STRENGTH ASSESSMENT
OF
REINFORCED CONCRETE STRUCTURES
UNDER EFFECT OF CORROSION

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Degree of Master of Engineering in

Structural Engineering Design

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DECLARATION

I declare that this thesis is the result of my own investigation and that it has not been submitted in candidature for a degree/diploma of this or any other university.

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UOM Verified Signature

Certified by Dr. K Baskaran

ABSTRACT

Main types of reinforced concrete structures such as buildings, bridges, transmission poles which were built specially in the last century, are reaching end of their life span and need strength assessment for their continuous safe use. Strength assessment has to be done as the capacity requirements of a structure can change with changes in technology and life style, change in use, deterioration of structures due to corrosion of reinforcement, chemical attack, thermal effects, shrinkage effects, construction tolerances etc.

The easy but expensive solution for the older building is to replace existing building with a new one but this is very uneconomical. The alternate and practicable solution is the assessment of load carrying capacity and then strengthening of the structure.

One of the major causes that would lead to deterioration of reinforced concrete structures is the corrosion of reinforcement. Damage to the concrete structures occurs in the form of cover cracking, reduction in rebar cross-section, deterioration of bond between reinforcement and concrete. Premature failure of reinforced concrete structures can therefore be prevented by proper control and monitoring of reinforcement corrosion. The assessment of structural behaviour of corrosion affected structures would help in making certain decisions pertaining to the inspection, repair, strengthening, replacement and demolition of such structures.

Corrosion of reinforcing steel and subsequent concrete deterioration is a major problem faced by the construction industry. Different methods have been utilized to study the response of corroded reinforced concrete. Tests have been widely used as a means to analyze individual elements and the effects of corrosion on concrete strength under loading while this is a method that produces real life response, it is extremely time consuming, and the use of materials can be quite costly.

The use of finite element analysis to study these components has been used in recent years. However, limited work is available for the estimation of the flexural strength of corrosion-damaged members. ANSYS is used to perform the non linear finite element analysis in this research and is a general purpose finite element modelling package for numerically solving a wide variety of mechanical problems. These problems include static/ dynamic, structural analysis (both linear and nonlinear), heat transfer, and fluid problems, as well as acoustic and electromagnetic problems.

The objectives of the research study are to study non-corroded and corroded reinforced concrete beams using finite element analysis to understand the response of non corroded and corroded reinforced concrete beams and to develop computer models to predict the behaviour of the corroded reinforced concrete beam to examine the structural behaviour of non-corroded and corroded reinforced concrete beams and to establish a methodology for applying computer modelling to non-corroded and corroded reinforced concrete beams.

This research is carried out for two case studies. Finite element models were developed to simulate the behaviour of beams from linear through nonlinear response and up to failure, using the ANSYS 11. SOLID 65, LINK 8 element represent concrete and discrete reinforcing steel bars respectively, based on each component actual characteristics, non linear material properties are defined for both elements.

Comparisons were made for load-deflection curves at mid span and crack patterns at failure. Conclusions from the current research efforts are included. It is concluded that the finite element analyses could be used to realistically predict the flexural behaviour of non-corroded reinforced concrete and corroded reinforced concrete beams.

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CONTENTS

List of figures

List of tables