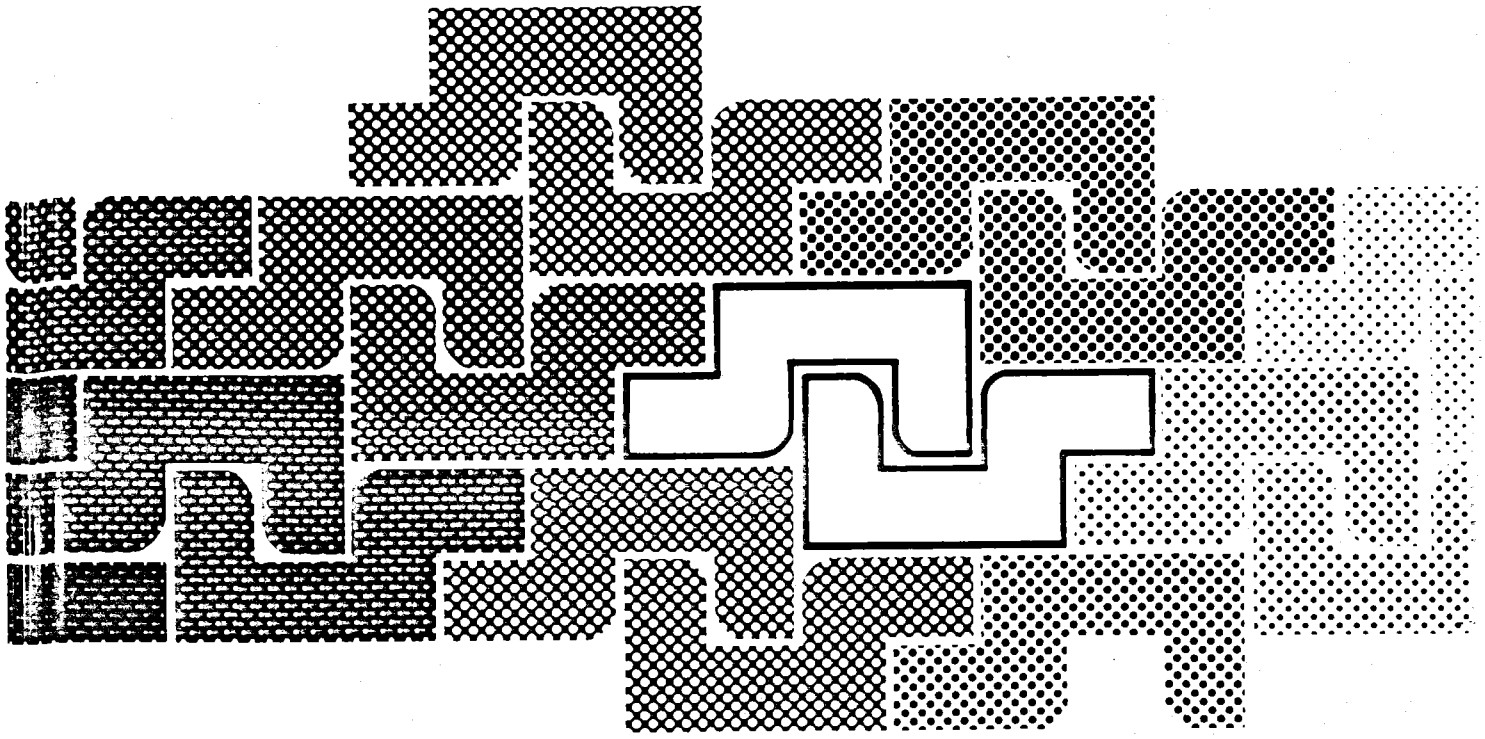
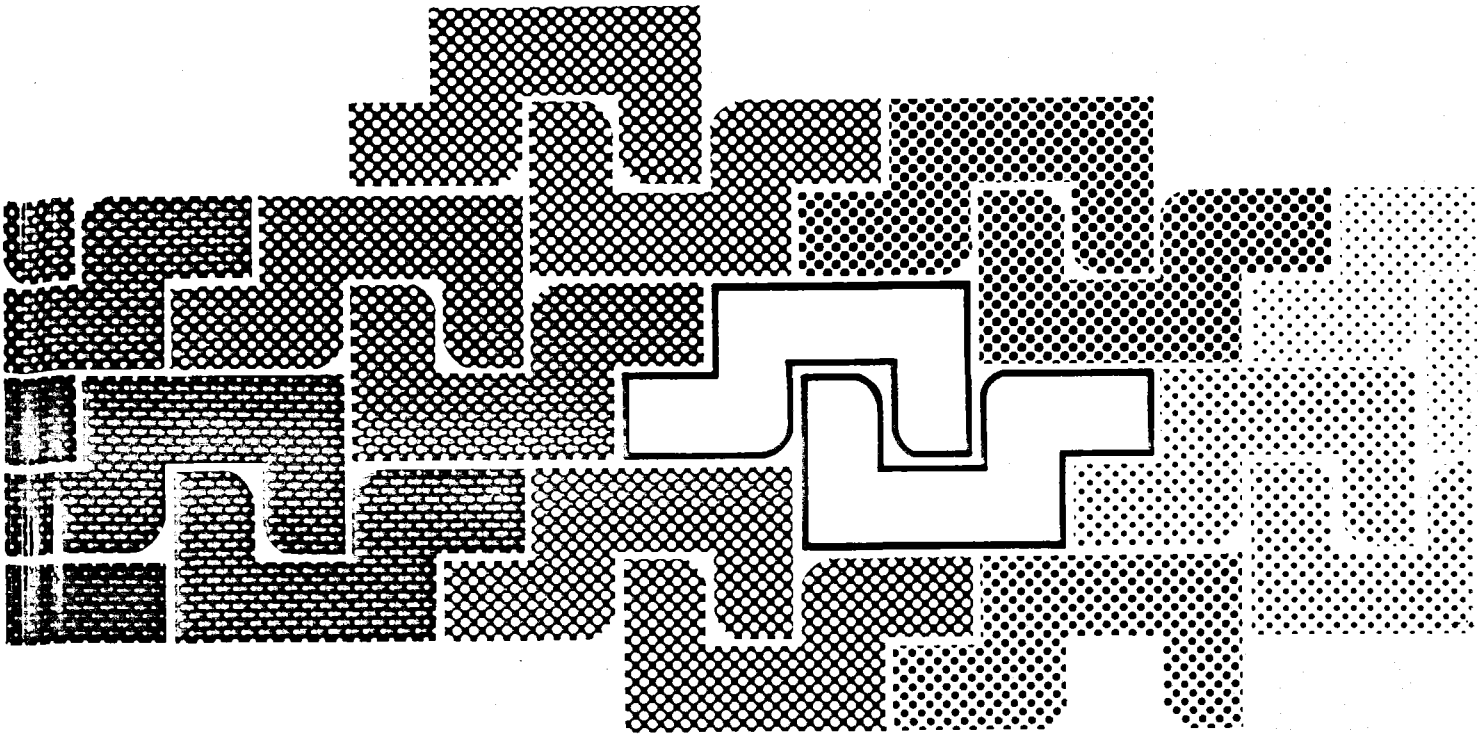


Engineering Reliability and Risk in Water Resources

Edited by

L. Duckstein and E.J. Plate

NATO ASI Series



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PREFACE

Hydraulic, hydrologic and water resources engineers have been concerned for a long time about failure phenomena. One of the major concerns is the definition of a failure event E, of its probability of occurrence P(E), and of the complementary notion of reliability. However, as the stochastic aspects of hydraulics and water resources engineering were developed, words such as "failure," "reliability," and "risk" took on different meanings for different specialists. For example, "risk" is defined in a Bayesian framework as the expected loss resulting from a precisely defined failure event, while according to the practice of stochastic hydraulics it is the probability of occurrence of a failure event. The need to standardize the various concepts and operational definitions generated numerous exciting discussions between the co-editors of this book during 1983-84 when L. Duckstein, under sponsorship of the Alexander von Humboldt Foundation (FRG), was working with E. Plate at the Institute of Hydrology and Water Resources of the University of Karlsruhe. After consulting with the Scientific Affairs Division of NATO, an organizing committee was formed. This comittee -- J. Bernier (France), M. Benedini (Italy), S. Sorooshian (U.S.A.), and co-directors L. Duckstein (U.S.A.) and E.J. Plate (F.R.G.) -- brought into being this NATO Advanced Study Institute (ASI).

Precisely stated, the purpose of this ASI was to present a tutorial overview of existing work in the broad area of reliability while also pointing out topics for further development. In order to provide a coherent set of lectures, substantial effort was undertaken to present a common mathematical framework for the various aspects of reliability and risk in water resources. This framework was to include the structural reliability aspects that refer to failure of structures such as dams, spillways, lakes, and locks, and the target-related reliability aspects that deal with water supply, both quantity and quality, for multiple purposes. The ASI program thus included sets of tutorial lectures on background, state-of-the-art, and pioneering aspects of reliability and risk. The present book is a reorganized and edited version of most of the lectures presented during the ASI.

It is remarkable that in November 1985, six months after the ASI, two meetings were held on subtopics of the ASI. The first was an Engineering Foundation-sponsored conference in Santa Barbara, California on "Risk-Based Decision Making in Water Resources." This conference dealt mainly with structural reliability. The second meeting was a workshop organized under the auspices of HYDROQUEBEC and the University of Montreal on "Risk Analysis in Hydrologic System Operations." As indicated by the title, only target-related reliability and risk were considered. Several participants in the NATO ASI also participated in at least one of these meetings.

It is hoped that other research endeavours will be developed from ideas presented at the ASI. The target readership of this book is a mix of university colleagues, practitioners from both the private and public

sectors, and advanced graduate students working in various hydrology and water resources-related branches of engineering. This is also the background of the participants in the ASI.

The book is organized as follows: The Introduction begins with a paper in which Duckstein, Plate and Benedini develop a systems engineering framework for incident and failure-related criteria. This framework embeds hydraulic and hydrologic reliability, and can thus be applied to the study of both structure-related and target-related reliability (and risk). This introduction thus strives to provide elements of a common language for the remainder of the book, which consists of three main sections that focus on structural reliability, supply reliability and decision-making. Each of these sections is preceded by introductory material designed to put the papers into perspective.

We gratefully acknowledge our sponsors, namely, the NATO Scientific Affairs Division, the Salt River Project (Arizona), the City of Tucson, the Arizona Foundation (Tucson), and the University of Arizona Department of Hydrology and Water Resources and Department of Systems and Industrial Engineering. We also are grateful to all the ASI lecturers, including those whose papers could not be included in this book for a variety of reasons, the lively ASI participants, and many individuals who helped kindly before, during, and after the ASI. In particular, we wish to thank JoAnn Roof and Corla Thies, who handled most of the correspondence and logistics; colleagues Russ Ferrell and Moshe Shiedovich; graduate students Jené Hendrickson, Aregai Tecle, Juan Bernal, Anand Rakshit, Leo Salgado, and others; technical editor Sally Adams and administrative assistant Janolyn Berry, who handled the preparation and typing of the final manuscript; and last but not least, our families here in Tucson who hosted this event as their own.