

軟岩中空環剪試驗儀之研發

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中文摘要

不少破壞邊坡的逆分析結果皆顯示邊坡破壞面上之剪應力接近材料之殘餘強度。理論上環剪試驗為決定試體殘餘剪力強度的最佳方法。環剪試驗以試體形狀分別可以分成實心環剪試驗及中空環剪試驗，其中又以中空環剪試驗較為理想。然而，因為軟弱岩層具有固結差與膠結不良特性，因此在鑽取實心試體時，使用液體當介質，鑽取岩心困難度相當高，鑽取膠結不良軟岩的中空試體更形困難。在目前文獻中，扭剪試驗在求取軟岩中空試體的殘餘強度時，都被迫採取重模試體的方式處理，但重模試體又無法充份的代表現地的岩樣。本研究嘗試發展新的軟岩取樣方法，可以成功製作軟岩的中空試體，同時改良既有之多功能大地材料試驗系統，可以從事軟岩中空試體在不同加載條件（包含：固定正向力、固定體積）之大剪應變環剪試驗，以分別考慮軟岩在不同條件下之殘餘強度與力學行為。

本研究以寶山第二水庫所在之膠結不良軟岩試體進行一系列中空環剪試驗，研究成果包括：(1) 確定所改良的儀器運作順暢、試體破壞情況合理；(2) 建立實驗室取得軟岩中空試體方法及試驗步驟；(3) 分析軟岩中空試體在不同加載控制條件下環剪試驗之行為與結果；並(4) 依現階段儀器改良、使用本儀器之經驗，對環剪儀未來之發展提供建議。

Development of a Hollow Ring Shear Apparatus for Soft Rock

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Abstract

Some backup analyses of failure slopes in soft rock support that the shear strength in the failure plane is close to the residual strength of material. In theory, hollow ring shear test is most appropriate for the determination of a material's residual strength. However, the preparation of hollow specimen for a poorly cemented soft rock by traditional approach using drilling liquid is extremely difficult. Hence, hollow ring shear test for poorly cemented soft rock has rarely been attempted. In this thesis, the technique for the preparation of hollow specimen for poorly cemented soft rock was suggested. A servo-controlled hollow ring shear apparatus for soft rock was also developed. With this servo-controlled apparatus, large shear-strain torsional ring shear tests for can be conducted in either a constant normal stress mode or in a constant volume mode. The residual strength of poorly cemented soft rock can thus be determined correctly.

Using the developed apparatus, a series of torsional ring shear tests were carried out. The results of the tests verified the capability of the developed apparatus. It was observed the specimen failed in torsional mode reasonably as expected. The results also show that both the constant-normal-stress mode and the constant-volume mode ring shear test can be controlled correctly. The results of hollow ring shear tests under various test modes were compared and discussed. Further possible modification and refinement of the developed apparatus was also recommended.