Estimation Irregular Wave Runup on Sloping Dike

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ABSTRACT

Hughes (2003b) proposed the momentum flux of regular wave runup was balanced mainly by the weight of water in the swash zone of wave which was assumed as a triangular wedge. However, from the experimental pictures, we can see the shape of wave runup similar to a curved shape. Juang etc (2009) use a parabolic wave runup wedge approach to estimate the regular wave runup height on sloped dike. After compare with the experimental data, some new correlation coefficients between the surf similarity parameter and the wave momentum flux parameter was found. It is helpful for estimate the irregular wave runup height on sloping dike more accurate.

KEY WORDS: Momentum flux, triangular wedge, wave runup, parabola wedge, surf similarity parameter

INTRODUCTION

One of the most important considerations in the design of a coastal structure is an understanding of the characteristics of wave runup. The height of wave runup would be influenced by several factors such as wave conditions, water depth, permeability and roughness of the dike and so on. In this study, the calculation method of wave momentum flux parameter that proposed by Hughes (2004b) was apply to estimate the wave runup height and with it to check by the experiment data. After that, use conservation of mass theory in parabola wave runup wedge assumptionto estimate wave runup height was presented.

THEORETICAL BACKGROUND AND ANALYSIS

Juang etc (2009) proposed a correlation between wave runup shape and surf similarity parameter in their study. They proposed the estimation equations of constant M and exponent N as follows.

\[ N = a \cdot (\xi p) \quad (1) \]

\[ a = 0.1321(\cot \alpha)^2 - 0.8819(\cot \alpha) + 2.6982 \]

\[ b = -0.1077(\cot \alpha)^2 + 0.8142(\cot \alpha) - 0.7476 \]

\[ M = c \cdot (\xi p)^d \quad (2) \]

\[ c = 1.8564(\cot \alpha)^{-1.9176} \]

\[ d = -0.0361(\cot \alpha)^2 + 0.3117(\cot \alpha) - 2.0187 \]

where N and M are the shape factors in parabolic wave runup wedge.

Hughes (2003b) recommended the following equations for estimate the irregular wave runup height on smooth, impermeable slope for non-breaking and breaking wave as follows.

For non-breaking waves \( \left( \frac{H_{sw}}{L_p} < 0.0225 \right) \):

\[ R_{runup} = 1.75 \left( 1 - e^{-0.25(\cot \alpha)} \right) \left( \frac{M_p}{\rho g h^2} \right)^{1/2} \quad 1.0 \leq \cot \alpha \leq 4.0 \quad (3) \]

For breaking waves \( \left( \frac{H_{sw}}{L_p} > 0.0225 \right) \):

\[ R_{runup} = 1.75 \left[ 1 + e^{0.47(\cot \alpha)} \right] \left( \frac{M_p}{\rho g h^2} \right)^{1/2} \quad 1.5 \leq \cot \alpha \leq 4.0 \quad (4) \]

where \( M_p \) is the depth-integrated wave momentum flux parameter, \( R_{runup} \) is the vertical runup distance exceeded by 2 percent of wave runup, \( \alpha \) is the dike slope angle, \( h \) the water depth.

Hughes (2003a,b) established an empirical equation for estimating the wave momentum flux parameter for finite amplitude, non-linear waves base on a numerical solution technique. The resulting purely empirical equation was given as

\[ \left( \frac{M_p}{\rho g h^2} \right) = A_1 \left( \frac{h}{gT} \right)^{-4.1} \quad (5) \]

\[ A_1 = 0.1804 \left( \frac{H}{h} \right)^{-0.391} \quad (6) \]

\[ A_2 = 0.6392 \left( \frac{H}{h} \right)^{2.0256} \quad (7) \]

in which \( H \) is the incident wave height and \( T \) is the wave period.