Non-destructive Evaluation of FRP-Concrete Structures using Microwave Techniques

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Background

Fiber-reinforced plastic (FRP) composite jacketing systems have emerged as an alternative to traditional construction, strengthening, and repair of reinforced concrete structures. Escalating deployment of this new technology is expected, especially in seismically active regions.

Assessment of the degree of damage in structural members that are confined in FRP jackets becomes problematic as the concrete core conditions cannot be fully revealed until physical removal of the jacketing system, unless the member has already been subjected to extensive damage. Based on previous studies, a concrete column may appear safe without showing any sign of substantial damage on the jacket, while the concrete core might have undergone severe cracking or crumbling [1]. Currently, several non-destructive evaluation (NDE) techniques for assessing FRP-confined concrete structures have been under development. They include acoustic, strain gauging, infrared thermography, and x-ray techniques. In spite of these studies, there is no currently available technology capable of characterizing the various forms of FRP-bonded concrete damages that is ready for real-time, large-scale damage detection on site. A reliable imaging technology is in pressing need to complement the rapidly growing deployment of FRP jacketing in concrete columns and bridge piers. The Infrastructure Research Group at MIT has initially attempt to develop novel microwave techniques to efficiently assess the condition of FRP-concrete confined structures.

Objective

The objective of the 1.541 Class Project is to establish the most current understanding of NDE imaging techniques to visualize and quantify damages on FRP-confined reinforced concrete members using wideband radar. According to previous research, microwave radar technology presents several advantages other methods [3,4]. Additionally, new imaging techniques have been developed to better focus the scattered and reflected electromagnetic radar waves [2]. The project will consist of an extensive literature review covering the developments in the area of NDE using microwave techniques, the study of the underlying physical principles of these techniques, and an analysis of the feasibility of today's research efforts in this particular area.

Cited References

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