

THE PROPERTIES OF CONCRETE
CONTAINING COCONUT SHELL AS PART OF
COARSE AGGREGATE REPLACEMENT

HAFIZ OSMAN BIN MOHAMMAD

B.ENG (HONS.) CIVIL ENGINEERING
UNIVERSITI MALAYSIA PAHANG

THE PROPERTIES OF CONCRETE CONTAINING COCONUT SHELL AS PART
OF COARSE AGGREGATE REPLACEMENT

HAFIZ OSMAN BIN MOHAMMAD

Thesis submitted in fulfilment of the requirements for the award of the degree of
B. Eng (Hons.) Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

JANUARY 2017

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 Civil Engineering and Earth Resources (Hons.)

(Supervisor's Signature)

Full Name : SHARIZA BINTI MAT ARIS

Position : SENIOR LECTURER

Date : 13 JANUARY 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 University Malaysia Pahang or any other institutions.

(Student's Signature)

Full Name : HAFIZ OSMAN BIN MOHAMMAD

ID Number : AA13052

Date : 13 JANUARY 2017

**Specially dedicated to
my beloved parents for their love and support**

ACKNOWLEDGEMENTS

I like to take this opportunity to thank and acknowledge certain people, whom if not for their contribution and helps, the completion of my study would not be possible. First and foremost, all praise to Almighty Allah who had given blessing, strength and acknowledge for me in finishing this thesis. Salawat and Salam also propose to the Prophet Muhammad SAW, the Uswatun Hasanah for all Moslems.

I would like to thank my family because without their love and support over the years, none of this would possible. They have always been there for me no matter what it is and I thankful for everything they have helped me achieved.

I am deeply grateful and I wish to express my deepest gratitude to my supervisor, Madam Shariza Binti Mat Aris for suggesting the point of this thesis, supervision of the work for the invaluable guidance, the long time and tremendous effort to offer every possible help to finish this thesis. I really do appreciate his continuous guidance from the beginning until the final revision of this research.

I am genuinely appreciated of all staff of concrete laboratory ump for their valuable technical assistance and great support to me during the lab session. I am also deeply indebted to my entire friend that helping me through the process in making the experiment for this thesis. Their keen interest and encouragement were a great help throughout the course of this research work.

I hereby extend my thanks to all concerned persons who co-operated with me in this regard.

TABLE OF CONTENT

	Page
SUPERVISOR'S DECLARATION	ii
STUDENT DECLARATION	iii
DEDICATION	iv
ACKNOWLEDGEMENTS	v
ABSTRACT	vi
ABSTRAK	vii
TABLE OF CONTENT	viii
LIST OF TABLE	xi
LIST OF FIGURES	xii
LIST OF SYMBOLS	xiii
LIST OF ABBREVIATIONS	xiv
CHAPTER 1 INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement	2
1.3 Objective of Study	3
1.4 Scope of Study	3
CHAPTER 2 LITERATURE REVIEW	5
2.1 General	5
2.1.1 Concrete	5
2.1.2 Definition 3R	8
2.2 Material	9
2.2.1 Cement	9
2.2.2 Aggregate	11
2.2.3 Water	13
2.2.4 Coconut Shell	13
2.3 Method	16

2.3.1	Testing Method	16
2.4	Type of Concrete	19
2.4.1	Normal Concrete	19
2.4.2	Light Weight Concrete	19

CHAPTER 3 METHODOLOGY 21

3.1	Introduction	21
3.2	Flow Chart	22
3.3	Form Work	23
3.4	Design Concrete Mix	24
3.5	Sample Preparing	25
3.5.1	Cement	25
3.5.2	Coarse Aggregate	25
3.5.3	Fine Aggregate	26
3.5.4	Water	26
3.5.5	Coconut Shells	27
3.6	Curing	28
3.7	Parameter Used For Testing	29
3.7.1	Slump Test	29
3.7.2	Compressive Strength Test	31
3.7.3	Flexural Strength Test	33

CHAPTER 4 RESULTS AND DISCUSSION 36

4.1	Introduction	36
4.2	Slump Test	36
4.3	Compressive Strength Test of Cube Sample	38
4.3.1	Compressive Strength Test for 7 Days Curing Age	38
4.3.2	Compressive Strength Test for 14 Days Curing Age	39
4.3.3	Compressive Strength Test for 28 Days Curing Age	40
4.3.4	Compressive Strength Test for All Ratios in Curing Age	41
4.4	Flexural Strength Test for Prism Samples	43

4.4.1	Flexural Strength Test for 7 Days Curing Age	43
4.4.2	Flexural Strength Test for 14 Days Curing Age	44
4.4.3	Flexural Strength Test for 28 Days Curing Age	45
4.4.4	Flexural Strength Test for All Ratios in Curing Age	46
CHAPTER 5	CONCLUSION & RECOMENDATIONS	48
5.1	Introduction	48
5.2	Conclusions	48
5.3	Recommendations	49
REFERENCES		50
APPENDIX		
A	Data for Sample	52
B	Result for Normal Concrete, Ratio 1, Ratio 2 and Ratio 3	55
C	Preparation Coconut Shell	64
D	Preparation sample for Slump Test	67
E	Preparation Sample for Compressive Strength Test	70
F	Preparation Sample Prism for Flexural Strength Test	74
G	Standard Test Method	78
H	Activities for This Study	99

LIST OF TABLES

Table No.	Title	Page
2.1	General Features of the Five Type of Portland Cement	10
3.1	Percentages Coconut Shells in Design Concrete Mixture	24
4.1	Result for Compressive Strength for 7 Days Curing	38
4.2	Result for Compressive Strength for 14 Days Curing	39
4.3	Result for Compressive Strength for 28 Days Curing	40
4.4	Result for Flexural Strength for 7 Days Curing	43
4.5	Result for Flexural Strength for 14 Days Curing	44
4.6	Result for Flexural Strength for 28 Days Curing	45

LIST OF FIGURES

Figure No.	Title	Page
2.1	Coarse Aggregate Use in Common Construction	12
2.2	Fine Aggregate Use in Common Construction	13
2.3	Coconut Shells	15
2.4	Crushed Coconut Shells	15
3.1	Methodology Flow Chat	22
3.2	Steel Formwork Size 750mm X 150mm X 150mm	23
3.3	Cement Uses in Concrete	25
3.4	Aggregate Used In Concrete	26
3.5	Crushed Coconut Shell Passes through Sieve Size 20mm	27
3.6	Processes Curing For Samples	28
3.7	Type of Slump	29
3.8	Slump Test	30
3.9	Compressive Testing Machine	31
3.10	Sample Cube That Are Finish the Test	32
3.11	Flexural Testing Machine	33
3.12	Loading Arrangement on Prism Specimen	34
3.13	Sample Ready for Flexural Test	35
4.1	Result for Slump Test for Every Ratio	37
4.2	Compressive Strength for 7 Days Curing Age	39
4.3	Compressive Strength for 14 Days Curing Age	40
4.4	Compressive Strength for 28 Days Curing Age	41
4.5	Compressive Strength for All Ratio	42
4.6	Flexural Strength for 7 Days Curing Age	44
4.7	Flexural Strength for 14 Days Curing Age	45
4.8	Flexural Strength for 28 Days Curing Age	46
4.9	Flexural Strength for All Ratio	47

LIST OF SYMBOLS

%	Percentage
kg	Kilogram
m	Meter
N	Newton
min	Minute
MPa	Mega Pascal
pcf	Per Cubic Foot
C ₃ S	Tri Calcium Silicate
C ₃ A	Tri Calcium Aluminate
kN	Kilo Newton
mm	Millimetre

LIST OF ABBREVIATIONS

ASTM	American Section of the International Association for Testing Materials
ACI	American Concrete Institute
BS	British Standard
FKASA	Fakulti Kejuruteraan Awam Dan Sumber Alam
UMP	Universiti Malaysia Pahang

THE PROPERTIES OF CONCRETE CONTAINING COCONUT SHELL AS PART
OF COARSE AGGREGATE REPLACEMENT

HAFIZ OSMAN BIN MOHAMMAD

Thesis submitted in fulfilment of the requirements for the award of the degree of
B. Eng (Hons.) Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

JANUARY 2017

ABSTRACT

The demand of concrete in the construction industry increased rapidly due to continuous development in Malaysia. Extensive use of concrete leads to sacristry of natural aggregates. The reuse solid waste from manufacturing is an alternative way to preserve waste management problem as well as to reduce the depletion of natural resources. This study was conducted to investigate the flexural strength and compressive strength of the concrete with coconut shell replacement as coarse aggregate. In this study, coconut shell was used to partial replace the coarse aggregate by 5%, 10% and 15%. All concrete was design to grade C25 / 30 and all samples cured for 7days, 14days and 28days. Test compressive strength and flexural strength conducted to determine the strength of hardened concrete. The result presented that 15% coconut shell replacement in concrete by compressive strength and flexural strength higher than the replacement of 5% and 10%. The results showed coconut shell can be used in concrete construction.

ABSTRAK

Permintaan konkrit dalam industri pembinaan semakin meningkat kerana pembangunan yang berterusan di malaysia. Penggunaan berterusan ini membawa kepada kekurangan agregat semula jadi. Penggunaan sisa pepejal dari industri adalah cara alternatif untuk menguruskan masalah pengurusan sisa dan juga untuk mengurangkan penggunaan terus sumber semula jadi. Kajian ini dijalankan untuk mengkaji kekuatan lenturan dan kekuatan mampatan yang menggunakan konkrit dengan penggantian tempurung kelapa sebagai agregat kasar. Dalam kajian ini, tempurung kelapa digunakan untuk menggantikan sebahagian agregat kasar sebanyak 5%,10% dan 15%. Semua konkrit direkabentuk dengan grade c25/30 dan semua sampel diawet selama 7hari, 14hari dan 28hari. Ujian kekuatan mampatan dan ujian kekuatan lenturan dijalankan untuk menentukan kekuatan konkrit keras.keputusan menunjukkan bahawa 15% gantian tempurung kelapa dalam konkrit mempunyai kekuatan mampatan dan kekuatan lenturan yang lebih tinggi berbanding gantian 5% dan 10%. Hasil menunjukan tempurung kelapa boleh digunakan dalam pembinaan konkrit.

CHAPTER 1

INTRODUCTION

1.1 Background

Malaysian is a country that is rapidly developing from economically. Therefore, Malaysia must have a building and good infrastructure facilities to attract more investors to come to Malaysian. In order to meet the needs of the many building projects and infrastructure conducted, this will lead to a high demand for concrete.

Concrete is the basic material in the construction of a building. Concrete used to build the foundation, column, floors and more. Generally, the basic material for producing concrete is cement, fine aggregate, coarse aggregate, water and additives.

Coarse aggregate is one of the materials in design the concrete mix. It is a mixture of the base material where the content consists of three-quarters of design the concrete mix. Since the total quantity of aggregate in design the concrete mix is something large, then the strength and durability of a concrete depends on the characteristics of coarse aggregate itself. Among important characteristics of a coarse aggregate are the bond strength, compressive strength, size, shape, permeability and chemical inertness.

Furthermore, the physical properties of coarse aggregate is density, density friable, porosity, lush, soundness and resistance to acid attack and alkaline, which also affects the strength. Therefore, we also know the concrete strength will be reduced due to increase of water content in concrete design mix.

Nowadays, there are many studies that have been done to find suitable material to replace the coarse aggregate in the concrete mix. The use of waste material as a substitute to replace the coarse aggregate in the concrete mix can be beneficial to humans. Coconut is one of the alternatives that can be used to replace the supply of coarse aggregate.

Coconut is grown in more than 93 countries. Southeast Asia is considered to be the origin of the coconut (Maninder and Manoreet, 2012). Malaysian has around 646,932 tons of coconut produced. The domestic demand for coconut produced taken in the form of fresh coconut, tender coconut, coconut oil and processed cream powders.

Malaysian has exported coconut and coconut products worth RM 466,210,137 and is willing to continue to grow with increasing global demand. However, it is also a major contributor to the pollution problem in the country as solid waste. Coconut shell affects serious disposal problems for the local environment. This solid waste can be used as potential or material substituents on aggregate in the concrete mix. Hence the aggregate replacement should be tested to ensure the use of appropriate or at least have the same properties as the existing aggregate.

1.2 Problem Statement

Since past, the construction industry in Malaysian increased. Therefore, the use of concrete will also increase because the concrete is widely used in building construction to make beams, floors, columns, slabs and more. A high demand on the concrete also will involve the growing demand for coarse aggregate.

In this situation, is not good if we just rely on one source of coarse aggregate demand as it was feared that the continued increase would cause a shortage and unable to cope with demand in the future. Therefore, some alternative must be established to cover the coarse aggregate demand in the future.

Of the results of the observations made, there are few studies conducted to generate an alternative of coarse aggregate. Mostly, an alternative of coarse aggregate

generated through waste materials such as concrete waste, tires, bricks destroyed and many others. Some of the results have been known from the previous study of student in construction industry.

For the purposes of this study, conducted on an alternative production of coarse aggregates from waste that will be used is coconut shell. Almost all Malaysians use coconut in cooking and coconut shells will usually throw away or burned. Coconut shell has the potential to replace the aggregate because the chemical composition is similar to wood. Coconut shells become hard and not easily deteriorate.

However, due to environmental issues recently and waste disposal are increasingly becoming important because we lack of natural resources and the lack of a place to dispose of waste. Besides solving the above problems, this study is to find alternative materials to replace the coarse aggregate and adjust with the objectives to be achieved.

1.3 Objective of Study

The research objectives of this study are:

- i. Determine the compressive strength of coconut shells concrete.
- ii. Determine the flexural strength of coconut shells concrete

1.4 Scope of Study

This study, focus on the alternatives coarse aggregate replacement from wasted materials of coconut shells. Coconut shells easily to get in Malaysia because mostly people use coconut in cooking and coconut shells are discarded or burned. Coconut shells easy to get in the market or a store that sells coconut milk.

Therefore, this study uses concrete grade C25 / 30 as standard mixture to control the percentage change of coconut shell as an alternatives coarse aggregate in the concrete. For this study, samples of concrete produced in the form of cubes and prisms.

REFERENCES

- Parag S. Kambli*, Sandhya R. Mathapati**, (2014), Application of Coconut Shell as Coarse Aggregate in Concrete: A Technical Review. Engineering Research and Applications www.ijera.com ISSN: 2248-9622, Vol. 4, Issue 3 (Version 1)
- Cordilia Marboh¹, Amrita Agnihotri¹, Rajni Raja Tomar¹, Rahul Kumar Satbhaiya², (2015), Behaviour Of Reinforced Concrete Beams With Coconut Shell As Coarse Aggregates. Engineering, Management & Medical Research, Vol- 1, Issue- 6
- E.A. Olanipekun, K.O. Olusola, O. Ata*, (2006), A comparative study of concrete properties using coconut shell and Palm kernel shell as coarse aggregates. Building and Environment 41 (2006) 297–301.
- Vishwas P. Kukarni, Sanjay kumar B. Gaikwad, (2013), Comparative Study on Coconut Shell Aggregate with Conventional Concrete. Engineering and Innovative Technology, Volume 2, Issue 12.
- B.Damodhara Reddy¹, S.Aruna Jyothy², Fawaz Shaik³, (2014), Experimental Analysis of the Use of Coconut Shell as Coarse Aggregate. Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X, Volume 10, Issue 6 (Jan. 2014), PP 06-13
- Daniel Yaw Osei, (2013), Experimental assessment on coconut shells as aggregate in concrete. Engineering Science Invention, ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726.
- Siti Aminah Bt Tukiman And Sabarudin Bin Mohd, (2009), Investigate The Combination Of Coconut Shell And Grained Palm Kernel To Replace Aggregate In Concrete: A Technical Review. Engineering and Earth Resources.
- Miss. Anjali S. Kattire, Miss. Priyanka A. Bhujugade, Mr. Shashiraj S.Chougule, (2015), Investigation Of Coconut Shell As A Replacement Of Course Aggregate In Concrete. Information, Knowledge And Research In Civil Engineering Issn: 0975 – 6744| Nov 14 To Oct 15 | Volume 3, Issue 2 Page 195

- Apeksha Kanojia¹, S.K. Jain²,(2015), Performance of Coconut Shell as Coarse Aggregate in Concrete: A Review. Engineering and Technology e-ISSN: 2395 - 0056 Volume: 02
- K. Gunasekaran*, R. Ramasubramani, R. Annadurai, S. Prakash Chandar,(2014), Study on reinforced lightweight coconut shell concrete beam behaviour under torsion Materials and Design 57 (2014) 374–382.
- K. Gunasekaran a*, R. Annadurai a, P.S. Kumar b,(2013), Study on reinforced lightweight coconut shell concrete beam behaviour under flexure. Materials and Design 46 (2013) 157–167
- Damre Shraddha, Firake Hitali, Dode Pradeep and Shrikant Varpe,*, (2014), Sustainable Concrete by Partially Replacing Coarse Aggregate Using Coconut Shell. Today's Ideas –Tomorrow's Technologies, Vol. 2, No. 1, June 2014 pp. 1–14
- Tomas U. Ganiron Jr, (2013), Sustainable Management of Waste Coconut Shells as Aggregates in Concrete Mixture. Engineering Science and Technology Review 6 (5) (2013)
- BS 12: 1996 Specification for Portland Cement7-14
- ASTM - C150 Standard Specification for Portland Cement
- ASTM - C39 Standard Test Method for Compressive Strength
- ASTM - C78 / C78m Standard Test Method for Flexural Strength of Concrete
- IS: 516-1959 Standard Specification for Test Flexural Strength.
- BS 1881-116: Method for determination of compressive strength of concrete cubes
- Civil Engineering Laboratory Manual Book