Experimental Studies on Sandy Beach Profile Evolution in 2D Wave Flume

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ABSTRACT
An experiment was conducted in a wave flume to examine the processes of sandy beach profile evolution under regular waves. The impacts of various wave conditions on quartz sand were discussed. Every case was initiated with one constant slope. Beach profile evolution was measured by remote video camera technique and bathymetry data collected from the laser total station was used to calibration. The results of a number of cases were discussed and video technique performed well in monitoring time series beach profile evolution.

KEY WORDS: Beach profile; video technique; sediment transport

INTRODUCTION
The process of sediment transport in the coastal regions has been investigated intensively these years due to its utmost importance in coastal structures. There is need to build the capacity to predict the beach morphology change due to storm to be able to combat with coastal disaster induced by beach erosion as well as beach nourishment. The beach morphology changes have received considerable attention, Sorensen and Beil (1988) carried out wave tank experiments to investigate the response of perched beach profiles to storm wave attack. Since most of the previous methods are based on equilibrium profile proposed by Dean (1977), there is a lack in the detailed process-based investigation in the beach profile evolution. Besides, considering the investigation of the morphodynamics of a movable bed in wave flumes, time series of sandy beach profile evolution is not easy to be obtained due to the lack of certain efficient instruments. Recently, optical instrumentations are becoming more favorable because of the large amount of information they can provide. The application of video camera to field studies like U.S. Army Corps Field Research Facility in Duck NC (Holland et al., 1997) was widely used to monitor the swash motion. Applications of the 2D video methodologies have been also tested at both small and large scale in order to analyze bottom change within highly dynamic swash zones, and the obtained results showed that these techniques are able to catch accurately the dynamics of the swash bottom change (Enrico Foti et al., 2011).

This paper presents an introductory experiment conducted to elucidate the process of sediment transport due to regular wave shoaling, and runup on sandy beach. A new simple method of video technique was introduced to monitor the whole morphodynamic processes. The results of several cases under different wave boundary conditions were discussed.

This paper is organized as follows, the first section is experiment setup which contains a brief introduction of instrumentation and cases involved in this study. The second section mainly describes the principles of video technique and discussions of each case. Finally, certain conclusions were drawn from video data which can be used for future studies.

EXPERIMENT
Experiment Setup
An experiment was conducted in Shandong Provincial Key Laboratory of Ocean University of China which was designed to generate regular waves (mono-chromatic) in a 2D wave flume. The facility consists of a 3.0-m wide, 40-m long, 1.5-m deep flume, and includes one wave generator, a sand beach, and other instruments. Fig. 1 shows the layout of the facility. A sandy beach was constructed landward of slope 1/5. The median diameter, specific gravity, fall velocity of the 12 3\text{mm} fine quartz sand were 0.40 mm, 1.4, 0.048 m/s, respectively. One piston-type wave paddle was used to generate regular waves in a still water level (SWL) of 0.5 m and 0.7 m, and the duration for each case varies but at least 1 hour.

Time series of water surface elevations was measured using single-wire capacitance-type wave gauges. Nine gauges for slope 1/5 were mounted on the instrumentation bridge to measure wave shoaling, breaking, and runup as they transformed from offshore to nearshore.