World Academy of Science, Engineering and Technology
International Journal of Geotechnical and Geological Engineering
Vol:9, No:06, 2015

Optimum Dimensions of Hydraulic Structures Foundation and Protections Using Coupled Genetic Algorithm with Artificial Neural Network Model

Authors : Dheyaa W. Abbood, Rafa H. AL-Suhaili, May S. Saleh

Abstract : A model using the artificial neural networks and genetic algorithm technique is developed for obtaining optimum dimensions of the foundation length and protections of small hydraulic structures. The procedure involves optimizing an objective function comprising a weighted summation of the state variables. The decision variables considered in the optimization are the upstream and downstream cutoffs length sand their angles of inclination, the foundation length, and the length of the downstream soil protection. These were obtained for a given maximum difference in head, depth of impervious layer and degree of anisotropy.The optimization carried out subjected to constraints that ensure a safe structure against the uplift pressure force and sufficient protection length at the downstream side of the structure to overcome an excessive exit gradient. The Geo-studios oft ware, was used to analyze 1200 different cases. For each case the length of protection and volume of structure required to satisfy the safety factors mentioned previously were estimated. An ANN model was developed and verified using these cases input-output sets as its data base. A MatLAB code was written to perform a genetic algorithm optimization modeling coupled with this ANN model using a formulated optimization model. A sensitivity analysis was done for selecting the cross-over probability, the mutation probability and level ,the number of population, the position of the crossover and the weights distribution for all the terms of the objective function. Results indicate that the most factor that affects the optimum solution is the number of population required. The minimum value that gives stable global optimum solution of this parameters is (30000) while other variables have little effect on the optimum solution.

Keywords : inclined cutoff, optimization, genetic algorithm, artificial neural networks, geo-studio, uplift pressure, exit gradient, factor of safety
Conference Title : ICCCGE 2015 : International Conference on Civil, Construction and Geological Engineering
Conference Location : Toronto, Canada
Conference Dates : June 15-16, 2015