Modelling the deposition process of failed bank material

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1. Introduction

Slope stability, seepage, and fluvial-erosion models are combined in order to further understand the interaction and the process of riverbank retreat. Fluvial erosion usually occurs at the bottom of the riverbank by removing soil particles then producing an overhang on the long term. The formed overhang at the top of the riverbank collapses as a block of mass and is accompanied by large deformation. This study presents an approach to describe the amount and the shape of the failed bank material.

2. Hydraulic conditions and simulation procedure.

Fluvial erosion and mass failure are investigated by a typical riverbank under the effect of the hydrograph shown in figure (1). The hydrograph is divided into several parts, each of 4-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.

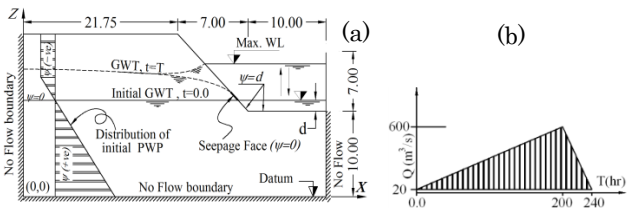

Fig.(1) (a) The simulated riverbank ,(b) Hydrograph

The geometry of the bank after collapse is modified based on two basic assumptions: (1) the failed bank material become loose and turned into small separate pieces (crumbs) that rests on a slope having the an angle of repose less than the original bank angle, (2) the collapsed sediment volume equals the deposited sediment volume.

3. Discussion, results and conclusions

The stability model uses the finite element technique, there is no assumption needs to be made in advance about the shape or location of the failure surface. Failure occurs "naturally" through the zones within the soil mass in which the soil shear strength is unable to resist the applied shear stresses. The rotational, planner, cantilever failures are considered the most common failure types observed in riverbanks. Each type depends on the geometry and the material of the bank. The expected plane of failure for the riverbank at the end of the hydrographs is shown in figure (2-a). On the other hand, the shape of the riverbank after failure is shown in figure (2-b). If the mean angle of bank slope increases due to lateral erosion, it consequently becomes less stable. As a result, bank failure occurs. The failed sediment at the bottom of the bank can be entrained and the process repeats itself.

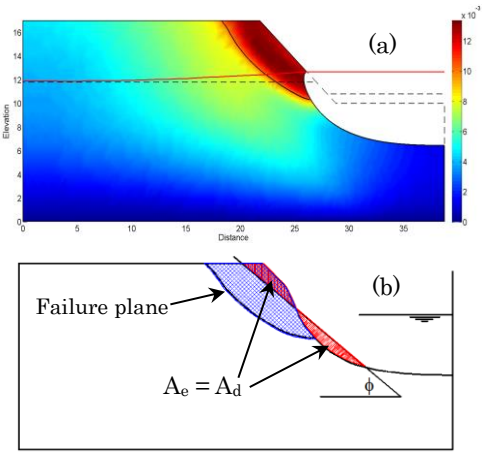

Fig.(2) (a)Expected plane of failure, (b) shape of the riverbank after failure.