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BOOK REVIEW

Changing a winning formula: the hydraulics of open channel flow: an introduction

By Hubert Chanson, 1999

Arnold, 495 pp.
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Tradition and change in the teaching of open channel flow

At first sight, one wonders whether there is a gap in the market place for an open channel hydraulics textbook given the still dominant position of such classic works as those by Ven Te Chow (1959) or Richard French. Despite being published almost 50 years ago, I still find myself referring back to Chow for basic information that one cannot so readily find elsewhere. To date, alternative volumes to Chow and French have tended to follow a very similar path through the subject (why change a winning formula?), but this very homogeneity repeatedly sends one back to the original sources. Nevertheless, the field of hydraulics has changed enormously in the intervening years, and an attempt to produce a modern open channel flow text is thus timely.

Much recent change in hydraulics has been stimulated by the interest shown in the subject by academics outside the civil engineering field which has been its traditional home. This has been primarily the result of two distinct forces. First, the growth of numerical hydraulic modelling and the availability of sufficient computing power has opened up a subject previously dominated by physical modelling and its attendant need for large-scale laboratory infrastructure. Such facilities were rarely found outside Civil Engineering Departments and Hydraulic Institutes, and this impacted on who was able to conduct hydraulics research. It is now possible to conduct sophisticated experiments in hydraulics on a desktop PC running commercial CFD software, and the incorporation of such technologies into the environmental sciences has been a dominant theme of the last decade. For example, geomorphologists have become increasingly interested in hydraulics (e.g. Wiele *et al.*, 1996; Lane *et al.*, 1999; Hardy *et al.*, 2000) as a way of connecting short-term flow processes with landform creation over much longer time scales. This ability to connect cause and effect in geomorphology in a way not hitherto possible has fundamentally changed our approach in this field and is beginning to filter strongly into PhD programmes and to a lesser extent onto undergraduate curricula. Similarly sophisticated flow models are beginning to be used in ecology for habitat modelling (e.g. Crowder and Diplas, 2000) and in hydrology to attempt to understand the spatial variability in floodplain water and solute transfers (e.g. Stewart *et al.*, 1998) and connections between hillslope hydrology and channel flow (e.g. Stewart *et al.*, 1999). A second force for change has been the rise of environmentally sensitive river engineering and the resultant involvement of ecologists and geomorphologists in design projects

that were traditionally the preserve of the hydraulic engineer.

Whilst at a research level the hydraulics community has become increasingly diverse, undergraduate courses in hydraulics (and consequently text books) are still largely dominated by a civil engineering approach. For this reason open channel flow texts have tended to follow the structure of Chow's volume in what could be thought of as the 'classical' model for this type of book. Flow physics, numerical modelling and environmentally sensitive design are little covered in such volumes, and the focus is on flow classification, basic one-dimensional flow equations for steady and gradually varied flow and design of hydraulic structures. Sediment transport and dispersion modelling are rarely considered (the book by Chadwick and Morfett, 1998 is an exception here). From a numerical modelling point of view the physics covered in such texts does not provide a sufficient coverage of fluid mechanics and such processes as flow turbulence to allow research level papers on higher dimensional models to be interpreted by students. Further, the treatment of modelling techniques, numerical analysis and model conceptual issues is limited. In terms of environmental engineering, the design of weirs and spillways probably still represents the tasks a practising hydraulic engineer would most routinely be called on to perform. Nevertheless, for undergraduate courses in the geosciences such material is pretty much wasted. Further, environmentally sensitive engineering requires a holistic treatment of flow and sediment transport that the classical open channel flow book does not provide.

Hubert Chanson's book meets some, but not all, of the needs for an open channel text in environmental hydraulics. It is split into four sections of roughly equal weight. Basic principles of open channel hydraulics are introduced in the opening section and then the topics of sediment transport, hydraulic modelling (both physical and numerical) and design of hydraulic structures are introduced in turn. In terms of a civil engineering undergraduate market this is about right, and the book is a worthy alternative to more traditional texts. For the geoscientist the book may be more useful than most of its competitors. For example, the coverage of flow physics commences (properly) with the Navier–Stokes equations, although more on flow turbulence would be extremely useful. Whether discussing hydraulics or sediment transport, each section is structured in a highly logical manner. Physical properties are discussed initially, followed by a consideration of the basic dynamic equations. In both cases, these descriptions are extremely clear. Too often this clarity is lost in open channel textbooks and the fundamentally simple Newtonian mechanics that form the physical basis of hydraulics can often be presented in a rather heavy manner. These sections are also both admirably comprehensive. Other useful features of the text are a detailed glossary, list of symbols and a section on physical constants, properties and conversions. There is also a useful reprisal of basic mathematics such as trigonometric functions, basic calculus and vector notation, complex numbers and polynomials that this reader, for one, often finds himself in need of as school and undergraduate studies become an increasingly distant memory! Lastly, the production from Arnold is excellent, and includes some very nice colour plates.

The coverage of both sediment transport and hydraulic modelling is a departure from the 'classical model' of open channel flow texts and very much to be welcomed, however, neither in my opinion really goes far enough. Whilst physical modelling is dealt with in admirable detail, numerical modelling is restricted to a discussion of backwater calculations and wave routing, and higher dimensional models are only mentioned in passing. This might be appropriate for undergraduate courses, but even here students are beginning to encounter research level models and an introduction to such schemes geared to the undergraduate market would have been a very useful addition. In the same way, approximately a quarter of the book is devoted to the design of hydraulic structures that not all readers will find useful. In this respect, the volume caters rather better for the civil engineering, rather than the environmental science, market, and those of us in the latter field are still waiting for a text more fully tailored to our specific needs.

The ultimate test of such a textbook is whether it can be useful for a range of problems and be accessible to a wide readership. To do this the hydraulics group at Bristol has been 'road testing' this volume for the past three months, turning to it as a first source of information to solve the day-to-day problems of a varied group of physical hydraulic, numerical hydraulic and sedimentological modellers.

In that time, a diverse range of queries has been initially researched in Hubert Chanson's volume, and it has passed each test with flying colours. All graduate and postdoctoral researchers who have used the volume have commented favourably on its clarity and completeness, and I can think of no better recommendation than this. This is an excellent book for undergraduate and graduate students in civil engineering interested in open channel flow, and a very useful resource text for those interested in hydraulics outside the engineering field.

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