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# Analysis of effective alternatives in the seepage and slope stability of Golfaraj earth fill dam using Geo-studio model

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**Abstract**

Seepage in earth fill dams is one of the important factors that may cause the erosion and slope stability if it is ignored, so it is crucial to calculate the leakage discharge through the body of dam and foundation, to avoid economic and life losses. In this research, the seepage analysis of body and the stability of upstream and downstream slopes of Golfaraj dam after construction, stable seepage, rapid discharge of reservoir and OBE,MCE earthquakes have been accomplished and compared applying different limit state equilibrium including: Spencer, Bishop, Johnber, Morgenstern-Price, built-in Geo studio software. The results show that seepage discharge in a deep section without dike is 18.144 $m^3/day$ which is reduced in the case of applying a dike or a concrete blanket by 95 and 30.20 percent, respectively. Data obtained from the slope analysis indicate that the slope is stable under any circumstances and the limit equilibrium methods are convergent.

**Keywords: Earth Fill Dam, Seepage discharge, Slope Analysis, Limit Equilibrium, Finite Element.**

## 1. INTRODUCTION

Despite the progress in understanding the behavior of earth dams in recent years, the optimal design of such structures stay difficult and complex [1].

The analysis of slope stability is an important issue for engineers. In general, slope stability analysis consists of two steps: the first step is to calculate a factor of safety for a specified slip surface, and the second is to find a critical failure surface that is associated with the minimum safety factor [2].

Also the slope stability is dependent on seepage field across it which is acquired by solving Laplace equations. Proposed a distributed arrangement of Multiple Reservoirs and Tubes Analog (MRTA) for simulating seepage through an embankment dam in the laboratory MRTA was a reliable and convenient experimental 34 tool for seepage simulation in transient conditions [3].

If Newmark's displacement approach is used, calculation of earthquake induced deformations is highly sensitive to stability analyses and thus to the assumption on failure mechanisms, and so a finite element analysis provides advantages over other methods because no failure mechanism has to be assumed a priori [4].

Comparisons were made between the finite element strength reduction technique and different search techniques used in slope stability limit equilibrium methods including the Monte-Carlo technique. It was shown that the reliability of using the limit equilibrium methods in slope stability analysis can be largely increased using the Monte-Carlo optimization technique [5].

A novel particle based Bluff Morphology Model (BMM) is developed to investigate the effect of two dimensional seepage on the stability and collapse of soil slopes The interplay of erosion, seepage and slope instability is examined [6].

Elastic damage mechanics is a method used for describing the constitutive law of the meso-level element, the finite element method (FEM) is employed as the basic stress analysis tool, and the maximum tensile strain criterion and the Mohr–Coulomb criterion are utilized as the damage threshold [2].

The stability of body and foundation of earth dams during earthquake, seepage control and pressure in the body are important factors included in their design. In this study the slope stability is considered in three conditions:

After construction

Exploitation and permanent seepage