CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
S1817

Project Title
Nondestructive Corrosion Detection in RC Using Heat Induction and IR Thermography

Abstract

Objectives/Goals
To monitor and assess corrosion in the aging civil infrastructure, we proposed integrated heat induction and IR thermography technology to detect corrosion in steel reinforced concrete. This project aims to evaluate the feasibility of the proposed method and study the thermal and electromagnetic characteristics of corrosion in response to the inductive heating.

Methods/Materials
An inductive heater was employed to remotely heat the steel rebar from the concrete surface, and an IR camera was applied to measure IR intensity at the concrete surface. Bare rebars and RC specimens with different cover depths were fabricated and induced with different levels of corrosion through an accelerated corrosion process. The IR thermographs were recorded during heating and cooling periods.

Results
From the bare rebar tests, the peak IR intensity depends on the amount of corrosion in the rebar; the more corroded rebar exhibited faster heating and cooling rates. From the RC specimen tests, the corroded rebars had a higher IR intensity on RC surface than the non-corroded ones. The heating rate in the corroded RC was also higher. As the concrete cover depth increased, however, it became less efficient to heat the rebar and more difficult to identify the difference between corroded and non-corroded specimens using the IR camera.

Conclusions/Discussion
Experiments on the bare rebars and RC concrete specimens were conducted using an inductive heater and IR thermography. Increases in the electrical resistivity and magnetic relative permittivity due to rust make the corroded rebar more sensitive to inductive heating. The peak IR intensity and heating rates strongly correlate to the corrosion level. This study demonstrates a potential application of the integration of heat induction and IR thermography for the nondestructive detection of rebar corrosion in concrete structures.

Summary Statement
This study demonstrates a novel application of heat induction and IR themography for the nondestructive detection of rebar corrosion in concrete using the thermal and electromagnetic characteristics of rust

Help Received
Used lab equipment at University of California, Irvine under the supervision of Dr. Maria Feng