THE MECHANICAI . . JEL ASH AS PARTIAL CEMEI NT BRICK

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Project Report submitted as partial fulfilment of
The requirements for the award of the degree of
B. ENG (HONS) CIVIL ENGINEERING

Faculty of Civil Engineering & Earth Resources
UNIVERSITY MALAYSIA PAHANG

JAN 2015

ABSTRACT

Both palm oil fuel industry and cement industry are causing native impact to the enviroment.The amount of land needed for the disposal of the waste can become increasing. Palm oil fuel ash are the waste products from the local palm oil industry that cause environmental pollution when they are discarded at the same time, cement are costly and production cause negative impact to the enviroment.Issue on the depletion of natural cement has lead towards the utilization of Palm Oil Fuel Ash (POFA) as cement replacement in the cement replacement production. Furthermore, the incorporation of POFA as partial cement replacement material in concrete production also helps us to reduce the cost of concrete production and able to curb environmental pollution problem. The objective of the study are to determine the effect of palm oil fuel ash (POFA) as partial cement replacement content on the compressive strength and moisture absorption of (POFA) cement brick . The impact of compressive test and water absorption test of cement brick containing palm oil fuel ash as partial cement replacement material has been investigated Concrete specimens with various percentage of palm oil fuel ash (POFA) as partial cement replacement material were water cured for 28 days before subjected towards compressive strength test and water absorption test. Findings shows that cement brick containing 20% of POFA demonstrate highest compressive strength compared to the other specimens. Inclusion of 20% POFA has lead to densification of cement brick internal structure making the concrete denser and exhibit lowest water absorption of all mixes.

ABSTRAK

Kedua-dua aktiviti perindustrian minyak sawit dan industri pembuatan simen menyebabkan kesan buruk kepada alam sekitar.Kawasan tanah yang diperlukan untuk melupuskan sisa pembuangan sentiasa meningkat.Abu terbang kelapa sawit adalah bahan buangan daripada industri minyak sawit tempatan yang menyebabkan pencemaran alam sekitar apabila sisa ini dibuang pada masa yang sama,harga simen dipasaran adalah mahal dan penghasilannya menyebabkan kesan negatif kepada alam sekitar.Isu pada pengurangan simen semula jadi telah membawa kepada penggunaan abu terbang kelapa sawit sebagai pengganti simen dalam pengeluaran gantian simen. Tambahan pula, pelaksanaan POFA sebagai bahan pengganti separa simen dalam konkrit juga membantu kita untuk mengurangkan kos pengeluaran konkrit dan dapat membendung masalah pencemaran alam sekitar. Objektif kajian ialah untuk mengkaji kesan abu terbang kelapa sawit sebagai bahan separa pengganti kandungan simen pada kekuatan mampatan dan kadar penyerapan air bata simen. Kesan mampatan ujian dan ujian penyerapan air bata simen yang mengandungi abu terbang kelapa sawit sebagai bahan gantian separa simen telah disiasat .Spesimen konkrit dengan pelbagai peratusan abu terbang kelapa sawit sebagai sebahagian bahan pengganti simen telah direndam di dalam air selama 28 hari sebelum diuji kekuatan mampatan dan ujian penyerapan air. Keputusan menunjukkan bahawa bata simen yang mengandungi 20% daripada abu terbang kelapa sawit menunjukkan kekuatan mampatan paling tinggi berbanding dengan spesimen lain. Kemasukan 20% POFA telah membawa kepada pemadatan bata simen struktur dalaman membuat lebih padat konkrit dan mempamerkan penyerapan air terendah semua campuran.

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LIST OF SYMBOLS

%	Percent
° C	Degree Celsius
Mpa	Megapascal
kg	Kilogram
N/mm^2	Newton per millimeter square
kg/m^3	Kilogram per meter cube

LIST OF ABBREVIATIONS

CaO	Calcium Oxide
$Ca(OH_2)$	Calcium Hydoxide
C-S-H	Calcium Silicate Hydrate
HCl	Hydrochloric Acid
Sp	Superplasticizer
$Fe(OH_3)$	Ferum (III) Oxide
OPS	Oil Palm Shell
LWAC	Lightweight Aggregate Concrete
POFA	Palm Oil Fuel Ash
OPC	Ordinary Portland Cement

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

Cement is the most widely used material in construction all over the world.It is the most important material in the field of construction and infrastuctural development.Nowdays,there are many modifications made for concrete for example that contains palm oil fuel ash (POFA).The annual production of palm oil fuel ash (POFA) in Malaysia is more than 4 millions tons (Teo, et al, 2006) and the production of palm oil fuel ash (POFA) keep increasing from year to year and these two products is classified as a waste materials. These waste material are being dump to the environment and left to decomposed by itself

The cement brick containing palm oil fue ash (POFA) were introduced as a method to reduce the amount of cement usage as the current cement price is very expensive.Futhermore,the palm oil fuel ash were added into the mixture to boost up the strength of the concrete since the reaction of plam oil fuel ash (POFA) with Calcium Hydroxide will give us the Calcium Silicate Hydrate gel that will make the concrete denser

In this globalization era,the price of cement is getting higher,therefore the use of supplementary cementing materials such as palm oil fuel ash (POFA) has become significant in the cement brick industry,besides that,effectives usage of POFA as a supplementary materials in concrete would reduced negative enviromental effect and also would solve the enviromental effect.

1.1 PROBLEM STATEMENT

Both palm oil fuel industy and cement industry are causing native impact to the enviroment.The amaount of land needed for the disposal of the waste can become increasing.In addition,the price of a normal plain cement is increasing as well and sometimes peoples are not able to afford it.The inventation of palm oil fuel ash(POFA) as the supplementary cementing materials will reduce the comsumptions of cement in construction process of the cement brick. There have some pollution that cause from industry. One of it was the production of cement because it released the Carbon Dioxide (CO_2) gas from the factory of cement production. According to (Kabir & Madugu, 2008), around the cement plantation and neighboring settlements, there have air pollution and the carbon dioxide emission.The cement is non-renewable material. So, it will finish soon. The Palm Oil Fuel Ash (POFA) can be substituted for cement in concrete composite because it is renewable. At the same time , the large amount of POFA that generated every year by palm oil industry become wastage especially in Malaysia. Therefore, it need to be use in order to decrease the waste of POFA.

1.2 OBJECTIVES OF STUDY

The objective of the study are follow

i. To determine the effect of palm oil fuel ash (POFA) as partial cement replacement content on the compressive strenght of cement brick
ii. To determine the effect of palm oil fuel ash (POFA) as partial cement the moisture absortion of (POFA) cement brick .

1.3 SIGNIFICANCE OF STUDY

As a renewable material, POFA had potential to be the reusable component for future benefits especially in the material for the constructin. Besides the ability to increase the 'greenness' of concrete, it also can help to provide a healthier and good environment and a greater concrete construction industry, with the using of POFA give the expectation in lower binder costs and the improvement of mechanical properties, workability, and durability of performance of cement brick. The POFA being the partial cement replacement can save the cement due to reduce the air pollution and emission of CO_2 gas because the increasing of associated in primary energy consumption and carbon dioxide emissions had adverse environmental impact .Cement replacement is important because the cement manufacturing process involve many non-renewable material and waste a lot of energy. Therefore, the alternative to find the cement replacement is very important in order to save the non-renewable material.Use of POFA in brick production would reduce amount of POFA disposed at landfill.Generally, clearner enviroment can achieved.

1.4 SCOPE OF STUDY

The scope of this study was focused on the laboratory test and experiments to investigate the performance of the cement brick containing with different proportion of POFA. POFA used in this study will be directly collected from the Kilang Sawit Lepar Hilir, Felda Lepar Hilir 3, 26300 Gambang, Pahang, Malaysia. The concrete samples were tested with different proportion POFA in partial cement replacement whish are 0%, 10%, 20% and 30%. Then, the optimum proportion were determined as the result.

Research by research had been done by many researchers towards the waste material like POFA. It has been found that POFA has pozzolanic properties which contain silica oxide that potential to be used as cement replacement to produce strong and durable concrete. (Awal and Hussin, 1997). Besides the ability to increase the 'greenness' of concrete, it also can help to provide a healthier and good environment and a greater concrete construction industry, with the using of POFA give the expectation in lower binder costs and the improvement of mechanical properties, workability, and durability of performance of brick.

In this study,the compressive strength of cement brick sample tested.In terms of the durability performance of cement brick, water absorption and density are within the scope of this study.All the sample has been using water curing method up to for 28 days.Water absorption of the concrete is tested by the absorption rate of the hardened cement brick.

1.5 LAYOUT OF THE THESIS

The thesis consist of five main part that are introduction, literature review, methology, result and discussions and lastly conclusion. Part one or the introduction eemphasizes the (POFA) as the partial cement replacement material, background of the research , objective of the research ,scope of the research , significance of the research and lastly the layout of the thesis. Part two discusses on the review of introduction of the brick, type of the brick, brick application, info and size and lastly introduction about the palm oil fuel ash.

Part three mainly discuss the methodology used in this study, the material preparation, method to obtained the best mix proportion and the mixing procedure. The testing method used used also include in this part. Part four is about laboratory testing result of the cement brick as used (POFA) as the additional material to reduce of the cement in term of compressive strength and water absorption properties test. Part five concluded the whole study. Some conclusions have been drawn with respective objective listed based on the result obtained from this study. A few recommendation also listed in this part for the future study.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Cement brick is one of the important construction materials. It is made by mixing the cement, fine aggregate and water. Due to high demand of the cement and concrete for the construction, the used of concrete keep increasing from year to year. Since the material used to mix the concrete the concrete is non-renewable, a lot of research had been done to find the other alternatives to replace the cement for the concrete and cement paste. The alternatives resource is more to the recyclable material like palm oil fuel ash and by replacing the original material for the concrete with the recyclable material, we can get a new type of cement brick.

2.2 TYPES OF BRICK

Bricks are used for building and pavement all throughout the world. In the Malaysia brick was once used as a pavement material, and now it is more widely used

as a decorative surface rather than a roadway material. Bricks are usually laid flat and are usually bonded forming a structure to increase its stability and strength.

There are various types of bricks used in masonry.

1. Common Burnt Clay Bricks
2. Sand Lime Bricks (Calcium Silicate Bricks)
3. Engineering Bricks
4. Concrete Bricks
5. Fly ash Clay Bricks

2.2.1 COMMON BURNT CLAY BRICKS

Common burnt clay bricks figure 2.1are formed by pressing in molds. Then these bricks are dried and fired in a kiln. Common burnt clay bricks are used in general work with no special attractive appearances. When these bricks are used in walls, they require plastering or rendering.

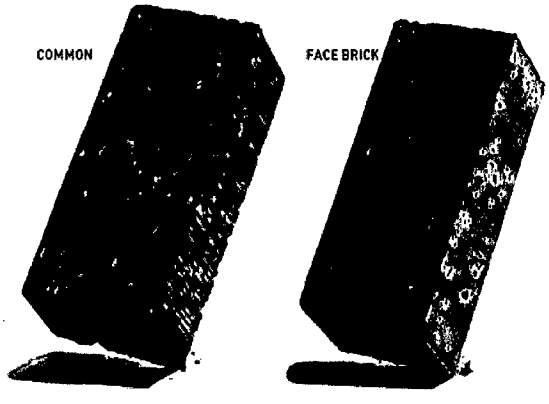

Figure 2.1: Common Burnt Clay Bricks

2.2.2 SAND LIME BRICKS

Sand lime bricks figure 2.2 are made by mixing sand, fly ash and lime followed by a chemical process during wet mixing. The mix is then moulded under pressure forming the brick. Figure these bricks can offer advantages over clay bricks such as:

1. Their colour appearance is grey instead of the regular reddish colour.
2. Their shape is uniform and presents a smoother finish that doesn't require plastering.
3. These bricks offer excellent strength as a load-bearing member.

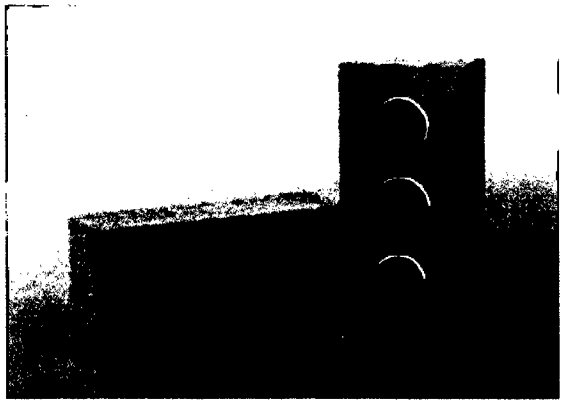

Figure 2.2: Sand Lime Bricks

2.2.3 ENGINEERING BRICKS

Engineering bricks figure 2.3 are bricks manufactured at extremely high temperatures, forming a dense and strong brick, allowing the brick to limit strength and water absorption. Engineering bricks offer excellent load bearing capacity damp-proof characteristics and chemical resisting properties.

Figure 2.3:Engineering Bricks

2.2.4 CONCRETE BRICKS

Concrete bricks figure 2.4 is made from solid concrete. Concrete bricks are usually placed in facades, fences, and provide an excellent aesthetic presence. These bricks can be manufactured to provide different colours as pigmented during its production.

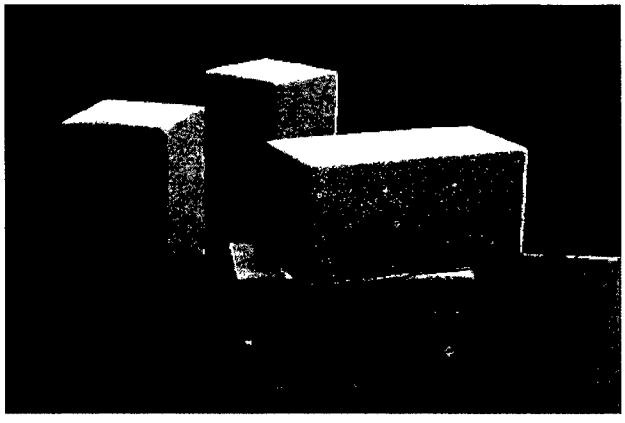

Figure 2.4: Concrete Bricks

2.2.5 FLY ASH CLAY BRICKS

Fly ash clay bricks figures 2.5 are manufactured with clay and fly ash, at about 1,000 degrees C. Some studies have shown that these bricks tend to fail poor produce pop-outs, when bricks come into contact with moisture and water, causing the bricks to expand.

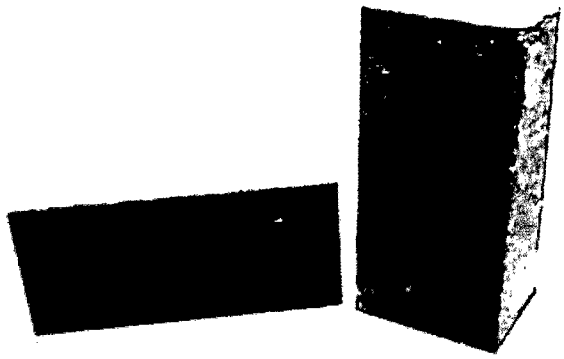

Figure 2.5: Fly Ash Clay Bricks

2.3 BRICKS ADVANTAGES

There are many advantages when bricks are used as part of the construction. The following list presents some of the most common advantages when using bricks instead of other construction materials. Bricks offer natural and a variety of colour, including various textures. Bricks offer excellent high compressive strength. The porosity of bricks in attributed to its fine capillaries. The ability to release and absorb moisture is one of the most important and useful properties of bricks, regulating temperatures and

humidity inside structures .When prepared properly a brick structure can give a fire protection maximum rating of 6 hours.

Brick can exhibit above normal thermal insulation when compared to other building materials. Bricks can help regulate and maintain constant interior temperatures of a structure due to their ability to absorb and slowly release heat. This way bricks can produce significant energy savings, more than 30% of energy saving, when compared to wood. A brick is so strong, that its molecular composition provides excellent wear resistance. Efflorescence forms on concrete structures and surfaces when soluble salts dissolved in water are deposited and accumulated on surfaces forming a visible scum.

2.4 PLAIN CEMENT BRICK

2.4.1 1NFO AND SIZE

Brick is one of the main thing in the construction of the development.For example the bricks which is sand and cement.Next,the size is rectangular, made of inorganic materials that are hard and rugged.The brick of size and weight designed for easy to hold by hand.The measure long held by the two measurements plus width to the thickness of a layer of bonding mortar, measure its thickness is approximately two-thirds the size lebarnya.it is have variuos form and also depends on type.The type and source of raw materials, method of manufacture and uses. Figure 2.6: Concrete brick size and demension

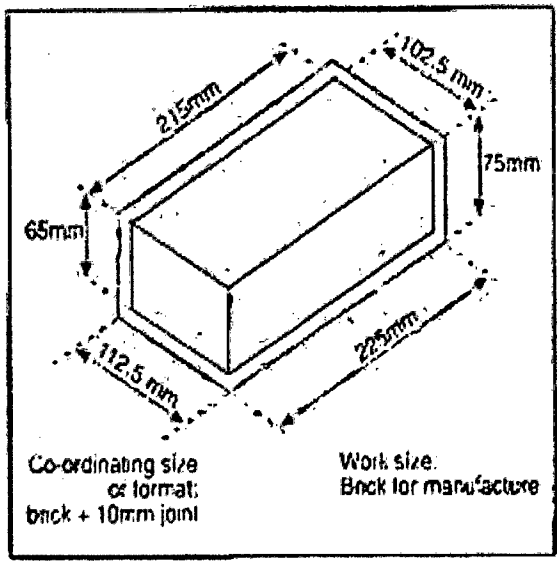

Figure 2.6: Concrete brick size and demension

(Source : Jabatan Kerja Raya Malaysia)

2.4.2 APPLICATION

There are a few advantages of bricks, first is strong and durable. An incredibly hard wearing building material, the brick is able to take the knocks of every day life as well as the weather extremes sometimes experienced. They won't fade, twist or warp, rot or decay, erode or dent and termites can't eat them. For hundreds of years, no material shows so few signs of ageing. All bricks have a strong load bearing capacity to Malaysia Standards.

Second is low maintenance. Brick houses figure 2.7 have negligible routine maintenance.Third is thermal performance. Brick buildings, particularly double brick, have excellent thermal mass. The ability of a material to retain heat energy when subjected to a temperature differential, plays a key role in stabilizing temperature swings, keeping the internal temperature in the comfort zone longer. This means it is cooler in summer and warmer in winter. It also showed the performance of walls with internal thermal mass was markedly improved by the inclusion of cavity insulation. In conjunction with good design principles, appropriate use of thermal mass throughout your home can make a difference not only to comfort but to your artificial heating and cooling usage as well. This is significant considering that more than 30 percent of the average home's energy use is made up of heating and cooling.

Next,acoustic performance. The density of brick makes for a quieter building compared to lighter weight materials, reducing external sound such as aircraft and road noise. When building in cavity brick, adding insulation helps further by absorbing resonating sound. Internal partition walls made of brick can reduce noise transfer further when used between rooms of the house. When assessing acoustic performance, it's important to look at the properties of the finished wall, not just the raw materials, and making sure they are sealed correctly and gaps filled in properly