LARGE-SCALE EXPERIMENTS OF WAVE OVERTOPPING AT A DIKE WITH VEGETATED FORESHORE

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INTRODUCTION

Coastal dikes are typically constructed to protect coastal areas from a range of coastal threats. When incoming waves interact with these dikes, wave overtopping often occurs if the runup of storm waves surpasses the dike's freeboard. This wave overtopping can result in natural disasters like coastal flooding and damage to the dike's protective layers. Extensive research has been dedicated to this phenomenon, primarily under the assumption of no vegetation presence, as detailed in EurOtop (2018).

However, in many tidal flat regions, such as the Yangtze River Delta, vegetation is abundant and forms a vegetated foreshore alongside coastal dikes (as illustrated in Figure 1). It's widely recognized that a vegetated foreshore not only dissipates waves more effectively than a natural beach, as shown in studies by Suzuki et al. (2019) and Zhao et al. (2023), but also reduces flow velocities, leading to sediment accumulation in the vegetated area, as observed in research by Hu et al. (2018). However, there is presently limited research quantifying the impact of vegetation on wave overtopping along coastal dikes.

METHODOLGY

This study aims to conduct a series of laboratory experiments using the wave flume facility at Dalian University of Technology in China for investigating the wave overtopping and wave force on the dike in the presence of vegetation under extreme conditions (Figure 1). The wave flume dimensions are 60 meters in length, 4 meters in width, and 2.4 meters in depth, enabling the simultaneous generation of waves and currents. The wave tank is constructed with a slope of 1:30, featuring a horizontal platform that spans 21 meters in length and stands at a height of 0.4 meters. The experimental setup also incorporates a 15-meter-wide area covered by vegetation and a dike on the horizontal platform to replicate the interaction between waves, vegetation and the dike. Subsequently, wave overtopping discharge is measured after the waves have passed through both the vegetation and the dike. The most severe hydrodynamic scenario involves a significant wave height of 0.5 meters, a peak period of 5 seconds, a water depth of 1.8 meters, and a current speed of 0.2 meters per second. This study will encompass various wave conditions, including regular and irregular waves, with and without the presence of a current.

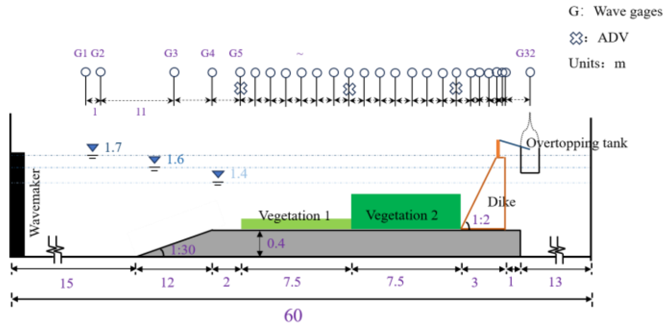

Figure 1 Experimental setup (not to scale)

FUTURE WORK

This study will analyze the influence of various factors, including vegetation density, width, and relative height, on wave overtopping at both vertical walls and sloping dikes. It will investigate mean and individual wave overtopping discharge and make comparisons between dikes with and without a vegetated foreshore. The research will also assess the impact of different combinations of vegetation and various dike structure types on wave overtopping discharge. The main goal is to establish relationships that account for vegetation configurations, wave conditions, and the resulting overtopping discharges. This research will improve the accuracy of predictions regarding the effects of vegetation on wave overtopping and refine the existing formulas found in EurOtop (2018).

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