



# University of Kentucky Transportation Center Conducts GPR Survey for Void Detection in Reinforced Concrete

Data Collected using GSSI's SIR-20 and SIR-3000

Geophysical Survey Systems, Inc.

## Investigate Voids

Persistent settling of concrete pavement in the Cumberland Gap Tunnel has led to numerous repair attempts in the past decade. Principal Investigator Brad Rister, Program Manager Clark Graves, and hydro-geochemist James Dinger of the Kentucky Geological Survey, alongside their team, performed ground penetrating radar (GPR) surveys and hydro-geochemical water testing (HGWT) to determine why the continuously reinforced concrete pavement had settled in various areas throughout the tunnel.

Just 10 years after the tunnel's completion, approximately 7,300 total square feet of pavement surface had voids beneath it that ranged from 0.5 to 40 inches in depth. Employing GSSI Ground Penetrating Radar (GPR) and hydro-geochemical water testing, investigators were able to establish the root cause of the sub-base erosion and propose an appropriate sub-base and surface replacement program.



**GSSI Control Units:** SIR-20 and SIR-3000

**GSSI Antenna:** 900 MHz

**Data Collection Location:** 1 pass per lane CWP

**Data Collection Density:** 3 scans p/ft.

**Data Collection Speed:** 20 mph

## Photos and data courtesy:

University of Kentucky Transportation Center  
Lexington, KY USA

## Survey Results

The study determined the best remediation strategy was to replace the existing limestone sub-base material with granite and rebuild the continuously reinforced pavement. The initial proposal was to replace approximately 2,800 feet of pavement in each tunnel, costing approximately \$10,000,000. The GPR and HGWT results, however, allowed crews to limit repairs to the isolated areas and save in excess of \$5,000,000.

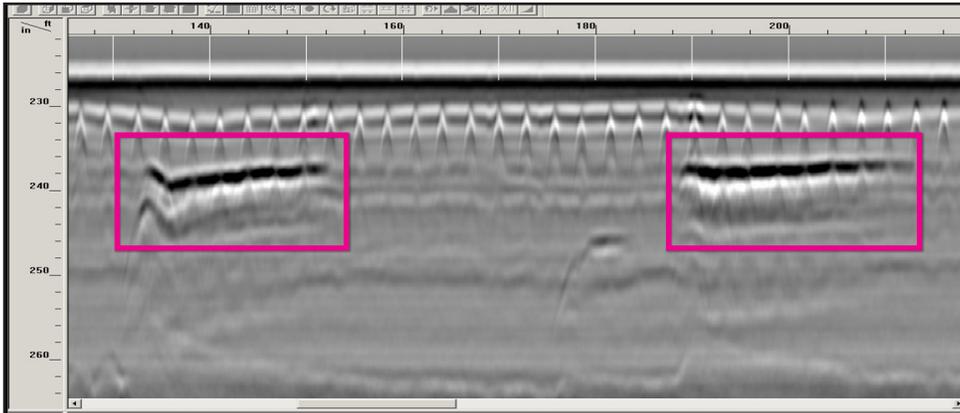
Quote: "If the corrective measures outlined in the report are performed, it is highly likely that a catastrophic pavement failure will be averted in the near term," Rister said. "This report will also help identify a long-term inspection process that will assist in finding other distressed areas within the tunnel as they arise in the future."

Full project details can be found in the American Association of State Highway and Transportation Officials (AASHTO) 2012 High Value Research compendium, "Research Impacts: Better- Cheaper- Faster."

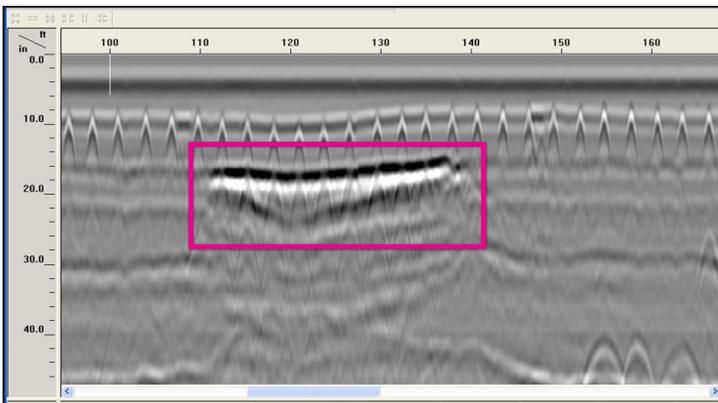


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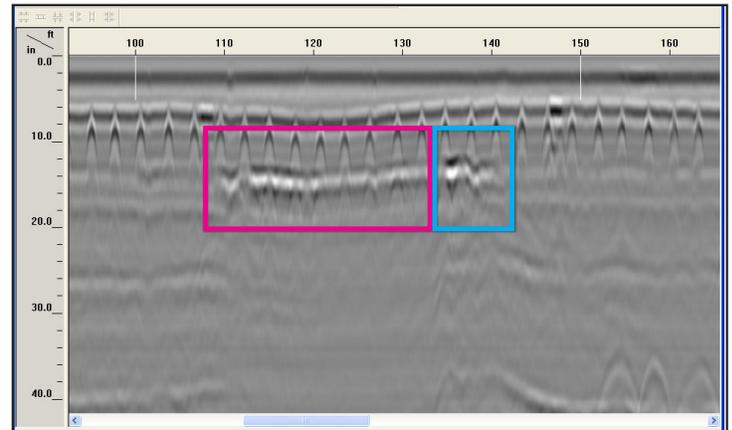
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Data illustrates multiple voids beneath concrete pavement in the northbound tunnel.



Data shows a void in the concrete pavement, northbound center wheel path.



Data shows void filled with grout as part of repair efforts. Blue box highlights a portion of the void not filled with grout, notice the difference in amplitude.



Kentucky Transportation Center deployed a SIR-20 control unit with a 900 MHz antenna and survey wheel attached to vehicle.

