DETERMINATION OF OPTIMUM CONCENTRATION OF LIME SLURRY FOR SOIL STABILISATION

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To my beloved family, Rafidah and Muhammad Hussien

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ABSTRACT

Lime has been used as active additive in soil stabilisation for the past 5000 years ago. The Pyramids of Shersi in Tibet were built using compacted mixtures of clay and lime. Lime powder is normally spread on the ground using mechanical means before mixing with the soil. The problem arise from lime mixing is dusting. The introduction of lime slurry method for soil stabilisation is intended to solve the problem. This research is focused on determination of optimum concentration of the lime slurry for soil stabilisation. Classification test on the natural soil was conducted to determine the suitability of soil to be treated with lime. Suitability of lime test also conducted to ensure the quality of lime used is acceptable. The compaction characteristic of soil treated with lime slurry posses the same behaviour as demonstrated by soil treated with dry lime where the optimum moisture content increases and the maximum dry density decreases. Unconfined compressive test (UCT) was conducted on soil treated with different range of lime concentration, ranging from 10 to 40 percent of weight of water and cured for 7 to 28 days. Based on UCT, it was illustrated that the strength development before 14 days is less significant. This could be due to the process of modification. However, after 14 days the strength increases rapidly. This phenomenon could be related to the process of stabilisation. The optimum concentration of lime slurry to stabilise the soil is 20 percent of weight of water, which is equivalent to 3.63 percent of dry lime.

Keyword: Soil stabilisation, lime slurry, unconfined compressive test (UCT)

ABSTRAK

Penggunaan kapur sebagai agen penstabilan tanah telah digunakan lebih 5000 tahun dahulu. Piramid Shersi di Tibet dibina menggunakan campuran kapur dan tanah yang dimampatkan. Serbuk kapur biasanyan diserakkan di atas tanah menggunakan alatan mekanikal sebelum kerja-kerja percampuran kapur dengan tanah. Masalah yang timbul daripada percampuran ini ialah habuk. Pengenalan kepada kaedah larutan kapur untuk kerja-kerja penstabilan tanah diperlukan untuk menyelesaikan masalah ini. Kajian ini memfokuskan kepada penentuan kepekatan larutan kapur yang optima untuk penstabilan tanah. Ujian pengkelasan dijalankan ke atas tanah asal untuk menentukan kesesuaian tanah tersebut untuk di rawat dengan kapur. Ujian kesesuaian kapur juga dijalankan untuk menentukan kualiti kapur yang digunakan. Ciri-ciri lengkung pemadatan tanah yang dirawat menggunakan larutan kapur menunjukkan sifat yang sama dengan tanah yang dirawat menggunakan kapur kering dimana kandungan lembapan optima meningkat dan ketumpatan kering maksima menurun. Ujian mampatan tak terkurung (UCT) dijalankan ke atas tanah yang di rawat menggunakan larutan kapur yang berbeza dalam lingkungan 10 hingga 40 peratus daripada berat air dan diawet selama 7 hingga 28 hari. Berdasarkan kepada ujian UCT, kekuatan tanah yang diawet kurang daripada 14 hari tidak begitu signifikan. Ianya disebabkan oleh proses modifikasi. Walaubagaimanapun, selepas 14 hari diawet berlaku peningkatan kekuatan tanah secara mendadak. Situasi ini disebabkan oleh proses penstabilan tanah. Kepekatan larutan kapur yang optima ialah 20 peratus daripada berat air dimana ianya bersamaan dengan 3.63 peratus kapur kering.

Katakunci: Penstabilan tanah, Larutan kapur, Ujian Mampatan Tak Terkurung (UCT)

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CHAPTER 1

INTRODUCTION

1.1 Background Study

Lime stabilisation is commonly resorted to in order to improve the strength and reduce the compressibility of weak clay deposits. Malaysia is one of the countries around the world that rich with limestone resources. Limestone formations are widespread in Langkawi Island, Kinta Valley, Gua Musang and Kuala Lumpur area (Khairul Anuar and Kok Kai Chern, 2004). The usage of lime as a stabilise agent is not new especially for road construction. Many researchers have studied the suitability of lime to improve soil properties such as strength and deformation behavior. Researchers have illustrated that the impact of lime addition on strength of clay soils depends on several factors. These include, soil type, curing time and method, moisture content and soil unit weight and time elapsed between mixing and compaction (Sudhakar M. Rao and P. Shivananda, 2004). In Malaysia, lime is not commonly use as a stabilise agent. It is because the lack of local research and understanding about suitability of lime stabilisation for Malaysian soil. The previous researcher found that by using 3% to 6% of dry lime, it contributed the significant increase in UCT test, ranging from 2.5 to 11 times of untreated soil (Khairul Anuar and Kok Kai Chern, 2004). Although dry lime is very useful in soil stabilisation, it always causes dusting problem and is corrosive to human skin especially quick lime. To counter this problem, lime in slurry form is suggested to stabilise the soil. 60 remolded samples with different concentration have been prepared for this study and cure for 7, 14 and 28 days. Then, unconfined compressive test is carried out on the cured samples to determine the highest shear strength. As a result, the optimum concentration of lime slurry in this study is 20% of weight of water where this percentage is equivalent to 3.63% of dry lime.

1.2 Objectives

The objectives of this research are as below:-

- To determine the optimum concentration of lime slurry for soil stabilisation
- To determine the compaction characteristic of the lime-soil mixture
- To study on strength development of the lime-soil mixture

1.3 Scope of study

These studies only focus on determination of the optimum lime slurry to be used in soil stabilisation in clayey soil. The clay will be used is kaolin clay from Tapah, Perak. Only hydrated lime slurry is used to stabilise the clayey soil in this study. All the testing for this study is conducted in laboratory by using British Standard as a reference.

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