P12

# Erosion and stability characteristics of banks under different flood conditions

○Ahmed ALY EL-DIEN, Hiroshi TAKEBAYASHI, Masaharu FUJITA, Shusuke MIYATA

## 1. Introduction

Riverbanks are subjected to sudden variation in water level during flood events. The same situation occurs to reservoir banks during dam operation. Such fluctuation in water surface level (WSL) and the groundwater table (GWT) severely affect the stability of riverbanks. In this study the cross section of cohesive riverbank during two flood events is estimated using a fluvial erosion model. In addition, the pore water pressure and GWT inside the riverbank are then calculated by applying a seepage model, and finally the bank stability is checked by using an elastic visco-plastic finite element (FE) model.

## 2. Hydraulic conditions and simulation procedure

Stability of a typical riverbank is checked under the effect of two hydrographs having the same total runoff volume and the same peak-discharges but different peak-times, as shown in figure (1). Each hydrograph is divided into several parts, each of 2-hours period and the river discharge is assumed constant within this time period. The eroded cross-section is obtained at the end of each time period. For the new riverbank geometry, the seepage model is run and the groundwater table is obtained, finally the factor of safety (FOS) and the plane of failure are determined.

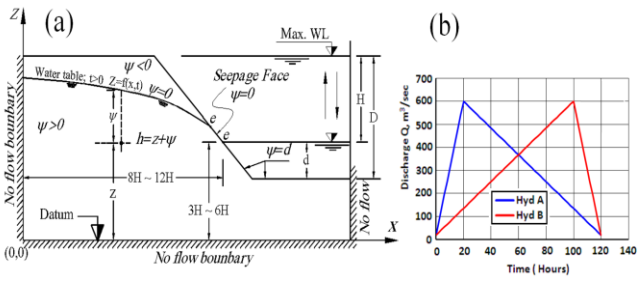


**Fig.(1)** (a) The simulated riverbank , (b) Flood Hydrograph

## 3. Results and discussions

The expected plane of failure for the riverbank at the end of hydrographs A, B is shown in figure (2). FOS in case of hydrograph-B is less than that of case hydrograph-A because of two main reasons. First, the fluvial erosion in case hydrograph-B removes a sufficient amount of material from the bank and bed causing the bank to be more steep and high. Second, the WSL in case hydrograph-B drops rapidly while the GWT is still high inside the riverbank which causes a big pressure difference between inside and outside the bank. Simulation results also shows that the expected mass failure in case hydrograph-B is much bigger than that from case hydrograph-A, as shown in figure (2).

## 4. Conclusions

Both the change in the riverbank geometry due to fluvial erosion and the rate of change in water surface level are key factors that affect the stability of riverbanks. Pressure differences between outside and inside the riverbank should be kept as small as possible. Sudden drawdown in the WSL is responsible for generating such pressure difference, so it is recommended to take into consideration the drawdown rate when operating the dam gates to keep the reservoir and river banks safe.

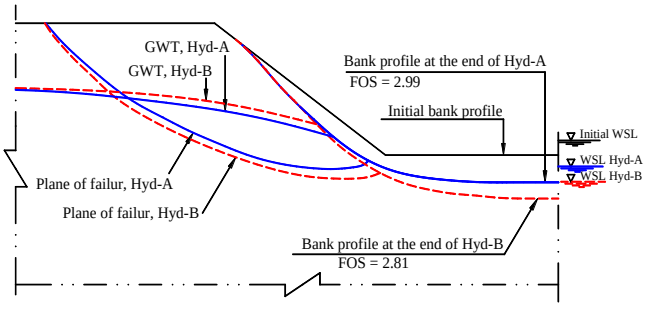


**Fig.(2)** Expected plane of failure, and the FOS