Proceedings of the Eighteenth (2008) International Offshore and Polar Engineering Conference
Vancouver, BC, Canada, July 6-11, 2008

ISBN 978-1-880653-70-8 (Set); ISBN 1-880653-68-0 (Set)

On Effect of Plane Arrangement of Submerged Breakwaters on Setup, Swash and Runup over Beach

Dong-Soo Hur
Dept. of Ocean Civil Engineering (Institute of Marine Industry) Gyeongsang National University,
Tongyeong, KOREA
Sung-Tai Kee
Dept. of Civil Engineering, Seoul National University of Technology,
Seoul, KOREA
Woo-Dong Lee
Dept. of Ocean Civil Engineering (Institute of Marine Industry) Gyeongsang National University,
Tongyeong, KOREA
Jong-Sung Yoon
Div. of Civil Engineering, Inje University,
Kimhae, KOREA

ABSTRACT

In this present study, we ***made a first attempt*** to investigate physical transformations of incident waves in surf and swash zone and hydrodynamic phenomena of detached and submerged breakwaters. For an accurate simulation of the complicated wave deformation, **T**hree-**D**imensional numerical model with **L**arge **E**ddy **S**imulation has been developed recently and expanded properly for the current applications, which is able to simulate an accurate and direct **WA**ve· **S**tructure· **S**eabed interaction (hereafter, **LES-WASS-3D**). **LES-WASS-3D** has been validated through the comparison with experimental results for limited cases, and has been used for the simulation of wave run-up in sandy beach, mean fluid flows over and around submerged structures and swash zone (alongshore/rip current), and spatial distribution of wave height in wide fluid regions. In addition, a strategy of efficient deployment of the submerged breakwaters has been discussed.

KEY WORDS: Submerged breakwater; Run-up; Wave setup; Swash Zone; 3-D Numerical Simulation; Sandy beach

INTRODUCTION

Profound understandings of the 3-D beach processing in the coastal regions require fundamental studies for hydrodynamic characteristics of wave transformations in swash zone and assessments of the run-up heights (Ruggiero et al., 2001; Sallenger, 2000). Many other relevant studies can be found in many references (Patrick J. Lynett, etc., 2002). The frequent disappearance of beaches has great impact in the environment of the costal region, in tourism and economy of regions affected by this aggravation of beach erosion. Thus, recently, submerged breakwaters become an alternative solution in many countries (such as Korea, Italy, Japan, Spain, Portugal etc.) and in the view of a wide variety of armored structures to coping with this problem and with reduced environmental impacts (water circulation) and favorable scenic views. The gradually growing installation of the detached and submerged breakwater (in places where tidal variations are small) increases the complexity of the wave interaction mechanism between surf zone and structural zone hydrodynamics. In view of this, we were motivated to investigate the hydrodynamic phenomena using a newly proposed 3D numerical simulation tool.

As wind-driven waves propagate from deep to shallow water they undergo a number of transformations mainly caused by the interaction with seabed of decreasing depth and by the interaction with submerged structures and gaps between breakwaters. The most spectacular transformation of all is wave breakings over submerged breakwaters causing great turbulence on lee side, which dramatically deform the spatial and temporal distribution of wave amplitudes on all areas including surf/swash zone, and especially wave run-up in swash zone, and wave induced current. Such wave transformations are heavily dependent on the deploying strategy of detached and submerged breakwaters pertaining to the varying geometry and seaward location (detached lengths and gaps) on the sloping seabed along the shoreline.

For the profound comprehension of wave transformations and complicated hydrodynamic phenomenon, **T**hree-**D**imensional numerical model with **L**arge **E**ddy **S**imulation has been developed recently (Hur et al., 2008a) and expanded for the ongoing study, which is able to simulate directly nonlinear interactions of **Wa**ve · **S**tructure · **S**eabed (**LES-WASS-3D**). The developed numerical codes are validated through the comparison with experimental results for the interaction between swash processes and the ground water tables. Simulation of wave run-up in sandy beach, mean fluid flows over and around submerged structures and swash zone (alongshore/rip current), and spatial distribution of wave height in wide fluid regions have been obtained by **LES-WASS-3D** that is potentially very useful for both practical and research applications.

NUMERCIAL ANALYSIS