INVESTIGATION OF SAW WOOD CHIPS WITH DIFFERENT PERCENTAGES IN SAND BRICK RATION 1:3

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ABSTRACT

Sand brick are mostly type of bricks that used in construction industry compared to clay brick because materials are used in sand brick are easy to get and quite cheap but not have environmental friendly value. The issue on the environment preservation and sustainability has lead into a new finding on the new materials that had been generated by product from the industrial sector. So, to produce sand brick that have environmental friendly value, fine saw wood chips are used as a partial sand replacement because it can reduce wood waste that are given effect to environment like air pollution and can also reduce waste sent to landfill. This research presents 100 pieces of sand brick that made from saw wood chips, river sand and cement. Saw wood chips is a main material that are used to produce this sand brick. This sand brick will be cured in two method of curing that are air curing and water curing. Experiments then have been conducted by replacing 5%, 10%, 15% and 20% of raw saw wood chips with river sand in this sand brick. The method used is to find of trial and error with 1: 3 ratio of cement to sand of the water cement ratio. Then, the ready sand brick will be cured by air and water for 7 and 28 days depends on the test that will be conducted on the sand brick. The saw wood chips bricks that are cured will be test to test the strength of brick, water absorption and its dimension will be tested after 28 days. From the another point, this research will show the saw wood chips sand brick are lighter compared to normal sand brick because weight of fine saw wood chips is used in it.

ABSTRAK

Bata pasir adalah jenis bata yang kebanyakannya digunakan dalam industri pembinaan jika dibandingkan dengan bata tanah liat kerana bahan-bahan yang digunakan dalam bata pasir adalah mudah didapati dan lebih murah tetapi bata pasir tidak mempunyai nilai mesra alam. Isu pemeliharaan alam sekitar dan kemampanan telah membawa kepada penemuan baharu terhadap bahan-bahan mentah setiap hasil produk daripada sektor industri. Maka, untuk menghasilkan bata pasir yang mempunyai nilai mesra alam, racik kayu halus digunakan sebagai separuh penggantian daripada pasir kerana racik kayu boleh mngurangkan sisa kayu yang akan memberi kesan kepasa alam sekitar seperti pencemaran udara dan boleh juga mengurangkan sisa yang akan dihantar ke tapak pelupusan sampah. Kajian ini menunjukkan 100 biji bata pasir yang dihasilkan daripada racik kayu, pasir sungai dan simen. Racik kayu merupakan bahan utama yang digunakan untuk menghasilkan bata pasir ini. Batá pasir ini akan diawet dalam dua kaedah pengawetan pengudaraan dan pengawetan rendaman air. Eksperimen dikendalikan dengan menggantikan 5%, 10%, 15% dan 20% racik kayu mentah bersama pasir sungai di dalam bata ini. Kaedah yang digunakan adalah untuk mendapatkan nisbah air simen adalah melalui kaedah cuba jaya dengan nisbah 1:3 simen kepada pasir. Setelah itu, bata pasir tersedia akan dikeringkan dengan kaedah pengudaraan dan rendaman air untuk 7 dan 28 hari bergantung pada ujian yang akan dikendalikan pada bata pasir. Bata daripada racik kayu yang diawet adalah untuk menguji kekuatannya, penyerapan air dan ukuran bata akan diuji selepas 28 hari. Dari sudut lain, kajian ini menunjukkan bahawa bata pasir racik kayu adalah lebih ringan dibandingkan dengan bata pasir biasa disebabkan daripada racik kayu yang digunakan dalam bata pasir racik kayu.

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LIST OF SYMBOLS

W_S	Saturated weight of specimen
W_d	Oven-dry weight of specimen
W_i	Immersed weight of specimen
%	Percentage

LIST OF ABBREVIATIONS

ASTM	American Society for Testing and Materials
BS	British Standard
BS EN	British Standard European Norm
Kg	Weight
MPa	Strength
N/mm^2	Strength
OPC	Ordinary Portland cement
UMP	Universiti Malaysia Pahang

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Key aspects in environment, economic and social constitute sustainable development. Sustainable development is conduct economic development with reduce uses of natural resources for achieving sustainability. Sustainable development give long life of resources to future generations. So, to make sure it can be stay in long life, civil engineer must handle a growing societal issue of global use of resources and priority infrastructure (National Research Council, 2006). Uses of waste in producing a renewal product in construction industry way to reduce uses of natural resources. As we can see, sand brick use river sand that is one of natural resources. Sand brick is one of important product that use in construction industry. That means, more river sand are used in manufacturing of sand brick. One alternative reduce uses of river sand is saw wood chips are used as a partial replacement of river sand.

Bricks are versatile and durable building and construction material, with good load-bearing properties, high thermal mass and potential low energy impact. It is also relatively cheap to make, very durable, and required little maintenance. Bricks are commonly used as a structural material as a walls, paving, perimeter and garden wall, cladding and facings, and flooring. Different properties and characteristics of bricks

depend on different types of bricks. Testing of a bricks is important, in order to ensure the engineering properties of saw wood chips which may give the best strength together with minimizing its environmental impact which increases its energy efficiency.

1.2 PROBLEM STATEMENT

River sand is one of the materials that are used in manufacturing sand brick. Uses much of river sand gives effects to environment such as erosion of river bank and effect of river water quality. River bank erosion make the river channel become wider and deeper (J. Alex). River erosion is mostly happen in vertical erosion than horizontal erosion. River bank erosion is also effects functioning of river ecosystems (Joan L. Florsheim, Jeffrey F. Mount, Anne Chin, 2008). It will gives effect when erosion happen in vertical erosion or river become wider because it will reduced space of land uses like minimize landscape space.

Next, the usage of river sand in excessively will effect water quality of a river because river sand is used to filter water and waste in the water. Without river sand, water flowing in the river will cause downstream user get not good quality of water and it also cost of water treatment plants increased for downstream. So, one way to solve this problems are use wastes as a partial river sand replacement to minimize quantity usage of river sand in manufacturing brick.

Wood wastes always found in a huge amounts of wastes in furniture and paper factory (Puvanasvaran, A.P1., Hisham, S2., Kamil Sued, M1, 2011). Usage of wood waste such as fine saw wood chips also can give effect to environment like reduced waste sent to landfill and give long life of landfill space.

1.3 OBJECTIVES OF STUDY

The main objectives of study are:

i. To investigate the compressive strength of sand brick by replacing fine saw woods chips with river sand with percentage of 0%, 5%, 15% and 20%.

ii. To determine the water absorption of bricks with percentages of fine saw wood chips.

iii. To determine dimensions of bricks after 7 and 28 days.

1.4 SCOPE OF STUDY

This research generally using saw wood chips as a partial river sand replacement. The main focus of this research is to get the compressive strength and determine water absorption of brick with using saw wood chips compared with brick did not use saw wood chips. Normally, in construction industry, they prefer to use sand brick because it easy to made and make it cheap than other bricks. In this research, every percentage of saw wood chips as a river placement will test to check whether it can be get better result in strength and it quality compared to 0% of saw wood chips bricks. All testing are being done in the concrete laboratory. The result is being analysed and will come out with significant conclusion after testing the saw wood chips sand brick.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In ancient times, the bricks were moulded by hand and left in the sun to dry (Cowan, Henry J., 1977). From the archaeological evidence, about the third millennium Before Century somewhere in Middle East, the invention of brick is believed to have arisen (James W., 2003). For the reasons of speed and economy, bricks were increasingly preferred as building material to stone, even in areas where the store was available. Until today, brick is still used because of its own characteristics which is more resistant and primarily used as a building material in construction industry. Bricks are produced in numerous classes, types, materials, and, sizes which vary with region and time period, and are produced in bulk quantities. From a choice of colour, surface texture, weight, thermal characteristics, fire resistance, thermal and moisture movement, density and absorption can be selected of the correct brick for a job.

In this research, it will presents the use of saw wood chips as a partial replacement of river sand in sand brick. As we know the sand brick is very similar to concrete of its manufacturing, except that sand / aggregate materials used are much finer. The brick will spread smoothly and evenly because the sand grains are fine and even. The discussion on this paper and research also is more focusing on the strength performance of saw wood

chips sand brick and other engineering properties such as compressive strength and water absorption. The size of sand bricks used in this research is 225mm x 115mm x 75mm.

2.2 TYPES OF BRICK

2.2.1 Clay Brick

In Malaysia, clay bricks is one most the largest manufacturing of many types of bricks. Clay bricks mostly used in construction of tunnels, waterways, bridges etc. Basic materials of bricks have provided of construction in centuries. Most important elements in this bricks is clay. Clay is used because it easy to be moulded into various shape after crushed itself and mixed with water then it will make it turn into plastic material.

2.2.2 Cement Brick

Cement brick is a one type of bricks that made from a mixture of cement and sand. Cement brick will be moulded under pressure and cured it under steam at 93°C (200°F). The bricks made of cement and sand . Mixture of ratio varies with the strength required . A ratio of 1 : 8 is the typical mixture used to make the local cement bricks . The water content in the mix should be controlled as not too damp. Cement bricks are produced by using a mold . The newly minted brick should be let it to dry by itself and will be cured for two weeks before it can be used . Preservation is done by watering once on the hardened bricks , especially during hot weather . Cement brick size is equal to the size of clay brick that is 216mm x 103mm x 65mm.

Cement brick is mostly similar to concrete, except the aggregate materials are used much finer. The cemnt brick will spread smoothly and evenly because the sand grains are fine and even. Cement brick can also be stained with various colours to blend in with or stand out from a back ground. While people who are wish to mix their own blend dry

cement and sand in the desired proportions before adding water, premixed of cement brick will comes in dry bags with cement and sand in controlled proportions.

2.2.3 Concrete Brick

Concrete brick is a concrete masonry unit made from Portland cement, water, and suitable aggregates, with or without the inclusion of the materials (ASTM Standard C55). Concrete brick may be more susceptible to cracking because of the nature shrinkage movement. Minimization the cracking due to shrinkage can be solved by require joint reinforcing steel. Concrete brick come in variety of colours. Concrete brick is type of brick that are not colour fast and they will fade over time.

2.2.4 Fire Brick

Fire brick is the oldest bricks have been found on the estimated to be about 600 years old on the sites of the ancient cities of Babylonia. Fire bricks are made of simple fireclay which is from most ordinary mud. Fire brick also known as refractory brick is use refractory ceramic material of a block that used in lining furnaces, kilns, fireboxes and fireplaces. Fire brick is produced to resist fire resistance because it can absorbs the heat into its mass very well. It also have good thermal conductivity. In the process of making fire brick, fireclay are fired in kiln until partly glassy and it may be also have given a special purposes like glazed. There have two standard size of fire bricks. First, is 229mm x 114mm x 64mm. Second, 229mm x 114mm x 64mm.

2.2.5 Calcium-Silicate Brick

Calcium silicate brick is developed commercially in Germany the end of the 19th century not until the beginning of the present century and it set going in the UK in the

beginning of the present century (B. Bryan, 1994). Calcium silicate brick made from mixing of blended lime or cement, high of silica and water. Then, the bricks will be pressed to get into the shape. Finally, it will be autoclave in 6 hours in the oven about 200°C. Advantages of calcium silicate brick it can immediately use in few days after in done with autoclaving. The brick is very consistent in colour, texture and shape. It is also quite expensive.

2.3 SIZE OF BRICK

Brick have various size depends on type of bricks. Brick that has dimension that not less than 337.5mm long, 225mm width and 112.5mm height can be defined as one unit brick (H.Bailey and D.W.Hancock, 1979). According to British Standard, BS 3921: 1985, size of 1 unit brick must have at least 215mm long, 102.5mm width and 65mm height. Table 2.3 show size of brick according to the British Standard BS 3921: 1985;

Table 2.1: Size of brick

Coordinating size (mm)			Work size (mm)		
Length	Width	Height	Length	Width	Height
225	112.5	75	225	115	75

Source: British Standard BS 3921: 1985

2.4 CLASSIFICATION OF BRICKS

2.4.1 Building Bricks (Common Bricks)

Common bricks that are typically used as a structural material and they are also strong and durable. This bricks are usually plastered and it is non-bearing loading. Building bricks are also the cheapest bricks available in market.

2.4.2 Engineering Bricks

Made from mixtures of fine clay and additives. Used for heavy construction work and require large power load , compact and does not absorb water. Used in engineering works of underground tthat are receive high load as the main structure or wall structure that is exposed to the effects of weather and different temperatures. This bricks also used in construction works such as retaining wall, sewerage bricks and another wall that may be exposed to the action of acid and corrosion.

2.4.3 Facing Bricks

Made from a mixtures of good quality clay or cement, sand and additives. This type of bricks have either a finish textured on its surface, sandy or slippery, and have the same colour or pattern. This bricks no need to be plastered and used to construct a work for aesthetic value that shows the beauty and smooth surface. This bricks are also create to resist extreme weather conditions (Mat Lazim Zakaria, 1987). Facing bricks are free from imperfections such as crack and very durable.

2.5 MATERIALS

The main compound of the producing saw wood chip bricks is the cement, river sand and saw wood chips that are used as partial river sand replacement with mixed together with water. Production of any construction product based on materials easy to obtain on the surrounding. In Malaysia, materials that needed to produce a brick masonry is easy to obtain because Malaysia located in tropical climate and nearby the South China Sea.

2.5.1 Cement

Cement is a major component in the process of construction product. There are various types of cement used in construction sites as necessary and suitability. Normally, supplied in bags weighing not more than 50 kg for transportation facilities. Cement is made of clay and lime stone then blended according specific rates. Cement is commonly used for concrete work, laying bricks, plastering and others. The process hardening of cement is the result of a complex chemical compound formation occurs as soon as they are mixed. This process is called hydration. In this research, Ordinary Portland Cement is used to produce brick.

2.5.1.1 Type of Cement

There are several type of cements in the construction industry:

a) Ordinary Portland Cement (OPC):

Produced by a controlled burning process. Clay and limestone materials undergoing combustion process will be burnt, a mixture of gypsum material made in

accordance with certain ratio to control the time it again. This results in partial fusion and formation of nodules called clinker. This clinker when ground with a certain percentage of gypsum results in cement. This type of cement was widely used to make mortar and concrete. OPC is suitable use for all modern types of construction, including pre-stressed concrete, concrete works, repair works, masonry etc.

b) High Alumina Cement:

Made from mixture results lime and mineral containing aluminium minerals through a process of slow freezing, but it is harder than cement quickly hardened. Suitable for large areas but it is not suitable sulphate in a hot place and have to be wet for 24 hours to obtain good quality concrete.

c) Colour Cement:

Used in or mental work in connection brick, floor, plastering walls and other uses deemed appropriate. Be kept separate from other cements to avoid the mixing of colours. It consists of a variety of colours such as brown, white, black, green, blue, yellow and so on.

d) Portland Quickly Hardened Cement

Made more delicate than other cements for maximum strength and will quickly harden in cold and damp weather. Suitable for use in wet areas and water.

2.5.1.2 Testing of Cement

There are several methods for testing cement:

a) Sampled by hand

A good cement can be used is in the form of powder and not lumpy.

b) More accurate

Mixed with water until it thickens. Plastered averaged over the mirror and with a spatula. Then, it is soaked in water for 24 hours. If the cement is cracked and not hardened, the results of cement was not suitable to be used.

A selection of test for setting time and compressive strength will be briefly described as they each have implications for cement performance.

i. Setting Time

The setting time test is based on the (BS EN 196-3) is test a sample of cement is mixed with water to form a paste of standard consistency. Vicat test is a cylindrical plunger in the apparatus that used to check the sample. In the first, measure penetration of 1.13mm diameter round needle. Then, cement have reach its initial set if it is between 4 and 6 mm from the base of the cement.

2.5.2 River Sand

Good quality if not containing impurities. Mixing mortar or concrete with river sand is difficult to work with. Thus, a substance known as a facilitator-blend (plasticizer) are sometimes used to enhance the enjoyment of work in the work of the mortar or concrete. If the material is not used, the material will require more mortar cement to make it easy for same work. River sand will used to produced 100 pieces of brick and weight

of river sand will be reduced based on percentage of saw wood chips are added. River sand acceptable in this research is passing 20mm of sieve passing.

2.5.2.1 Test for Sand

Impurities in the sand will affect the strength of the concrete or mortar that use it. Thus, two types of tests should be performed as follows:

i. Sedimentation tests: to determine the amount of silt and foreign materials.

1. This test is to investigate the presence of foreign materials such as mud fine, sediment, in the sand content.
2. This test was done with a normal jam bottle. Sand to be tested is inserted into the bottle of 50mm. then, filled up to ¾ full of clean water and the bottles shaken for one minute.
3. After shaking, the bottle is left for one hour to allow silt content to settle into a separate layer above the sand. This layer thickness will measured. If more than 3mm means tested sand is too dirty.
4. This sand is not suitable for mixing concrete and must be cleaned before use.

ii. Colour test: to investigate the presence of chemicals that damage the sand.

1. This test was conducted using a 500ml bottle is marked with measurements.
2. Fills up 200ml bottles with sand to be tested. Enter 3% solution of caustic soda and bottles closed with rubber cover.
3. After sodium hydroxide solution is mixed with sand, the bottle was shaken and left for 24 hours. Brown or dark colour indicates sand contains chemicals that may be damaging.
4. Sand is not suitable to be used except after cleaning with water.

2.5.3 Water

Water is one of the most important elements in construction but people still ignore quality aspect of this element. The water is required for preparation of mixing of cement concrete, mortar and for curing work etc. during construction work. The quality and quantity of water has much effect on the strength of mortar and cement concrete in construction work.

2.5.3.1 Roles of Water

Water plays three roles in the brick work:

1. Water spread the cement. So, that every grain of sands or aggregates covered closely.
2. Water gives pleasure working on a mix of brick.
3. Water is the agent of chemical reactions in cement to bind all the sands or aggregates in the mix of brick.

2.5.3.2 Quality of Water

For mixing and curing the water used should be clean and free from injurious quantities of acid, sugar, alkali, vegetable growth, oils, organic materials and other substances that may be destroy to bricks, steel, concrete and stone. Potable water generally considered satisfactory for mixing. The pH value should not less than 6 because less than 6 it means the water in acid condition.