EFFECT OF CONCRETE COMPRESSIVE STRENGTH WITH VARIOUS NATURAL ADDITIVES FIBER FOR GREEN ENVIRONMENT

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ABSTRACT

This study is to investigate the comparisons compressive strength of concrete with egg albumen and coconut fiber as additive materials in concrete composition mixture. Four type of samples are prepared which named by 1% egg albumen (EA), of coconut fiber (CF), 0.5% of egg albumen with 0.5% of coconut fiber (EACF) and Ordinary Portland Cement (OPC) as a control sample (CC). A total 72 cylinders with 150 mm diameter and 300mm height were prepared in four groups according to different mix proportions. The composition mixture rate for sand-cement (s/c) ratio is 2.15, water-cement (w/c) is 0.60, aggregate-cement (a/c) is 3.10 and target density is 2400kg/m^3. Then, the samples were cured under two curing conditions which were air and water curing for 7^{th}, 14^{th} and 28^{th} days before testing. The compressive strength for concrete with egg albumen was 15. 83MPa, while for the concrete with coconut fiber was 14.78MPa and concrete with both additives materials added was 12.07MPa. The result obtained showed that the concrete with additive material achieved lower compressive strength than the control samples for water curing condition. The samples with 1% of egg albumen showed the higher compressive strength compared to other mixture in both the curing condition. Through the observation, the concrete mixture with egg albumen showed lower early strength gain but is satisfying improvement of strength as the time increased. The study demonstrated that better engineering properties of concrete can be achieved with proper curing condition and type of additive material added.

ABSTRAK

Kajian ini adalah untuk menyiasat perbandingan kekuatan mampatan konkrit dengan albumen telur dan serabut kelapa sebagai bahan aditif dalam komposisi campuran konkrit. Empat jenis sampel disediakan iaitu sebanyak 1% albumen telur (EA), serabut kelapa (CF), 0,5% albumen telur dan 0,5% serabut kelapa (EACF) dan Ordinary Portland Cement (OPC) sebagai sampel kawalan (CC). Sebanyak 72 silinder disediakan mengikut dengan 150 mm diameter dan tingginya ialah 300mm. Kadar nisbah campuran bagi pasir-simen (s / c) ialah 2,15, air-simen (w / c) ialah 0,60, agregat-simen (a / c) ialah 3.10 dan kepadatan ialah 2400kg/m^3. Kemudian, sampel diletakan dalam dua keadaan pengawetan iaitu pengawetan udara dan pengawetan air bagi 7, 14 dan 28 hari sebelum ujian dilakukan. Kekuatan mampatan konkrit dengan albumen telur mencapai sebanyak 15. 83MPa, manakala konkrit dengan serabut kelapa adalah sebanyak 14.78MPa dan konkrit dengan kedua-dua bahan aditif tambah adalah 12.07MPa. Keputusan yang diperolehi menunjukkan bahawa kekuatan konkrit dengan bahan aditif adalah lebih rendah berbanding dengan sampel kawalan dalam keadaan pengawetan di dalam air and udara. Sampel dengan 1% albumen telur menunjukkan kekuatan mampatan yang lebih tinggi berbanding dengan campuran konkrit yang lain. Kekuatan konkrit diperolehi adalah lebih renda dalam masa pengawetan yang singkat tetapi kekuatan ini akan meningkat dalam jangka masa yang panjang. Kajian ini menunjukkan bahawa sifat-sifat kejuruteraan konkrit yang lebih baik dapat dicapai dengan keadaan rawatan yang tepat dan jenis-jenis bahan aditif ditambahkan ke komposisi campuran konkrit

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LIST OF ABBREVIATION

IBS	-	Industrial Building System
EN	-	EuroCode Standard
EA	-	Egg Albumen
CF	-	Coconut Fiber
OPC	-	Ordinary Portland Cement
CC	-	Concrete Control
w/c	-	Water to Cement Ratio
s/c	-	Sand to Cement Ratio
a/c	-	Aggregate to Cement Ratio
MPa	-	Mega Pascal
kg	-	Kilogram
mm	-	Millimeter
nm	-	Nanometer
µm	-	Micrometer
<	-	Less than
%	-	Percent
m	-	Modulus of rupture, N/mm^2;
P	-	Load
l	-	Distance
d	-	Diameter
h	-	Depth
F	-	Maximum load

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

In Malaysia, Industrial Building System (IBS) was the most popular and widely used in the building constructions. It had been used to manage the quality and productivity of construction industry. A requirement of concrete performance due to rapid development of super high building, larger size and larger span concrete structure was very important so that the concept of improvement and quality can be achieved. For this study, the comparison of concrete compressive strength with various natural additives fiber as reinforcement was conducted to investigate it quality to the environmental and human living.

According to Amlan K.S and Devdas M. (2000), concrete was defined as a composite material that consisted essentially of a binding medium, such as a mixture of Portland cement and water, within which were embedded particles or fragments of aggregate, usually a combination of fine and coarse aggregate. Concrete was by far the most versatile and most widely used for construction material worldwide. It could been

engineered to satisfy a wide range of performance specifications, unlike other building materials such as natural stone or steel, which generally had been used in construction.

Furthermore, an ever-expanding population and high rates of economic development in Malaysia resulted in the generation of vast amount of waste. It was estimated about 17,000 of waste generated in Peninsular Malaysia which was about average per capita generation of waste 0.85kg/ cap/ day. As a promoting of green environment area for human living, 3R (reduce, reuse and recycle) concept was introduced. This green environment issues helps in promoting new source of growth so as to strengthen and diversity the industrial base. According to the Local Government Department Ministry of Housing & Local Government Report, about 1 to 5 % of the generated wastes were reduced, reused, recycled while the remainder was taken to disposal sites.

Egg albumen which contained of high protein composition would influenced of the cement properties when biopolymer-added cement composition with egg albumen. According to Chandra S. et al (1987), proteins used work as air entraining agents in cement mortar. Steam curing had an adverse effect on the strength of mortar specimens mixed with protein. Protein addition introduces hydrophobic properties in the cement mortar.

Md. Hasim (2005) stated that the used of coconut fiber from the dispose of coconut shell could be a valuable material in the formation of a composite material that can be used as an internal panel wall in housing construction.

As such, a new material for construction industry with composition materials of cement, natural additive fiber (egg albumen and coconut fiber), water, fine sand and coarse aggregate were developed to investigate the performance of concrete due to it compressive strength under EuroCode Standard (EN 1992-1-2: 2004)

1.2 Problem Statement

A production of building with higher strength, lightweight, higher toughness and others will be the main reason for constructing the building in Malaysia. Nowadays, problems occur due to deterioration of concrete which caused by interior materials was leaded to the failure of the building happened in concrete construction. As a result, a new development of concrete composition with natural additives was introduced in construction industry. Chandra S. et al (1987) reported that type of additive used would be influence the strength of concrete when added to concrete mixture.

Nowadays, large amounts of waste natural organic material such as egg albumen and coconut fiber were disposed in Malaysia. If the waste could not been disposed properly it would leaded to environmental problems. Recycling of the disposed material was one of the methods of treating the agricultural waste.

1.3 Objectives

The general objective of this study was to investigate the compressive strength of concrete with various natural additive materials. The specific objectives of this study were:

i. To determine the compressive strength of concrete with various additive materials under EuroCode Standard (EN 1992-1-2: 2004)

ii. To study the effects of the curing conditions to the compressive strength of the concrete.

iii. To study the comparisons compressive strength of concrete with various additives material composition under different code of practices.

1.4 Scope of Work

This study was conducted through experimentally where all the experimental work was involved in order to investigate the compressive strength of concrete with various additive materials. Four type of samples were prepared which named by 1% egg albumen (EA), of coconut fiber (CF), 0.5% of egg albumen with 0.5% of coconut fiber (EACF) and Ordinary Portland Cement (OPC) as a control sample (CC). The raw materials such as OCP, water, fine sand, coarse aggregate, additive materials (egg albumen and coconut fiber) were used in laboratory work. The total numbers for all cylinder samples were shown in Table 1.1. The mix proportion of the concrete was shown in Table 1.2. The dimensions of the cylinders were shown in Figure 1.1.

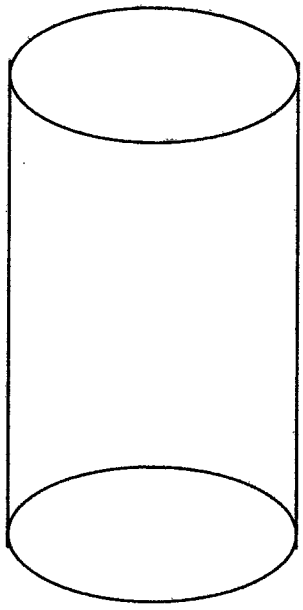

Figure 1.1: Dimensions of Cylinder

Table 1.1: Number of Samples and Tests for Laboratory Work

Percentages		100% CC			1% EA			1% CF			0.5 % EA + 0.5% CF		
Test	**Curing**	7	14	28	7	14	28	7	14	28	7	14	28
Compression Test	Air	3	3	3	3	3	3	3	3	3	3	3	3
	Water	3	3	3	3	3	3	3	3	3	3	3	3
Total		6	6	6	6	6	6	6	6	6	6	6	6
Total samples		**72 of samples**											

Table 1.2: Mix Composition of Concrete Mixture

Mix composition	
Sand / Cement (s/c)	2.15
Water/ Cement (w/c)	0.60
Aggregate/ Cement (a/c)	3.10
Target Density	2400kg/m^3

The experimental study was conducted at the Concrete Laboratory, at Faculty Civil Engineering and Earth Resources, University Malaysia Pahang, Malaysia. The compression test and slump test were carried out based on EuroCode Standard (EN 1992-1-2: 2004) as a code of practice for this study. All samples were placed under air and water curing condition and then tested under compression test via on the 7th, 14th, and 28th days. The flowchart of the study was shown in Figure 1.2.

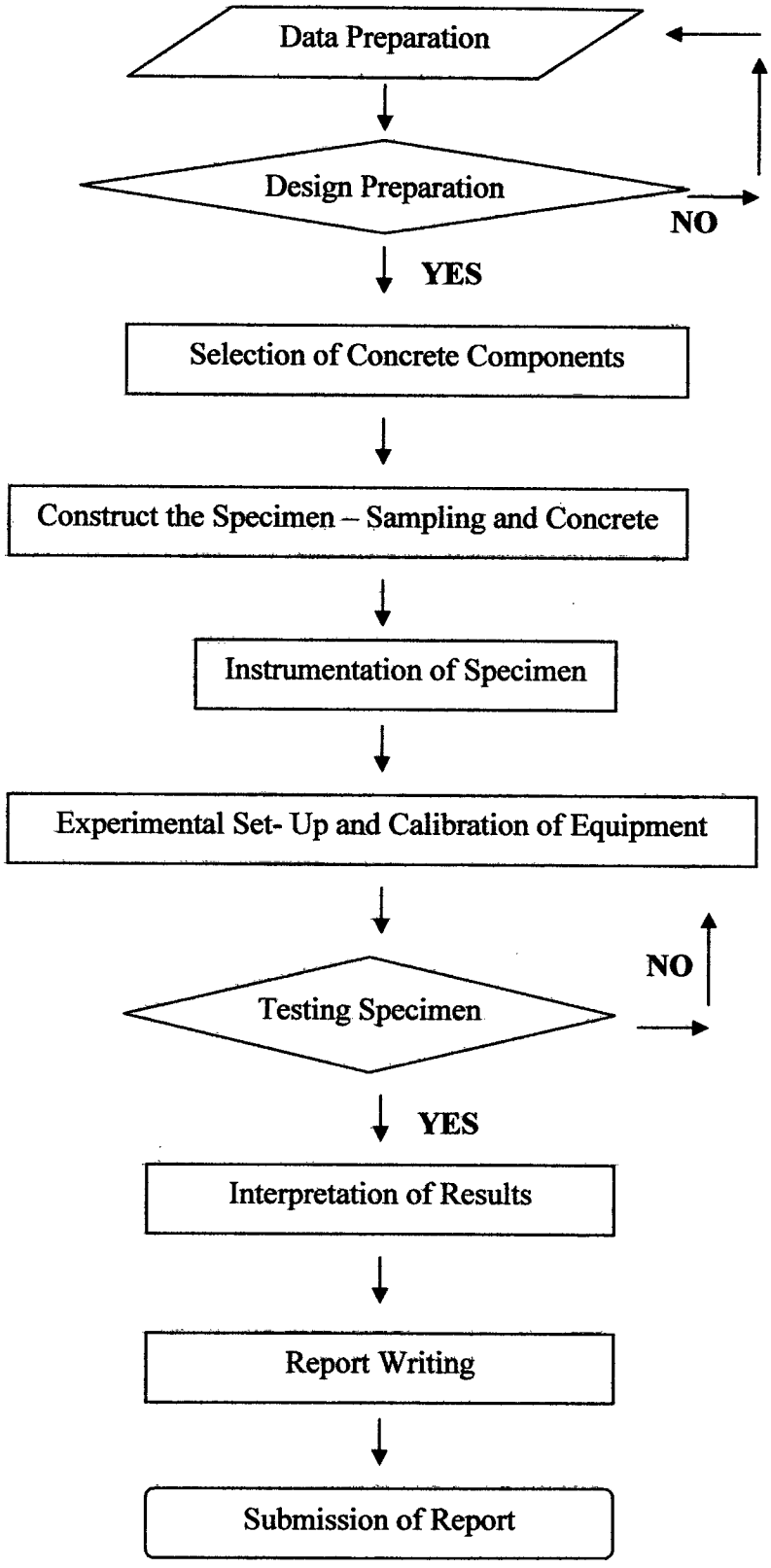

Figure 1.2: Flowchart of Study

1.5 Significance of Study

This study was conducted to study the advantages of using additive material (egg albumen and coconut fiber) added to the concrete composition mixture. The advantages of using the concrete and natural material was discussed in term of the ultimate strength which corresponding to the compressive strength. Other engineering behaviors that discussed were included with its workability.

As a egg albumen and coconut fiber act as a additive material for concrete mixture, this study was determine the different behaviors of different proportion additive material that can produce the better quality of concrete. This study also used to determine the best additive materials to be added to concrete mix proportion that would fit the entire characteristic needed in designing concrete.

Furthermore, this was study carried out in order to determine the comparison compressive strength of different proportion which was the strength development for 7^{th}, 14^{th} and 28^{th} of curing for the all mix proportion of the concrete. The results that been obtained from experimental works were used for future study such as lightweight concrete with natural organic material as a new structure element in the construction activity.

1.6 Summary

The usage of concrete with natural waste material for cementitious material commonly gave a lot of advantages. In this day and age, construction was looking forward for a high strength with low water-to-cement ratio, durability with low permeability, minimum cement content and proper mixing, compaction and curing, high quality, high performance and but in an optimum quantity for overall cost. As by using concrete, all of these characteristics and benefits may be achieved. Natural additive materials were able to increase the strength of concrete when mixed together. Plus, it was been superior environmental friendliness due to ecological disposal of large quantities of waste materials (the solid waste or organic waste) were reduced and enhancement productivity of the construction industry.

LITERATURE REVIEW

2.1 Introduction

The purpose of studying a literature review was to find, read, and analyze the body of literature which been published by books, journal article, conference articles, research papers and thesis. Previous reviews on engineering properties of concrete and it performance in the existing applications will be studied in order to analyze more valuable information associated to the construction activity. In this chapter, the review on waste material such as egg albumen, and coconut fiber also were analyzed.

2.2 Introduction to Concrete

Concrete was a name applied to any of a number of compositions consisting of sand, gravel, crushed stone, or other coarse material, bound together with various kinds of cementitious materials, such as lime or cements. When water was added, the mix undergoes a chemical reaction and hardens. The word concrete comes from the Latin word "concretus", which means "headened" or "hard". Concrete has been used in construction for over 2000 years, perhaps first by the Romans in their aqueducts and roadways. According to Nan Su and Buquan Miao (2003), concrete was the dominant construction material today with an annual worldwide production of cover 4.5 billions metric tons.

2.3 Historical Development of Concrete

Anonymous said that the Romans found that the mixture of lime putty with pozzolana, a fine volcanic ash, would harden under water. The result was possibly the first hydraulic cement. It became a major feature of Roman building practice, and was used in many buildings and engineering projects such as bridges and aqueducts. Concrete technology was kept alive during the Middle Ages in Spain and Africa, with the Spanish introducing a form of concrete to the New World in the first decades of the 16th century. It was used by both the Spanish and English in coastal areas stretching from Florida to South Carolina. Called .tapia., or .tabby., the substance was a creamy-white, monolithic masonry material composed of lime, sand, and an aggregate of shells, gravel, or stone mixed with water. Concrete was widely used in domestic, commercial, recreational, rural and educational construction.

Un-reinforced concrete was a composite material containing aggregates (sand, gravel, crushed shell, or rock) held together by a cement combined with water to form a

paste. It gets its name from the fact that it does not have any iron or steel reinforcing bars. It was the earliest form of concrete. The ingredients become a plastic mass that hardens as the concrete hydrates, or .cures. While for the reinforced concrete was concrete strengthened by the inclusion of metal bars, which increase the tensile strength of concrete. Both un-reinforced and reinforced concrete can be either cast in place or pre-cast.

2.4 Advantages and Disadvantages of Concrete

Concrete definitely presents technological advantages: it can be made from local inexpensive materials and it can be cast in a any shape. Concrete has a good compressive strength, it does not rot, it was not much affected by humidity, it does not burn and it was not attacked by insects (but it can be attacked by certain bacteria). Moreover, when concrete was well proportioned, adequately mixed, transported, placed and cured, it becomes a durable construction material in most environmental conditions. Concrete technology was simple: it consists essentially in thoroughly mixing a fine powder with aggregates, water and admixtures and in compacting of this freshly mixed material into forms where it takes its final hardened shape and strength within less than a day.

Concrete also presents some weakness: it was weak in tension, it was heavy, it was not volumetrically stable because it shrinks and creeps or sometimes swells. Moreover, concrete must be properly cured to reach its full potential as a structural material, and its durability can be impaired in severe environmental conditions, usually acidic conditions which stated by Baron and Ollivier (1992). Today, some of these weaknesses have been partially overcome with reinforcing bars, fibres, admixtures and lightweight aggregates.

As concrete's advantages out-weight its weakness, it was not surprising that concrete was presently the most widely used material after water. According to Syndicat Francais de I'Industrie Cimentiere (1998), every year more than 1.5 billion tonnes of cement were produced. From this huge amount of cement, around 6 billion cubic metres of concrete were made. Moreover, ACI Committee 125 stated that concrete can be made from the equator to the poles, in the desert, on the sea, under water and even on he Moon. It was so successful a material that was can be considered as the basis on which our present civilization has been built.

2.5 Properties of Fresh Concrete

The performance requirements of hardened concrete were more or less well defined with respect to shape, finish, strength, durability, shrinkage and creep. To achieve these objectives economically, the fresh concrete, in addition to having a suitable composition in terms of quality and quantity of cement, aggregates and admixtures, should satisfy a number of requirements from the mixing stage till it was transported, placed in formwork and compacted.

The mix should be able to produce a homogenous fresh concrete form the constituent materials of the batch under the action of the mixing forces. The mix should be stable, in that it should not segregate during transportation and placing when it was subjected to forces during handling operations of limited nature. Beside that, the mixture should be cohesive and sufficiently mobile to be placed in the form around the reinforcement and should be able to cast into required shape without losing continuity or homogeneity under the available techniques of placing the concrete at the particular job which termed as flowability and mobility for of fresh concrete. Besides that, it can be be ameable to proper and thorough compaction into a dense, compact concrete with minimum voids under the existing facilities of compaction at the laboratory work or site. Lastly, it should be possible to attain a satisfactory surface finish without honeycombing

or blowing holes from moulds and on free surface by trowelling and other process which namely by finishing. These entire requirements were affected of the workability of the concrete.

2.5.1 Workability of Concrete

Workability defined as that property of freshly mixed concrete or mortar which determined the ease and homogeneity with which it can be mixed, placed, compacted and finished. A slump test can be used to measure the workability of concrete. The workability was affected by the amount of cement paste added. The cement paste was the soft or liquid part of the concrete mix. The more mixed with the coarse and fine aggregates, the more workable a mix. Furthermore, it's also affected by the aggregate grading. Well- graded, smooth, rounded aggregates will improve the workability of a mix. An additional water to the concrete mixture will lead to the lowers the strength and durability of the concrete

The workability was affected by the mix proportions of the mixtures, aggregate properties, admixtures, environmental conditions and time.

2.6 Properties of Hardened Concrete

The main properties of hardened concrete were early volume change, creep, and permeability.