UTILIZATION OF OIL PALM FROND (OPF) AS PARTIAL FINE AGGREGATE REPLACEMENT IN CONCRETE BLOCK

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I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering.

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I hereby declare that the work in this thesis 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 Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Di dalam jangka pembangunan Malaysia, permintaan konkrit meningkat secara beransur-ansur dari masa ke semasa melalui pembangunan infrastruktur yang berterusan. Penggunaan pasir sebagai agregat halus dalam pengeluaran konkrit telah meningkat secara mendadak. Penyelidikan baru telah dilakukan dengan menggunakan daun kelapa sawit untuk menggantikan pasir dalam campuran konkrit. Kajian ini dijalankan untuk mengkaji kebolehkerjaan dan kekuatan konkrit dengan daun kelapa sawit sebagai pengganti agregat halus. Daun kelapa sawit dikisar ke pada saiz yang lebih kecil untuk mencapai tahap kesesuaian sifat fizikal dengan saiz pasir kerana digunakan sebagai penggantian separa agregat halus. Untuk kajian ini, peratusan yang berbeza iaitu 0%, 2.5%, 5.0%, dan 7.5% daripada daun kelapa sawit digunakan sebagai pengganti separa agregat halus untuk menghasilkan pelbagai jenis campuran. Semua konkrit direka bentuk untuk gred C25 / 30. Kemudian, semua sampel direndam selama 7, 14 dan 28 hari di tangki air. Ujian kemusnahan dilakukan untuk menentukan kebolehkerjaan konkrit baru manakala ujian kekuatan mampatan dan ujian lenturan dilakukan untuk menentukan kekuatan konkrit yang keras. Keputusan menunjukkan bahawa kekuatan mampatan penggantian separa agregat halus 0%, 2.5%, 5.0% dan 7.5% mencapai kekuatan mampatan 38.02, 26.34, 24.89 dan 19.33 N/mm2, masing-masing pada 28 hari. Sementara itu, bagi keputusan kekuatan lenturan menunjukkan bahawa selepas penggantian agregat halus, masing-masing mencapai 35.33, 22.17, 19.71, dan 16.81 N/mm2 untuk penggantian 0%, 2.5%, 5.0% dan 7.5%. Dapatan menunjukkan bahawa peratusan optimum penggantian agregat halus adalah 2.5%. Keputusan ini menunjukkan bahawa konkrit daun kelapa sawit boleh digunakan sebagai pengganti agregat halus yang mengurangkan kos dan mesra alam. Pada masa yang sama, penggunaan OPF sebagai penggantian agregat halus separa dalam konkrit akan mengurangkan pergantungan tinggi pada agregat halus semulajadi dan menawarkan alternatif untuk mengekalkan pasir semulajadi untuk penggunaan generasi akan datang

ABSTRACT

Within the development of Malaysia, demand of concrete increasing gradually from time to time through continuously development of infrastructure. The uses of sand as fine aggregate in the production of concrete has become excessive. New research has been up by using oil palm frond to replace sand in the concrete mixture. This research was conducted to investigate workability and strength of concrete with oil palm frond as partial fine aggregate replacement. The oil palm frond is grind into smaller size suitable to sand's size as it be used as partial fine aggregate replacement. For this research, different percentage which are 0%, 2.5%, 5.0%, and 7.5% of oil palm frond was used as partial fine aggregate replacement to produce various type of mixes. All concrete was design to grade C25/30. Then, all samples were cured for 7, 14 and 28 days in the water tank. Slump test was conducted to determine the workability of fresh concrete while compressive strength test and flexural test were conducted to determine the strength of hardened concrete. Results show that, the compressive strength of 0%, 2.5%, 5.0% and 7.5% fine aggregate replacement achieved the compressive strength of 38.02, 26.34, 24.89 and 19.33 N/mm2, respectively at 28 days. Meanwhile, for flexural strength results show that after the fine aggregate replacement it achieved 35.33, 22.17, 19.71, and 16.81 N/mm2, respectively for replacement of 0%, 2.5%, 5.0% and 7.5%. Findings showed that the optimum percentage of fine aggregate replacement was 2.5%. These results show that oil palm frond concrete can be used as fine aggregate replacement in which reduced cost and eco-friendly. At the same time, uses of OPF as partial fine aggregate replacement in concrete would reduce the high dependency on natural fine aggregate and offering alternatives to preserve natural sand for the use of future generation.

TABLE OF CONTENT

DECLARATION

TITLE PAGE

ACKNOWLEDGEMENTS **ii**

ABSTRAK **iii**

ABSTRACT **iv**

TABLE OF CONTENT **v**

LIST OF TABLES **viii**

LIST OF FIGURES **ix**

LIST OF SYMBOLS **xi**

LIST OF ABBREVIATIONS **xii**

CHAPTER 1 INTRODUCTION **1**

1.1 Background of Study 1

1.2 Problem Statement 2

1.3 Objective 3

1.4 Scope of Study 3

1.5 Significant of Study 4

CHAPTER 2 LITERATURE REVIEW **5**

2.1 Introduction 5

2.2 Waste use in Concrete Production 5

2.3 Sand Mining and its Effect 6

2.4 Oil Palm Frond and Environment 7

CHAPTER 3 METHODOLOGY **10**

3.1 Introduction 10

3.2 Flowchart of Experimental Work 10

3.3 Materials 11

3.3.1 Cement 11

3.3.2 Coarse Aggregate 12

3.3.3 Fine Aggregate 13

3.3.4 Water 13

3.3.5 Oil Palm Frond 14

3.4 Mixture Design 16

3.5 Preparation of Sample 17

3.6 Testing of Sample 23

3.6.1 Slump test 23

3.6.2 Compressive strength test 24

3.6.3 Flexural strength test 25

CHAPTER 4 RESULTS AND DISCUSSION **26**

4.1 Introduction 26

4.2 Workability of Concrete 26

4.3 Compressive Strength of Concrete 28

4.4 Flexural Strength of Concrete 32

CHAPTER 5 CONCLUSION **36**

5.1 Introduction 36

5.2 Conclusion 36

4.4 Recommendations 37

REFERENCES **38**

LIST OF TABLES

Table 2.1	The composition of waste (percentage of wet weight) in Malaysia for 1975-2005	6
Table 2.2	Nutritive Value of OPF	9
Table 3.1	Mix Proportion	17
Table 3.2	Detail on proportion of OPF and type of specimen	18
Table 4.1	Results of Slump Test	27

LIST OF FIGURES

Figure 2.1	Oil Palm Frond	8
Figure 2.2	Feedlot Pellet	8
Figure 3.1	Flowchart Of Experimental Work	11
Figure 3.2	Portland Composite Cement	12
Figure 3.3	Coarse Aggregate	12
Figure 3.4	Fine Aggregate	13
Figure 3.5	Tap Water	14
Figure 3.6	Process of grinding the oil palm frond	15
Figure 3.7	Oil Palm Frond before grinding	15
Figure 3.8	Oil Palm Frond after grinding, ready to use as partial fine aggregate replacement	16
Figure 3.9	Mix for Slump Test	19
Figure 3.10	Concrete curing in water tank	19
Figure 3.11	Cube samples contain 0% OPF	20
Figure 3.12	Cube samples contain 2.5% OPF	20
Figure 3.13	Cube samples contain 5.0% OPF	21
Figure 3.14	Cube samples contain 7.5% OPF	21
Figure 3.15	Cube samples from 0% to 7.5% OPF	22
Figure 3.16	Beam samples from 0% to 7.5% OPF	22
Figure 3.17	Concrete slump test procedure	23
Figure 3.18	Type of Slump	24
Figure 3.19	Compressive strength test machine	24
Figure 3.20	Flexural strength test machine	25
Figure 4.1	Result of Slump Test	27
Figure 4.2	Results on compressive strength of concrete samples subjected to water curing with 7, 14 and 28 days	29
Figure 4.3	Compressive strength of concrete containing various content of OPF at 7 days	30
Figure 4.4	Compressive strength of concrete containing various content of OPF at 14 days	30
Figure 4.5	Compressive strength of concrete containing various content of OPF at 28 days	31

Figure 4.6	Results on flexural strength of concrete samples subjected to water curing with 7, 14 and 28 days	33
Figure 4.7	Flexural strength of concrete containing various content of OPF at 7 days	34
Figure 4.8	Flexural strength of concrete containing various content of OPF at 14 days	34
Figure 4.9	Flexural strength of concrete containing various content of OPF at 28 days	35

LIST OF SYMBOLS

%	Percentage
N/mm2	Newton per millimetre square
kg/m3	Kilogram per metre cubic
mm	Millimetre
C	Concrete grade
MPa	Mega Pascal

LIST OF ABBREVIATIONS

OPF	Oil Palm Frond
MS	Malaysia Standard

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Concrete is the main material in constructing a building and widely used in the construction industry. The concrete industry consumed most resources such as water, sand, gravels and crushed rock (Mefteh et al., 2013). Over the years, within the development of Malaysia, the number of population, through continuously development of infrastructure, public facilities, road and residential are increasing essentially. Effect of the development has contributed to the demand of concrete and its production in constructing a building is enormous and increasing gradually from time to time. Natural aggregates consume about 70% - 80% of the total volume of the concrete. There are 8 to 12 million tonnes of aggregates consumed annually by concrete industries since 2010. Current global issues related to the environmental sustainability for concrete in construction are more emphasize on material resources in producing concrete as the demand for sand increased. There are different types of concrete such as mass concrete, reinforced concrete and pre-stressed concrete. The high compressive strength of concrete block is used for load bearing material (Azrizal et al., 2015). Material in the production of concrete has brought our world's environmental issue at risk. The uses of sand as fine aggregates had become excessive and need to be replace as its becoming unsustainable to the environment and getting expensive day by day.

Therefore, the replacement of fine aggregates with natural fibre has been introduced as an alternative solution for sustainable construction in the development of environmental - friendly and economical process in construction. Environmental awareness increases the concern of greenhouse effect that have stimulated several industries to look for sustainable substitutes that can replace conventional synthetic fibre.

Starting early seventies, number of studies have been made regarding the use of natural fibre, such as sisal and bamboo, as reinforcing elements in cement mortars and in concretes. The focus in these works has been on the evaluation of the mechanical properties of the resulting composites as a function of the characteristics of their constituents, and the results obtained have indicated the viability of using natural fibre as reinforcing agents. Cement composite laminates reinforced with long sisal fibre, manufactured using a cast hand lay-up technique, were found to exhibit high energy absorbing capacity reflected in high toughness values under tension and bending loads. Ultimate strength, on the other hand, achieved average levels of 12 and 25 MPa for tensile and bend loading respectively. Non – load bearing is usually used for interior walls or divider and this is not intended to carry load except for its own load.

Oil palm frond is one of the waste material since it being disposed and it has affected our environment. The oil palm frond had been used in the latest research to make pellet as food resources for cows and goats in order to overcome and reduce the waste disposal in the oil palm landfill. To pursue better environment, oil palm frond waste is a strategy to reduce the effect.

1.2 Problem Statement

The uses of sand in concrete has attracted a lot of interest worldwide. Unfortunately, the uses of sand had become excessive, expensive and risking the environment. Current issues in and mining increases the demand of fine aggregate, as the demand is voracious, the industrial – seek sand mining is causing wildlife to die, local trade to wither and bridges to collapse. The booming in urbanization where the sand is globally devouring colossal amounts of sand is produced as it is the key ingredient of concrete means the demand for increasingly valuable resources is likely to let up. For the past few years, China has produced more cement than US used in the back to 20^{th} century. It is estimated as the researchers assumed that 236m cubic meters of sand are taken out annually, this is the key reason why lake's water level has dropped dramatically in recent years, sand has been scooped out 30 more times than amount that follow in tributary lake as it non – renewable resources. Other than that, it ruined area's inhabitant, both human and animal. The expanding of cities and number of people living in urban area also lead to more than quadruple since 1950, estimated to the 4 billion today which is required mind-boggling amounts of sand. Different types of sand mining inflict different types of

damages. On the other hand, OPF are pruned regularly and left on the ground for natural decomposition which is slow and uneconomical process. Other than that, only small amount of oil palm frond waste was used for chemical decomposition while other has been disposed by direct decaying and burning on site which are not desirable and not preferable to the environment as they do not only polluted environment but also can cause harm to human beings and animal due to the effect of polluted air (Afeefah et al., 2013). Therefore, to overcome excessive use of sand and oil palm frond negative effect to the environment, the uses of OPF has been choose to reduce the uses of sand in the production of concrete.

1.3 Objective

The objective of this research are as follows:

1) To investigate the workability of concrete containing oil palm frond as partial fine aggregate replacement in the concrete block.

2) To investigate the effect of oil palm frond content as partial fine aggregate replacement on compressive strength of concrete block.

3) To determine the flexural strength of oil palm frond content as partial fine aggregate replacement of concrete block.

4) To study the suitability of oil palm frond in the production of concrete block as the partial replacement of fine aggregate for material in the construction industry.

1.4 Scope of Study

To achieve the objective, the scope of this research was to determine the strength and workability of concrete after the replacement of fine aggregates in production of concrete block. Different percentages of OPF is used to get the best strength of concrete mixture for the production with minimum compressive strength of 25 N/mm2. Furthermore, effect of test conducted at the laboratory test was investigated. Some experiments had been carried out by previous researcher to investigate the strength and quality of concrete such as compressive strength test, water absorption test and flexural test using other type of natural fibre. Test will be tested at the duration of 7, 14 and 28

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