POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

EFFECT OF EMPTY FRUIT BUNCH (OIL PALM) IN CONCRETE

NAME	MATRIC NO.
CHAN VIN SHENG	08DKA17F1270
CYPRIAN JOHN	08DKA17F1290
MUHAMMAD HAZQI HAFIZI BIN MD. ZAHID	08DKA17F1164
MOHD RIDZWAN BIN MOHD SYAKUR	08DKA17F1294

JABATAN KEJURUTERAAN AWAM

JUNE 2019

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Laporan ini dikemukakan kepada Jabatan Kejuruteraan Awam sebagai memenuhi sebahagian syarat penganugerahan Diploma Kejuruteraan Awam

JABATAN KEJURUTERAAN AWAM

JUN 2019

DECLARATION FORM

‘This is to certify we have no objection to publish the report entitled Effect of Empty Fruit Bunch (Oil Palm) in Concrete’

1. Signature :
   Name : CHAN VIN SHENG
   Matrix No. : 08DKA17F1270
   Date :

2. Signature :
   Name : CYPRIAN JOHN
   Matrix No. : 08DKA17F1290
   Date :

3. Signature :
   Name : MUHAMMAD HAZQI HAFIZI BIN MD. ZAHID
   Matrix No. : 08DKA17F1164
   Date :

4. Signature :
   Name : MOHD RIDZWAN BIN MOHD SYAKUR
   Matrix No. : 08DKA17F1294
   Date :

AKUAN KEASLIAN DAN HAK MILIK

TITLE : EFFECT OF EMPTY FRUIT BUNCH (OIL PALM) IN CONCRETE

SESSION : JUNE 2019

1. Kami,
   1. **CHAN VIN SHENG 08DKA17F1270**
   2. **CYPRIAN JOHN 08DKA17F1290**
   3. **MUHAMMAD HAZQI HAFIZI BIN MD. ZAHID 08DKA17F1164**
   4. **MOHD RIDZWAN BIN MOHD SYAKUR 08DKA17F1294**

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2. Kami mengakui bahawa 'Projek tersebut diatas' dan harta intelek yang ada didalamnya adalah hasil karya/ rekacipta asli kami tanpa mengambil atau meniru mana-mana harta intelek daripada pihak-pihak lain.

3. Kami bersetuju melepaskan pemilikan harta intelek 'Projek tersebut' kepada 'Politeknik tersebut' bagi memenuhi keperluan untuk penganugerahan **Diploma Kejuruteraan Awam** kepada kami.

Diperbuat dan dengan sebenar-benarnya diakui oleh yang tersebut;		)	
a)	CHAN VIN SHENG (No. Kad Pengenalan:- 990522-05-5689),	)	……………………………… CHAN VIN SHENG
b)	CYPRIAN JOHN (No. Kad Pengenalan:- 990525-12-5291)	)	……………………………… CYPRIAN JOHN
c)	MUHAMMAD HAZQI HAFIZI BIN MD. ZAHID (No. Kad Pengenalan:- 990813-01-6997)	)	……………………………… MUHAMMAD HAZQI HAFIZI BIN MD. ZAHID
d)	MOHD RIDZWAN BIN MOHD SYAKUR (No. Kad Pengenalan:- 991026-12-5419)	)	……………………………… MOHD RIDZWAN BIN MOHD SYAKUR
	Di PSA, pada 15/10/2019.	)	

Di hadapan saya, ATIKAH FATMA BINTI MD. DAUD (720302-02-5488) dan MARLIZA ASHIQIN BINTI KHAZALI (761119-14-5984) sebagai penyelia projek pada tarikh: ()	)	……………………………… ( )

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ABSTRACT

It has been more than a decade since the understanding and use of organic fiber reinforced concrete was developed. The behaviour and promising desired characteristic led to many studies and research work to reveal the potential of this material as a suitable, safe and economical building material. One of the many challenges of research work in engineering material is to improve the material in different ways to obtain a better product.

Various percentages of oil palm fibre were used to conduct a study on the strength of concrete. In the preliminary study, adding certain percentages of oil palm fibre will effect the strength of the concrete. The percentage of fibre was 1.0%, 3.0%, 4.0% and 5.0% of cement weight. A total of 30 concrete cube specimens 150 mm x 150 mm x 150 mm were prepared for standard testing. These include compression test was conducted at concrete age of 7, 28 days. The test results showed that at 3.0% fibre content can yield up to 10% of increase in strength development compared to the control specimen. This has indicated a good sign for further investigation of other engineering properties to produce a more effective engineering material using palm oil fibre.

ABSTRAK

Ia telah lebih daripada satu dekad sejak pemahaman dan penggunaan konkrit bertetulang serat organik telah dibangunkan. Tingkah laku dan ciri-ciri yang menjanjikan yang diingini menyebabkan banyak kajian dan kerja penyelidikan untuk mendedahkan potensi bahan ini sebagai bahan binaan yang sesuai, selamat dan ekonomi. Salah satu daripada banyak cabaran kerja penyelidikan dalam bahan kejuruteraan ialah untuk memperbaiki bahan dengan cara yang berbeza untuk mendapatkan produk yang lebih baik.

Pelbagai peratusan serat minyak kelapa sawit digunakan untuk menjalankan kajian mengenai kekuatan konkrit. Dalam kajian awal, dengan menambahkan peratusan tertentu serat kelapa sawit akan mempengaruhi kekuatan konkrit. Peratus serat adalah 1.0%, 3.0%, 4.0% dan 5.0% berat simen. Sebanyak 30 spesimen kiub konkrit 150 mm x 150 mm x 150 mm disediakan untuk ujian standard. Ini termasuk ujian mampatan yang dilakukan pada usia konkrit 7, 28 hari. Keputusan ujian menunjukkan bahawa kandungan serat 3.0% boleh menghasilkan sehingga 10% daripada peningkatan kekuatan berbanding dengan spesimen kawalan. Ini menunjukkan tanda baik untuk penyiasatan selanjutnya terhadap sifat kejuruteraan lain untuk menghasilkan bahan kejuruteraan yang lebih berkesan menggunakan serat minyak kelapa sawit.

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LIST OF ABBREVIATIONS

PSA	Politeknik Shah Alam
EFB	Empty Fruit Bunch
OPT	Oil Palm Trunks
OPF	Oil Palm Fronds
PFF	Pressed Fruit Fibre
MPOB	Malaysian Palm Oil Board
SIRIM	Standard and Industrial Research Institute of Malaysia

CHAPTER 1

1INTRODUCTION

1.1 GENERAL

Concrete is the most common material that has been used in the construction sector of the world. Its usage is around 10 billion tons per year, which is equivalent to 1 ton per every living person. Even though this material is being used as a modern material, concrete has been in use for hundreds of years. Concrete is a tremendously popular structural material due to its low cost and easy of fabrication of construction.

The word concrete comes from the Latin *concretus,* which means mixed together or compounded. Concrete consist of sand or stone, known as aggregate, combined with cement paste to bind it. Aggregate can be found in various sizes and be categorized as fine (sand) and coarse (crushed stone or gravel). The aggregate in concrete can be in greater proportion of concrete which is bulky and cheaper than the cement.

As the constituents of concrete come from stone, people have always thought that concrete has the same quality and will last forever. However, concrete must be thought of as a distinct material to stone. It has its own characteristics in terms of durability, weathering and repair.

Concrete is a relatively durable and tough building material, but it can be severely weakened by poor manufacture or a very aggressive environment. A number of historic concrete structures exhibit problems that are related to their date of origin. These problems can be solved by application of polymer in concrete construction. (Lee, 2007)

1.2 PROBLEM STATEMENT

Concrete is subject to some form of restraint, such as steel reinforcement, forms or adjacent members. As concrete begins to lose volume, the restraint inhibits movement, which then induces tensile stress in the concrete. Once the tensile capacity of the concrete has been exceeded, it will crack. According to ACI 544.1R-82 fibre reinforced concrete is defined as a concrete made of hydraulic cements containing fine or fine or fine and coarse aggregate and discontinuous discrete fibres. The fibres can be made from natural material.

The major reason to incorporate fibres into the cement matrix is to provide some reinforcement for the concrete products and increase the tensile strength by delaying the growth of cracks, and to increase the toughness by transmitting stress across a cracked section so that much larger deformation is possible beyond the peak stress than without fibre reinforcement. Addition of fibre in concrete has also other advantages such increased fracture toughness, modify properties of elastic modulus and reducing density. Higher fibre content use in concrete is not plausible since it will cause ‘balling’ during mixing and hence will adversely affect the properties of concrete products.

Secondly, the explosive expansion of plantation in Malaysia has generated enormous amounts of plantation waste. However, crude palm oil and its economic co-products such as palm oil kernel cake, constitute only 10% of the crop, leaving the rest of the biomass to waste. The biomass includes empty fruit bunch (EFB), the oil palm trunks (OPT), oil palm fronds (OPF), pressed fruit fibre (PFF). At present, these products are not only underutilized but frequently the causes of pollution. Finally, the statement of problems encountered on the site involving concrete work is:

a) Low compressive strength of concrete

b) There are many empty fruit bunch (oil palm) in factory

1.3 OBJECTIVE

The main objective of this research is to determine the compressive strength of the concrete. By referring the main objective, others objective are as follows:

1. To determine the compressive strength of the concrete

2. To produce concrete with EFB(Oil Palm)

1.4 SCOPE

The concrete cube will be done at Lab Concrete Polytechnic Sultan Salahuddin Abdul Aziz Shah (PSA). The concrete ratio we are using is 1: 2: 4. We are using empty fruit bunch (oil palm) as an additive in the concrete mixture. The percentage of fibre we are adding inside the concrete mixture are 1.00%, 3.00%, 4.00%, 5.00%. The fibre length we use are around 30mm-50mm. The cube will also be tested at Quality Control Material Laboratory S/B which at the area Subang Jaya SS15.

This study will involve comparisons between standard concrete and fibre concrete. The purpose of using fibre is to study the strength of fibre concrete compared to normal concrete. This comparison will be made based on the cube compression test.

CHAPTER 2

2LITERATURE REVIEW

2.1 INTRODUCTION

Many studies on the effect of fibre's application in concrete material have been reported (Torrijos et al., 2007; Aruntas et al., 2008; Haddad et al, 2007; Mohammadi et al., 2006; Brandt, 2008; Ibell, 2008; Alnahhal and Aref 2007; Hsie et al., 2008; Megandran, 2007; Huzaifa, 2008) and conducted recently. However, there is insufficient data on strength and durability aspects of palm oil fibre as addictive to concrete. Therefore, further investigation should be conducted concerning the application of this material. Either properties of the palm oil fibre or the effect of palm oil fibres after incorporating with concrete is required. Normal concrete has a fragile nature and is vulnerable to stress. The use of fibre in concrete is able to increase its compressive strength. But the fibre is needed processed first before it is added into concrete. Therefore, the knowledge of recognizing the properties of concrete and fibre strength is important in determining whether the concrete can support the load.

2.2 OIL PALM TREE

The oil palm (Elaeis guineensis) is a native of West Africa. It flourishes in the humid tropics in groves of varying density, mainly in the coastal belt between 10 degrees north latitude and 10 degrees south latitude. It is also found up to 20 degrees south latitude in Central and East Africa and Madagascar in isolated localities with a suitable rainfall. It grows on relatively open ground and , therefore originally spread along the banks of rivers and later on land cleared by humans for long-fallow cultivation as described by (Hartley, 1988).

The palm fruit develops in dense bunches weighing 10 kilograms (kg) or more and containing more than a thousand individual fruits similar size to a small plum. Palm oil is obtained from the flesh of the fruit and probably formed part of the food supply of the indigenous populations long before recorded history. It may also have been traded overland, since archaeological evidence indicates that palm oil was most likely available in ancient Egypt. The exaction of an early tomb at Abydos, dated to 3000 B.C., yield "a mass of several Kilograms still in the shape of the vessel which contained it" (Friedel, 1897). In the oil extraction process the fruits or nuts are first stripped from fruit bunches, leaving behind the empty-fruit bunches as waste.

Oil palm tree consists of trunk, leaf, fruits and roots. All the parts of the oil palm tree can be used in another purpose. The table below will show the usage of the parts of the oil palm tree.

Table 2-1: Table of Usage of Parts of Oil Palm Tree
(Resources : Pinterest, 2016)

PARTS OF OIL PALM TREE	USAGE
Leaf	Broom
Fruits	Oil Palm
Bunches	Oil Palm Fibre
Branches	Roof Houses

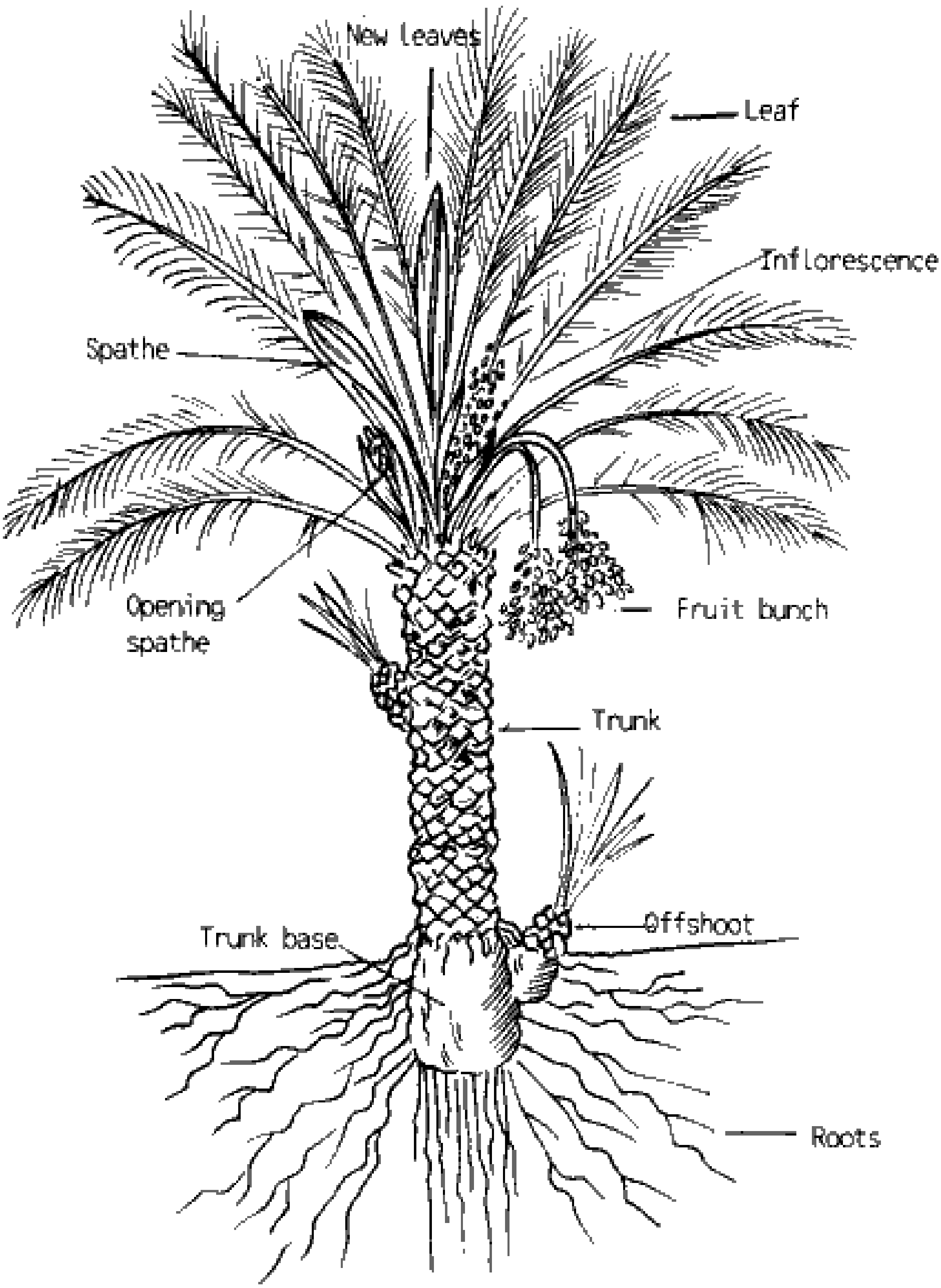


Figure 2-1: Diagram of the Oil Palm Tree Parts
(Source: Pinterest, 2016)

2.3 OIL PALM FIBRE

Palm oil fibre is a lignocellulosic material which mainly consists of cellulose, lignin and hemicelluloses, has achieved demand thrust in the recent years. As such, lignocelluloses fibres are available plentiful, they have been fully exploited even with insufficient technology development.

Oil palm fibre is a non-hazardous biodegradable material extracted from oil palm's empty fruit bunch (OPEFB) through decoration process. The fibres are clean, non-carcinogenic, free from pesticides and soft parenchyma cells. Figure 2.1 show the fibres that have been used for this study.

There has been a growing interest in utilizing natural fibres as reinforcement in construction industry for making low cost construction material. Several studies on application of the fibre in concrete structure have been conducted by researchers but not many on fibre characteristic. The study on characteristic of this biomass would influence in generating the utilization and application in all field.

Figure 2-2: Empty Fruit Bunch (Oil Palm)

Figure 2-3: Oil Palm Empty Fruit Bunches Fibre
(Source : Ismail & Hashim, 2008)

According to the nature of oil palm which is not long enough to consider as long fibre, scientists used short length fibres or nanoparticle of OPFs in their researches so there is not any report about using long length of OPF as a continuous fibre concept. Several kinds of resins including thermoset or thermoplastic resins were used in studies by researchers; although, thermosets are much harder than thermoplastics and also using this kind of polymer is reasonable (C.Varga, N. Miskolczi, L.Bartha, and G. Lipozi, 2010). Some engineers made hybrid composites of OPF by the usage of other natural fibres or even synthetic fibres to enhance the properties of OPF. In this paper, the most important and significant results are considered and discussed.

Table 2-2: Application of Oil Palm Fibres
(Sources: Abdul Khalil et al. 2010c)

OIL PALM BIOMASS	PRODUCTS
Oil Palm EFB Fibres	Plywood MDF Polymer Bio composite Hybrid Composite Particle Board Biofuel
Oil Palm Frond Fibres	Pulp Paper Nutrient Recycling Fibreboard Biodegradable Film Animal Feed
Oil Palm Trunk Fibres	Lignin Plywood, Furniture

2.3.1 Fibre Properties

Oil palm empty fruit bunch (OPEFB) was characterized in terms of tensile strength, Young’s modulus, elongation at break, density, and so forth. (Mahjoub, Bin Mohamad Yatim, & Mohd Sam, 2013)shows the results gathered from other researches. According to (Mahjoub et al., 2013), it is clear that results reported by researchers are not identical because of variation in the kind of oil palm fibre used and also the irregular sectional area which fluctuates along the length of OPF (A. S. Virk, W. Hall, and J. Summerscales, 2010). Consequently, some of references reported wide range of value for mechanical properties. In addition, linear stress-strain diagram of OPF tensile behaviour was reported by researchers, although, there is no unified diagram. However, comparison between OPF fibres is not the major purpose of this paper, and this paper focuses on the performances of OPF fibre in polymers (composites) for engineering aims.

Addition of fibre in concrete has advantages such increased fracture toughness, modify properties of elastic modulus and reducing density. Research has shown that the beneficial effect of fibres in concrete is at low fibre content of 1% to 3%. Higher fibre content use in concrete is not plausible since it will cause ‘balling’ during mixing and hence will adversely affect the properties of concrete products.

2.3.2 Chemical Composition

Table 2.4 shows the percentages of various chemical components present in oil palm fibre. Samples of Palm Oil fibre were sent to MPOB/UKM to determine the chemical composition. Results in the table shown as in percentage unit were determine by Lignocellulosic analysis. The results obtained were almost similar compared with Law et al. (2007) for a few certain properties.

According to Joseph (1999), the characteristics of the fibre individual depend on the constituents, the fibrillar structure and lamellae matrix. The fibre is composed of numerous elongated fusiform fibre cells that taper toward each end. The fibre cells are linked together by means of the middle lamellae, which consists hemicellulose, lignin and pectin. Dinwoodie (1981) summarizes the polymeric state, molecular derivatives and function of cellulose, hemicellulose, lignin and extractives as shown in Table 2.3.

Table 2-3: Cellulose, hemicellulose, lignin and extractives, polymeric state, molecular derivatives and function
(Dinwoodie, 1981)

Content	Polymeric State	Molecular Derivatives	Function
Cellulose	Crystalline highly oriented large molecule	Glucose	Fibre
Hemicellulose	Semi-crystalline smaller molecule	Galactose, Mannose, Xilose	Matrix
Lignin	Amorphous large 3-D	Phenyl propane	Matrix
Extractives	Some polymeric; others nonpolymeric e.g. Terpentes	Polyphenols	Extraneous

Table 2-4: Chemical Composition

Constituent	MPOB/UKM	Reference		
		Law et al. 2007	*Khoo & Lee 1991*	*Law & Jiang 2001*
Extractives	**3.323**	3.7 ± 0.3	0.9	2.8
Acid-insoluble lignin	**20.917**	18.8 ± 0.3	17.2	17.6
Ash-free acid-insoluble	-	17.8 ± 0.2	-	-
Ash	-	1.3 ±0.2	0.7	3.8
Hot-water soluble	-	7.5 ± 0.8	2.8	9.3
1% NaOH soluble	-	14.5 ± 2.7	17.2	29.9
Holocellulose	**62.785**	82.4 ± 1.4	70.0	86.3
Cellulose	**39.405**	62.9 ± 2.0	42.7	-
Hemicellulose	**23.380**	28.0	32.5 (Leh, 2002)	-

Lignin

Complex chemical such as Lignin (lignen) is a compound usually derived from wood and is an integral part of the secondary cell walls of plants. Lignin fills the spaces in the cell wall between cellulose, hemicellulose, and pectin components, especially in tracheids, sclereids and xylem. The lignin content of fibres influences its structure, properties and morphology. Joseph (1999) reported that each cell of hard plant fibres is bonded together by lignin, acting as a cementing material. This researcher also reported that the lignin content in fibres influences its structural, morphology and properties.

Holocellulose

Holocellulose is a mixture of cellulose and hemicellulose in fibre. Holocellulose is also the fibrous residue that remains after the extractives, the lignin, and the ash-forming elements, have been removed.

Cellulose

The structural component of the primary cell wall of green plants, many forms of algae and the oomycetes is Cellulose. Cellulose is the predominant constituent of cotton, linen, and other plant fibres made for paper and cardboard and of textiles.

Hemicellulose

A hemicellulose can be any structural component present in almost all plant cell walls along with cellulose. As cellulose is crystalline, tough, and resistant to hydrolysis, hemicellulose has a random, amorphous structure with only a little strength.

2.3.3 Mechanical Properties

Properties of Oil palm fibre determined by this study are very useful in the evaluation of new fibre at the research and development level. Because of their nature, fibre does not have a unique strength rather a distribution of strength. This test result obtained from the strength of a single fibre. Tensile strength is calculated from the ratio of peak force and the cross-sectional area of a plane perpendicular to the fibre axis, at the fracture location or in the vicinity of the fracture location, while Young's Modulus is determined from the liner region of the tensile strain curve.

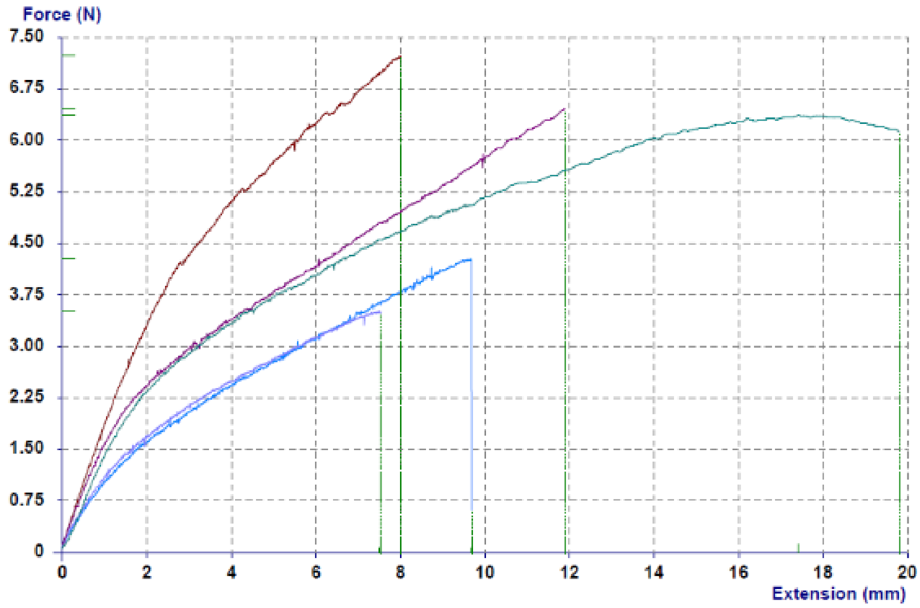
The percentage of amorphous and crystalline components of natural fibre is a determining factor in the mechanical behaviour of natural fibre and also due to the organic compound. (Sreekala et al., 2000). The tensile stress relaxation behaviour of individual oil palm empty fruit bunch fibre was investigated.

Table 2.5 shows the result of mechanical properties of palm oil fibre. The mechanical properties such as tensile strength, elongation and the modulus of elasticity of fibre were determined in accordance with standards ASTM C1557, in a Tinius Olsen machine at a cross-head speed of 8x10-6 m/min. The tensile test lengths were 100 mm. Five fibres were tested for each parameter setting. The graph of the mechanical properties of fibres can be seen in Figure 2.4.

Table 2-5: Mechanical Properties of Oil Palm Fibre
(Sources: Sreekala et al. 2004; Bismarck 2005)

FIBRES	TENSILE STREGTH (MPa)	YOUNG'S MODULUS (GPA)	ELONGATION AT BREAK (%)
Oil palm EFB	50 - 400	0.57 - 9	2.5 - 18
Oil palm frond	20 - 200	2 - 8	3 - 16
Oil palm trunk	300 - 600	8 - 45	5 - 25

Figure 2 4: Ultimate tensile force vs. extension graph
(Result from SIRIM)



2.3.4 Physical Properties

Physical characteristic of the fibrous elements is shown in Table 2.6. In comparison with those from a Canadian trembling aspen, the OPEFB fibres have similar length cell diameter but much thicker cell wall and, as a result, higher coarseness and rigidity index (Law et al., 2007). Consequently, they yield paper with higher bulk or lower sheet density and inferior tensile strength when compared to paper made from aspen fibres (Law and Jiang, 2001). However due to the presence of particularly long vessel elements, they give considerably high tear index (Law et al., 2007). Note worthily, granules of starch are found in the interior of the vascular bundle; their presence was identified using iodine solution (Law et. al., 2007).

Table 2-6: Fibre Properties
(From Law, Wan Rosli, W.D., Arniza, G. (2007). Morphological and Chemical Nature of Fibre Strands of Oil Palm Empty- Fruit- Bunch (OPEFB). Bioresources. 2(3): 351-360)

Property	OFEFB fibre	Aspen fibre
Length-weighted fibre length, mm	0.99	0.96
Fibre diameter (D), µm	19.1	20.8
Cell-wall thickness (T), µm	3.38	1.93
Fibre coarseness, mg/m	1.37	1.01
Fines (<0.2mm), % (arithmetic mean)	27.6	18.1
Rigidity index, (T/D) 3 x 10-4	55.43	7.99

CHAPTER 3

3METHODOLOGY

3.1 INTRODUCTION

There are several factors that influence the properties of concrete including the design of concrete mixing, sand content and coating size. These factors are important in determining the strength of concrete. Therefore preparation of materials and tests carried out must be in accordance with the standards set. British standards and Malaysian Standards are among the standards referred to in this study.

3.2 PREPARING OF MATERIALS

Materials that needed to produce control concrete and fibre concrete are :

I. Portland Cement
II. Coarse Aggregates and Fine Aggregates
III. Water
IV. Oil Palm EFB
V. Shovel
VI. Tamping Rod

VII. Mould Oil
VIII. Small Shovel
IX. Cement Trowel
X. Mould Tray

3.2.1 Portland Cement

Common Portland Cement Materials for the production of ordinary Portland Cement are calcium carbonate derived from limestone, silica, aluminium and iron oxide found in clay. The common Portland cement used in this mixture has a strength of 5 N / mm2 and 23 N / mm2 at 3 and 7 days. This freeze time for Portland Cement is based on the BS 12:1991 “Specification for Portland Cement standard "

Figure 3-1: Portland Cement

3.2.2 Coarse Aggregates and Fine Aggregates

Specific for aggregates from natural sources BS:882 concrete "Specification for aggregates from natural sources BS 882 concrete" states that the mixtures used must be within the specified limits based on their size and type.

The sieve analysis is based on the BS 812 Section 103.1: 1985 "*sieve test*" and BS 410: 1986 *"Specification for test sieve"* stating that the fine sludge used must exceed 5 mm sieve. Gravel is suitable for all types of concrete work as it has a square shape. In this mix it used 20mm thick aggregates. It should be clean and free of impurities in organic matter, dust, mud and clay as these impurities can hinder the hydration process and reduce the cement adhesion.

Figure 3-2: Coarse Aggregates

Figure 3-3: Fine Aggregates

3.2.3 Water

BS 3148 "Test for water making concrete" states that water used for concrete must be free of harmful substances such as silt, soil, organic acids and other organic materials such as salt, alkaline and others. Materials such as silt and soil are easy to separate by doing the precipitation process. Usually water used for drinking is safer to mix concrete.

Figure 3-4: Water

3.2.4 Oil Palm EFB

Oil Palm EFB that used for concrete mixture must be free of harmful substances such as silt, soil, organic acids and other organic materials that will decrease the mixture quality. The length of the Oil Palm EFB that used must be in the ratio between 30mm-50mm. Water absorption test will also be conducted on Oil Palm EFB to calculate the moisture content needed for mixture of concrete. The physical studies conducted were the density of composite boards made from the oil palm EFB, moisture content of the boards manufactured, water absorption and thickness swelling tests of 2 and 24 hours elapsed.

Figure 3-5: Oil Palm EFB Fibres

3.2.5 Shovel

We use shovel for digging, lifting, and moving bulk materials, such as fine aggregates and coarse aggregates. Most shovels are hand tools consisting of a broad blade fixed to a medium-length handle. Shovel blades are usually made of sheet steel or hard plastics and are very strong.

Figure 3-6: Shovel

3.2.6 Tamping Rods

We used tamping rod to compress the cement inside the cube. we compress the cement inside the cube to make sure there are no empty spaces in the cube. Each layer must be compacted fully either by using a tamping rod or by using vibration techniques. If concrete is compacted by hand tamping, in 150 mm^3 mould, then 35 strokes are given per layer uniformly covering the entire surface especially the corners.

Figure 3-7: Tamping Rod

3.2.7 Mould Oil

We use oil to apply on the surface of the cube to prevent cement from sticking to the surface of the cube and causing the cube concrete hard to be removed.

Figure 3-8: Mould Oil

3.2.8 Small Shovel

A small shovel is used to take sand, stone and cement from sack and place it in a bucket for weighing.

Figure 3-9: Small Shovel

3.2.9 Cement Trowel

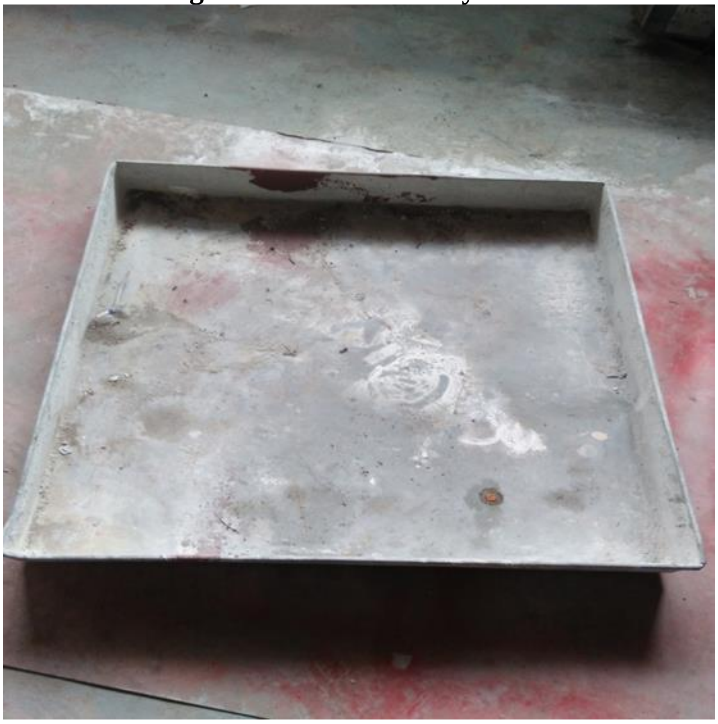
We use cement trowel to mix coarse aggregates, fine aggregates, water and EFB to make the materials mixed and easy to facilitate the process of mixing cement.

Figure 3-10: Cement Trowel

3.2.10 Mould Tray

We used the mould tray as a container to do the process for mixing all the materials (EFB fibres, water, coarse aggregates and fine aggregates).

Figure 3-11: Mould Tray



3.3 METHOD OF CURING

The curing process starts after demoulding, the specimens were cured in water in curing tank before testing for 7 and 28 days. Figures 3.11 to 3.12 show the curing process.

Figure 3-12: Concrete Cube in Mould

Figure 3-13: Concrete Cube Cured in Water Tank

3.4 CUBE COMPRESSION TEST

The main purpose of the cube test is to obtain a uniform sample of 150 mm cube to determine the density of concrete compressive strength used in the construction site. This test will be performed on 150 mm x 150 mm x 150 mm sized cubes made during the preparation of the concrete mix either in the factory or at the site of Compression Strength will be tested after 7 days and 28 days after the concrete cubes are made. The minimum specification of the design strength for concrete on day 7 is 21 N/mm and on day 28 is 30 N/mm

The compression strength obtained will be compared to the concrete design strength value. If the strength of the tested cube strength reaches at least the characteristic strength of a concrete grade, then the concrete is considered to have passed or met the design specification. On the other hand, if the strength of the tested cube is less than the strength value of the feature, then the concrete is considered to have failed and certain steps will be taken to ensure the strength of the structure involved.

Some of the equipment used in this test are:

I. Size 150mm x150mm x 150mm
II. Rod 16mm diameter Rod and 600mm length.

Cube test steps:

I. The cube should be rubbed with grease (glycerine) oil to prevent the concrete from sticking to the cube.

II. The 6-inch cube mould is filled with concrete in 3 equal thicknesses.

III. Each filled concrete layer needs to be compressed with a 35-foot rods.

IV. After the concrete cubes harden, they are soaked in water.

V. In the first stage, it will be soaked for 7 days and the second stage for 28 days

VI. In the first stage test after 7 days, the concrete cubes tested need reach 75% power. If less than 75% of the second level test should be conducted after 28 days

There are a number of precautions to take when testing a cube:

1 Take enough samples to make all the cube needed.

2 To illustrate, buckets and shovels should be provided Large shovels are not suitable for use as they will cause large volcanic falls.

3 Components such as bolts and nuts and retaining clips should be tightly tightened to prevent the concrete from forming in the moulding holes especially during stamping work.

4 The mould surface should be rubbed with oil to facilitate the removal of concrete cubes.

5 Add a little of the mixture to the mould to allow water splitting.

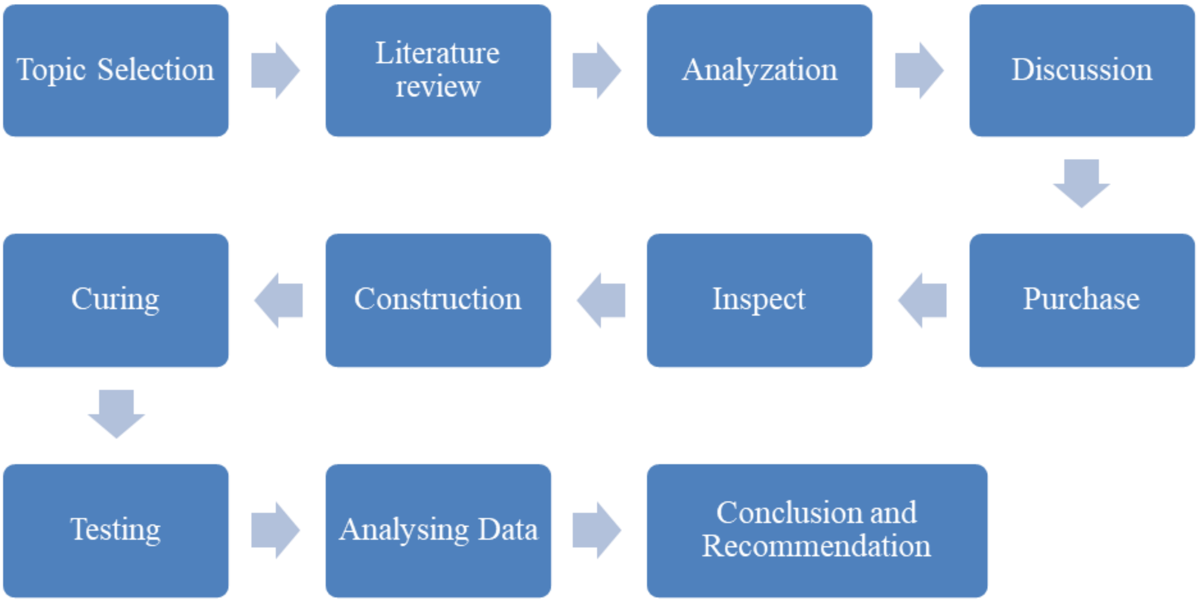
6 The mould should be fully opened while removing the cube from the mould to prevent damage to the cube.

7 Make sure the water level in the curing tank is always above the immersed cube.

8 Reading records for each cube test should be taken correctly.

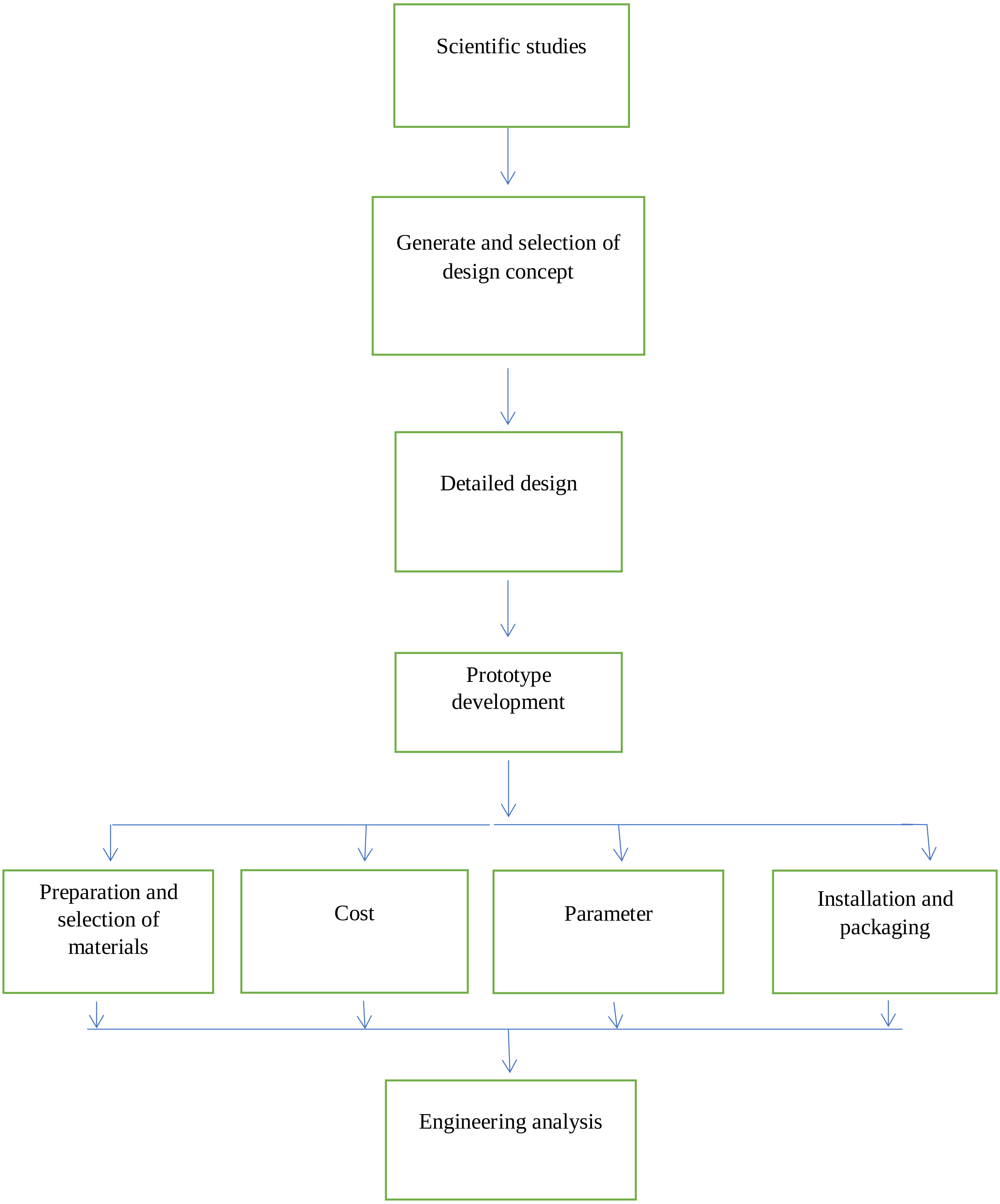
Figure 3-14: Compression Test Machine

3.5 PROJECT SEQUENCE



NO.	Title	Explanation
1	Topic Selection	Fibre Concrete Using EFB (oil palm)
2	Literature review	Gather all the adequate information and reference needed to carry out this project smoothly
3	Analyzation	Analyse the suitable materials to be used for the fibre concrete
4	Discussion	Discuss the most appropriate material to use, based on reference from the advisor
5	Purchase	Purchase required materials according to discussion
6	Inspect	Inspect the materials used
7	Construction	Construct the fibre concrete cube using empty fruit bunch (oil palm)
8	Curing	Put the concrete cube inside water tank for 7 and 28 days
9	Testing	The cube was tested using cube compression machine
10	Analysing Data	Analyse the data and construct a table
11	Conclusion and Recommendation	Make a conclusion or suggest a idea to improve the data

3.6 FLOW CHART



CHAPTER 4

4DATA

4.1 INTRODUCTION

In this chapter, a study is conducted on the comparison between normal concrete and fibre concrete. As is commonly known, concrete is a type of material with high compressive strength but weak tensile strength. The lower the concrete mix then the lower the load will be and the higher the concrete mix the bigger the load will be. Every load that is load (variable load and permanent load) should be referred to the strength of the concrete as well used reinforcements. Typically, the type of reinforcement used in a construction especially on "slabs" is Reinforced Concrete. In this study, which was mixed with EFB in concrete it was an additive in it. concrete. With the addition of these materials, it increases the compressive strength of the concrete.

4.2 HARDENED CONCRETE

Testing The hardened concrete test conducted was compression test. They are conducted to control the quality of the concrete and to check specification compliance. The most common test performed on the hardened concrete is the compressive strength test. This is because it's fairly easy to perform and shows strength correlation between the compressive strength and many desirable properties, (Mamlouk, 2006).

4.2.1 Cube Compression Test

This test is for cube compression testing only. All concrete that tested have the same quantity for control concrete that are total of 30 where 15 of them for 7-days and 15 for 28-days. All the cubes were construct by 6 control mix, 6 with 1% content of EFB (Oil Palm) Fibre, 6 with 3% content of EFB (Oil Palm) Fibre, 6 with 4% content of EFB (Oil Palm) Fibre and 6 with 5% content of EFB (Oil Palm) Fibre.

4.2.2 Observation

Concrete strength increases directly with the concrete age. During compression testing is carried out using a compression test machine. Normal concrete experiences significant fractures when it reaches the ultimate load and subsequently breaks in the form of debris when the ultimate load is reached. EFB (Oil Palm) in concrete undergoes a small crack when the final load is reached and the crack becomes clear when the final load is reached for the cube 7 days.

Figure 4-1: Cracking on the Cube(7-days)

4.2.3 Compressive Strength

Figure 4-2: Bar Chart of Compressive Strength at 7 and 28 days.

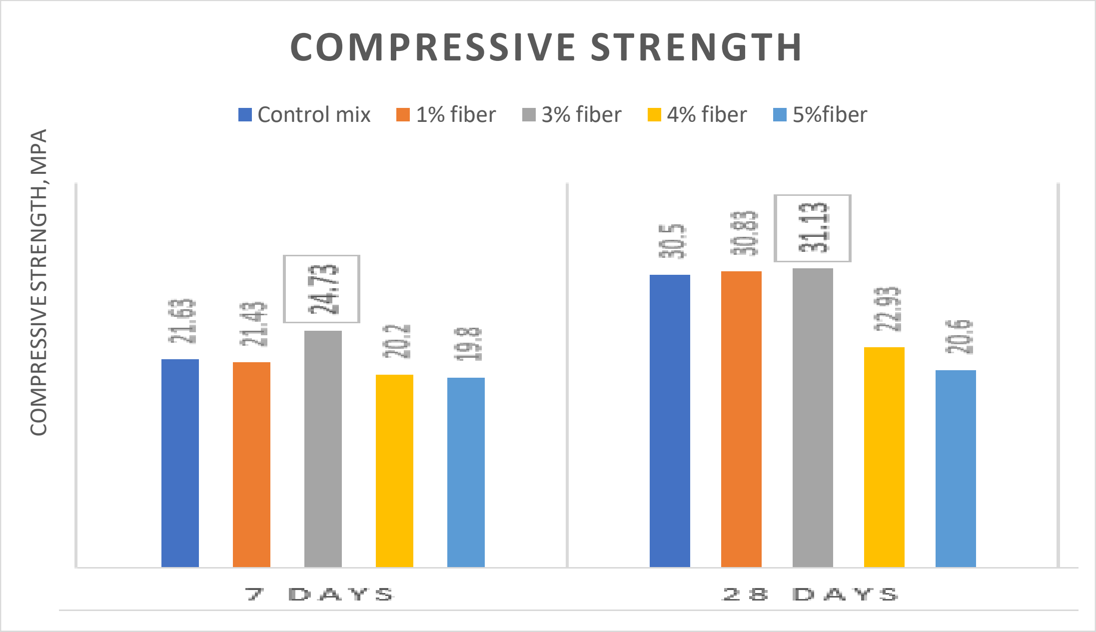


Figure 4.2 shows the results of the compression strength of the specimen used in the test, concrete mix and concrete mix with 1.0%, 3.0%, 4.0% and 5.0% fibre. The length of fibre used is 3cm - 5cm. This test is runs 7 and 28 days to get their strength. Concrete mixing is designed with a compression strength of 20 MPa for 28 days.

The result of the experiment shows that adding palm oil fibre to the concrete mix increases the strength at 7 and 28 days respectively compared with the control mix The result of the experiment shows that adding palm oil fibre to the concrete mix increases the strength at 7 and 28 days respectively compared with the control mix. The 3% fibre mix shows the highest average compressive strength (31.13MPa) from the results. This result is in agreement with the research done by (Huzaifa, 2008). Although the additional of fibre can contribute to increasing compressive strength, the strength doesn't increase linearly with an increase of fibre content, (Megandran, 2007). However, with the increase of fibre length from 3 cm to 5 cm, the compressive strength increases for all duration of time.

From this figure, as can be seen, fibre mixed with the concrete increases the compressive strength slightly compared to normal concrete. According to (Mamlouk, 2006), the addition of fibers to concrete does not greatly increase the strength of concrete.

EFB (Oil Palm) concrete helps to make the concrete more tough and durable to avoid the cracks from happening. While compressive strength test is conducted, time of concrete mix with oil palm fiber to fail were longer than time of the control mix. According to (Mamluok, 2006), fiber-reinforced concrete can sustain load even after initial cracking, which means that the time for micro-crack to occur are with hold when the fibers upholds the concrete binder and course aggregate are good, and prolong the failure time.

Referring to Table 4.2 we can see the result of a blend of palm oil fiber with 3.0% build strength on concrete where concrete strength is stronger than control concrete. we can also see that the use of as much as 5.0% palm oil in concrete mixing resulted in a decrease in concrete strength from control concrete.

CHAPTER 5

5CONCLUSION AND RECOMMENDATION

5.1 DISCUSSION

In this regard, it has been discussed that the use of Empty Fruit Bunch (EFB) can be reduced to obtain higher concrete strength. Furthermore, the use of EFB (Oil Palm) fibres in concrete has great potential in increasing the strength of concrete. This is because EFB (Oil Palm) fibres have greater strength to withstand pressure in the concrete in the event of any cracking on the concrete.

5.2 CONCLUSION

After the study, it can be concluded that the addition of Empty Fruit Bunch (EFB) in the concrete mix has given a positive change to the concrete. The following conclusions can be drawn on the effect of using EFB (Oil Palm) fibres in concrete mixing: -

a) The significant difference between normal and Empty Fruit Bunch (EFB) concrete is the ability of the material to bear the load even after a fracture occurs.

b) The use of additives can also reduce the cost of materials to make concrete.

5.3 RECOMMENDATION

EFB (Oil Palm) fibres have the potential to grow in the future as they can provide the desired strength. More extensive studies should be conducted to study the effects of the use of EFB (Oil Palm) fibres on concrete. Here are some suggestions for future studies:

a) Uses EFB (Oil Palm) fibres together with reinforcement bars by making EFB (Oil Palm) fibres as secondary reinforcement to increase concrete strength.

b) Comparison of the strength of EFB (Oil Palm) fibres concrete in a similar

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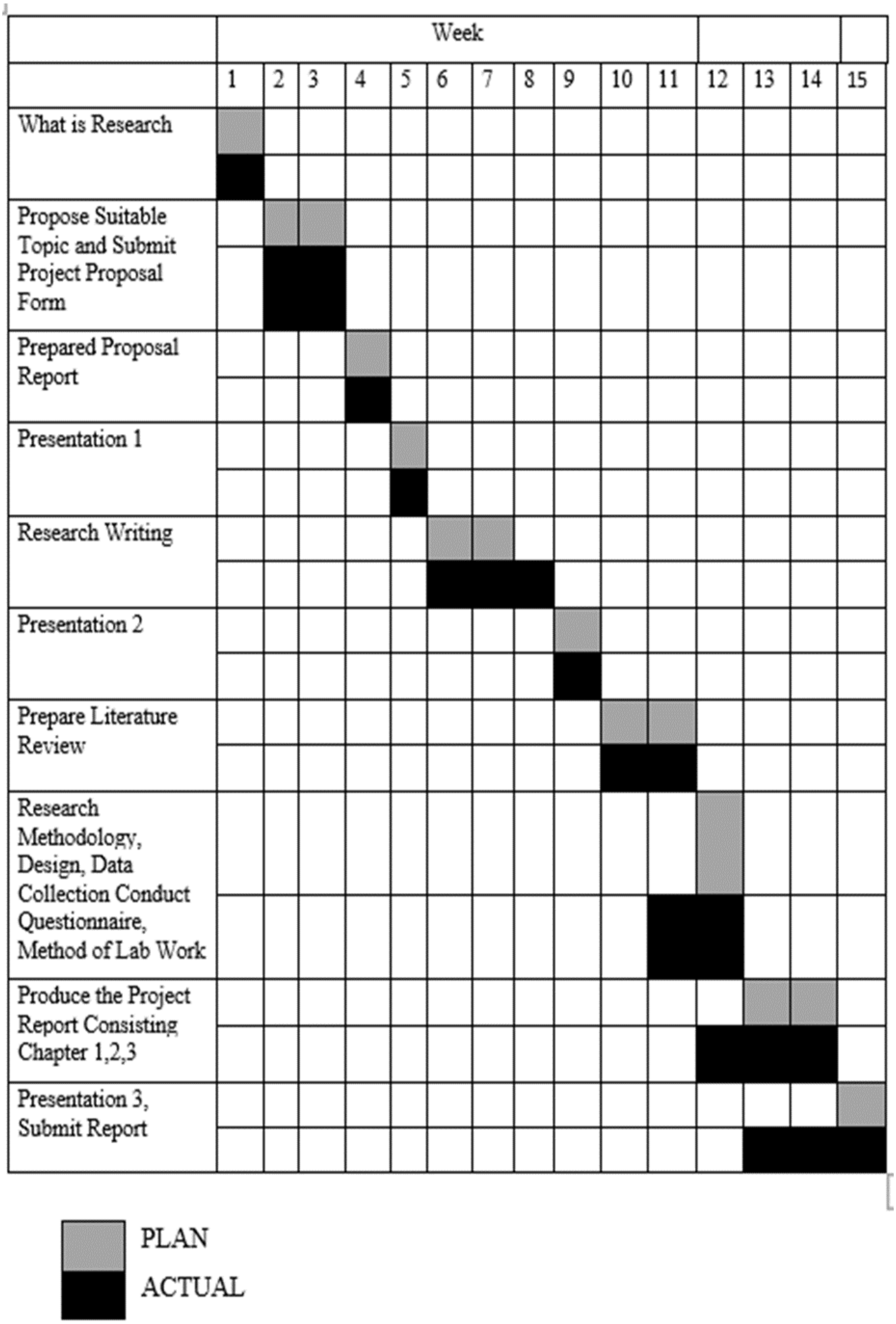
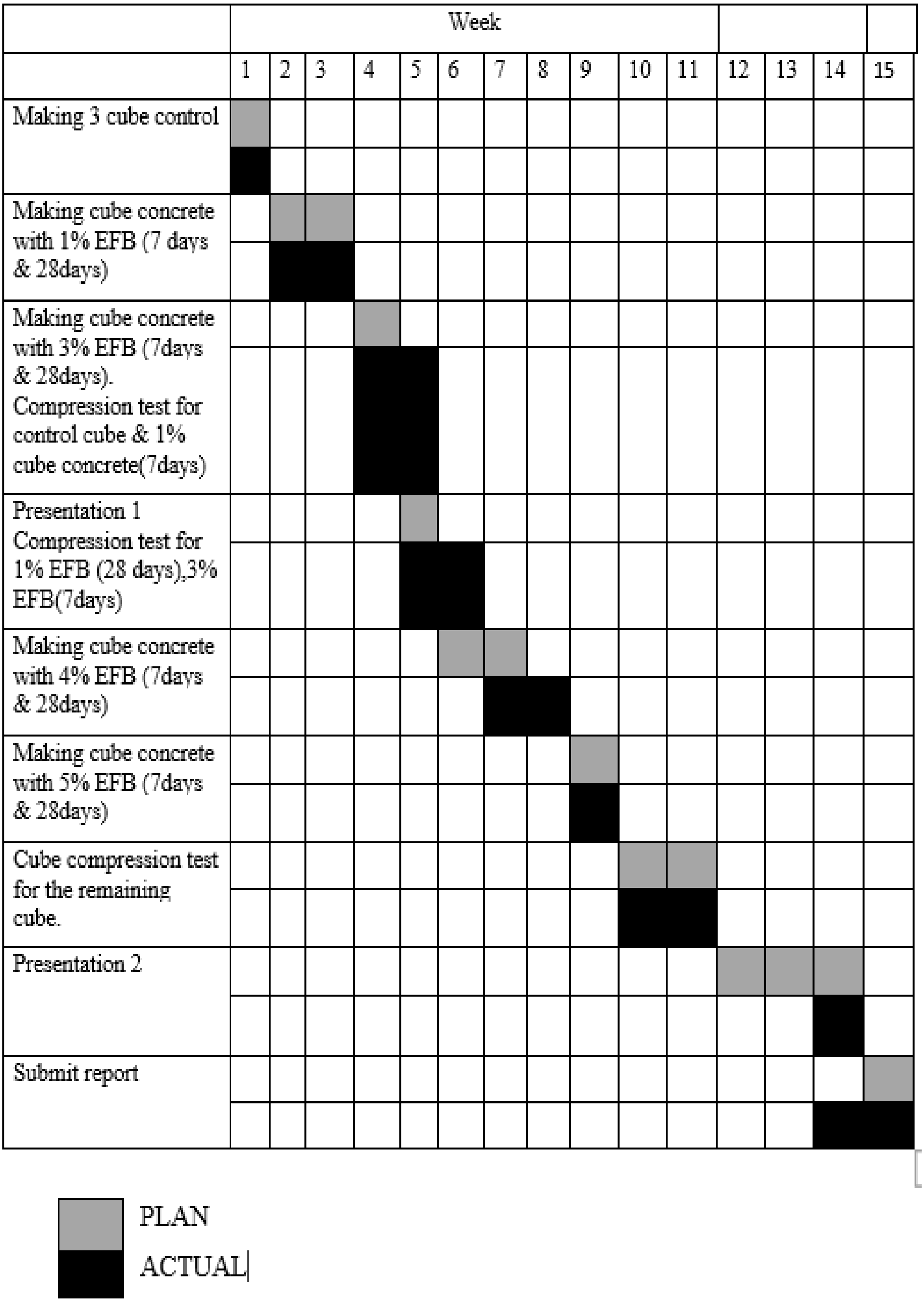
APPENDIX

A) GANTT CHART FOR SEMESTER 4 (SECTION DECEMBER 2018)



B) GANTT CHART FOR SEMESTER 5 (SECTION JUNE 2019)



C) COMPRESSIVE STRENGTH TEST DATA AT 7 DAYS

NO.& SAMPEL	DATE CAST	DATE TEST	AGE	WEIGHT (G)	LOAD (KN)	STRENGTH (N/mm²)	AVERAGE STRENGTH
1(0%)	3/7/19	10/7/19	7	8080	507	22.5	
2(0%)	3/7/19	10/7/19	7	7990	452	20.1	21.63
3(0%)	3/7/19	10/7/19	7	8045	501	22.3	
4(1%)	10/8/19	17/8/19	7	7790	492	21.9	
5(1%)	10/8/19	17/8/19	7	7865	482	21.4	21.43
6(1%)	10/8/19	17/8/19	7	7770	473	21.0	
7(3%)	2/9/19	9/9/19	7	7925	544	24.2	
8(3%)	2/9/19	9/9/19	7	7860	541	24.0	24.73
9(3%)	2/9/19	9/9/19	7	7935	586	26.0	
10(4%)	11/9/19	18/9/19	7	7835	450	20.0	
11(4%)	11/9/19	18/9/19	7	7900	453	20.1	20.20
12(4%)	11/9/19	18/9/19	7	7790	461	20.5	
13(5%)	23/8/19	30/8/19	7	7610	473	19.3	
14(5%)	23/8/19	30/8/19	7	7530	419	18.6	19.80
15(5%)	23/8/19	30/8/19	7	7645	426	21.5	

D) COMPRESSIVE STRENGTH TEST DATA AT 28 DAYS

NO.& SAMPEL	DATE CAST	DATE TEST	AGE	WEIGHT (G)	LOAD (KN)	STRENGTH (N/mm^2)	AVERAGE STRENGTH
16(0%)	3/7/19	31/7/19	28	8080	686	30.5	
17(0%)	3/7/19	31/7/19	28	7980	692	30.8	30.50
18(0%)	3/7/19	31/7/19	28	8030	690	30.2	
19(1%)	7/8/19	4/9/19	28	7903	694	30.8	
20(1%)	7/8/19	4/9/19	28	7905	695	30.9	30.80
21(1%)	7/8/19	4/9/19	28	7900	692	30.7	
22(3%)	2/9/19	30/9/19	28	7905	713	31.7	
23(3%)	2/9/19	30/9/19	28	7950	702	31.2	31.83
24(3%)	2/9/19	30/9/19	28	7935	732	32.6	
25(4%)	11/9/19	9/10/19	28	7610	513	22.8	
26(4%)	11/9/19	9/10/19	28	7630	515	22.9	22.93
27(4%)	11/9/19	9/10/19	28	7645	520	23.1	
28(5%)	23/8/19	20/9/19	28	7570	484	21.5	
29(5%)	23/8/19	20/9/19	28	7565	482	21.4	21.60
30(5%)	23/8/19	20/9/19	28	7590	489	21.9	