Dams and Appurtenant Hydraulic Structures

2nd Edition

Ljubomir Tanchev

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Ljubomir Tanchev
University professor, retired


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Illustration front cover:
Arch dam "Karun 3", 2004, Khuzestan Province, Iran, 205 m in height.

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Preface

It is now more than ten years since the manuscript of the first edition was completed. This new (second) edition gave me a good opportunity to correct some errors, to update the text and references throughout, and, most importantly, to rewrite and enlarge parts of the text in response to some important developments in the field of dam design, analysis and construction. Major changes were imposed by the development in the field of embankment dam analysis (Chapters 8 and 9), concrete faced rockfill dams (Chapter 12), rockfill dams with a geomembrane facing (Chapter 13), rockfill dams with internal non-earth core (Chapter 14), roller-compacted concrete gravity dams, and hardfill dams (Chapter 18), and roller-compacted concrete arch dams (Chapter 20).

The main aim of the book remains the same as that of the first edition, i.e. to provide a complete and comprehensive picture of dams and the appurtenant hydraulic structures which are essential for their safe functioning, to: engineers specialising in the design, construction and exploitation of dams, to researchers and higher degree candidates in science, and to post-graduates in the fields of civil engineering, hydraulic engineering and environmental protection. The author also hopes that it will prove a useful text for students in their final year of undergraduate studies in the relevant disciplines.

The author would like to thank the publisher for the great effort made in providing the opportunity for this second edition.

Ljubomir Tanchev
Skopje, October 2013

Preface to the first edition

Water, one of the few natural resources without which there is no life, is distributed throughout the world unevenly in terms of place, season and quality. For this reason it is essential to construct dams on rivers, thus forming reservoirs for the storage and the even use of water. To date, forty-two thousand large dams have been built worldwide, and hundreds of thousands of smaller ones, which have made possible a rational use of a certain amount of river water – the most important water resource for human life and activity. Dams, together with their appurtenant hydraulic structures, belong among the most complex engineering works, above all because of their interaction with the water, their great influence on the environment and their high cost. Therefore great significance is given to theoretical research relating to dams, to improving the methods of analysing and constructing them, and to the knowledge gained in the course of their exploitation. In the past forty years great progress has been made in this respect.

More than twenty large dams and over a hundred smaller ones have been built in the Republic of Macedonia, which have still only partially exploited the available water, and flood control remains incomplete. The majority of the large dams were built in the period from 1952 to 1982 while, principally because of the lack of investment, the past twenty years have seen the construction mainly of smaller dams with a height of up to twenty metres and a reservoir volume of 300,000 cubic metres. In the next few years some two or three more large dams will be completed which will still not satisfy the need for water for the water supply, for irrigation and for the production of electrical energy, which are continually on the increase. The situation in all developing countries is similar, so that dams will continue to be built in the future despite the resistance on the part of devotees of the unobstructed flow of rivers.

The volume you have before you is a translation of the publication which came out in Macedonian in 1999, with certain improvements and additions. The text has been written with the intention of providing the reader with a comprehensive picture of dams and the appurtenant hydraulic structures which are essential for their safe functioning. The author hopes that it will prove useful to engineers specialising in the design, construction and exploitation of dams, to researchers and higher degree candidates in science, and to post-graduates in the fields of civil engineering, hydraulic engineering and environmental protection. Three years of experience of the Macedonian edition of the book have also demonstrated that a remarkable interest in it has also been shown by students in their final year of undergraduate studies in the relevant subjects.

Some 70% of the book is concerned with dams, while 30% is devoted to appurtenant hydraulic structures, hydromechanical equipment and to river hydraulic

schemes. The material is divided into five parts and thirty-five chapters. The *First Part* considers general questions about dams and appurtenant hydraulic structures (Chapters 1–5). The *Second Part* is devoted to embankment dams (Chapters 6–15) and the *Third Part* to concrete dams (Chapters 16–22). The *Fourth Part* deals with hydromechanical equipment and appurtenant hydraulic structures at dams (Chapters 23–30) while the *Fifth Part* is concerned with river hydraulic schemes as follows: Chapters 31 and 32 with the composition of structures in various different designs and types of hydraulic schemes, Chapter 33 with reservoirs, and Chapter 34 with the negative effects of river hydraulic schemes and with environmental protection, while Chapter 35 looks into questions of major importance relating to the repair and reconstruction of river hydraulic structures.

The most important achievements of the author's 25 years of research and practical work in the field of dams and hydraulic structures together with the achievements and experience of colleagues at the Department of Hydraulic Structures of the Faculty of Civil Engineering at the Ss. Cyril and Methodius University in Skopje have been incorporated into this book, and at appropriate points virtually all the more important dams in the Republic of Macedonia are described.

The list of people and institutions who have supported and assisted me in preparing this edition of the book is a long one. I would like to thank the *Fund of Waters* – Skopje, and the *Institute for Testing of Materials and New Technology 'Skopje'*, which financially supported the translation that was accomplished by Mr. Blagoja Neškoski and Prof. Graham Reid. I would also like to express my gratitude to the publisher who has made an English edition possible.

Ljubomir Tančev
Skopje, January 2005

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