scale and numerical) within the same chapter makes reading challenging but also enriching in the sense that for an engineer they are just two different tools sometimes applicable to carry out the same design and possibly complementary.

One may be disappointed at first glance that not everything is dealt with in this book. For example, computational

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hydraulics of one-dimensional flows is developed in-depth while 2D and 3D mathematical problems are rather summarised. But such disappointment is not justified: 1D developments show mathematical and algorithmic difficulties deeply enough to make clear that development of the codes is not trivial and that the quality of the core of a simulation system is more decisive than colourful presentation of the results. At the same time it is made clear that a 3D model is not necessarily "better" than 2D or 1D, that there are theoretical (physical formulation as well as mathematical and numerical) unsolved questions and, for those who are interested in such, the sufficient bibliographic references are given. Moreover, it is shown in examples of 1D algorithms encompassed within globally-used commercial software that actually these codes *cannot* simulate all hydraulics situations, that for some situations they give the *wrong* results, and that only an educated user can decide if correct simulation of such situations is necessary for his purpose (and hence such code should not be used) or, to the contrary, knowing that the local result is wrong he can accept it because the overall result is sufficient for his purpose.

On the other side (as the authors recognise) one may regret the absence of a description of groundwater modelling. But once the available volume is defined, the choices are to be made.

The decision to include in the book the examples of applications both for scale models and numerical models is very positive. This is very important because a reader can see how some apparently theoretical problems lead to the tools that are necessary to carry out very practical and down to earth studies. Again, the examples are not addressed to strangers to the profession: not much is said on the distance in terms of time, effort and technology between a numerical algorithm solving partial differential equations and the velocity fields in an estuary shown on the screen, or on the distance between definition of essential variables and scales of a model and the synthesis and interpretation of measurement of sediment movements in a meandering river. Not much but enough to suggest that the distances are considerable and to tell where one can find more information.

There is one very original aspect of scale modelling (and one most likely unknown to many civil engineers working in the water sector): air analogy models. This technique is virtually unknown to the wider public of civil engineers and yet is used very successfully at few places leading to important savings and the limitation of the number of tests and variants of studied situations on reduced scale water models.

There are a few errors (typing or references made in the text to figure numbers) but they are not essential and can be immediately seen and clarified by a reader.

In conclusion, this book should definitely find its place in all libraries concerned with hydraulics, hydroinformatics and modelling. It certainly should be available in their respective institutions to all engineers who are involved in modelling *or* are using results of models. And it should be advised as essential reading to the students at postgraduate level of hydraulics and hydroinformatics.

For information, the main chapters of the book are: Theoretical background-mathematics; Numerical techniques used in hydraulic modelling; Theoretical background-hydraulics; Development of physical models; Tools and procedures; modelling of open-channel systems; Environmental modelling of open-channel systems; Modelling of closed-conduit flow; Modelling of urban drainage systems; Modelling of estuaries; Modelling of coastal and near-shore structures and processes; Modelling of hydraulic structures.