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Research Article

Investigation of optimal designs for concrete cantilever retaining walls in different soils

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ABSTRACT

In this paper, the investigation of the optimum designs for two types of concrete cantilever retaining walls was conducted utilizing the artificial bee colony algorithm. Stability conditions like safety factors of sliding, overturning and bearing capacity and some geometric instances due to inherent of the wall were considered as the design constraints. The effect of the existence of the key in wall design on the objective function was probed for changeable properties of foundation and backfill soils. In optimization analysis, the concrete of the wall, which directly affects parameters such as carbon dioxide emission and the cost, was considered as the objective function and analyzes were performed according to different discrete design variables. The optimum concrete cantilever retaining wall designs satisfying constraints of stability conditions and geometric instances were obtained for different soil cases. Optimum designs of concrete cantilever retaining wall with the key were attained in some soil cases which were not found the feasible optimum solution of the concrete cantilever retaining wall. Results illustrate that the artificial bee colony algorithm was a favorable metaheuristic optimization method to gain optimum designs of concrete cantilever retaining wall.

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1. Introduction

In geotechnical engineering, cantilever retaining wall is commonly employed for enduring lateral soil pressure occurred between two different soil levels. Cantilever retaining wall, which comes into existence by combining a base and thin stem, is manufactured utilizing materials like stone, concrete or concrete-reinforcement. Design of a cantilever retaining wall must not be only ensured stability conditions but also should have a low cost. While a designer is trying to meet the requirement of being safe and economical wall design, the effect of changing parameters on the wall design should also be deliberated. In the wall design, considering parameters, for instance, retained height, the existence of groundwater, the physical position of construction area, intended use of the structure, the completion time of the construction and soil properties have made the design process complex with many unknowns. That is why utilizing metaheuristic optimization methods in the solution of this kind of engineering problems has become quite popular in recent years. Metaheuristic optimization methods are algorithms that mimic the behaviours of creatures like the process of survival, foraging, and migration in nature. The metaheuristic optimization methods which does not guarantee the accurate solution are robust and effective by courtesy of approaching the feasible solution in a reasonable time.

Many metaheuristic optimization methods that provide optimum solutions for the complex engineering problems have been presented hitherto; the genetic algorithm (GA) by Goldberg (1989), the particle swarm optimization (PSO) by Kennedy and Eberhart (1995), the ant colony algorithm (ACO) by Dorigo and Gambardella

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