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WAVE LOADINGS ACTING ON AN INNOVATIVE CAISSON BREAKWATERS FOR ENERGY PRODUCTION

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INTRODUCTION

Any kind of Wave Energy Converter (WEC) requires information on how optimize the device in terms of hydraulic performances and structural responses. This paper presents results on an innovative caisson breakwater for electricity production: Seawave Slot-Cone Generator (SSG). The concept is based on the known principle of overtopping and storing the wave energy in several reservoirs placed one above the other. Using this method practically all waves, regardless of size and speed are captured for energy production. In the present SSG setup three reservoirs have been used (Figure 1).

Figure 1 – Scheme of Seawave Slot-Cone Generator

A key to success for the SSG will be low cost of the structure. The wave forces on the main structure can be estimated using experiences from coastal protection structures, but the differences between the structures are so large that more reliable knowledge on the wave forces is desired. The purpose of the work is to derive information on wave loadings acting on sloping walls constituting the structure. The research is intended to be of direct use to engineers analyzing design and stability of this peculiar kind of breakwater. Comprehensive 2D and 3D hydraulic model tests were carried out at the Department of Civil Engineering, Aalborg University (Denmark) in the 3D deep water wave tank (Vicinanza and Frigaard, 2008). The model scale used was 1:60 of the SSG. In order to follow up on model-prototype scaling discrepancies a full scale pilot device in Kvitsøy island (Stavanger, Norway) will be instrumented and measurements will be taken over the next year.

PRELIMINARY RESULTS

The design method suggested by the CEM (2002) for prediction of pressure distribution on sloping top structures is Takahashi et al. (1994) formula. The sloping top caisson has been used for many years against very heavy wave conditions; the oldest caisson of this type being constructed in 1906 at Naples harbour (Italy). The Authors developed corrections to Goda's formula (Goda, 1974; 1985) to take into account for a structure with a sloped portion beginning just below the waterline. The results show an underestimation using the prediction formula between 20-50% (Figure 2). Pressure gradients analysis highlights large discrepancies. One of the reasons is that the SSG model was fixed rigidly instead the design method was tested using sliding experiments.

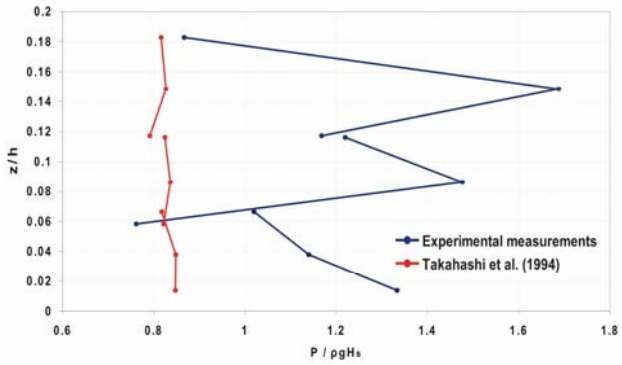

Figure 2 – Takahashi et al. (1994) formula compared to measured data for test 4.

A second run of tests is in progress to investigate the relative effects of loading characteristics and the physical parameters of the dynamic system on the response of the structure. A new design method for this type of caisson will be proposed, which enables estimation of the wave forces acting on the SSG structure.

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