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SLOPE DEFORMATION MONITORING USING REFLECTOR-LESS TOTAL STATION

by

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SLOPE DEFORMATION MONITORING USING REFLECTOR-LESS TOTAL STATION

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A Thesis
Submitted to the Postgraduate Studies Programme
as a Requirement for the Degree of

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PERAK

JANUARY, 2010

DECLARATION OF THESIS

Title of thesis | **Slope Deformation Monitoring Using Reflector-less Total Station**

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hereby declare at the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTP or other institutions.

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Slope Deformation Monitoring Using Reflector-less Total Station

Abstract

Continuous deformation monitoring of slope along the roads and highways in Malaysia is one of the most effective method of early landslide detection, which could contribute to avoiding or reducing the risk of landslide. There are many factors that influence the success of the monitoring system such as accuracy of the instruments, existing information, frequency of slope failure in a particular area, size of potential hazard area and the involvement of people in that project. To overcome the above problems Reflector-less Total Station method is introduced as an alternative method. This method is able to reduce the usage of reflectors, thus more survey points can be covered. It is also more economical since not only the costs for the prisms are saved, but high installation expenses can also be reduced. Additionally it can lower the risk to the people involved in measuring slope deformation in areas that are dangerous and difficult to access.

This research focuses on the potential of using reflector-less Total Station for slope deformation monitoring. In order to check the performance and reliability of the reflector-less Total Station, periodical calibration of the instrument is necessary. The instrument with its related reflectors is calibrated to verify its constant and scaling errors, which is often accomplished by calculation from a series of measurements on a calibration baseline. A parametric least squares formula was used to obtain the constant and scaling correction calculations based on the series of distances on six sub-baselines. The calibration was performed at Jabatan Ukur dan Pemetaan Malaysia (JUPEM) permanent calibration benchmarks at Batu Gajah, Perak Malaysia. The result shows that the values of the constant and scaling corrections for the prism and the various targets are less than the values of the instrument specification, which indicate that the reflector-less Total Station is functioning well. Data on slope deformation monitoring were collected for the three epochs within a six months gap of each other and were carried out independently in the study area located at chainage 23+800 at Simpang Pulai - Cameron Highland highway. To prove that the movement is significant, statistical test has been

adopted in this study using t-student distribution. The test results show that there is a significant movement in the study area, whereby there has been a maximum of 0.09 m in the northing, 0.08 m in the easting and 0.012 m in the elevation in some of the points during the 18 months observation period.

Keywords deformation1, monitoring2, calibration3, reflector-less4, total station5

Pengawasan Deformasi Cerun menggunakan Alat Stesen Penuh Tanpa Pemantul

Abstrak

Pengawasan berterusan pergerakan cerun di sepanjang jalan dan lebuhraya-lebuhraya di Malaysia adalah salah satu cara yang paling efektif untuk mengesan tanda awal kejadian tanah runtuh, bagi mengelakkan atau mengurangkan risiko tanah runtuh. Walau bagaimana pun terdapat banyak faktor yang mempengaruhi kejayaan sesuatu sistem pengawasan, seperti ketepatan peralatan, maklumat yang sedia ada, kekerapan berlaku pergerakan cerun dalam sesebuah kawasan tertentu, keluasan kawasan berisiko tinggi dan penglibatan tenaga manusia didalam projek tersebut. Untuk mengatasi masalah ini, penggunaan alat stesen penuh tanpa prisma telah diperkenalkan sebagai satu kaedah alternatif. Kaedah ini dapat mengurangkan penggunaan alat prisma, dari itu lebih banyak titik-titik pengukuran boleh diambil. Ia juga lebih ekonomikal kerana bukan sahaja kos alat tersebut boleh dijimatkan malahan kos pemasangan yang tinggi juga dapat dikurangkan. Disamping itu, penggunaan peralatan ini juga dapat mengurangkan risiko kepada pekerja yang menjalankan pengawasan cerun di kawasan merbahaya dan juga yang sukar dimasuki.

Penyelidikan ini memberi tumpuan kepada potensi penggunaan alat stesen penuh tanpa prisma untuk pengawasan cerun. Bagi tujuan memeriksa prestasi dan kebolehpercayaan alat stesen penuh tanpa prisma, ujian penentukuran berkala alat tersebut adalah perlu. Alat tersebut berserta pemantul berkaitan ditentukur untuk menentukan pemalar dan ralat penskalaan yang kebiasaannya boleh dilakukan menggunakan pengiraan berdasarkan beberapa siri pengukuran di garis tapak penentukur. Formula kuasa dua terkecil parametrik telah digunakan untuk mendapatkan pemalar dan pengiraan pembetulan penskalaan berdasarkan beberapa siri jarak pada enam garis tapak kecil. Penentukuran ini telah dijalankan di tapak penentukuran piawai Jabatan Ukur dan Pemetaan Malaysia (JUPEM) yang terletak di Batu Gajah, Perak Malaysia. Keputusan menunjukkan bahawa nilai pemalar dan pembetulan penskalaan untuk prisma dan beberapa sasaran adalah lebih rendah dari nilai spesifikasi alat tersebut, yang menunjukkan bahawa alat stesen penuh tanpa prisma itu berfungsi dengan baik. Data

pengawasan cerun telah dicerap bagi tiga epok pada sela masa enam bulan di antara satu sama lain dan telah dijalankan secara berasingan di kawasan kajian yang terletak di rantaian 23+800 lebuh raya Simpang Pulai–Cameron Highland. Bagi membuktikan bahawa pergerakan adalah signifikan, ujian statistikal telah digunakan dalam kajian ini menggunakan taburan t. Analisis kajian telah menunjukkan berlaku anjakan tanah yang ketara di tapak kajian, dimana terdapat beberapa titik yang telah berganjak sebanyak 0.09 m bagi komponen utaraan, 0.08 m bagi komponen timuran dan sebanyak 0.012 m bagi komponen pugak bagi tempoh cerapan selama 18 bulan.

Kata kunci deformasi1, pengawasan2, kalibrasi3, tanpa pemantul4, stesen penuh5

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