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JUDUL : **CORROSION MANAGEMENT OF STEEL REINFORCED CONCRETE**

SESI PENGAJIAN : 2005 / 2006

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CORROSION MANAGEMENT OF STEEL REINFORCED CONCRETE

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A project report submitted in partial fulfillment of the requirements for the award of the Degree of Master of Science (Construction Management)

Faculty of Civil Engineering
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APRIL, 2006

I declare that this thesis entitled “Corrosion Management of Steel Reinforced Concrete” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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DATE : APRIL 2006

TO MY BELOVED MOTHER , FATHER AND SISTERS

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ABSTRACT

Structural failures are closely linked with the corrosion of steel bar in reinforced concrete. Repair or maintenance works on corroded structures are usually costly. Corrosion is actually a slow process and can be detected for further repair before causing any damage. Failure to do so would only cause expensive economical as well as physical damage to the structure itself. Corrosion management includes activities performed to mitigate corrosion, to repair corrosion-induced damage and to replace the structures that are badly corroded. The objectives of this study are to study the corrosion management program, to identify the methods of corrosion prevention, to evaluate the cost-benefit ratio of corrosion management and to identify the problems in the management of corrosion. The study was carried out by conducting literature reviews, questionnaires and interviews. The data collected through questionnaires were then analyzed using average mean index. The outcome of the study indicates that awareness of practicing professional is relatively low regarding issues on corrosion management. The potential of cost saving through implementation of proper management program can be surprisingly high

ABSTRAK

Kegagalan struktur pada kebiasaannya berkait rapat dengan masalah pengaratan besi tetulang dalam konkrit. Kerja penyelenggaraan atas struktur yang berkarat pada kebiasaannya akan menyebabkan kos yang tinggi. Pengaratan adalah prosess yang perlahan dan keadaannya boleh dibaiki. Kegagalan untuk memperbaiki masalah pengaratan pada fasa awal hanya akan menelan kos yang lebih tinggi. Program pengurusan pengaratan termasuk aktiviti-aktiviti yang dilaksanakan untuk memberhentikan pengaratan, membaiki pulih struktur yang berkarat dan juga mengganti anggota struktur yang terkarat. Kajian ini dijalankan untuk menentukan tatacara pengurusan masalah pengaratan yang berpotensi untuk menjimatkan kos. Untuk mencapai matlamat kajian ini, soal selidik, temubual serta kajian kes telah dilaksanakan. Keputusan daripada kajian ini didapati bahawa tahap kesedaran para professional terhadap masalah pengaratan masih rendah. Masalah ini perlu diatasi supaya pelaburan ke atas struktur adalah lebih effisien. Juga didapati, jumlah wang yang berpontensi boleh dijimatkan adalah tinggi sekiranya adanya system pengurusan yang baik terhadap masalah pengaratan.

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CHAPTER I

INTRODUCTION

1.1 Introduction

Corrosion is a natural process. The problem started as soon as human started digging the ores. It terrorized industries that have the application of steel ranging from chemical plant, power plant and agricultural sector. However, corrosion that takes place in construction industry is the most critically acclaimed as it involves the lives of human being living under these structures.

Corrosion of rebars in concrete structure is a major problem in the construction industry. Corrosion is generally caused by chloride attack and carbonation which are acidic reaction. Concrete which contains microscopic pores with high concentration of soluble calcium, sodium and potassium oxides are highly alkaline. Ironically, alkalinity is the opposite of acidic. Under high alkalinity condition in concrete, a layer of passive protection would form on the steel surface. A passive layer is a dense, impenetrable film, which if fully established and maintained, prevent further corrosion of steel.

However, as mentioned above, two processes can break down the passivating environment in concrete, one is chloride attack while the other one is carbonation. Therefore, the passive layer is not always maintained.

It was reported that corrosion of metal cost the U.S economy some near $300 billion per year as published by National Association of Corrosion Engineer (NACE). As a general statement, the cost of combating corrosion would keep on growing as long as the country has the capacity to develop. Therefore, it shows that a proper system is very much in need to manage to rising problem of corrosion.

1.2 Problem statement

Concrete is strong in compression but weak in tension. Based on this statement, other material has been introduced to the manufacturing of concrete in hoping to increase the tensile strength of it. Thus, the term of reinforced concrete has been created. Reinforced concrete can be defined as introduction of steel in concrete structure purely for the purpose of strengthening its tensile properties.

Reinforced concrete is a very versatile structure as it can be moulded into variety of shapes. Therefore, application of reinforced concrete is usually very wide in the construction industry. Ranging from substructure to super structure, from beams to columns, from slabs to walls, reinforced concrete can be found in almost every member of the structure.

However, one common problem face by engineers around the globe is that reinforced concrete is an aging material. In other word, the steel will corrodes as time goes by. The severe environment condition in tropical region as well as the process of deicing of saltwater in seasonal countries has led to shorter lifetime of a structure. Right after planting of metal into concrete, nature sets the reversing process.

Of all that, it has prompted one common interest, to study, understand and tackle the problems of corrosion. Realizing the damage and potential danger caused by corrosion, researchers have taken the initiative to identify the mechanism of corrosion and thus introduce methods of curing for it. The methods that are commonly practiced will be further discussed in this study.

As the saying of “prevention is better than cure” goes by, it is wise to design and construct the structure accordingly to avoid any inconvenience.

Corrosion is actually a slow process and can be detected for further repair before causing any damage. Failure to do so would only cause expensive economical as well as physical damage to the structure itself. For that, overlooking the maintenance aspect of a structure could prove to be a costly error.

1.3 Objectives

Engineered structures are built to serve with a purpose. However, all members of a structure undergoes the process of aging. For instance, the most significant aging process is the corrosion of steel in reinforced concrete member.

Corrosion management includes all activities throughout the service life of the structure that are performed to mitigate corrosion, to repair corrosion-induced damage and to replace the structures that are badly corroded. All these activities are governed by large sum of money and are characterized by annual cost. These factors had triggered the need for a proper and systematic ways of conducting corrosion management for reinforced concrete structures ensure maximum profit. In this study, the main objectives are:

1. To study the corrosion management programs.
2. To identify the methods of corrosion prevention.

3. To evaluate the cost-benefit ratio of the management program.
4. To identify the problems in corrosion management.

1.4 Scope of studies

Among the methods that will be carried out to determine the current trend in Malaysia are as follow:

a. Interviews with local contractors, consultants and developers.
b. Survey, in the form of questionnaire to be handed out to local contractors, consultants and developers.
c. Internet research.
d. Application of cost analysis to determine the cost-benefit ratio for corrosion prevention program.
e. Reference of previous studies.