



Determination of Multilayer Soil Strength Parameters Using Genetic Algorithm

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Abstract

This paper employs a back analysis method to determine soil strength parameters of the Mohr-Coulomb model from in situ geotechnical measurements. The lateral displacement of a soil nailed wall retaining an excavation in Tehran city used as a criterion for the back analysis. For this purpose, a genetic algorithm is applied as an optimization algorithm to minimize the error function, which can perform the back analysis process. When the accuracy of modeling is verified, the back analysis is performed automatically by creating a link between genetic algorithm in MATLAB and Abaqus software using Python programming language. This paper demonstrated that the genetic algorithm is a particularly suitable tool to determine 9 soil strength parameters simultaneously for 3 soil layers of the project site to decrease the difference of lateral displacement between the results of project monitoring and numerical analysis. The soil strength parameters have increased, with the most changes in Young's modulus of the first to third layers as the most effective parameter, 49.45%, 61.67% and 64.35% respectively. The results can be used in advanced engineering analyses and professional works.

Keywords: Excavation; Back Analysis; Parameters Determination; Mohr-Coulomb Model; Genetic Algorithm; Python Programming Language.

1. Introduction

Geotechnical in situ tests do not permit the identification of the soil parameters directly, which is considered as a limitation in engineering works. Given the recent advances, finite element method can be used to design geotechnical structures and developed as a numerical analysis technique since 1960. In geotechnical engineering, this method is often used to model and simulate problems for the prediction of geotechnical behaviour. But, this method is limited by the mechanical properties of the soil. So, it is possible to overcome the limitation by back analysis method [1, 2].

Optimization methods have been used in the back analysis method and divided into two general categories, such as optimization is based on the math basics and iterative methods (iterative algorithms). In this paper, the strength parameters of the Mohr-Coulomb model are determined by the back analysis based on genetic algorithm. A number of studies on back analysis using genetic algorithm of various problems have been already carried out, among which the following can be mentioned:

Gao et al (2016) used a back analysis procedure based on immunized genetic algorithm for parameter identification of elastic-plastic model for rock surrounding an underground excavation. The results showed that this model identification algorithm can significantly improve the computation efficiency and the computation effect [3].

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