Video: Field Validation Testing of Nondestructive Testing Technologies on a Concrete Bridge Deck

In October and November of 2010, field validation testing of nondestructive testing (NDT) technologies was performed on a concrete bridge deck in Haymarket, Virginia, as part of a SHRP2 research project. This research project was conducted by Rutgers University with the University of Texas at El Paso and the German Federal Institute for Materials Research and Testing, Berlin, Germany. Teams from industry and academia demonstrated how their NDT technologies—such as ground penetrating radar, impact echo, and infrared thermography—can be used to detect deterioration in concrete bridge decks. Video segments of the rodeo are included on this page.
Please note: The videos and images below are not an endorsement of any product.

You can jump to a section of this page by clicking on one of the links below:

Why Research NDT?
Test Site
Electrical Resistivity
Galvanostatic Pulse Measurement
Ground Penetrating Radar
Half-Cell Potential
Impact Echo
Impulse Response
Infrared Themography
Ultrasonic Pulse Echo
Ultrasonic Surface Waves

Why Research NDT?

Highway agencies need to evaluate bridge deck condition to optimize the timing of preventive maintenance, prioritize bridge deck repair and rehabilitation, determine the scope of required repairs, and make repair-or-replace decisions. To meet rapid renewal goals, inspections and evaluations need to be accomplished quickly, effectively, and at the right time. Innovative NDT technologies exist, but are not widely used and the range of NDT technologies, and the strengths and limitations of each are not widely understood.

SHRP2 research project R06A (Nondestructive Testing to Identify Concrete Bridge Deck Deterioration) is identifying NDT technologies that can effectively detect and characterize deterioration in bridge decks. The project is evaluating the strengths and limitations of applicable NDT technologies from the perspective of speed, accuracy, precision, and ease of use. The technologies are also being validated. Test procedures and protocols for the most effective application of the bridge deck NDT methods evaluated will be identified and the results will be used to develop an electronic library of NDT technology resources for practitioners.

Test Site

The bridge used for the NDT rodeo is located on Rt. 15 over I-66 in Haymarket, Virginia. Constructed in 1979, the two-span bridge is a concrete deck on a steel-girder structure with a 15-degree skew. The reinforced concrete deck is about 8 inches thick with clearly visible deterioration on its surface. The bridge was selected in coordination with the Federal Highway Administration's Long Term Bridge Performance (LTBP) Program, the Virginia Center for Transportation Innovation and Research, and Virginia Department of Transportation. In 2009,

Haymarket Bridge underwent extensive preliminary evaluation as a part of the LTBP Program's Pilot project, using both destructive and nondestructive means, visual inspection, and full-scale loading.

Side View of Rt. 15 over I-66 Bridge in Haymarket, Virginia

Aerial View of Test Site

Electrical Resistivity

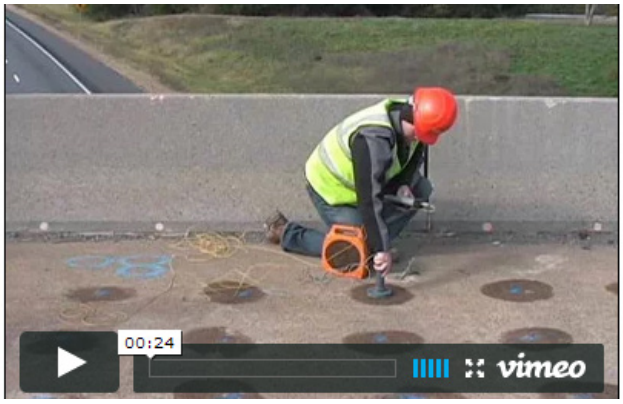
The electrical resistivity method measures the concrete's ability to support ionic flow by measuring the concrete resistance. In many cases the measured resistance can be related to the corrosion rate.

Rutgers

Galvanostatic Pulse Measurement

In the galvanostatic pulse measurement method, an anodic current pulse is galvanostically induced into concrete from a counter electrode that is placed on the surface together with a reference electrode. This method is designed to estimate the corrosion rate of concrete by measuring the potential variation, electrical resistance, and polarization.

Olson Engineering

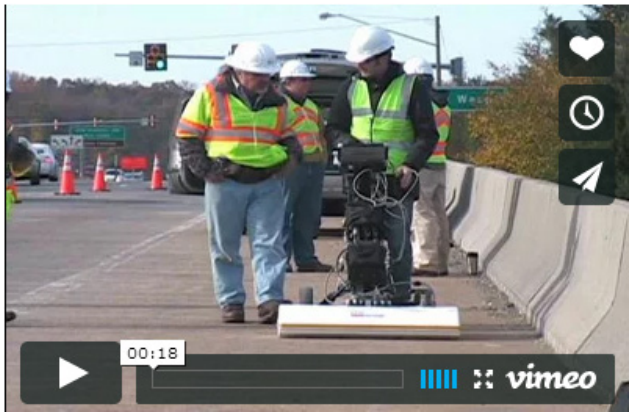


Ground Penetrating Radar

Ground penetrating radar is an electromagnetic method that produces graphic images of subsurface as a result of reflection of electromagnetic waves from material interfaces. It can detect deterioration in concrete, signs of corrosive environment, delamination, voids, anomalies in concrete, water-filled or epoxy-injected cracks, and debonded overlays.

3D Radar

IDS, Italy



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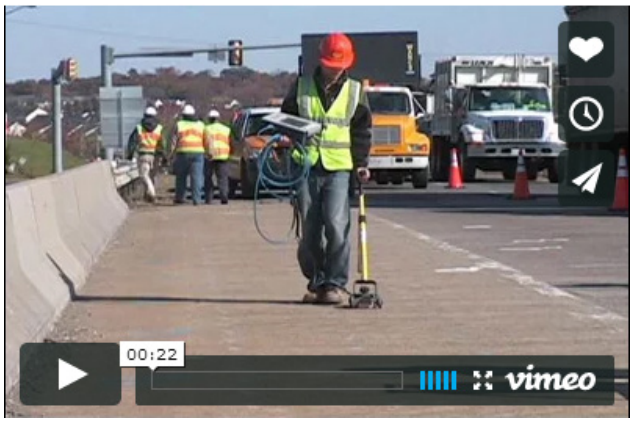

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Half-Cell Potential

The half-cell potential measurement is used to evaluate the activity of corrosion processes in steel-reinforced and prestressed concrete structures. In this method, a reference electrode is placed on the surface. When the electrode is shifted along a line or grid on the surface of a concrete surface, the spatial distribution of corrosion potential can be mapped.

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Impact Echo

The impact echo method is a frequency response technique used to detect and assess delamination, evaluate vertical cracks and materials, and characterize grouting conditions in tendon ducts.

University of Illinois

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NDT Corp
This technology also uses ultrasonic surface waves to identify vertical cracks.

Impact Echo-Spectral Analysis of Surface Waves (SASW) Olson Engineering

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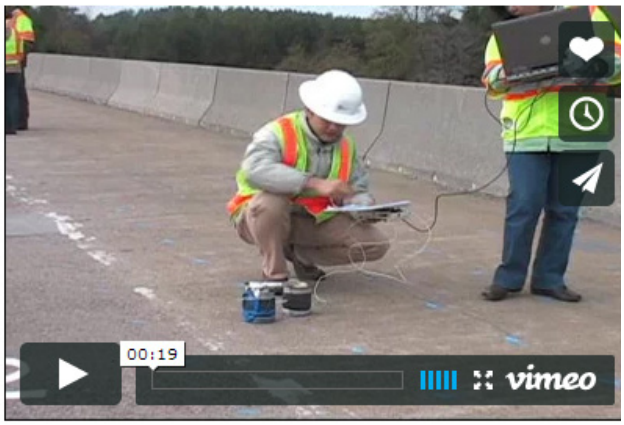
University of Texas at Austin
If one receiver is used, this technology applies the impact echo method. If both receivers are used, ultrasonic surface waves are used to identify vertical cracks.



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Impulse Response

In impulse-response NDT, a stress pulse is generated by a mechanical impact on the surface of the tested object and the response of the object recorded using a nearby receiver. To learn about the condition of the object, both the impact and response functions are transformed into the frequency domain to obtain impedance functions or mobility spectra.

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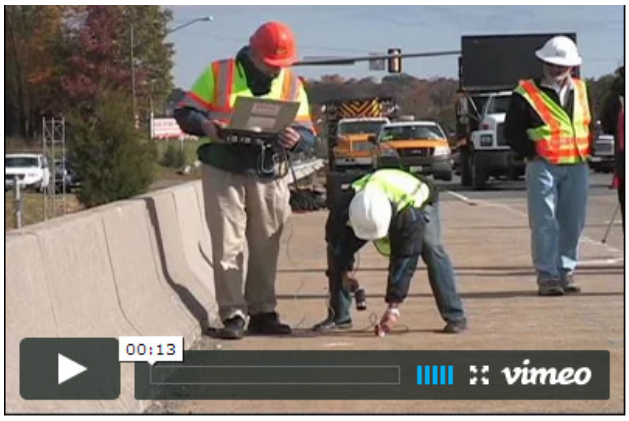

Infrared Themography

Infrared (IR) thermography is used to detect concrete defects, such as delaminations, debonding, and concrete disintegration. IR thermography can quantify these defects by measuring the surface temperature influenced by the changes in subsurface material density, heat capacity, and heat conductivity changes.

Federal Highway Administration

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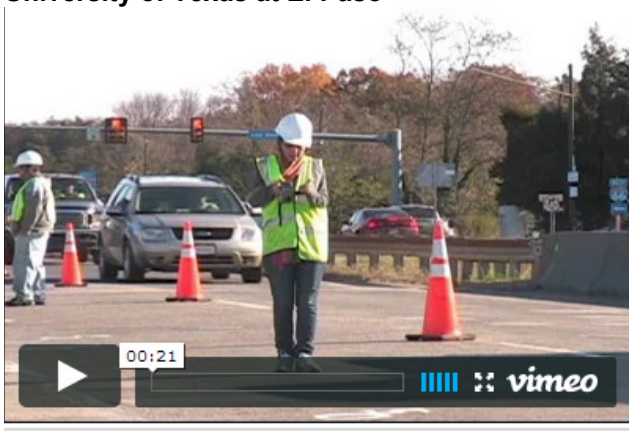
University of Texas at El Paso



Ultrasonic Pulse Echo

The ultrasonic pulse echo technique method uses high-frequency transducers to create and detect arrivals of ultrasonic pulses. The time it takes to travel to another point is measured. This method can be used to detect voids, grouting conditions in ducts, material degradation or changes, and other anomalies. It can also be used to localize rebars and tendon ducts.

MIRA System - University of Texas at El Paso

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Ultrasonic Surface Waves

The ultrasonic surface waves (USW) method involves measurement of the surface wave velocity to obtain material modulus, as a sign of possible degradation of material properties, or detect possible defects, like vertical cracks or delaminations. Waves generated by an impact of an electromagnetic or mechanical source are being recorded by a pair or several receivers to enable calculation of the surface wave velocity.

Rutgers

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