
DCC 6203 : PROJECT 2

REPORT FINAL YEAR PROJECT

TITLE : USING OIL PALM SHELLS AS ADDITIVES IN LIGHTWEIGHT CONCRETE

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**POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH**

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**JABATAN KEJURUTERAAN AWAM**


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This report is submitted to the Civil Engineering Department in compliance with some of the requirements of the Diploma in Civil Engineering

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## ACKNOWLEDGMENT

Acknowledgment to the Almighty Allah for His permission, favor and blessing in the completion of this Diploma project. A heartfelt congratulations to the Messenger of Allah (may peace be upon him) for his mercy to all the world.

Our deepest appreciation and appreciation to Madam Zurina bt Safee as a supervisor, guidance, support, assistance and comments provided from the beginning to the completion of this Diploma Project.

Special thanks to the lecturers who assisted us in making this project possible. All your education and advice has been invaluable in the process of furthering the quality of our work.

Thanks to Sultan Salahuddin Abdul Aziz Shah's Polytechnic for their cooperation in making this study a success.

Lastly, we would like to express our sincere thanks to those directly and indirectly involved in this work.

## ABSTRACT

Oil Palm Shell (OPS) is a waste lightweight aggregate originating from palm oil industry, which is 50% more lighter than conventional aggregate. The objective of this study was to investigate the effect of oil palm shell (OPS) when it replaced with coarse aggregate on the properties of high strength lightweight concrete and to reduce agriculture waste from palm oil tree in ours industry. Oil Palm Shell (OPS) is commonly known as carbon active that can function as a gas absorber. This research is conducted to test the strength and workability of oil palm shell as additives in lightweight concrete. This experiment is being tried for 7 days, 21 days, and 28 days for the more accurate result. The experimental of this research use a ratio 1:2:4 and the percentage were used is 5%, 10% and 15% of oil palm shell will be replaced the aggregate.



**Keywords-** Oil Palm Shell (OPS), Additives, Lightweight concrete, strength, Workability

# ABSTRAK

Cangkang Kelapa Sawit (OPS) adalah agregat ringan sisa yang berasal dari industri minyak sawit, iaitu 50% lebih ringan daripada agregat konvensional. Objektif kajian ini adalah untuk mengkaji kesan cangkang kelapa sawit (OPS) apabila ia digantikan dengan agregat kasar pada sifat kekuatan konkrit ringan yang tinggi dan untuk mengurangkan sisa pertanian dari pokok kelapa sawit dalam industri kita. Cangkang kelapa sawit (OPS) biasanya dikenali sebagai aktif karbon yang boleh berfungsi sebagai penyerap gas. Kajian ini dijalankan untuk menguji kekuatan dan kebolehkerjaan cangkang kelapa sawit sebagai bahan tambah dalam penghasilan konkrit ringan. Percubaan ini sedang diuji selama 7 hari, 21 hari, dan 28 hari untuk hasil yang lebih tepat. Eksperimen kajian ini menggunakan nisbah 1: 2: 4 dan peratusan yang digunakan adalah 5%, 10% dan 15% daripada tambahan cangkang kelapa sawit yang akan digantikan sebagai agregat.



**Kata kunci**: Cangkang Kelapa Sawit (OPS), bahan tambah, Konkrit ringan, kekuatan, Kebolehkerjaan.

CONTENT

# TOPIC 1

## 1.1 Introduction

Currently, Malaysia has shown a shift towards advancements from various angles, especially the changes in the construction sector. This can be seen with the result of the construction of buildings that use wood to change to building construction using concrete which is significantly stronger than using concrete. In view of the overall context of use, concrete contributes to the second highest use after water use (Nawi, 1996).

Therefore, many studies have been conducted to identify different features and workmanship due to various factors. The resulting concrete should have good quality in terms of strength, durability and workability and also have more cost effective time and energy. This factor is important as it will make fixed concrete continue to be used as a major component in construction and civil engineering.

Given that one of the composition that affects the strength of the concrete is its mixed material, a study and research has been studied. The purpose is to produce concrete that is lighter than ordinary concrete. On the other hand, the quality of concrete produced depends on the quality of the materials used. If the materials used are not of good quality then the resulting concrete will have low quality and will not last long for a long time. The result of the study was to use the palm oil shell as an additive for the aggregate which is an alternative material into the concrete mixture produced.

## 1.2 Problem Statement

The production of lightweight concrete has become one of the ways to increase productivity in the construction sector. Nevertheless, the high demand for concrete use in construction activities and the increase in concrete prices from time to time will cause the construction industry to be subjected to a defamation. This is because, there are many construction sectors that will use the materials at the same time as building housing, road construction, bridge construction and so on.

At the same time, high demand for concrete use will lead to the release of toxic smoke and toxins such as carbon dioxide ($CO_2$ ), carbon monoxide, sulfur dioxide and other consequences of concrete producing effects in concrete manufacturing factories. This will slightly increase the haze phenomenon, global warming and environmental pollution (Orenge, 2007).

Furthermore, the natural resources required in concrete construction such as sandstone are decreasing and will be exhausted as the need for mixing and adding material into the concrete mix. At the same time, in the agricultural sector we are facing the problem of dumping palm oil shell ( Utusan Online, 2013). Its also will disrupting the local scene because the wastage of oil palm shells will increase from time to time if not disposed of. Therefore, this study aims to use the waste of oil palm shells as an additive for the aggregate in the manufacture of lightweight concrete. This can be taken as a step of initiative to alleviate the problems currently being faced.

## 1.3 Research Objectives

In this study it is to find and identify the following:

a) To study the oil palm shells as an additive moisture of lightweight concrete.

b) To test compressive strength of oil palm shells lightweight concrete.

## 1.4 Scope of Study

This study is to additive part of the use of crude stone in the production of concrete by using oil palm shell. In this case, using the ratio of 1: 2: 4 (cement: sand: coarse sand) ratio and 0% for concrete control, while the remaining 5%, 10% and 15% oil palm as an additive to gravel in concrete mix. This study was conducted to examine the effectiveness additives the oil palm shell in the manufacture of lightweight concrete. The test will be done to test the compression test to compare the level of strength and extent of the workability of the concrete. The size sample for each test is 150mm × 150mm × 150mm for one cube and total sample to make is 6 cube for each percentage to get the best result.

# TOPIC 2

# LITERITURE REVIEW

## 2.1 Introduction

Literary studies are basically the unification of an informational body obtained from secondary sources such as books, magazines, newspapers and other appropriate resources in other words is a careful selection of ideas derived from the discovery of others on a topic. The main aim of this study is to ensure that the views used by past researchers are the same in the theoretical and methodological uses.

## 2.2 Concrete

Concrete is the most commonly used man-made material on earth. It is an important construction material used extensively in buildings, bridges, roads and dams. It uses range from structural applications, to paviours, kerbs, pipes and drains.

Concrete is a composite material, consisting mainly of Portland Cement, water and aggregate (gravel, sand or rock). when these materials are mixed together, they form a workable paste which then gradually hardens over time.

### 2.2.1 Type Of Concrete

i) Plain / Ordinary concrete

ii) Lightweight concrete

iii) High density concrete

iv) Reinforced concrete

v) Precast concrete

vi) Prestressed concrete

## 2.3 Introduction to Lightweight Concrete

Lightweight concrete is concrete that uses lightweight. This lightweight stone can be composed of lightweight rocks used in conventional concrete, gravel and sandstone, expand clay, foamed slag, clinker, crushed stone, organic and inorganic.

**Table 2.1: Compressive Strength of Different Grades of Concrete at 7 and 28 Days**

| Grades of Concrete | Minimum compressive strength N/mm² at 7 days | Specified characteristic compressive strength (N/mm²) at 28 days |
|---|---|---|
| M15 | 10 | 15 |
| M20 | 13.5 | 20 |
| M25 | 17 | 25 |
| M30 | 20 | 30 |
| M35 | 23.5 | 35 |
| M40 | 27 | 40 |

### 2.3.1 Methods In Preparation and Characteristic of Lightweight Concrete

The method in preparation of lightweight concrete is preparation of lightweight concrete, provision of non-smooth concrete and preparation of lightweight concrete. The characteristic of lightweight concrete is fire prevention, durability, water absorption, rainwater redemption, acoustic properties and thermal insulation

## 2.4 Palm Oil

Palm oil production is crucial to the Malaysian economy, which is the second largest commodity producer in the world after Indonesia.

The Malaysian Palm Oil Board (MPOB) is a government agency responsible for promoting and developing the palm oil sector in the country. The country's palm oil industry produces approximately 90 million lignocellulosic biomass tones, including empty fruit bunches, oil palm stems, and palm leaves, as well as palm oil refinery effluents (POME).

In 2010, in response to concerns over the social and environmental impact of palm oil, the Government of Malaysia pledged to limit the expansion of palm oil plantation by maintaining at least half of the country's land as forest protection.

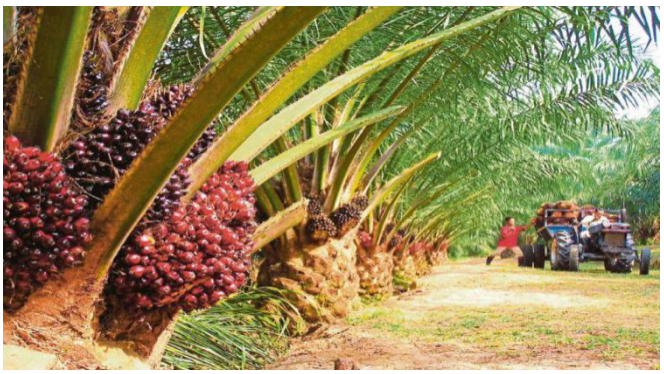

**Figure 2.1: Oil Palm**

## 2.5 Palm Oil Shells

Oil palm shells are one of the alternative materials to be used as crude stone additives in the manufacture of lightweight concrete. In this case, an observation has been carried out against the oil palm shell. It has been proven that oil palm shells have the potential to be used as a spare part because of their abundance in quantities, as well as waste materials especially in market areas. In addition, palm oil shells also have high strength and are not easy to decay. At the same time, palm shells also have their own special features that are lighter, making them smoother and also suitable for buildings requiring attractive surfaces such as floors other than lightweight concrete.

**Figure 2.2 : Palm Oil Shells**

## 2.6 Cement

Cement is an important component of the construction industry. It is kind of soft dust, which when mixed with water will become hard. This hardening occurs due to chemical reaction that converts cement dust into clinking crystal until the cement becomes hard.

Cement is an artificial material from a mixture of clay and gravel. The mixture was heated to a temperature of as high as 1400℃ forming a clinker or a scorched rock, and then pounded finely into flour. In most construction projects, the type of cement used is from Portland grade 20.

The type of cement is Common Cement Portland, Low Heat Portland Cement, Portland Cement Sulfate Retarder and Rapid Hardening Portland Cement.

**Figure 2.3: Cement**

## 2.7 Aggregate

Here the aggregate has two types that are smooth and rough. For fine type it consists of sand-like material while for the rough type it is made of stoneware.

### 2.7.1 Fine Aggregate

Sand is a major component of the mortar and is also the second most important component in the manufacture of concrete. In the manufacture of mortar or concrete, it must be clean and does not contain any impurities in it during the mixing work. This is to improve the quality of construction of a building itself.

The sand is used with cement for the construction of walls, pillars, tops of walls, floors, beams, stairs and even terraces. In construction projects, usually two sand grades are used, namely, 1: 3 and 1: 6 types of cement and sand.

**Figure 2.4: Fine Aggregate**

### 2.7.2 Coarse Aggregate

Stoning is a major component in the construction of concrete structures. It function an important role in the concrete mixing process. Coarse stone is composed of rock fragments of more than 5 mm to the maximum allowable size for certain concrete work, usually not more than 50 mm.

Coarse stone is available from mines or quarries and large stones crushed by machines and graded according to their specific uses. Sometimes large stones are also obtained from the river. This type of stone is usually round and smooth.

For hard, solid and durable rocks produce high quality concrete. The type of stone commonly used in the local construction industry is granite and limestone stones as these two types of stone are easily available and they are cheap. For most construction projects, the gross aggregate used is grade 20.

**Figure 2.5 : Coarse Aggregate**

## 2.8 Previous studies

### 2.8.1 Slump Test

Study on the use of oil palm shell as an additive in concrete mix (Aniza bt Tahir, 2010). Based on **Table 2.2** shows the results of the rubble test conducted to test the permeability and workability of the concrete mixture by applying 5% and 10% additional oil palm shells in each batch.

**Table 2.2: Runoff Test Results (Slump Test)**

| Types of concrete | Permeability | Strength | Condition ruins |
|---|---|---|---|
| Concrete control | fall | 150-200 | True ruins |
| Concrete with oil palm shell 5% | fall | 150-200 | True ruins |
| Concrete with oil palm shell 10% | fall | 150-200 | True ruins |

### 2.8.2 Compression Test

Based on **Table 2.3** shows the results of the average for cube compression test for control concrete, concrete with 5% oil palm shell and 10% oil palm concrete. This test is conducted to determine the level of concrete strength produced.

**Table 2.3: Average for Cube Compression Test Results for Concrete, Concrete with 5% and 10% Oil Palm Shells.**

| Day/Concrete | Concrete Control (kg) | Concrete with Oil Palm Shell 5% | Concrete with Oil Palm Shell 10% |
|---|---|---|---|
| 7 | 14.377 | 15.693 | 17.963 |
| 14 | 22.232 | 17.930 | 18.957 |
| 21 | 26.083 | 20.390 | 19.747 |

Conclusions from previous studies show that oil palm shells are used as an alternative material for additives in concrete mix. From the results of the experiments conducted, all the mixtures produced a good result. Although the concrete produced with oil palm shells gives a low value on day 14 and 21. However, the resulting value does not exceed the value of the concrete strength of concrete control.

# CHAPTER 3

# RESEARCH METHODOLOGY

## 3.1 Process Flow Chart

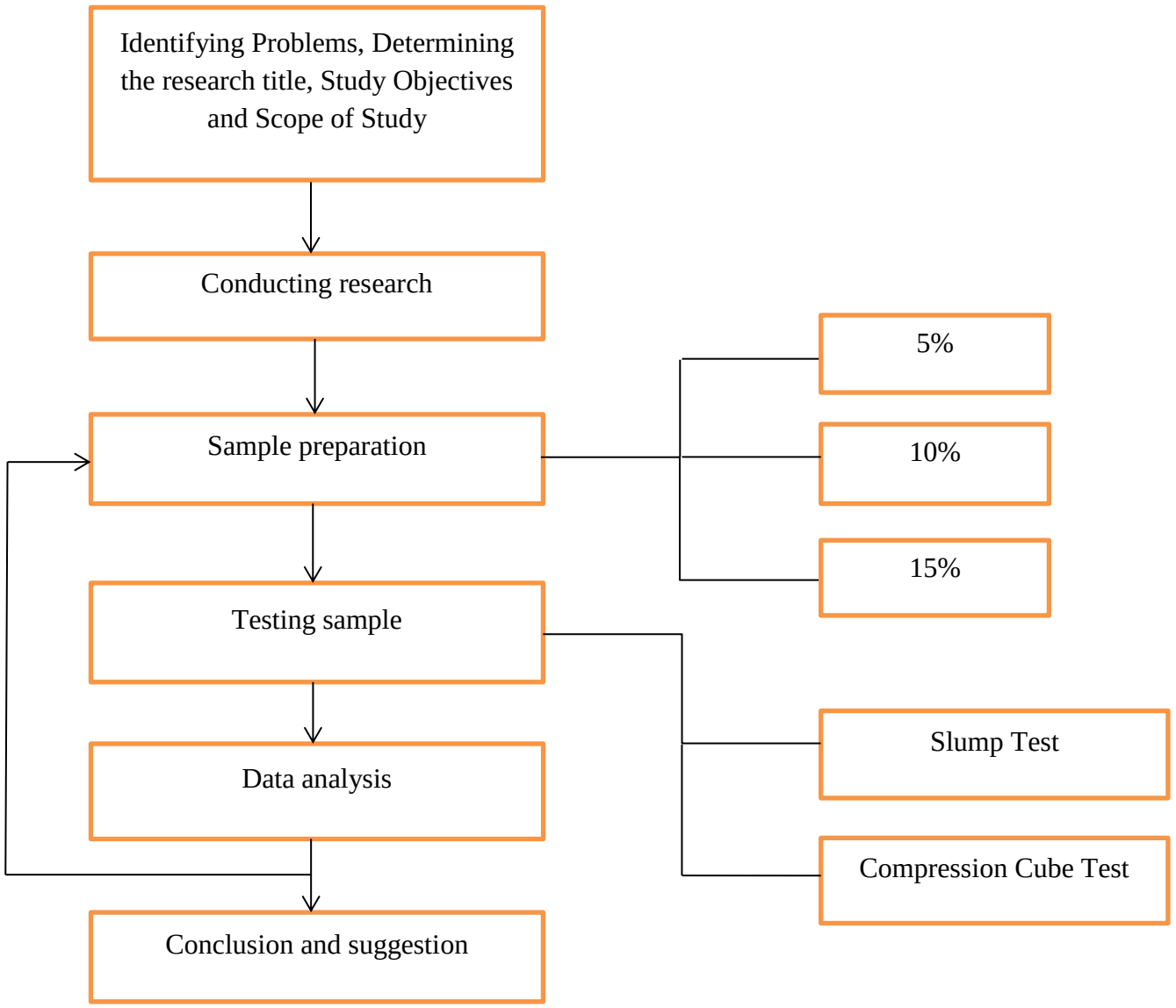


**Figure 3.1 : Methodology Flow Chart**

## 3.2 Preliminary Review

Preliminary study is a preliminary step to study a study. Data collection methods from previous studies used in this study are secondary data. In this case, secondary data is the source of research data obtained through intermediate media in the form of books, reports and records.

In the study of the use of oil palm shells as an additive in concrete mix. The earned data is qualitative data for debris testing and quantitative data for cube compression tests. Qualitative data is information data in the form of words and not in numerical form while quantitative data is information data obtained in the form of numbers.

## 3.3 Costing

The important of project costing is to make sure researcher know about the budget and know how much material that should to buy to produce the lightweight concrete.The main material to buy to make this research :

**Table 3.1 : The Expenses on each Material**

| Materials | Price (RM) |
|---|---|
| Sand | 7.50 |
| Cement | 14.00 |
| aggregate | 12.00 |
| Palm Oil Shell | 15.00 |
| Testing | 100.00 |
| **Total** | **148.50** |

### 3.4 Preparation of Concrete Samples.

#### 3.4.1 Equipment and Materials

i) Aggregate

ii) Sand

iii) Regular Portland cement

iv) Water

v) Oil palm shells

#### 3.4.2 Preparation of Concrete

i. The mixing ratio used is 1: 2: 4 which is 1 for cement, 2 for sand and 4 for brick and palm oil shells.

**Figure 3.1 : The Mixture Concrete**

ii. Slowly add water to the dry ingredients. Pour slowly so that the water doesn't splash around

**Figure 3.2 : Add Water To The Ingredient**

iii. Mix the ingredient together. Use a hoe or a shovel to mix the water and dry concrete mixture together. Continue to stir the concrete mixture together until it's stiff. If the concrete is still dry and crumbly, add more water to the concrete mixture.

**Figure 3.3 : Mix The Ingredient Together**

iv. Step 1-3 was repeated with a mixture of 10% and 15% addictive oil palm shell in the concrete mixture.

### 3.5 Data Collection

Data collection is a technique or means that researchers can use for data collection. In this study, experimental methods were used for data collection purposes. This method can explain the relationship between cause and effect between one variable and another. This method has two variables ie independent variables and dependent variables. The independent variable is the manipulated variable to test its effect on the dependent variable. For example, the percentage of oil palm shells used in the mix. For a dependent variable the variable is measured to see how it changes with the manipulation of the free variable. For example, the dependent variable is the strength of the concrete.

### 3.6 Experimental Methods

#### 3.6.1 Slump Test

This test is carried out to ensure that the light concrete manufacturing process is carried out according to the correct procedure. In general, it is done to confirm the conformity of concrete as usual or not and suitable for construction to be carried out.

#### 3.6.1(a) Slump test Procedure

i. When the concrete mixture was properly prepared, the first layer of concrete mixture is inserted into the cone

 .

**Figure 3.4 : Concrete Mixture Inserted into The Cone**

ii. The mixing is compacted using a compacting rod of 25 times the impact.

**Figure 3.5 : Compacting Rod of 25 Times the Impact**

iii. Next, the second layer is inserted into the cone and compacted.

iv. Once perfect, the third layer is inserted and solidified by 25 times the impact.

v. The mixing is leveled and the cone is pulled in parallel

**Figure 3.6 : The Cone is Pulled in Parallel**

vi. If placed next to the mix and the resulting collapse was measured to get the result.

**Figure 3.7 : The Collapse is Measured**

vii. Rubble test steps re-used for concrete mix with additive 5%, 10% and 15% of palm oil shells are added to the concrete mix as additives for crude stone.

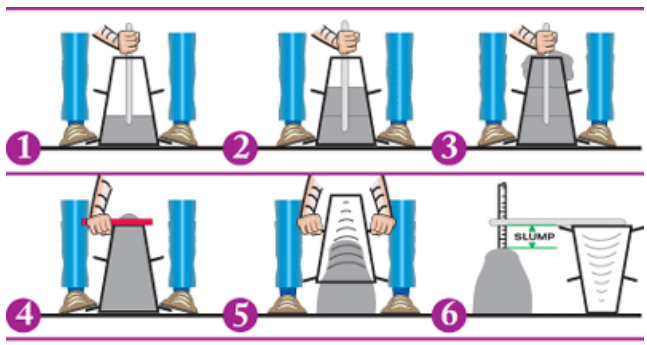


**Figure 3.8 : Ruins Test Procedure (Slump test)**

### 3.6.2 Cubes Compression Test

This test is conducted to determine the level of concrete strength produced. The ready-mix concrete is put into molds and left for 24 hours to harden at room temperature. Samples used are samples that have reached 7 days and 14 days.

### 3.6.2(a) Compression test Procedure

1) After mixing all the ingredient, the mold was rubbed with a lubricant to make the concrete easier to remove from the mold.

2) Then, the mixture of concrete mixture is placed into the mold of 3 layers. In each layer the mixture was compacted using rod by 35 times of compact.

**Figure 3.8 : The Mixture was Compacted**

3) Step 2 was repeated 9 times to produce 9 samples cube concrete for each percent.

**Figure 3.9 : Repeated the Step to Get 9 Samples**

4) Any concrete that has reached 7, 21 and 28 days will be weighed before any tests.

**Figure 3.10 : The concrete soaked in the former**

5) Before placing concrete on the platform of the machine, the rig is cleaned first and there is no impurities such as the impact of broken concrete remains.

6) The test starts with the automatic load applied.

7) For the next ages, the procedure as mentioned above will be carried out.


**Figure 3.11 (a) : Compression test** **3.11(b) : Compression Test Machine**

# TOPIC 4

# COLLECTION OF DATA

## 4.1 Introduction

In this chapter, to identify the objective and look at the process of producing lightweight concrete as well as to solve the problems mention in the previous chapter. Lightweight concrete is made by adding palm oil shell in a percentage of aggregate with a 5%, 10%, and 15% percentage of palm oil shell content used in lightweight concrete mixing. 0% palm oil shell was also used as a control concrete for reference to compare the percentage of lightweight concrete tested with the slump test and compression strength test at Quality Control Material Laboratory Sdn Bhd.

## 4.2 Produce Lightweight Concrete Using Oil Palm Shells as Additives in Aggregate

For this project, the concrete produced is 9 sample for every percentage. Each sample has different materials in terms to be use such as aggregate and oil palm shells. In addition, the sample size we use is 150mm × 150mm × 150mm and use ratio 1 : 2 : 4 as main reference in the production of lightweight concrete grade 20.

**Table 4.2.1 Calculation Of Mixing Concrete**

| Percentage (%) | Cement (Kg) | Fine aggregate (Kg) | Coarse aggregate (Kg) | | Water ( l ) |
|---|---|---|---|---|---|
| | | | oil palm shell | aggregate | |
| 0 | 6.0 | 12.0 | 0.0 | 24.0 | 3.6 |
| 5 | 6.0 | 12.0 | 1.2 | 22.8 | 4.2 |
| 10 | 6.0 | 12.0 | 2.4 | 21.6 | 4.8 |
| 15 | 6.0 | 12.0 | 3.6 | 20.4 | 5.3 |

## 4.3 Data

### 4.3.1 Slump Test

Study on the use of oil palm shell as an additive in concrete mix. Based on **Table 4.3.1** showing the results of the rubble test conducted to test the permeability and workability of the concrete mixture by applying 5%, 10% and 15% additional oil palm shells in each batch

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**Figure 4.1 Slump Test**

**Figure 4.2 Slump Test Ruins**

**Table 4.3.1 : Runoff Test Results (Slump Test)**

| Types of Concrete | Permeability | Strength | Condition Ruins |
|---|---|---|---|
| Concrete control | Fall | 150-200 | True ruins |
| Concrete with oil palm shell 5% | Fall | 150-200 | True ruins |
| Concrete with oil palm shell 10% | Fall | 150-200 | True ruins |
| Concrete with oil palm shell 15% | Fall | 150-200 | True ruins |

The **Table 4.3.1** show that the concrete slump test decrease evenly , signifying high quality concrete with good mixing quality but low in workability. The collapse indicates strong concrete compressive strength.

### 4.3.2 Compression test

Based on **Table 4.3.2 , Table 4.3.3** and **Table 4.3.4** showing the results of the average for cube compression test for control concrete, concrete with 5%, 10% and 15% oil palm concrete for 7, 21 and 28 days. This test is conducted to determine the level of concrete strength produced.

**Figure 4.3 : Weight Concrete was Measured**


**Figure 4.4 : The Concrete is Positioned at the Bottom of the Pallet**

**Table 4.3.2: Test Result Compressive Strength for 7 Days**

| Percentage Additional Palm Oil Shell | Compressive Strength for 7 Days, N/mm² | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | Average |
| **0%** | 13.8 | 14.3 | 14.1 | 14.1 |
| **5%** | 12.0 | 12.8 | 15.1 | 13.3 |
| **10%** | 10.4 | 11.0 | 11.0 | 10.8 |
| **15%** | 12.9 | 12.5 | 11.8 | 12.4 |

Based on the table above, the compressive strength of lightweight concrete using oil palm shells data according 4 different mixing ratio was recorded. Therefore, Lightweight concrete is made by adding palm oil shell in a percentage of aggregate with a 5%, 10%, and 15% percentage of palm oil shell content used in lightweight concrete mixing. 0% palm oil shell was also used as a control concrete for reference to compare the percentage of lightweight concrete tested.

The table above shows that the concrete control of 0% has the highest compression strength value among the ratio that use the oil palm shells as an additives to the concrete mixture. The average of 0% is 14.1 N/mm². While the lowest compression strength average is 10.8 N/mm$^2$ at the 10% of percentage additional oil palm shells. Next the compression strength of 5% and 15% is 13.3 N/mm$^2$ and 12.4 N/mm$^{2.}$.

The recorded average show a different of 3.3N/mm$^2$ between the highest and the lowest compression strengths. The conclusion from the table is if the percentage of the addition of oil palm shells to the concrete mix increase the compressive strength of the concrete will be decrease. This is because, when natural fiber was added into the mixture of containing cement,sand and coarse it will created air pores at the concrete.

**Table 4.3.3: Test Result Compressive Strength for 21 Days**

| Percentage Additional Palm Oil Shell | Compressive Strength for 21 Days, N/mm² | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **Average** |
| 0% | 16.5 | 15.9 | 16.4 | 16.3 |
| 5% | 23.3 | 22.0 | 23.8 | 22.7 |
| 10% | 15.6 | 15.1 | 15.3 | 15.3 |
| 15% | 14.7 | 13.8 | 14.4 | 14.3 |

Based on the table above, the compressive strength of lightweight concrete using oil palm shells data according 4 different mixing ratio was recorded. Therefore, Lightweight concrete is made by adding palm oil shell in a percentage of aggregate with a 5%, 10%, and 15% percentage of palm oil shell content used in lightweight concrete mixing. 0% palm oil shell was also used as a control concrete for reference to compare the percentage of lightweight concrete tested.

The table above shows that the 5% of addition oil palm concrete into the mixture of lightweight concrete has the highest compression strength. The average of 5% is 22.7 N/mm². While the lowest compression strength average is 14.3 $N/mm^2$ at the 15% of percentage additional oil palm shells. Next the compression strength of concrete control 0% and 10% addition oil palm shell into the mixture lightweight concrete is 16.3 $N/mm^2$ and 15.3 $N/mm^{2.}$.

The recorded average show a different of 8.4 $N/mm^2$ between the highest and the lowest compression strengths. The conclusion from the table is if the percentage of the addition of oil palm shells to the concrete mix increase the compressive strength of the concrete will be decrease. This is because, when natural fiber was added into the mixture of containing cement,sand and coarse it will created air pores at the concrete.

**Table 4.3.4: Test Result Compressive Strength for 28 Days**

| Percentage Additional Palm Oil Shell | Compressive Strength for 28 Days, N/mm² | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **Average** |
| 0% | 19.5 | 20.1 | 20.4 | 20.0 |
| 5% | 23.3 | 23.0 | 24.1 | 23.47 |
| 10% | 14.1 | 16.4 | 14.2 | 14.9 |
| 15% | 12.0 | 12.4 | 13.3 | 12.57 |

Based on the table above, the compressive strength of lightweight concrete using oil palm shells data according 4 different mixing ratio was recorded. Therefore, Lightweight concrete is made by adding palm oil shell in a percentage of aggregate with a 5%, 10%, and 15% percentage of palm oil shell content used in lightweight concrete mixing. 0% palm oil shell was also used as a control concrete for reference to compare the percentage of lightweight concrete tested.

The table above shows that the 5% of addition oil palm concrete into the mixture of lightweight concrete has the highest compression strength. The average of 5% is 23.47 N/mm². While the lowest compression strength average is 12.57 $N/mm^2$ at the 15% of percentage additional oil palm shells. Next the compression strength of concrete control 0% and 10% addition oil palm shell into the mixture lightweight concrete is 20.0 $N/mm^2$ and 14.9 $N/mm^{2.}$.

The recorded average show a different of 10.9 $N/mm^2$ between the highest and the lowest compression strengths. The conclusion from the table is if the percentage of the addition of oil palm shells to the concrete mix increase the compressive strength of the concrete will be decrease. This is because, when natural fiber was added into the mixture of containing cement,sand and coarse it will created air pores at the concrete.

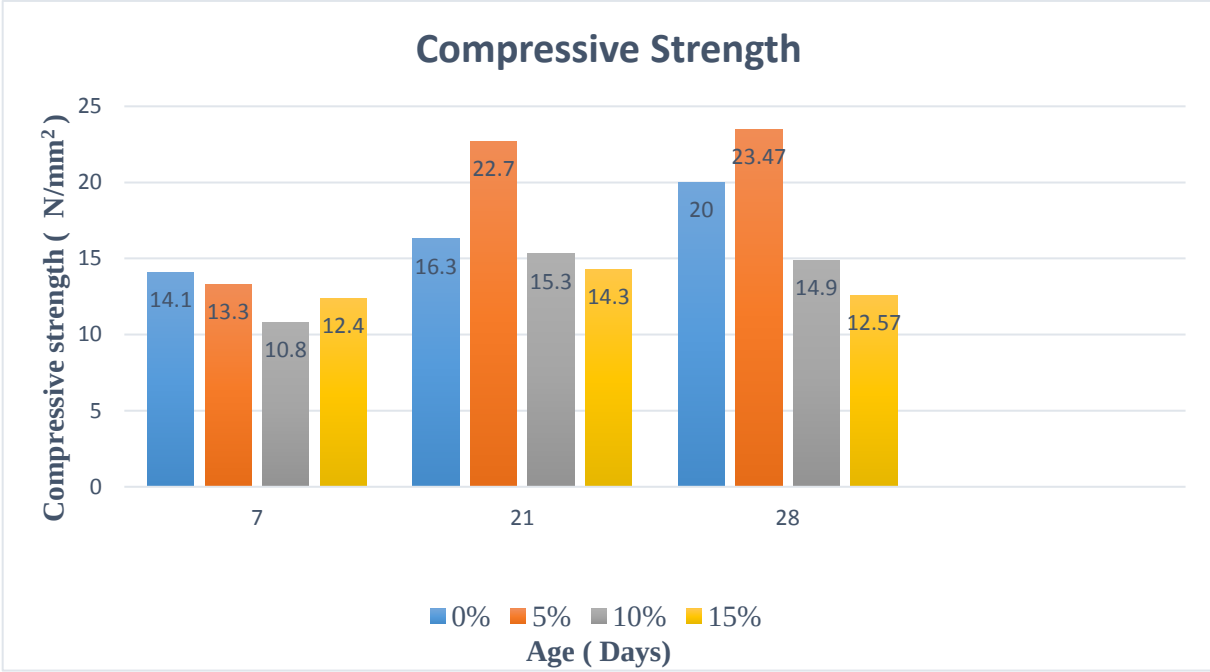


**Figure 4.5 : Compressive Strength for 7 , 21 , and 28 Days**

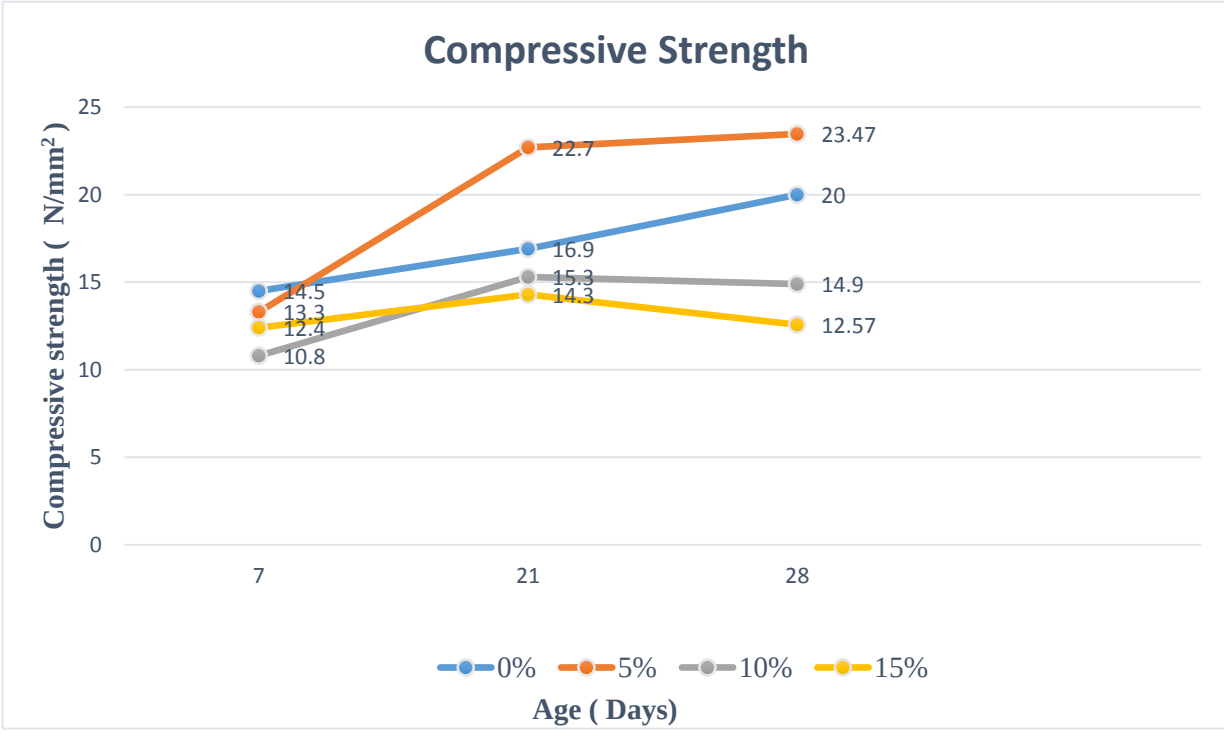


**Figure 4.6 : Average of Compressive Strength for 7, 21 and 28 Days**

## 4.4 DENSITY OF CONCRETE

**Table 4.4.1 : Test Result of Density Concrete for 7 Days**

| Percentage Additional Palm Oil Shell | Density Concrete , Kg/m³ | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | Average |
| 0% | 2.326 | 2.359 | 2.348 | 2.344 |
| 5% | 2.252 | 2.284 | 2.304 | 2.280 |
| 10% | 2.191 | 2.210 | 2.250 | 2.217 |
| 15% | 2.130 | 2.090 | 2.135 | 2.118 |

Based on the table above, the density of lightweight concrete using oil palm shells data according 4 different mixing ratio was recorded. Therefore, Lightweight concrete is made by adding palm oil shell in a percentage of aggregate with a 5%, 10%, and 15% percentage of palm oil shell content used in lightweight concrete mixing. 0% palm oil shell was also used as a control concrete for reference to compare the percentage of lightweight concrete tested.

The table above show that the concrete control (0%) has the highest density value among the ratio that use the oil palm shells as an additives to the concrete mixture. The average of 0% is 2.344 Kg/m³. While the lowest density average is 2.118 Kg/m³ at the 15% of percentage additional oil palm shells. Next the density of 5% and 10% is 2.280 Kg/m³ and 2.217 Kg/m³.

The conclusion from the table is if the percentage of the addition of oil palm shells to the concrete mix increase, the density of the concrete will be decrease. So the concrete density of 15% additional oil palm shells into the mixture concrete is the lightest compared to the control concrete.

**Table 4.4.2 : Test Result of Density Concrete for 21 Days**

| Percentage Additional Palm Oil Shell | Density Concrete , Kg/m³ | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | Average |
| 0% | 2.352 | 2.312 | 2.325 | 2.330 |
| 5% | 2.280 | 2.274 | 2.280 | 2.278 |
| 10% | 2.201 | 2.212 | 2.236 | 2.216 |
| 15% | 2.142 | 2.138 | 2.151 | 2.144 |

Based on the table above, the density of lightweight concrete using oil palm shells data according 4 different mixing ratio was recorded. Therefore, Lightweight concrete is made by adding palm oil shell in a percentage of aggregate with a 5%, 10%, and 15% percentage of palm oil shell content used in lightweight concrete mixing. 0% palm oil shell was also used as a control concrete for reference to compare the percentage of lightweight concrete tested.

The table above show that the concrete control (0%) has the highest density value among the ratio that use the oil palm shells as an additives to the concrete mixture. The average of 0% is 2.330 Kg/m³. While the lowest density average is 2.144 Kg/m³ at the 15% of percentage additional oil palm shells. Next the density of 5% and 10% is 2.278 Kg/m³ and 2.216 Kg/m³.

The conclusion from the table is if the percentage of the addition of oil palm shells to the concrete mix increase, the density of the concrete will be decrease. So the concrete density of 15% additional oil palm shells into the mixture concrete is the lightest compared to the control concrete.

**Table 4.4.3 : Test Result of Density Concrete for 28 Days**

| Percentage Additional Palm Oil Shell | Density Concrete , Kg/m³ | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | Average |
| 0% | 2.298 | 2.310 | 2.301 | 2.303 |
| 5% | 2.265 | 2.250 | 2.267 | 2.261 |
| 10% | 2.089 | 2.231 | 2.147 | 2.156 |
| 15% | 2.107 | 2.102 | 2.110 | 2.106 |

Based on the table above, the density of lightweight concrete using oil palm shells data according 4 different mixing ratio was recorded. Therefore, Lightweight concrete is made by adding palm oil shell in a percentage of aggregate with a 5%, 10%, and 15% percentage of palm oil shell content used in lightweight concrete mixing. 0% palm oil shell was also used as a control concrete for reference to compare the percentage of lightweight concrete tested.

The table above show that the concrete control (0%) has the highest density value among the ratio that use the oil palm shells as an additives to the concrete mixture. The average of 0% is 2.303 Kg/m³. While the lowest density average is 2.106 Kg/m³ at the 15% of percentage additional oil palm shells. Next the density of 5% and 10% is 2.261 Kg/m³ and 2.156 Kg/m³.

The conclusion from the table is if the percentage of the addition of oil palm shells to the concrete mix increase, the density of the concrete will be decrease. So the concrete density of 15% additional oil palm shells into the mixture concrete is the lightest compared to the control concrete.

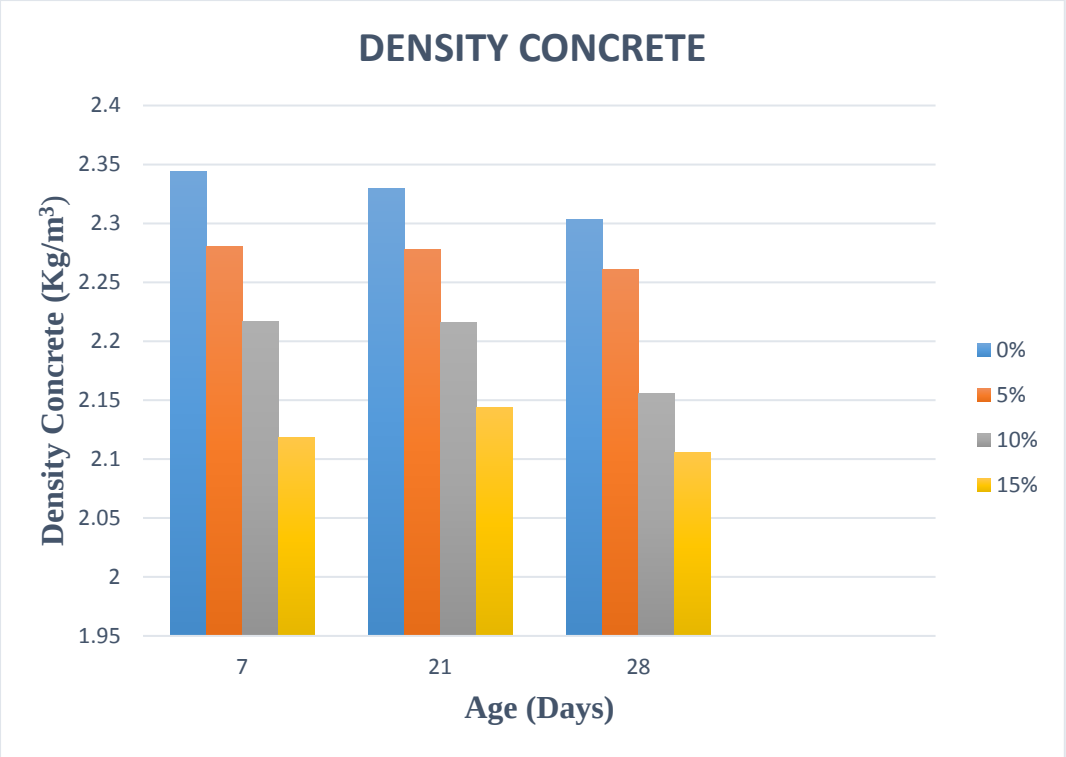


**Figure 4.7 : Density Concrete for 7, 21, and 28 Days**

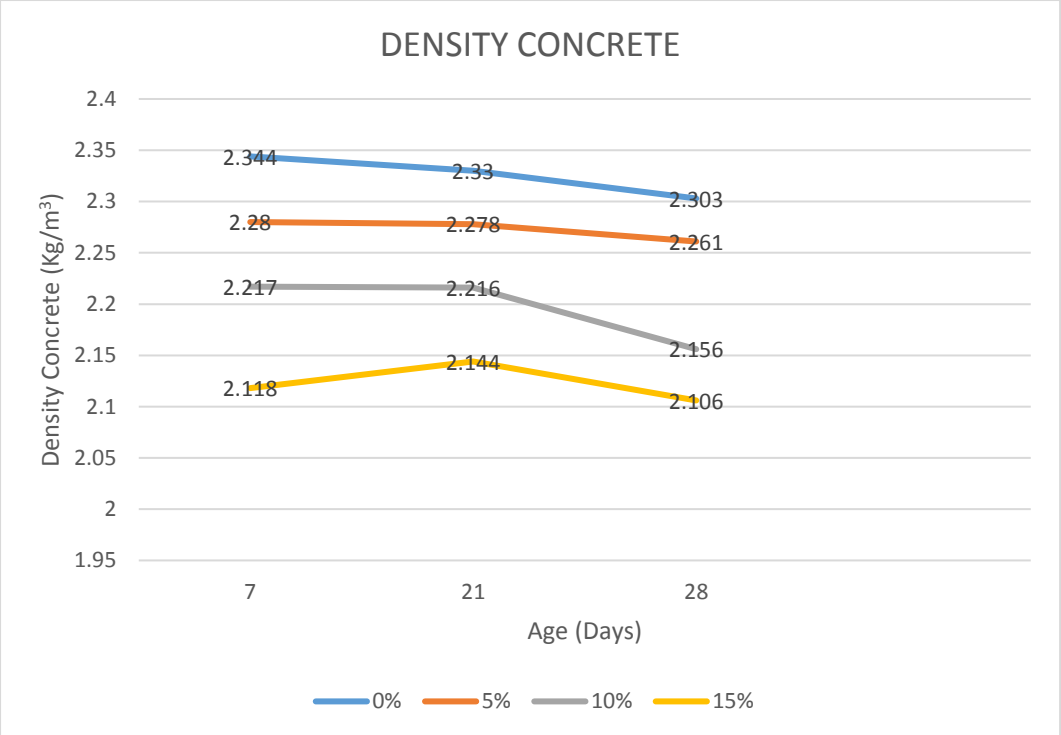


**Figure 4.8 : Average of Density Concrete**

# CHAPTER 5

# DISCUSSION AND CONCLUSION

## 5.1 Introduction

This study was conducted to test the compressive strength and density of concrete when the mixing material was added with 5%, 10% and 15% of palm oil shells. The results of this study found that concrete mixed by mixing oil palm shells in the mixture has a few disadvantages. This chapter will discuss the results of the study and discuss suggestions for product improvement.

## 5.2 Discussion

This study made control concrete that is concrete mixed without any additives in the mixture. Concrete control was made to compare the density and compressive strength with the concrete mixed with 5%, 10% and 15% palm oil shells. Discussion on compressive strength and density of concrete based on concrete maturity of 28th day. In this study it was found that the density concrete of the control was 2.303 Kg/m³ and its compressive strength is 20 $N/mm^{2.}$

The study found that concrete mixed with 5% oil palm shells has density 2,261 kg/m³ as compared to control concrete density 2.303 kg/m³, while its compressive strength is 23.47 $N/mm^2$. For concrete mixed by adding 10% palm oil shell, its compressive strength decreases by 14.9 $N/mm^2$ but the density is lighter than concrete mix with 5% palm oil shells. The density of 10% of the mixture is 2.156 kg/m³. The percentage of oil palm used last was 15%. The concrete produced with a mixture of 15% palm oil shells that has density 2.106 kg/m³ while its compressive strength is 12.57 N /$mm^2$.

Based on the values of compressive strength and the density of concrete obtained from the study, it is found that the density of the concrete is lighter as the percentage of oil palm shell increases in concrete mixing. While the concrete compressive strength decreases as the percentage of additives increases in the mixture. It can be said that only 5% of the palm oil can be mixed in the mixture to achieve a standard level of concrete compressive strength.

## 5.3 Suggestion

Based on the discussion, it is found that concrete mixed with additives of palm oil shells is lightweight but its compressive strength does not match the standard compressive strength of 20 N/mm$^2$. The compressive strength decreases with each increasing percentage of palm oil shells that mixed in the mixture but the concrete is lightweight. Therefore, concrete with a mixture of 5% palm oil shells as an additive still can be used to bear the high load but 10% and 15% mixtures are not suitable for bearing loads such as slab structures.

The concrete in this study is not suitable for bearing loads, it is suitable for use as a partition wall or as a non-load bearing wall. Partition wall are built on floor slabs without beams underneath to divide the rooms. Therefore, this type of wall should be lightweight to prevent cracks on the slab. Generally, the partition walls don't need any support like beam or anything.

**Figure 5.3 : Concrete Partition Wall**

# APPENDIX

**GANTT CHART PROJECT 1**

| NO | WEEKS / EVENT | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Introduction of Project 1 | | | | | | | | | | | | | | | |
| 2 | Briefing about Format of Report | | | | | | | | | | | | | | | |
| 3 | Prepare Proposal Report | | | | | | | | | | | | | | | |
| 4 | Presentation to Defense Proposal | | | | | | | | | | | | | | | |
| 5 | Prepare Literature Review | | | | | | | | | | | | | | | |
| 6 | Research Methodology,Method of Lab Work,Data of previous studies | | | | | | | | | | | | | | | |
| 7 | Produce Report of Project 1 Consisting Chapter 1, 2 and 3. | | | | | | | | | | | | | | | |
| 8 | Presentation 1 | | | | | | | | | | | | | | | |
| 9 | Corrected The Report | | | | | | | | | | | | | | | |
| 10 | Presentation 2 | | | | | | | | | | | | | | | |
| 11 | Submit Report | | | | | | | | | | | | | | | |

**GANTT CHART PROJECT 2**

| NO | WEEKS / EVENT | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Preparation for Project | | | | | | | | | | | | | | | |
| 2 | Implement the Project | | | | | | | | | | | | | | | |
| 3 | Test the Product | | | | | | | | | | | | | | | |
| 4 | Presentation 1 | | | | | | | | | | | | | | | |
| 5 | Collection of Data | | | | | | | | | | | | | | | |
| 6 | Manage and Analyse Data | | | | | | | | | | | | | | | |
| 7 | Summarize the Data | | | | | | | | | | | | | | | |
| 8 | Produce Complete Report | | | | | | | | | | | | | | | |
| 9 | Presentation 2 | | | | | | | | | | | | | | | |
| 10 | Submit Report | | | | | | | | | | | | | | | |

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