Proceedings of the 9th International Conference on Physical Modelling in Coastal Engineering (Coastlab24)

Delft, Netherlands, May 13-16, 2024

Extended Abstract, DOI: 10.59490/coastlab.2024.761

FULL-SCALE EXPERIMENTAL STUDY ON WAVE IMPACTS AT STEPPED REVETMENTS

MAXIMILIAN HERBST[1], NILS B. KERPEN[1], TALIA SCHOONEES[2], TORSTEN SCHLURMANN[1]

1 Leibniz University Hannover, Ludwig-Franzius-Institute for Hydraulic, Estuarine and Coastal Engineering, Germany, maxi.herbst@lufi.uni-hannover.de, kerpen@lufi.uni-hannover.de, schlurmann@lufi.uni-hannover.de

2 Holcim, Alphen aan Den Rijn, South Holland, Netherlands, talia.schoonees@holcim.com

KEYWORDS: Coastal structures, Stepped revetment, Scale effects, Impact pressures, Physical model test, Large scale.

ABSTRACT

Stepped revetments have shown to be effective in limiting wave overtopping and wave run-up compared to sloped revetments. However, literature on wave impact pressures and comprehensive design guidelines for these structures is scarce. Laboratory experiments support establishing design recommendations. So far, studies for wave impacts at stepped revetments were mainly performed at small scales. Results from these tests are likely to be subjected to scale effects and therefore inaccurately replicate the wave-structure interaction at full scale. This study quantifies scale effects of wave impact characteristics for design cases based on a comparison to small-scale tests (Kerpen et al., 2018). Full-scale flume experiments were studied with a slope of 1:3 and uniform step heights of 0.17 m and 0.50 m in the Large Wave Flume (GWK) in Hannover, Germany. Horizontal and vertical wave impacts were measured at 15 locations in the plunging region of the revetment for a range of wave steepnesses ($2.0 \leq \xi \leq 2.76$). The results show that previous small-scale tests underestimate design wave impact pressures by a factor of up to 7.7. Impact loadings occur considerably faster than at small scale with relative peak rising times decreasing by a factor of up to 5.6. Prediction formulae are derived for the vertical distribution of horizontal impact pressures (Figure 1b) as well as for temporal characteristics of these pressures at stepped revetments.

a)

b)

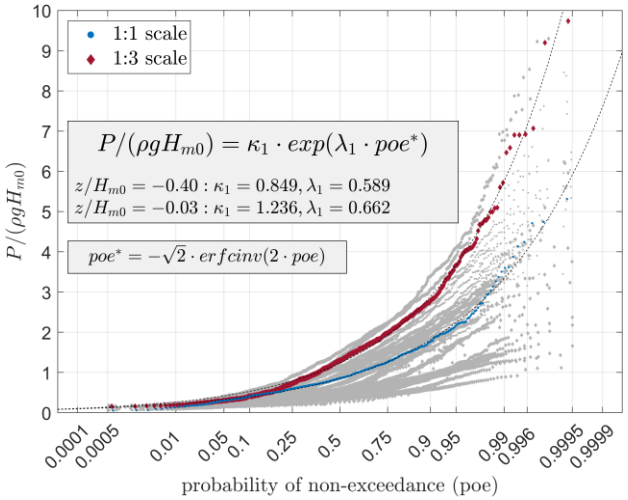

Figure 1. a) Breaking wave on a stepped revetment with step height of 0.5 m in the Large Wave Flume (GWK). b) Vertical distribution of normalized horizontal impact pressures.

REFERENCES:

Kerpen NB, Schoonees T, Schlurmann T. Wave Impact Pressures on Stepped Revetments. Journal of Marine Science

and Engineering. 2018 Dez;6(4):156. Epub 2018 Dez 13. doi: 10.3390/jmse6040156