THE EFFECT OF VERY OBLIQUE WAVES ON WAVE OVERTOPPING AT A CONVEX FORMED SEA DIKE

B. Scheres[1], S. Lorke[1], R. Pohl[2], J.W. van der Meer[3] and H. Schüttrumpf[1]

Paper topic: Laboratory and field observations and techniques

1. Introduction

The mean overtopping discharge is one of the key parameters for the design of coastal dikes. Former laboratory experiments resulted in design guidance for straight aligned dikes under wave attack with angles up to ± 60° (0° is defined as perpendicular wave attack). However more oblique approaching waves or even waves propagating parallel to the dike can be found during field observations. Furthermore the behavior of waves at convex and concave formed parts of coastal structures still needs to be examined. Model tests to analyze the influence of very oblique wave attack on wave overtopping at a convex formed dike were carried out during the EU-HYDRALAB-CornerDike project and are described in the following sections.

2. Model setup

Laboratory model tests were performed within the EU-HYDRALAB-IV CornerDike project in the shallow water basin of DHI in Hørsholm (Denmark) in 2012. The wave run-up and wave overtopping on a 1:4 sloped dike were investigated during these tests. The dike was formed convex with an angle of 90° and was rotated by 15° to assure a fully developed wave field at both dike arms. Figure 1 illustrates the model setup.

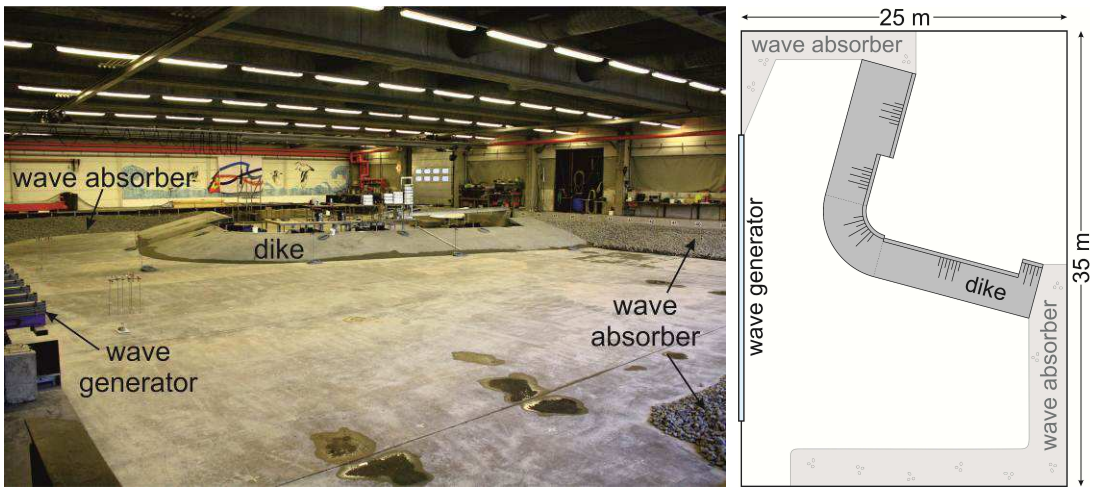

Figure 1. Overview of the model setup (left) and plan view (right).

Five overtopping units were set up behind the dike to measure the overtopping rate. Sampled signals of weighting cells which were installed beneath the overtopping tanks allow the analysis of mean and wave-by-wave overtopping discharges. Several wave arrays were positioned in front of the wave generator and at the toe of the dike to observe the development of the waves along the dike. Figure 2 shows the model setup during a test.

[1] Institute of Hydraulic Engineering and Water Resources Management, RWTH Aachen University, Mies-van-der-Rohe-Str. 1, 52056 Aachen, Germany. babette.scheres@rwth-aachen.de, lorke@iww.rwth-aachen.de, schuettrumpf@iww.rwth-aachen.de

[2] Institute of Hydraulic Engineering and Applied Hydromechanics, TU Dresden, George-Bähr-Straße 1, Beyer-Bau, 01069 Dresden, Germany. reinhard.pohl@tu-dresden.de

[3] Van der Meer Consulting B.V., P.O. Box 423, 8440 AK Heerenveen, The Netherlands. jm@vandermeerconsulting.nl

Figure 2. Dike model with overtopping units behind the dike during a test.

3. Testprogramme

Unidirectional (long crested) and multidirectional (short crested) waves were generated during the CornerDike tests using the JONSWAP spectrum. Short crested waves had a directional spreading of 12° respectively 34°. Up to six different sea states were tested due to variations of the wave height and wave period. The following angles of wave attack were investigated: between - 45° to + 22.5° at the dike arm which is almost parallel to the wave generator respectively between + 45° to + 112.5° at the other dike arm.

4. Scientific background

Mean overtopping discharges are predicted according to formulae described in the EurOtop-Manual (2007). The effect of oblique waves is considered due to influence factors (see i.e. de Waal & Van der Meer, 1992). Only little knowledge is available for angles of wave attack > 60°. No overtopping is assumed for angles of wave attack > 110°. Multidirectional waves under oblique wave attack lead to higher wave overtopping rates than unidirectional waves.

Investigating the wave overtopping on a concave formed vertical wall, an increased amount of overtopping water for this type of plan geometry was not found (Napp et al., 2002).

5. Objective of the paper

The forthcoming paper will give a detailed description of the model setup, test programme and first results concerning the mean overtopping discharges at the convex formed dike under very oblique wave attack for unidirectional and multidirectional wave fields.

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