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Book review
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Fluvial Hydrodynamics: Hydrodynamic and Sediment Transport Phenomena

Subhasish Dey. Springer-Verlag, Berlin, Germany, 2014, ISBN 978-3-642-19061-2, £117, 687 pp.

This is a very comprehensive book that systematically covers all topics related to turbulence phenomena in open-channel flows. It covers in depth important topics such as turbulence, channel meandering and braiding, bedforms, sediment transport, scour, and dimensional analysis and similitude. The book is excellent for postgraduates, research students, postdoctoral fellows and academicians.

Although some of the research topics, such as the turbulent kinetic energy budget and double averaging of turbulence parameters over a rough bed, are described at an advanced level suitable only for research students working in this area, the concepts are explained thoroughly and in a step-by-step fashion. For example, Kolmogorov theory, turbulence anisotropy, secondary flows and quadrant analysis are presented well and discussed at length. The relevant numerical examples given at the end of each chapter help the reader, even one beginning to study this area, understand the application of the theory.

The book covers the latest and most advanced research topics such as the Bose–Dey instability theory, bedform resistance models and probability distributions of turbulence. The author is internationally known in the field of fluvial hydrodynamics. He has used his broad experience in this research area to write about topics such as the development of analytical solutions to Navier–Stokes equations for various fluid flows, jets and scour problems. A great amount of effort has obviously been put into the drawing of lucid, beautiful and neat figures that greatly assist the reader in understanding the phenomena described. Indeed, after studying this book, one may find complex hydrodynamics problems rather easy.

The author has provided an extensive and up-to-date bibliography for each topic covered, and the excellent referencing makes this book a great resource. For example, to find the velocity profile equation for the buffer layer one may need to refer to many journal articles on the subject, but this book provides all the available equations on the topic. Furthermore, all the equations required for calculating equivalent roughness and velocity shift in hydraulically rough open-channel flow are discussed in great detail at one place. The author starts with the fundamentals of turbulence and sediment initiation, and moves on to advanced topics such as sediment transport, bedforms, meandering, scour etc., in a systematic way.

The properties of fluid and sediment, which are required to describe sediment transport phenomena, are explained in Chapter 1. Chapter 2 gives the derivations of kinematics of fluid flow, continuity, momentum, energy and boundary layer equations, and an explanation of pressure distribution in convex and concave flows, flow phenomena in curved channels, hydrodynamic drag and lift on sediment particles. Kolmogorov theory is explained in Chapter 3, and all aspects of turbulence in hydraulically smooth, transitional and rough flow regimes are discussed extensively with the help of the Reynolds-averaged Navier–Stokes (RANS) equations. In addition, the concept of probability distributions of turbulence parameters is explained. Chapter 4 is dedicated to the concepts of sediment threshold, describing different approaches to the computation of the forces on a sediment particle under equilibrium conditions, the computation of the threshold bed shear stress on inclined channels, probabilistic and turbulence concepts of sediment entrainment, the threshold of graded sediments and the design of a stable channel. Probabilistic and deterministic concepts of bed load transport are presented in Chapter 5, along with a description of the sediment pickup function, saltation, sediment sorting and armouring, effects of bed load on the velocity distribution, and the von Karman constant. Chapter 6 outlines various concepts of suspended load transport, and an explanation is given of the different approaches used for suspended load, sediment concentration equations, the conditions for sediment in suspension, probabilistic approaches and the effects of suspended load on turbulence characteristics; finally, wash load is described.

Chapter 7 discusses indirect and direct approaches to total load transport. Indirect approaches discussed include Laursen's, Engelund and Hansen's, Ackers and White's, Yang's, and Karim and Kennedy's approaches. Chapter 8 explains different types of bedforms, different mathematical models, such as the kinematic model, potential flow model, Exner model, Bose–Dey instability theory and bedforms in gravel bed streams, and discusses the different methods of estimating the flow resistance due to bedforms. The basics of the meandering phenomenon of a river, mathematical modelling of meandering and the mechanics of braided rivers are discussed in Chapter 9, and scour caused by channel contractions, scour downstream of control structures, scour below pipelines, and scour at bridge piers and abutments are described in Chapter 10. Finally, dimensional analysis using the Buckingham Pi theorem, and similitude for mobile and immobile beds are discussed in Chapter 11.

This book is highly recommended for all those working in the area of fluvial hydrodynamics, and will also fulfil the needs of those taking postgraduate or undergraduate courses.

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