Rounding out an infrastructure inspection program with non-destructive testing

Ground penetrating radar can help capture subsurface data for roads and bridges.

By Kevin Vine

Aging infrastructure, costly traffic gridlock and recent road and bridge failures across the country have municipalities looking beyond traditional infrastructure inspection techniques. Events such as the recent sinkhole on Ottawa's St. Joseph's Boulevard and crack in Montreal's Champlain Bridge indicate the need for a more proactive approach to infrastructure assessment.

Traditional road and bridge inspection methods, when applied on their own, lack in effectiveness for a variety of reasons. Visual data is highly subjective and influenced by technician training and interpretation. Coring is often costly and fails to provide a quantifiable, representative sample of the entire inspection area.

In response to these challenges, project stakeholders are increasingly incorporating a non-destructive technology known as ground penetrating radar (GPR) into the inspection process. The technology works by transmitting high-frequency radio waves into the ground or structure and analyzing the reflected energy to create a profile of the subsurface features. The reflections are caused by a contrast in the electrical properties of subsurface materials which can be indicative of changes in water content, void spaces in the ground, rebar or post tension cable corrosion, asphalt deterioration and other factors. Combined with inspection data acquired through traditional testing, GPR provides a substantive dataset on subsurface conditions and supports more informed decision-making around infrastructure rehabilitation spending.

Capturing subsurface conditions on roads and bridges

Sound maintenance decisions rely on the ability to capture and interpret a wide range of infrastructure-related information including asphalt, concrete and granular thickness; pavement or concrete damage; moisture in the concrete; rebar positioning and thickness, among others.

Traditional inspection techniques, when applied on their own, fail to capture a continuous profile of a road or bridge deck. For example, localized sampling may not account for varying degrees of deterioration over a vast area that can worsen over time. Integrating GPR into the inspection program closes this information gap by capturing subsurface data across a vast area and reporting on anomalies deep below the surface.

"Non-destructive technology has the unique ability to detect deterioration and other subsurface anomalies before they develop into serious concerns," said Dr. Peter Annan, P.Eng, Ph.D Geophysics, Founder, Sensors & Software. "Techniques such as GPR reveal changes in subsurface properties that allow suspicious areas to be targeted for further evaluation and preventative remediation. More traditional methods such as chain drag, for example, will detect deterioration only once the concrete or bridge deck has already become cracked or delaminated."

Investigating subsurface conditions along an eastern Ontario roadway

GPR was recently incorporated into a pavement investigation along a roadway just outside of Ottawa. The project area contained active construction projects which made it difficult to coordinate field work. This impeded the ability to carry out the traditional inspection method which would typically involve conducting a visual inspection to identify distress, extracting pavement every 100 to 200 metres and then drilling boreholes to collect material from the roadway.

GPR was incorporated into the investigation to assess pavement structure interfaces while driving at posted speeds. Captured data, which was reported at five-metre intervals, was analyzed to identify asphalt thickness and granular layers. The data was then referenced using GPS coordinates.

"Leveraging GPR allowed us to continue the investigation while reducing conflict with ongoing construction," said Mark Popik, Senior Pavement Engineer, Thurber Engineering Ltd. "It supplemented the borehole information that we were able to collect, and provided a representative snapshot of conditions beneath the paved surface."

The investigation resulted in a digital report that detailed the location, depth and thickness of asphalt and granular layers along the stretch of road. Google Earth files were also provided so that the road could be visualized section by section along with corresponding pavement structure summary information.

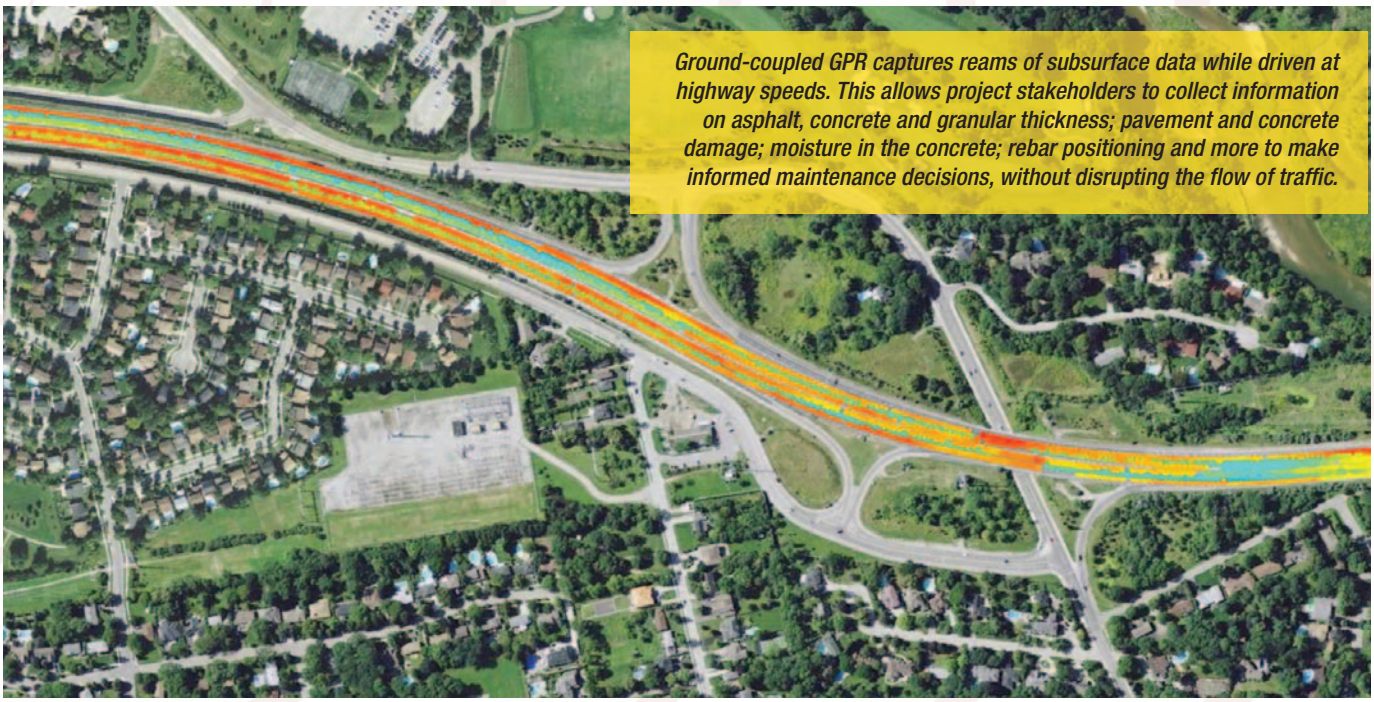
"Often, when a stretch of road has recently been repaved, it may appear to be in good condition, but the subsurface conditions might be poor," said Popik. "GPR has the ability to detect areas where asphalt is unusually thin or thick and this information can then be correlated with observed road performance and factored into the construction design process."

Taking a proactive approach to infrastructure maintenance

In 2012, Canada's first infrastructure report card found that more than half of the roads owned by Canadian municipalities fell below the rating of "good" while 32 percent were found to be in fair condition and 20.6 percent in "poor" to "very poor" condition. The study also found that a majority of municipalities do not implement regular condition-assessment programs.

Over the next several years, many of the country's roads will be in need of costly repair and rehabilitation. Incorporating GPR data into the condition-assessment process will make it possible to accurately define the scope of work required and more proactively monitor Canada's transportation infrastructure. Guided by GPR data, project stakeholders can readily identify potential areas of deterioration and conduct intrusive sampling judiciously to save on costs and minimize traffic disruption.

Furthermore, each time a condition survey is completed, subsurface inspection data can be added to a digital record to be referenced years down the line for future rehabilitation projects. This makes it possible to examine patterns of deterioration overtime and evaluate the effectiveness of rehabilitation programs in support of a safer, preventative approach to infrastructure maintenance.



Ground-coupled GPR captures reams of subsurface data while driven at highway speeds. This allows project stakeholders to collect information on asphalt, concrete and granular thickness; pavement and concrete damage; moisture in the concrete; rebar positioning and more to make informed maintenance decisions, without disrupting the flow of traffic.