INVESTIGATION OF ABUNDANT THREATED SEA SAND IN CEMENT BRICK WITH THE RATIO OF 1: 6 WITH DIFFERENT PERCENTAGES

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ABSTRACT

Nowadays the high demand of river sand is an indication of development especially for the construction industry. Therefore, it is needed an alternative way in fulfill this condition. However, from the study, it stated that the quantity of the river sand became slowly decrease. Thus, the alternative that is viable to replace the river sand is by using the sea sand. In applying this alternative, the chloride content and the sea sand shape particles are the major problems that should be taken note. High level of chloride content is possibility affecting the strength of the construction structure. Therefore the sea sand that will used should be washed first to reduce the chloride content for a particular period of time. In the basic structure material, they are already having their own limitation of chloride level. This is to ensure that the construction structure such as reinforcement bars would not corrode in the concrete. In the cement brick manufacture, the high rate of chloride content will affected the strength of the brick because the Portland cement also have its own chloride content. Brick is one of the basic normal structures in the building. In this study, there are several experiments need to be performed to determine the chloride content and the grading size of the abundant treated sea sand (ATSS).The compressive strength and the water absorption testing also need to be performed in order to study the comparison strength by using river sand and the sea sand. The ratio cement to sea in this study is 1:6. The brick size that been used was 215mm x 102.5mm x 65mm which is work size stated in British Standard (BS). The result showed that the properties and strength of the sea sand brick samples have exceeded the minimum strength required.

ABSTRAK

Pada masa kini , permintaan yang tinggi terhadap pasir suangai merupakan satu petunjuk pembangun terutamanya dalm industry pembangunan.Oleh yang demikian, ia adalah perlu untuk memnuhi keperluan semasa ini. Walau bagaimanapun, mengikut kepada kajian semasa, peratusan kandungan pasir pantai semakin menurun. Oleh itu, alternatif lain yang boleh ditekankan untuk menggantikan pasir sungai ialah dengan menggunakan pasir pantai. Dalam mengapalikasikan alternatif ini, kandungan klorida dan juga pengkelasan saiz pasir laut merupakan masalah utama. Kandungan klorida yang banyak juga akan melemahkan sesuatu struktur binaan. Pasir pantai yang akan digunakan terlebih dahulu akan dibasuh dan dibilas untuk satu jangka masa bagi mengurangkan kandungan klorida Di dalam sesuatu asas structur bahan, kadar kandungan klorida yang dibenarkan sudah ditetapkan. Ini adalah untuk memastikan struktur binaan seperti besi tetulang tidak terkakis di dalam konkrit. Di dalam pembuatan bata simen, kadar kandungan kloride yang tinggi juga akan mengurangkan kekuatan bata itu kerana simen Portland juga mengandungi kandungan klorida. Bata merupakan satu asas normal yang ada dalam sesuatu bangunan. Dalam kajian ini, beberapa ujikaji perlu dijalankan untuk menentukan kadar kangunan klorida dan juga pengkelasan saiz pasir pantai. Ujian mampatan dan penyerapan air juga dijalankan untuk membandingkan kekuatan antara pasir sungai dengan pasir laut bagi tujuan penilaian. Nisbah simen kepasa pasir dalam kajian ini adalm 1:6. Saiz bata yang digunakan ialah 215mm x 102.5mm x 65mm iaitu saiz kerja merujuk kepada Standard British. Keputusan menunjukkan bahawa ciri-ciri kekuatan sample pasir pantai telah melebihi minumum piawaian yang telah ditetapkan.

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CHAPTER 1

INTRODUCTION

1.1 Background of the study

Nowadays, Malaysia is one of the world developing countries that develop lots of invention and innovation in the technology. For example, Petronas Twin Tower, Kuala Lumpur Tower, Kuala Lumpur International Airport (KLIA) and also the Smart Tunnel are the symbolic of Malaysia for its construction development. In term of engineering technology, Malaysia also produce lots of engineers, researchers and create lots of implementations regarding to the technology in construction industry.

In most common structure, brick are really needed to foam the structure of the building. Therefore, brick is one of the important component or material needed for building construction especially for building structures. Normally brick can be classified into two types which are clay brick and sand brick. Until now, there are lots of researches and further implementations of brick manufacturer found by the researchers. Brick very unique and it is only man made building materials that testify to their use

since the early human civilization. It can be attractive appearances and also have superior properties such as compressive strength and durability.

Sand is a main type of aggregate that used in manufactured of Portland cement concrete, masonry and also brick in the construction sector. For the sand brick manufacture, river sand is the raw material for the overall manufacture other than water and cement. The demanding use of sand in construction industry lead the used of river sand widely. Now a days, the quantity of river sand become decrease and hard to find the cleanliness. Furthermore the river sand also hard to get the absence of salinity

Abundant Treated Sea Sand (ATSS) can be use as an alternative way for replacing the overall used of river sand. It is the reliable replacement for river sand in terms of cost, impact environmental impact and also its availability of sand properties. By using ATSS and mixing with different type's ratio and percentage of ATSS, the comparison of it results and analysis can be made whether it is suitable for construction material. It is great practical significance to developing new product for civil engineering works.

1.2 Problem Statement

Sand is one of the principal components of brick. The cost of sand brick is increasing due to the high demand on the construction industry. Furthermore, if using the laterite sand as the material in brick, the cost becomes extremely high.

This study is conducted and constructed in order to know the effectiveness of the ATSS as the replacement of the normal sand in brick making with different percentages of the ATSS. The properties of sea sand and the cement itself are important to make sure that the combination between sea sand, sand and water are properly combine with each other.

With the ratio 1:6 of cement-sand and percentage constitutions, the ATSS is been taken to add and combine with the river sand in brick making. The selection of ratio must be done properly by considering the result of the quality of brick. The scope of this study is based on the source of material added and proportion of the material according to British Standard 3921 1985 (BS3921 1985).

1.3 Objectives

The objectives of this study are:

i. To measure the compressive strength of bricks ratio 1.6 with different percentage of ATSS replacement.

ii. To determine the water absorption of bricks 1.6 with with different percentage of ATSS replacement

1.4 Scope of Study

The study is basically focused on the east peninsular of Malaysia which is, Pahang, Terengganu and Kelantan. For the sample, it was taken from the Teluk Lipat which is located at Dungun, Terengganu. During the sample taking, it only involves the sea sand that been spread near the road or the sea shore and not involving the sea sand that close to the water.

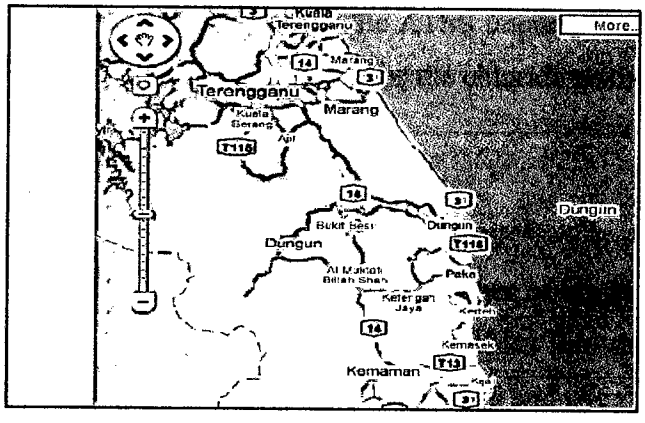

Figure 1.1: Location of samples taken

Source: Anonymous 2010a1

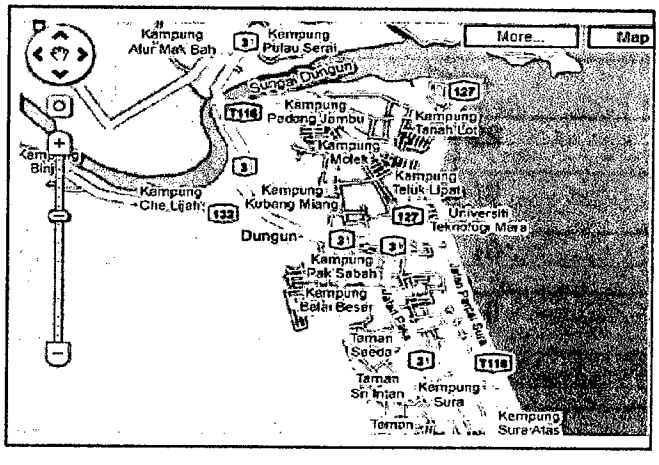

Figure 1.2: Location of samples taken

Source: Anonymous 2010a2

The constitutions of the properties of sea sand might be change because of the weather changes and also pollution circumstance. The entire sample taken will sieve to classify into grade of sizes. Test method for compressive strength of brick is based on BS3921 1985. For the water absorption of brick, the test is based on BS3921 1985.

Abundant sea sand that will use is the treated sea sand where the abundant sea sand that been taken from the sea shore is treated by using the natural water and classify as Abundant Treated Sea Sand (ATSS). The percentages that will use are between 0% as the control percentages until up to 20%. For the ATSS impurities, this experiment only considered for chloride testing only. Therefore for the chloride testing, HACH programs DR5000 will be run.

Table.1.1 below shows the detailing of the number of bricks that needed for the overall thesis. For every percentages research, it is divides into three different day of testing which are seven days testing, fourteen days testing and twenty eight days testing. For every single percentage, the number of bricks needed is 10.

Table 1.1: The Number of Bricks Needed for The Compressive Testing.

Percentage ratio	**Days**	
	7	**28**
0%	10	10
5%	10	10
10%	10	10
15%	10	10
20%	10	10
Total	**100**	

The total 100 bricks as mentioned in Table 1.1 only for compressive testing. With these numbers of bricks, water absorption also can be used at the same time. The value of its dry and wet weight is been recorded before the compressive testing is been run.

Table 1.2 below showed that the number of bricks required for testing regarding to British Standard.

Table 1.2: Number of Bricks Required for Testing

Purpose	Appendix reference	Number of bricks required for sample
Dimensional checks	A	24 (available for subsequent tests)
Determination of soluble salts content	B	10
Determination of compressive strength	D	10
Determination of water absorption	E	10 (available for subsequent compressive strength tests)

Source: BS 3921, 1985

1.5 Significance of Study

Sea sand one of the largest sources of sand on earth. Generally beach covered almost three quarter of the land. This study is important to know the strength in the sea sand that will affect the brick block. Sea sand is not commercially used since its interior properties which are chloride can affect the structure of the material by damaging it with chemical attack.

This study is worthy to investigate because sea sand is finer than river sand and easy to get the material and crucial to know the factor in the sea sand that effect cement brick structure. Laterite sand is the most expensive sand because the type of sand are really give a good strength on the structure but it will course extremely high cost. If this study is reliable, ATSS can be used widely in brick making and decrease cost in construction progress.

CHAPTER 2

LITERATURE RIVIEW

2.1 Introduction

In the construction industry, sand is one of the most valuable materials that really needed to run the construction. Sand is the material in concrete production and sand also is the main constitutions in sand brick production. Concrete also apart of construction materials and is a man-made material. Therefore it is the most widely building material in the construction industry.

In the production of sand brick, normally river sand been used for the manufacturer. River sand have a grain textures that have many surface where it good to attach each other when the cement is added. Compare to the sea sand, river sand are larger than the sea sand.

Sea sand nowadays is been adapt to implement the new technology and uses in the manufacturer. Therefore this study tries to come with another use of sea sand to be

commercialized by sea sand brick. According to Naalir (2006), he stated that some steps have been taken to popularize the use of sea sand for construction. This is because the shortage of sea sand at certain place.

Nowadays, abundant sea sand is one major environmental aspect that been taken note by the local authority. Therefore the study is really needed in order to act an action to this environmental problem and wastage problem and finally apply it for industry especially in construction.

2.2 Sand

According to the Selvaraju and Pushpavanam (2000), sand and brick used for construction activity in the Indian Institute of Technology Madras was taken without any chemical treatment. The bricks were broken down to increase the surface area. The sand and brick particles were sieved with mechanical sieves and the fraction containing particle size less than 710 um was used for experiments.

The desired fraction was then washed withwater and then decanted. After settling, the water was poured out and the sand was taken for drying. After drying at 85 °C, the solid particles were ready for use as the adsorbent. Analysis of the physical characteristics of sand included specific surface area, pore specific volume and pore size distribution.

2.3 Sea Sand

On the previous research held on by Lee (2002), he finalize that sea sand has become a potential resource capable to supplying fine aggregate material for domestic civil engineering and construction usage and sea sand mainly contains much salinity as sodium chloride. He also stated that if the salt is not treated and sea sand is directly utilized for civil engineering and construction concrete project, the durability of the structural may be affected and as the result the concrete might be swelling, precipitating, sulfating and other adverse consequences. Therefore, the salt content of the sea sand must be eliminated before it is utilized to avoid the potential hazards (Lee, 2002).

According to Shantha (2006), the top most layers of sand dunes contain higher chloride content due to continuous exposure to sea breeze. However, when sea sand is actually utilized, the first problem encountered is the salt contained in the sea sand. A distinction must also be made between sea sand and sand deposits in dry coastal areas. The latter would tend to have very high chloride contents resulting from salt spray and evaporation over long periods of time.

2.4 Sieve Analysis Sea Sand

The sieve analysis of sea sand is to determine the gradation of sea sand such as the distribution of aggregate particles, by size and within a given sample. The Figure 2.1 shows the sieve analysis of sea sand that use as concrete aggregate.

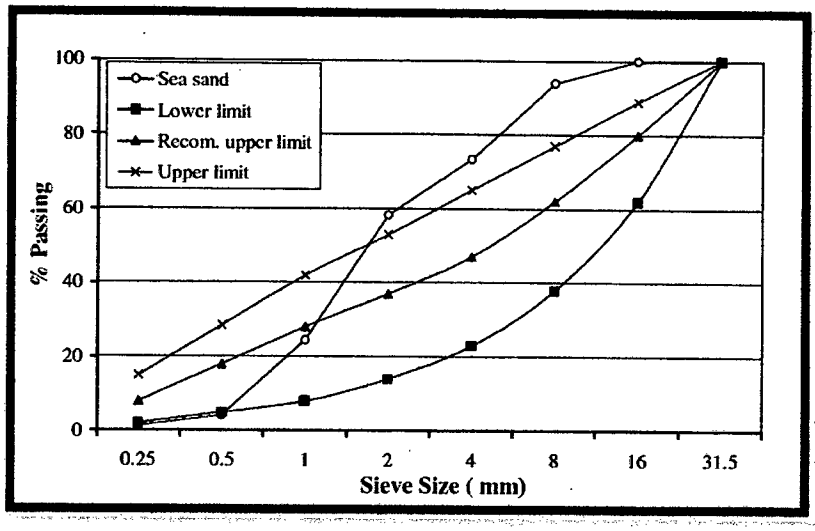

Figure 2.1: Average Granulometric Curve of a Typical Sea Sand Used As Concrete Aggregate

Source: H.Cagatay,(2004)

From the Figure 2.1, it illustrated that the percentage of passing sea sand to get 100% on sieve analysis. It also showed that the sieve size is quickly than other material. It is definitely cause by the sea sand which is a fine aggregate that less retain in sieve size. Basically, sieve shakers function to provide sieving thoroughness within a reasonable time and it also have to provide a vertical or lateral and vertical motion to the sieve, causing the particles thereon to bounce and turn so as to present different orientations to the sieving surface.

Table 2.1 shows the key characteristics of the grading curves for various offshore sand samples. This shows that differences between the typical, medium and coarse offshore sand samples are small, with a D_{50} value around 0.6 mm, while the fine sample is considerably different. A D_{50} value of around 0.6 mm is very good for concrete production. Such values tend to be much lower in the European offshore sand deposits, say between 0.2 and 0.4 mm (Dias, 2006).

Table 2.1: Grading Characteristics of Fine Aggregate

Characteristic	Sea sand types			
	Typical	Coarse	Medium	Fine
<0.60 mm (%)	44	42	49	85
<0.15 mm (%)	2.6	2.5	2.7	12
D50 (mm)	0.63	0.66	0.60	0.21

2.5 Application of Sea Sand in Construction

Dias (2007) stated that although offshore sand is reportedly used in many countries such as the UK, Continental Europe, India, Seychelles and Singapore, most of the documentation regarding its use was found mainly regarding UK practice, and to a lesser extent regarding European practice .

From a research by Dias (2002) , he stated that study done on Sri Lankan beach sands has also shown fairly high chloride levels in some samples. He also said that the use of sea water for batching or for curing would also promote corrosion; such practices should not be resorted to. In the UK around 11% of its aggregate extraction is from offshore sources. In South East England and South Wales, the situation is as high as 30% and 90%, respectively. While much of this aggregate is processed (inclusive of washing), it is largely unprocessed sand (together with land based coarse aggregate) that is used on the West Coast and along the Bristol Channel (Dias, 2007).

According to Dias (2002), he clarify that the use of such aggregate in concrete has not caused any major durability problems in the UK during the past 60 or more years of its use. In fact, chloride related durability problems in the UK have largely been due to the use of Calcium chloride as an accelerator up to a dosage of 0.15% by weight of cement, a practice that had been permitted up to 1977. The use of de-icing salts also causes chloride related durability problems in many countries. It shows that with well processed sea sand, they are pretty safe to human's life and property(Dias *et al*, 2002)

2.6 Brick

Brick have their own characteristics. It included compressive behavior, water absorption behavior and also durability behavior (BS3921, 1985)

2.6.1 Compressive Characteristics of Brick

The compressive strength of perforated bricks and hollow blocks is determined by dividing the ultimate load by the gross plan area of the unit, as if it were solid. This compressive strength should therefore be used in obtaining the value of compressive strength, fk from Table 2.1. Table 2.1 shows application of masonry to build with standard format bricks complying with the requirements of BS 187, BS 6073-1 or BS 3921.

For normally bonded masonry can be defined in terms of the shape and compressive strength of the structural units and the designation of the mortar. The values

given in Table 2 inclusive may be taken to be the characteristic compressive strength, *f*k, of walls constructed under laboratory conditions tested at an age of 28 days under axial compression in such a manner that the effects of slenderness may be neglected (Cavalieri, 2000).

Table 2.2: Characteristic Compressive Strength of Brick Masonry, *f*k,

(a) Constructed with standard format bricks									
Mortar designation	**Compressive strength of unit (N/mm^2)**								
	5	**10**	**15**	**20**	**27.5**	**35**	**50**	**70**	**100**
(i)	2.5	4.4	6.0	7.4	9.2	11.4	15.0	19.2	24.0
(ii)	2.5	4.2	5.3	6.4	7.9	9.4	12.2	15.1	18.2
(iii)	2.5	4.1	5.0	5.8	7.1	8.5	10.6	13.1	15.5
(iv)	2.2	3.5	4.4	5.2	6.2	7.3	9.0	10.8	12.7
(b) Constructed with blocks having a ratio of height to least horizontal dimension of 0.6									

Source: BS5628-1, 1992

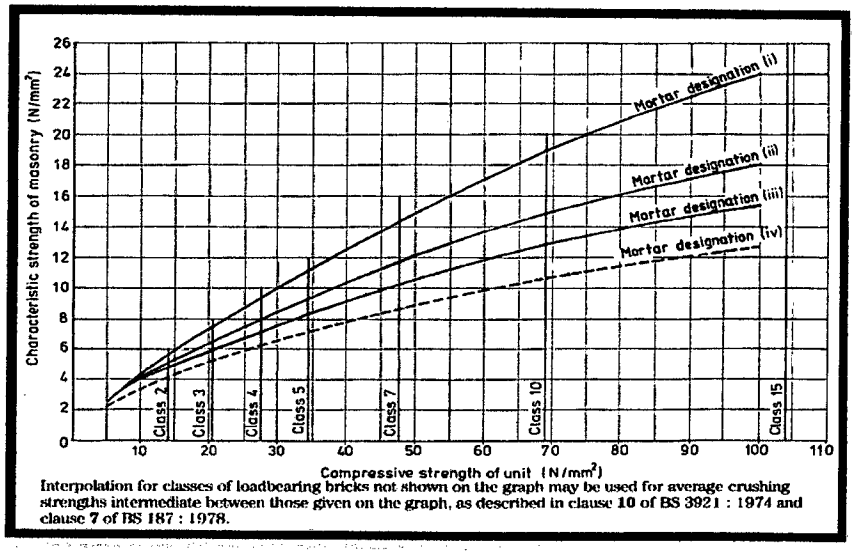

Figure 2.2: Characteristic Compressive Strength of Brick Masonry, *f*k

Source: (Cavalieri, 2000)

2.6.2 Water Absorption Characteristics of Brick

The method for the determination of water absorption specified in this standard is the 5 h boiling test. Methods of test by 24 h cold immersion and absorption under vacuum are also used as works control tests only. The results obtained from these tests are generally lower than, and are not proportional to, those obtained using the method given in this standard, nor are they equivalent to each other.

Table 2.3: Classification of Bricks by Compressive Strength and Water Absorption in N/mm^2

Class	Compressive strength (see 2.1)	Water absorption (see 2.2)
	N/mm^2	% 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 limits

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).

Source: BS5628-1, 1992

2.6.3 Cement Brick

Cement brick is a construction material which is used to bond bricks together. It is also known as brick mortar or masonry cement, and it comes in a variety of styles for different applications. Home supply stores usually sell brick cement, and can order