Minimization of Earth Dam Cross Section Area Using Modified Harmony Search algorithm

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Abstract

Many critical slip surface search programs using different optimization search algorithms have been written but using these to design an optimized earth dam has never performed. Reducing cross section area of earth dams causes reducing cost of construction and material consumption of these structures. Obtaining optimum cross section for earth dams using traditional methods is a time consuming work that may not really result the best answer. In this paper, a modified harmony search optimization algorithm has been used to solve this complicated problem. Slope stability analysis is performed considering non-circular random-slip surface by MATLAB programming and Spencer method. Performing proposed method showed that obtaining the stable slopes in case of design an earth dam with minimum cross section can be achieved in less time and result in the most optimum shape comparison to traditional trials and error method.

Keywords: Earth Dam, Slope stability, Failure surface, Factor of safety, Harmony Search Algorithm

1. INTRODUCTION

Soil slopes are general in civil engineering and their stability assessment is of great importance to engineers. By using limit equilibrium method, a value FS, also named the factor of safety can be estimated without the knowledge of the initial stress conditions and a problem can be defined and solved within a relatively short time. Limit equilibrium method is a statically indeterminate problem and different assumptions on the internal forces distributions are adopted for different methods of analyses. At present, the famous method proposed by Spencer (1967) is used to give the factor of safety for specified slip surface.

Earth dams are one of the most important and expensive civil engineering structures. Expense of construction of structures and looking for enough material barrow areas directly depends on embankment volume of earth dams which in turn depends on their cross section area. Reducing cross section area of earth dams causes reducing cost of construction and material consumption of them. Obtaining optimum cross section of earth dams using traditional methods is a time consuming trial and error work that may not really result the best answer.

Design of an earth dam has different phases; almost always the slopes get in feasibility study would not change in further phases. Method of analysis in this phase is limit equilibrium and loading conditions would apply to find the stable slope.

Many critical slip surface search programs using different optimization search algorithms have been written but using these to design an optimized earth dam has never performed. In this paper, a modified harmony search optimization algorithm has been used to solve this complicated problem which is known as one the most important problems in geotechnical engineering. Slope stability analysis is performed considering non-circular random-slip surface by MATLAB programming and Spencer method.

2. SLOPE STABILITY

There are four parameters affecting the result of a slope stability analysis containing shape of slip surface, slip surface generation method, formulation of FS calculation and optimization algorithm[1]. To obtain the best result using literature review, non-circular slip surface using modified harmony search algorithm performed to find the factor of safety by Spencer method. The codes have been written in Matlab.