Appendix 2

Abstract of Thesis

| Report number | Ph.D. obtained through coursework and thesis No. 3 2 6 | Name | LIU ANG 2M 4H6 |

Title of the thesis: Time dependent behavior of discontinuities and its relationship with long-term strength

Abstract of theses

Rock mass, as an engineering material, is a complex geological material containing numerous discontinuities such as geological faults, joints, fractures, etc. Discontinuities are among the most important factors that governing the mechanical behavior of a rock mass. Investigated data has demonstrated that the failure of the rock engineering along discontinuities is always not a brittle behavior but progressive damage after years or decades by creep and stress relaxation. Currently, intensive emphasis has been put on studying the time-dependent behaviors of rock masses through laboratory creep tests. However, stress relaxation behaviors and its correlation with long-term strength has been rarely investigated.

A series of conventional shear tests, shear creep tests and shear relaxation tests under different normal stresses were performed on artificial discontinuities with different Joint Roughness Coefficient (JRC). Special interests of this study are given to understand the time dependent behaviors of discontinuities, especially stress relaxation behaviors, and their relationship with long-term strength of discontinuities.

The main research contents are as follows:

1) A series of conventional shear tests on discontinuities with various normal stresses and JRC were conducted to explore the shear mechanical behaviors impacted by normal stress and JRC.

2) A series of stepwise shear creep tests of discontinuities were conducted, and evolutions of creep and creep rates are analyzed. Accordingly, an improved K-B model was proposed to describe the creep characteristics of discontinuities, and the fitting results present a good agreement with test results.

3) The isostress cyclic loading method (ICLM) was proposed to study the shear stress relaxation behaviors of discontinuities. The evolutions of stress relaxation curves under different normal stress as well as cyclic loading were analyzed. Accordingly, a nonlinear model (H-K-M) was proposed to describe the stress relaxation characteristics of discontinuities, and the fitting results agree well with test results.

4) Correlation between stress relaxation behavior and long-term strength, as well as between creep behaviors and long-term strength are analyzed. Stress relaxation method is put forward and proposed to determine long-term strength of discontinuities, from which the obtained long-term strengths present a good agreement with Mohr-Coulomb shear formula. Besides, long-term strengths were also obtained by creep tests. Differences between these methods were compared, which shows that stress relaxation method is more accurate.

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