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)

Numerical Assessment on Inundation Risk and Efficiency of Countermeasure for Wave Overtopping in a Coastal Area

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ABSTRACT

The risk of wave overtopping and overflowing is increasing in the water-front of several countries because of the rise of mean sea level by global warming and the rise of the storm surge due to the typhoon or hurricane scale increasing. In the paper a tree dimensional fluid analysis model for wave overtopping and inundation is introduced. A numerical prediction of inundation risk in a coastal area is carried out applying the model and its applicability is demonstrated.

KEY WORDS: 3-D wave overtopping simulation, Coastal hazard risk, Storm surge simulation, MARS-model

INTRODUCTION

Sea level change due to global warning now becomes an urgent problem to coastal areas. In the Japanese urban areas facing to the oceans, the rise of storm surge deviation and wave heights are also risky to the human lives and properties as well as the rise of mean sea level. The inundation risk management like implementation of tidal barriers or warning system risk should be established especially in the residential and office areas located in the backyards of sea walls. As countermeasure against inundation due to wave overtopping and overflows the construction of high tidal barrier or sea wall has been carried out so far. But such construction of large walls may cause the disadvantages in landscape and need a large cost.

Other simple facilities and development of soft ware to mitigate the risk of inundation is in great importance to protect the risky coastal areas in relatively short time. At the first the paper describes the characteristics of inundation due to wave overtopping and storm surges in a model area facing to the Tokyo Bay, Japan employing a numerical simulation method. The MARS (Multi-Advection Reconstruction Solvers) is employed to simulate the wave overtopping. The validity and applicability of the model was obtained by Hiraishi et al.(2006). The MARS model has been originally developed by Kunugi (1997) and the two layers (water and air) interaction is calculated using fine cubic meshes composed of water and air domain. Yasuda et al.(2004a) improved the model to aply to the calculation of wave transformation. Similar numerical tools have been proposed today (ex. Kawasaki et al. (2007)). The 3-D calculation models take relatively long computation time, so the combination with the depth-integrated wave models is under development (ex., Sitanggang et al. (2006)). Such sophisticated numerical calculation models for wave transformation will becomes more general to the risk analysis for coastal hazards near future. The numerical evaluation of simple countermeasures continues in the latter part of this paper. The efficiency of curved-parapet at sea wall and drain behind sea wall are demonstrated. Finally the application of warning system in the model space is discussed.

CALCULATION OF INUNDATION

Calculation Model

The target area of numerical simulation is the Port and Airport Research Institute facing to Tokyo Bay in which two hundreds people are working in several low-stories buildings. The area has been heavily inundated in 2002 by storm waves due to the typhoon No.19 (Yasuda et al.,2004b). Improvement of seawall was carried out after the inundation

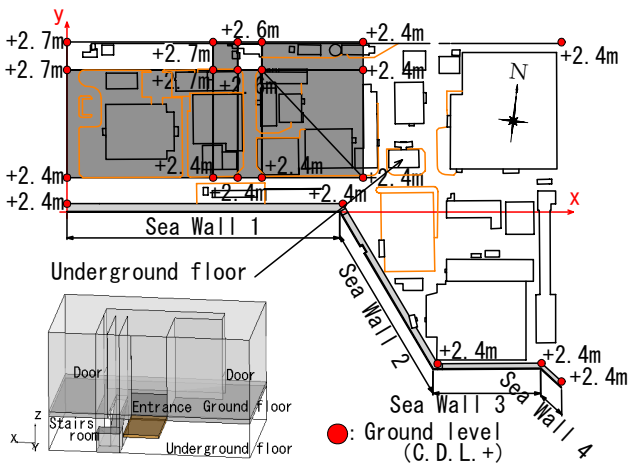

Figure 1 Calculation model for risk analysis