Spectral Analysis of Wave Reflection in Model Tests

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Abstract
Wind waves, which can travel beyond the direct effect of the generating forces, are reflected by beaches, breakwaters, shoreline structures and submerged or floating offshore structures. The interactions between reflected and incident waves contribute to the characteristics of the wave field and flow field beneath the waves. A laboratory study carried out to consider the reflection characteristics from the beach with a constant mild slope of a wave flume and a model vertical seawall using the two dimensional method of Goda and Suzuki (1976). An extensive series of experiments set up covering different regular, irregular and groupy waves to find the percentage of reflected waves. Two methods of 1) Averaging the reflection coefficient components 2) Using the power spectra of incident and reflected waves in a suitable range of frequency were employed to obtain the reflection coefficients. The results showed that in both methods the proper handling of spurious spikes is vital to get real results for reflection coefficient. The results also showed that the rate of reflection coefficient increases with an increase in fundamental wave frequency. However the reflection coefficient get larger for groupy waves with longer duration.
Keywords: Spectral Analysis, Wave Reflection, Laboratory Model, Irregular Waves, Groupy Waves

1 Introduction

As water waves attack marine structures or sloping beaches a part of wave reflects and propagates in the opposite direction of incoming waves. Reflected waves cause increased agitation of the water in front of the structure or they may propagate some distances to become a source of disturbance in a calm area of water. In many laboratory studies it is necessary to separate the measured wave train into components of incident and reflected waves, so that the model response can be related to the parameters of the incident wave field. In a wave flume a complicated multi-reflection system of wave trains is formed as waves are reflected and re-reflected by the model structure, sloping beach and wave paddle. Some methods of analysis have been developed for determination of the reflection coefficient in laboratory wave flumes.

2 Reflection Analysis Methods

Methods of reflection analysis may substantially be divided into the two following categories:

2-1 Reflection Analysis of Regular Waves

According to linear first order wave theory, a non-breaking regular wave can be expressed as:

$$\eta(t) = a_I \cos(kx - \omega t + \varepsilon'') + a_I K_R \cos(kx + \omega t + \varepsilon'' + \theta'') \qquad (1)$$

where a_I is incident wave amplitude, ε'' is the arbitrary incident wave phase angle, K_R is the reflection coefficient and θ'' is the reflection phase shift. The first term is a regular