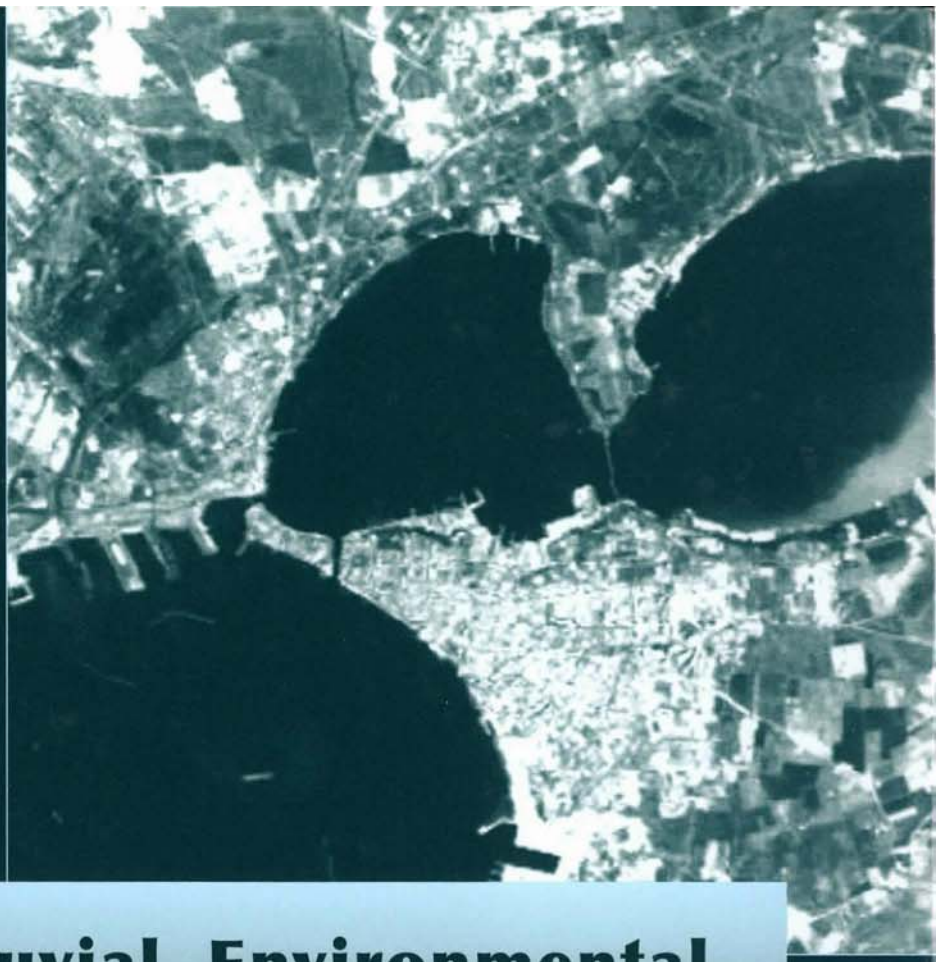

Fluvial, Environmental & Coastal Developments in Hydraulic Engineering

Edited by
M. Mossa, Y. Yasuda & H. Chanson

PROCEEDINGS OF THE INTERNATIONAL WORKSHOP ON STATE-OF-THE-ART HYDRAULIC ENGINEERING, 16–19 FEBRUARY 2004, BARI, ITALY

Fluvial, Environmental and Coastal Developments in Hydraulic Engineering

Edited by

Michele Mossa
Technical University of Bari, D.I.A.S.S., Italy

Youichi Yasuda
Nihon University, College of Science and Technology, Department of Civil Engineering, Tokyo, Japan

Hubert Chanson
University of Queensland, Department of Civil Engineering, Brisbane, Australia

A.A. BALKEMA PUBLISHERS LEIDEN / LONDON / NEW YORK / PHILADELPHIA / SINGAPORE

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Published by: A.A. Balkema Publishers, a member of Taylor & Francis Group plc
www.balkema.nl and www.tandf.co.uk

ISBN 04 1535 899 X

Printed in The Netherlands

Fluvial, Environmental and Coastal Developments in Hydraulic Engineering – Mossa, Yasuda & Chanson (eds),
© 2004 Taylor & Francis Group, London, ISBN 04 1535 899 X

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Preface

This book has grown out of a series of presentations given at the International Workshop on State-of-the-Art Hydraulic Engineering held in Bari from 16–19 February 2004, at the LIC, Coastal Engineering Laboratory of the Technical University of Bari, Italy, on the (i) behavior of air-water flows, (ii) stepped spillways, (iii) environmental and coastal hydraulics, and (iv) transition flows. Research in these areas is continuing and the recent development of sophisticated instrumentation promises to lead us to a better understanding of these topics.

Air–water flows have been studied recently compared to classical fluid mechanics. Laboratory and prototype investigations show the complexity of the free-surface aeration process. In this book the basic mechanisms of air entrainment is shown: singular aeration and interfacial entrainment. Basic dimensional analysis, similitude and scale effects are presented, with the aim to fill the gap between leading gas–liquid flow expertise and traditional hydraulic engineering.

New experiments on stepped spillways are presented in the book. The energy loss of skimming flows, in which the main flow skims on the stepped-channel chute, has been investigated by many researchers. But general agreement concerning experimental results has not been obtained. In this book, the energy loss of skimming flows is investigated systematically under a wide range of discharges, channel slopes, step heights, and dam heights. The energy loss of skimming flows is clarified, and the change of the energy loss with dam height and step height is discussed. Furthermore, interactions between free-surface and cavity recirculation are shown, and the air–water flow structures (bubble and droplet size distributions, clustering factor) have been analyzed, with the results discussed in the context of overflow embankment stepped spillway design.

Regarding environmental and coastal hydraulics, it is well known that environmental problems have assumed an increasingly pivotal role in recent years. One of the problems which causes particular concern and is still subject to study is wastewater ocean outfall. While there are several studies in literature on non-buoyant and buoyant jets and their interaction with currents, few deal with jet-wave interaction. Although stagnant ambient conditions are of interest, they are almost never present in real coastal environmental problems, where the presence of waves or currents is common. As a result, jets cannot be analyzed without considering the surrounding environment, which is only rarely under stagnant conditions. In particular, the study of jet-wave interaction still lacks experimental results. This section of the book presents results on jet-wave interaction, still rare in literature.

Furthermore, the increasing utilization of new resources and the progressive industrialization of wide areas were, over time, the cause of alterations in the environmental equilibrium, with important repercussions on plants, animals and human health. One of the most damaged natural elements is water and, hence, the aquatic environment (seas, rivers, lakes). Therefore the necessity of paying more attention to these systems has been growing, with the purpose of analyzing the effects and locating the causes of the pollution and managing it. For these reasons water quality models have been developed recently. The final goal is to simulate the consequences of different measures in improving water quality and then to determine the optimal measure both in the economical and environmental sense. To reach this ultimate objective ecological-hydrodynamic models should be developed, but several preliminary steps are needed. Since pollutants which flow into the sea are transferred by both advection and diffusion and react chemically and biologically, the priority is to configure the flow velocity and direction of the target area, so hydrodynamic models able to simulate circulation and currents are needed. Along with this, it is indispensable to test the output of the numerical model with real data taken in *situ* and/or in laboratory experiments. Therefore, one

of the studies shown in this book is an attempt to reproduce the principal ocean circulation patterns of the target basin under fixed conditions by means of a numerical model, and to validate it with field measurements, using a VM-ADP, Vessel Mounted Acoustic Doppler Profiler.

Analyses of tidal bores are also shown in one section of this book. The occurrence of a bore has a significant impact on estuarine systems. Bed erosion and scour take place beneath the bore front while suspended matter may be carried upwards in the sequential wave motion. Tidal bores also have a significant impact on eco-systems. The existence of tidal bores relies upon a fragile hydrodynamic balance, which may be easily disturbed by changes in boundary conditions and freshwater inflows. All these important aspects are presented in this book.

Another important aspect of environmental hydraulics is the new fishway design and the effect of the fishway on the migration of aquatic animals. A section of the book shows the interesting work that was carried out in order to arrange a fishway in the slit-type Sabo dam, where new fishways for the migration of aquatic animals were proposed. In this part of the book a discussion is presented on the effect of the proposed new fishways on the migration of multi-diadromous aquatic animals that live in the local river. A design method for arranging the proposed fishway in a slit type concrete Sabo dam is also introduced. Furthermore, experimental results revealed that diadromous crabs, shrimp (i.e., crustaceans), and swimming and benthic fish can migrate easily upstream and downstream by the proposed fishway.

The flow condition immediately downstream of hydraulic structures such as dams, weirs, and drop structures is apt to become from supercritical to subcritical transition flows. In the transition flow, various types of flow conditions are formed in accordance with inflow Froude number, boundary-layer development at inflow section, aspect ratio, relative downstream depth, channel geometry, Reynolds number, air concentration at inflow section, etc. Systematical clarification of the transition flows is the most significant for effective hydraulic design of hydraulic structures. In this book, a section is reserved for the analysis of various types of transition flows, presented on the basis of experiments in the hydraulic laboratory.

Finally, I would like to express my personal appreciation for the discussions and the research contributions from all the participants at the workshop. I am sure that all the contributions represent a significant improvement in the very wide field of Hydraulic Engineering. Special thanks to the Editors, who desired this workshop and contributed to the writing of this book.

Antonio F. Petrillo
Full Professor of Hydraulics
Person in Charge of the LIC (Coastal Engineering Laboratory)
Technical University of Bari, Italy

The Editors (from the left, Prof. M. Mossa, Prof. Y. Yasuda and Prof. H. Chanson) and some participants.

Fluvial, Environmental and Coastal Developments in Hydraulic Engineering contains the Proceedings of the International Workshop on State-of-the-Art Hydraulic Engineering (16-19 February 2004, Bari, Italy). The book is divided into four sections:

1. Air-water flows / Transitional flows;
2. Stepped chute / Transitional flows;
3. Environmental and coastal hydraulics with dispersion in estuaries and jets, and
4. Transitional flows.

In this volume the energy loss of skimming flows is investigated systematically under a wide range of discharges, channel slopes, step heights, and dam heights.

It is well known that in recent years environmental problems have an increasing pivotal role. The section on environmental and coastal hydraulics presents results on jet-wave interaction, which is still rare in literature. It also includes an attempt to reproduce the principal ocean circulation patterns by means of a numerical model, and to validate this with field measurements, using a Vessel Mounted Acoustic Doppler Profiler (VM-ADP). Other topics covered in this section are (a) tidal bores, which have a significant impact on estuarine systems, and (b) new fishway design and the effect of fishways on the migration of aquatic animals, including a design method for arranging the proposed fishway in the slit-type concrete Sabo dam.

Various types of flow conditions are formed in accordance with inflow Froude number, boundary-layer development at inflow section, aspect ratio, relative downstream depth, channel geometry, Reynolds number, and air concentration at inflow section. As systematical clarification of the transitional flows is most significant for effective hydraulic design of hydraulic structures, various types of transitional flows are analyzed, and presented.

The volume is of special interest to scientists and students of hydraulics and fluid mechanics, to engineers, and to specialists in the field of environmental protection.