

The hydraulics of stepped chutes and spillways¹

By Hubert Chanson

Stepped chutes have received considerable attention within the past decade because they are an available alternative method to conventional smooth-concrete spillways for safely discharging flood waters over spillways and partly over embankments. Stepped chutes are not a novelty but the combination of the Roller compacted concrete method with a fast, economical, and safe construction method of particular interest to the civil engineering profession. Accordingly, that branch of hydraulics suddenly was reactivated with hundreds of research contributions over a comparatively short time period. Chanson was and is still one of the authors that contribute significantly to the understanding of the hydraulics of stepped spillways. He has authored other books in that branch, the work presently under consideration being the first devoted entirely to stepped channel flows.

The book is subdivided into ten chapters and presented as follows: (1) introduction, (2) historical development, (3) nappe flow regime, (4) transition flow regime, (5) skimming flow, (6) mass transfer, (7) design, (8) accidents and failures, (9) wave phenomena, and (10) summary. In addition, a rather long glossary including a historical background and nine appendices are added. Chapters 3–5 involve the hydraulics of stepped chutes, including the three different types of flow that are now termed the nappe and the skimming flow, plus the transition between the two. Chapter 5 may be considered typical and of main interest for readers because features like skimming flow and entrainment of air discussed together with the characteristics of fully developed skimming flow are presented. The latter section may be considered the core of this book because the main characteristics of skimming flow are discussed, such as air entrainment, velocity distribution, flow resistance, and the gradually varied flow region. There is also a section on the energy dissipation of stepped chutes, a topic that has created lots of discussion among researchers because of the proper definitions and the adequate methods of measurement of a highly turbulent two-phase flow. It should be noted that all these aspects cannot yet be considered as a final state-of-the-art method, given

the many research projects currently under progress, the significant limitations of the individual mainly experimental results due to reasons of particular experimental setups, and the progress in instrumentation that allows improved observation and discussion of those flows as compared to 10 years ago.

Chapter 7 is intended as a summary of the presently available knowledge that should be intended for the designer. After a description of phenomena associated with stepped chutes, the reader would thus expect that the design guidelines be presented. However, Chanson continues with still other material directed to the history of those structures, to the instrumentation used, and to other fields and thus dilutes the essential message of how to design these structures. The interested reader is, once at that point, definitely eager to learn how a stepped chute should look like and finds a partial answer in that chapter, in the summary chapter, and in the appendix. It is thus unfortunate that this important information of how to design a definite hydraulic structure, to which that work is directed, may not be found in the chapter under which it would be expected. The book includes an exhaustive list of references in which almost all works ever written in that narrow topic are included plus an extensive index that should be welcomed by the fast reader.

To conclude, this book may be regarded as the first book and also the most complete document available on stepped spillways with a particular value as a reference on that topic. It is a pity that the individual chapters do not contain the material that is described in the respective chapter titles and that a real design chapter is not presented. This book can be recommended to specialists in that field of modern hydraulics that are looking for broad information without special requests for design considerations.

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