Safe construction
starts with the right technology

Photo by jacobfergusphoto.com

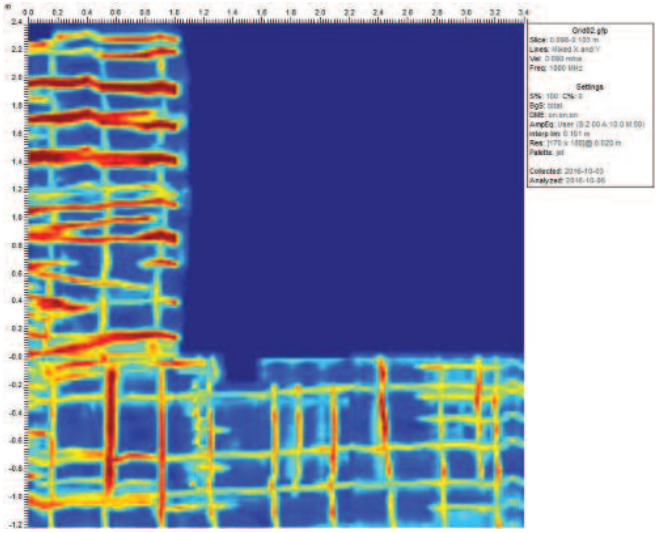
Construction in Ottawa is booming. The City's projected budget for road renewal, growth and integrated infrastructure projects is estimated at approximately $173.8 million for 2017. Furthermore, it was recently announced that the City is eligible for as much as $92.3 million in projects for water, wastewater and stormwater rehabilitation under the federal Clean Water and Wastewater Fund.

With increased activity comes increased risk, and a heightened focus on safety. Short-duration construction projects involving cutting, trenching and excavation around gas, electrical, water and sewer connections can often pose the biggest threat to worker and public safety. When larger projects occur in and around aging infrastructure, safety-related issues can be exasperated.

It is now common knowledge that the key to ensuring safe cutting, coring or excavation is to start with a scan or locate to map out buried objects and identify potential hazards. Though this is old news, the methods and technologies applied to carry out these techniques continue to evolve. Traditional x-ray technology is largely being replaced by ground penetrating radar (GPR), which has become the go to method for knowing where to cut and drill without the risk of contacting a conduit or other hidden dangers.

A smart approach to risk reduction

Concrete x-ray for construction projects first began to surface in the early 1980s and gained significant traction over the following decade. The technology offers extremely accurate imaging which provided project owners with an unprecedented risk reduction technique. Previously, little to no information was available to indicate the presence and location of rebar, utility conduits or post tension cables beneath the surface of a concrete slab. As a result, the act of cutting or coring always carried some level of risk.



GPR data depicting rebar located approximately 10cm into the concrete slab. Multiple grids were merged together to cover a large area.

However, a major challenge with the technology is that the radiation emitted poses a risk to human health. An 80- to 100-foot clearance is generally required, and often, a building may need to be evacuated prior to performing the scan. This can introduce project delays and disrupt business continuity around the project site.

Unlike x-ray, GPR transmits harmless electromagnetic waves into the ground or structure and then analyzes the reflected energy to create a profile of the subsurface features. It can assess slab thickness and detect features deep below the surface that show the presence of utilities, rebar, mesh and post-tension cables. It can also provide information on concrete conditions such as deterioration in reinforcement materials, void spaces and delamination. No personnel evacuation is required and it can be performed during regular business hours.

This feature of GPR has benefited construction works in and around the City of Ottawa. Prior to a drain being installed at the Ottawa Public Library, a GPR concrete scan was performed in the electrical room and garage below to prepare for coring. As the library is a public space in close proximity to a sidewalk, applying x-ray technology would have required a complete evacuation of the building and surrounding area. Similarly, when a scan was required at the Elgin Street police headquarters, vacating the building would not have been an option. Applying GPR allowed the day's activities to proceed as scheduled without disruption.

GPR has been applied to a number of construction projects in and around Ottawa to avoid the need to evacuate the project site and disrupt surrounding businesses

No project too big or too small

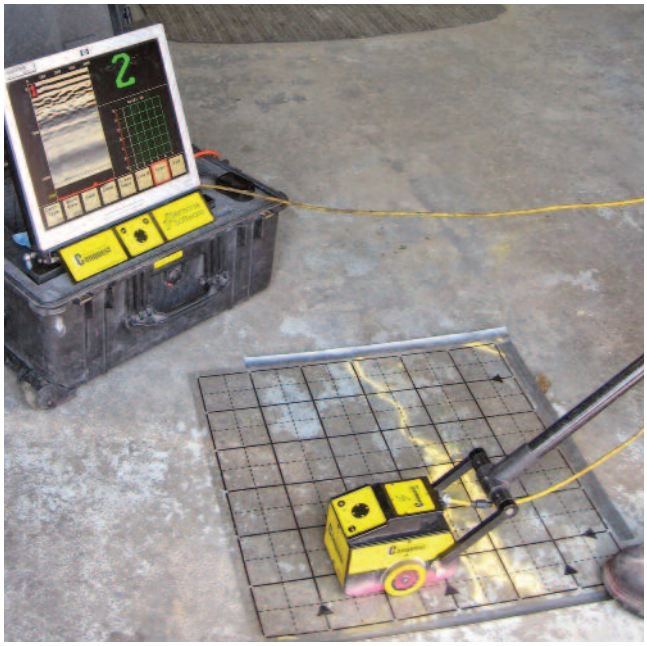
Another advantage of GPR comes down to accessibility. X-ray techniques require access to both sides of a concrete object, often limiting projects to elevated concrete slabs or surface walls. As such, the technology is ineffective for slab on grade and foundation walls, where corrosion, voids and utility placement are most common. In contrast, a GPR scan can be conducted on a single side of the concrete. Small areas can be scanned using a hand held device that combines a screen and antenna in a single unit allowing technicians to maneuver confined access areas with ease.

An example of this occurred just outside Renfrew, where GPR was used to scan a 12-foot by 3-foot surface area on three hydro dam towers to determine the location of structural reinforcement and utilities within the base of the towers. The towers were being replaced and the project owner needed to map out the embedded rebar as well as any active or empty conduits prior to construction. The scan identified the presence, location and position of both rebar and electrical conduits and the information was provided to the client as a geophysical map along with selected profile sections. X-ray technology would not have been an option for this project due to the small, restricted surface areas.

A few things to consider

Although GPR is an obvious choice when it comes to safety, versatility and convenience, the one advantage of x-ray technology is that it is capable of yielding a very high-resolution image of the embedded features in concrete. If a project requires precise visuals showing the condition and structure of a buried object or a detailed comparison between similar objects, x-ray should be considered. GPR is more suited to highlighting the location, position and depth of buried objects.

Another consideration is the thickness of the survey area. X-ray is only effective for concrete thickness of 20 inches or less, whereas GPR can be adjusted to accommodate various depths and is commonly used to image the thickness of entire bridge decks from just the road surface. As such, a project owner must consider the level of detail required to achieve the project's goals in addition to access, safety, and thickness of the area being scanned.



X-Ray is limited to elevated concrete slabs or above grade walls because technicians require access to both sides of an object. A GPR scan can be conducted on a single side of the concrete.

Other things to think about include budget and project schedule. An advantage of GPR data is that it can be revealed in real-time. Technicians can view the results of the scan on screen and immediately mark the concrete slab. The data can also be presented in a number of ways such as plan view, profile view and 3D. As GPR data requires an analysis component, the key to deriving maximum value from the data always comes down to ensuring the interpretation is conducted by a certified and experienced GPR professional.

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