Closure works

Interactive professional course

Cover photo: Closing of the Saemangeum estuary, Korea (Maartje van der Sande/TU Delft).

Closure works

Interactive professional course

Henk Jan Verhagen

TU Delft Delft University of Technology

DAP Delft Academic Press

Related textbooks published by VSSD:

Introduction to bed, bank and shore protection, Engineering the interface of soil and water
Gerrit J. Schiereck, updated by Henk Jan Verhagen
2012/ xii+411 p./ISBN 978-90-6562-306-5
eBook: ISBN 978-90-6562-307-2
www.delftacademicpress.nl/f007.php

Ebb and Flood Channel Systems in the Netherlands Tidal Waters
Johan van Veen
2002 / 32 p. / ISBN 978-90-407-2338-4
eBook ISBN 978-90-6562-228-0
www.delftacademicpress.nl/f015.php

Het verjaagde water
A. den Doolaard
Edited by K. d'Angremond en G.J. Schiereck
2001 / 592 p. / ISBN 978-90-407-2224-0
eBook ISBN 978-90-6562-277-8
www.delftacademicpress.nl/f012.php

First edition 2016
Published by
Delft Academic Press / VSSD
Leeghwaterstraat 42, 2628 CA Delft, The Netherlands
Tel.+31 15 27 82124
e-mail: dap@vssd.nl
about this book: **www.delftacademicpress.nl/f048.php**

ISBN 978-90-6562-4024
NUR 956
Keywords: coastal engineering, closure dams, closure works

Table of Contents

1. Introduction

For this book we have deliberately chosen that the text should follow a more or less logical design procedure for closure dams. It is emphasized that only the construction aspect of stopping the water movement is considered in this book. This means that only the closing operation itself is treated; the transformation of the closing dam into a permanent structure like an embankment is beyond the scope of this book.

It is expected that the reader possesses basic knowledge of hydraulic engineering. Only in some cases, where they are deemed useful for a proper understanding of the actual design process, are aspects of basic hydraulic engineering presented. For more background info on the interaction between water and bed protections is referred to SCHIERECK, G.J. [2001].

This book is an educational textbook, not a design manual or a reference book. Part of this book is based on a lecture note by VAN ROODE [1994].The focus of this book is the understanding of the basic principles. It is not an overview of all existing formulas pertaining to closure dam design. Also, because the results of new research will modify existing formulas, it is not useful to focus on the minute details of such formulas, but more on the physical concepts behind the formulas. For a reference book describing all aspects related to closure works is referred to HUIS IN 'T VELD, *ET AL*. [1984].

2. Positioning the subject

In this chapter the subject "closure works" is positioned. It is related to other works, the different types are explained and a historical overview of the subject is given.

2.1 General aspects

Closure dams are constructed for a variety of very different purposes; such as the creation of a separate tidal basin for power generation or as sea defence structures to increase safety. Compared to closure works, few other engineering works have such an extensive impact on the environment in all aspects. For instance, the main purpose of the construction of the Afsluitdijk closure dam in the Netherlands was to provide protection against high storm surge levels and to facilitate land reclamation. Additional advantages were fresh water conservation and a road connection between the provinces of Holland and Friesland. The purpose of a closure dam may be one or more of such objectives, but these are automatically accompanied by other side effects, some of which may be negative. A thorough study of these impacts is part of the design process. A feasibility study that does not detail and forecast the negative aspects of the closure works is incomplete and valueless. These partly unforeseen negative effects for the Afsluitdijk include: the drastic change in tidal amplitude in the Waddenzee, consequential impact on the morphological equilibrium of the tidal flats and channel system, the social impact on life and employment in the bordering cities, the influence on drainage and the ground water table in the surrounding land areas, the changes to the fisheries industry, and effects on flora and fauna.

Non-technical aspects, including environmental, social and cultural values, cannot be expressed in financial terms. The evaluation of such considerations is not within the scope of this book. Nevertheless, engineers must identify the consequential effects to the best of their ability and present them in such a way that they are understood by decision-makers.

This book focuses on the technical aspects of the construction of a closure dam in a variety of circumstances. Every closure operation is a struggle against nature. Every action taken to obstruct the water flow will immediately be counteracted by nature itself. The knowledge gained from experience, whether successful or not, is supplemented by the results of advanced research and experiment. Nevertheless, the changes in conditions during the progression of the closure are

sometimes difficult to predict. Allowing for flexibility in operations that are incorporated in the design provides an important tool.

2.2 Functions of a closure work

There are three main categories of closure works:

- closure of tidal inlets, estuaries, etc.
- closing works in rivers, mainly to create diversion dams
- closing of existing dikes around low lying land, usually after a breach in such a dike

It is good to mention that the construction of reservoir dams is not a part of this course on closure works. There could be many functions of closure works. Sometimes a combination of several functions is present. Functions of closure works could be:

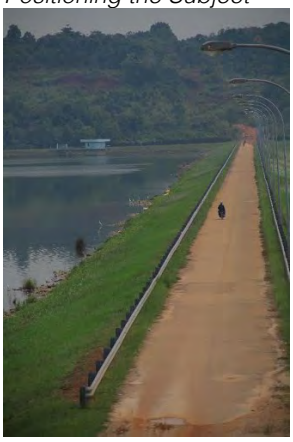
Land reclamation
An example of such a closure is the Afsluitdijk in the Netherlands. The dam creating a non-tidal lake, not influenced by storm surges where the creation of reclamation works was relatively easy. Also in Korea this was often the main driver for closure works.
Photo: Saemangeum dam, SGFEZ Authority

Shortening of the length of a sea defence
After the storm surge disaster of 1953 it was decided in the Netherlands to close off a number of estuaries and inlets. The main reason was that in this way the length of the sea defence could be reduced with several hundreds of kilometres. This decreased the maintenance effort considerably. Also the closure of the Feni river in Bangladesh is an example of such a closure.
Photo: Brouwersdam, Netherlands, beeldbank Rijkswaterstaat

Creating a fresh water reservoir

In many locations in the world there is during the dry season a shortage of fresh water. Often a tidal inlet is present and can be used. The Duriangkang reservoir on Batam island (Indonesia, near Singapore) is an example. But this was also one of the major reasons for the closure works in Korea.

Photo: Duriangkang reservoir dam, T. Palgunadi, Panoramio



Creation of a tidal energy basin

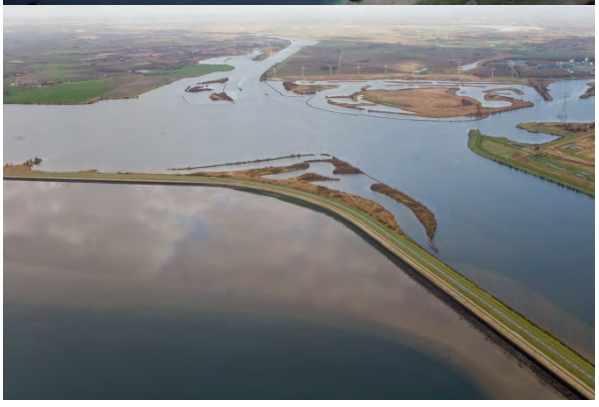
The dam through the Rance estuary in France was constructed for this purpose. But also the closure dam of the Siwha estuary just south of Seoul in Korea is a dam for the creation of tidal power[1].

Photo: La Rance tidal basin "Barrage de la Rance" by Tswgb/Wikipedia

Creation of a fixed-level harbour basin

An example of this is the navigational fairway from Antwerp to Rotterdam (Schelde-Rijn verbinding). The Oesterdam has been constructed especially for this function.

Photo: Oesterdam, Beeldbank Rijkswaterstaat



[1] Originally this dam was created for reclamation and as a freshwater reservoir. However managing the lake as a freshwater reservoir proved impossible, and later the reservoir was converted to a tidal power reservoir.

Creation of a construction dock
In order to build large structures in the middle of a large waterbody a dry hare has to be created. An example of this is the building dock for the construction of the Haringvliet sluices.
Photo: Haringvliet sluices under construction, postcard

Providing a road or railroad
In Germany the connection from the mainland the island of Sylt is an example. In the Netherlands the railroad from Brabant to the city of Middelburg had to cross two tidal channels (Sloe and Schelde); these channels were closed with a closure dam
Photo: Hindenburgdam in the sixties, from a German postcard

Repair a dike breach
After the storm surge of 1953 many dikes in the Netherlands were breached. Especially in the tidal area closing is a complicated job. But also non-tidal breaches in rivers are sometimes a problem, especially when the surrounding land is lower than the normal water level in the river. This was for example the case during the floods of Yangtze river in 1998.
Photo: closure of the Schelphoek-breach in 1953, KLM-Aerocarto