PERFORMANCE OF LATERITE AGGREGATE CONCRETE

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To my beloved father, mother and all my family members.

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First and foremost, praise belongs to Allah, the Most Gracious and Most Merciful Who has created the mankind with knowledge, wisdom and power. Being the best creation of Allah, one still has to depend on others for many aspects directly or in directly.

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ABSTRACT

Concrete is one of the oldest manufactured construction aterial used in construction of various structures around the world. Due to its high demand the material used for concrete production depleting every year. Thus, around the world new construction materials are being investigated. In this study local laterite aggregate was used as replacement of coarse aggregate. In this study, a total of three mixes were made of crushed granite aggregate as control mix, crushed granite aggregate replaced with 25% laterite aggregate and 25% laterite aggregate with the combination of 2.5% silica fume, and 30% slag replacing part of cement content, respectively. The scope of study includes the investigation on the compressive strength, flexural strength and splitting tensile strength. The main objective of the research is to study the mechanical properties of laterite aggregate concrete compared with crushed granite aggregate. However, before all of those tests were conducted the samples were tested using Ultrasonic Pulse Velocity (UPV) equipment to determine the pulse velocity. The method of study to be carried out is through the appropriate test of aggregates. The types of test done were sieve analysis, flakiness index and elongation index, and aggregate crushing value test. All the tests have been carried out and the results had been recorded and analyzed in appropriate table and graph. The experimental results show that the strength of normal laterite concrete is lower than the normal crushed granite concrete.

ABSTRAK

Konkrit adalah bahan binaan yang paling lama telah digunakan dalam proses pembinaan di seluruh dunia. Oleh kerana permintaan yang tinggi terhadap bahan ini, sumber ini semakin berkurangan saban tahun. Oleh itu, bahan binaan baru untuk konkrit semakin giat dikaji. Dalam kajian ini agregat laterit tempatan telah digunakan bagi menggantikan agregat kasar. Dalam kajian ini, sebanyak tiga campuran konkrit telah disediakan iaitu campuran batu granit hancur, campuran batu granit yang digantikan dengan 25% agregat laterit dan 25% agregat laterit bersama kombinasi 2.5% wasap silika, dan 30% slag menggantikan sebahagian kandungan simen. Skop kajian merangkumi ujian terhadap kekuatan mampatan, kekuatan lenturan dan kekuatan tegangan. Objektif utama kajian ini adalah untuk mengkaji sifat mekanikal konkrit dengan agregat laterit berbanding batu granit hancur. Sebelum semua ujian dijalankan, sampel telah diuji menggunakan *Ultrasonic Pulse Velocity* (UPV) bagi menentukan kelajuan denyutan. Kaedah kajian dijalankan menggunakan ujian yang bersesuaian untuk agregat. Ujian berbentuk analisis tapisan, ujikaji indeks flakiness dan pemanjangan dan juga ujian nilai hancur agregat. Kesemua ujikaji telah dijalankan dan hasil ujian telah direkodkan serta dianalisa dalam bentuk jadual serta graf. Keputusan ujikan menunjukkan kekuatan konkrit menggunakan agregat laterit addah kurang berbanding konkrit normal menggunakan agregat granit.

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Abbreviations:

BS	=	British Standard
ASTM	=	American Society for Testing and Materials
DOE	=	Department of Environment
SF	=	Silica Fume
GGBFS	=	Ground Granulated Blast furnace Slag

Symbols:

SiO_2	=	Silicon Oxide
Fe_2O_3	=	Ferric Oxide
Al_2O_3	=	Aluminum Oxide
$Ca(OH)_2$	=	Calcium Hydroxide
C-S-H	=	Calcium Silicate Hydrate

CHAPTER 1

INTRODUCTION

1.1 Introduction

Concrete is one of the oldest manufactured construction material used in constructing of various structures around the world and the most widely used in all types of civil engineering works, including infrastructure, low and high-rise buildings, defence installations, environment protection and local/domestic developments [1]. It is a construction material obtained by mixing a binder (such as cement, lime, mud etc.), aggregate (sand and gravel or shingle or crushed aggregate), and water in certain proportions [2]. Through this combination of materials, three – quarters of the volume of concrete is occupied by aggregate [3]. The aggregate itself is categorized as fine and course aggregates.

Since aggregates occupy three-quarters of the volume of concrete, it is to be expected that properties of the aggregate have a major effect on the properties of concrete [4], as aggregate with undesirable properties cannot produce strong concrete, but the properties of aggregate greatly affect the durability and structural performance of concrete [3].

Crushed stone, sand and gravel are the three main types of aggregate commonly used in the manufacture of Portland cement concrete and asphalt concrete, used in

buildings, bridges, highways, dams and airports [2]. Traditionally aggregates have been readily available at economic prices and of qualities to suit all purposes. However, in recent years the wisdom of our continued wholesale extraction and use of aggregates from natural resources has been questioned at an international level. This is mainly because of the depletion of quality primary aggregates and greater awareness of environmental protection. In light of this, the availability of natural resources to future generations has also been realized [1]. Therefore, natural aggregate are non-renewable resources that may be depleted in the future. Thus, number of other materials has been studied throughout the world in search for aggregate replacement materials [5]. In this study, the scope of research will be focused on the use of laterite aggregate as coarse aggregate.

Figure 1.1 Laterite Aggregate

1.2 Aim and Objectives of Research

The objectives of this present research are to study the suitability of laterite aggregate as coarse aggregare in concrete and investigate the performance of concrete replaced by 25% laterite aggregate and 25% laterite aggregate with combination of 2.5% silica fume and 30 % slag replacing part of cement content, and compare it with normal concrete composed of 100% crushed granite aggregate.

1.3 Significance of the Research

In construction industries, aggregates are the most important material as main composition of concrete. However, natural aggregate are non-renewable resources. Thus, the results of this research will be useful in search of alternative material to be used as aggregates.

The advantages of this study are:-

i) To provide some information about the use of laterite aggregate in concrete.
ii) Compare between laterite concrete and normal concrete performance.

1.4 Scope of the Research

The construction industries are becoming more challenging than ever before. To be competitive, the field of engineering related to the industries has to be established. One of the areas that can be established is the use of material in the construction industry. This study focuses on investigating the properties of laterite aggregate and studies the performance of concrete with laterite aggregate.