Florida Department of Transportation Research

Reinforced Concrete Foundation Remote Monitoring

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Project Manager
Randy Pierce
Ivan R. Lasa
FDOT Materials Office

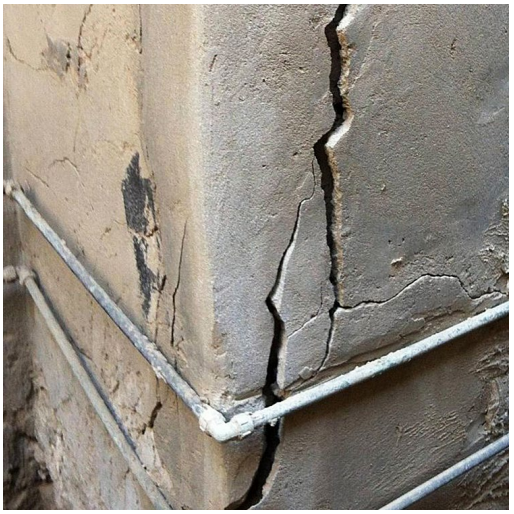
Principal Investigator
Brian Kopp
Juan Aceros
University of North Florida

Current Situation

Many transportation structures are built with reinforced concrete, which can be vulnerable to corrosion promoted by Florida's hot, humid, and salty environments. For this reason, research that seeks improvements in materials and methods for construction of reinforced concrete is an ongoing effort, as are efforts to better inspect and detect reinforced concrete structures for signs of corrosion.

Research Objectives

University of North Florida researchers investigated the use of embedded sensors to monitor reinforcing steel for corrosion.



Corrosion monitoring is important because corrosion of reinforcing steel can cause severe cracking in concrete structures, loss of concrete, and possible structural failure.

Project Activities

The researchers conducted a literature review focused on the technologies that are available for remote monitoring. They selected the single wire transmission line technique, which they adapted for use in reinforcing steel (rebar) embedded in concrete. A series of experiments were conducted on rebar, first, in an ambient air medium and, then, embedded in concrete.

The testing in air verified that the rebar could function as a single wire transmission line and that special directional couplers designed for this project worked. However, when the rebar was encased in concrete, the performance degraded significantly, suggesting that the high frequency chosen for these initial experiments (2.4 GHz) might not support the desired remote monitoring.

In a second design approach, the researchers used a much lower radio frequency (8 kHz). At this low frequency, it was not possible to use directional couplers, so simplified mechanical connections were used. When the second design was used on rebar in air, the results were acceptable. However, when placed in concrete, the performance once again degraded significantly, but not as much as with the higher frequency. It was clear that though the rebar single wire transmission line approach was promising and had attractive features, it faces many challenges for rebar embedded in concrete. For embedded rebar, other techniques should be explored.

The techniques and knowledge developed in this project can be applied in situations where the concrete embedment does not interfere as much. For example, these techniques could be applied to monitoring steel structures or in concrete structures such as columns, which have concentric steel reinforcing cages.

Project Benefits

This project opened the door to the development of a technique for corrosion monitoring which may have applications in many transportation structures.

For more information, please see www.fdot.gov/research/.