EurOtop wave overtopping manual: development of the manual and its application in practice

Dick Thomas, Chrissy Mitchell, \textsuperscript{1}Tim Pullen, William Allsop, Jentsje van der Meer, Tom Bruce, Holger Schüttrumpf and Andreas Kortenhaus

\textsuperscript{1}Senior Engineer, HR Wallingford, Howbery Park, Wallingford, OXON, OX10 8BA, UK. tap@hrwallingford.co.uk, Tel: 0(044)1491 822231

Introduction
This paper describes the new Wave Overtopping Manual (EurOtop) developed for EA / Defra, Rijkswaterstaat in the Netherlands and the German Coastal Engineering Research Council (KFKI). The new manual extends and updates the EA's Overtopping Manual (W178) (Besley, 1999), the Netherlands TAW manual (Van der Meer, 2002), and the German Die Küste (EAK, 2002). Considerable research since those publications prompted the production of an updated and extended manual combining European expertise. Research for Defra and the Environment Agency, carried out at HR Wallingford, has provided considerable research into overtopping at embankments and dikes, and the recent European research project CLASH (de Rouck et al. 2005) has expanded understanding of overtopping and scale effects.

EurOtop draws on advice developed for the equivalent guides in the Netherlands and Germany, and incorporates the latest techniques and data from European and UK research on wave overtopping predictions. EurOtop covers more types of sea and shoreline defence structures, gives more detail on overtopping responses, and includes a wider choice of how to calculate those responses. EurOtop is supported by a Calculation Tool, a web-based tool that guides the user through a series of steps to establish empirical overtopping predictions as described in the manual.

Understanding future changes in flood risk from waves overtopping at seawalls and other structures is a key requirement for the effective management of coastal defences. Occurrences of loss of life and economic damage due to the hazardous nature of wave overtopping are becoming more frequent, and coastal managers and users are becoming more aware of health and safety risks. Seawalls make up most of these defences, and range from simple earth banks through to vertical concrete walls and on to more complex composite structures. Each of these require different methods for assessing the overtopping. In the UK, the Environment Agency guidance on seawall design requires that issues such as climate change, sea-level rise, and increased awareness of hazards, can be fully included in design analysis.

Guidance on tolerable mean overtopping discharges have been completely revised, and detailed explanations of the wave overtopping processes and hazards (see Figure 1) are described. Discussion concentrates on the different ways in which waves overtop and how this should be interpreted, with particular emphasis on the different discharge rates for different structure types and use. Full details on EurOtop, including a downloadable copy, can be found at http://www.overtopping-manual.com.

Figure 1: Hazardous overtopping.

The Manual
EurOtop incorporates new techniques to predict wave overtopping at seawalls, flood embankments, breakwaters and other shoreline structures facing waves. Supported by web-based programmes for the calculation of overtopping discharge and design details, EurOtop’s appendices include case studies and example calculations. EurOtop has an author team of experts in the field of overtopping from several European countries, and has been supervised by a steering committee representing owners and designers from across Europe. EurOtop presents the latest techniques and approved methods for establishing overtopping hazards and flooding for an extensive range of structure types.

EurOtop has been intended to assist an engineer analyse the overtopping performance of any type of sea defence or related shoreline structure found around Europe. The methods described can be used for current performance assessments and for longer-term design calculations. The manual defines different types of structure, provides definitions for each of the parameters, and gives some guidance on how the results should be interpreted. It gives discussions on waves and water levels in the context of overtopping, and wave overtopping processes. A chapter on hazards is included that gives guidance on tolerable discharges and overtopping processes. Further discussion describes the different methods available for predicting or assessing overtopping discharges, such as empirical methods, physical modelling and numerical techniques.
Empirical Methods

Embankments and Dikes: Discusses empirical wave overtopping methods for coastal dikes and embankment seawalls. This includes the techniques described in the Dutch (TAW) and German (EAK) overtopping manuals, in addition to the method of Owen. This chapter expands upon the techniques described in the previous manual (Besley, 1999) for simplified embankment structures and explains how to assess overtopping discharges on compound embankment structures (see Figure 2).

Figure 2: Complex compound structure.

Rubble Mound Structures: This covers overtopping for rubble mounds and armoured slopes and uses the techniques described for embankment structures. It includes new coefficients for a much wider range of armour types.

Vertical Structures: Overtopping at vertical, steeply battered and compound vertical structures (see Figure 3) is covered. Considerable research on vertical structures has been completed since the last manual was published, and the new techniques will be included here.

Each of the empirical methods describes how deterministic and probabilistic overtopping assessments can be made, and the degree of any uncertainty that should be considered. Methods are described that can be used to adjust predictions to allow for any scaling or wind effects.

Calculation Tool

Accessible from the website, there is an online Calculation Tool that guides the user through a series of steps to establish empirical overtopping predictions for: embankments and dikes; rubble mound structures; and vertical structures. By clicking on graphical representations of structure types and structural features, and by adding the dimensions of the geometric and hydraulic parameters, a range of outputs will be calculated and displayed online (see Figure 4). Mean overtopping discharges, overtopping volumes and the percentage of overtopping waves will be displayed. Where appropriate, the calculation of flow velocities and depths at the crest of waves overtopping sloping structures will be given.

A tool developed from the Dutch (TAW) overtopping manual is also available for online calculations. The CLASH Neural Network calculation tool can be downloaded and can be used for structures of an unusual geometry. The calculation tool can be found at http://www.overtopping-manual.com.

Figure 4: EurOtop Calculation Tool

References


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