BULK DISSIPATION AND FLOW CHARACTERISTICS IN CUBE ARMORED BREAKWATERS

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INTRODUCTION

The main function of a breakwater is dissipating wave energy. The breakwater dissipates energy by means of three mechanisms: (1) wave breaking over the slope; (2) wave propagation through the secondary layers and porous core; (3) interaction with the main armor layer.

A revised dimensional analysis shows that relative water depth, *h/L,* and wave steepness, *H/L,* are key factors of breakwater performance. The product of (*h/L*) (*HI/L*) (hereinafter named as χ, alternate slope similarity parameter) can be applied to quantify the reflected and transmitted energy coefficients and the dissipation rate (Díaz-Carrasco et al., 2020) and to identify the type of wave breaking and the domains of wave energy transformation (Moragues et al., 2020).

The aim of this work is to analyze the dissipation term and its relation with the alternate slope similarity parameter χ, as well as correlate the flow characteristics (run-up, run-down) with the type of wave breaking and the bulk dissipation. For that purpose, former data (Clavero et al. 2020) and data from new tests have been analyzed. Whereas it is not clear that the use of different experimental techniques will give the same results in the laboratory, three different techniques for sea states selection have been taken into account in the new tests: (1) keeping constant h/L; (2) keeping constant H/L or Ir; and (3) varying h/L and H/L.

DATA ANALYSIS

The bulk dissipation (D^*) is quantified solving the energy conservation equation, from incident and reflected wave energy fluxes ($\mathfrak{F}_\mathrm{I}, \mathfrak{F}_\mathrm{R}$). The incident and reflected wave energy are calculated from wave gauges located seawards of the breakwater. Except the main layer, all the other parts of the breakwater are the same for all the runs. The difference of bulk energy dissipation is mainly caused by the hydrodynamic interaction among the incoming wave and the main armor layer. The flow characteristics analyzed have been the the run-up (R_u), run-down (R_d) and the total water excursion ($R_u + |R_d|$) measured on the slope.

RESULTS

As mentioned in Moragues et al. (2020) the bulk dissipation and the flow characteristics are directly related to each other. For a breakwater typology (cube armored with two layers of D=44mm), Figure 1a shows the relation between h/L and H/L with the three considered different experimental testing techniques. Figure 1b shows the relationship between the bulk dissipation and the dimensionless total excursion (Ru+|Rd|)/H. On the other hand, Figure 2 shows (a) the bulk dissipation and (b) the dimensionless run-up versus χ.
In each figure, the linear regression for each experimental technique is plotted.

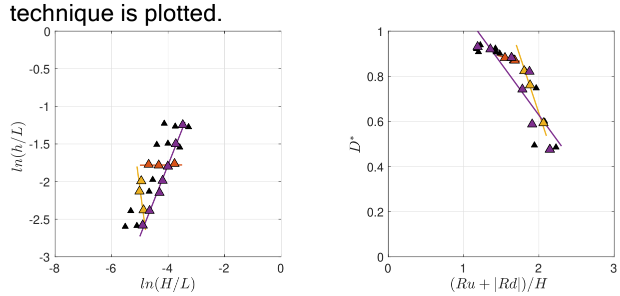

Figure 1. (a) Experimental space [H/L vs h/L] with three experimental testing techniques: (orange) constant h/L; (yellow) constant H/L or Ir; and (purple) varying h/L and H/L. (b) relationship between the bulk dissipation and the total excursion.

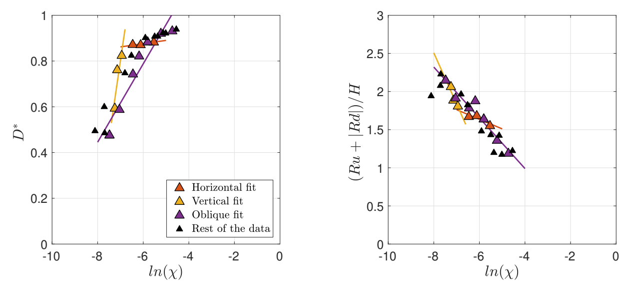

Figure 2. (a) Bulk dissipation versus χ. (b) Total water excursion versus χ.

CONCLUSIONS

It is necessary to pay attention to dissipation by breakwaters, since dissipating energy is the main objective of these structures and it is related to the flow characteristics occurring in the slope through the different breaker types. On the other hand, the selection of the testing technique to be used is not trivial.

REFERENCES

Clavero et al. (2020): Bulk Wave Dissipation in the Armor Layer of Slope Rock and Cube Armored Breakwaters. JSME, 8(3), 152.
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