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I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Engineering (Hons) in Civil Engineering.

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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THE EFFECT OF STEEL WIRE MESH ON MECHANICAL PROPERTIES OF
ADOBE

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ABSTRAK

Tujuan kajian ini adalah untuk menyiasat sifat-sifat asas campuran tanah menggunakan dawai kekuatan sokongan. Campuran tanah terdiri daripada pasir, tanah, tanah liat, kelodak dan Kenaf. Bangunan Adobe didapati di hampir setiap kawasan di dunia dan merupakan satu ciri penting daripada warisan budaya antarabangsa. Walau bagaimanapun, ciri-ciri bahan adobe dan tanah masih belum disiasat secukupnya. Bahan binaan ekologi seperti batu-bata adobe telah menjadi kepentingan ekonomi yang lebih besar dalam tahun-tahun kebelakangan ini. Adobe adalah satu bentuk seni bina semula jadi dibina dengan bahan-bahan mesra alam sekitar yang memberi perlindungan dalaman dari keadaan suhu di luar. Ia adalah penting untuk mempertimbangkan kekuatan bata adobe. Kajian ini dijalankan untuk menentukan kesan kekuatan antara sampel dengan menggunakan dawai dan tanpa wayar mesh pada adobe bata. Sebagai program eksperimen telah dirancang, yang terdiri ujian seperti kekuatan mampatan dan kekuatan lenturan, telah dijalankan untuk menyiasat kekuatan bata adobe. Hasil kajian menunjukkan bahawa penggunaan wire mesh meningkatkan kekuatan mampatan 40% kepada 50% masing-masing. Di samping itu, dawai kekuatan meningkatkan kekuatan mampatan bata adobe. Untuk langkah ini kajian impak untuk menggunakan dawai kekuatan pada ujian kekuatan mampatan adalah ketara. Walau bagaimanapun, adobe efektif dalam mengambil tegasan lenturan. Sampel dirawat dengan menggunakan dawai pameran tertinggi mampatan dan lenturan ujian kekuatan. Purata kiub dan sampel rasuk telah menunjukkan penggunaan dawai kekuatan telah meningkatkan kekuatan sampel. Oleh itu, kesan dawai kekuatan lenturan dan kekuatan mampatan adobe ketara.

ABSTRACT

The aim of this research is to investigate basic properties of soil mixture using wire mesh as support strength. The soil mixture consists of sand, soil, clay, silt and Kenaf. Adobe buildings are encountered in almost every region of the world and constitute a significant feature of the international cultural heritage. However, the behaviour of adobe materials and earth has not yet been adequately investigated. Ecologic building materials such as adobe bricks have become of greater economic importance in recent years. Adobe is a form of natural architecture built with environment friendly materials which provide indoor protection from outside temperature conditions. It is important to consider the strength of adobe brick. This study was conducted to determine the effect of the strength among the sample with wire mesh and without wire mesh on adobe brick. As the experimental program was planned, consisting tests such as compressive strength and flexural strength, were conducted to investigate the strength of adobe bricks. The result showed that the use of wire mesh increases the compressive strength 40% to 50% respectively. In addition, that, wire mesh increases the compressive strength of adobe bricks. For this measure of study the impact for using wire mesh on compressive strength test is noticeable. However, adobe is good in taking flexural stresses. The samples treated with wire mesh exhibits highest compressive and flexural strength test. The average of the cubes and beams sample have shown usage of wire mesh has increased the strength of the samples. Thus, the impact of wire mesh on flexural strength and compressive strength of adobe is noticeable.

TABLE OF CONTENT

| | |
|------------------------------------|-------------------------------------|
| DECLARATION | |
| TITLE PAGE | |
| ACKNOWLEDGEMENTS | ii |
| ABSTRAK | iii |
| ABSTRACT | iv |
| TABLE OF CONTENT | v |
| LIST OF TABLES | viii |
| LIST OF FIGURES | ix |
| LIST OF SYMBOLS | x |
| LIST OF ABBREVIATIONS | xi |
| CHAPTER 1 INTRODUCTION | 1 |
| 1.1 Background | Error! Bookmark not defined. |
| 1.2 Problem Statement | 3 |
| 1.3 Objectives of Study | Error! Bookmark not defined. |
| 1.4 Research Methodology | 5 |
| 1.5 Scope of Study | 6 |
| 1.6 Significance of Study | 7 |
| CHAPTER 2 LITERATURE REVIEW | 8 |
| 2.1 Introduction | 8 |
| 2.1.1 Previous Findings | 10 |

| | | |
|---|---|-----------|
| 2.2 | Adobe | 11 |
| | 2.2.1 Types of Adobe | 12 |
| 2.3 | Wire Mesh | 16 |
| 2.4 | Soil | 19 |
| | 2.4.1 Soil Specification | 20 |
| | 2.4.2 Classification of Particle Size Distribution | 21 |
| | 2.4.3 Compressive Strength Test | 23 |
| | 2.4.4 Flexural Test | 24 |
| 2.5 | Summary of Literature Review | 25 |
| CHAPTER 3 METHODOLOGY | | 27 |
| 3.1 | Introduction | 27 |
| 3.2 | Planning work | 28 |
| | 3.2.1 Preparation using Wire mesh and Chain link mesh for Adobe | 29 |
| | 3.2.2 The materials used in Adobe mixing | 29 |
| | 3.2.3 Mixing process | 30 |
| | 3.2.4 Compacting process | 30 |
| | 3.2.5 Curing process | 30 |
| | 3.2.6 Preparation of samples | 31 |
| | 3.2.7 Compressive strength test | 32 |
| | 3.2.8 Flexural Test | 33 |
| CHAPTER 4 RESULTS AND DISCUSSION | | 35 |
| 4.1 | Introduction | 35 |
| 4.2 | Analysis of Compressive Strength Test | 36 |

| | | |
|---|------------------------------------|-----------|
| 4.3 | Analysis of Flexural Strength Test | 38 |
| CHAPTER 5 CONCLUSION | | 43 |
| 5.1 | Introduction | 43 |
| 5.2 | Conclusion | 43 |
| 5.3 | Recommendations | 44 |
| REFERENCES | | 45 |
| APPENDIX A THE SAMPLES DURING COMPRESSIVE TEST AND FLEXURAL TEST | | 47 |
| APPENDIX B EXAMPLE CALCULATION ON BEAM AND CUBE | | 48 |

LIST OF TABLES

| | | |
|-----------|---|----|
| Table 2.1 | Chain Link Mesh Specification Details | 17 |
| Table 2.2 | Chicken Mesh Specification Details | 18 |
| Table 2.3 | Expanded Metal Mesh Specification Details | 19 |
| Table 3.1 | Gantt chart of project planning | 28 |
| Table 3.2 | Table of Sample of Cubes and Beams for Testing | 32 |
| Table 4.1 | Compressive strength without wire mesh table result | 37 |
| Table 4.2 | Compressive strength with wire table result | 37 |

LIST OF FIGURES

| | | |
|-------------|---|----|
| Figure 2.1 | Typical adobe making | 11 |
| Figure 2.2 | Traditional Adobe | 12 |
| Figure 2.3 | Semi Stabilized Bricks | 13 |
| Figure 2.4 | Stabilized Bricks | 13 |
| Figure 2.5 | Pressed Adobe Brick | 14 |
| Figure 2.6 | Burnt Adobe, or Quemado | 15 |
| Figure 2.7 | A-typical terrón measures 7 x 7 x 14 inches | 15 |
| Figure 2.8 | Chain Link Mesh | 17 |
| Figure 2.9 | Chain Link Mesh | 18 |
| Figure 2.10 | Expanded Metal Mesh | 19 |
| Figure 3.1 | The flow chart of the research methodology | 28 |
| Figure 3.2 | Compressive test equipment | 33 |
| Figure 3.3 | Flexural strength test equipment | 34 |
| Figure 4.1 | Compressive strength with wire Chart result | 38 |
| Figure 4.2 | Flexural strength with Wire Mesh graph | 39 |
| Figure 4.3 | Flexural strength without Wire Mesh graph | 39 |
| Figure 4.4 | Flexural strength with Wire Mesh + average graph result | 40 |
| Figure 4.5 | Flexural strength without Wire Mesh + average graph result | 41 |
| Figure 4.6 | Flexural strength Average of samples with and without Wire Mesh | 42 |

LIST OF SYMBOLS

| | |
|-----------------|------------------------------|
| N/mm^2 | Newton per millimetre square |
| kN | Kilo Newton |
| N | Newton |
| mm | Millimetre |
| m | Metre |
| Mpa | Megapascal |

LIST OF ABBREVIATIONS

| | |
|-------|---------------------------------------|
| BS EN | British Standard European Norm |
| ASTM | American Standard Test Method |
| MIT | Massachusetts Institute of Technology |

CHAPTER 1

INTRODUCTION

1.1 Background

Adobe is a term that arises from Arabic however adobe has been used more widely on Spanish language to know that all building material made from, clay, sand, straw, and water mixed up with some organic material. Adobe is a construction material, low cost and easily available around the world (M, 2003). The prolific and good earth materials in construction in the past world have detector in most various places have surviving examples which are the city of Shibam in south Yemen and the walls of Marrakech in Morocco. However, the selection of a good soils is very important property for the earth construction to be more resistance during the tests.

Clay is very important additive to the earth mixing, because it works as nature cover. The earth bricks will be more convenience if it is produce during autumn or spring, because in these times the sun is not much strong to help the drying process to cause cracks and shrinkage. While sometimes it is necessary to be produced on winter and summer but in this case, have to take some precautions which are the wet straw acts as a cover with the bricks this is in order to prevent the high drying from the sun and in this case dry sand is covered with bricks, this is as to help a good seasoning of adobe blocks and the effected of winter (Enrico Quagliarini, 26 March 2010).

Romans have tried so many experience and by the practicing of using earth materials they have enough knowledge and they said it is impossible to use earth materials to make large amount of adobe bricks, because it can help to have shrinkage and cracking also the lower workability of the mixture. In order to reduce clay fraction, Romans have mixed sand relatively with other components. This is so as to minimize

the shrinkage of adobe when the existing components of the earth material are smaller. They, too, used to add some materials such as vegetables fiber and dry grass into the mixture. This can help to minimize hygrometric shrinkage. Thus, resulting in improving the traction strength capability of removing water slowly from the mixture (Enrico Quagliarini, 26 March 2010).

According to Fratini, that most of the people who are living in the rural areas are still so far using adobe and earth as a building material. This is absolutely can be seen in the developing countries such as Africa, Iran, Yemen, Iraq, Afghanistan and so on. In fact, earth as a building material can be extensively used worldwide even in the current time and age (Fratini, 2011).

Though adobes are most use for softly loaded single and double-story dwelling building, the ancient people in (Hadramout Yemen) have been used adobes to construct ten stores high building. The clay part largely less than in earth applied for adobe bricks, and is usually lower than 25% of a mass. Fired bricks can be several times higher than similar compressive strength of compressed earth blocks. Strength is developed by density and the content of cement (linear relationship), yet decreased when the moisture content and clay content (cement stabilized blocks) are increased (Lenci E. Q., The influence of natural stabilizers and natural fibres on the mechanical, 26 March 2010).

All in all, adobe can be considered as natural source that composed of many fabulous properties. Economically such earth resource is available everywhere, is easily treated and can be enhanced to extremely high level of perfect thermal properties used in housing. However, without correctly strengthened and appropriate designed, this leads to a defective result when exposed to seismic action, suffering severe structural damage and sometimes reaching collapse. The main advantage of using adobe in construction is that its raw materials are available worldwide. The raw materials are a mix of ingredients such as coarse, sand, argillaceous earth and lime. Moreover, some additive natural materials such as clay and sand can be involved in adobe production so as to get rid of cracking once subjected to the direct sun-light (Silveira, March 2012).

1.2 Problem Statement

With no doubt, Adobe is considered as one of the oldest building materials in use. It is basically just soil that has been moistened with water, sometimes with chopped straw or other fibers added for strength, and then allowed to dry in the desired shape (Burlacu, 2011). However, it is as a traditional building material, it has a number of shortcomings. Adobe does not withstand weather effects, often, rainstorms causes a lot of damage to the construction thereby requiring seasonal maintenance which consume time and labor. In agreement to this, Shehu (2002) observed that natural disasters such as flood during the rainy season also affect adobe building in rural and even in some semi-urban buildings particularly at the mid of the rainy season when excess water is released.

Adobe constructions have the problem of cracking due to drying shrinkage, high rate of water absorption which leads too many houses collapsing during heavy rain fall, low compressive, tensile and shear strength. Thus, these problems have made building with adobe not strong, durable and have led to the collapse of many buildings especially during heavy rain. Because of these problems posed by the traditional method of utilizing adobe and with the increase in demand for housing, the traditional building system has not satisfied the need for adequate building materials and techniques for constructions. Hence, the challenge for the study is to determine the technique to improve adobe blocks used for building constructions (Lertwattanakruk, 2011).

Many old construction and recent samples have been constructed, and they resort to have a brief lifetime as earth construction. The shortcoming of this kind can be occurred from shrinkage, cracking and shortage of strength this, because of drying process reduction of resistance to water. So as to control this kind of problem, there are two ways have been discovered. The first is accomplished by means of settlement of the earth either by using cement and lime which are chemical binder or by means of mechanical compaction. However, the second rely much of compile natural fibres to the earth mixing that is in order to have the adobe. In many developing countries have been used natural fibres for long period in earth blocks and cement composites this is due to their available and low cost (M. Bouhicha, 19 November 2004). However, in my current research I have to use wire mesh as an additive to the natural or vegetation material.

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