TIDC Transportation Infrastructure Durability Center AT THE UNIVERSITY OF MAINE

Ground Penetrating Radar Detection of Steel Rebar Corrosion in Concrete Specimens

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Abstract

Corrosion of reinforcement in concrete highway bridges due to carbonation and chloride attack is an ongoing and commonly observed problem in the United States, especially in cold regions that salt-spraying on concrete bridge decks is a routine practice during the winter. If left undetected in time, late-stage corrosion of rebars not only leads to section loss and subsequent reduction of concrete's tensile strength, but the uneven redistribution of stresses will lead to subsurface cracks that will ultimately reach the surface and lead to spalling, causing major safety and cost issues. Nondestructive testing and evaluation (NDT/E) sensors like ground-penetrating radar (GPR), are commonly used to detect subsurface anomalies (such as water and air pockets), utilities, and rebars. In this experiment, the feasibility of a 1.6GHz GPR for detection and identification of reinforcement corrosion, and its relationship with the scattering response (geometry), and response strength (amplitude) at different stages is tested. For this purpose, three concrete blocks (12 x 12 x 5 in^3) were cast with a #5 rebar at their center. The rebars in two of the specimens were corroded via the accelerated corrosion test (ACT), yielding stage two (rebar depassivation), and stage 3 (surface cracks) corrosion specimens. The specimens were scanned at six different angles with respect to the rebars. The impacts of scan angle, position, and corner scattering were considered and modeled accordingly. From our results, it was found that a 1.6GHz GPR sensor can successfully detect corrosion in concrete reinforcement and quantify and model the image parameters of the response patterns, and amplitudes of the reflected signals.

Acknowledgements: Funding for this research is provided by the Transportation Infrastructure Durability Center at the University of Maine under grant 69A3551847101 from the U.S. Department of Transportation's University Transportation Centers Program.

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