UNIVERSITI PUTRA MALAYSIA

NON-DESTRUCTIVE TEST ON DISTRESSED REINFORCED CONCRETE STRUCTURE

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ABSTRACT

The concrete characterization and properties of reinforced concrete members subjected to reinforcement corrosion was studied using several non-destructive tests and in-situ tests. A few structures suffered corrosion problem were selected for the study.

This project presents some findings on the use of parameters to detect corrosion damage in reinforced concrete members. The changes of concrete properties of deteriorated reinforced concrete members caused by corrosion of reinforcement were depicted base on some cases study in Malaysia. The nominated structures consists of a bridge in Seberang Perai, a low cost apartment and a college in Melaka, two shop-lots in Tanjung Sepat and silo structures in Wilayah Labuan, Sabah.

A set of diagnostic tool and parameter was established for purpose of ascertaining the presence of damage, cause, geometric location, severity and structural capacity through nominal non-destructive test and laboratory test.

Correlation between the tests and the changes of its modal parameter was analyzed and revealed by the nominal tests conducted. This investigation provided further insight on the use of NDT and to minimize the frequency of destructive testing in appraisal and diagnosis to the corroded reinforced concrete members.

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CHAPTER 1: INTRODUCTION

1.1 GENERAL

Past assessments and surveys have revealed that deterioration caused by reinforcement corrosion causes the design life span of structures to be shortened. As reported by Wallbank [8], of 200 concrete highway bridges examined, 25 had minor blemishes, 114 were classed as fair 61 categorized as being in poor condition. The primary reason for this deterioration was corrosion of reinforcement.

This phenomenon has been confirmed by researches worldwide. Transport and Road Research Laboratory, UK [9] studied on the effects of corrosion deterioration on the assessment of concrete bridges. The results show that severe general corrosion could cause a complete breakdown of the bond between concrete and the reinforcement. Similarly, Yoshihiro et. al [6] found that the reduction in stiffness and load carrying capacity occurred in the corrosion damaged beams.

Nevertheless, the use of concrete as a structural material has increased tremendously ever since it was introduced to the construction industry worldwide. In Malaysia, concrete has gained immense popularity as a construction material and is widely used in many structures and buildings over the last three decades.

As problems related to long term performance and durability of the material unveil gradually, monitoring and assessing the health and safety of existing concrete structures and buildings has become a major and important activity in structural engineering. Engineers have at their disposal techniques ranging from visual inspection to full-scale load testing for appraisal and assessment of structures.

Recently, in-situ testing such as *Rapid Chloride Tester* and *Half-cell Potential* tester has been introduce for the purpose of establishing the structural integrity in construction industry. Others test required to compliment the results of *Rapid Chloride Tester* and *Half-cell Potential* Measurement are Compressive strength test, Rebound Hammer measurement and Density test.

However, the tests results acquire specialized skill and others engineering input for the raw data obtained. Different engineers might have their own perspective and engineering judgment to the building suffered corrosion problem. Further to that, there were no provision of any technical note or code of practice that serve as a guidance to conduct a comprehensive appraisal and assessment to the structure. This had eventually lead to many discrepancies and doubt in the structural appraisal industry.

1.2 CORROSION DIAGNOSTIC TOOLS AND PARAMETER

Many reinforced concrete structures have given excellent service with minimal maintenance. However, as the infrastructure has aged it has become apparent that some environments were more severe than originally thought, and some construction and design problems have led to lower service lives and higher maintenance costs than originally envisaged. The worst of these problems is caused by corrosion of steel in concrete, either due to carbonation, chloride attack and other factors.

It is important that to establish a building diagnostic tool and parameter to determine the root causes and extend of damaged of the structures suffered corrosion problem so that cost effective remedial works could be carried out to restore the serviceability and durability of the structures.

Recently, there was no provision of definite parameters and guidance in accordance to code of practice for the corrosion diagnostic and this project would serve for the purpose.

1.3 OBJECTIVES OF PROJECT

This project presents some findings on the use of parameters to detect corrosion damage in reinforced concrete members. It was also concerned with the changes of concrete properties of deteriorated reinforced concrete members caused by corrosion of reinforcement based on some cases study in Malaysia.

Thus, the primary objective of the project is to establish a diagnostic tool and parameter for purpose of ascertaining the presence of damage, cause/s, geometric location, severity and structural capacity through nominal non-destructive test and laboratory test. The aim could be achieved by establishing a relationship between the structural integrity of defect concrete members and the changes of its modal parameter, revealed by the nominal tests conducted.

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