

## **Ground Penetrating Radar and Infrared Thermography: Modern Day Tools in Bridge Program Maintenance and Management**

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([PRWEB](#)) August 04, 2016 -- Delamination in bridge decks are the results of separation of the concrete from reinforcing steel bars, and are caused by corrosion of the steel. Different methods of delamination detection have been used through the years by transportation authorities to assess the conditions of reinforced concrete bridge decks. However, most of the methods require lane closures or at most slow-moving mobile lane closures. Ground Penetrating Radar (GPR) and InfraRed (IR) thermography can be performed at highway speed. They survey bridge decks quickly, cost-effectively, and with no traffic disruption and safety risks. They are covered by ASTM specifications, D6087-8 (2015) for GPR and D4788-03 for IR.

A recent report from Strategic Highway Research Program (SHRP2) regarding the assessment of nondestructive testing technologies for concrete bridge deck deterioration detection and evaluation concluded that the technology that provides the highest value is GPR. The rating was based on accuracy, repeatability, speed, ease of use, and cost. GPR has become a means of locating areas of delamination on bridge decks with asphalt overlays, bridge decks overlaid with Portland cement concrete, and decks without an overlay. Data gathered is processed and interpreted by certified engineers, and translated into scaled plan view drawing showing deck delamination. IR is a valuable and cost effective method for locating overlay de-bonding in concrete bridge decks. GPR is a well-established and accepted inspection technique for accurately assessing the condition of reinforced concrete structures. The combination of IR and GPR is very powerful, maximizing the capabilities of each method and compensating for the limitations. Together, they offer a high degree of accuracy in locating deteriorated and de-bonded areas and provide a great deal of confidence in the overall deteriorated quantities.

### **Infrared Thermography**

Resource International, Inc. (Rii) uses a combined GPR/IR technology to detect and map delamination on reinforced concrete bridge decks. IR is used to collect high-resolution digital imagery and infrared data. The deck scanning system uses a very sophisticated last generation IR camera (FLIR A6700sc), enabling the bridge deck scanning team to drive at highway speed while collecting high-quality IR images for analysis. The collected video images and Infrared data are analyzed to identify potholes, major cracks, spall, patches and concrete de-bonding. The depth of investigation is limited to the top 2 inches of the deck.

### **Ground Penetrating Radar**

GPR is used to investigate deeper into the deck. The data is collected at highway speed utilizing two air-launched horn antennas (1 GHz) mounted on booms so that the antennas scan on two different paths. Survey scan lines are spaced in 2.0 foot increments over the entire deck surface and achieved at intervals of 2-inch longitudinally. The survey method using two antennas has the advantage of covering more deck surface in a single day. The method provides accurate deterioration quantity assessments that can be used to help identify locations that can best confirm that corrosion is taking place in predicted areas. The collected data are analyzed by measuring the amplitude of the reflection at the top rebar mat. If the radar signal is strongly attenuated as a result of moisture, high chloride content, concrete delamination, rebar corrosion or a combination of some or all

of these factors within the concrete, the amplitude of the signal is greatly reduced. A combination of IR and GPR provides the maximum amount of information and creates a more effective bridge deck condition assessment.

#### Rii Survey Vehicle

The Rii Project Team uses equipment manufactured by Geophysical Survey Systems, Inc. (GSSI) whose antennas feature the highest signal-to-noise ratio of any antenna available in the industry, providing the highest quality data with clear and accurate results. Rii survey vehicle is equipped with GSSI SIR-30 radar system (Control Unit) and two 1 GHz air-launched antennas attached to the rear of the van on an adjustable mounting system, Corrsys-Datron DMI wheel pulse encoder for accurate survey length measurements, Trimble GPS system PROXH, a three camera alignment system for accurate survey width measurements, a workstation inside the van for the operator during data collection, an Inverter Generator and several safety and hazard lights.

The IR system, mounted on the front of the vehicle, utilizes an innovative deck top scanning system which includes an infrared camera to locate near-subsurface structure defects such as delamination, and a high resolution camera for detecting deck surface distresses like cracks and potholes. The system uses the latest FLIR A6700sc thermal imaging camera with FLIR cooled InSb detector, with an excellent image quality, high sensitivity, and high speed image acquisition.

Rii exercises caution to ensure the safety of the public during the testing procedures. The survey vehicle, equipped with flashing lights, travels at the posted speed limit, without requiring lane or shoulder closures.

#### Deliverables

The results of GPR/IR data analysis are plotted on the plan sheets of the bridge decks using AutoCAD. These results, indicating the deterioration conditions of the decks are also presented in tables, including the total percent deterioration of the deck areas.

Following the conclusion of the work, Rii prepares a report on the results of the GPR/IR and visual inspection for the bridge decks. The report describes the work completed, the techniques and equipment used, the results obtained (including schematic layouts) and interpretation of the results based upon GPR/IR and visual inspection. The analysis identifies and summarizes concrete deterioration as a percentage of the total area surveyed from the completed GPR/IR investigation. The condition report consists of an executive summary and a general description including narrative, supporting graphs, pictures, charts and deterioration maps of the structures. The report provides a plan view map of each bridge deck showing the areas of deteriorated concrete. It also shows the estimate of the required full-depth and partial-depth bridge deck repair quantities, and the estimate of the average depth to the top mat of deck reinforcing. Rii provides a sample draft report early in the process to receive comments from the client regarding the content, format and necessary appendices for the report. These comments are incorporated in the future draft and final report submittals.



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