

**PROPERTIES OF CEMENT SAND BRICK
CONTAINING GROUND PALM OIL FUEL
ASH (POFA) AS PARTIAL SAND
REPLACEMENT**

MUHAMMAD AZREEN BIN IBRAHIM

B. ENG(HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG



SUPERVISOR'S DECLARATION

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 degree of Bachelor of Engineering (Hons.) in Civil Engineering.

(Supervisor's Signature)

Full Name : KHAIRUNISA BINTI MUTHUSAMY

Position : ASSOCIATE PROFESSOR

Date : 19 JUNE 2017



STUDENT'S DECLARATION

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.

(Student's Signature)

Full Name : MUHAMMAD AZREEN BIN IBRAHIM

ID Number : AA 13178

Date : 19 June 2017

**PROPERTIES OF CEMENT SAND BRICK CONTAINING GROUND PALM
OIL FUEL ASH(POFA) AS PARTIAL SAND REPLACEMENT**

MUHAMMAD AZREEN BIN IBRAHIM

Thesis submitted in fulfillment of the requirements
for the award of the
Bachelor Degree in Civil Engineering

Faculty of Civil Engineering and Earth Resources
UNIVERSITI MALAYSIA PAHANG

JUNE 2017

ACKNOWLEDGEMENTS

First and foremost, I would like to express my sincerely gratitude to my research supervisor, Assoc. Prof. Dr Khairunisa Binti Muthusamy for his guidance throughout my final year project. His effort to guide me step by step and advised me in solving all the problems facing throughout my final year project are invaluable. Without his patience and motivation, it will be hard for me to complete my final year project either in laboratory works or writing thesis.

I am so grateful that our university, University Malaysia Pahang had provided me with a comfortable working environment and refined equipment. I would like to show my appreciation to the laboratory staffs for their guidance and instructions during the laboratory works of my research. Their instructions are clear and without fail. In addition, I also would like to give a special credit to LKKP Corporation Sdn. Bhd. for providing me my research material.

Apart from that, I also would like to thank all my beloved friends who always willing to help me during the research work especially the laboratory work. The knowledge shared provide me a constructive ideas and useful advices throughout the journey to complete this research.

Lastly, I also would like to send my deepest appreciation to my parents for their love, endless support and accompany at all the time to the completion of my task in this research. I appreciate the advices and encouragement for everyone that I met during the research.

TABLE OF CONTENT

DECLARATION	
TITLE PAGE	
ACKNOWLEDGEMENTS	ii
ABSTRAK	iii
ABSTRACT	iv
TABLE OF CONTENT	v
LIST OF TABLES	viii
LIST OF FIGURES	ix
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 Significance of study	3
1.6 Layout of thesis	4
CHAPTER 2 LITERATURE REVIEW	5
2.1 Introduction	5
2.2 Aggregate	5
2.2.1 Sand mining	5
2.2.2 The Effects of Sand Mining	7
2.3 Industrial by-product as replacement material	11
2.3.1 Rice Husk Ash (RHA)	11

2.3.2	Fly Ash	13
2.3.3	Ground Granulated Blast furnace Slag (GGBS)	15
2.4	Palm oil fuel ash	16
2.4.1	Chemical properties of POFA	17
2.4.2	Strength and durability of POFA	21
2.4.3	Treatment and grinding process of POFA	22
2.4.4	Benefits of addition POFA	23
2.5	Brick	24
2.5.1	Clay Bricks	24
2.5.2	Sand-lime	26
2.5.3	Concrete Bricks	26
2.5.4	Green Brick	27
CHAPTER 3 METHODOLOGY		28
3.1	Introduction	28
3.2	Flowchart of experimental work	28
3.3	Materials	30
3.3.1	Cement	30
3.3.2	Sand	31
3.3.3	Water	31
3.3.4	Palm Oil Fuel Ash (POFA)	32
3.4	Mix proportion	36
3.5	Specimen preparation	38
3.5.1	Mixing and casting	38
3.6	Testing procedure	41
3.6.1	Compressive Strength Test	41

3.6.2	Flexural Strength Test	42
3.6.3	Water Absorption Test	44
CHAPTER 4 RESULTS AND DISCUSSION		46
4.1	Introduction	46
4.2	Compressive strength of cement sand brick	46
4.3	Flexural strength of cement sand brick	48
4.4	Water absorption of cement sand brick	50
4.5	Discussion	52
CHAPTER 5 CONCLUSION AND RECOMMENDATIONS		53
5.1	Introduction	53
5.2	Conclusion	53
5.3	Recommendation	54
REFERENCES		55

LIST OF TABLES

Table 2.1	Chemical composition of POFA based on different mills	19
Table 2.2	Comparison chemical composition of Ordinary Portland Cement and POFA	20
Table 3.1	Mix proportion by weight per volume	36
Table 3.2	Total specimen for each test	37
Table 4.1	Result of compressive strength	47
Table 4.2	Result of flexural strength	49
Table 4.3	Result for water absorption	51

LIST OF FIGURES

Figure 2.1	Mineral extraction in year 2013	6
Figure 2.2	Sand mining located at Johor	7
Figure 2.3	Destruction flora and fauna	9
Figure 2.4	Bank erosion	10
Figure 2.5	Illustration of water pollution	11
Figure 2.6	Example of raw rice husk ash	13
Figure 2.7	Pulverised Fly Ash	14
Figure 2.8	Ground Granulated Blastfurnace Slag (GGBS)	15
Figure 2.9	Palm oil fruit	16
Figure 2.10	Illustration of POFA	17
Figure 2.11	Comparison concrete compressive strength of POFA and OPC	21
Figure 2.12	Effect of fineness of ash on compressive strength of concrete	23
Figure 2.13	Clay brick	25
Figure 2.14	Sand lime brick	26
Figure 2.15	Cement sand brick	27
Figure 3.1	Flowchart of experimental work	29
Figure 3.2	Orang kuat Ordinary Portland Cement	30
Figure 3.3	Air dry river sand	31
Figure 3.4	Tap water	32
Figure 3.5	POFA treatment	33
Figure 3.6	Obtaining palm oil fuel ash at the LKPP Corporation mill.	34
Figure 3.7	POFA oven dry for 24 hours	34
Figure 3.8	Sieve POFA	35
Figure 3.9	POFA was grind	35
Figure 3.10	Specimen preparation flow	38
Figure 3.11	Mixer machine	39
Figure 3.12	Handmade brick mould	39
Figure 3.13	Unmould brick specimen	40
Figure 3.14	Brick was cured using air curing	40
Figure 3.15	Brick under compressive strength test	42
Figure 3.16	Flexural strength testing	44
Figure 3.17	Water absorption test	45
Figure 4.1	Compressive strength at 7, 14, 28 and 60 days	48

Figure 4.2	Flexural strength at 7, 14, 28 and 60 days	50
Figure 4.3	Water absorption test result	51