COMPRESSED CONCRETE BLOCK USING CRUSHED LATERITE BRICK AS SAND SUBTITUTION

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ABSTRACT

During last decades, it has been recognized with growing concern that wastes from a construction are of large volume and that this volume is increasing year by year. The problem of waste accumulation exists worldwide. Most of waste materials are left as a landfill materialor illegally dumped. Environmental impact can be reduced by making more sustainable use of this waste by recycling process. Main objectives of this research are to determine the mechanical properties of crushed laterite brick and also to determine the compressive strength of concrete block using crushed laterite brick as sand substitution. Based on these two objectives, all sample will undergoes certain process starts from finalizing mix design, then followed by preparing samples that covered sieving, batching, mixing, compacting and end with curing process. At age 7 days and 28 days all sample will be tested on their compressive strength by compressive test method. Data obtained from compressive test shows that by substituting sand with crushed laterite brick, the strength of concrete block can be enhance. As a conclusion crushed laterite bricks meets all the requirements to be used as sand substitution in concrete block.

ABSTRAK

Lebih sedekad yang lalu, kebimbangan terhadap pembuangan sisa dari pembinaan dalam jumlah yang besar bertambah dan jumlah ini semakin meningkat dari tahun ke tahun. Masalah pengumpulan sisa wujud di seluruh dunia. Kebanyakan bahan-bahan buangan yang tinggal sebagai materialor tapak pelupusan sampah yang dibuang secara haram. Kesan alam sekitar dapat dikurangkan dengan penggunaan lebih mapan sisa ini melalui proses kitar semula. Objektif utama kajian ini adalah untuk menentukan sifat-sifat mekanikal bata laterit yang dihancurkan dan juga untuk menentukan kekuatan mampatan blok konkrit yang menggunakan bata laterit yang dihancurkan sebagai gantian kepada pasir.Berdasarkan kedua-dua objektif, semua sampel akan menjalani proses tertentu bermula dari memuktamadkan reka bentuk campuran, kemudian diikuti dengan menyediakan sampel yang meliputi pengayakan, pencampur, membancuh, memadat dan selesai dengan proses pengawetan. Pada usia 7 hari dan 28 hari semua sampel akan diuji terhadap kekuatan mampatan mereka dengan kaedah ujian mampatan. Data yang diperolehi dari ujian mampatan menunjukkan dengan menggantikan pasir dengan batu-bata laterit yang dihancurkan, kekuatan blok konkrit boleh ditingkatkan. Kesimpulannya, bata laterit yang dihancurkan memenuhi semua ciri-ciri yang diperlukan sebagai pengganti pasir dalam blok konkrit.

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CHAPTER 1

1.0 INTRODUCTION

During last decades, it has been recognized with growing concern that wastes from a construction are of large volume and that this volume is increasing year by year. The problem of waste accumulation exists worldwide. Most of waste materials are left as a landfill materialor illegally dumped. Environmental impact can be reduced by making more sustainable use of this waste.

Waste management is one of the priorities of every community and it has become evident that good waste management can enhance the quality of life. the main principle of a quality waste management is in lowering the mass production of new, finding ways to recycle and reuse existing, and safe and ecologically acceptable depositing of unused waste.

Laterite can be consider as one of the natural resources material that has a lot of benefit in construction due to the low cost process and has high workability while it always been forgotten and be consider as waste in construction. Laterite also comes with adequate compressive strength to be used as load bearing wall as normal as concrete block has been used.

The used crushed laterite brick can be utilized as a subtitution to the aggregates in cocncrete mixture. This research can help to reduce the percentage of brick in construction waste and helpfull in preserved natural material since recycling concept is apply in this project.

1.1 PROBLEM STATEMENT

Recycling and reuse of waste materials is a topic of global concern and of great international interest. The urgent need for recycling is driven mainly by environmental considerations, due to the increase scarcity of natural resources and the increasing cost of land fill in most countries. Construction and demolition (C&D) materials are generated by regeneration of infrastructure such as demolition activities of buildings and construction activities of tunnels and roads. Recycled crushed brick, crushed concrete, crushed basaltic rock are viable substitute materials for natural construction materials in engineering applications. However, there have only been a few attempts to utilize recycle brick in concrete mixture.

Nevertherless, the subtituion of recycled crushed laterite brick to the aggregate in concrete mixture will be helpfull to improve the technology of concrete used in construction. This idea will focus on strength of concrete and their workability of the concrete.

1.2 OBJECTIVE

The purpose of this study is to minimized clay brick as wastage in construction and utilized the used of recycled laterite brick as subtitution to the aggregates in concrete mixture. In order to archeive the result in this study, the objective are:

1) To determine the mechanical properties of crushed laterite brick.
2) To determine the compressive of concrete using crushed laterite brick as aggregates.

1.3 SCOPE OF STUDY

This study will cover most of the laboratory work that involve in concrete work suck as curing and also compressive test for concrete.

1) Only laterite brick which interchangable to clay brick will be used in this project, those bricks will be crushed and seived to 6mm size.
2) Portland cement 25 will be used for all samples and mixtures.

For compressive test, this project will be using BS 1881 as refering standard. The size for all compressed concrete block will be 300mm x 125mm x 112mm.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

What is concrete?

Concrete most widely used as construction material all over the world. Concrete can be define as a mixture of cement, sand, aggregate and water. In certain situation, mixture will be added to fullfill the characteristic of concrete to be archived. A good quality of concrete is directly related to the high quality of material used in mixing process. In construction normally the workability, durability and strength of concrete will be the first characteristic that will be focus on to ensure the good result in construction. Hardened concrete can be done by the chemical reaction between material in mixing concrete. The strength of concrete will increase due to the age of concrete it self.

Concrete is common material used in construction because of the economical approach and also concrete is easy to handle compare to the

other material. Concrete can be molded in any shape or size depends on needed.

The maintenance cost for concrete are also minimal and the effect of corrosive and the weathering are also minimal. The most important charactheristic is concrete has high compressive strength but has very low tensile strength. The use of reinforement steel in commonly help to overcome this problems. Concrete also sensetive due to the changes in temperature, concrete can expand in hot temperature.

What is laterite brick?

Laterites are soil types rich in iron and aluminium, formed in hot and wet tropical areas. Nearly all laterites are rusty-red because of iron oxides. They develop by intensive and long-lasting weathering of the underlying parent rock. Tropical weathering (laterization) is a prolonged process of chemical weathering which produces a wide variety in the thickness, grade, chemistry and ore mineralogy of the resulting soils.

When moist, laterites can be easily cut with a spade into regular-sized blocks. Laterite is mined while it is below the water table, so it is wet and soft.Upon exposure to air it gradually hardens as the moisture between the flat clay particles evaporates and the larger iron salts lock into a rigid lattice structure and become resistant to atmospheric conditions. The art of quarrying laterite material into masonry is suspected to have been introduced from the Indian subcontinent.

Normally in construction, the intention to maximized the use of aggregates in concrete mixture always a priority in order to reduce cost as the price of aggregates is cheaper compared to the cement binder. Aggregate

occupies between 70 % and 80 % of the total concrete volume, and because of that the strength of aggregate is very important o the final strength of the concrete. [Ivana & et.al].

2.2 CONCRETE MIX DESIGN

In simplest form, concrete in a mixture of cement , aggregates and water. In this study portland cement will be used while recycled crushed clay brick will be used as aggegates subtitution in concrete mixture. By using recycle crushed brick as an aggregates in concrete mixture, it is possible to design concrete mixtures in the same way as the design mixtures for commonly used aggregates.

The bond between brick and mortar is largely influenced by the tug-of- war between the capacity of the brick to absorb water and the ability of the mortar to retain the water. This water is needed for the proper hydration of cement where the mortar contacts the brick. If the brick wins this tug-of-war (and sucks the water too quickly from the mortar), the mortar strung out for the bed joint stiffens so rapidly that the bricks in the next course cannot be properly bedded. If the mortar retains too much water the bricks tend to float on the mortar bed, which makes it difficult to lay plumb walls at a reasonable rate. In either case there will be poor bond. High suction bricks require a mortar with very high water retention, making it necessary to shorten the length of the bed joint or wet the bricks to reduce their suction. It should be noted however that wetting the bricks can lead to efflorescence in the brickwork, Bricks - Influence of Initial Rate of Water Absorption on Mortar Bonding <http://www.azom.com/article.aspx?ArticleID=1444> (28/11/2011) .

The water absorption of recycled crushed brick is estimated to a value between 22 % and 25 % by weight in relation to the material in its dry state. From the studies of absorption recycled bricks aggregates, it was concluded that recycled crushed brick will be almost saturated with water after water submission in 30 minutes. Submersion for a further 24 hour produces only an increase of about 2 % water absorption. [Hensen 1992]

By using recycled aggregates, the dust content must be taken into consideration because it can cause a reduction in workability. In that case, if extra water has to be added to the concrete mix to increase the workability, the loss of strength will be evident. If the reduction in strength is limited to around 5%, the maximum amount of dust should be limited also. That limitation could be in ranges from 5%of the total aggregate content for low workability with a coarse grading, 10 % for low workability with fine grading and 20 % for a high workability with fine grading. [Khalaf & De Venny 2004]

As using crushed recycled brick as aggregates, concrete will has a lower density due to the density of recycled brick that 8-17% than commonly used concrete that situation will increase the percentage of entrained air. [Debieb & Kenai 2008]

2.3 PROPERTISE OF CONCRETE WITH CRUSHED LATERITE BRICK AS AN AGGREGATES

2.3.1 COMPRESSIVE STRENGTH

Compressive strength is the capasity of material to withstand direct axial load given. Generally, using crushed recycled brick as aggregates will couse low compressive strength due to higher water absorbtion compared to normal concrete.

By using Ordinary Portland Cement or Sulphate Resisting Portland Cement the compressive strength of concrete can be estimated based on ordinary concrete test mixes made with free-water cement ratio of 0.5 and the value of compressive strength should be increasing due days and normally this test will be conducted when concrete's age 3 days, 7 days, 28 days and 91 days.

TABLE 1 : Type of Cement And Their Compressive Strength.

TYPE OF CEMENT	**TYPE OF COARSE AGGREGATE**	COMPRESSIVE STRENGTH (N/mm^2) AGE (DAYS)			
		3	7	28	91
Ordinary Portland Cement @ Sulphate Resisting Portland Cement	Unchrushed	22	30	42	49
	Crushed	27	36	49	56
Rapid Hardening Portland Cement	Unchrushed	29	37	48	54
	Crushed	34	43	55	61

$1\ N/mm^2 = 1\ MN/m^2 = 1$ Mpa

Increasing of the rate of substitution natural aggregate with brick decreases the compressive strength. After 28 days o , the decreasing in compressive strength was in the order of 10-35%for the recycled coarse aggregates concrete in comparison with an ordinary concrete. [Debieb & Kenai 2008]. Strength of concrete with crushed recycle clay brick as aggregates can be estimated based on strength of original brick.

In this situation, type of recycled brick must be first determined for better result estimation. For example, engineering brick is one of the best type for this study because it was designed to withstand load.

2.4 PREVIOUS TEST OF USING FINE AND COARSE CRUSHED LATERITE BRICK AS AGGREGATES

Clay brick is common material used in construction. In Malaysia, the used of clay brick in construction has refer to BS 3291: 1985 (Specification for Clay Brick). Further, clay brick can be classified into three categories ; common brick, facing brick and engineering brick based on their properties and strength.

TABLE 2 : Type Of Brick And Their Mechanical Properties.

Class	Compressive strength. N/mm^2	Water absorption. % by mass
Engineering A	≥ 70	≤ 4.5
Engineering B	≥ 50	≤ 7.0
Damp-proof course 1	≥ 5	≤ 4.5
Damp-proof course 2	≥ 5	≤ 7.0
All others	≥ 5	No limit
NOTE 1 There is no direct relationship between compressive strength and water absorption as given in this table and durability. NOTE 2 Damp-proof course 1 bricks are recommended for use in buildings whilst damp-proof course 2 bricks are recommended for use in external works (see Table 13 of BS 5628-3:1985).		

Some work has been carried out into the possibility of using crushed brick as an aggregate in concrete but most of the research dates back to just after WorldWar II. Only a small amount of work has been carried out using the types of brick that are commonly used in construction today and there is little knowledge on the subject in the United Kingdom and other countries.

Recently, Akhtaruzzaman and Hasnat (1983) carried out some research using well burnt brick as coarse aggregate in concrete. They found that it was possible to achieve concrete of high strength using crushed brick as the coarse aggregate. [Khalaf and De Venny 2004] Their research was mainly concentrated on determining the mechanical properties of brick aggregate concrete, rather than the properties of the brick aggregate itself. Khaloo (1994) used crushed clinker bricks as the coarse aggregate in concrete. He reported only a 7% loss in concrete compressive strength compared with concrete made with natural aggregates. In contrast to this decrease in strength, there is a decrease in the unit weight of crushed brick concrete of 9.5%.

In Ferdowsi University in Iran, one research on using crushed clay brick as aggregate in concrete has been made. Brick was taken from demolition building. Discharged brick aggregate was sieved according to ASTM C33 designation. Coarse aggregate were sized-screened to a maximum 19 mm. The fine grading must be within the fine aggregate zone specified by ASTM. The lower bound of this zone was selected since the grading of crushed aggregate in the laboratory jaw crusher was very close to this boundary.

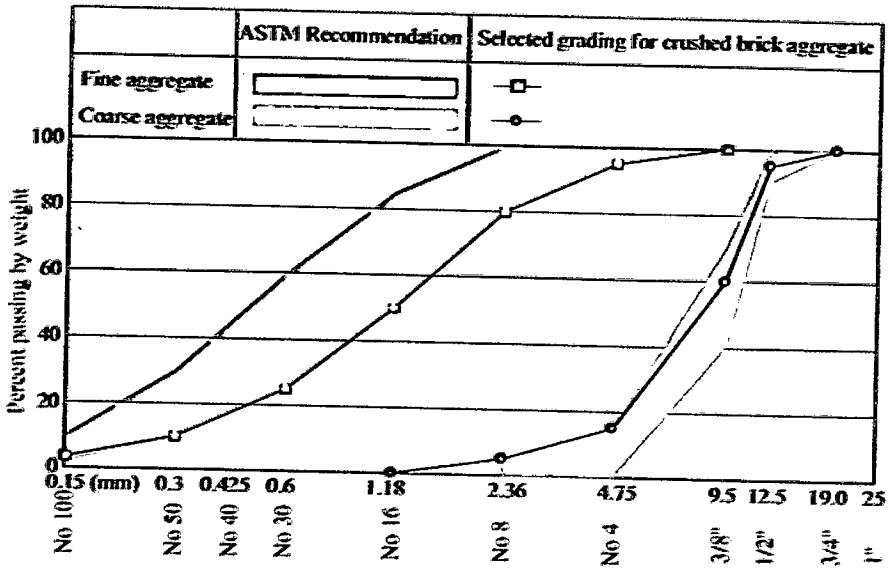

FIGURE 1 : Fine and course aggregate grading according to ASTM C33.

Figure 2 illustrates the selected grading of fine and coarse aggregate based on ASTM C 33. Before adding water, coarse and fine aggregates and cement were placed in the mixer and mixed for about 1 min. Then water was added gradually for a period of about of 2 min, and then the concrete was mixed for 3 minutes to produce a uniform mix.

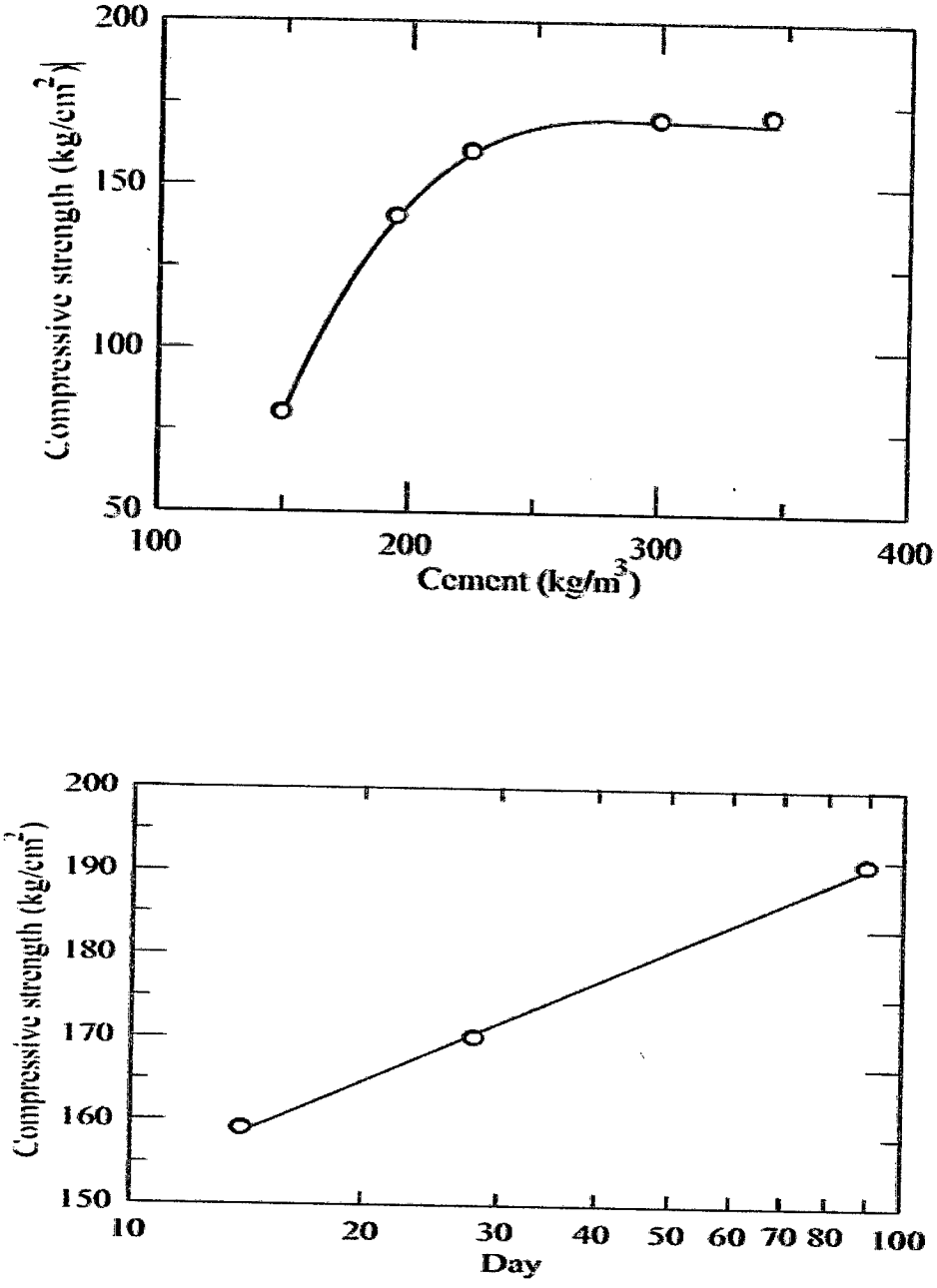

FIGURE 2. Compressive strength of concrete made with crushed brick as aggregate.

A water cement ratio of w/c=0.5 was selected for different cement content (150-350 kg/m3). The prescribed constant water ratio led to workability with slump varying from 40 mm to 90 mm respectively. The