Chapter

Introductory Chapter: Hydraulic Structures for Managing Water Resources Efficiently

Amimul Ahsan and Monzur Imteaz

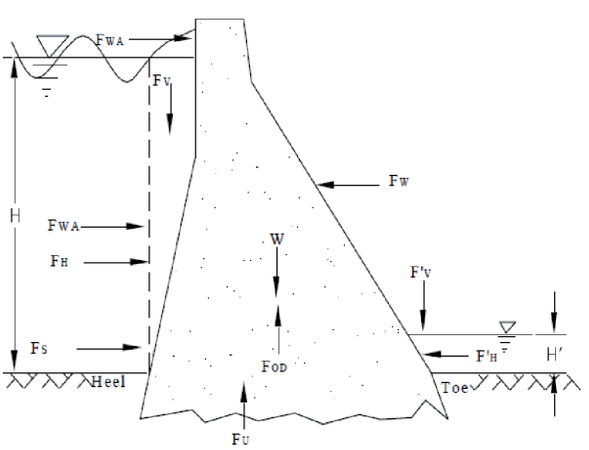
1. General

This book (*Hydraulic Structures: Theory and Applications*) conveys a broad understanding of the fundamental mechanisms of various hydraulic structures. The emphasis is given on analysis and design of different types of hydraulic structures. Various applications of the hydraulic structures analysis are also incorporated in this book. The aim of the book is to provide a text for undergraduate and postgraduate students. Researchers, designers, and operators of hydraulic structures can find the text of interest and a stimulating up-to-date reference source.

2. Hydraulic structures

Hydraulic structures such as dam, reservoir, culvert, weir, and spillways are engineering constructions designed and maintained for managing and utilizing water resources efficiently for the betterment of human being and to save our environment. A dam is a barricade across flowing water that obstructs or directs or retards the water flow, commonly forming a reservoir [1–3]. **Figure 1** represents the typical forces acting on gravity dam. **Figure 2** shows the plan and longitudinal section of a rectangular culvert and a trapezoidal weir. **Figure 3** shows the hydraulic scheme and cross-section of a trapezoidal weir.

In general, a lake is an area that is filled with water and enclosed by soil, and it may have inlet(s) and outlet(s). An artificial lake can be a reservoir that is created



Where:
H = *Head water depth*
H' = *Tail Water depth*
F_{WA} = *Wave pressure force*
F_H = *Horizontal hydrostatic force*
F_S = *Silt/sediment pressure force*
F_{EQ} = *Earthquake/Seismic force*
F_W = *Wind pressure force*
$F_{H'}$ = *Tail water hydrostatic force*
W = *Weight of dam*
F_{OD} = *Internal pore water pressure*
F_U = *Uplift pressure force [base of dam]*
F_V = *Weight of water above dam [u/s]*
$F_{V'}$ = *Weight of water above dam [d/s]*

Figure 1.
Typical forces acting on gravity dam [1].

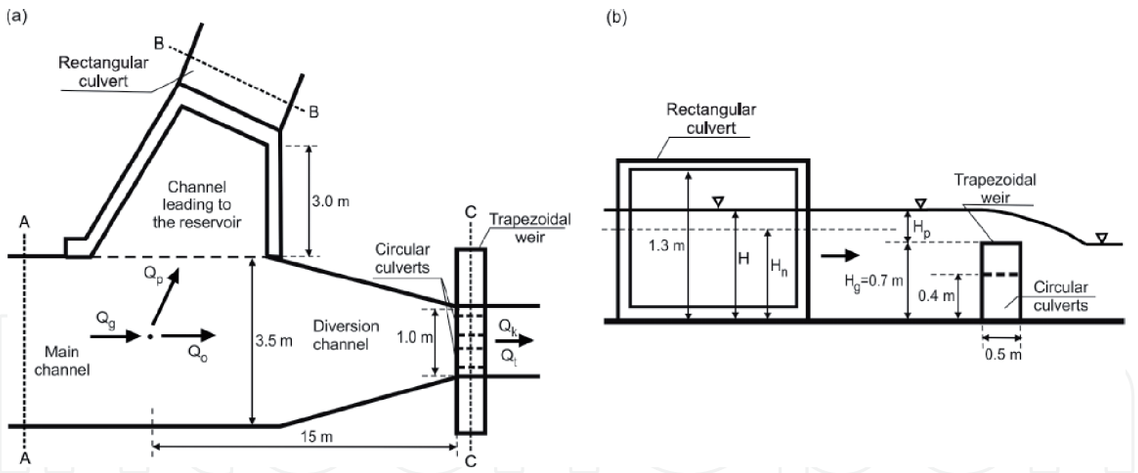


Figure 2.
Plan and longitudinal section of a rectangular culvert and a trapezoidal weir [4]. (a) Plan of culvert and weir, and (b) Longitudinal section of culvert and weir.

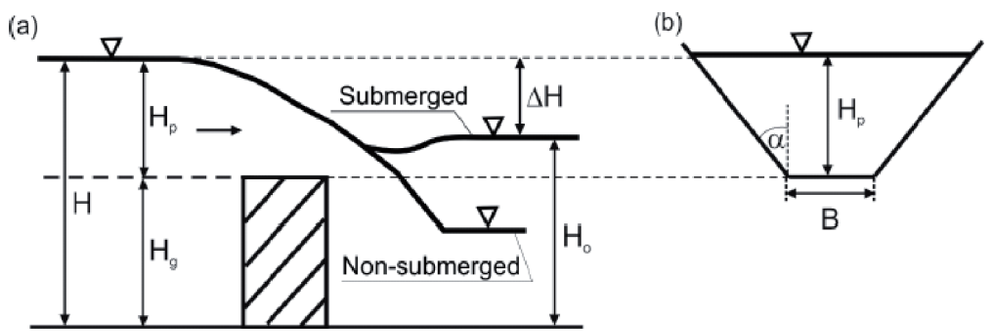


Figure 3.
Hydraulic scheme and cross-section of a trapezoidal weir [4]. (a) Hydraulic scheme of weir, and (b) Cross-section of weir.

behind an embankment or a dam by flooding soil. A few of the biggest lakes in the world are reservoirs. A spillway is a segment of an embankment or a dam intended to carry water downstream from the upstream side of an embankment or a dam. It may have doors that are intended to regulate the flow of water, i.e., flood. Flood can be defined as a water overflow on the soil, which is an accumulation of water over land that is not normally submerged [1].

The differences between dam and embankment and causeway are clarified. A dam is a wall constructed across a river to create a reservoir upstream side, an embankment is a built-up river or seawall (at the shore or bank), whereas a causeway is a high road or path across wet or tidal ground. A few railway embankments are also constructed using the same idea [3].

Ghomri et al. [5] studied the hydraulic jump of a hydraulic structure controlled by threshold, moving in a channel profile in a lab scale for a single roughness. The hydraulic jump was developed at the sharp transition from a supercritical flow.

3. Plant basket hydraulic structures (PBHS)

River restoration is attractive as it offers considerable benefits to the environment and economy. A new plant basket hydraulic structure (PBHS) as a new river restoration measure is applied in the Flinta River, central Poland. It focuses on changes of hydromorphological conditions in a small lowland river. This is a pilot project of the construction of vegetative sediment traps (plant basket hydraulic structure) [6].

4. Conclusions

Various types of hydraulic structures are used in the world. Each of them has pros and cons. The readers of this book (*Hydraulic Structures: Theory and Applications*) will appreciate the current issues on analysis of hydraulic structures in different aspects. The approaches would be applicable in various industrial purposes as well. The advanced idea and information described here on hydraulic structures will be fruitful for the readers to find a sustainable solution in an industrialized society.

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