Influences of Horizontal Initial Stress and Slope Angle on Stress Distribution in Mountains and Cavern Stability

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Abstract	Inbetween the many factors, which will influence the distribution character of initial stress in a mountain, different angle of mountain slopes and horizontal geostress will have important effects on it. Therefore, stress distribution in mountains under different slope angles with considering different lateral coefficients of initial stress is studied using numerical method in here. In this paper, the initial geostress distribution of mountain at typical vertical profiles are studied in the gravity field, with the slope angles being 30°, 45° and 60°, respectively. After the calculation, it can be known that the actual initial vertical stresses may be 2-5 times of the gravitational stresses calculated by direct depth gh for some zones. Meanwhile, it reveals that different horizontal geostress has a momentous impact on it as well. Computation of damage-fracture model for jointed rock is adopted to analyze the rock stability of a cavern. Comparison of the rock stability excavated in a mountain area or under a flat surface is made also.

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Influences of horizontal initial stress and slope angle on stress distribution in mountains and cavern stability

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Keywords: slope angle; the initial lateral stress; stability of the surrounding rock; damage-fracture model; numerical simulation

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Introduction

The 21st century is the century of which human beings exploit and utilize the underground space. Along with the development of Chinese economic construction and the increasing number of underground engineering, technical problems are increasingly complex. Features of deep burial depth in a mountain area and other complex geological conditions require higher demand of the stability of surrounding rocks.

In-situ stress is one of the elementarey factors that mightily influence the surrounding rock stability of the project. It is influenced by many factors, including the slope angle of the mountain related to engineering. At present, such problem is lack of systematic research. In an underground engineering, the weight of the direct overburden rock is defined as the vertical initial stress generally. However, thus definition of the initial stress may cause a considerable error. The purpose of this article is to study the problem by comparing the two basic conditions: Firstly, assuming that the project is located under a slope with a angle; Secondly, it is under a flat surface of ground. Different horizontal initial stresses are taken into account as well.

Establishment of computing model Ⅰ and model Ⅱ

According to conventional idea, a vertical initial stress in a point should be $6y=\gamma h$. h is the direct overburden depth, γ is the rock density. But in fact it is not always right for a mountain area. For study the question two types of computational models are established.

Model Ⅰ. The model includes a hill slope area with different angles of it(Figure 1) and assume a cavern with the depth h located in it.

Model Ⅱ. For comparison the another model with horizontal surface(no slope) is established as well(Figure3). The cavern's depth is the same as model I.

It can be seen from Figure 2 and Figure 4 six survey lines AB, CD, EF and A′B′, C′D′, E′F′ are set up for above two models respectively .