NEAR-SHORE FLOATING WAVE ENERGY CONVERTERS: APPLICATIONS FOR COASTAL PROTECTION

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INTRODUCTION

Coastal areas are vital economic hubs often affected by erosion, flood risk and long-term habitat deterioration. The growth of economy coupled with the acceleration of climate change draws the attention to sustainable coastal defence plans.
Nearshore floating Wave Energy Converters (WECs) may be an innovative way to defend the coast with low environmental and aesthetic impact together with a secondary benefit as energy production.
This note addresses a class of floating WECs of the oscillating water column (OWC) type, named multi-absorbers OWC, that unifies the flow direction by use of non-return valves, into a unidirectional flow, making the use of more efficient air turbines possible. Hereby, a more steady flow is also obtained. The specific concept under investigation is the LeanCon device (www.leancon.com).
Aims of this note are to examine, for the given WEC:

- the wave transmission with particular reference to produced power;
- the hydro-morphodynamic consequences of such installations on coastal areas;
- the proper design of mooring system.

The analysis is based on the experimental results of existing and new tests in the 3D deep water wave tank of Aalborg University.

EXPERIMENTS DESCRIPTION

Wave basin tests were carried out in a 1:40 model scale in the wave basin of the laboratory at Aalborg University (DK), Department of Civil Engineering, Water and Soil.
The basin is 8.5 m wide, 15.7 m long and 1.5 m deep.
Long-crested waves are generated with significant wave height in the range 2-15 cm.
The tested device is of the multichamber type. Its peculiarity is the V shaped layout that induces a phase shift between chambers, without wave attenuation. The overall length, measured as wing span, is 6 m. A picture of the device is shown in Fig.1.
Three arrays of 4 resistive wave gauges are used to measure surface elevation: two arrays are positioned along the wave direction, seaward and shoreward of the WEC, aiming at measuring incident and transmitted waves; another array is placed perpendicular to the wave-maker to assess wave decay along the WEC arm.
In order to (indirectly) "measure" the absorbed power in time, pressure measurements are carried out by means of extremely sensible cells, covering the range 0-500 Pa. Velocity is acquired by means of a thermal flow meter working in the range (0-10 m/s), accurately calibrated in the section of duct under exam.

ANALYSIS AND EXPECTED RESULTS

The experimental analysis will provide: incident, reflected and transmitted waves; loads on moorings (so far the Leancon was moored with a spring board only); power production of the WEC.
It is expected that a correlation between wave transmission and power production is found, showing that the device has a larger sheltering effect than a similar floating device without oscillating water columns.

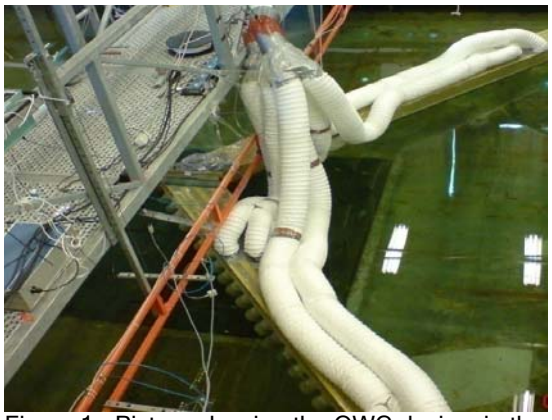

Figure 1 – Picture showing the OWC device, in the preliminary tests moored with a spring board

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