INVESTIGATION OF ABUNDANT TREATED SEA SAND (ATSS) WITH DIFFERENT PERCENTAGES IN CONCRETE BRICK MAKING RATIO 1:3

ABDUL RAHMAN BIN OTHMAN

A Final Year Project submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Civil Engineering

Faculty of Civil Engineering and Earth Resources
Universiti Malaysia Pahang

NOVEMBER 2010

ABSTRACT

This study is to investigate the Abundant Treated Sea Sand (ATSS) with different percentages as material replacing in concrete brick making ratio 1:3. The abundant means that it is supplies are more than sufficient. By relating to this study, the ATSS is same as normal sea sand but it was located far away from sea water exposure. The field of studies covers crucial parameters in determining the flexural and drying shrinkage. A total of 200 ATSS concrete bricks with dimensions of 225 mm in length, 105 mm in width, and 75 mm in depth were prepared and been divided into two group with an equal numbers according to different type of testing. Every of 100 ATSS concrete brick in each of the test had five different replacements of ATSS percentages. There were 20%, 15%, 10%, 5% and 0% as the control mixture. All the samples were only cured under water curing for 7 and 28 days before testing. The water to cement ratio of 0.40 and cement to aggregates ratio 1:3 were applied to all of the sample mixtures. In accordance to the drying shrinkage testing, the 10% ATSS mixture shows the highest drying shrinkage strain compared to other mixture at indoor condition while 0% ATSS mixture shows the greatest drying shrinkage strain reading than other mixture at outdoor condition. By according to the BS 6073, it requires 0.65 MPa as a minimum flexural strength for the building materials to be used in structural applications. The final result representated that the control sample did not achieved the minimum flexural strength and the ATSS mixtures also did not meet or exceed the flexural strength of control mixtures. The study finally demonstrated that the period of abundant sea sand treated must be extended due to get the lower chloride content.

ABSTRAK

Kajian ini adalah untuk menyiasat pasir pantai melimpah yang dirawat atau dikenali sebagai 'abundant treated sea sand' (ATSS), dengan peratus yang berlainan sebagai bahan pengganti di dalam bata konkrit dengan nisbah simen kepada pasir 1:3. Melimpah bermaksud bekalan yang melebihi dari sedia ada. Dengan perkaitan terhadap kajian ini, ATSS adalah sama seperti pasir pantai tetapi ia dibezakan dengan lokasi ATSS yang jauh daripada pengaruh air laut. Bidang kajian ini merangkumi parameter-parameter dalam menentukan ujian kekuatan lentur dan susut pengeringan. Sejumlah 200 ATSS bata konkrit yang berlainan peratus iaitu 20%, 15%, 10%, 5% dan 0% dengan ukuran 225mm panjang, 105mm lebar dan 75mm dalam disediakan dan dibahagikan kepada dua kumpulan dengan bilangan yang sama rata berdasarkan perbezaan jenis ujian. Semua sampel hanya dirawat menggunakan perawatan air untuk 7 dan 28 hari sebelum ujian dijalankan. Nisbah air kepada simen adalah 0.4 dan simen kepada aggregate adalah 1:3 dan diaplikasikan kepada semua sampel. Berdasarkan ujian pengecutan, 10% ATSS menunjukkan pengecutan yang paling tinggi di kawasan dalam menakala 0% ATSS menunjukkan pengecutan yang paling tinggi di kawasan luar. Dengan merujuk kepada BS 6073, nilai minimum bagi kekuatan lentur adalah 0.65 MPa. Hasil akhir bagi sampel kawalan dan sampel ATSS tidak menepati dan melepasi nilai yang ditetapkan BS 6073. Kajian ini dapat disimpulkan bahawa masa rawatan pasir pantai melimpah mesti dipanjangkan tempoh rawatan untuk mendapatkan nilai klorin yang paling rendah untuk membolehkan penggunaan ATSS yang sesuai di dalam penggunaan di dalam konkrit.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

ASS	-	Abundant Sea Sand
ATSS	-	Abundant Treated Sea Sand
ASTM	-	American Society for Testing and Materials
$CaCO_3$	-	Calcium Carbonate
Ca^{+2}	-	Calcium
Cl^{-}	-	Ion Chloride
DMS	-	Dredged Marine Sand
EN	-	European Standard
FKASA	-	Faculty of Civil Engineering and Earth Resources Laboratory
K^{+}	-	Kalium
LPW	-	Limestone Powder Waste
$Mg(OH)_2$	-	Magnesium Hydroxide
Mg/l	-	Milligram per Litre

Mg^{+2}	-	Magnesium
NaCl	-	Natrium Chloride
Na^{+}	-	Natrium
OPC	-	Ordinary Portland Cement
PF	-	Plastic Fibres
PVC	-	Poly (vinyl chloride)
SO_4^{2-}	-	Sulphate
SS	-	Percentage Ratio of Sea Sand Replacing
SS-0%	-	Sea Sand Replacing 0% from river sand in concrete brick
SS-5%	-	Sea Sand Replacing 5% from river sand in concrete brick
SS-10%	-	Sea Sand Replacing 10% from river sand in concrete brick
SS-15%	-	Sea Sand Replacing 15% from river sand in concrete brick
SS-20%	-	Sea Sand Replacing 20% from river sand in concrete brick
UPV	-	Ultrasonic Pulse Velocity
WGP	-	Waste Glass Powder

LIST OF APPENDIXES

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Every materials use in building construction have their own advantages like wood which resistance to acids, petroleum products, and salts. Another material like steel have high tensile strength, high modulus elasticity which responsible for economical use of concrete, it also have same temperature coefficient of expansion (imparts zero thermal stresses) and it is cheaply available in abundance. While brick advantages are high in durability and strength, low cost, uniform shape and size, easy handling and availability (Böke, 2008).

Brick usage has been used since ancient times and it has proved with existing of bricks at Egypt pyramid and Great Wall of China. Mostly in the past, bricks made primarily from limestone material. While nowadays there are variety of bricks that manufactured based on concrete, clay, limestone and others.

Many observations by many researchers have been conducted by civil engineers and researchers to improve the brick performance. There are various experiment conducted by researchers as example reusability of sewage sludge in clay bricks which demonstrated that sludge can be constructively and successfully incorporated into bricks with sludge additions (dry basis) (Liew *et al.*, 2004). There are also study of limestone dust and glass powder wastes as new brick material that show the compressive strength, flexural strength, water absorption, unit weight, volume loss values on wear that satisfy the requirements for a bulding materials to be used in the structural applications (Turgut, 2008).

Investigating of Abundant Treated Sea Sand (ATSS) as material replacing in brick is a new study in civil engineering field and therefore the study of this material will be carried out.

1.2 Problem Statement

River sand is the major material in construction industry. Since the increasing of demand and cost of river sand on building materials in the last decade, the civil engineers and researchers have been challenged to convert any excessives material as additional material into useful building and construction materials. Accumulation of unmanaged excessives material especially at the developing countries has resulting in an increase on environmental concern. Uses of such excessives material as building materials appears to be a viable solution not only to solve such environmental problem but also to problem of river sand reduction. Environmental problem that caused by excessive intake of river sand can be explained as effects the flow of the rivers and damaging the island's ecological system.

For this study, ATSS is used as excessive material and will use with river sand as a material in brick. It will be used in the study because it can be categorized as excessives and wastage material which located at coastal sand beaches. It also located at the edge of the road-side and it will cause the affection of environment in terms of scenery and sights for road users. The sample of sea sand will be taken from Dungun and will be seived to classify into grade of sizes. The ratio of cement and river sand that will be used is 1:3. In the end of the study, the experiment result will be used to ensure how the suitability and performance of the brick if this ratio use in brick mixture.

1.3 Objectives

The objectives of this study are:

1. To determine the flexural strength of brick for variable percentage replacement sea sand (0%, 5%, 10%, 15%, 20%).
2. To determine the shrinkage of brick for variable percentage replacement sea sand (0%, 5%, 10%, 15%, 20%).
3. To investigate the suitability percentage (0%, 5%, 10%, 15%, 20%) of ATSS as a material replacing in brick with ratio 1:3.

1.4 Scope of Works

The scope of this study is based on the source of material added and proportion of the material according to British Standard Code 410-1:2000, 5628-2:1995, BS 1199 and 1200:1976, 3148:1980, BS 12:1996, BS 812-103.1:1985, 6073-1:1981 and American Society for Testing and Materials Code ASTM C55 – 09 and ASTM C67 – 09. The next of page shows the scopes of work for this study:

1. The sample of ATSS was sieved to classify into grade of sizes.
2. Testing for shrinkage of brick is by using Demec gauge.
3. Testing for flexural of brick.
4. Only chloride testing for sea sand will be performed in this study.
5. The percentages that will be used is for replacing are 0%, 5%, 10%, 15%, 20% of weight sand.

Shrinkage is influence by several factors such as ambient humidity, type of aggregate, admixtures and other factors. The shrinkage testing for this study needed a specifically unit of bricks. Each of percentage ratio of sea sand replacing have 20 unit of concrete bricks. Then from total 20 bricks are separated into 10 for each 7 and 28 days of curing. Table 1.1 shows the detail or complete information for amount of concrete bricks in shrinkage testing.

Table 1.1: Number of Bricks Needed for the Shrinkage Testing

Percentage Ratio of Sea Sand Replacing (SS)	Indoor	Outdoor
SS-0%	10	10
SS-5%	10	10
SS-10%	10	10
SS-15%	10	10
SS-20%	10	10
Total	100	

Flexural testing is held for concrete brick to determine the limit of material ability to withstand the load imposed. Based on this study, flexural testing also needed 20 unit of concrete bricks for each of percentage ratio of sea sand replacing. Thus, from total 20 unit of bricks are divided into 10 unit for each 7 and 28 days.

Table 1.2: Number of Bricks Needed for the Flexural Testing

Percentage Ratio of Sea Sand Replacing (SS)	Days	
	7	28
SS-0%	10	10
SS-5%	10	10
SS-10%	10	10
SS-15%	10	10
SS-20%	10	10
Total	100	

Therefore the scope of this study is to identify the possibilty of sea sand well mix in concrete brick products.

1.5 Significance of Study

This study is crucial to know the treating of sea sand effects to concrete brick structure. As known, sea sand normally has chloride ion and can influences the steel become weak since the steel is rusted and corrode depend on amount of ion chloride composition in sea sand. Relating to this study, ion chloride still can causes the bad action for concrete. The concrete will be less strength since the ion chloride that origin from sea sand attack to the surface and pore capillary inside the concrete brick. Therefore, this study will be carried out to identify the effect of treating of sea sand.

There are many material in the world that can be categorized as excessives material including sea sand. Sea sand will accomodate the lack of river sand and might reduce the cost to provide a concrete brick. Therefore an alternative way to propose a new concrete brick mixture is needed. This should be a crucial step in the development of construction industry to be more realistic and flexible.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Basically, concrete brick is a material that has been used as engineering material. In manufacturing of concrete brick, it is made with a blend of fine-grain sand, a cementitious material such as polymer cement or Portland cement, and water.

Over recent years, many researches done on the wastage or excessives materials in brick construction. Wastes or excessives materials, such as sludge, limestone powder, glass powder may be used with conventional materials as binder enhancement or aggregate replacement.

Paki (2008) has conducted a study on limestone dust and glass powder wastes as brick material. He stated the Waste Glass Powder (WGP) used in Limestone Powder Waste (LPW) remarkably improves the compressive strength, flexural strength, modulus of elasticity, abrasion resistance, and thermal conductivity of LPW brick samples produced in this study.

By referring to Paki (2008) study, it can be related to this study whether the treated sea sand can improves the flexural strength of concrete brick. In this study, if the using of sea sand in brick is succes, it will show advantages in economical use of river sand and already to be used safely in the construction field. It supported by Paki (2008) study that using admixture like LPW and WGP combination as a fine aggregate in its natural form has allowed economical and environmental-friendly new composite material.

2.2 Concrete

Neville (2008) mentioned that concrete is any product or mass by the use of a cementing medium. Generally, this medium is the product of reaction between hydraulic cement and water. But, these day, even such a definition would cover a wide range of product which concrete is made with several types of cement and also containing pozzolan, fly ash, blast furnace slag, a 'regulated set' additive sulphur, admixtures, polymers, fibres, and others. These concretes can be heated, steam-cured, autoclaved, vacuum-treated, hydraulically pressured, shock-vibrated, extruded, and sprayed.

2.3 Brick

There are many types of brick in the world. It can be categorized with different use like load bearing wall, non-load bearing wall, insulation wall and covering wall. Three types of brick that usually used in construction are sand-lime brick, clay brick and concrete brick.

Concrete brick is made with mix of cement, sand and water and it use steel or wood mould to form it. Normally, the design is not produce a good appearance and come out with rough surface.

2.3.1 Concrete Brick

American Society for Testing and Materials (ASTM) have been used as standard specifications for the numerous types and grade of brick. In this study, ASTM C55, standard specification for cement brick is used to manufacture concrete brick.

2.3.1.1 Concrete Brick Dimension

The research made by Poon *et al.* (2002), they used recycled aggregates in molded concrete bricks and blocks. They stated that the concrete bricks and paving blocks were fabricated in steel moulds with internal dimensions of 225 mm in length, 105 mm in width, and 75 mm in depth.

According to Courtesy Construction Metrication Council of the National Institute of Building Sciences, Washigton, D.C., there have many sizes of bricks for Roman brick, Modular brick, Engineer Modular brick, Standard brick others. The table of the standard size of brick that taken from the Institute can be shown in Table 2.1.

Table 2.1: Standard Size of Brick

Unit Name		Actual Sizes (inches)	Actual Sizes (mm)	Modular Metric Size (mm)	Vertical Coursing
Standard	Width	3- 5/8	92	57	3:200mm
	Height	2- 1/4	57		
	Length	8	203		

Source: Courtesy Construction Metrication Council of the National Institute of Building Sciences, Washington, D.C.

2.4 Sand

Sand is defined as granular material that passes through different sizes of strainers or "sieves". According to the classification parameters, material of which 50% or more is coarser than the 200 sieve but which 50% or more is finer than the 4 sieve, is classified as sand. The 200 sieve has openings of 0.075mm of diameter while the 4 openings are 4.75 millimeters in diameter. If there are large amounts of particles smaller than 75 microns, the material is called clay, or silt. If there are large amounts of particles bigger than 4.75 mm, the material is called gravel.

Sand is used to achieve economy by its use as adulterant in concrete, prevent shrinkage and development of cracks in concrete and furnish strength to concrete against crushing. Fine aggregate can be loosely defined as a material which passed through a 5 mm (3/16 inch) BS 410 test sieve. The types of sand may be further described into river sand and sea sand.

2.4.1 River Sand

Sand constitutes bulk of the mortar volume. Composition of sand and its grading can influence the characteristics of mortars in fresh as well as in hardened state. Also, it could influence brick–mortar adhesion and other masonry characteristics. Reddy *et al.* (2008) used natural river sand in their experiments. They stated that sand is the common ingredient for masonry mortars even though varieties of cementitious materials are used for mortars.

Rounded river sand gives workability than crushed sand composed of sharply angular pieces with rough surfaces. Angular sand particles have an interlocking effect and less freedom of movement in the freshly mixed concrete than smooth rounded particles. Natural sand may give satisfactory results with a coarser grading than would be permitted with crushed manufactured sand. In addition, concrete must contain 2-3 % more sand by absolute volume of total aggregates and 6-9 kg more water/m^3 (10-15 lb/y^3) when crushed sand is used, Lamond (2006).

2.4.2 Sea Sand

The research reported on offshore sand, which was considered the most viable of the alternatives for river sand, with respect to availability, ease of extraction, environmental impact and cost, Dias *et al.* (2008). Regarding to this study, when the sea sand is treated by freshwater, it will become useable in construction industry because of reducing of chloride content. Sea sand contains much the same constituents as river sand in terms of particle shape and texture. It also contains significant "impurities" by way of salts such as magnesium and sodium chlorides, which lead to corrosion in iron. In past research, sea sand is considered unsuitable for the construction industry because of its small particle size and unless the chloride content that causes rusting is reduced by washing with freshwater.

2.4.2.1 Sieve Sizes for Sea Sand

A set of sieves fitting tightly one on top of the other is used to determine size and gradation of aggregate. There are many type of sieves depend on different of sieve sizes. A sample of the aggregate to be analyzed is placed in the top sieve, which has the largest holes. The second sieve has smaller holes, and each succeeding sieve has holes smaller than the sieve above it. At the bottom is a solid pan. The pan collects all particles smaller than the openings in the finest sieve, which is chosen to collect particles of the smallest significant size like Figure 2.1.

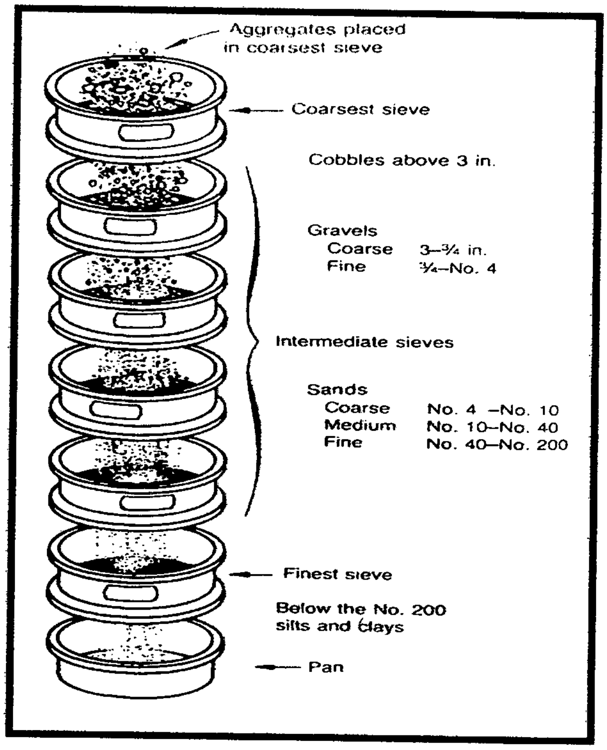

Figure 2.1: Sieve Sizes and Particles Passing

Source : Marotta (2005)