



A comparison of sophisticated neural network and Finite Element Method in estimating of variations in permeability of earth-dam body in leakage phenomenon

Ali R. Ahmadi¹, Foad Ghasemi², Ehsan Sadrossadat³, Ahmad Ghasemi⁴

1- Associate Professor of Kerman Graduate University of Technology

2 & 3- Master student of Kerman Graduate University of Technology

4-Master student of Shiraz university

1-iran.mahan@gmail.com, 2-zzfqassemi@yahoo.com, 3-ehsan.sadr12@gmail.com,
4-ahmadghasemi@yahoo.com

Abstract

Leakage is one of the most important problems in earth dam construction. Lake of leakage phenomenon analysis for earth dams can lead to destructive problems like increase in leakage forces, increase in pore water pressure and instability of the earth dam. In this study, leakage in two sections of an earth dam are modeled and analyzed by Finite Element Method (FEM), Multilayer Perceptron network (MLP) and Radial Basis Function network (RBF) and the results are compared. Based on the results, it can be concluded that FEM prediction are not compatible with actual data, whereas sophisticated neural network give acceptable results.

Keywords: sophisticated neural networks, leakage, finite element.

1. INTRODUCTION

In recent years, Artificial Neural Networks (ANNs), successfully being used in many engineering fields such as geotechnical engineering. The initial research of programming that knowledge, began from the mid-19th century by Parlf Lvrya and continued by scientists such as William James in the 19th century, Mac Klv and Pittsburgh in 1943, Hb in 1949, Frank Rosen Blatt 1958, have been continued until today.

Mathematical models need to determine the relationship between input and output, but (ANNs) transfer knowledge or the law lies beyond the data, by processing experimental data, to the network structure. Although, (ANNs) is more suitable when there are complex relationships between variables that can not be computed. On the other hand the mathematical functions cause large error in results if given incorrect or incomplete input, while (ANNs) results are exact and precise.

Considering to special geometry of large earth dams' body, one of parameters can cause effects on it, is leakage. Wide valley in river basin, earthquake region in Iran are reasons of building earth dams, because of the flexibility and resistance of them against incoming earthquake forces. Also, being available materials of earth dams can reduce the cost of construction. Inconsideration of earth dams' leakage analysis, may cause leakage forces, pore water pressure and instability of earth dams.

Earth dam's leakage (Sattar Khan Earth Dam), implemented by using black box models by Noorani and others. [5, 6] Also, a numerical modeled by FEM software is used for non-permanent leakage in earth dams by Taylor and others. [7]

2. ARTIFICIAL NEURAL NETWORKS (ANNs)

(ANN) is consists of arithmetic operators similar to a biological neural systems. In fact, all artificial neural networks include a series of simple computing elements that require a bit of memory to perform calculations and other tasks. Each neural network includes a series of inputs, number of hidden layers and output layer. Inputs are processed in hidden layer and after exit from output layer turn into the network's results. Within the network, data change into new values by weight linkage then used as variables of transmission functions. The process performs in each layer of a neural network until network's output ultimately obtained. This feature of neural network has the ability to achieve acceptable results, unlike conventional methods, in less time and without need to predefined criteria or rules. Several types of artificial neural networks with special features exist, so to achieve the desired results an appropriate neural network should be selected. Also, the