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Research Article

Parametric investigation for discrete optimal design of a cantilever retaining wall

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ABSTRACT

In this paper, discrete design optimization of a cantilever retaining wall has been submitted associated with a detailed parametric study of the wall. In optimal design, the minimum wall weight is treated as the objective function. Through design algorithm, the optimal design variables (base width, toe width, thickness of base slab and angle of front face) yielded minimum structural weight of the wall and satisfied stability conditions have been determined for different soil parameter values. At the end, a detail parametric study searching the effect of change of soil parameters on the retaining wall design has been conducted with 120 optimized wall designs for different values; eight values of the angle of internal friction, three values of the unit volume weight and five values of wall heights. The obtained results from optimization analyses indicate that change of the angle of internal friction more effective than change of the unit volume weight on the optimal wall weight. Economic wall design with optimization analysis is achieved in a shorter time than the traditional method.

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1. Introduction

In geotechnical engineering, the retaining walls are employed to resist lateral soil load in case of constructing works like an excavation, slopes, railway or highway as lateral support. In conventional design of a retaining wall, stability conditions like sliding and overturning are checked by using selected wall dimensions, firstly. If selected wall dimensions do not ensure stability conditions, this trial and error process is continued, till satisfying stability conditions. Even though safe wall dimensions have been obtained in plenty of time, it is not certain that obtained wall design is the most economic among all possible solutions. On the other hand, conditions of worksite like ground water level, soil height to be supported laterally or intended use of structure and soil properties such as bearing capacity or behavior of settlement under loads of soil should be considered in case of design. Existing of all mentioned situations in wall design with reasonable cost make this design a challenging engineering problem with many unknowns. Optimization methods have been commonly employed to obtain optimal solution of these kind of complex engineering problems by Rhomberg and Street (1981) and Keskar and Adidam (1989).

In real world problems, the existence of some cases like the sophisticated characteristics of problems with many unknowns, an infinite solution space, or the numerous iterations have given metaheuristic optimization methods prominence. The metaheuristic optimization algorithms, which are quite popular in recent years, have been used effectively in solving such problems over the last two decades. Popularity of metaheuristics that mimics the natural phenomenon is based on being simple, compatible and effective. While, preliminary information is required to solve the problem normally, such advantages eliminate this necessity even in the case of a broad array of optimization problems. Metaheuristics have been commonly utilized for solving engineering problems with multiple variables in case of deterministic

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