

**STRENGTH ASSESSMENT  
OF  
REINFORCED CONCRETE STRUCTURES  
UNDER EFFECT OF CORROSION**

K A S L Kurumbalapitiya



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Degree of Master of Engineering in  
Structural Engineering Design

Department of Civil Engineering

University of Moratuwa  
Sri Lanka

May 2011

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**(07/8806)**

**A Thesis submitted to the Department of Civil Engineering of  
University of Moratuwa,  
for the partial fulfilment of the degree of**



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**MASTER OF ENGINEERING**

**IN**

**STRUCTURAL ENGINEERING DESIGN**

University of Moratuwa



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**May 2011**

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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.



K A S L Kurumbalapitiya



Certified by Dr. K Baskaran



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## 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

Declaration	i
Abstract	ii
Acknowledgement	iv
Contents	v
List of Figures	vi
List of Tables	viii

## Chapter 1

### Introduction

1.1	General	1
1.2	Objectives	5
1.3	Methodology	5
1.4	Outline of the report	5

## Chapter 2

### Literature review

2.1	Introduction	6
2.2	Strength assessment	10
2.3	Strength assessment of rcc structures with gfrp & cfrp laminates	24
2.4	Non linear finite element analysis	29
2.5	Non linear finite element analysis using ANSYS	33
2.6	Corrosion monitoring	36
2.7	Strength assessment methods and repair of reinforced Concrete structures	49

## Chapter 3

### Case Study

3.1	Introduction	67
3.2	Case Study	
	3.2.1 Case study I	68
	3.2.2 Case study II	75

3.3	Data considered for computer analysis using ANSYS	
3.3.1	Case study I	77
3.3.2	Case study II	80
3.4	Analysis Process for the finite element model	
3.4.1	Case study I	82
3.4.2	Case study II	84

## Chapter 4

### Results and Discussion

4.1	Case study I	85
4.2	Case study II	90

## Chapter 5

### Conclusions

99

### References



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101

### List of figures

Figure 2.1	Load – Deflection curve of A-2, B – 2, C – 2 beams and analytical quantities	17
Figure 2.2	Arrangement of loading on test beam	18
Figure 2.3	Arrangement of reinforcement	19
Figure 2.4	Setup of galvanostatic method for accelerated corrosion	20
Figure 2.5	Comparison of structural behaviour (Corrosion crack width of 0.5mm)	20
Figure 2.6	Comparison of structural behaviour (Corrosion crack width of 0.8mm)	20
Figure 2.7	Loading test setting for tested beam	23
Figure 2.8	Maximum principal stress and crack pattern for an outside oxide expansion of 4µm	32



Figure 2.9	Typical potential-time curve as response to a galvanostatic pulse	41
Figure 2.10	ECI sensor during operation	43
Figure 2.11	Cover meter	44
Figure 2.12	Taking a core sample	53
Figure 2.13	How to take a core sample	53
Figure 2.14	Shape of core sample	54
Figure 2.15	Rebound hammer	56
Figure 2.16	Scale of rebound hammer	56
Figure 2.17	Doing a test	56
Figure 2.18	Test and read the number	56
Figure 2.19	Surface transmission	58
Figure 2.20	Surface transmission	58
Figure 2.21	RC structures after deteriorated concrete has been cut away	62
Figure 2.22	Hand-applied mortars in progress	62
Figure 2.23	Cement gun on surface	63
Figure 2.24	Spraying concrete	63
Figure 2.25	Insertion entry ports for cracked slab specimen	64
Figure 2.26	Surface seal paste and ports along the crack plane of a typical slab specimen	64
Figure 2.27	Automatic metering, mixing and dispensing device used in a cracked slab specimen	64
Figure 2.28	Caulk gun used to manually dispense the epoxy mixture in cracked slab specimen	64
Figure 2.29	Spray gun	66
Figure 2.30	Application of SFRP	66
Figure 3.1	Typical Detail for Control Beam Reinforcement	69
Figure 3.2	Load test set up	69
Figure 3.3	Accelerating corrosion set up	70
Figure 3.4	Corroded Beam	70
Figure 3.5	Arrangement for Flexural Testing	71
Figure 3.6	Solid 65 Elements	71
Figure 3.7	Solid 45 Elements	72
Figure 3.8	Link 8 Element	72

Figure 3.9	Loading and Boundary conditions	74
Figure 3.10	Four Point Bending Test Setup for Case Study IIA	75
Figure 3.11	Four Point Bending Test Setup for Case Study IIB	76
Figure 3.12	Simplified compressive uniaxial stress-strain curve for concrete	78
Figure 3.13	Simplified stress-strain curve for steel reinforcement	78
Figure 3.14	Stress strain relationship for concrete	79
Figure 3.15	Stress strain relationship for tor steel	79
Figure 3.16	Stress strain relationship for mild steel	79
Figure 3.17	Stress strain relationship for concrete	80
Figure 3.18	Stress strain relationship for tor steel	81
Figure 3.19	Stress strain relationship for mild steel	81
Figure 3.20	Newton-Raphson iterative solutions (2 load increments) (ANSYS 11.0)	82
Figure 4.1	Experimental Crack Pattern for Control Beam - Case Study I	85
Figure 4.2	Finite Element Crack Pattern for Control Beam - Case Study I	85
Figure 4.3	Load - Deflection curves for Control Beam - Case Study I	86
Figure 4.4	Experimental Crack Pattern for Corroded Beam - Case Study I	87
Figure 4.5	Finite Element Crack Pattern for Corroded Beam - Case Study I	88
Figure 4.6	Load - Deflection curves for Corroded Beam - Case Study I	88
Figure 4.7	Experimental Crack Pattern for control beam – Case Study IIA	90
Figure 4.8	Finite Element Crack Pattern for half of the beam for control beam - Case Study IIA	90
Figure 4.9	Load - Deflection curve for control beam – Case Study IIA	91
Figure 4.10	Experimental Crack Pattern for 8.9% corrosion – Case Study IIA	91
Figure 4.11	Finite Element Crack Pattern for half of the beam for 8.9% corrosion – Case Study IIA	92
Figure 4.12	Load – Deflection curve for 8.9% corrosion - Case Study IIA	93
Figure 4.13	Experimental Crack Pattern for control beam – Case Study IIB	94
Figure 4.14	Finite Element Crack Pattern for half of the beam for control beam - Case Study IIB	94
Figure 4.15	Load - Deflection curve for control beam – Case Study IIB	95
Figure 4.16	Experimental Crack Pattern for 8.8% corrosion – Case Study IIB	95

Figure 4.17	Finite Element Crack Pattern for half of the beam for 8.8 % corrosion – Case Study IIB	96
Figure 4.18	Load – Deflection curve for 8.8 % corrosion - Case Study IIB	97

### List of tables

Table 2.1	Corrosion condition related with half – cell potential (HCP) Measurements	37
Table 2.2	Corrosion risk from resistivity	39
Table 2.3	Corrosion current vs. condition of the rebar	40
Table 2.4	Longitudinal pulse velocity vs. quality of concrete	46
Table 3.1	Dimensions for Concrete and steel support	73
Table 3.2	Element types for Working Model	76
Table 3.3	Properties for steel and concrete	77
Table 3.4	Real constants	77
Table 3.5	Properties for steel and concrete	80
Table 4.1	Test data for control beam	86
Table 4.2	Test data for corroded beam	89

