Calculation of Wave Transmission through Single Perforated Sheets

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Abstract

The prediction of reflection and transmission coefficients through single perforated sheets plays an important role in the assessment of the hydraulic responses of screen breakwaters and upright perforated wave filters and absorbers and their efficient design.

This paper reviews the result of laboratory tests in wave flumes to determine the reflection and transmission coefficients (C_r and C_t, respectively) through single perforated sheets. It has been shown that these coefficients can be calculated by using two new formulas which relate C_r and C_t to the wave-screen parameter. This parameter is the ratio of the product of discharge coefficient and the porosity of the sheet to the root square of wave steepness in deep water.

Introduction

When waves impinge on a perforated sheet, a series of jet is created which dissipate the incident wave energy through the formation of turbulence and eddies.

Theoretical models for dissipation of waves through a single perforated sheet were presented by tuck (۱۹۷۱), Porter (۱۹۷۲), Guiney et al. (۱۹۷۲), Packham and Williams (۱۹۷۲), Hattori (۱۹۷۲), Chwang and Dong (۱۹۸۴), Macaskill (۱۹۷۹), Owen and Bhatt (۱۹۸۵), Chegini (۱۹۹۵ & ۱۹۹۷) and Isaacson et al.(۱۹۹۸ & ۲۰۰۰).

Hattori (۱۹۷۲) perfomed a series of laboratory tests to measure the reflection and transmission coefficients of waves through perforated walls. He found that the dissipation of wave energy due to the perforated wall depends on the porosity of the wall, the discharge coefficient of the perforated holes, the incident wave steepness and relative water depth.

Faure (۱۹۹۲) performed an empirical study on single sheets made of expanded metals as the porosity was increased by deforming sheet above each perforation. He carried out all the tests in the flume of the National Research Council of Canada (NRCC) with a depth of ۱ m. The periods of regular waves were ۱, ۱,۵۴, ۲,۱۶, ۲,۸۱ and ۳,۴۶ seconds. The porosity of the sheets was ۵, ۱۵, ۲۰, ۳۰, ۴۵ and ۵۵ percent. Faure measured the reflection and transmission coefficients and concluded that four factors determine the characteristics of reflected and transmitted waves through a perforated plate, which are: sheet porosity, shape of perforation, incident wave steepness and wave period.

McBride et al. (۱۹۹۳) carried out a series of laboratory tests on single perforated sheets to measure the reflection coefficients of irregular waves from these wave absorbers. The