PERFORMANCE OF MORTAR WITH EGG ALBUMEN

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ABSTRACT

This study is to investigate the performance of mortar with 1% and 5% egg albumen. The field of studies covered the important parameters in determining the engineering properties such as compressive and flexural strength and drying shrinkage of egg albumen additive in mortar. It was achieved by compression test and flexural test conducted to determine the highest strength development between samples for 7, 14 and 28 age days of both air and water curing time. There were three types of samples that has been tested, which are mortar containing 1% of egg albumen, 5% of egg albumen and mortar with plain ordinary Portland cement as the control samples. The result obtained showed that the compressive strength for water curing for 100% mortar control samples achieved the highest strength where is it 5.78Mpa and it is 3.58% higher strength than the air cured samples, while mortar with 5% egg albumen achieved 5.02Mpa of strength where it is 9.37% higher than sir cured samples. Next it is mortar with 1% egg albumen that achieved 4.64Mpa where it is only 4.71% higher than air cured samples. For flexural test, the result obtained where mortar with 5% egg albumen achieved the highest flexural strength for water cured samples where it is 36.27% higher than the air cured samples, while for mortar with 1% egg albumen has achieved flexural strength of 2.4Mpa for air cured samples, where it is 20.6% higher than the water cured samples. As for 100% mortar control samples has achieved the lowest strength, where it is 1.98Mpa for air cured samples. As for the result achieved from drying shrinkage test, result obtained for air cured samples achieves highest shrinkage if compared with water cured samples. The used of concrete as samples besides mortar is recommended for future works and studies.

ABSTRAK

Penyelidikan ini bertujuan untuk mengetahui prestasi mortar dengan 1% dan 5% albumen telur. Bidang kajian meliputi parameter penting dalam menentukan sifat teknikal seperti tekanan dan lenturan dan susut pengeringan albumen telur sebagain bahan penambahan di dalam mortar. Hal ini semua dengan uji tekanan dan uji lenturan dilakukan untuk menentukan penbangunan kekuatan yang lebih tinggi antara sampel untuk hari ke 7, 14 and 28, baik udara dan air semasa peneraman. Ada tiga jenis sampel yang telah diuji, iaitu mortar mengandungi 1% dari albumen telur, 5% dari albumen telur dan mortar dengan simen Portland biasa sebagai sampel kawalan. Keputusan yang diperolehi menunjukkan bahawa kuat tekan untuk air menyembuhkan untuk sampel mortar 100% kawalan mencapai kekuatan tertinggi di mana itu 5.78Mpa dan itu adalah kekuatan 3,58% lebih tinggi berbanding hawa sembuh sampel, sedangkan mortar dengan albumen telur 5% semua 5.02Mpa dari Kekuatan mana 9,37% lebih tinggi daripada sampel sembuh Sir. Berikut ini adalah mortar dengan albumen telur 1% yang dicapai 4.64Mpa yang biayanya hanya 4,71% lebih tinggi daripada sampel hawa sembuh.Untuk ujian lentur, hasilnya diperolehi di mana mortar dengan albumen telur 5% mencapai kekuatan lentur tertinggi bagi sampel air disembuhkan dimana 36,27% lebih tinggi berbanding hawa sembuh sampel, sedangkan untuk mortar dengan albumen telur 1% telah mencapai kekuatan lentur 2.4Mpa untuk sampel hawa disembuhkan, di mana 20,6% lebih tinggi daripada sampel air sembuh. Adapun 100% sampel kawalan mortar telah mencapai kekuatan yang paling rendah, di mana 1.98Mpa untuk sampel hawa sembuh. Adapun hasil yang dicapai dari uji susut pengeringan, keputusan yang diperolehi untuk sampel hawa disembuhkan mencapai penyusutan tertinggi jika dibandingkan dengan sampel air sembuh. Yang digunakan sebagai sampel konkrit mortar selain disyorkan untuk bekerjbekerja di masa mendatang dan kajian.

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LIST OF ABBREVIATION

IBS	-	Industrial Building System
EA	-	Egg Albumen
MEA	-	Mortar with egg albumen
BS	-	British standard
w/c	-	Water to cement ratio
s/c	-	Sand cement ratio
w/b	-	Water to binder ratio
IRA	-	Initial rate of absorption
FKASA	-	Fakulti kejuruteraan awan dan sumber alam
UMP	-	Universiti Malaysia Pahang
°C	-	Celcius
MPa	-	Mega Pascal
kg	-	Kilogram
mm	-	Millimeter
µm	-	Micrometer
-	-	Negative
%	-	Percent

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Industrialized building system or IBS has been adapted by Malaysia to improving the construction sector in Malaysia. IBS roadmap 2003-2010 was to let the construction sector to improve its productivity and its efficiency of the industry. The roadmap was formulated for improving the construction output through five main issues, namely manpower, materials, management, monetary and marketing. Nowadays building should build with low density material but high in strength to reduce cost and density for example in bricks or bind construction blocks together and more, so by using mortar with egg albumin can solve this problem. Beside using normal foaming agent in concrete, by using waste material such as egg white as foam in concrete and as one of the material that can improving the strength of concrete can already to follow up this improvement to the construction industry by turning waste to wealth.

Egg albumin (EA) or egg white were the main material in this project to test its strength in mortar and it was an organic material that full of protein to test the

performance of it in mortar. Egg white that have been beaten and turn into a foam can increase the strength of mortar. According to S. Chandra and J. Aavik (1987) egg albumen or also can be protein work as air entraining agents in cement mortar. Steam curing has an adverse effect on the strength of mortar specimens mixed with protein. Protein addition introduces hydrophobic properties in the cement mortar.

1.2 Problem Statement

The current cost of construction materials was too high, resulting the expenditure for construction project was increasing. It was worth to know that the use of egg albumen have the potential to reduce the material cost since the egg albumen itself was a waste material.

High density concrete or normal concrete cost was very high, but with mortar it can help to reduce cost and it was low density when it's come in making the bricks and the lining and even the finishing. Beside that it was important to having high stability, so the stability of foam concrete was the consistency at which the density ratio was nearly one without any segregation and bleeding. As K. Ramamurthy et. al (2009) stated that mortar was very durable and have a lot of advantages.

Egg albumin was a waste material that can increase the strength of mortar, hence egg albumen was a material that was not widely used in Malaysia, this material cannot convince a lot of people in construction industry because there were lack of information about the usage of this material in the construction industry and they do not noticed the advantages and the behaviors properties of this material. In term of environment concern, the egg albumen leaves the positive effect to the environment.

1.3 Objective

The objective of this study was to investigate the performance of foam concrete with egg albumin due to compression tests. The specific objectives of this study were:

I. To determine the engineering properties of mortar in term of strength for 1% and 5% of egg albumen as additive material.

II. To study the effect of the curing conditions to the compressive strength and flexural test of mortar.

III. To study the performance of egg albumen as additive material and its effectiveness in improving the properties of mortar.

1.4 Scope Of Work

The scope of this study involved the experimental works where the experimental study was carried out to investigate the performance of mortar with egg albumen (MEA). The purpose of the research was determined that was the compressive strength, flexural strength and the drying shrinkage of the mortar. In this study the dimension of the cube were 150mm x 150mm x 150mm, while the prism were 500mm x 100mm x 100mm, in determining the compressive strength, flexural strength and drying shrinkage that accordance to BS8110-4:1997. In order to ensure that the concrete mortar cubes were properly tested for their compressive strength, flexural strength for cubes samples, d drying shrinkage under standard condition, they should carefully store in a curing. Both cubes and prisms was tested at the appropriate age while still damped on the surface in a properly calibrates testing machine and at a set-loading rate.

In this study, 54 cubes of sample were prepared, which was 18 specimens for 1% egg albumen (EA) with 100% mortar, 18 specimens for 5% egg albumen (EA) with 100% of mortar and 18 specimen of 100% mortar. For prisms, also 54 samples were prepared, which 18 specimens were 1% egg albumen (EA) with 100% mortar, 18 specimens for 5% egg albumen (EA) with 100% of mortar and 18 specimen of 100% mortar. All 108 samples were curing under air and water condition, on the seventh day 3 specimen of each sample for cubes were tested under compression for cubes samples, flexural test and drying shrinkage test for prisms samples. Figure 1.1 shows the dimensions of cubes samples, while figure 1.2 shows the dimensions of prism samples. Table 1.1 shown the number of samples and tests for laboratory work while Figure 1.3 shown the flow chart of this study.

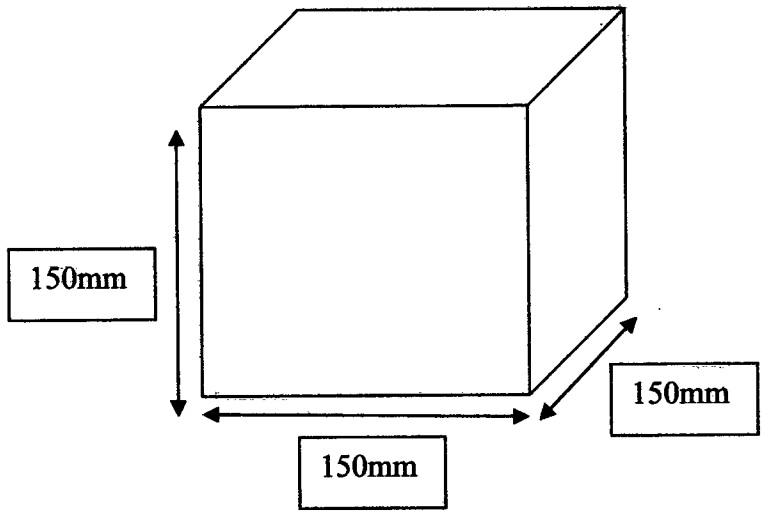

Figure 1.1: Dimension of Cubes Samples

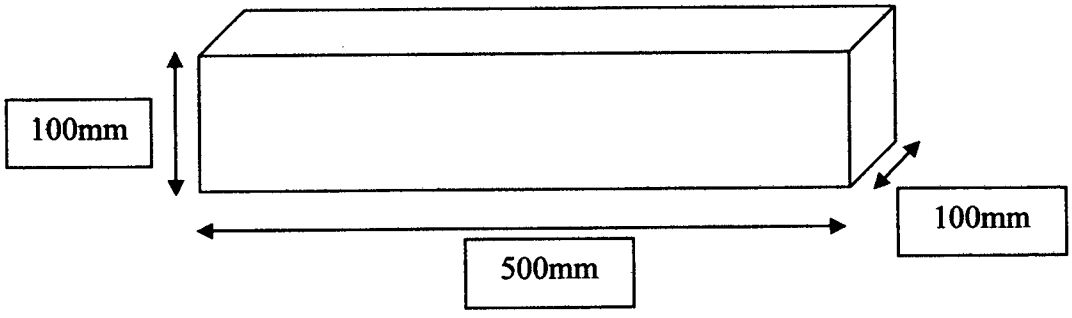

Figure 1.2: Dimension of Prism Samples

Table 1.0: Number of Samples and Tests for Laboratory Work

Percentages		**Control Samples**			**1% egg albumen**			**5% egg albumen**		
Type of Sample	**Curing**	7 day	14 day	28 day	7 day	14 day	28 day	7 day	14 day	28 day
Cube	Air curing	3	3	3	3	3	3	3	3	3
	Water curing	3	3	3	3	3	3	3	3	3
Prism	Air curing	3	3	3	3	3	3	3	3	3
	Water curing	3	3	3	3	3	3	3	3	3
Total		12	12	12	12	12	12	12	12	12
Total samples		**108 of samples**								

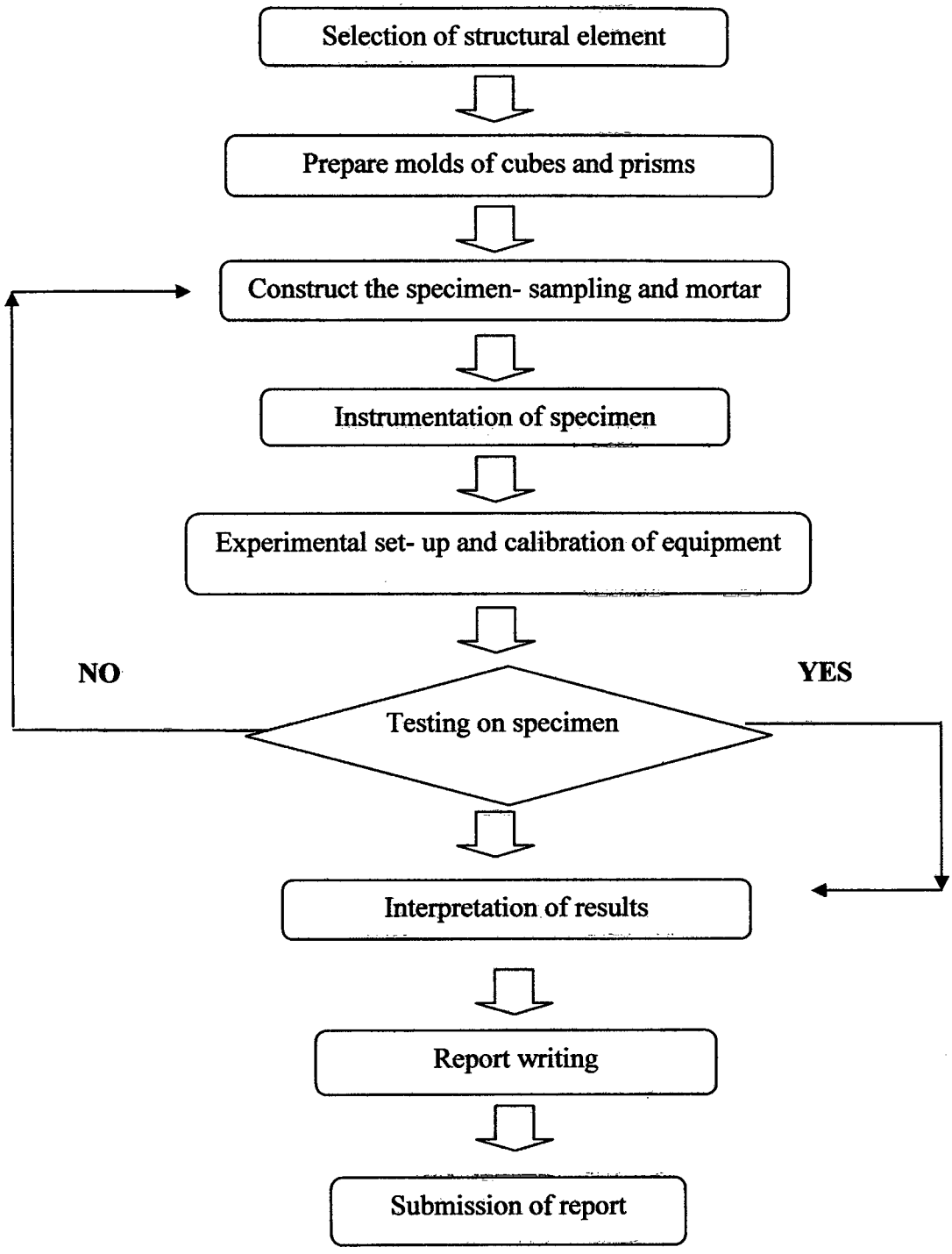

Figure 1.3: Flow Chart of Study

1.5 Significance of Study

The application of egg albumen as part of materials for mortar or even in concrete in Malaysia was still not widely applied in normal construction whereas mostly the egg albumen was being used in the cooking factor. The properties of egg albumen were not fully understood as the result of less information about the usage of egg albumen in foam concrete which was amazingly capable to reduce the cost for construction materials, can also expected to increase the strength of the foam concrete.

It was appears that it was possible to use egg albumen as one of the material in mortar which was predicted to cause some changes to some of the engineering properties such as drying shrinkage, flexural strength and especially compressive test.

This study conducted to study the advantages of using egg albumen as an additive material for Portland cement in mortar. The advantages of using egg albumen were discussed in term of its ultimate strength which corresponding to its compressive and flexural strength. Other engineering behaviors that discussed were included its drying shrinkage and its workability.

1.6 Summary

An overview about the egg albumen application was presented. This study was about an experimental works in the laboratory, the performance of mortar due to compression test, flexural test and drying shrinkage by using 1% and 5% of egg albumen as a partial material to the mortar haven been investigated. The purpose of this study was to identify the effectiveness of egg albumen in mortar. As by using egg albumen as a partial material in mortar, the effectiveness of egg albumen to mortar for example high strength, high durability, high performance and high quality have achieved. Other than that, it was also be superior environmental friendly due to ecological disposal of large quantities of waste material.

Through this studies all the testing that has been conducted, it was believed that mortar with additive egg albumen have better quality in its engineering behaviors such as its compressive and flexural strength.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The purpose of a literature review was to analyze, convey to the reader what knowledge and ideas have been established on literature published related to mortar with egg albumen and what were the strength and weaknesses. Other than that, the purpose of a literature review were also to see what has and has not been investigated, to identify data sources that other researchers have used, and to discover how a research project was related to the work of others. In this chapter, related literature from the primary resources of published materials such as books, journal articles, conference articles, research papers and thesis were reviewed and presented.

2.2 Introduction to Mortar

According to Amateur Work Magazine and Masonry Advisory Council, cement mortar was a mixture of cement as a binding agent and sand mixes with sufficient water to produce a plastic mass. When the sand and cement mixed together with water, a chemical reaction will occur which was called hydration. Sand in the mortar was used to avoid cracks due to shrinkage of cement in setting and for the sake of economy. Where great strength was required, there should be at least sufficient cement to fill the voids or air spaces in the sand, and a slight excess was preferable in order to compensate for any uneven distribution in the mixing. The common ratios for Portland cement mortar were 3 parts of sand to 1 part of cement, and for natural cement mortar was 2 parts of sand and to 1 part of cement. Refer to Masonry Advisory Council, Mortar plays an important role in the performance of the structure. It does not only bonds the individual units together but it also seals the building against moisture and air penetration. The most important qualities of mortar were bond strength and durability. There were several properties of mortar that can influence bond strength and durability.

Defined by the Masonry Advisory Council, other characteristics that influent general performance of the mortar was aggregate grading, water receptivity, and water flow. Water retentivity allows mortar to resist the proper curing. It was the mortar's ability to retain its plasticity. Less retentive mixes can "bleed" moisture, creating a thin layer of water between mortar and masonry unit and substantially decreasing bond strength. Masonry was the building of structures from individual units laid in and bound together by mortar.

Also the Masonry Advisory Council tells that the compressive strength of mortar was sometimes used as a principal criterion for selecting mortar type, and it commonly relates to some other properties, such as tensile strength and absorption of the mortar. The compressive strength of mortar depends largely upon the cement content and the

water-cement ratio. The accepted laboratory means for measuring compressive strength was to test 2 in. cubes of mortar.

Flexural strength was also important because it measures the ability of a mortar to resist cracking. Often overlooked were the size or shape of mortar joints in that the ultimate compressive load. The single most important property of mortar was the bond strength, and it was critical that this bond be complete, strong, and durable. The strength and extent of the bond were affected by many variables of material and workmanship. The moisture content and suction of the units, the water retention of the mortar, and curing conditions such as temperature, relative humidity, and wind combine to influence the completeness and integrity of the mechanical and chemical bond.

2.3 History Development of Mortar

According to R.T. Kreh(2003), clay was the first material to be used for mortar. It has been used through history in masonry wall of unburned brick, but the lack of a hard binding agent makes clay impractical in humid climates. In 2690 B.C. the great pyramid of Giza was built in Egypt. The huge blocks of this structure were cemented together with mortar made form burned gypsum and sand. Many years later, the Greeks and Romans developed mortar from volcanic waste and sand. Structures built with this mortar still stand.

Mortar made from lime- sand was commonly used until the later nineteenth century. However, in 1824, Portland cement was developed, an occurrence that marked the beginning of modern- day cement.

Portland cement was a much stronger material than had been used before, whether it was applied alone or combined with lime. Mortar used today was a

combination of Portland cement, hydrated lime, and masonry sand. More recently, masonry cements have been developed which require that only sand water be added for the formation of mortar.

The formula or percentage of ingredients were usually not printed on bag of mortar must pass specifications for a mortar of medium strength. This mortar may be sold under various brand names, but Portland cement was always specified by type. Besides binding the masonry materials into a permanents structure, mortar seals the joints against penetration of air and moisture. Mortar acts as a bond for various parts of the structure such as reinforcement rods, anchor bolts, and metal ties so they may become an integral part of the walls which can be attributed directly to the used of defective mortar.

2.4 Properties of Fresh Mortar

According to Mortar Industry Association the role of fresh mortar during construction were a very important and complex one, where the mortar must spread easily and remain workable longs enough to enable the accurate laying to line and level of the masonry units. Other than that, it also must retain water so that it does not dry out and stiffen too quickly, especially when using absorbent masonry units. Then it must then harden in a reasonable time to prevent it deforming or squeezing out under the weight of the units laid above. These various properties of fresh mortar were described in the following sections below.

2.4.1 Workability

Workability may be defined as the behavior of a mortar in respect of all the properties required during application, subsequent working and finishing. The operative's opinion of workability was greatly influenced by the flow properties of the mortar, its cohesiveness and retention of moisture against the suction of the substrate. A mortar with good workability has the following property, where it was ease of use, as we can see the way it adheres or slides on the trowel. The next workability property was ease of spread in the masonry unit. Other than that mortar also can ease of extrusion between courses without movement due to its own weight of additional courses. Mortar also can ease of positioning of the masonry unit without movement due to its own weight and the weight of additional courses.

If a mortar were harsh, that was of poor workability, the output of craftsmen was reduced. Picking up and spreading can be slow and difficult was in placing the cross or perpendicular joints and in obtaining a good finish.

2.4.2 Water Retentivity

This was the property of mortar that resists water loss by absorption into the masonry units and to the air, in conditions of varying temperature, wind and humidity. Water retentivity was related to workability. A mortar with good water retentivity remains plastic long enough to allow the masonry units to be aligned and plumbed without breaking the intimate bond between the mortar units.

Low- absorption units in contact with mortar with high water retentivity may "float" and move out of alignment and plumb. Therefore, water retentivity should be neither too low nor too high. Adjustments can be made by varying the amount of