INTI INTERNATIONAL UNIVERSITY

Faculty of Engineering and Quantity Surveying

INVESTIGATION ON COMPRESSED STABILIZED EARTH BLOCK USING LATERITE SOIL STABILIZED WITH CEMENT

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SUPERVISOR'S DECLARATION

This project report entitled Investigation on Compressed Stabilized Earth Block using Laterite Soil Stabilized with Cement is prepared and submitted by Thamendran A/L Magindran I14004712 as partial fulfillment of the requirement for Bachelor of Engineering (HONS) in Civil Engineering, INTI International University.

APPROVED BY:

Date: 04/05/2018

STUDENT'S DECLARATION

I hereby declare that the final year project 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 INTI INTERNATIONAL UNIVERSITY or other institutions.

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ABSTRACT

An increase towards urban development have created less importance towards rural areas as the community depending on economical and low cost housing. This study is based on determining geotechnical properties of laterite soil encountered in Sungai Buloh. Related journals and articles were reviewed to obtain sufficient experimental result informations. The objectives of this study were satisfied by a series of preliminary laboratory experiments. Comparison from past researchers were made for each experiments to justify and assure the results obtained are diverse and favourable. The main aim of this study is to obtain unconfined compressive strength, UCS of suitable natural geotechnical properties of laterite soil stabilized with cement in the production of CSEB. The findings from this research started with Natural Moisture Content, NMC of laterite soil ranged at 17.04%. Particle size distribution curve shows that the soil is well graded with proportions of aggregate less than 15%, sand and fine grains in the range more than 50%. Liquid Limit, Plastic Limit and Plasticity Index of laterite soil is 40.13%, 26.53% and 13.60% respectively. Plasticity Chart plot lies above A-line classifying as soil containing inorganic clays of low or medium plasticity (CL). Laterite soil attains Optimum moisture content, OMC at 16% and Maximum dry density, MDD at 1.88 g/cm^3. Samples prepared once the OMC and MDD were attained to be stabilized with (0%, 2.5%, 5%, 7.5% and 10%). The UCS of laterite soil with OMC and MDD stabilized with 10% cement content achieved 3.4 $\frac{N}{mm^2}$ after 28 days of curing. As the curing days increased, the compressive strength also increase among the stabilized samples. Calculations from experimental readings with necessary graphs and tables are summarized in Chapter 3. The results are presented in Chapter 4 with discussion. Each citation made are included in References. In depth data and tables are included in Appendix 1- 4.

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LIST OF ABBREVIATIONS

w	Moisture content
LL	Liquid Limit
PL	Plastic Limit
PI	Plasticity Index
NMC	Natural moisture content
OMC	Optimum moisture content
OPC	Ordinary Portland Cement
MDD	Maximum dry density
AASHTO	American Association of State Highway and Transportation Officials
ASTM	American Society for Testing and Materials
BS	British Standard
CSEB	Compressed Stabilized Earth Block
IS	Bureau of Indian Standard
NIS	Nigerian Industrial Standard
USCS	Unified Soil Classification System

CHAPTER 1

INTRODUCTION

1.1 General

Soil is formed through the change of underlying minerals affected by chemical, physical and biological process followed by natural and climatic changes. It is vastly found emerged on the surface of the earth as deposits and comes in various types. These variety in the soils introduced at the surface can be credited to a progression of natural process through time. Soil has been one of the primary components of construction since ancient times due to its common availability on earth. The applications can be found in a variety of forms like rammed earth, adobe blocks, and mud plaster. It is one of the basic material for the production of blocks. Predominantly, clay and laterite soil used to enhance engineering performance in various application. Laterite soil is unique due to its iron and aluminium content. They are formed by undergoing high and long lasting weathering process. Block masonry is a well proven building material possessing excellent properties in various aspects, for instance, strength, durability, appearances and cost (Hendry *et al.* 1997). However, the quality of masonry in building mainly depends on the soil and stabilizer used and all the bricks or blocks must meet the requirement standards for its engineering application.

Cement are products produced by grinding hard nodular clinker formed by burning raw materials (argillaceous and calcareous) mainly composed of silicate, alumina, lime and iron oxide. Cement has cohesive and adhesive characteristics which set and hardens when mix with a paste of water. When cement used as stabilizer, liquid limit(LL) is decreased and plasticity index(PI) is increased through chemical reactions in turn the soil workability is enhanced (Waziri *et al.*, 2013). The common shortcomings in masonry are weak mechanical characteristics, environmental damage low protection from weathering processes and

responsible to volume change particularly in the utilization of clay. Therefore, to overcome these obstacles, combination of mechanical and chemical technically known as stabilization is needed with soil that have suitable natural geotechnical properties.

1.2 Problem Statement

Developing countries facing challenges in provision of housing such as in Malaysia. Construction materials costs are increasing tremendously such as cement, timber and steel, which make contractors less encouraged to construct houses on limited budget. Based on statistical data from Valuation and Property Services Department (JPPH), the housing demand is estimated to continue slow progress in 2017, due to Malaysia weak currency performance among others and effects of slowing economy. Housing is important to manage one's daily life, however 50% of world population still living in shack houses in rural areas (Noorbaya *et al.*, 2014). As an alternative solution to this problems, using low-cost housing material will be beneficial to provide affordable housing in order to meet society demand (Nasly *et al.*, 2009), (Raheem *et al.*, 2010). Ideally, locally accessible raw material which are abundant in quantity and renewable in nature allows progression of low cost housing.

Cement content in interlocking block have the ability to alter the compressive strength of interlocking block however, the most favourable outcome of mixed design still depends on the optimum propotions. Maximum strength can be achieved with optimum mixed proportions of soil, cement and water content. The problem is that there is not well documented guide on how to produce soil cement interlocking blocks and the best curing period to give the optimum strength. While in general building construction such as single storey economical housing, burnt clay bricks may be replaced with soil cement block which usually require compressive strength of 1-4$\frac{N}{mm^2}$.(Nasly *et al.*, 2009)

. In The Public Works Department (JKR standards) and (MS 76:1972), minimum compressive strength for load bearing internal walls of block is 2.8 $\frac{N}{mm^2}$ and 1.4 $\frac{N}{mm^2}$ for non load bearing partitions which indicated that its suitable to be used in one or two storey

dwelling house construction. Therefore, a better understanding on geotechnical properties of soils needed to utilize the benefits fully in construction work

The strength and durability characteristics of soil-cement blocks mainly depends on three important ratios which is soil composition, water and cement content. There were very less research done by using laterite soil and cement for stabilization. (Noorbaya *et al.*, 2014) indicated that eventhough gradual success have been achieved by all the research on laterite soil cement block, still the study need to be more in depth to further implement full benefits of the laterite soil. Mostly, clayey soil were used to produce soil cement blocks. The study of laterite soil properties are diverse and complex which needs knowledge of geotechnical engineering. Since Malaysia is a tropical country, laterite soil is found extensively in Kedah, Pahang, Seremban, Melaka and Johor (Eyles *et al.*, 1970). However, the procedures of identifying laterite soil for sampling need to be studied. On the other hand, process of curing is very important in where the strength of cement soil mixture increases with curing period as indicated by (Starcher, 2013). Stabilization processes are very complex due to numerous parameters need to be considered. The knowledge of soil mechanics can help to study optimum properties of laterite soil that achieves high compressive strength when stabilized with cement.

1.3 Research Objectives

The objectives of this research are:

I. To determine engineering properties and characterization of laterite soil for application of soil cement blocks.

II. To demonstrate effects of cement on the compressive strength of soil with respect to curing days.

III. To determine optimum moisture content of laterite soil stabilized with cement to achieve minimum compressive strength required by Malaysian Standard (MS 76: 1972) for blocks.