WAVE BY WAVE OVERTOPPING ANALYSIS OF COASTAL STRUCTURES

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Paper topic: Coastal and port structures

1. Introduction

Nowadays, the evaluation of overtopping discharges in coastal structures is still done mainly using the concept of mean discharge, q [l/s/m]. This variable has been related to the level of damage in seawalls, buildings or other types of infrastructures and danger to pedestrians and vehicles (Pullen et al., 2007). However, mean overtopping discharges alone may not give a complete overview of such a dynamic and irregular phenomenon.

To have a more comprehensive evaluation of overtopping and the associated risks, it is important to study also the wave by wave overtopping volumes, V [l/m] and estimate the maximum volume, Vmax. Depending on the wave conditions and the structure type, the latter may be up to a hundred times larger than q. Presently, there is already some guidance on tolerable values of Vmax (Pullen et al., 2007). Nevertheless, Vmax is calculated by methods that are not as well validated as those for the determination of q and are limited to fewer types of structures. This study analyzes wave by wave overtopping and mean overtopping discharges measured during physical model data collected at LNEC for the West breakwater of Sines Harbour, Portugal.

The overtopping volumes per wave were calculated with both the time series of the surface elevation at the back of the structure and with the time series of the water level variation inside an overtopping tank. The number of overtopping waves, the individual volumes and the Vmax were the variables estimated from raw data. The empirical probability distribution function of the overtopping volumes per wave was compared with the Weibull distribution, a function often suggested in the literature for rubble mound breakwaters (Van der Meer & Janssen, 1995).

2. Case Study

Physical model tests of stability and overtopping were carried out in 2008 (Reis et al., 2011) in one of the LNEC's wave flumes to study solutions for the cross-sections of the final rehabilitation of the Sines West breakwater. This study analyses both the mean and individual overtopping results for one of the solutions (Figure 1).

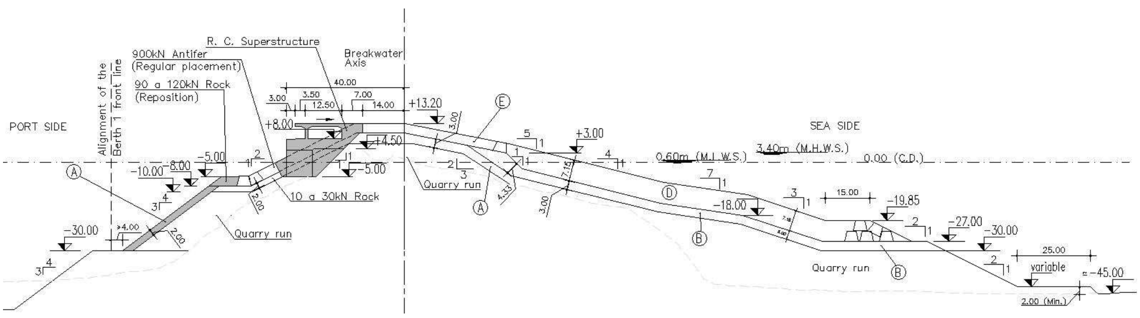

Figure 1 - Studied cross-section in prototype values (Reis et al., 2011).

To determine the overtopping discharges in the flume, a tank was located at the back of each

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structure to collect the overtopping water. The water was directed to the tank by means of a chute 50 cm wide (Figure 2). A pump and a gauge were deployed in the overtopping tank and connected to a computer that monitored and recorded the water level variation. Once a preset maximum water level was reached in the tank the pump was activated for a fixed period. The pumped volume of water was estimated from the pump calibration curve. The measurement of the water level variation inside the tank, together with the pump calibration curve, allowed the determination of the mean overtopping rates. To identify overtopping events and determine the wave by wave overtopping volumes a gauge was located at the chute (Figure 2).

Figure 2 - Overtopping observed during physical model tests.

3. Results

Figure 3 illustrates an example of the obtained results. Shown are the time series of the cumulative overtopping volume, which is the basis for the calculation of individual volumes (left panel) and the comparison of the empirical and Weibull distributions (right panel).The paper will present the obtained results and their discussion.

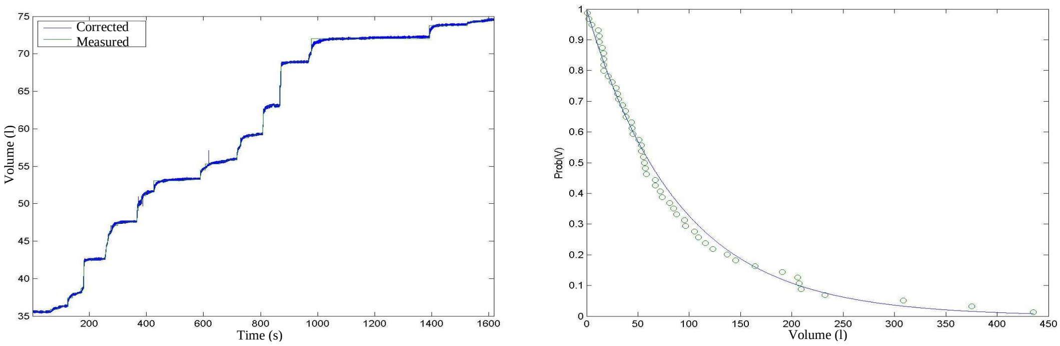

Figure 3 – Example of time series of cumulative overtopping volume (left) and of goodness of fit to the Weibull distribution (right)

Acknowledgements

The authors gratefully acknowledge the Sines Port Authority for the permission to use and publish physical model data. They also acknowledge the financial support provided by the *Fundação para a Ciência e a Tecnologia*, Portugal, through project HIDRALERTA (PTDC/AMB/120702/2010).

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