FORENSIC ENGINEERING TESTING TECHNIQUES FOR STRUCTURAL ASSESMENT: A CASE STUDY ON PRE-STRESSED REINFORCED CONCRETE BRIDGE AT KLANG VALLEY

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ABSTRACT

Integrity test on existing concrete structures is often being carried out to determine the assessment for the structure through several aspects such as to determine the whether the structure is suitable for its designed use, for proposed change of usage or extension of a structure, to ensure the acceptability of structure following to any deterioration or structural damage. The evaluation of integrity of existing concrete structures has been carried out through several testing methods and procedures such as non destructive test (NDT) and partially destructive test using sophisticated testing techniques. However, the criteria of selection for suitable testing method and techniques is still are being unclear depending types of structure that need to be tested. The criteria determination of most suitable codes and standards specification for Malaysia perspective is also unclear. Therefore, it is vital to study the reality in selecting most suitable testing method incorporated with most suitable codes and standardizations to carry out integrity test on existing concrete structures in Malaysia.

This case study consisting testing on existing concrete structures using concrete core method, rebound hammer test and ultra sonic pulse velocity (UPV) on existing pre-stressed T-beam and concrete structures of an unnamed bridge in Klang Valley. Results obtained from testing tabulated for comparison between BS 1881& BS 6089 cube characteristic strength and BSEN 13791, 2007 cube characteristic strength. Selected civil and structural consulting engineers was interviewed using prepared questionnaire to identify the selection criteria and views in selecting appropriate testing method to evaluate integrity of existing concrete structures. Finally, the factors influencing selecting the most suitable testing method and comparison of selected standard code and practice identified.

ABSTRAK

Konkrit merupakan di antara bahan bina yang sering digunakan di dalam projek kejuruteraan awam di Malaysia. Di antara alasan penggunaanya adalah faktor ekonomi dan keperluan pembaik pulihan yang rendah sepanjang tempoh keboleh khidmatannya. Walau bagaimanapun, konkrit mengalami beberapa kerosakan dan kemerosotan sepanjang hayatnya kerana kekurangan pengetahuan pada sifat dan kelakuannya. Dengan mengunakan teknik-teknik untuk pemeriksaan kualiti konkrit bagi struktur yang sedia ada ama ada ujian separa musnah ataupun tak musnah, kualiti konkrit yang hendak diuji boleh dikenalpasti. Namun, dalam persepti Negara kita, criteria untuk mengenalpasti ujian konkrit bagi tujuan kajian tertentu masih tidak ada definasi dengan mengambil kira kod-kod specifikasi yang tertentu. Maka, adalah pentingnya untuk membuat kajian untuk mengenalpasti criteria untuk pilihan ujian konkrit mengikut kod-kod specifikasi tertentu untuk mengenalpasti ujian yang terbaik untuk pemeriksaan kualiti struktur konkrit yang sedia ada.

Kajian ini termasuk membuan ujian konkrit yang dipilih iaitu "Schmidt rebound hammer", "Ultrasonicpulse velocity" dan "core test". Kajian in telah dilalukan atas jambatan yang sedia ada di Pelabuhan Klang. Segala keputusan akan ditafsirkan mengunakan bentuk jadual dan graf untuk analysis. Data kajian juga telah dibezakan mengunakan kod-kod specifikasi yang dipilih untuk mendapatkan perbezaan dalam penerimaan data untuk tujuan analisis. Kajian juga dilalukan dalam bentuk temurah dengan pakar jurutera yang berpengalaman dalam bidang kajian konkrit mengunakan boring soal selidik. Segala keputusan temuramah di pamerkan dalam bentuk jadaul dan graf. Melalui kajian ini, mendapat tahu bahawa, ujian "concrete core" memberikan data keputusan yang lebik relevan berbanding dengan keputusan ujian yang lain. Ujian "concrete core" juga disetujui oleh pakar-pakar jurutera yang terlibat dalam bidang kajian konkrit.

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INTRODUCTION

1.1 Introduction

Integrity test on existing concrete structures is often being carried out to determine the assessment for the structure through several aspects such as to determine the whether the structure is suitable for its designed use, for proposed change of usage or extension of a structure, to ensure the acceptability of structure following to any deterioration or structural damage such as caused by fire, blast, fatigue or overload and to ensure the serviceability or adequacy of member known or suspected to contain material which does not meet specifications or with design faults.

The fundamental of structural integrity and durability is to develop continuous monitoring concepts for structural concepts for structural components and for the global behavior. A structure is said to have general structural integrity if localized damage does not lead to widespread collapse. Structural integrity has to be guaranteed by the

structural safety under ultimate and serviceability conditions and by ductility as well as redundancy of load path.

The integrity of concrete structures can justify by using several tests available for testing concrete range from completely non-destructive, where there is no damage to the concrete, through those where the concrete surface is slightly damaged, to partially destructive test, such as core test, and pullout and pull off test, where the surface has to be repaired after the test. The range of properties that can be assessed using non-destructive test and partially destructive test quite large and includes such fundamental parameters as density, elastic modules, and strength as well as surface hardness and surface absorbtionand reinforcement location, size and distance from the surface. At times, it is also possible to check the quality of workmanship and structural integrity by the ability of detects void, cracking and delamination.

The assessment of integrity of existing concrete structures should also taken into consideration of requirements of several codes, standards, specification and procedures established by most countries national bodies and relevant organizations. Standards can play important role in international co-operation when they are used in contracts. The growth in international trade has resulted in a growth in the need for International Standards which can be acceptable compromise between different national standards.

1.2 Problem Statement

Integrity test on existing concrete structures is being implemented widely in Malaysian concrete structures that deteriorate as the effects of structural and

environments loading take place over time. The evaluation of integrity of existing concrete structures has been carried out through several testing methods and procedures such as Non Destructive Test (NDT) and partially destructive test using sophisticated testing techniques. However, the criteria of selection for suitable testing method and techniques is still are being unclear depending types of structure that need to be tested. The criteria determination of most suitable codes and standards specification for Malaysia perspective is also unclear. Therefore, it is vital to study the reality in selecting most suitable testing method incorporated with most suitable codes and standardisation to carry out integrity test on existing concrete structures in Malaysia.

1.3 Research Objectives

The main objectives of this study are as per listed below:-

i. To identify the factors that influences in selecting the most suitable testing method and procedures to conduct integrity test on existing concrete structures.

ii. To analyse and compare on selected codes of practice and standardization for integrity test on existing concrete structures

1.4 Research Scope

This case study scope will be focusing on testing methods and techniques on existing concrete structures incorporated with comparison of codes of practice and standardisation established by BS 1881, BS 6089 and BSEN 13791. This case study is based on several concrete core results obtained from testing carried on existing bridge concrete structures and pre-stressed concrete beams located in Klang Valley. The details of the project will not be illustrated because the project contains certain confidential statements.

1.5 Research Methodology

This case study will be consisting testing on existing concrete structures using concrete core method, re-bound hammer test and Ultra sonic Pulse Velocity (UPV) on existing concrete structures of an unnamed bridge in Klang Valley. Results will be tabulated for comparison between BS 1881, BS 6089 and BSEN 13791. Results will be analyzed using calculation for cube characteristic strength and design requirement and acceptability of the results obtain from the tabulation and wrapped out with conclusion and recommendations. Recommendations will be an overview on options for strengthening the affected structures. The methodology flow chart are shown as below as in Figure 1.1.

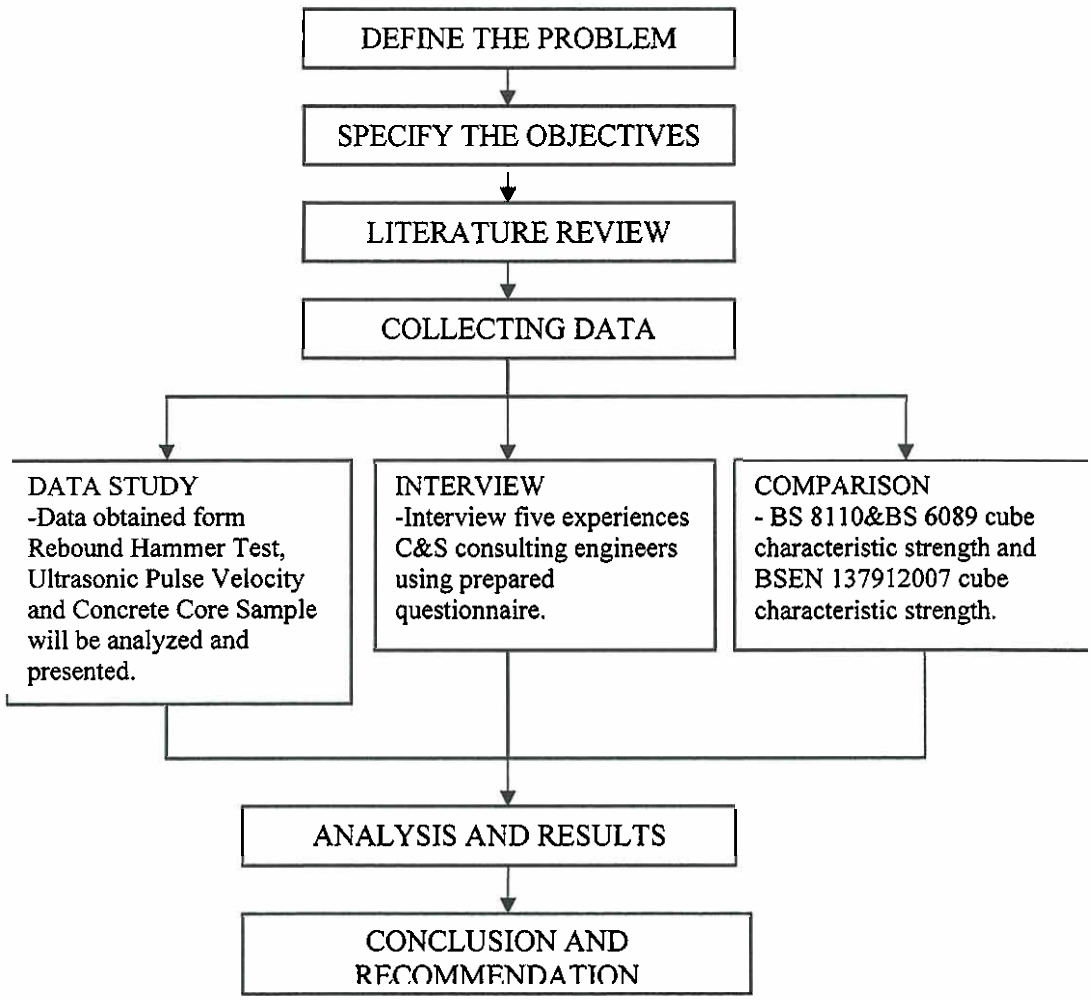

Figure 1.1: Research Methodology Flow Chart

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