



Best Practice

Title: Operating in GPR Scanned Slabs
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Introduction

This document provides an overview and methodology for core drilling, sawing or hand breaking in concrete when Ground Penetrating Radar (GPR) scanning has been utilized as it applies to the sawing and drilling industry.

GPR is an accepted and routinely used nondestructive method for imaging embedments in concrete prior to cutting. It is a safe application of radar regulated by the Federal Communications Commission in the U.S. Imaging results are generated on-site for immediate mark out and analysis of embedments in the defined area(s). The inspection, under normal circumstances, can be performed on one side of the slab, which permits slab-on-grade scanning. Some common applications of GPR include, but are not limited to:

- Locating reinforcing bars
- Locating post-tension cables
- Locating metallic and non-metallic conduits
- Detecting voids beneath slab-on-grade
- Slab thickness and cover depth to targets

Core drilling typically requires one operator. It is utilized to drill through concrete reinforced slabs or structure to accommodate access for utilities, openings and other access purposes. It is typically a wet cut process to minimize any silica exposure.

Sawing typically requires one operator. It is utilized to cut through concrete reinforced slabs or structure to accommodate demolition limits, trenching for utilities, openings and other purposes. It is typically a wet cut process to minimize any silica exposure.

Hand breaking concrete typically requires one operator. It is utilized to remove partial or full depth areas in a concrete reinforced slab or structure to accommodate access for utilities, openings and other access purposes. It is typically a dry process utilizing HEPA vacuum systems to minimize any silica exposure. This method is not to be confused with robotic demolition or robotic breaking.

This document covers various operations in conjunction with practical considerations when using GPR scanning on a job site. This document is to be used as a general guide. Operations will vary between manufacturers and models. It is very important that every operator of equipment be a competently trained person on the equipment for the proper use of the equipment. The operator should, as a minimum requirement, have completed CSDA training or contractor in-house training. The operator needs to know the limitations of the equipment and be able to interpret the marking or data from the GPR scans.

1. Practical Considerations

Understanding the limitations of GPR scanning is an integral part of successful sawing, it is as equally important to consider the practical side of being on-site and properly surveying the cutting area. Every site is different, and the following are some guidelines to keep in mind:

- 1.1. Before arriving at the jobsite, the following are some questions to ask the customer:

- Why does the customer need the concrete cut, drilled or broke (opening, trench, limit cut, joint)?
 - What are potential hazards in the concrete (post-tension cables, conduits, utilities, reinforcing, membrane)?
 - Was the floor scanned using GPR, standard or digital X-ray?
 - How old is the concrete (wet concrete is a GPR limitation)?
 - How thick is the concrete?
 - Will the area be free of obstructions?
 - Are there special safety considerations to be met?
 - Recommend that hole, opening, trench, saw cut locations be available prior to GPR scanning so technicians can properly mark all embedments.
- 1.2. When you first arrive at the site, a walk around should be performed while you are completing your “JSA” Jobsite Safety Analysis and a Silica Site Specific Report. Useful information regarding the structure will prove valuable when reaching conclusions about potential embedment in the area. Below are some good questions to ask once on site:
- Is the area a slab on grade or a suspended slab?
 - Is the underside of the slab or back side of wall accessible to be viewed?
 - Are there conduits connected to the underside of slab or backside of wall?
 - Could there be electrical conduits in the concrete?
 - Could there be radiant floor heating in the slab?
 - Has the concrete been scanned before (past problems)?
 - How was the structure constructed (i.e., pan deck, pre-cast, post-tension, filigree or terrazzo)?
 - Is there a support beam under the slab?
 - Make customer aware of any observations or concerns you might have.
- 1.3. Make sure the floor/wall is clear of any debris that could interfere with operations and the placement of markings.
- 1.4. Sometimes it is permissible to cut reinforcement. No imaging contractor should offer anything more than an estimate when it comes to differentiating between rebar, post-tensioning and electrical conduit. Look for telltale signs of objects that deviate from the rebar pattern. Post-tension cables tend to be draped between columns, starting high near the beam/column line and draping progressively lower towards the center point between beam/column lines (the point of greatest slab deflection). Conduits may curve and take the most direct path from A to B. Non-metallic conduits also return a lower strength signal than metal objects and rebar.
- 1.5. Refer to CSDA-BP-017 for markings that are to be left by a GPR imaging contractor.
- 1.6. Placing safety cones over GPR markings helps avoid cutting through marks.
- 1.7. Certified operator training is critical to the success of any project. You must have a firm understanding of the technology, the equipment, its strengths and limitations. Communication of the equipment’s capabilities and limitations must be clear to the end client, thus preventing the danger of overselling the GPR technology and its impact to your operations.
- 1.8. As it is critical in all construction processes, communication is vital. All parties involved in cutting/coring/breaking operations, including but not limited to the GPR technician, the concrete cutting/coring/breaking operator and the customer should all be aware of the limitations of all steps involved in GPR scanning and concrete cutting/coring/breaking.

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2. Limitations

Some common limitations encountered when using GPR, and recommended setbacks for your processes:

- 2.1. Core Drilling Specific: GPR does not measure diameter of objects, just their location. Allow at least a 2" setback from center of the marked embedment or 1" setback from the edge of the marking, whichever is greater, to the closest point of core drilling. Refer to CSDA-BP-017 for the marking of embedments.
- 2.2. Sawing Specific:
 - 2.2.1. GPR does not measure diameter of objects, just their location. Allow at least 12" setback on each side of the marks to the closest point of sawing. A partial depth cut may be utilized in the setback area if the depth of embedment is indicated. It is recommended that your depth of cut be at least 2" above the marked-out depth. Refer to CSDA-BP-017 for the marking of embedments.
 - 2.2.2. Use caution when sawing in slab on grade as bottom of slab typically varies and GPR scanning can be difficult to interpret in slab-on-grade situations. This is due to the interference of the wire mesh and the weak reflection from the concrete-gravel base interface. It is important to verify the thickness of the slab on grade to avoid cutting into subgrade as conduits are typically laid on top of subgrade. Methods which assist in determining slab depth include: having the GPR scanner mark for bottom of slab, roto-hammering test holes on a regular interval, or visual evidence of different slab thicknesses. Note differences in GPR marked depths vs actual depths, i.e. if the concrete is marked at 6" thick and the actual saw cut depth is measured 5" concrete, adjust all GPR depths by the same distance.
- 2.3. Hand Breaking Specific: GPR does not measure diameter of objects, just their location. Allow at least a 2" setback from center of the marked embedment or 1" setback from the edge of the marking, whichever is greater, to the closest point of breaking. Take into consideration the potential targets in a setback area to determine size, impact and chisel point type. Refer to CSDA-BP-017 for the marking of embedments.
- 2.4. A limitation distance adjacent to an obstruction (walls, conduits, studs, etc.) is present with GPR devices due to the orientation of the internal transmitter/receiver. Each limitation is unique to the specific devices of individual manufacturers. It is recommended that operators maintain a 4" or more setback when operating near a vertical obstruction. Take into consideration the potential targets in a setback area to determine size, impact and chisel point type.
- 2.5. The operator must be aware that locating metal and PVC conduits in the "valleys" of corrugated steel decks is difficult and, in some circumstances, impossible. Efforts should be made to avoid core drilling into these "valleys".
- 2.6. The operator must be aware that a GPR antenna or antenna array cannot image through metal wire mesh/metal fiber with specified spacing (i.e., chicken wire mesh). Consult with the GPR scanner to determine these limitations specific to the manufacturer antenna they utilize.
- 2.7. The operator must be aware that GPR cannot image through foam used within slabs or on roofs. On roofs, these areas need to be opened by a qualified individual a minimum of 1 foot larger on all sides than the intended scanned area. For example, a required scan area of 2-foot x 2-foot should

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be opened to at least a 4-foot x 4-foot area. Foam placed internally in a slab requires scanning from both sides of the deck.

- 2.8. Ability to image on opposing side of air voids in concrete (i.e., hollow core slabs, CMU block walls) cannot be performed. Access to the opposite side is required to complete the scan.
- 2.9. The operator must be aware that relatively uncured concrete is difficult and sometimes impossible to image due to the electrical conductivity of the material. Depending on concrete thicknesses and cure time it is recommended that no scanning occur within a minimum of 30 days after pouring. This time may need to be adjusted on a case-by-case basis.

3. Liability

The concrete cutting/coring/breaking operator is relying on GPR markings and any onsite observations. GPR scanning is like any investigative tool, GPR is not perfect. It is subject to the scanners interpretation skills and the physical limitations of the equipment. Regardless of the quality of the equipment, or how skilled one is, there are situations that just cannot be overcome (e.g. freshly poured concrete, hidden targets, voids in concrete, corrugated decking, etc).

It is important to understand these limitations and convey this to the customer. It is recommended to have a disclaimer included in the sub-contract or job form.

When directed by the property owner and/or contracting agency to operate within the offset area it is advisable to have an authorization to proceed as part of your contract to work. Work within these offset areas implies a certain amount of risk and the contracting agency and/or owner should be made aware of these risks and should take responsibility if they direct you to operate within these offset areas.

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