多功能孔內試驗儀之改良及試驗結果詮釋

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摘　要

台灣中北部之軟弱岩石具有固結差、膠結不良、遇水易軟化之特性。岩層在取樣過程中岩心因為受到水及解壓的擾動，岩樣本身之組織構造可能受到破壞，而且軟弱岩石中可能存在不連續面，室內試驗結果無法考慮不連續面對軟弱岩石的影響，很難歸納出其力學性質與工程參數，所以軟弱岩石應施作現地試驗，並藉以瞭解現地材料之性質，以減少材料的擾動。

本研究旨在改善多功能孔內試驗儀以施作現地孔內千斤頂試驗、鑽孔剪力試驗、孔底平板載重試驗，首先針對現有儀器存在缺失加以改良，克服原有之缺點。此外，藉由數值模擬分析孔內千斤頂試驗與傍壓儀試驗應力-應變曲線之關係，找出其比例關係，藉以修正孔內千斤頂的解析方法，試驗結果若套用修正的解析方法，其結果會較直接套用原有 Goodman 之解析方法正確。本研究並施作一系列現地多功能孔內試驗，由孔內千斤頂試驗可得到徑向(水平)方向的剪力模數，結果亦顯示沿走向及傾角方向的剪力模數會因為異向性之關係而有不同；孔底平板載重試驗可以得到縱向(垂直)方向的楊氏模數；由孔內剪力試驗可以得到儀器與軟岩介面上的剪力強度。比對多功能孔內試驗儀試驗與室內三軸試驗之結果，可發現相當一致。

關鍵詞：軟弱岩石，孔內千斤頂試驗，鑽孔剪力試驗，平板載重試驗，現地試驗。

Improvement of a Multiple-Purposed Borehole Testing Device and Result Interpretation

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Abstract

Soft rock in the central and northern regions of western Taiwan is generally poorly cemented. The strength of soft rock can significantly degraded after disturbed or wetted. Typical rock coring process may inevitably disturb the in situ soft rock to some extent. Besides, soft rocks may contain some fissures and cracks. Laboratory results of cored specimen hence may not represent in-situ material's true properties due to the effects of disturbance. In situ test, on the other hand, offers certain benefits to avoid disturbance and to obtain real properties of in-situ soft rock.

This thesis aims to improve an in-situ multiple-purposed Borehole Testing Device (BTD) already developed earlier. The BTD is capable of performing lateral jacking test, direct shear test and plate bearing test in a same bored hole. The tasks in this thesis included the refinement of an existing BTD and the interpretation of the stress-strain relationships by comparing the numerical results of lateral jacking test and pressure-meter tests. Refinement of the BTD successful overcame existing problems in the original apparatus. Numerical comparison of lateral jacking test and pressure-meter tests improve the accuracy of data interpretation by using a suggested correction factor. The modified method appeared more accurate than using the Goodman's method. Subsequently, this study carried out a series of in-situ BTD tests. With the lateral jacking test, the shear moduli in two radial (horizontal) directions were obtained. Anisotropic shear moduli were investigated by comparing the shear moduli obtained along the strike and the dip directions. From the plate-bearing test performed at the bottom of the bored hole, the young's modulus in the longitudinal (vertical) direction was obtained. The borehole direct shear test was conducted to estimate the shear strength on the rock-structure interface. The results were found consistent with laboratory tests on undisturbed specimen.

Keywords: soft rock, borehole jack test, borehole shear test, plate loading test, in-situ test.