Buried Pipes Analysis in Reinforced Sand under Repeated Loading

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SUMMARY: This study presents a feed forward back-propagation neural network model to estimate vertical deformation of high-density polyethylene (HDPE), small diameter flexible pipes buried in reinforced trenches and settlement of soil surface, which are subjected to repeated loadings to simulate the heavy vehicle loads. Also, a genetic algorithm was used to optimize the model aimed to reach minimum vertical diametric strain of pipe (VDS) by considering an allowable settlement of soil surface (SSS) and the neural network model was used as a fitness function in the genetic algorithm process. The results show that predictions of the vertical diametric strain and settlement of soil surface using the trained neural network are in good agreement with experimental results. The link between genetic algorithm and neural network is observed to be as a powerful tool to optimize the model.

Keywords: Buried pipe, genetic algorithm, neural network, settlement of soil surface, soil reinforcement, Vertical diametric Strain.

INTRODUCTION

In spite of the fact that buried pipes are gaining popularity for use as buried underground conduits for road way and highway gravity-flow applications, but this system is decaying due to insufficient quality control, resulting in poor installation, little or no inspection and maintenance, and a general lack of uniformity and improvement in design, construction and operation practices. Many researchers have focused on this topic and developed the soil-pipe interaction experimentally, numerically or presented the mathematical relations or empirical equations. The original work was carried out by Marston and Anderson[1] and a theory for calculating diametric change under soil overburden was used by Spangler[2] to obtain a formula for calculating the horizontal deflection of buried pipes under soil overburden. Masada[3] revisited the classical work of Spangler to derive a modified Iowa formula for estimating vertical deflection of flexible pipe under soil overburden.

In mathematics, the term optimization, or mathematical programming, refers to the study of problems in which one seeks to minimize or maximize a real function by systematically choosing the values of real or integer variables from within an allowed set. A genetic algorithm (GA) is a search technique used in computing to find exact or approximate solutions to optimization and search problems. Genetic algorithms are categorized as global search heuristics. In this research the optimization of deflection of buried plastic pipe in sand due to some constraints specially reaching the allowable soil surface settlement using GA technique has been done[4]. In this work, analysis of small diameter flexible pipes buried in reinforced trenches and settlement of soil surface, which are subjected to repeated loadings, is approximated using some efficient artificial neural networks. Artificial neural networks are extensively employed in structural analysis and design[5].