Large and small scale wave overtopping measurements for Afsluitdijk rehabilitation project

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INTRODUCTION

The 'Afsluitdijk' is a 32 km enclosure dam which separates the Wadden sea and the Lake IJssel. The dam currently undergoes a major rehabilitation to meet the requirements with regard to water safety. The Dutch Ministry of infrastructure and Water Management (Rijkswaterstaat division) has commissioned Levvel, a consortium of BAM, Van Oord and Rebel, to prepare the design and carry out the reconstruction of the dam including sluices and highway. The project includes reinforcement of the armour layers and wave overtopping reduction. As part of the contract Rijkswaterstaat prescribed the contractor (Levvel) to verify the design with large scale physical model tests (min. 1:3 scale). These tests were carried out in the Delta Flume of Deltares. Prior to the large scale tests, smaller scale tests (1:20) have been carried out to optimize the design with regard to armour stability and wave overtopping. The research described here focuses on the wave overtopping.

CROSS-SECTION

Levvel proposed an innovative design which consists of a composite slope. The 1:2 lower slope is designed with Levvel-blocs, internationally known as Xblocplus®. The berm is located around the design water level and is used as a bicycle path during normal conditions. The 1:4 upper slope is covered with Quattroblocks®, a product of Holcim Coastal (See figure 1). Additional roughness has been created by constructing ribs in the wave run-up zone (see figure 2). The number of rows has been varied as well as the rib height along the slope. The crest level has been optimized to meet the prescribed average overtopping discharge of q = 10 l/s/m.

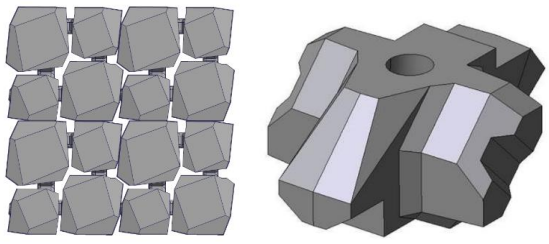

Figure 1 - Quattroblock® of Holcim Coastal (left) and Levvel-bloc (right)

MODEL TESTS

The crest level has initially been determinded using the EurOtop manual (EurOtop, 2018), in which the roughness of the ribs has been estimated using the method from Capel (2015). The designed sections have been verified in a small scale model prior to the Delta flume tests. In this way wave overtopping measurements are available for similar situations on two different scales. The tests were performed with irregular waves and for different water level and wave conditions, with wave overtopping discharges ranging from approximately q = 2 l/s/m to q = 25 l/s/m. The tests show the effectiveness of the applied ribs for wave runup reduction, and give indication for a significant scale effect for small scale tests in overtopping, which deviates from the engineering practice in which this scale effect is expected to be insignificant for discharges of 7-10 l/s/m (a.o. EurOtop, 2018).

Figure 2 - Cross-section in the Delta flume

REFERENCES

Capel (2015) Wave run-up and overtopping reduction by block revetments with enhanced roughness. Coastal Engineering, vol. 104, pp 76-92.
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