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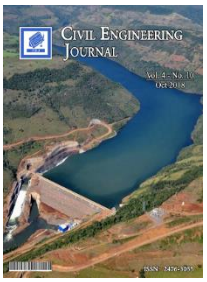

Effect of Soil Types on the Development of Water Levels and Erosion Processes during Overtopping Test

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Abstract

The construction of dike materials is an essential parameters in controlling the safety of hydraulic engineering. The dike material is an earthfill material constructed from non-cohesive materials or mixed from cohesive and non-cohesive materials. Overtopping failure can affect the dike stability during water cross above dike crest and could threat people lives and property. It is reduced the matric suctions binds soil particles due to the increasing volumetric water content during the transition of water level from the upstream into downstream slopes. In this paper, two spatial overtopping tests are conducted in Hydraulic Geotechnical laboratories at the Universiti Sains of Malaysia to observe the evolution of horizontal and vertical water levels as well as the development of lateral and vertical erosion processes under constant inflow discharge of 30 L/min. The vertical and horizontal water levels as well as the vertical erosion process are measured using one digital camera installed in front of dike embankment, while the horizontal erosion process was measured using another digital camera installed in front of downstream slope. Two types of coarse sand and very silty sand soils are used to construct dike embankment in small flume channel. The small flume is constructed from transparent PVC material to observe the development of water distributions and erosion processes with sediment box to collect the eroded materials. A pilot channel is cut in dike crest along the side wall of small flume channel to initiate breach channel in the dike crest. The initiation of breach channel is crucial for the evolution breach channel failure in the downstream and upstream slopes. The results show that the vertical and horizontal water levels are distributed faster in coarse sand soil compared with those in the very silty sand soil while the horizontal water levels are distributed faster than vertical water levels for both soils. The permeability of coarse sand increases the velocity of water flow for occupation soil particles and beginning failure in dike crest faster. The presence of fine particles in the very silty sand has reduced the rate of erosion processes inside dike particles in horizontal and vertical directions. The fine particles absorb a large amount of water content and, thus reduce the easiest water infiltration into particles with higher matric suctions. The analyzing of the distributions of water levels and erosion process help to understand the behavior of dike embankment during overtopping failure and increase the maintenance for dikes parts to reduce the potential danger.

Keywords: Dike; Horizontal Erosion Process; Vertical Erosion Process; Overtopping Failure; Spatial Breach Test.

1. Introduction

One of the major issue in the hydraulic engineering is the construction and maintenance of dike embankment. The dike embankment is defined as an earthfill material (cohesive or non-cohesive materials) constructed in front of rivers and lakes to preserve the water and provide a safe environment for people lives and property [1, 2]. The dikes embankments are classified into natural and man-made constructions [3]. Natural dikes are formed during the large movement of earth layers, due to earthquake failure, that preserves huge quantity of water volumes such as volcanic

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