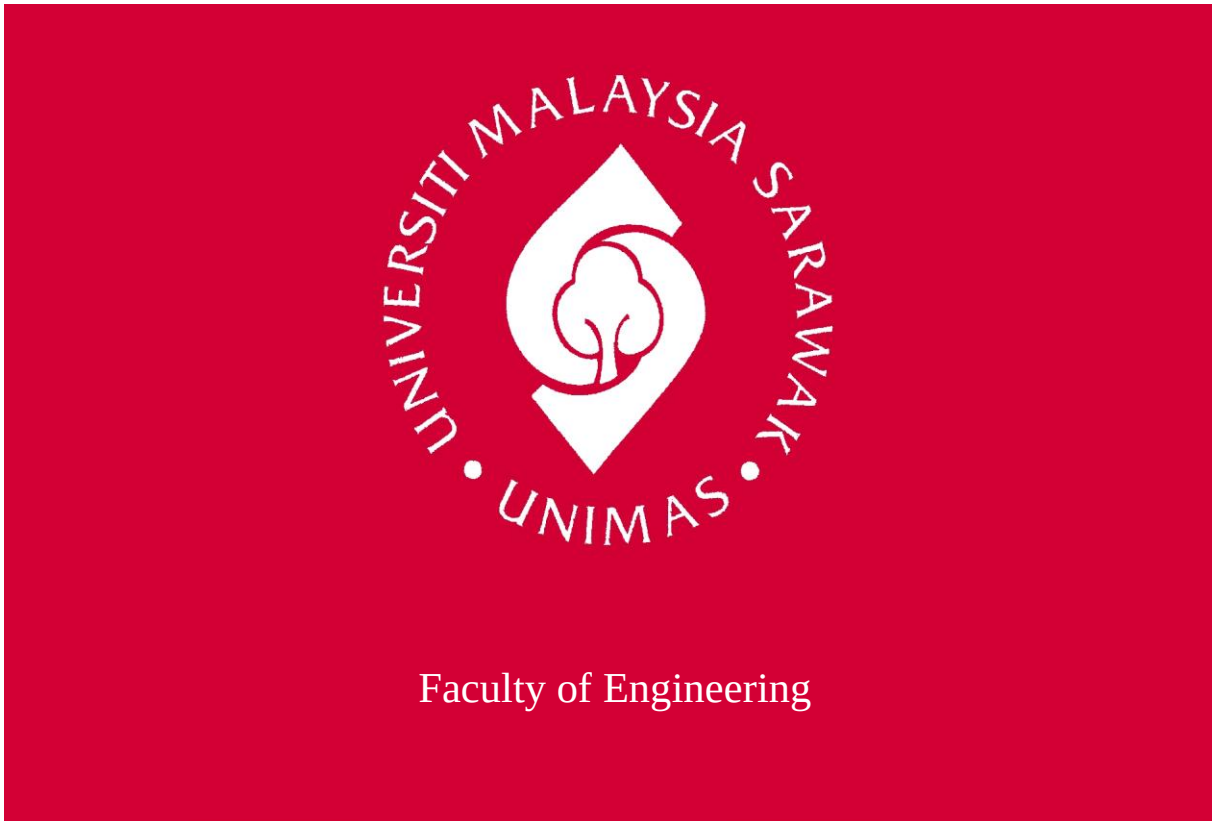


MODIFIED CEMENT SYSTEM: DURABILITY AND AESTHETIC

Siti Zarini Binti Mohamed Jizi

Bachelor of Engineering with Honours
(Civil Engineering)
2009

UNIVERSITI MALAYSIA SARAWAK

BORANG PENGESAHAN

JUDUL: MODIFIED CEMENT SYSTEM: DURABILITY AND AESTHETIC

SESI PENGAJIAN: 2008-2009

Saya **SITI ZARINI BINTI MOHAMED JIZI**
(HURUF BESAR)

mengaku membenarkan tesis * ini disimpan di Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hakmilik Universiti Malaysia Sarawak.
2. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Membuat pendigitan untuk membangunkan Pangkalan Data Kandungan Tempatan.
4. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
5. ** Sila tandakan (√) di kotak yang berkenaan

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972).
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan).
√	TIDAK TERHAD	

Disahkan oleh

_____ _____

(TANDATANGAN PENULIS) (TANDATANGAN PENYELIA)

Alamat Tetap: 967,Taman Nuri,
Jalan Dato' Kumbar,
05300 Alor Star,
Kedah.

PN. NORSUZAILINA MOHAMED SUTAN
(Nama Penyelia)

Tarikh: 14 Mei 2009

Tarikh: _____

Catatan: * Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah, Sarjana dan Sarjana Muda.
** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

This project report attached here to, entitle **"MODIFIED CEMENT SYSTEM: DURABILITY AND AESTHETIC"** prepared and submitted by SITI ZARINI BINTI MOHAMED JIZI (15312) as a partial fulfillment of the requirement for degree of Bachelor of Engineering with Honors in Civil Engineering is hereby read and approve by:

_____ Date: _____

(Puan Norsuzailina Mohamed Sutan)
Project Supervisor
Faculty of Engineering
Universiti Malaysia Sarawak

For my beloved family, special friends and my friends

Thanks for everything.

ACKNOWLEDGEMENT

First of all, I would like to thank Allah SWT, the Al-Mighty, with His guidance and wishes that this final year project can be completed successfully I would like to express my greatest appreciation to my supervisor, Mdm Norsuzailina Bt Mohamed Sutan, for her generous guidance, advice and motivation throughout this research.

My sincere appreciation also extends to all my friends, my special friend and the structural laboratory personnel, Mr Adha Abd Wahab, who was directly or indirectly involved in the process of producing this research report, for his generous assistance, useful views and tips. Without his support and contribution, this research project would not have been possible.

Finally, I would never finish this project without the encouragement and prayers from my mom and my beloved family members. Special thanks dedicated to my beloved parents and family, for their continuing financial and morale supports throughout my studies. All the hard works and perseverance that I put in this project is not easy without their motivations and endless supports.

ABSTRACT

Efflorescence is a type of discoloration. It is a deposit salt, usually white in color that occasionally develops on the surface of concrete. Although unattractive, efflorescence is usually harmless to the structure such as concrete bridge. In rare cases excessive efflorescence, within the pores of the material, can cause expansion that may disrupt the surface. Efflorescence is caused when soluble salts and other water dispersible materials come to the surface of concrete and mortars. It is induced by low temperatures, moist conditions, condensation, rain, and water added to the surface of concrete. The modified cement system can reduce the efflorescence but cannot avoid it because of the reaction of cement hydration itself. This study proved that by using the modified cement system such as Pulverized Fly Ash (PFA) and Polymers (water based latex grade 29Y46), the efflorescence can be reduced. The mix proportion with and without PFA and Polymers are tested with various properties such as strength test, water absorption and efflorescence in order to understand the effect against the performance of the mortar. The results from this study showed that the modified mortar which is the sample with PFA and Polymers has higher strength, durability, and less efflorescence compared with non-modified cement system.

ABSTRAK

Efflorescence adalah perubahan warna yang berlaku pada konkrit. Ia adalah sejenis garam deposit, biasanya berwarna putih dan terbentuk di permukaan konkrit. Walaupun menjejaskan nilai estetika, *efflorescence* biasanya tidak merbahaya terhadap struktur seperti jambatan konkrit. Untuk sesetengah kes, pengembangan pada liang-liang di dalam konkrit juga mungkin akan mengganggu permukaan konkrit. *Efflorescence* berlaku disebabkan garam-garam larut dan air yang terkandung dalam bahan-bahan binaan akan bertindak balas, (contohnya pasir dan batu baur) dan berlaku di permukaan konkrit. Faktor ini disebabkan oleh suhu yang rendah, kelembapan, pemeluwapan, hujan, dan penambahan air di permukaan konkrit. Cara pencegahan pembentukan efflorescence adalah dengan menjalankan beberapa kajian termasuk ujian penyerapan, ujian ketahanlasakan dan ujian terhadap *efflorescence* itu sendiri. Sistem campuran di dalam mortar adalah salah satu cara untuk mengurangkan pembentukan *efflorescence* tetapi tidak dapat dilupuskan secara keseluruhan disebabkan tindak balas yang berlaku di dalam bahan campuran simen. Walau bagaimanapun, kajian ini membuktikan bahawa sistem campuran di dalam mortar contohnya *Pulverized Fly Ash* (PFA) and *Polymers* (*water based latex grade* 29Y46) dapat mengurangkan pembentukan *efflorescence* ke atas konkrit atau mortar. Sistem campuran di dalam mortar dan tanpa campuran diuji dengan beberapa ujian seperti ujian penyerapan air, ujian ketahanlasakan dan *efflorescence*, bagi memantapkan pemahaman terhadap prestasi kesan-kesan yang berlaku ke atas konkrit. Keputusan dari kajian mendapati sistem campuran di dalam mortar adalah lebih tinggi terhadap kekuatan konkrit, ketahanlasakan serta dapat mengurangkan pembentukan *efflorescence* dibandingkan dengan sistem campuran tanpa PFA and *Polymers*.

TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURE

CHAPTER 1

INTRODUCTION

1.1 PROJECT OVERVIEW

Concrete is a very durable material as exhibited by the number of Roman concrete construction. Durability is achieved by the correct selection of materials, good design and strict quality control when mixing, placing and curing the concrete is essential. The materials and mix proportions used should be such as to maintain its reliability, protect the reinforcement from corrosion and maintain the durability of the concrete. One of the main characteristics influencing the durability of concrete is its permeability. The ingress of water, oxygen, carbon dioxide, chloride and others are the most of the durability problems in the concrete that can be attributed to the changes in the concrete. Volume changes in the concrete can caused by many factors such as hydration process, pozzolonic action, sulphate attack, carbonation, moisture movement, and others. A crack can decrease the durability of the concrete that occurs by interactions involving the materials of concrete and its surroundings environment.

Colours changes of concrete can arise due to a well known yet not well understood phenomenon called efflorescence. Efflorescence occurs when water

percolates through poorly compacted concrete or through cracks when evaporation can take place at the surface of the concrete. It will form white deposits which can decrease the aesthetic values of the concrete.

Efflorescence, which used to be ignored due to its negligible structural effect, is now viewed as a major problem in colored concrete products. To date there are no economical and effective methods to guarantee the prevention of efflorescence. (P.Kresse, 1991)

1.2 OBJECTIVES OF STUDY

The objectives of this study are as follows:

a. To correlate between compressive strength, water absorption and efflorescence at different ages and different percentage of PFA and Polymers.

b. To determine the effects of polymer and PFA addition on to efflorescence.

1.3 SCOPE OF STUDY

The scopes of this project are to investigate the durability and aesthetic of non- modified cement system and modified cement system. There are three main scope of the project are:

i. To study the strength development of the modified mortar and non-modified mortar with addition of pozzolans.

ii. To investigate the absorption factor of mortars that is one of the important properties that determine the durability of mortars.

iii. To study the relationship between water absorption, strength development and efflorescence

Below are the limitations of this project:

1. Water-cement-ratio of 0.5 was used.
2. The size of samples was 100 x 100 x100mm and 300 x 300 x 60mm,
3. The size of aggregates used is sand aggregates.
4. Cubes and slab were tested at the age 7, 14, 21 and 28 days.
5. For hardened concrete, compressive strength (destructive test), water absorption test, and puddle test were tested.
6. The desired characteristic strength of 30 N/mm² at 28 days was used in this study.

1.4 OUTLINE OF THE PROJECT

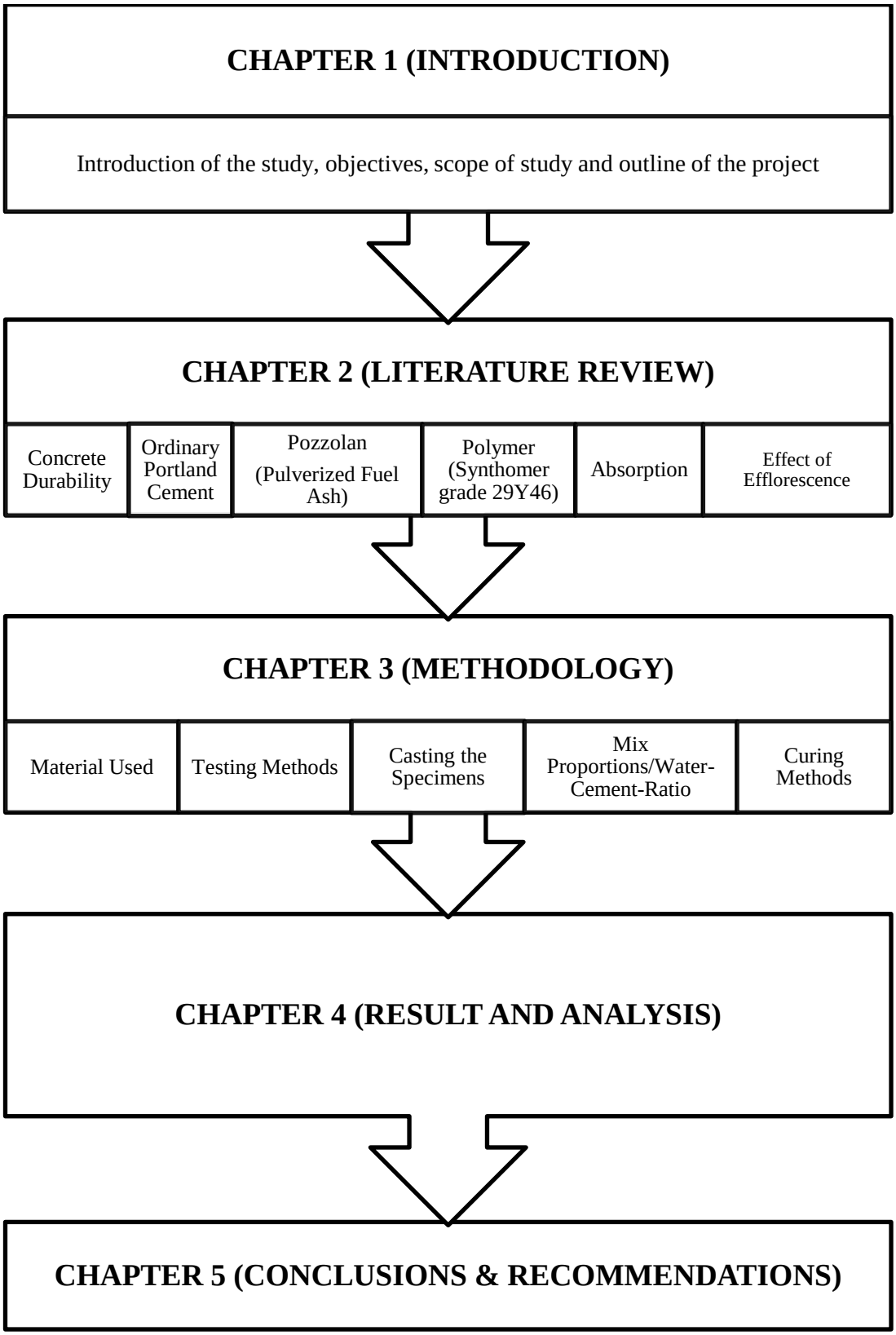
This report is divided into 5 Chapters. The first chapter is the introduction of this project. Chapter 2 is the literature review of OPC, pozzolans (fly ash) and polymer, and detailed explanation of the durability of concrete due to the several effecting factors.

Chapter 3 is the methodologies which consist of method are used in experimental program.

Chapter 4 is an analysis of result. Analyses that were done are being reported in this chapter.

In the last chapter, Chapter 5 is the discussion and conclusion for this project. This chapter wraps up this project with some suggestions for improving the production of good quality concrete. **Figure 1.1** shows the thesis organization for this project.

Figure 1.1: Thesis Organization



CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Cement is a well known building material and has occupied in construction works. There are a variety of cements available in market. A mixture of cement and sand when mixed with water to form a paste is known as cement mortar. The cement commonly used is ordinary Portland cement (OPC). In order to obtain a strong, durable and economical concrete mix, it is necessary to understand the characteristics and the effect of durability of concrete.

In order to understand the durability of concrete which consist the ordinary Portland cement, a review on the properties of concrete will be covered in this section. These include the factors affecting the durability of concrete. The influence of OPC on permeability and porosity to the concrete also will be discussed in this chapter.

2.2 ORDINARY PORTLAND CEMENT (OPC)

Portland cement is most often used in concrete and mortar. Concrete is made by combining water, sand, gravel, and cement, whereas mortars are made by combining cement with water and sand only. Concrete is much stronger than mortar, and is used in most modern buildings as a durable and strong construction material capable of bearing great loads. Mortar is used to bind other substances together, such as the bricks in a house.

Portland cement usually takes several hours to set, and will harden in a matter of weeks. Cement is a somewhat curious material in that it continues to harden over time as long as there is water available for the components of the cement to form bonds with. One week old Portland cement has strength of around 23 MPa, whereas three month old cement has strength of 41 MPa. These numbers apply to standard Portland cement which has not had any additives added to it. Various treatments and additives can make cement set and harden at different rates, and various types of Portland cement also posse's different properties which affect the rate of setting and hardening.(Neville, 1996)

The term cement in the construction can be defined as a material with adhesive and cohesive properties that make it possible to bond together mineral fragments into a compact mass. For structure that carry loads, hydraulic cement is used which exhibits the character of setting and hardening under water from the results of a chemical reaction. (Neville, 1996)

2.2.1 Process of Production

Cement is produced by pulverizing raw materials, which consists of calcareous material and argillaceous materials like limestone or chalk, alumina and silica found as clay or shale. It is then mixed in certain proportions and followed by the burning process is crushed into fine powder named cement. The mixing and grinding process takes place.

There are two methods of producing cement. It is categorized by the condition where the mixing and grinding process takes place. If the process is done in water, it is named the wet process. Normally, wet process is meant for softer raw materials like clay and lime. Harder raw materials like shale and limestone is process by the dry process where the raw materials are mixed without the presence of water (Neville, 1996)

2.2.2 Chemical Composition of Portland Cement

Constituents of Portland cement vary and result in several numbers of compounds that may develop in the clinker. However, there are four major compounds obtained from appropriate combinations of the raw constituents as listed below. A slight change in the proportions will result in different properties of concrete (Neville, 1996).

It should also note that in the clinking process, impurities such as $Mn_2O_{3,}P_2O_5$, and TiO_2 would also be formed (G.D. Taylor, 2002). These