WAVE-POWER ABSORPTION BY AN OSCILLATING WATER COLUMN WITH RECTANGULAR GEOMETRY

Arne Reitan

Department of Physics, College of Arts and Science, University of Trondheim, N-7055 Dragvoll, Norway

and

Department of Mathematics, University of Bristol, Bristol BS8 1TW, England

In a previous paper[1] we considered the absorption of wave energy by an oscillating water column with simple geometry. The absorber in question consisted of a rectangular pressure chamber separated from a rectangular harbour by a barrier of zero thickness, the system being placed in an infinitely wide and totally reflecting wall. The water depth was assumed to be the same everywhere, both inside and outside the system.

After the completion of the first Norwegian wave-power station employing an oscillating water column we have felt the need for a description of the absorption process in a system somewhat more general than the one treated in ref 1. The following generalizations are included in the work to be presented.

1) The barrier separating the chamber and the harbour has arbitrary thickness.

The velocity potential in the region under the barrier is now written as a double Fourier series in the vertical and lateral directions, the possible modes being determined by the requirement of zero normal derivative of the velocity potential on the various solid surfaces. As in the other parts of the system the velocity potential under the barrier contains unknown coefficients that are determined by the matching conditions at the boundaries between the various regions.

2) The water depth outside the absorber is allowed to be different from that on the inside.

This generalization of the geometry leads to a change in the boundary conditions at the harbour mouth and to a somewhat more complicated set of linear equations for the unknown coefficients.

3) We are aiming for a model which allows for differences in the environment in which the absorber is placed.

To this end we are studying a situation where the absorber is embedded in an infinitely wide, thin wall with a certain mass and mechanical resistance per unit area. The incident and radiated waves are then partly transmitted and partly reflected at the wall, and we shall be able to simulate different conditions by varying the complex reflection coefficient that appears in the theory.

At the time of this writing the changes introduced by the generalizations 1) and 2) have been worked out. We are still in the process of completing item 3). Among other things, this requires a new Green's function for the radiated potential from the harbour mouth. The method does reproduce the usual point-absorber results for the maximum absorption width in two limits, viz $w = 2/k$ for an absorber in a totally reflecting wall and $w = 1/k$ for an absorber on the open sea.

REFERENCE

1
Malmo, O and Reitan, A Wave-power absorbtion by an oscillating water column in a reflecting wall, Appl Ocean Res 1986, 8, 42.