APPLICATION OF CROSS-SHORE MORPHOLOGICAL MODELS FOR PERCHED BEACHES

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INTRODUCTION

Perched beaches are beaches that are supported at the offshore side by a submerged structure. The advantages of such design schemes are that less dredged material is required, and more protected waters are created in front of the beach. Apart from the hydraulic stability of the submerged structure itself, the stability of the beach needs to be studied in order to make sure it fulfils the requirements during its design lifetime. Aspects that play a role here are the expected sand losses over the submerged structure, the (dynamic) equilibrium profile of the beach and the performance during storm conditions. In order to study the morphological responses of such beaches, morphological models should be applied that can take into account the influence of the submerged structure. This paper discusses two cross-shore models that have been used to study a large perched beach project that is under construction in unusually deep waters, severe wave climate (mostly unidirectional) and small tidal range. The models applied are SBEACH (Larson et al., 1989) and CROSMOR (Van Rijn et al., 2003). First the models are validated and calibrated hydrodynamically by comparing the wave transmission and wave setup with measurements from 2D flume tests. Next, the models have been used to predict the future cross-shore development of the beach.

VALIDATION & CALIBRATION BASED ON 2D FLUME TESTS

2D flume tests were performed at the University of Roma TRE to investigate the hydraulic stability of the submerged structure and the wave transmission and water level setup behind the barrier, which influence the stability of the protected artificial beach. Three semi-submerged sections with different crest heights combined with different water levels were tested for 13 irregular wave conditions and 10 regular wave conditions. This data was used for the validation and calibration of the hydrodynamics in both morphological models.

CROSMOR

This model is a very advanced cross-shore profile model (Fortran code) which computes the cross-shore distribution of wave height, longshore and cross-shore flow velocity, peak orbital velocities (including asymmetry effects), bed load and suspended load transport (using a single-fraction or multi-fraction method), morphological changes (including dune erosion). The CROSMOR profile model is a probabilistic model (wave by wave model). CROSMOR. It recently has been expanded for this project to include the possibility of non-erodible layers, a necessity to correctly schematize the submerged structure.

SBEACH

The SBEACH (Storm-induced BEAch CHange) numerical simulation model was developed at the U.S. Army Engineer Waterways Experiment Station, Coastal and Hydraulics Laboratory (CHL), to calculate beach and dune erosion under storm water levels and wave action. The magnitude of cross-shore sand transport is empirically related wave energy dissipation per unit water volume in the main portion of the surf zone. Direction of transport is dependent on deep water wave steepness and sediment fall speed.

RESULTS

Both models have been hydrodynamically validated against the measured wave transmission and water level setup. By tuning specific parameters, the models perform reasonably well although for very small freeboards it becomes more difficult. In a next step, the models have been used to predict the future long-term development of the beach profile. The models are capable of simulating up to 5 to 10 years ahead. The results of both models compare fairly well with each other. The models show that reshaping becomes stable in time, and that the beach profile approaches an equilibrium in a few years. The number of years needed to reach an equilibrium depends on several factors which are addressed in the paper.

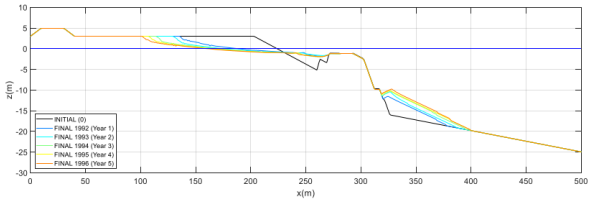

Figure 1 - Simulated SBEACH profile

REFERENCES

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