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Date: 23.03.2024

To Whom It May Concern

This is to certify that the college has no objection in permitting Dr. Dibakar Mondal, Assistant Professor in Mathematics to continue his research/academic linkages/activities with the Department of Mathematics, Jadavpur University, Kolkata, West Bengal started in 2018 without hampering the normal duties of the college.

I wish him all success in life.

Principal
Government General Degree College
Kalna-I

যাদবপুর বিশ্ববিদ্যালয়

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TO WHOM IT MAY CONCERN

This is to certify that Dr Dibakar Mondal, Assisstant Professor, Department of Mathematics, Government General Degree College at Kalna-I, Muragacha, Medgachi, Purba Burdwan-713405, is my research collaborator. Our collaboration produced a number of research papers which contributed substantially in the fields of Applied mathematics and Ocean Engineering. It is my pleasure to collaborate with him and I would like to continue to work with him as my research collaborator.

Sudeshna Banerjea 26/04/2024
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Effect of thin vertical porous barrier with variable permeability on an obliquely incident wave train

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ABSTRACT

The present paper is concerned with a study of wave propagation due to incidence of an obliquely incident wave on a thin porous vertical barrier with variable porosity. Two different configurations of the barrier are considered: 1. partially immersed barrier 2. bottom standing barrier in water of finite depth. The problem is formulated in terms of a Fredholm integral equation of the second kind, where the unknown function represents the difference of potentials across the barrier. The integral equation is then solved using two methods: the boundary element method and the collocation method. Using the solution of the integral equation, the reflection coefficient and amount of energy dissipated are determined and depicted graphically. It is observed that a barrier with variable porosity induces more reflection than a barrier with constant porosity. Also the energy dissipation for barrier with variable porosity is in general less than a barrier with constant porosity. However for partially immersed long barrier, energy dissipation of waves with certain wavelength is more for barrier with variable porosity than a barrier with constant porosity. For both configurations of the barrier, a long barrier induces more reflection and dissipation of wave energy. The inertial force coefficient of the porous material of the barrier reduces the reflection and dissipation of wave energy. Also, for an obliquely incident wave, the presence of porous barrier reduces reflection and dissipation of energy as compared to a normally incident wave.

1. Introduction

The interaction of water waves with breakwater-type offshore structures has been a subject of interest since the early twentieth century. Breakwaters are coastal structures that are widely constructed to reduce the wave action in inshore water and thereby reduce coastal erosion and protect a port or harbour from the effects of rough seas. During the early twentieth century, the breakwaters were mathematically modelled as a rigid, impermeable, thin vertical plate either partially immersed or submerged in the ocean. A number of researchers were engaged in the study, and consequently, many sophisticated mathematical concepts have evolved to handle the boundary value problem associated with the study of water wave scattering by a thin, rigid vertical plate present in the ocean with a free surface. It may be mentioned here that the exact solution to the aforesaid boundary value problem exists when the barrier is present in the deep ocean. In all other cases, only approximate analytical or numerical methods are used to obtain an approximate solution A detailed discussion on the topic of wave-structure interactions is given in the books of Mandal and Chakrabarti [1] and Linton and McIver [2]. The singular integral equation is a very powerful and useful mathematical tool that is widely used to handle these problems. Parsons and Martin in 1992 and 1994 [3,4] used a very efficient method based on a first-kind hypersingular

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Water wave interaction with a circular arc shaped porous barrier submerged in a water of finite depth

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Abstract

In this paper, we study the problem of scattering of water waves by a thin circular arc-shaped porous barrier submerged in ocean of finite depth. By judicious application of Green's integral theorem, the problem is formulated in terms of a hypersingular integral equation of second kind where the unknown function represents the difference of potential function across the curved barrier. The hypersingular integral equation is then solved by two methods. The first method is Boundary Element method where the domain and range of the integral equation are discretised into small line segments. Assuming the unknown function satisfying the integral equation to be constant in each small line segment, the hypersingular integral equation is reduced to a system of algebraic equations. This system of equations is then solved to obtain the unknown function in each subinterval. Making the subinterval finer, the process is continued till the solution converges to a desired degree of accuracy. The second method is based on using collocation method where the unknown function is expanded in terms of Chebyshev polynomials of second kind. Choosing the collocation points suitably, the integral equation is reduced to a system of algebraic equations which is then solved to obtain the unknown function satisfying the hypersingular integral equation. Using the solution of the hypersingular integral equation, obtained by both the methods, the reflection coefficient, transmission coefficient and energy dissipation coefficient are computed and depicted graphically against the wave number. It was observed that the reflection, transmission and energy dissipation coefficients obtained by using the solution of hypersingular integral equation by the two methods are in good agreement. In addition, the reflection coefficient obtained by the present method found to match with the known results in the literature. From the graphs, the effect of the porous barrier on the reflected and transmitted waves and energy dissipation are studied. It was observed that the porosity of the barrier has some effect on the wave propagation.

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HYPERSINGULAR INTEGRAL EQUATION FORMULATION OF THE PROBLEM OF WATER WAVE SCATTERING BY A CIRCULAR ARC SHAPED IMPERMEABLE BARRIER SUBMERGED IN WATER OF FINITE DEPTH

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Summary

In this article, we study the problem of scattering of water waves by a thin impermeable circular arc shaped barrier submerged in ocean of finite depth under the assumption of linearised theory of water waves. The problem is formulated in terms of a hypersingular integral equation of an unknown function representing the difference of potential function across the curved barrier. The hypersingular integral equation is then solved by using two numerical methods. The first method is BEM where the domain and range of integral equation are discretised into small line segments and the unknown function satisfying the integral equation is assumed to be constant in each small subinterval. This reduces the integral equations to a system of algebraic equations which is then solved to obtain the unknown function in each sub-interval. The second method is collocation method where the unknown function is expanded in terms of Chebyshev polynomials of second kind. Choosing the collocation points suitably, the integral equation is reduced to a system of algebraic equations which is then solved to obtain the unknown function satisfying the hypersingular integral equation. The physical quantities of interest viz, the reflection coefficient, transmission coefficients, which are expressed in terms of the solution of the hypersingular integral equation, are computed by both the methods. The comparison of the reflection coefficient by the two methods shows reasonably good agreement. The reflection coefficient is depicted graphically against the wave number. The graphical results show that the size, position of the barrier and the depth of the water region has some effect on the reflected and transmitted wave.

1. Introduction

Hypersingular integral equations are a powerful mathematical tool whose solution plays a crucial role in solving boundary value problems arising in wave propagation problems. Parsons and Martin (cf. (1)) first initiated the hypersingular integral equation formulation of the problem of scattering of

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