THE PROPERTIES AND FLEXURAL BEHAVIOUR OF SELF COMPACTING CONCRETE USING RICE HUSK ASH AND ADMIXTURE

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Especially to…

My beloved **FATHER** and **MOTHER** ;
MUDA BIN AWANG and **ROHANI BINTI ABD KADIR**
Thank you for your softness in take care of me, supporting,
advisory and loving that gives my life
happiness all the time.

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Wish all the happiness and cheerfulness will always colouring our life.

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ABSTRACT

Technology in concrete has been developing in many ways to enhance the quality and properties of concrete. One of the technological advances in improving the quality of concrete is by using self compacting concrete (SCC). This research was carried out to establish the properties and flexural behaviour of SCC using rice husk ash (RHA) and admixture with mix design of constant water-cement ratio. The main objective of this study is to find the suitable concrete composition which can be categorized as SCC that using RHA as cement replacement material together with admixture. There are nine composition of mixes were prepared and laboratory test was carried out to investigate the properties of fresh SCC and the strength development of hardened SCC. A total of 108 concrete cube specimens 100 mm x 100 mm x 100 mm were prepared for compression test at 1, 7, 14 and 28 days. Three 100 mm x 200 mm x 1500 mm reinforced concrete beams were prepared for flexural test. Two beams were casted using the optimum mix of SCC while the other one made of normal concrete (NC) to act as control. The results for cubes tests indicated that sample with 5% RHA and 1% Sika Viscocrete is the optimum composition for SCC. This composition increased the performance of hardened concrete. While for the flexural test, SCC concrete have better performance than NC and result for adding RHA as a cement replacement material does not give any significant differences in flexural strength of SCC.

ABSTRAK

Teknologi konkrit telah berkembang dalam pelbagai skop bagi meningkatkan kualiti dan sifat-sifat konkrit. Salah satu teknologi maju yang digunakan untuk meningkatkan kualiti konkrit ialah Konkrit Tanpa Mampatan (SCC). Kajian ini dijalankan untuk mengkaji sifat-sifat dan kelakuan lenturan konkrit tanpa mampatan yang menggunakan abu sekam padi (RHA) dan bahan tambah dengan nisbah air-simen dimalarkan. Objektif utama kajian ini adalah untuk mencari nisbah komposisi konkrit yang sesuai yang boleh dikategorikan sebagai konkrit tanpa mampatan dengan menggunakan abu sekam padi sebagai bahan pengganti simen bersama dengan bahan tambah. Sebanyak sembilan komposisi konkrit disediakan dan ujian makmal dijalankan bagi mengkaji sifat-sifat konkrit basah dan juga keras. Sejumlah 108 kuib bersaiz 100 mm x 100 mm disediakan untuk ujian kekuatan mampatan pada konkrit berumur 1, 7, 14 dan 28 hari. Tiga rasuk bertetulang bersaiz 100 mm x 200 mm x 1500 mm disediakan untuk ujian kekuatan lenturan. Dua rasuk dibancuh dengan menggunakan bancuhan optimum konkrit tanpa mampatan dan satu lagi menggunakan bancuhan konkrit biasa bertindak sebagai rujukan. Ujian kiub menunjukkan sampel dengan campuran 5% abu sekam padi dan 1% Sika Viscocrete adalah komposisi optimum untuk konkrit tanpa mampatan. Komposisi ini meningkatkan kekuatan konkrit keras. Untuk ujian kekuatan lenturan, konkrit tanpa mampatan mempunyai kekuatan lenturan yang lebih baik berbanding konkrit biasa dan kesan penggunaan abu sekam padi sebagai bahan pengganti simen tidak memberikan kesan yang besar pada kekuatan lenturan konkrit tanpa mampatan.

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LIST OF ABBREVIATIONS

SCC	-	Self compacted concrete
NC	-	Normal concrete
RHA	-	Rice husk ash
OPC	-	Ordinary Portland cement
PC	-	Portland cement
w/b	-	Water-binder ratio
CO_2	-	Carbon dioxide
SiO_2	-	Silica Oxide
H_2O	-	Water
Al_2O_3	-	Aluminums Oxide
CRM	-	cement replacement material
GGBS	-	Ground granulated blast furnace slag
ASTM	-	American Standard Test Method

HRWR	-	High range water reducer
POFA	-	Palm oil fuel ash
FA	-	Fly ash
NVC	-	Normally vibrate concrete
MS	-	Malaysian standard
CC	-	Normal concrete
R	-	Concrete with rice husk ash
BS	-	British standard

LIST OF SYMBOLS

E	-	Modules of elasticity
Fcu	-	Compressive strength
H_1	-	Length at start point of L-Box test
H_2	-	Length at end point of L-Box test

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CHAPTER 1

INTRODUCTION

1.1 Background

The importance of concrete in modern society cannot be underestimated. There is no escaping from the impact of concrete on everyday life. Concrete is a composite material which is made of filler and a binder. Typical concrete is a mixture of fine aggregate (sand), coarse aggregate (rock), cement, and water. Nowadays the usage of concrete is increasing from time to time due to the rapid development of construction industry. The usage of concrete is not only in building construction but also in other areas such as road construction, bridges, harbor and many more. Thus technology in concrete has been developing in many ways to enhance the quality and properties of concrete. One of the technological advances in improving the quality of concrete is Self Compacting Concrete.

Self-compacting concrete (SCC) is considered as a concrete which can be placed and compacted under its self-weight with little or no vibration effort, and which is at the same time cohesive enough to be handled without segregation or bleeding. The use of chemical admixtures is always necessary when producing SCC in order to increase the workability and reduce segregation. The content of coarse aggregate and the water to binder ratio in SCC are lower than those of normal

concrete. Therefore SCC contains large amounts of fine particles such as palm oil fuel ash (POFA), blast-furnace slag, fly ash and rice husk ash (RHA) in order to avoid gravity segregation of larger particles in the fresh mix.

This research was implemented to develop and to determine the properties and flexural behaviour of Self Compacting Concrete (SCC) by using Rice Husk Ash (RHA) and admixture.

1.2 Problem Statement

The explosive expansion of plantation in Malaysia has generated enormous amounts of vegetable waste, creating problems in replanting operations and tremendous environmental concerns. When left on the plantation floor, these materials create great environmental problems [18]. For this reason, economic utilization of this waste will be beneficial. Some countries are experiencing predicament in disposal of rice husk heaps due to their abundance. Concrete technologists are gradually finding applications in rice husk ash (RHA) as an additive for producing high-strength concrete. The use of rice husk ash, an indigenous agro-waste in its raw form, as a supplementary binder to cement for treatment of contaminated soils not only can create new workable and high strength concrete also assists in alleviating disposal problem of rice husk heaps in Asian countries.

1.3 Objectives

The objective of this study are :

1) To produce a suitable concrete composition which can be categorized as SCC that using RHA as cement replacement material together with admixture.
2) To investigate the properties and strength development of SCC.
3) To compare the flexural behavior of reinforced concrete beam of SCC and normal concrete (NC).

1.4 Research Scope

The scope of this research are :

1) The mixtures of SCC are only using rice husk ash (RHA) as cement replacement material and admixtures (Sika ViscoCrete-15RM)
2) Ordinary Portland Cement (OPC) is used for the proposed SCC mix.
3) The water- binder ratio (w/b) for all the mixes is fixed at 0.38.
4) The comparison in flexural behaviour aspect only involves the most optimum design mix of SCC to be compared with normal concrete.

1.5 Research Significance

Concrete has been used in the construction industry for centuries. Many modifications and developments have been made to improve the performance of concrete, especially in terms of strength and workability. Engineers has found new technology of concrete called Self Compacted Concrete that use pozzolans as a cement replacement material together with admixtures.

The introduction of pozzolans as cement replacement materials in recent years seems to be successful. The use of pozzolan has proven to be an effective solution in enhancing the properties of concrete in terms of strength and workability. The current pozzolans in use are fly ash, silica fume and slag. Development and investigation of other sources of pozzolan such as rice husk ash will be able to provide alternatives for the engineer to select the most suitable cement replacement material for more cheaper material.

Like other pozzolans, rice husk ash is a by-product which can be abundantly found in this country. Therefore, using rice husk ash should promise some advantages in reduce the environmental problems. In this case, studies are needed to determine the properties and behaviour of SCC using rice husk ash.

In addition, the use of rice husk ash as a cement replacement material is not common in the Malaysian construction sector. This study will be able to enhance the understanding on the suitability of rice husk ash as cement replacement material.

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