



## **Modification of Hazen's equation in coarse grained soils by soft computing techniques**

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Hazen first proposed a Relationship between coefficient of permeability ( $k$ ) and effective grain size ( $d_{10}$ ) was first proposed by Hazen, and it was then extended by some other researchers. However many attempts were done for estimation of  $k$ , correlation coefficients ( $R^2$ ) of the models were generally lower than  $\sim 0.80$  and whole grain size distribution curves were not included in the assessments. Soft computing techniques such as; artificial neural networks, fuzzy inference systems, genetic algorithms, etc. and their hybrids are now being successfully used as an alternative tool. In this study, use of some soft computing techniques such as Artificial Neural Networks (ANNs) (MLP, RBF, etc.) and Adaptive Neuro-Fuzzy Inference System (ANFIS) for prediction of permeability of coarse grained soils was described, and Hazen's equation was then modified. It was found that the soft computing models exhibited high performance in prediction of permeability coefficient. However four different kinds of ANN algorithms showed similar prediction performance, results of MLP was found to be relatively more accurate than RBF models. The most reliable prediction was obtained from ANFIS model.