INTRODUCTION

Corrosion of steel in concrete bridges and other structures could lead to structural failures and it is a high concern for owners and engineers. On the other hand, non-destructive detection of corrosion in RC beams has some difficulties because the reinforcement is embedded in concrete and hidden from the view of inspectors. For such RC beams, Magnetic Flux Leakage (MFL) is an effective method for diagnosing corrosion. In this study, the effect of corrosion on the magnetic field has been simulated by section loss using 3D transient finite element analysis. The simulation results have been compared with experimental data which for verification.

OBJECTIVES

- How much is the effect of the section loss on the magnetic field?
- What is the variation of peak to peak magnitude versus section loss percentage?

METHODOLOGY

When a ferrous metal is magnetized up to saturation with a powerful magnetic field, any flaw like corrosion or pitting leads to the leakage of the magnetic field. This leakage effect is detected by magnetic sensors like Hall-effect sensors located between two blocks of magnets (Figure 1 and 2).

SIMULATION RESULTS

The 3D transient magnetic finite element analysis has been carried out to simulate the magnetic flux leakage and for several amounts of section loss percentages. In the following figure, the leakage of the magnetic field at the location of the section loss is shown.

Due to the motion magnets and sensors along the length of steel bars, the sensors detect any changes in the magnetic field in a direction perpendicular to the steel bars longitudinal axis.

The following diagram show the variation of the magnetic field through the motion of the magnet blocks from left to right with the velocity of 3 in per second for a 50% section loss.

EXPERIMENTAL VERIFICATION OF RESULTS

Figure 8 shows the comparison of the results from simulation with the experimental data. A close agreement exists between the experimental data and those from the simulation.

CONCLUSIONS

- 3D transient finite element analysis is a reliable tool for investigating the effect of corrosion areas in the RC beams.
- The amplitudes obtained from simulations can be obtained for several percentages of section loss in reinforcing steel as a helpful pattern to diagnose the amount of corrosion.

FUTURE WORKS

- Effect of transverse steel bars like stirrups on the magnetic fields
- Develop a method for cases in the presence of the corrosion of longitudinal bars and stirrups
- Studying the effect of volume of section loss
- Establish a procedure to diagnose low levels of flaws in real cases