Numerical and Experimental Modeling of Wave Evolution over Submerged Breakwaters

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ABSTRACT
Two dimensional experimental and numerical modeling of wave transmission over detached submerged breakwaters has been carried out in this paper. A comprehensive series of 2D laboratory experiments have been conducted in the 3 m wide wave flume including wide variety of wave climates, breakwater geometry and water depth. The 2D laboratory tests examined wave breaking as well as wave transmission over submerged breakwater/reef structures.

Different approaches to experimental data processing are examined in producing reliable application of the 2D laboratory measurements. Sensitivity of wave transmission coefficient, over submerged breakwaters to various dimensional and non-dimensional parameters is comprehensively investigated. Previously published experimental studies for predicting/calculating wave breaking and wave transmission are discussed and compared with the present experimental results. Improved empirical equations/models are presented.

The 2D depth averaged numerical modeling of wave transmission over submerged breakwaters was investigated using the recent research version of Delft3D. Wave energy dissipation model of Battjes and Janssen (1978) was found to overestimate wave-induced breaking dissipation over submerged breakwaters. Alternative equations for wave breaker parameter were developed for incorporation in the model of Battjes and Janssen (1978) to improve the calculation of transmitted wave height over and behind submerged breakwaters/reefs.

KEYWORDS
submerged breakwaters- wave transmission- breaker parameter- energy dissipation

INTRODUCTION
The functional design knowledge of submerged breakwaters including their impacts on wave transmission, currents, sediment processes and shoreline response is still developing. Various experimental studies and numerical models have been reported for predicting wave transmission passing across low-crested breakwaters (Johnson et al., 1951; Adams and Choule, 1986; d'Angremond et al., 1996; Seabrook, 1997; van der Meer et al. 2004). Most of the previous experimental research on wave transmission over submerged breakwaters has been carried out for relatively narrow crested and semi submerged breakwaters, with the results of the experimental research being limited to the tested ranges of breakwater crest width. Previous studies show that narrow crested (fully) submerged breakwaters are ineffective in coastal protection in most field investigations. Therefore more investigations are needed to extend the studies of wave transmission over submerged breakwaters with wide to broad crest width due to their increasing application to achieve improved efficiency in coastal shoreline protection.