New Solutions for Non-Destructive Evaluation of Infrastructure

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Abstract

There are many powerful technologies developed in other industries that are directly applicable to the non-destructive evaluation of civil infrastructure. Applications include: excavations, utilities, foundations, roads, bridges, buildings, and other structures. These same technologies are valuable for quality control - being capable of evaluating the effectiveness of construction, installation or rehabilitation efforts. A number of case histories are as follows:

Characterization of proposed sewer alignment Induction logging (essentially a borehole metal detector) was used to identify tie-back cables and utilities that might be in the path of the tunneling machine to be used. Many potential intersections were found, and tunneling was abandoned, saving the city an estimated $500,000. Has application to trenchless installations in crowded urban environments.

Characterization of excavations under critical structures Borehole radar and seismic techniques were used to determine obstacles to excavation for several boring operations passing under highways and runways. Obstacles located included boulders, wood and general trash. The collective beneficial impact of these surveys was estimated at millions of dollars. Has application to any situation where a boring or drilling operation has the potential to encounter underground obstacles that could significantly impact excavation and cost.

Evaluation of existing utility Magnetic susceptibility plus standard and deep induction were effective in locating other utilities adjacent to an existing clay pipe sewer that was to be replaced by pipe bursting. Due to the sensitive nature of the facility, there were major concerns about damage to adjacent utilities by the pipe bursting operation. In addition to known utilities, several unknown utilities were located, as well as several sections of pipe that had been repaired or reinforced with steel casings, all of major concern for a pipe bursting operation. It was estimated 100s of thousands of dollars were saved in problems avoided by performing this survey. Applications include pipe bursting and pipe over-boring where damage to adjacent utilities or structures is a concern. Also, any time conditions outside an existing pipe need to be known, such as the presence of voids or contamination.

Grouting effectiveness evaluation Borehole density measurements were used to characterize the effectiveness and extent of compaction grouting. The vertical grout column shape could be implied from the results, and actual *in situ* strengths would be determinable with the addition of a seismic shear wave measurement. Has application to situations where *in situ* soil properties need to be known, or where the effectiveness of a soil treatment process needs to be evaluated.

Backfill QA/QC Density and moisture content logs were used to determine backfill compaction in trenches. The method was better, faster and less costly than conventional compaction evaluation techniques. Compaction is determined continuously to full depth of backfill, and can be used during construction to allow correction of any problems while the contractor is still on site. Has application to any situation where backfill is being used.

Void detection – Ground-penetrating radar was used to determine the extent of a void outside of a storm sewer pipe. Changes in soil conditions were also imaged. This allowed the city to make repairs before a collapse occurred. Has application to the evaluation of existing pipe for wall damage, void identification, and leak detection.

Subsurface stratigraphy determination - Borehole radar was used to map formation thickness out from an active mining operation where surface access was limited. Demonstrated potential for saving millions in development of uneconomic reserves. Has application to any situation where you need to know ground conditions ahead of excavation.

Detection of adjacent openings and structure – Ground-penetrating radar and seismic techniques were used to locate other tunnels/bores that might be too close for safely continuing excavation. Has application to situations where there may be structures adjacent to an ongoing excavation.

If you have any questions, please contact **Dr. C.Vipulanandan**