OVERTOPPING FLOWS AND RELATED HAZARDS: A CASE OF STUDY FROM THE CATALAN COAST

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INTRODUCTION

Design criteria for coastal defenses exposed to wave overtopping are usually restricted to the assessment of mean discharges and maximum individual overtopping volumes, however it is not possible to give unambiguous or precise limits to tolerable overtopping for all kind of layouts (EurOtop, 2018). A few studies (e.g. Endoh and Takahashi, 1994) analyzed the relationship between wave overtopping flows and hazard levels for people at the crest of sea dikes. Sandoval (2016) confirmed that one single value of admissible mean discharge or individual overtopping volume is not a sufficient indicator of the hazard, but detailed characterization of flow velocities and depths is required. This work presents the results of an experimental campaign aiming at characterizing the flow characteristics associated to maximum individual overtopping volumes for an urbanized stretch of a town along the Catalan coast, where a bike path and a railway run along the coastline, exposed to significant overtopping events every stormy season.

MODEL SETUP

Physical model experiments are carried out in the CIEMito wave flume at LIM/UPC. The flume is 17m long, 0.37m wide. Water depths of 0.29-0.30m are tested, corresponding to 14.5m and 15m in prototype, assuming a model scale of 1:50. A 1:1 dike with 1:15 foreshore slope was installed. The freeboard varies between 3.5m and 4m, with toe depths of 0.5-1m. Overtopping measurement system consisted of: overtopping tank with two load cells to measure the weight of the overtopping water later converted into volume; two high-speed cameras to measure overtopping flow depths and velocities; two ultrasonic sensors on the dike top to measure flow depths.

RESULTS AND DISCUSSIONS

Irregular wave tests are carried out for wave storms with return periods of 1,2 and 5 years, corresponding to offshore wave heights of 3.6, 4.0 and 4.6m and periods between 12 and 12.6s. Durations corresponding to 1000, 500 and 300 waves are tested. Besides, SWASH model (Zijlema et al., 2011) has been employed to widen the range of hydrodynamic conditions, including also the influence of 10m wide promenade. A direct link between maximum individual overtopping volumes has been found. However, overtopping flow depths and velocities proved to be dependent on the geometry layout, even for same overtopping rates. The experimental and numerical flow depths and velocities are plotted in Figure 1 together with instability curves by Sandoval (2016) for adult and 10-year-old child. Average discharges bigger than 2 l/s/m with individual volumes of 1500 l/m considered safe based on Table 3.3 of EurOtop (2018) show flow depths bigger than 0.5m with velocities of 3-5 m/s, which lie already in the unsafe zone of Figure 1. This preliminary results show that further study is needed to amend the actual design criteria for wave overtopping on sea dikes. Further results on influence of time series and duration and different foreshore slopes and crest widths will be presented at the conference.

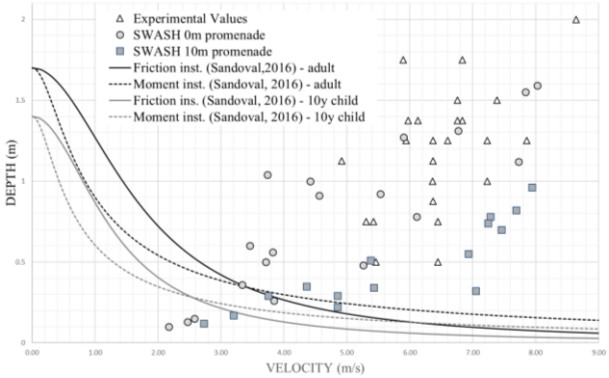

Figure 1 - Flow depth and velocity results vs instability curves from Sandoval (2016)

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