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An Experimental Study on the Effect of Corrosionon Steel Reinforcement of Concrete Column

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ABSTRACT - Corrosion is one of the most important factor to achieve in completing the service life of concrete structures also cause significant losses in load carrying capacity of structures. In this study, the reinforced concrete column designed in small geometrical scale was subjected to accelerated corrosion test for 30 days under 1 ampere constant current. As a result of the experiment, weight loss and strength reductions was obtained. Loss of strength in reinforcement due to corrosion damage was obtained with experimental procedure. Loss of cross section and reduction of tensile and flexural strength of columns and beams were obtained. As a result of the comparisons, it was observed that corrosion damage caused significant loss in load carrying capacity of the structure.
Keyword – Corrosion, RC columns, Residual Strength, corroded beam, Tensile Strength, Flexural Strength.

I. INTRODUCTION

Corrosion of reinforcing steel is widely accepted as the primary cause of premature deterioration in Reinforced Concrete (RC) structures. Concrete, which is a composite material due to its structure, is formed as a result of chemical reactions. Due to the environmental factors, the chemical influences taken from outside cause significant changes in the structure of the concrete. Although the compressive strength of concrete is emphasized in our country, it is a fact that the durability and usability of the concrete is more important as it decreases the service life. The corrosion products occupy a larger volume and these induce stresses in the cover concrete resulting in cracking, delamination and spalling. In addition to loss of cover concrete, a RC member may undergo structural damage due to loss of bond between steel and concrete and loss of rebar cross-sectional area.

1.1 OBJECTIVE OF STUDY

1. To determine flexural strength of reinforced concrete beams.
2. To compare the tensile strength of reinforcement barsof columns before and after corrosion.
3. To determine the weight losses of reinforcement.

II. MATERIALS AND METHODS

2.1 For Columns

The specimens of column were 150 mm in diameter and 600 mm in height. The specimens were cast with a M25 grade of concrete.The specimens were provided with four bars of 10 mm diameter as longitudinal reinforcement. Each specimen also contained 8 mm diameter stirrups with a spacing of 115 mm c/c. The specimens were cast in an mould of internal diameter 150 mm as shown in Fig. 1. Electric wire is attached with every columns reinforcement for current supply.

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Figure 1 : View of Column at the time of casting

2.2 For Beams

The specimens of Beam were 150 mm *150 mm in cross-section and 700 mm in length. The specimens were cast with a M25 grade of concrete. The specimens were provided with four bars of 10 mm diameter as longitudinal reinforcement. Each specimen also contained 8 mm diameter stirrups with a spacing of 115 mm c/c. The longitudinal bars were kept protruded from the column face to accommodate the electrical connections for accelerated corrosion.


Figure 2 : View of beam at the time of casting process

2.3 Steel

Characteristic strength of reinforcement steel is (HYSD BARS) f_y =500 N/mm^2.

2.4 Accelerated corrosion technique

In this study the accelerated corrosion method is used to induce accelerated corrosion in bars in concrete. To induce current in bars DC power supply of 1 ampere constant current is used. And 0.5% concentrated NaCl is used as electrolyte solution. Specimens are placed in NaCl solution for a month with 1 ampere constant current to induced corrosion.

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Figure 3 : View of Accelerated Corrosion Technique

Figure 4 : Specimens under water tank with 0.5 % NaCl Solution

III. EFFECT OF BEFORE AND AFTER CORROSION

The concrete sample which was produced to expose to accelerated corrosion test was subjected to corrosion damage in laboratory conditions. In this regard, reinforcement bars shows corrosion on it.

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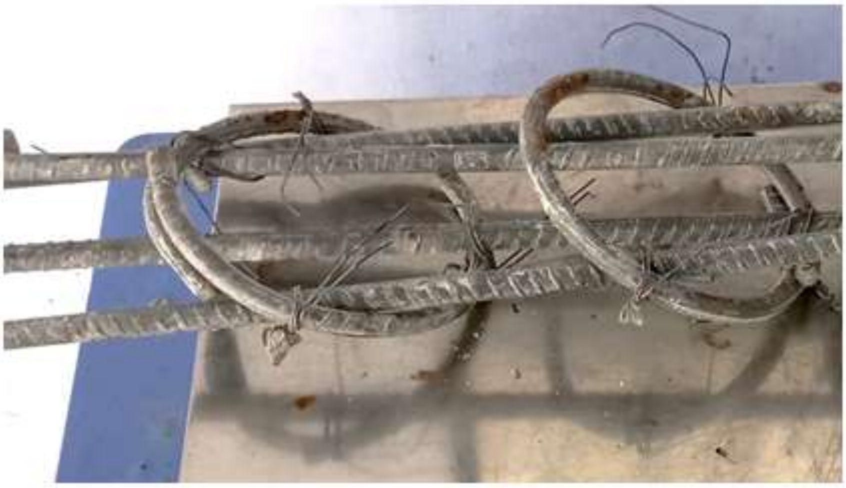

Figure 5 : View of reinforcements without accelerated corrosion test

Figure6:View of reinforcements after accelerated corrosion test

IV. RESULTS

4.1 Tensile Strength

Tensile tests were performed on column longitudinal reinforcement. The yield strength of the longitudinal reinforcement was 792.6 and the yield strength values was obtained 685.36 Mpa after the corrosion process.

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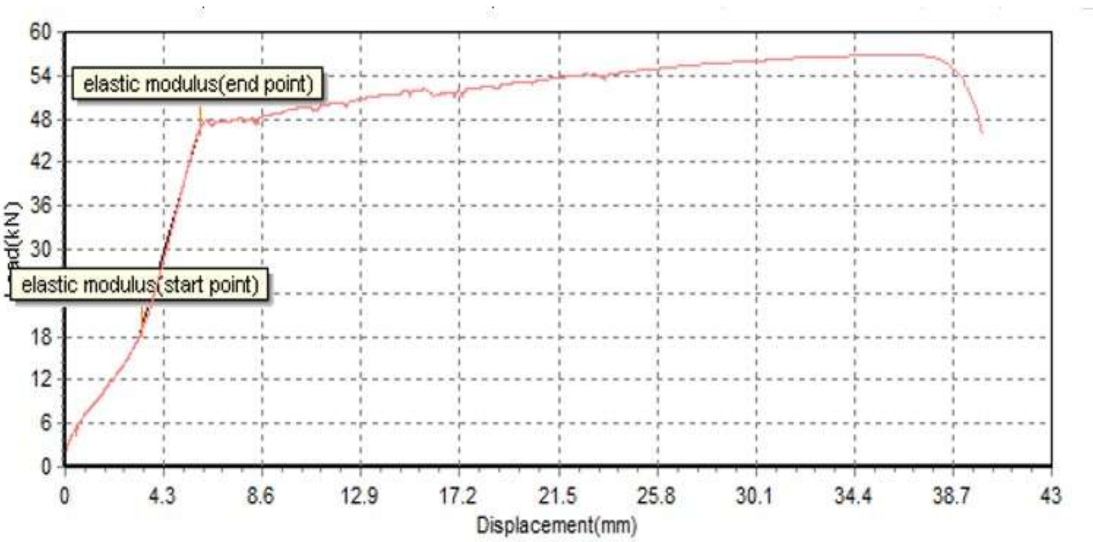

Figure 7 : Graphical representation of Tensile Strength of Corroded Bar

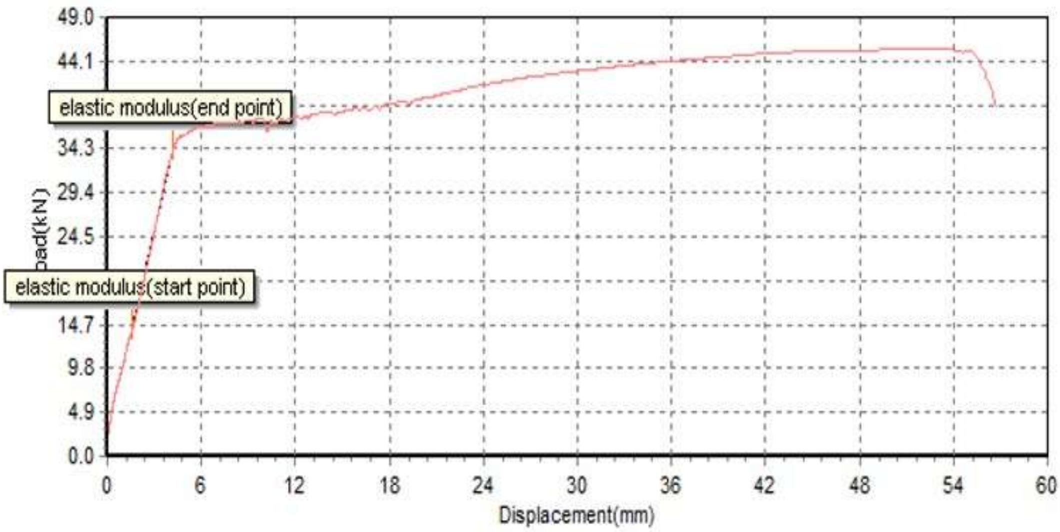

Figure 8 : Graphical Representation of Tensile Strength of Non-Corroded bar

4.2 Weight Test

After a month, a weight loss of 4% was obtained in specimens. Weight of specimens before corrosion is 2127.5 gm. But after accelerated corrosion in specimens, weight of specimens is 2050 gm.

4.3 Flexural Strength

Two-point loading test were also performed on beams for determining flexural strength. The flexural strength of the specimens was 106.2 Mpa without corrosion. But after the accelerated corrosion process, flexural strength of the specimens is 98.5 Mpa.

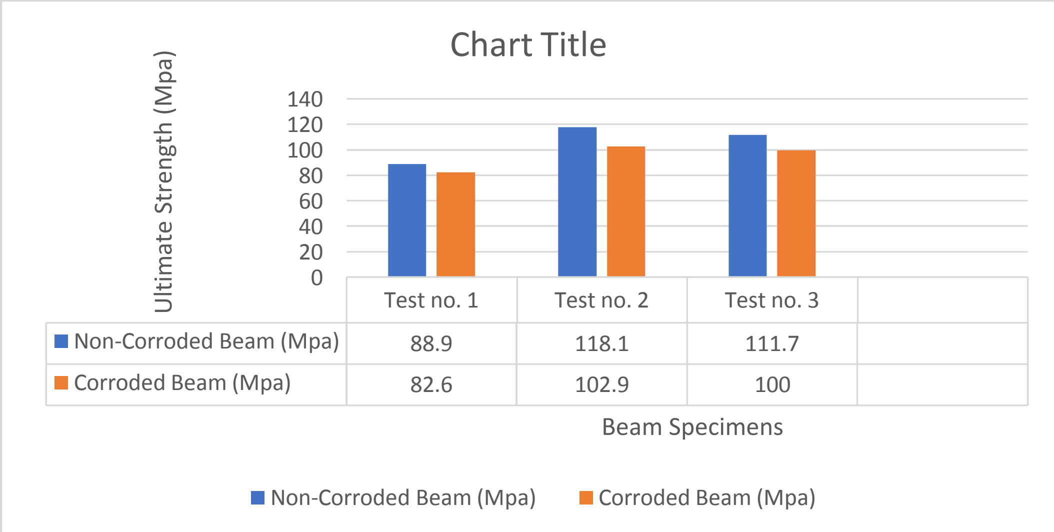

Figure 9 : Chart representation of Flexural Strength of Beams

V. CONCLUSION

Based on the results presented, the following conclusions are drawn:

1. Corrosion of the main steel bar causes surface concrete cracking.
2. Corrosion usually results in a weakened bond which usually takes place at the interface of concrete and corroded bars.
3. Due to weight loss of the reinforcement bars, causes significant losses in the load carrying capacity of the whole structure.
4. Reduction of flexural strength in beams leads to deflection in structure.
5. Stirrups bars reduces their diameter much more faster than longitudinal bars.

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