EXPERIMENTAL INVESTIGATION ON HYDRO-MORPHODYNAMIC PERFORMANCES OF A GEOCONTAINER SUBMERGED SILL

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Paper topic: Laboratory and field observations and techniques

1. Introduction

Beaches accomplish not only recreational functions but have also the important role to protect the backward coasts from severe storm impacts. To this aim beach nourishment represents a low-impact mitigation work to ensure an adequate protection to the littoral areas.

In the framework of the design of the Messina Strait Bridge, the possibility to adopt a large amount of sediments coming from the rail and highway excavations and trenches connecting to the bridge to nourish strongly eroded coasts close to the building site has arisen. Following the pioneer work of Oumeraci & Recio (2009), the project plans a nourishment protected at the toe by a submerged sill made by geocontainers. This paper illustrates the results of an experimental campaign focused on the effects of the sill both on the hydrodynamics and on the stability of the intervention.

2. Experiments

The results of an experimental investigation on the performances of a geocontainer sill, carried out at the Hydraulic Laboratory of Messina University, are presented. The experiments have been carried out in a wave flume 18 m long, with a rectangular cross-section 0.4 m wide and 0.8 m high. Both regular and random waves have been generated by means of a flap type wave maker, remotely controlled by a PC. At the end of the flume, a physical model of the beach nourishment, protected at the toe by a sill made of geosynthetic bags has been set up at a model to prototype scale of 1:50.

The experiments are aimed at providing some indication about the effectiveness of the sill in reducing the wave transmission at the back of the structure. Reflection and transmission coefficients have been measured by means of the Goda & Suzuki (1976) method, adopting four wave gauges, two of them located offshore the sill and the other two onshore. Moreover the scour holes at the toe and at the back of the sill have been measured along with the stability of the geocontainers by means of optical instrumentations.

3. Experimental results

In Figure 1 the transmission coefficients, measured for both regular and irregular wave conditions, have been plotted versus the relative crest height, i.e. the crest to incident wave height ratio. In the same plot the reference formula proposed by Van der Meer (1990) for armour stone breakwaters is also shown. It is possible to observe that generally the geocontainer structure well behaves especially when highly energetic waves propagate through the sill, providing transmission coefficients smaller than those predicted by Van der Meer (1990). Higher transmission coefficients occur only for small incident waves.

However during the experimental campaign it was found that the most energetic waves were able to pull up and move some of the geocontainers (see Figure 2a), thus leading to an overall instability of the submerged reef. In order to overcome such problem the cross section of the sill and more specifically the top layer of the structure have been modified in order to better resist to stronger waves. With this new configuration it was found that the whole structure stability do not

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suffer for high wave propagation (see Figure 2b).

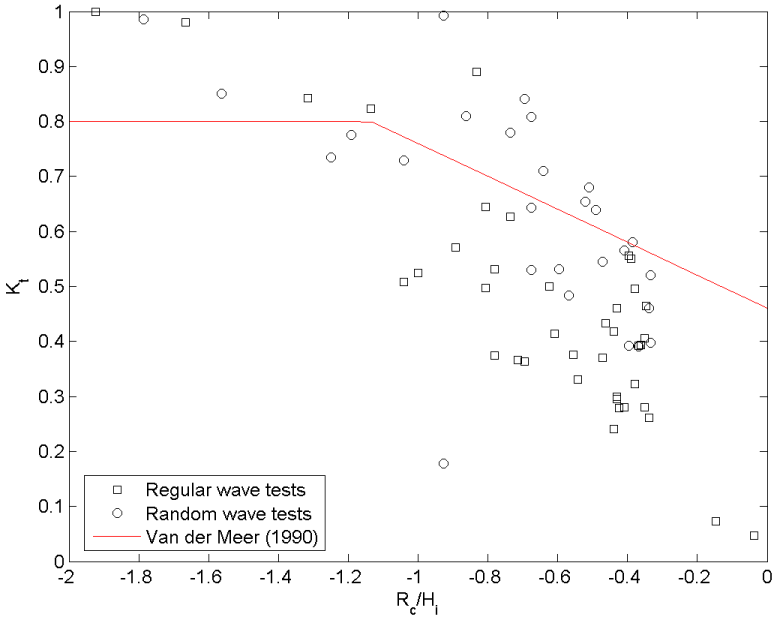

Figure 1. Comparison between transmission coefficients and Van der Meer (1990) formula.

Figure 2. Stability tests: (a) original and (b) modified configuration (H_i=0.075 m, T=1.6 s at laboratory scale).

References

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