POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

MODIFICATION OF CONCRETE DESIGN USING COCONUT SHELL AND PALM KERNEL SHELL

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CONFIRMATION OF THE PROJECT

The project report titled "Effect on Replacement of Coconut Shell and Palm Kernel Shell as a Substitute for Coarse Aggregate on Compressive Strength of Concrete" has been submitted, reviewed and verified as a fulfills the conditions and requirements of the Project Writing as stipulated

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AUTHOR'S DECLARATION

We declare that the work in this final year project paper was carried out in accordance with the regulations of Polytechnic. It is original and is the results of our own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any diploma or qualification.

We, hereby, acknowledge that we have been supplied with the Academic Rules and Regulations for Undergraduate, Polytechnic, regulating the conduct of my study and research.

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ABSTRACT

Agricultural industrial wastes produced after extracting palm oil from palm fruits known as oil palm shell (OPS) or palm kernel are available in large quantities in Malaysia, and other tropical countries. Another organic waste the large quantities in Malaysia is coconut shell. The aim of the study is to study the effect of palm kernel and coconut shell as coarse aggregate replacement on compressive strength of concrete and water absorption. Firstly, the palm kernel and coconut shell were cleaned from any impurities before it was crush into smaller size. A set of laboratory tests including workability test, compressive strength test and water absorption were conducted on the concrete made by different percentage of coconut shell and palm kernel replacement from 5% to 15% at intervals of 5%. Concrete grade 20 with 1:2:4 ratio has been choose. All samples were submerged for 7 and 28 days as curing age. The result showed, the true slump was occurred for all the sample. Similarly, for compressive strength, the trends of compressive strength decreases dramatically below standard strength as the replacement material were increases. This show that the replacement material not suitable for using concrete.

Keywords : *Palm kernel, coconut shell, compressive test, water absorption*

ABSTRAK

Sisa industri pertanian yang dihasilkan selepas mengekstrak minyak kelapa sawit dari buah sawit yang dikenali sebagai cankang kelapa sawit (OPS) atau tempurung kelapa sawit boleh didapati dalam kuantiti yang besar di Malaysia, dan negara-negara tropika lain. Satu lagi sisa organik jumlah besar di Malaysia adalah tempurung kelapa. Tujuan kajian ini adalah untuk mengkaji kesan cangkang kelapa sawit dan tempurung kelapa sebagai pengganti batu baur kasar keatas kekuatan mampatan dan kadar resapan air. Pertama,cangkang kelapa sawit dan tempurung kelapa dibersihkan dari sebarang kekotoran sebelum ia dihancurkan bagi mendapatkan saiz yang sesuai. Ujian makmal termasuk ujian kebolehkerjaan, ujian kekuatan mampatan dan penyerapan air dilakukan pada konkrit yang dibuat menggunakan peratusan yang berlainan. Konkrit dibancuh menggunakan peratusan bahan pengganti yang berbeza iaitu, 5%, 10% and 15%. Gred konkrit 20 dengan nisbah 1:2:4 telah dipilih. Semua sampel telah diawet selama 7 dan 28 hari. Hasilnya menunjukkan, kekuatan mampatan konkrit menurun apabila peratus bahan gentian bertambah. Kajian menunjukan bahawa, bahan gantian yang digunakan tidak sesuai digunakan.

Kata kunci: *Cangkang kelapa sawit, tempurung kelapa, ujian mampatan, kadar resapan air*

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In this era of globalization, concrete is the one of the most widely used construction material today. In Malaysia, more than 90% of the structures ranging from building, bridges, roads, dams, retaining walls etc. utilize the concrete for their construction. This is the popular construction material where strength, durability, fire resistance are required. Strength, durability and workability may be considered as main properties of concrete. Various step that is been taken and applied in concrete to making the concrete more friendly, more economical and have the strength that same with the conventional concrete.

In recent years, researchers have also paid more attention to some agriculture wastes for use as building material in construction (George, Babu, Franco, & P, 2016). The result is from construction building using wood to convert concrete building construction. Since concrete use builds many benefits and benefits to human, concrete has become the most important ingredient in the construction industry today. Construction using concrete shows that there are many buildings can be produced and remain to this day.

According to Alengaram, Abdullah, Muhit, & Zamin (2013) , the high demand for concrete in construction using normal weight aggregates , such as gravel and granite, has drastically reduced natural stone deposits and this has caused irreparable damage to our environment. As a result, the emphasis on sustainable materials has intensified recently. The growing need for sustainable development has motivated researchers to focus their investigation on the use of waste or recycled materials into potential construction material

1.2 Problem Statement

In the current construction industry, Desire and aspiration to gain profits and great success in construction pushing for new challenges that focus on new innovations in implementing construction tasks. The production of concrete has become a method can increase productivity in building construction. Demand for high use of concrete and increased concrete prices caused the rise in the price of raw materials in Malaysia led to the construction industry of the defendant.

There is a large amount of agricultural waste such as coconut shell and palm kernel shell was disposed in most of tropical countries especially in Asia such as Malaysia. According to Izzad Amir (2012), the survey conducted by the Agricultural Ministry of Malaysia, there are about 156,000 hectares of coconut plantation in Peninsular Malaysia alone. If the waste cannot be disposed properly it would lead to social and environmental problem. Utilized these disposed material was one method of treating the agricultural waste from waste to wealth. The used of coconut waste from dispose of coconut shell could be a useful material in the formation of an admixture for housing construction.

According to N. I. Ahmad & Yahya (n.d), Malaysia is the second largest palm oil exporting countries in the world. The demand for vegetable oil in the international market is on the rise. Every year, palm oil industries produce large volume of oil palm shell (OPS) as waste material after the production of palm oil. Nearly 5 million hectares of palm oil trees is expected by the year 2020 in Malaysia alone. This will increase the production of both palm oil and its wastes.

1.3 Research Objectives

In this project, we want to overcome the problem and to archive our objective. The objective are:

i. To produce the high compressive strength of concrete.
ii. To find out the optimum percentage of coconut shell and palm kernel shell can be used in the mixing to get the optimum strength.

1.4 Research Importance

There are some research importance in this project, such as:

i. To study the effectiveness of coconut shell and palm kernel shell as coarse aggregate.
ii. To reduce depending on aggregate

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review is an important element for more description of each variable based on secondary sources. It may give more information in developing a better theoretical framework that can continue further exploration, analysis and hypothesis testing. This chapter will explains the various findings and focuses on information about concrete with coconut shell and palm kernel shell from the past researchers by reviewing journal from another researcher regarding to this topic.

The benefit from the literature review is help researcher to discover new viewpoints about concrete, coconut shell and palm kernel shell that is need further exploration by revising what has been describe on a topic and also helps the researchers and reader to get better understanding on this study. Furthermore, it can helps the current researcher to expand on existing knowledge by reviewing the previous study based on the topic of research, method and concept framework. The current study will consist on the review of palm kernel shell and coconut shell. The discussion and the results that have been made by previous researcher are very important for current researcher to assist by giving as a guideline.

2.2 Concept of Green Concrete

Concrete which is made from concrete wastes that are eco-friendly are called as "Green Concrete". Green Concrete is the production of concrete using as many as recycled materials as possible and leaving the smallest carbon footprint as possible. The other name for green concrete is resource saving structures with reduced environmental impact for e.g. Energy saving, CO_2 emissions, waste water. "Green Concrete" is a revolutionary topic in the history of concrete industry. This was first invented in Denmark in the year 1998 by Doctor WG. Concrete wastes like slag, power plant wastes, recycled concrete, mining and quarrying wastes, waste glass, incinerator residue, red mud, burnt clay, sawdust, combustor ash and foundry sand. Green Concrete is a term given to a concrete that has had extra steps taken in the mix design and placement to insure a sustainable structure and a long-life cycle with a low maintenance surface e.g. Energy saving, CO_2 emissions, waste water. The goal of the Centre for Green Concrete is to reduce the environmental impact of concrete. To enable this, new technology is developed. The technology considers all phases of a concrete construction's life cycle, i.e. structural design, specification, manufacturing and maintenance, and it includes all aspects of performance (Agarwal, 2018).

According to Agarwal (2018) , there is 4 benefits to using green concrete:

i. **Lasts Longer**: Green concrete gains strength faster and has a lower rate of shrinkage than concrete made only from Portland cement. Structures built using green concrete have a better chance of surviving a fire (it can withstand temperatures of up to 2400 degrees on the Fahrenheit scale). It also has a greater resistance to corrosion which is important with the effect pollution has had on the environment (acid rain greatly reduces the longevity of traditional building materials). All of those factors add up to a building that will last much longer than one made with ordinary concrete. Similar concrete mixtures have been found in ancient Roman structures and this material was also used in the Ukraine in the 1950s and 1960s.

ii. **Uses Industrial Waste**: Instead of a 100 percent Portland cement mixture, green concrete uses anywhere from 25 to 100 percent fly ash. Fly ash is product of coal combustion and is gathered from the chimneys of industrial plants (such as power plants) that use coal as a power source. There are copious amounts of this industrial waste product. Hundreds of thousands of acres of land are used to dispose of fly ash. A large increase in the use of green concrete in construction will provide a way to use up fly ash and hopefully free many acres of land.

iii. **Reduces Energy Consumption**: If you use less Portland cement and more fly ash when mixing concrete, then you will use less energy. The materials that are used in Portland cement require huge amounts of coal or natural gas to heat it up to the appropriate temperature to turn them into Portland cement. Fly ash already exists as a product of another industrial process so you are not expending much more energy to use it to create green concrete. Another way that green concrete reduces energy consumption is that a building constructed from it is more resistant to temperature changes. An architect can use this and design a green concrete building to use energy for heating and cooling more efficiently.

iv. **Reduces CO_2 Emissions**: In order to make Portland cement–one of the main ingredients in ordinary cement–pulverized limestone, clay, and sand are heated to 1450 degrees C using natural gas or coal as a fuel. This process is responsible for 5 to 8 percent of all carbon dioxide (CO_2) emissions worldwide. The manufacturing of green concrete releases has up to 80 percent fewer CO_2 emissions. As a part of a global effort to reduce emissions, switching over completely to using green concrete for construction will help considerably

2.3 Concept of palm kernel shell

According to Salman Zafar (2019), palm kernel shells (PKS) are the shell fractions left after the nut has been removed after crushing in the Palm Oil mill. Kernel shells are a fibrous material and can be easily handled in bulk directly from the product line to the end use. Large and small shell fractions are mixed with dust-like fractions and small fibres. Palm kernel shells contain residues of Palm Oil, which accounts for its slightly higher heating value than average lignocellulosic biomass. Compared to other residues from the industry, it is a good quality biomass fuel with uniform size distribution, easy handling, easy crushing and limited biological activity due to low moisture content.

Source : Halim (2016)

Figure 2.1: Palm Kernel Shell

According to Ahmad (2017) **,** palm kernel is a material which can be easily found and have a lot of uses both commercially and industrially. In industries it is used for the production of palm oil and we can found palm kernel shell as commercially and industrial waste. Palm kernel shell which is hard and light in weight has been used as partial replacement in concrete to be used in low-cost building with a view to reduce cost of production and motivate the interest of low income earner to have the hope in owning personal residential building (Bara & Usman, 2014).

According to Eziefula, Opara, & Anya (2017) , the top five producers of palm oil in the world Indonesia, Malaysia, Thailand, Columbia, and Nigeria account for around 90% of the total production worldwide. Palm kernel shell and periwinkle shell seem to be suitable lightweight aggregates in concrete based on their properties such as size, shape, surface texture, toughness, and hardness. The size of broken palm kernel shell varies according to the cracking force.

2.4 Concept of coconut shell

Coconut shell is the strongest part covered in coconut fruit. Coconut shell is located in between the coconut flesh and coconut husk. This shell is naturally created to protect the inner part of coconut. This is shell is use to produce various handicraft applies and other applications. Most of handmade decorative are created by using coconut shell due to their strength. Coconut shells are also used to made charcoal which is use as fuel and this coconut charcoals are far better than other charcoals.

Coconut shell is one of the solid disposal wastes that came from agricultural activities. The used of coconut shell as one of the composite materials in the production of concrete driven by the problem caused by the disposal of solid waste. Coconut shell represents more than 60% of the domestic waste volume and had a serious disposal problem for local environment. However, these wastes can be used as potential material or replacement material in construction industry (Kalin & Suchkov, 2016) .

According to Rao, 2015, Coconut shells have good durability characteristics, high toughness and abrasion resistant properties; it is suitable for long standing use. Besides that, coconut shell are potential candidates for the development of new composite material in concrete mix design because of their high strength and modulus properties. Apart from that, the usage of coconut shell in concrete are much cheaper as it is an agricultural waste that was dumped and not been use. A better and a green environment can be created by using this coconut shell.

According to Kambli & Mathapati, 2014, Coconut shell aggregates are potential candidates for the development of new composites because of their high strength and modulus properties. An approximate value of coconut shell density is 1.60 g/cm3. The study on use of coconut shells as a substitute for coarse aggregates in concrete is gaining importance in terms of possible reduction of waste products in the environment and finding a sustainable alternative for non- renewable natural stone aggregates (George et al., 2016).

Source: George, Babu, Franco, & P, 2016

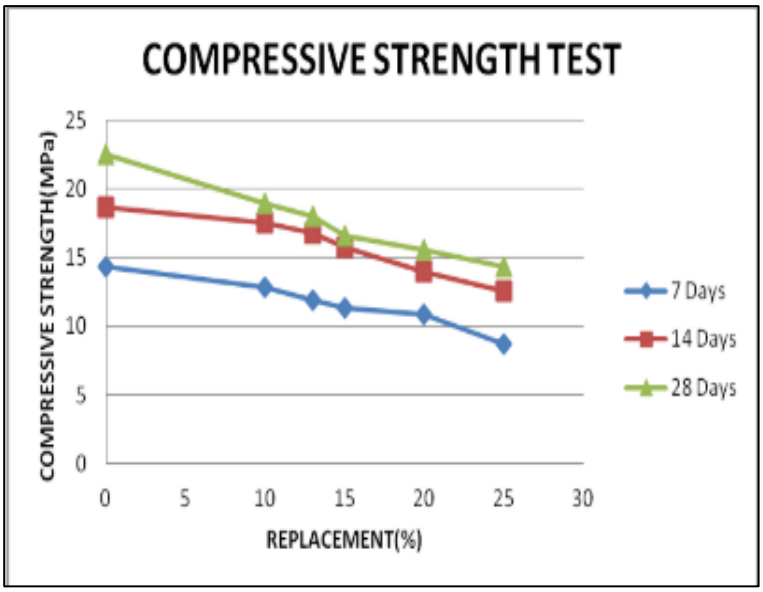
Figure 2.2: Crushed coconut shell

According to Sonawane & Chitte (2016), coconut Shell concrete has superior workability because of the smooth surface on one side of the shells. The impact resistance of Coconut Shell concrete is high when compared with conventional concrete. Moisture retaining and water absorbing capacity of Coconut Shell are more compared to conventional aggregate. Coconut shell being a hard and not easily degrade material if crushed to size of sand can be a potential material to substitute sand (Shelke, Ninghot, Kunjekar, & Gaikwad, 2014).

2.4 Previous research

Previous research is to get information about the research and make sure the project carried is not same with previous research.

i. The title of the previous research is "Partial Replacement of Coarse Aggregate with Palm Kernel Shell in concrete". According to Ahmad, 2017, the percentage of palm kernel shell in concrete and the compressive strength are increase while cost and weight of the concrete decreases simultaneously. At around 10% partial replacement of coarse aggregate with palm kernel shell in concrete gives a significant decrease in cost and weight of the concrete without much affecting the compressive strength of concrete. There is a large scope of making the construction environmental friendly by replacing the construction material with waste. With the increase in the percentage of palm kernel shell in concrete the weight of concrete gets continuously decreasing. Thus producing lightweight concrete.



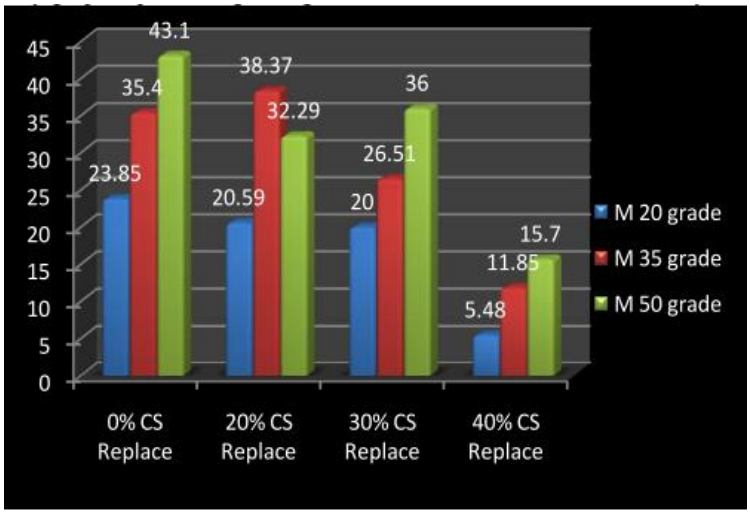
Source : Ahmad, 2017

Figure 2.3: Compression Test Result

ii. According to Kambli & Mathapati (2014), the coconut shell has potential as lightweight aggregate in concrete. Also, using the coconut shell as aggregate in concrete can reduce the material cost in construction because of the low cost and abundant agricultural waste. Coconut Shell Concrete can be used in rural areas and places where coconut is abundant and may also be used where the conventional aggregates are costly. Coconut shell concrete is also classified as structural lightweight concrete. It is concluded that the Coconut Shells are more suitable as low strength-giving lightweight aggregate when used to replace common coarse aggregate in concrete production. Trying to replace aggregate by coconut shell partially to make concrete structure more economic along with good strength criteria.

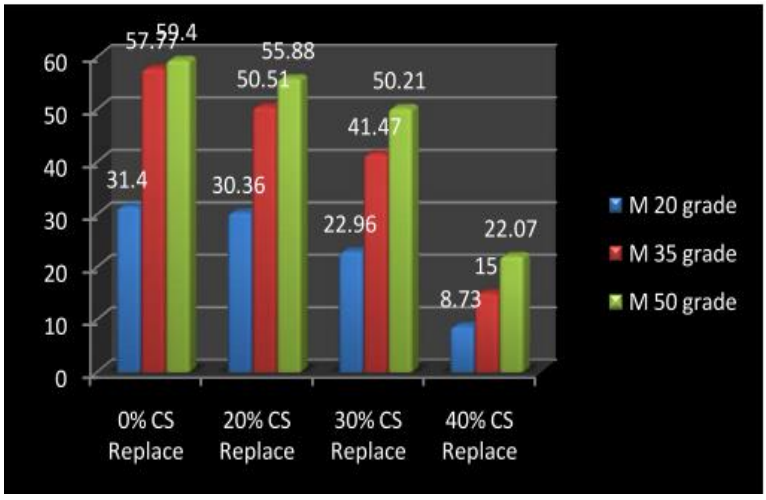
From one cube calculation bulk amount of shell replacement can be evaluated & reduces over all construction cost. This can be useful for construction of low cost housing society. In this study, three different concrete mixes namely Grade 20, Grade 35 and Grade 50 with different combination of natural material coconut shell content in the proportion 0%, 10%, 20%, 30% and 40% will be replaced. Six sample specimen will be prepared for each concrete mixes. The

parameters will be tested are compressive strength behaviour of cube specimens for 7 and 28 days.



Source : Kambli & Mathapati, 2014

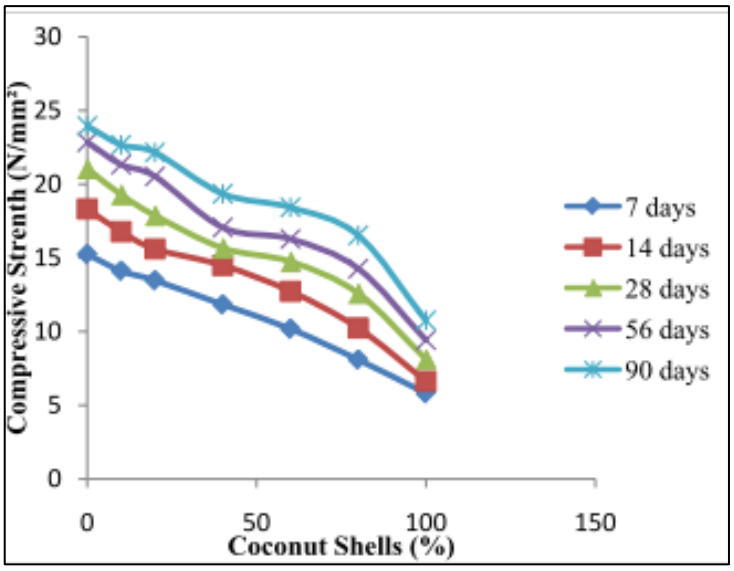
Figure 2.4: Compression Test Result in 7 days



Source : Kambli & Mathapati, 2014

Figure 2.5: Compression Test Result in 28 day

iii. According to Duna (2017) , control concrete with normal aggregate and binary concrete mixes (containing 10, 20, 40, 60, 80 and 100 % coconut by weight of coarse aggregate) were produced and cured for 7, 14, 28, 56 and 90 days respectively. A total of one hundred and five (105) cubes and beams were cast and tested for compressive strength, flexural strength as well as the density. The results showed that generally strengths decrease with increase in coconut shell content and increase with prolong curing period. The results also showed that, the density of the concrete decreases with increase in coconut shell content. Concrete cubes made with 10% to 20% coconut shell and cured for beyond 28 days, achieved the 28 days target strength of 20 N/mm^2. The optimum replacement level was observed at coconut shell 20% cured for beyond 28 days. The data obtained were subjected to regression analysis and analysis of variance in the statistical software. Models were developed to predict compressive strength, flexural strength and concrete density with curing period and coconut shell content as predictors at 5% level of significance, the result showed that, there is no significant difference between the predicted and the experimental values. The coefficients of determination of 93.4%, 91.0% and 94.3% for the models of compressive strength, flexural strength and density are reasonably high, indicating a good correlation between the response and the predictor variables.

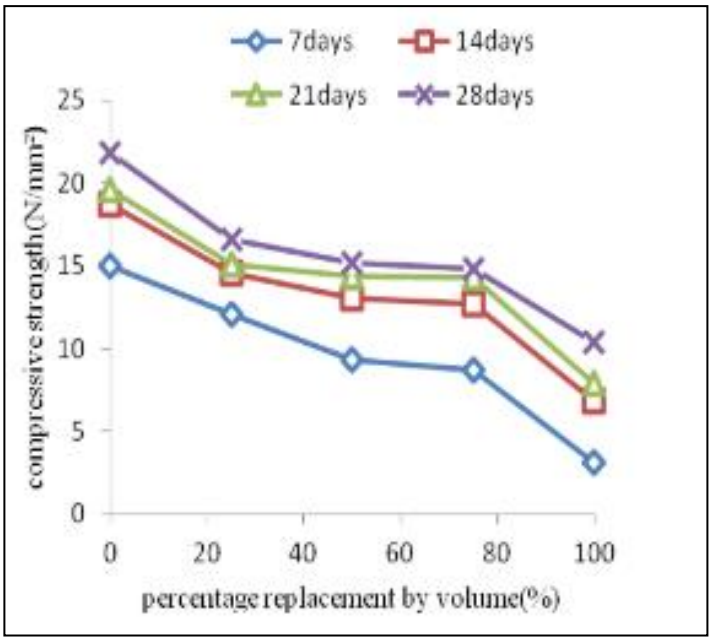


Source : Duna(2017)

Figure 2.6: Compression Test Result

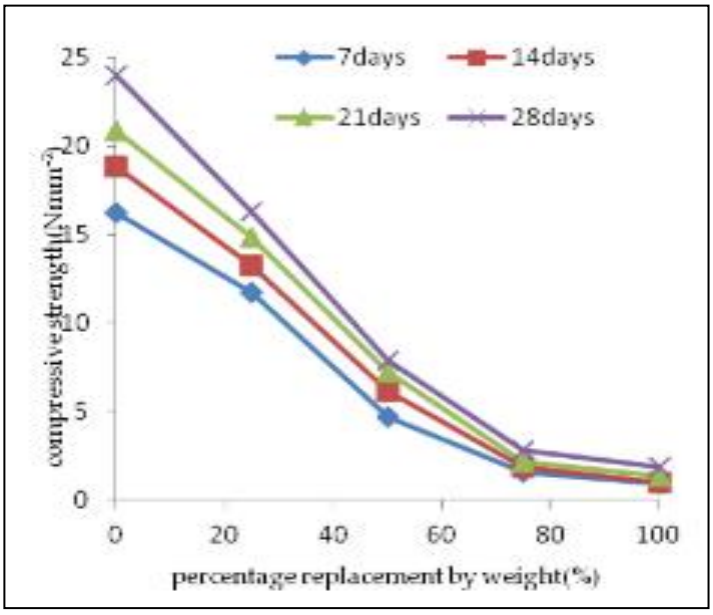
iv. According to Osei & Jackson(2012) , experimental investigations on the effects of replacing crushed granite in concrete with palm kernel shells on the strength, density and workability of concrete. Two control mixes of ratios 1:2:4 were batched by volume and by weight. Palm kernel shells were used to replace the crushed granite aggregate by volume and by weight respectively. The percentage replacement varied from 0% to 100% at intervals of 25%.The compaction factor test was used to assess the workability of the fresh concrete .The compressive strengths and densities of cured concrete cubes of sizes, 150mm×150mm×150mm were evaluated at 7days, 14days, 21days and 28days. Increase in the percentage replacement of granite lowered compressive strength, density and workability. Density on the average decreased at a rate of 7kgm^{-3} and 11kgm^{-3} per unit percentage increase in replacement for volume-batched concrete and weight-batched concrete respectively while concrete strength decreased at a rate of 0.11 N/mm^2 and 0.22 N/mm^2 per unit percentage increase in palm kernel shell content for volume-hatched concrete and weight-batched concrete respectively. There exists the possibility of replacing coarse aggregates with palm kernel shells in the production of structural concrete. The study identified possible cost reduction in replacing granite with palm kernel shells

and recommended codification of the use of palm kernel shells as aggregates in concrete.



Source: Osei & Jackson(2012)

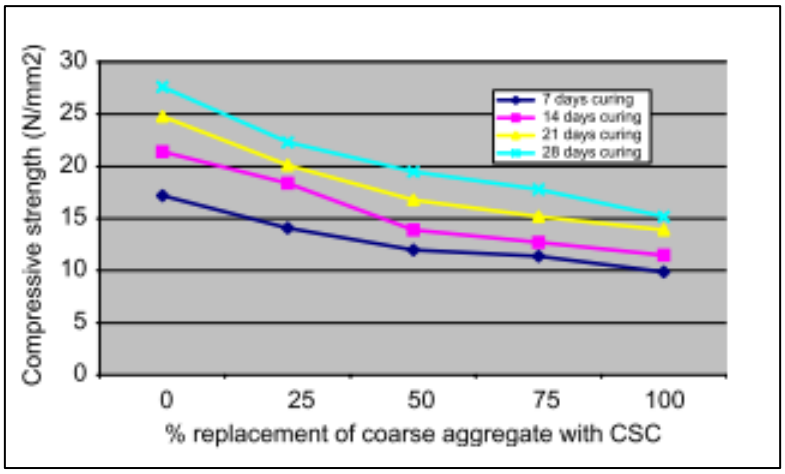
Figure 2.7: Compressive Strength Result



Source: Osei & Jackson(2012)

Figure 2.8: Compressive Strength Result

v. According to Press (2006), the high cost of conventional building materials is a major factor affecting housing delivery in Nigeria. This has necessitated research into alternative materials of construction. This paper presents the results of an investigation carried out on the comparative cost analysis and strength characteristics of concrete produced using crushed, granular coconut and palm kernel shells as substitutes for conventional coarse aggregate in gradation of 0%, 25%, 50%, 75% and 100%. Two mix ratios 1:1:2 and 1:2:4 were used. A total of 320 cubes of size 100mm x 100mm x 100mm were cast, tested and their physical and mechanical properties determined. The results of the tests showed that the compressive strength of the concrete decreased as the percentage of the shells increased in the two mix ratios. However, concrete obtained from coconut shells exhibited a higher compressive strength than palm kernel shell concrete in the two mix proportions. The results also indicated cost reduction of 30% and 42% for concrete produced from coconut shells and palm kernel shells, respectively. Considering the strength/economy ratio, it was concluded that coconut shells were more suitable than palm kernel shells when used as substitute for conventional aggregates in concrete production. A comparative study of concrete properties using CS and PKS as coarse aggregates has been carried out. Generally the compressive strength of the concrete decreased as the percentage shell substitution increased. In all cases, the coconut shell exhibited a higher compressive strength than PKSC in the two mix proportion tested. Both types of concrete performed fairly equally well in terms of their water absorption capacities. In terms of cost, the PKSC appears to be cheaper. However, considering the strength/economy ratio and expecting further studies on the durability performance of both types of shell concrete, it could reasonably be concluded that coconut shell would be more suitable than palm kernel shell when used as substitute for conventional aggregates in concrete production.



Source : Press, 2006

Figure 2.9 Compressive Strength Result

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

As it is indicated in the title which is, effect on replacement of coconut shell and palm kernel shell as a substitute for course aggregate on compressive strength of concrete. This chapter is about the research methodology involve all variables. To be more details, in this chapter also cover about data collection, hypothesis statement and overall of research methodology. The main purpose is to know the flow on how the sample of concrete cube is make.

Research methodology is a systematic way to know the process to make the cube concrete. It is science of study on how the result of research is being carried out. Technically, when researches identifying, evaluating, determining, describing and conclude of all the data of producing a cube concrete, are called research design. It is also can be defined as the study of knowledge gains.

The next step taken is making a preparation of material and the sample is made based on the research design that we have collect. The sample that have been done will go through the test that are required such as cube test. If the sample reach the compressive strength that are needed. The data will be collected and analyse to know the result of our project is successful and reach the objectives. Last but not least, the conclusion and recommendation will be presented for improvement or otherwise.

3.2 Flow Chart

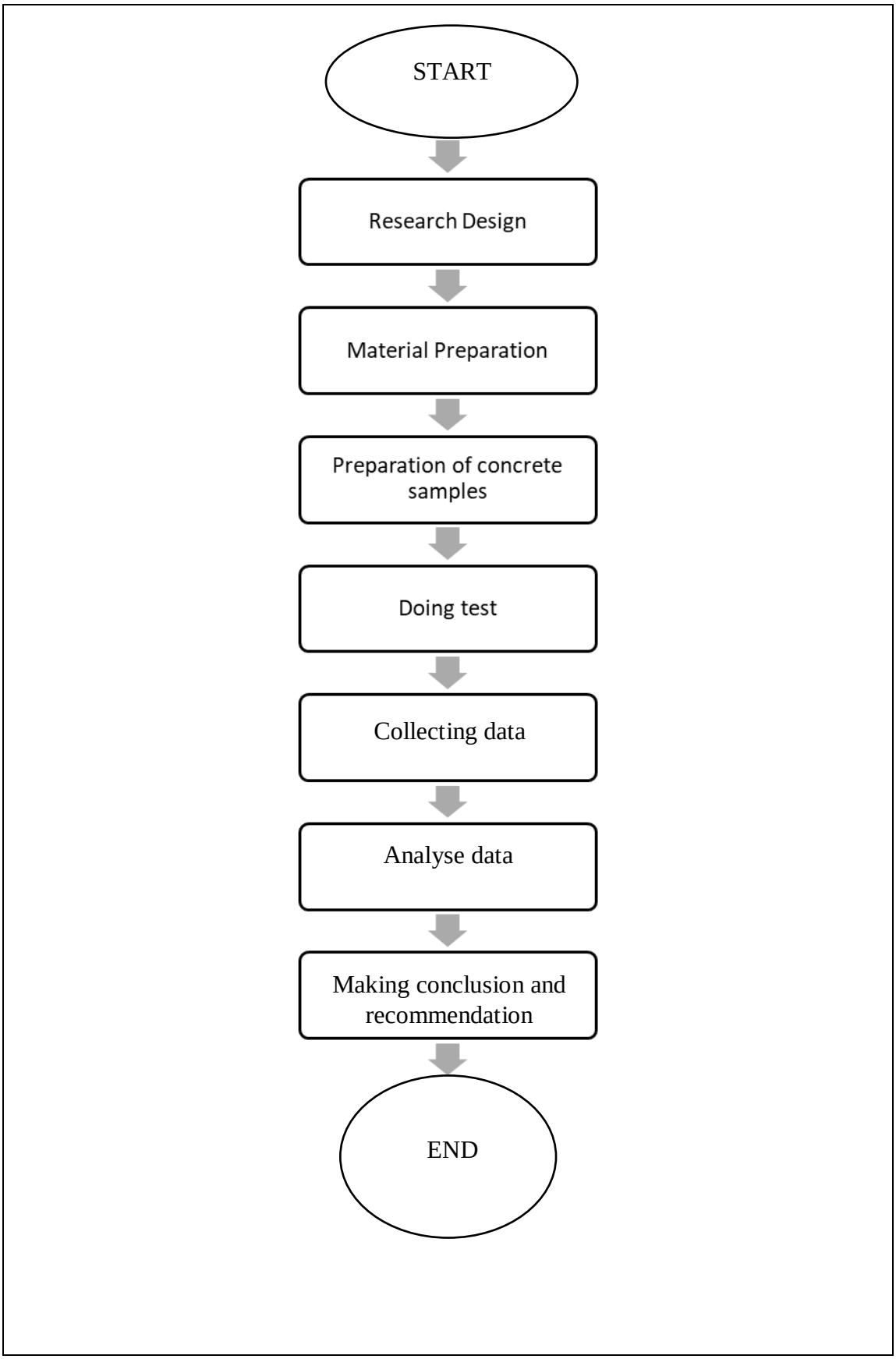


Figure 3.1: Flowchart progress of project

3.3 Research design

This research will be conducted in the form of experiment where the size of cube that we use is 150mm × 150mm × 150mm. The ready mixing of the concrete will be form into cube based on the mold that had been used. Every cube will be test based on the test that are required to reach the research objectives. Additive material that has been used is the material that suitable for concrete production.

3.4 Material Preparation

This research will be conducted in the form of experiment where the size of cube that we use is 150mm × 150mm × 150mm. The ready mixing of the concrete will be form into cube based on the mold that had been used. Every cube will be test based on the test that are required to reach the research objectives. Additive material that has been used is the material that suitable for concrete production.

3.4.1 Cement

The cement we get it from the nearby construction good store at Taman Ttdi Jaya, Shah Alam, Selangor. According to Conditions et al. The cement to be used throughout the work shall be cement obtained from SIRIM-certified manufacturer. The cement shall be described and complied with MS EN 197-1.

Figure 3.2 Ordinary Portland Cement

3.4.2 Palm Kernel Shell

The palm kernel shell used in this research was collected from Keck Seng (M) Berhad which is located at Masai, Johor. This factory is provided a services of palm oil cultivation and manufacturing. The palm kernel shell is air-dried naturally or in the oven, and then soaked for few days under ambient temperature to obtain Saturated Surface Dried (SSD) aggregates. The palm kernel shell grading size used was between 10.0 to 12.5mm to replace coarse aggregates at 5, 10, and 15% of the total coarse aggregate value.

Figure 3.3 Palm Kernel Shell

3.4.3 Coconut Shell

The coconut shell used in this research was collected from Pasar Moden Seksyen 2, Shah Alam, Selangor. The coconut shell is dumped at the back of the store that sell grated coconut. The coconut shell that we have been collected, we exposed it to the sun to make sure the coconut shell is dried perfectly. The coconut shell has been crushed into pieces by using a hammer to get the ideal size that can be used in concrete.

Figure 3.4 Coconut Shell

3.4.4 Costing

The importance of project costing is to make sure researcher know the budget and now how much materials that should be buy. The main materials to buy to make this research:

Table 3.1: The expenses on each material

Materials	**Price (RM)**
Sand	7.00
Cement	17.00
Aggregate	12.00
Coconut shell	Free
Palm kernel	35.00
Testing	90.00
Total	**161.00**

3.5 Preparation of concrete sample

Preparation was made to make the process of making concrete became easier and organized.

3.5.1 Sieve analysis

Sieve analysis is a test which commonly used in civil engineering to classify soils. The standard sieve analysis test determines the relative propositions of different grains sizes and classified them into certain size ranges (Baskara, 2018).

Sieve analysis has been done to make sure the size of coarse aggregate are in the same size. The purpose of this analysis are to remove small aggregate and other material that can affect the concrete mixture. The size used in this research is 20mm. Weight sample taken was 5Kg.

Table 3.2 Sieve analysis of aggregates

Sieve size	Weight retained (kg)	Cumulative weight retained (kg)	Cumulative percentage retained (%)	Cumulative percentage passing (%)
80mm	0.000	0.000	0.000	100.000
40mm	0.000	0.000	0.000	100.000
20mm	1.519	1.519	30.380	69.620
10mm	3.444	4.963	99.260	0.740
4.75mm	0.037	5.000	100.000	0.000
2.36mm	0.000	5.000	100.000	0.000
1.18mm	0.000	5.000	100.000	0.000

600 micron	0.000	5.000	100.000	0.000
300 micron	0.000	5.000	100.000	0.000
150 micron	0.000	5.000	100.000	0.000
Total	**5.000**		**729.64**	

Fineness Modulus = 729.64 / 100 = 7.30

Table 3.2 shows, the average size of aggregate are 7.30. Aggregate that retained on sieve 20mm were used to make the concrete.

Table 3.3 Sieve analysis of palm kernel

Sieve size	Weight retained (kg)	Cumulative weight retained (kg)	Cumulative percentage retained (%)	Cumulative percentage passing (%)
80mm	0.000	0.000	0.000	100.000
40mm	0.000	0.000	0.000	100.000
20mm	2.105	2.105	42.100	57.900
10mm	1.530	3.635	72.700	27.300
4.75mm	1.221	4.856	97.120	2.800
2.36mm	0.144	5.000	100.000	0.000
1.18mm	0.000	5.000	100.000	0.000
600 micron	0.000	5.000	100.000	0.000
300 micron	0.000	5.000	100.000	0.000
150 micron	0.000	5.000	100.000	0.000
Total	5.000		711.92	

Fineness Modulus = 711.92 / 100 = 7.12

Table 3.3 shows, the average size of palm kernel are 7.12. Palm kernel that retained on sieve 20mm were used to make the concrete.

Table 3.4 Sieve analysis of coconut shell

Sieve size	Weight retained (kg)	Cumulative weight retained (kg)	Cumulative percentage retained (%)	Cumulative percentage passing (%)
80mm	0.000	0.000	0.000	100.000
40mm	1.662	1.662	33.240	66.760
20mm	2.375	4.037	80.740	19.26
10mm	0.963	5.000	100.000	0.000
4.75mm	0.000	5.000	100.000	0.000
2.36mm	0.000	5.000	100.000	0.000
1.18mm	0.000	5.000	100.000	0.000
600 micron	0.000	5.000	100.000	0.000
300 micron	0.000	5.000	100.000	0.000
150 micron	0.000	5.000	100.000	0.000
Total	5.000		813.98	

Fineness Modulus = 813.98 / 100 = 8.14

Table 3.4 shows, the average size of coconut shell are 7.12. Coconut shell that retained on sieve 20mm were used to make the concrete.

Figure 3.5 Sieve analysis for palm kernel shell

3.5.2 Slump Test

Slump test is a test to determine the workability of the ready mix of concrete. Slump test procedure is:

i. The mould for the slump test is a frustum of a cone, 300 mm (12 in) of height. The base is 200 mm (8in) in diameter and it has a smaller opening at the top of 100 mm (4 in).
ii. The base is placed on a smooth surface and the container is filled with concrete in three layers, whose workability is to be tested.
iii. Each layer is temped 25 times with a standard 16 mm (5/8 in) diameter steel rod, rounded at the end.
iv. When the mould is completely filled with concrete, the top surface is struck off (levelled with mould top opening) by means of screening and rolling motion of the temping rod.

v. The mould must be firmly held against its base during the entire operation so that it could not move due to the pouring of concrete and this can be done by means of handles or foot - rests brazed to the mould.

vi. Immediately after filling is completed and the concrete is levelled, the cone is slowly and carefully lifted vertically, an unsupported concrete will now slump.

vii. The decrease in the height of the centre of the slumped concrete is called slump.

viii. The slump is measured by placing the cone just besides the slump concrete and the temping rod is placed over the cone so that it should also come over the area of slumped concrete.

Figure 3.6 slump test of concrete

3.5.3 Curing Test

Curing test used to get early high compressive strength in concrete. This method is also used to find out 7 and 28 days compressive strength of concrete. There are many types of curing test which is water curing, sheet curing and membrane curing. The test that will be taken is water curing. Water curing can be done using the following techniques:

i. Immersion: Immersion curing is usually done during concrete testing when curing concrete test specimens.
ii. Ponding: Used to cure flat surfaces on jobs or controlled areas where water can be easily retained on top of the concrete slab. Sand or earth dikes surround the slab and a layer of water is maintained on top of the slab.
iii. Fogging: Fogging or misting is used in circumstances where temperatures are above freezing and there is low humidity. Fogging raises the humidity above the curing concrete by spraying a fine mist of water regularly across it to maintain moisture.
iv. Wet Covering: Curing concrete with wet covering is done after the concrete has hardened sufficiently and the water covering will not damage concrete's surface.

3.5.4 Compression Cube Test

This test is the most important test for concrete. Compressive strength of material or structure to carry loads on its surface without crack or deflection. The test os to determine the compressive strength and tensile strength of the concrete when subjected to the load. The results of this test will show a concrete mix that results in high strength of concrete. A material under compression tends to reduce the size, while in tension, size elongates. The size mould of cube is 150mm × 150mm ×150mm.

Figure 3.7 Compressive test of concrete cube

3.6 Data Collection

There are many techniques and ways that can be used in collecting data. The techniques that been used in this research is through reading. Such as, reading books, journals, article and newspaper. From those materials, there will be a lot of data and evidence that could help to carry this research.

All data that gained form the reading will be print and used as a reference material. The data will be added into previous research slot. Other than that, the data will be selected to match the research that will be carried. It is to avoid errors during doing the research.

3.7 Analysing Method

Firstly, manual method will be used to analyse the data. In this process, it includes transferring data from observation into a complete report. The will be table to insert the result from the test and to compare the result with conventional concrete.

Moreover, graph will be done by referring to the table of result. Other than that, there will be a Gantt chart to show time taken to done the research form beginning to the end of this research. Therefore, the method of analysing data needs to be done carefully to get positive result and match the objective.

3.8 Gantt Chart

The gantt chart were made to make sure there were no delay in the proses of making the project.

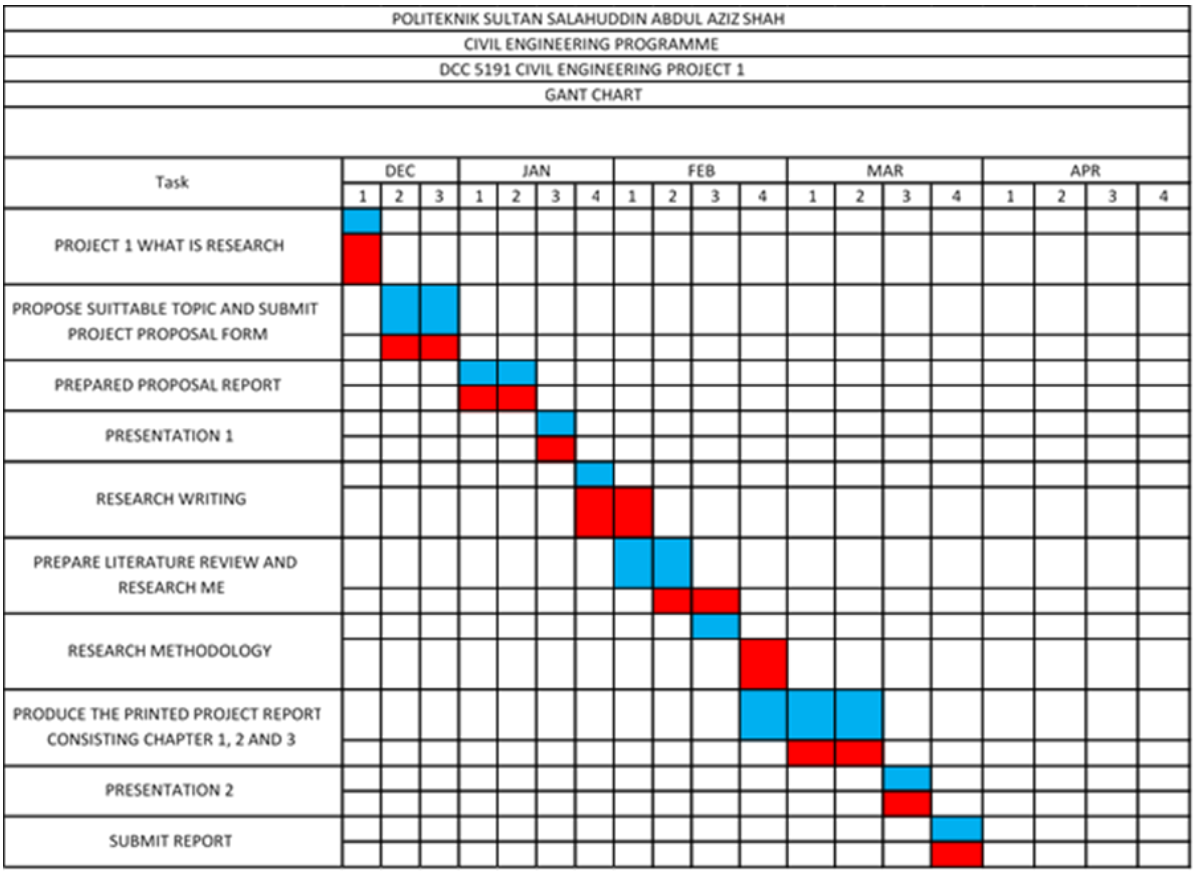


Figure 3.8 Progress for Final Year Project 1

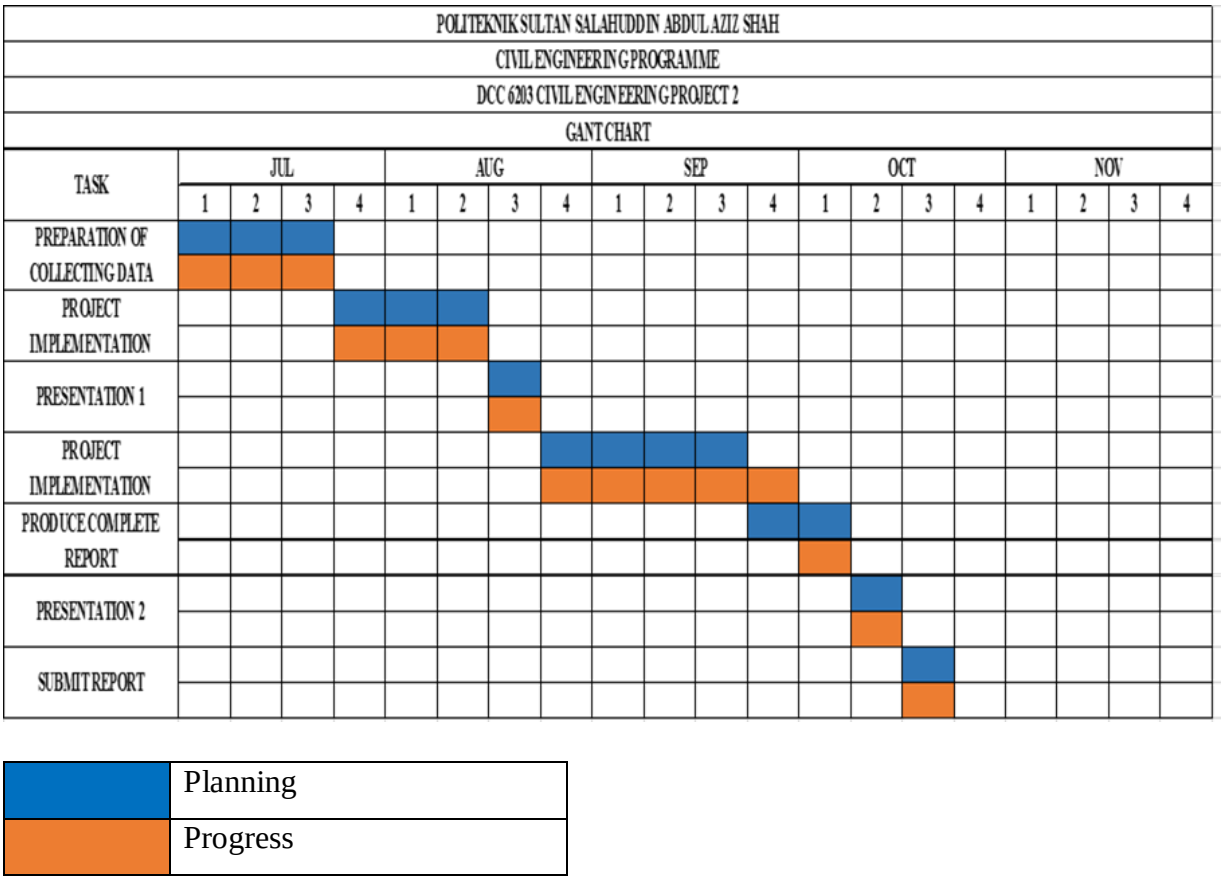


Figure 3.9 Progress for Final Year Project 2

CHAPTER 4

DATA ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter is to identify the objective and the progress of producing the concrete. The high compressive strength concrete produced to solve the problems as mention previous chapter. Concrete with palm kernel shell and coconut shell made by different percentage with a 5%, 10% and 15%.. Process of producing concrete will follow the specification and rules. The concrete produced by manual process. The data that gained will be study and analyze. The British Standard used as reference to control quality and the standard of concrete. Concrete will be tested with slump test, curing test, and compressive strength.

4.2 Production of Concrete

Concrete that produce six samples for each percentages. Each percentage is different in amount of material such as coarse aggregate, fine aggregate, cement, palm kernel shell and coconut shell and water. Other than that, dimension cube concrete is follow the standard size which is 150mm×150mm×150mm. Before produced the cube concrete, calculation of mixing concrete must be calculate first as shown in Table 4.1.

Next, to determine the strength of concrete, the concrete with palm kernel shell and coconut shell produced at Concrete Laboratory, Civil Engineering Department in Politeknik Sultan Salahuddin Abdul Aziz Shah. Concrete will be test to determine the

maximum compressive strength at Quality Control Material Laboratory in Subang Jaya. It is the most important and useful properties of concrete. The compressive strength was calculated from the failure load divided by the cross sectional area resisting the load.

Table 4.1 Mass of material for making cement

Percentage (%)	Cement (kg)	Fine aggregate (kg)	Coarse aggregate (kg)			Water (l)
			Palm kernel shell	Coconut shell	Aggregate	
5	6.6	13.2	0.66	0.66	25.08	4.50
10	6.6	13.2	1.32	1.32	23.76	4.80
15	6.6	13.2	1.98	1.98	22.44	5.00

4.3 Test result

The result for each percentage was recorded. The test result is slump test, compressive strength and water absorption.

4.3.1 Slump Test (Workability test)

When making the slump test, the base of the slump cone was put on a flat surface. The cone was then filled with wet concrete in three layers. Each layer was tempered 25 times with a standard 16mm. When the cone was completely filled with concrete, the top surface was struck off by means of screening and rolling motion of the temping rod. The cone was firmly held against its base during the entire operation so that it could not move due to the pouring of concrete and this can be done by means of handles or foot-rest brazed to the mould. After filling the mould with wet concrete, it

was levelled and the cone was slowly and carefully lifted vertically, an unsupported concrete will then slump. The slump was measured by placing the cone just besides the slump concrete and tempering rod was placed over the cone so that it should also come over the area of slumped concrete. The decrease in height of the concrete to that of the mould was noted with scale.

Table 4.2 shows the result of slump test carried out on sample used in the concrete. Slump test is to measures the consistency of fresh concrete before it sets. The results show represented that 5%, 10% and 15% replacement of coarse aggregate gave a true slump result. It show each percentage achieved high workability in concrete.

Table 4.2 Slump Test Result

Percentage concrete (%)	Slump (mm)	Slump type
5	6	True slump
10	8	True slump
15	10	True slump

Figure 4.1 Slump Test

Figure 4.2 Measure the ruins

4.3.2 Compressive strength

Compression cube test is used to determine the mechanical strength of concrete to sustain the axial force applied on the surface of concrete. To produce the high strength concrete, 3 mixing of concrete in different grade 20 (1:2:4) used to test the average compressive strength. One set concrete containing 3 samples which is Sample A, Sample B and Sample C. This test is to determine the maximum compressive strength and tensile strength of the concrete and the substitute when subjected to the load. The results of this test will show a concrete mix that results in a high strength of concrete to achieve the Malaysian standards (MS 1993).

Figure 4.3 Compression test at Quality Control Subang Jaya

Table 4.3 Compressive strength at 7 days

Compressive strength at 7 days				
Type of Samples / Percentage Of Concrete	A (N/mm²)	B (N/mm²)	C (N/mm²)	Average (N/mm²)
5%	10.2	11.7	16.2	12.7
10%	7.8	6.1	8.4	7.43
15%	8.6	8.8	9.9	9.1

The compressive strength for the different percentage of concrete with palm kernel shell and coconut shell has been recorded. Each percentage is containing three samples in produce the concrete.

The table 4.3 shows that the 5% concrete has value 12.7N/mm² which is the highest compressive strength value compare to other samples. While, the lowest value

of compressive strength is at 15% which is 9.1 Nmm². Next, the compressive strength for 5% and 10% is 12.7N/mm² and 7.43N/mm².

The compressive strength value that recorded shows the difference between the highest and the lowest values is 4.4N/mm². So, the conclusion is when percentage concrete with palm kernel shell and coconut shell is high, the value of compressive strength for concrete decreases. Based on the Malaysia Standard (MS1993), the compressive strength of concrete must achieve or more than 13 N/mm² at 7 days.

Table 4.4 Compressive Strength at 28 days

Compressive strength at 28 days				
Type of samples / Percentage Of Concrete	A (N/mm²)	B (N/mm²)	C (N/mm²)	Average (N/mm²)
5%	15.6	17.3	15.3	16
10%	10.6	9.8	11.3	10.57
15%	9.2	8.5	8.5	8.73

Table 4.4 shows the results of compressive strength at age 28. From the table, the highest value of compressive strength is 16N/mm² at 5%. While the lowest value for compressive strength is 8.73 N/mm² at 15%. The compressive strength for 5% and 10% is 16N/mm² and 10.57 N/mm².

The difference of compressive strength between the highest and lowest value is 11.27N/mm². The value of 5% is nearest to standard which is 16N/mm². Figure 4.4 shows the compressive strength of 0%, 5% and 15% at 7 days and 28 days. The data can be refer at table 4.2 and 4.3. It can be seen that at 7 days, the highest of compressive strength is 5%, followed by 15% and 10%.The conclusion is, when added high

percentage of concrete additives, compressive strength is decreases. Based on the Malaysia Standard (MS1993), the compressive strength of concrete must achieve or more than 20 N/mm² at 28 days.

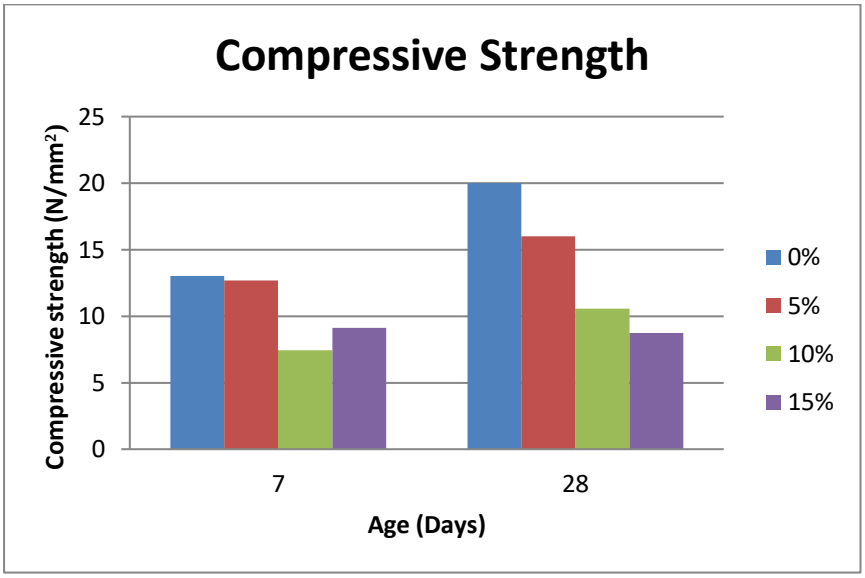


Figure 4.4 Bar Chart of Compressive Strength at 7 days and 28 days.

4.3.3 Water Absorption

Table 4.5 Water Absorption at 7 days

Percentage (%)	Sample	Dry mass(kg)	Wet mass(kg)	Water Absorption (%)	Average water absorption (%)
5	A	7.399	7.540	1.906	1.48
	B	7.671	7.830	2.073	
	C	7.485	7.520	0.468	
10	A	7.182	7.230	0.668	1.75
	B	7.047	7.080	0.468	
	C	6.998	7.285	4.101	
15	A	7.189	7.305	1.614	2.27
	B	6.987	7.320	4.766	
	C	7.304	7.335	0.424	

Table 4.6 Water Absorption at 28 days

Percentage (%)	Sample	Dry mass (kg)	Wet mass (kg)	Water absorption (kg)	Average water absorption (%)
5	A	7.619	7.775	2.048	1.34
	B	7.716	7.735	0.246	
	C	7.687	7.820	1.730	
10	A	7.019	7.215	2.792	1.60
	B	7.115	7.190	1.054	
	C	7.083	7.150	0.946	
15	A	7.111	7.230	1.673	2.77
	B	7.005	7.200	2.784	
	C	6.992	7.220	3.261	

Table 4.5 and 4.6 shows that, 5 % additives has the lowest water absorption than other percentage followed by 10% and 15%. Harmful substance has the highest chances to penetrate in concrete which has 15% of additives. The water absorption is achieved the standard which is extremely good concrete , below 4% or 5%.

4.4 Discussion

The result that obtained from slump test is true slump for 5%, 10%, and 15%. In a true slump concrete just subsides shortly and maintain the mold shape. This type of slump is most desirable for construction. Lowest workability can cause low energy to handle the raw concrete.

The result form the compressive test for mixture 5%, 10% and 15% are lower that concrete standard. The standard value of compressive test for concrete grade 20 is 20 kN. If the value is below 20 kN, there is higher chances that structural failure can occur.

Water absorption test show, concrete mixture with 15% of replacement has the highest value. The more water can be absorb by the concrete, the more risk that the concrete can be infected by harmful substances.

Sieve analysis show that, only 30.38% of coarse aggregate that can be used to make the concrete. The size that we wanted to use has been fixed before the making of the concrete. The size is 20mm.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

This section is a final step in this project, which is we make some discussion and conclusion from the result because some of the problems that arose in this concrete project, we got some idea to improve the way in making a strong green concrete. In addition, student also make a good preparation for presentation such as refer to the supervisor to complete this part which is need some advice and recommendation as something that we learn from this project.

The following is a discussion of the results obtained and the problems arising from the research on the strength and durability of concrete using a mixture of coconut shell and palm oil coconut shell as a substitute for waste. Data collection is taken to identify problems that arise and how to solve them. So the important thing from using a palm oil coconut and coconut shell and why must continue this idea is because of possible to be lightweight concrete, from the percentage that we use, the more percentage of shell that we used, the less concrete weight can we achieve. Other than that, from using coconut shell we also can reduce a waste pollution and high demand based on a single source can be overcame. Finally, costing for this project are suitable for student.

The costing to spend in this project is low cost if we want to compare with other project and for comparison with the standard concrete, there is no big different between this project costing and also suitable for student research.

5.2 Recommendation

Within a given time frame, we successfully complete this project. This product can achieve the objective as planned but need some improvement in this innovation project. This problem in plot the data, and strength of concrete are because of possibility that we are not follow the execution work as the specification. So for solve this problem is, we recommend for you to doing a compaction of concrete properly to avoid honeycomb, make sure the sizing of coconut shell was small and average for the maximum strength that you will achieve. For improvement in plot the data and get more result, better do diversify in testing of concrete and record the data properly. For innovation in this project, we should try new combination with chemical item but you should make a confirmation with a chemical lab department to collaboration with them.

Lastly, try made this sample of project in small cube size for the accurate results in strength. We also hope that next generation can make more improvement to this product so we can see a great product will be made and solve some problem.

5.3 Conclusion

Based on the results of the concrete strength and discussion, it is concluded that our project failed to achieve the standard strength of the concrete. We determine our project become failure because of sizing of coconut shell that we use are not suitable, this is because we use the coconut shell in a big size so this is the point we can't achieve a maximum strength. Other than that, we believe that from this material we still can get a good result with some improvement in method of made a concrete or with a new concept. This is because this project is simple and does not require high cost.

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APPENDIX

APPENDIX 1: QUALITY CONTROL MATERIAL LABORATORY RESULT SHEET