Crest level optimization of the multi level reservoir overtopping based wave energy converter Seawave Slot-cone Generator

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Introduction

The Seawave Slot-cone Generator (SSG) is a wave energy converter based on the wave overtopping principle utilizing a total of three reservoirs placed on top of each other in which the potential energy of the incoming wave will be stored. The water captured in the reservoirs will then run through the multi-stage turbine.
Using multiple reservoirs will results in a higher overall efficiency, compare to a single reservoir structure.

The SSG is built as a robust concrete structure with the turbine shaft and the gates controlling the water flow as virtually the only moving part of the mechanical system.

The SSG concept will make use of the innovative patent pending multi-stage turbine developed by WaveEnergy. The multi-stage turbine has the advantage to utilize different heights of water head on a common turbine wheel. The multi-stage technology will minimize the number of start/stop sequence on the turbine even if only one reservoir is supplying water to the turbine, resulting in a high degree of utilization.

Content of Paper

The purpose of the work described in the paper is to optimize the crest levels and geometrical layout of the SSG structure in a combination of irregular wave conditions, focusing on maximizing the obtained potential energy in the overtopping water.
In two rounds model tests have been performed in a wave tank at AAU, in 1:15 length scale compared to the Kvitsoey prototype. During these tests average overtopping discharges into the individual overtopping reservoirs have been measured. The initial tests provided data allowing for the formulation of an expression describing the derivative of the overtopping discharge with respect to the vertical distance. Based on this expression numerical optimizations of the crest levels for a number of combinations of wave conditions have been performed. The hereby found optimal crest levels will then be tested in the wave tank and further optimizations of the geometry will also be carried out.
The found expression describing the derivative of the overtopping discharge with respect to the vertical distance is based on the generic study on wave overtopping, Kofoed (2002), and is an extension of that work to cover structures with fronts on all reservoirs.

References

Kofoed J. P. (2002): Wave Overtopping of Marine Structures – Utilization of Wave Energy. Ph. D. Thesis, defended January 17, 2003 at Aalborg University. Hydraulics & Coastal Engineering Laboratory, Department of Civil Engineering, Aalborg University, December, 2002.