Experimental Investigation on Adaptive Countermeasure Using Floating Panel for Wave Overtopping Reduction

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ABSTRACT

Global climate change is acknowledged as a cause of the increasing severity of sea level rise. Consequently, coastal areas are now at severe risks from coastal disasters such as storm surge, wave overtopping and flooding. To adaptively prevent and mitigate wave overtopping disasters induced by storm surge or high wave, this study proposes a countermeasure system for wave overtopping reduction, in which a floating panel is newly installed to the front of an existing upright seawall. The effectiveness of the floating panel as a countermeasure against wave overtopping is furthermore verified by conducting laboratory experiments with a two-dimensional wave flume. The experimental results show that the floating panel has a great reduction effect of wave overtopping under regular wave action by following the water surface elevation in front of the seawall.

KEY WORDS: Floating panel; adaptive countermeasure; wave overtopping; upright seawall; hydraulic model experiment.

INTRODUCTION

A majority of the world’s population lives within coastal zones. These zones are therefore of critical importance to the world’s civilians and affect our economic activities. To protect the coastal zones from a threat of storm surge, wave overtopping and so on, a variety of coastal structures such as vertical seawalls, wave absorbing breakwaters and submerged breakwaters have so far been constructed and installed in coastal sea areas. These present structures have considerably contributed to the development of coastal areas, but the global climate change would require the additional improvements of their functions in the near future.

IPCC (Bindoff et al., 2007) reported that global warming has been increasing the sea level, which is predicted reaching 22cm to 44cm above 1990 levels by the mid-2090s. On the other hand, global climate change is recognized as a cause of the increasing severity of storm events. As a result, coastal areas are currently at severe risks from coastal disasters of sea level rise, storm surge, overtopping and flooding. Many lives and properties of civilians living at coastal zones have been lost by the coastal disasters, and public infrastructures such as roads and transportation activities sometimes have been damaged as well as interrupted under these disasters, as shown in Fig. 1.

Figure 1. Wave overtopping under a typhoon at Okinawa island, Japan.

Various solutions for preventing and mitigating wave overtopping disasters have been discussed in recent years. Sawaragi et al. (1988) examined the effects of artificial reefs on wave overtopping reduction rate. Their results showed that when the height of the reef in the front of a sea dike was given, a proper width of the reef was required to reduce wave overtopping. Cornett et al. (1999) investigated systematically the influence of parapets on wave overtopping at vertical-walled structures. They concluded that an overhanging geometry was very effective at reducing wave overtopping rate, but its effectiveness was highly variable, depending on the prevailing water level and wave condition. Kortenhaus et al. (2001) reported the experimental tests in which wave overtopping and wave loading on a vertical seawall with and without parapet were measured. It was revealed from their study that the effectiveness of the parapet on the reduction of wave overtopping was found only under conditions where the relative crest freeboard $R_c/H_s$ was larger than 1.5 ($H_s$: significant