LONG TERM DEFLECTION AND CRACKING PERFORMANCE OF PALM SHELL AGGREGATE CONCRETE BEAM SUBJECTED TO TRANSVERSE LOADING

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This project is submitted to Faculty of Engineering,
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ABSTRAK

Kajian ini addalah bertujuan untuk mengkaji kegunaan kulit kelapa sawit sebagai pengantian batu-bata untuk mengahsilkan konkrete struktur. Satu eskperimen telah dijalankan untuk mengkaji perilaku defleksi dan belahan bagi kulit kelapa sawit konkrete balak dan konkrete biasa balak dengan 1500mm panjang apabila menahan beban dalam jangka masa panjang. (120 hari) Tambahan pula, Kajian leturan juga dijalnkan dalam laporan tersebut. Sembilan batang konkrete balak telah disediakan di makmal. Empat batang kulit kelapa sawit konkrete balak dan dua konkrete biasa balak dibawah oleh beban yang berbeza dalam masa emapat bulan. (120 days) Manakala, dua konkrete biasa balak dan satu kulit kelapa sawit konkrete digunakan untuk mengkaji kelenturan. Menurut espekrimen penilikan dan teoritis analisis, keputusan tersebut menunjukkan bahawa bahagian belahan balak dibawah bebanan menpunyai defleksi yang tinggi jika berbading dengan bahagian yang tiada belahan. Hal ini menunjukkan bahawa teoritis hampiran berupaya memberi perkiraan yang dekat dalam defleksi bagi fungsi merangkak yang tinggi. Kulit kelapa sawit konkrete balak mempunyai defleksi yang tinggi berbading denagn konkrete biasa. Bagi kajian lenturan, beban yang digunakan untuk menahan kulit kelapa sawit konkrete balak lebih kecil daripada beban yang digunakan untuk menahan konkrete biasa balak.

ABSTRACT

The research is about the use of oil palm shell (OPS) as coarse aggregate to produce structural concrete. An experimental investigation was designed to study the deflection and cracking behavior of Oil Palm Shell (OPS) beams and normal weight concrete beams under long-term sustained loading. Flexural test also involved in this study. Nine concrete beams were prepared at laboratory. Four OPS concrete beams and two normal weight concrete beams were subjected to different loading in four months. (120 days) The other two OPS concrete beams and one normal weight concrete beam were used to carry out the flexural test. From the experimental observation and theoretical analysis, the result shows that cracked section beams under sustained loading had produced larger deflection comparing to the uncracked section beams. This incident was concluded that theoretical approaches are able to give closer estimate of deflection for the larger values of creep function. In addition, OPS concrete beams showed larger deflection comparing to the normal weight concrete beam. The results from flexural test showed the loading that had applied to OPS concrete beam less than the loading that applied to the normal Weight concrete beams. Besides, the experimental results obtained were less than the theoretical result.

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LIST OF ABBREVATIONS

NWC	-Normal weight concrete
OPS	-Oil palm shell
PKSC	-Palm kernel shell concrete
CMS	-Cahaya Matahari Sarawak
CaO	- Lime
SiO_2	- Silica
Al_2O_3	- Alumina
BS	-British standard
PSB	-Palm shell beam
PSBU	-Palm shell beam uncracked
PSBC	-Palm shell cracked

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CHAPTER 1

INTRODUCTION

1.1 Background

Malaysia is a country that produces oil palm. Since oil palm industry developed in Malaysia has grown a largest producer and exporter of oil palm in world. Oil palm industry in Malaysia has produce 17.60 million tonnes of palm oil in 2009 comparing to the production in 2008 is 17.56 million tones. (PALM OIL HQ 2009) This meaning that the production of palm oil is increasing in Malaysia.

From the mills, roughly over 4 millions tones of oil palm shell (OPS) solid waste is produced annually. Thus the large amount of waste produced has caused the nation's pollution problem occurs (Teo et al, 2006) One of the ways to prevent the pollution, these wastes would be utilization of some of these into constructive building materials. Besides that, OPS are light weight and having a naturally sized, thus it is suitable to be a replacement of aggregates in lightweight concrete in construction. It is also waste materials that do not produce toxic when they are mixed with concrete. This has indicated that OPS able to prevent the damage of natural resources and also able to control or maintain the ecological balance.

Recently, replacement aggregates with OPS can produce lightweight concrete with a moderate strength and it is able to applicant in flooring and walls. (Basri.H.B, Mannan.M.A. & Zain .M.F.M, 1998). There are some product of OPS concrete that had been done, for instances University Malaysia Sabah (UMS) has constructed a 2 meter span footbridge in the years of 2001 and an effective cost house with the area of about 59m ^{2}in the years 2003 (Teo et al, 2006). Therefore, the demand of the OPS concrete in construction development will be increasing and able to become an alternative approaches in construction.

Moreover, OPS can save the expenses of construction. This is because OPS are waste material and easily to obtain. Thus, the cost of construction can be minimized by using replacing aggregate as OPS in concrete matrix.

Thus, the studies of performances have carried out to show that oil palm shell aggregate concrete is applicable and able to have the same properties with normal concrete nowadays. Since the oil palm shell considered lightweight, cost-effective and environmental friendly, it can be the alternative way to produce a lightweight concrete.

This report is about the investigation of long term deflection of beam with oil Palm Shell (OPS) as coarse aggregate. Before investigates the result, the some properties test on OPS had to be done. The purpose is to understand the properties

of the OPS. The design of mix proportion will be decided to produce a maximum compressive strength. The mix proportion of OPS with high compressive strength will be chosen to construct beam. There are some test will be taken on the beam. The tests are long term deflection test and flexural test. Besides that, the test also will be tested on Normal weight concrete. The reason is to do the comparison between OPS concrete and Normal weight concrete.

Oil palm shell is an ideal replacement material for coarse aggregate. However, oil palms shells still considering a new raising material. Most of the researches had done on the compressive strength and workability of the oil palm shell concrete. (Basri et al, 1998) Besides that, the properties of palm shell concrete also had been modified to increase their compression strength. (Mannan M.A, Ganepathy C, 2001) However, time dependent performance such as long term deflection, flexural performance of oil palm shell concrete have not observed.

Therefore, this research work is focusing on the OPS as an aggregate to produce maximum compressive strength of OPS concrete and study the time dependent behavior of the OPS concrete. The Coarse aggregate replaces by oil palm shell and added partially to obtain the maximum compressive strength of concrete mix proportional. The beam of oil palm shell concrete is designed based on the desirable strength and the tested is carried out in the laboratory to observe the effect of sustained load and time dependent behavior of the beam.

1.2 Objectives

The objectives of the study are stated below:

a) To design a suitable mix proportion for oil palm shell concrete with a maximum compressive strength.
b) To study the flexural behavior of OPS concrete beams
c) To investigate the long term deflection of OPS concrete beams
d) To Compare the experimental result of OPS concrete beams with the corresponding result of normal weight concrete beams

1.3 Research program

This section is written about the tasks that need to carry out in this research. There are two tasks that have to consider. The first task is theoretical study of the research. In the theoretical study, some literature review and analysis work are carried out.

The second task is the experimental work. Material properties test on the materials used in the research have to be taken. The reason is to obtain the specific gravity, bulk density, moisture content and water absorption of the materials.

Besides that, the main material used which is oil palm shell (OPS) also needs to investigate.

After the properties are done, the several samples are prepared which is oil palm shell concrete. The quantity of oil palm shell is added partially by reducing the quantity of the coarse aggregate in concrete. Then, the compressive strength test is tested on oil palm shell (OPS) concrete. The objective of this test is to obtain the maximum compressive strength of OPS concrete.

An oil palm shell (OPS) concrete beam is prepared after the maximum strength of OPS concrete is obtained. The different quantities of OPS concrete beams are casted. The flexural test and long term deflection test are carried out. The results from different quantity of OPS concrete beams are obtained. The results are compared and analyzed. The purpose is to study the behavior of the concrete under a sustain load in long term period.