

Non-Destructive Evaluation Techniques for Construction and Rehabilitation in Urban Environments

Russell J. Miller

Abstract

With the ever increasing rate of construction and rehabilitation in our already congested cities, subsurface exploration is becoming super-critical. Hence it is important to know what conditions exist in the subsurface in order to have technical and cost effectiveness for our projects. Prior to excavation it is important to know what hazards and conditions are present for method/equipment selection and more realistic bids. For rehabilitation work, it is important to know conditions both inside and outside the pipe to identify where and what techniques to apply. And, for post-rehabilitation/installation a method of evaluating the quality/effectiveness of the work is needed. The technologies already exist, often developed in support of other industries, that can provide this critically needed information.

A key issue in the application of trenchless excavation is an understanding of subsurface conditions along the proposed alignment. Since much of this excavation will be in cities or developed areas, there is risk of intercepting existing structures or utilities, as well as general obstacles such as boulders, voids, faults, fractures, geologic materials variations, general trash or contaminated ground. Test borings from the surface can only sample a very small portion of the conditions at depth. What is needed is a technique (or techniques) that can examine subsurface conditions along the entire alignment. Methods can take the form of seismic, electromagnetic, or potential fields, and be applied from the surface or in boreholes. Primarily, the contrast of the target anomaly to the surrounding material will affect its detectability, but there is also the issue of depth of penetration versus resolution. Since the electrical and acoustic properties of the local earth materials affect the usefulness of various techniques, it is recommended that more than one approach be used at a site. This increases confidence in results, and greatly reduces the risk of missing an anomaly that is insensitive to a particular search strategy.

Relative to the issue of rehabilitation of existing pipe systems, municipal and industrial entities face an overwhelming amount of system infrastructure potentially needing rehabilitation. To have any hope of tackling the job with always-limited funds, a form of triage must be applied to prioritize where and what rehabilitation needs to be performed. CCTV has provided a valuable means for evaluating conditions inside a pipe, but often we need to know about conditions outside the pipe as well. This is not unlike logging outside of casing in oil & gas applications, and many of the same techniques apply.

Post-rehabilitation is another area where being able to "see" into a structure would be valuable. After slip lining and grouting, voids behind the liner which might cause buckling failure can be identified and repaired. For CIPP, bond integrity and liner thickness can be evaluated. Even lateral reinstatement can be improved by more accurately locating the intersecting pipe. Lateral connection/patch integrity can also be examined, as well as any "piping" that may be occurring behind the pipe/liner.

There have been a number of projects where both pre-excitation pilot holes and existing pipes have been "logged," and disasters costing many times that of applying the technology were avoided. Obstacles to excavation such as wires, foundations, piles, boulders, and wood were identified. An interesting project was recently completed where the owner was concerned about damage to adjacent structures and utilities from pipe bursting. By using simple electromagnetic logging of the pipe to be burst, it is possible to tell where and how close the typically-metallic structures were.

If you have any questions, please contact [Dr. C.Vipulanandan](#)

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