

**DURABILITY OF EPOXY CONCRETE UNDER
MALAYSIAN ATMOSPHERE**

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“Dedicated to my beloved family and Ann Kee...”

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ABSTRAK

Kekuatan dalam konkrit adalah kebimbangan utama dalam teknologi konkrit dan kemajuannya. Dalam berdekad yang mutakhir, ketahanan telah menjadi satu aspek penting dalam konkrit terutama ia telah terdedah kepada atmosfera Malaysia. Banyak pembangunan dan teknik telah diimprovisasi untuk meningkatkan kekuatan yang konkrit dan ketahanan. Satu daripada kaedah-kaedah untuk mendapat sifat-sifat yang kedua dalam konkrit dengan menambahkan epoksi dalam campuran konkrit. Satu kajian telah dikendalikan untuk menyiasat ketahanan dan pembentukan kekuatan konkrit epoksi di atmosfera Malaysia. Enam yang berlingkapkan pelbagai kandungan konkrit epoksi yang berbeza, $100 \times 100 \times 100$ mm dan $150 \times 150 \times 150$ mm telah disediakan dengan menggunakan Sikadur-52 sebagai epoksi. Mortar tulen sebagai sampel kawalan. Konkrit-konkrit tersebut telah dibandingkan dan diuji melalui ujian daya kemampatan, ujian kesan cuaca, ujian serangan asid, and ketelapan bagi memperlihatkan ketahanan dan pembentukan kekuatan konkrit epoksi. Didapati bahawa, epoksi adalah berkesan dalam mengikat agregat dan simen di mana pembentukan kekuatan bertambah. Epoksi boleh menambahkan kekuatan konkrit di mana lebih tinggi kandungan epoksi, lebih tinggilah kekuatan dibandingkan dengan mortar tulen. Juga didapati bahawa, epoksi akan menghasilkan ketelapan yang lebih rendah berbanding dengan mortar tulen. Perubahan dalam dimensi dan ketumpatan juga terjejas dalam ujian rintangan acid. Ia dapat disimpulkan bahawa kesan itu pada konkrit epoksi dipengaruhi oleh kandungan epoksi.

ABSTRACT

Strength in concrete is the main concern in concrete technology and its advancement. In the recent decades, durability had become a crucial aspect in concrete especially it was exposed to Malaysian Atmosphere. Many development and techniques were improvised to enhance concrete strength and durability. One of the methods to gain both traits in concrete is by adding epoxy in the concrete mixture. In Malaysia, epoxy concrete is relatively new, and thus experimental investigations need to be conducted to understand in depth how its responses under Malaysian conditions. A study was conducted to investigate the durability and development of strength of epoxy concrete under Malaysian Atmosphere. 6 series of samples were prepared with various contents of epoxy concretes, 100×100×100 mm and 150×150×150 mm were casted by using Sikadur-52 as the epoxy. Pure mortar acts as control sample. The concretes were compared and tested with compressive strength test, weather effect tests, acid attack test and permeability test to see development of strength of epoxy concrete. It was found that the epoxy was effective in binding the aggregates and cement where the development of strength was increased. The epoxy was able to increase the strength of the concrete where the higher content of epoxy will return the strength much higher if compared with lower content of epoxy and pure mortar. Also it was found out that epoxy will give a lower permeability compared with the pure mortar. Changes in dimensions and density were also affected in the acid resistance test. It can be concluded that the effects on the epoxy concrete is influenced by the content of epoxy.

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LIST OF SYMBOLS

N	Newton
m	meter
mm	millimeter
kg	kilogram
°F	Degree Fahrenheit
°C	Degree Celsius
Ca ₂ SO ₄	Gypsum
Na ₂ SO ₄	Sodium sulphate
K ₂ SO ₄	Potassium sulphate
MgO SO ₄	Magnesium sulphate
C ₃ A	Tricalcium aluminate
Ca(OH) ₂	Calcium hydroxide
Na(OH) ₂	Sodium hydroxide
K(OH) ₂	Potassium hydroxide
CO ₂	Carbon dioxide
Fe(OH) ₂	Ferrous hydroxide
Pa	Pascal
%	Percent

CHAPTER 1

INTRODUCTION

1.0 General

Concrete is a construction material composed of cement commonly Portland cement as well as other cementitious materials such as fly ash and slag cement, aggregate, water and chemical admixtures. Generally aggregate is coarse aggregate such as gravel limestone or granite, plus a fine aggregate such as sand. The word concrete comes from the Latin word “concretus”, which means “hardened” or “hard”.

Concrete solidifies and hardens after mixing with water and placement due to chemical process known as hydration. The water reacts with the cement, which bonds the other components together, eventually creating a stone-like material. The reactions are highly exothermic and care must be taken that the build-up in heat does not affect the integrity of the structure. The uses of the concrete are pavements, architectural structures, foundations, motorways/roads, bridges/overpasses, parking structures, brick/block walls, footing for gates and etc.

An epoxy resin is defined as a molecule with more than one epoxy group, which can be hardened into a usable plastic. The epoxy group which is also called the glycidyl group has through its characteristic appearance given the name to epoxy (Augustsson, 2004). Epoxy resin is manufactured from simple basic chemicals that are readily available.

1.1 Problem Statement

With the ongoing construction trend in Malaysia, the demand of the harden concrete such as epoxy concrete is getting higher. The use of epoxy concrete is very wide because it has more workability if compared with lightweight concrete and ordinary concrete (Neville, 1996). Thus, the durability of the epoxy concrete under Malaysian Atmosphere is one of the main issues to be studied. Epoxy concrete is required to be strong enough for its uses than others concrete. However, the durability of epoxy concrete such as acid attack, permeability, weather effects and others are still at the satisfactory level. Hence, further study of the epoxy concrete is necessary.

The highly dependency on the concrete in construction field has contribute to make use of lightweight concrete because it is lighter than ordinary concrete. The quality of work such as beams and columns has also affected by the type of concrete.

It is hoped that the epoxy concrete can bring out the tremendous potential towards quality improvements as it encompasses aspects of standardization, durability and quality in our construction field under Malaysian Atmosphere.

1.2 Aim and Objective

The purpose of this research project is to determine the durability of epoxy concrete under Malaysian atmosphere. This study essentially studies the mixture between epoxy and concrete by determine the durability with consideration Malaysian atmosphere which exist in the projects.

The objectives of this study are:

- a) To determine the compression strength of epoxy concrete with different epoxy content.
- b) To determine the permeability of the epoxy concrete under Malaysian atmosphere.
- c) To determine the effects of acid attack towards epoxy concrete under Malaysian atmosphere.
- d) To determine the effect of weather exposure of epoxy concrete under Malaysian atmosphere.

1.3 Scope of Study

This project focuses on the durability for epoxy concrete under Malaysian atmosphere. The durability of epoxy concrete includes strength, permeability, acid attack and weather exposure.

This project encompasses the needs to study and analyse the result of the mixture between epoxy and concrete. The project will identify some properties of the epoxy concrete such as durability, compressive strength and ductility. Then, those problems which are generally encountered in the use of epoxies with concrete will be looked into. The results will hopefully be applicable real data for future construction project. All the testing will be done at Civil Engineering Laboratory, Universiti Malaysia Sarawak.

1.4 Project Outline

This thesis consists of 5 chapters. Chapter 1 presents the general information regarding the background, problem statement, objectives, scope of study and the project outline. This chapter also outlines the duration and work progress of the project.

Chapter 2 describes the literature reviews on the different topics that are related to this study. This chapter reviews on the durability and information of concrete. This chapter also outlines the behavior of concrete with epoxy as the cement replacement material.

Chapter 3 provides the methodology used to carry out this study. It provides overall experimental program for the study. This chapter includes the procedures of the preparing testing the samples. Proper methods and procedures are outlined in this chapter as well.

Chapter 4 presents the result, analysis and discussion from the laboratory testing. This chapter includes the properties of epoxy concretes derived from the results obtained from the laboratory testing. This chapter also includes the changes of physical properties of the samples observed in the study.

Chapter 5 presents the conclusion of the major findings in the study, problems encountered and recommendation for the future work on the related topic to the present study.

1.5 Gantt Chart

Activity / Duration	JULY 2008	AUG 2008	SEPT 2008	OCT 2008	NOV 2008	DEC 2008	JAN 2009	FEB 2009	MAC 2009	APR 2009
Literature Review										
Lab Preparation										
Data Collection										
Data Analysis										
Report Writing										
Final Report										