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Rock Slope Stability: Comparison of Geogrid Box Method with Conventional Reinforcement Methods

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Abstract

This research sets out to review critically the current slope stability methods including geometry modification, rock bolt and wire mesh and to offer geogid box method as an alternative to conventional rock slope stability methods. Achieving the objectives of this research, the limit equilibrium (LE) and finite element (FE) analysis were conducted to predict the response of rock slopes to a broad range of possible scenarios, namely dry, half-saturated and saturated states; as well as, static, quasi-static and dynamic conditions. The results indicate that the factors of safety obtained through the geogrid box method are higher than those obtained through conventional reinforcement methods.

Keywords: Rock slope stability, geogrid box, rock bolt, geometry modification, finite element analysis.

1. INTRODUCTION

The term slope stability may be defined as the resistance of inclined surface to failure by sliding or collapsing. The field of slope stability is concerned with the analysis of static and dynamic stability of slopes earth and rock-fill dams, landfills, road cuts, excavated slopes, and natural slopes in soil and rock (Walsh 2003). In the last two decades, increasing infrastructural development works and construction demands in Iran and elsewhere has necessitated construction of increasingly reinforced soil and rock structures. Soil and rock slope stabilization problems, vary considerably throughout Iran. This is chiefly because of the vastness of the country; different climates, rainfall; as well as, in some areas, freeze-thaw and snow conditions. Therefore, making out a simple solution for slope stabilization that will work everywhere in Iran is almost impossible.

Reinforcement can be used to improve the stability of slopes and embankments, making it possible to construct slopes and embankments steeper and higher than would otherwise be possible. Currently lots of methods are being used to stabilize rock slopes. These comprise adding reinforcement, altering the geometry of slope, installing drainage or using a combination of these methods. Installing rock bolts is the most common type of internal reinforcement currently is utilized to secure potentially unstable sections of the rock mass and improve long-term rock stability. However, a rational basis for all bolting system designs has not yet been achieved. In fact, the process of bolting system design remains an art rather than a science since most decisions are made based on previous experiences. This system works to reinforce the rock mass internally by increasing its resistance to shear stress and sliding along fracture. Rock bolts are considered a type of active reinforcement due to the post-tensioning they provide, and are used to add compressive stress to joints within a rock mass. This force increases the friction along the fracture planes and contributes to reduce block movement. Rock bolts usually are used