Journal of Water and Soil Science
Vol. 27, No. 4, Winter 2024, Isfahan University of Technology, Isfahan, Iran.

Determining the Thickness of the Filter Layers to Protect the Upstream Sideslope of the Homogeneous Earth Dam Due to Rapid Drawdown Condition with Experimental and Numerical Models

H. Azadbeygi*, M. Najarchi and S. H. Lajevardi[1]

(Received: April 9-2023 ; Accepted: August 30-2023)

Abstract

The present research explores the experimental and numerical investigation of homogeneous earth dams in rapid drawdown conditions. The numerical model was evaluated and calibrated due to the saturation status using the experimental model. The calculated error between the piezometric pressure data and the seepage line in the numerical and experimental model indicated that the results of the Seep/W numerical model data had acceptable accuracy. Also, to determine the thickness of the filter adjusted in the upstream side slope of the homogeneous earth dam in rapid drawdown condition, input data to the numerical model including hydraulic conductivity, rate of the water level drop (depletion of the dam reservoir in three scenarios of 2, 3, and 4 days), the different side slopes of the body (m = 1, 2, and 3), and the thickness of the filter layers were determined. It is worth mentioning that the number of layers and the soil properties of the filter materials were determined based on the USBR which consisted of three types of soil structure (sand, gravel, and gravel with sand). The maximum hydraulic gradient of the dam materials was used to estimate the thickness of the filter layers. Finally, some dimensional fewer numbers were presented to estimate the filter layers by changing the input data through the numerical model to attain the safe conditions for the values of the hydraulic gradient at the upstream side slope. Results of the numerical model indicated that for the construction of the dam with the thickness of the presented filter, the values of the available hydraulic gradient at the point of water exit from the upstream side slope of the body of the earth dam were lower than the critical hydraulic gradient of the earth dam materials in rapid drawdown condition.

Keywords: Thickness of the filter, Rapid drawdown, Earth dam, Hydraulic gradient, Seep/w

1. Department of Water Engineering, Faculty of Agriculture, Arak Azad Islamic university, Arak. Iran.
*: Corresponding author, Email: Hasanazadbeygi7202@gmail.com