WAVE RUN-UP AND OVERTOPPING IN RUBBLE-MOUND BREAKWATERS UNDER OBLIQUE WAVE INCIDENCE

Maria Teresa Reis, LNEC - Laboratório Nacional de Engenharia Civil, treis@lnec.pt
João Alfredo Santos, ISEL - Instituto Superior Engenharia de Lisboa, Instituto Politécnico de Lisboa, jasantos@dec.isel.ipl.pt
Conceição Juana Fortes, LNEC - Laboratório Nacional de Engenharia Civil, jfortes@lnec.pt
Rute Lemos, LNEC - Laboratório Nacional de Engenharia Civil, remos@lnec.pt
Rita Carvalho, Civil Engineering Department, Universidade de Coimbra, ritalmfc@dec.uc.pt
Reinhardt Pohl, Technische Universität Dresden, reinhard.pohl@tu-dresden.de
Antje Bjornschein, Technische Universität Dresden, antje.bornschein@tu-dresden.de

MOTIVATION
Former investigations on wave run-up and overtopping of (impermeable and permeable) coastal structures aimed at quantifying the influence of oblique waves on mean overtopping discharge, water layer thickness and velocities by developing empirical formulas of a reduction factor for wave obliquity, \( \gamma \) (e.g. EurOtop, 2007; Nørgaard et al., 2013). However, most formulas did not consider very oblique waves.

The existing data gaps triggered the interest in developing the present experimental work, whose main goal is to contribute to a new whole understanding of the phenomena to mitigate future sea level rise impacts in European coastal structures, including the run-up and overtopping characterization on rough and permeable slopes. The key point is to extend the range of wave steepness values in run-up, overtopping and armour layer stability studies, focusing on oblique extreme wave conditions and on their effects on a sloping breakwater’s trunk armour and roundhead.

BREAKWATER MODEL
A stretch of a rubble mound breakwater (head and part of the adjoining trunk, with a slope of 1(V):2(H)) was built in the wave basin of the Leibniz Universität Hannover to assess, under extreme wave conditions (wave steepness of 0.055) the structure behaviour in what concerns wave run-up, overtopping and damage progression of the armour layer. The breakwater trunk is 7.5m long and the head has the same cross-section as the exposed part of the breakwater. The total model is 9.0m long, 0.82m high and 3.0m wide. Details of the model can be found at the data storage report (Santos et al. 2019).

For long-crested waves and the water depth of 0.60m, 5 incident wave angles (40\(^\circ\), 55\(^\circ\), 65\(^\circ\), 75\(^\circ\) and 90\(^\circ\)) were considered, whereas with the water depth of 0.68m, the number of incident angles was reduced to 3 (40\(^\circ\), 55\(^\circ\), 65\(^\circ\)). The influence of the directional spreading of short-crested waves was investigated for the lowest water depth (0.60m) and the incident angles of 40\(^\circ\) and 65\(^\circ\), the directional spreading being 50\(^\circ\). Finally, for the incident angle of 40\(^\circ\) results were also obtained for the highest water depth (0.68m) and short-crested waves with a directional spreading of 50\(^\circ\).

ACKNOWLEDGEMENTS
This work was supported by the European Community’s Horizon 2020 Programme of the Integrated Infrastructure Initiative Hydralab+, no. 654110. Projects Bsafe4Sea (PTDC/EGC/31090/2017) and TO-Sealert (PTDC/EAM-OCE/31207/2017) and EW-Coast (Ref. 28657 ERDF, are also acknowledge.

REFERENCES
Santos et al. (2019): Data Storage Report. RODBreak - Wave run-up, overtopping and damage in rubble-mound breakwaters under oblique extreme wave conditions due to climate change scenarios. https://doi.org/10.5281/zenodo.3355657