



Best Practice

Title: Depiction/Marking of Existing
Subsurface Embedments
Issue No.: CSDA-BP-017
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Introduction

This document provides an overview and methodology for properly marking out embedments found with Ground Penetrating Radar (GPR).

Due to significant and recent advances in GPR, an increasing number of building owners, architects, engineers and contractors are specifying imaging be performed for the correct identification of utilities and structural elements. This increasing demand for imaging is related directly to the specifier's need to avoid unnecessary and/or costly damage to subsurface structures and/or embedments.

This document is intended to supplement CSDA Best Practice CSDA-BP-007 *Ground Penetrating Radar for Concrete Imaging* by providing GPR technicians with a standardized guide for the proper and accurate marking out of embedments on concrete cutting jobsites.

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1. Background

GPR is now the most recognized and useful tool for the investigation of embedded objects within concrete structures. Its accuracy and ability to locate a variety of embedments, with minimal to no disruption, has made it the preferred tool in scanning for subsurface embedments within concrete. The use of GPR also expands into other investigative uses.

The increased number of GPR users has resulted in some jobsites having several GPR contractors present onsite at once. To avoid confusion between imaging contractors regarding the data they have collected, a standardized depiction of subsurface embedments should be agreed upon and implemented.

2. Definitions

Contracting agency: The contractor hired directly or indirectly by the owner that is sub-letting the imaging requirements to an imaging contractor. Owner of and responsible for the preservation of markings created by the imaging contractor.

Embedment: Any signal return interpreted by the imaging technician that is different to the surrounding environment.

Exclusion Zone: Markings used to indicate a safe working distance from an embedment or utility. These exclusion zones are marked to help prevent utilities coming into contact or being damaged by cutting tools.

Locating: The process of exposing the vertical and horizontal location of an embedment.

Marking: The process of leaving a mark on site to identify the location of an embedment or utility. Ownership of marks rests with the owner or contracting agency, not with the imaging contractor.

Owner: Legal owner of the structure being imaged and consequently, the owner of the markings created by the imaging contractor.

Imaging: The use of Ground Penetrating Radar to search for embedments within a defined area.

Imaging Contractor: The contractor hired to perform the imaging operations.

Utility: A privately, publicly, or cooperatively owned line, facility or system from producing, transmitting, or distributing communications, cable television, power, electricity, light, heat, gas, oil, crude products, water, steam, waste or any other similar commodity, including any fire or police signal system or street lighting system (CI/ASCE 38-02).

3. Concrete Investigation

Investigation of concrete for various embedments is one of the most common applications in the field of GPR as it relates to the construction industry. It is important that proper markings be generated to minimize confusion with other contractors and personnel on site.

3.1 Reinforcement

The marking of embedments interpreted by the imaging contractor to be reinforcement within the deck shall be identified with an appropriate device as job conditions allow. In situations where markings are to be made on exposed concrete that is not the natural exposed surface, a black lumber crayon or black marker shall be preferred. If black markings are not appropriate or are difficult to see, another appropriate color (except red) may be used. Use of another color must be specifically noted to the appropriate contractor in the pre-job and post-job walkthroughs. On finished surfaces, such as polished concrete, tiled floors and carpet, a more temporary mark may be necessary. In these situations, the imaging contractor may use chalk, tape or other appropriate device as job conditions allow. Every effort should be made to avoid the use of temporary markings, as they can easily be moved, altered and/or erased. It is recommended that the GPR contractor take photos of all locations with temporary markings to avoid disputes later.

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3.2 Conduits

The marking of embedments interpreted by the imaging contractor to be conduits shall be marked out in red, where appropriate. If red is not appropriate, another color may be used and specifically noted to the appropriate contractor in the pre-job and post-job walkthroughs. The color used to denote conduits must never be the same color used to denote reinforcement. Failure to do so will create confusion and is not in following with this best practice/standard.

3.3 Exclusion Zones

Because GPR cannot initially identify the size/width of an embedment, an appropriate exclusion zone shall be marked on either side of it. This exclusion zone shall be no less than 1 inch on either side of the identified center point of an embedment. This may be larger based on GPR data or other supplied information that may indicate the need for a wider exclusion zone. The area within the exclusion zone markings shall be filled in with an appropriate mark. This may include a separate wavy line, hash marks, text, spray paint or any other appropriate mark (as shown in Figures 1,2 and 3). If a temporary mark is required on a finished surface, such as carpet, tape must be used that has a width of no less than 2 inches.

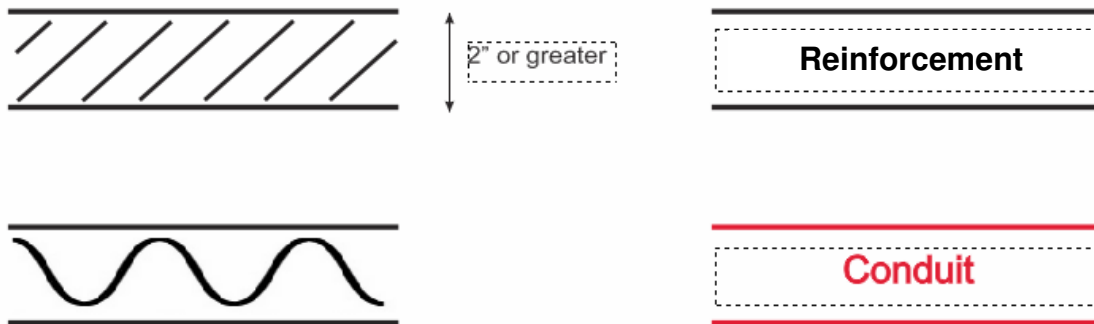


Figure 1: Samples of proper markings of embedments



Figure 2: Sample markings identifying embedments in concrete with appropriate exclusion zone

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Figure 3: Sample markings identifying electrical utilities in/below concrete with appropriate exclusion zone

In situations where the depths of embeddings are necessary, the depth should be written in the same color as the embedment and in a location that will not be confused with another embedment. Refer to CSDA-BP-007 for the proper method of establishing accurate depths.

In order to depict markings for utilities, this CSDA Best Practice shall, where appropriate, remain consistent with the established American Public Works Association (APWA) Uniform Color Code [ANSI Z535.1] (Figure 4). Because GPR does not specifically identify the buried utility, the imaging contractor must use reasonable assessment for the identification of the utility. This may include using as-built drawings, scanning the embedment back to an originating point or using a separate technology to tone or trace a specific utility.

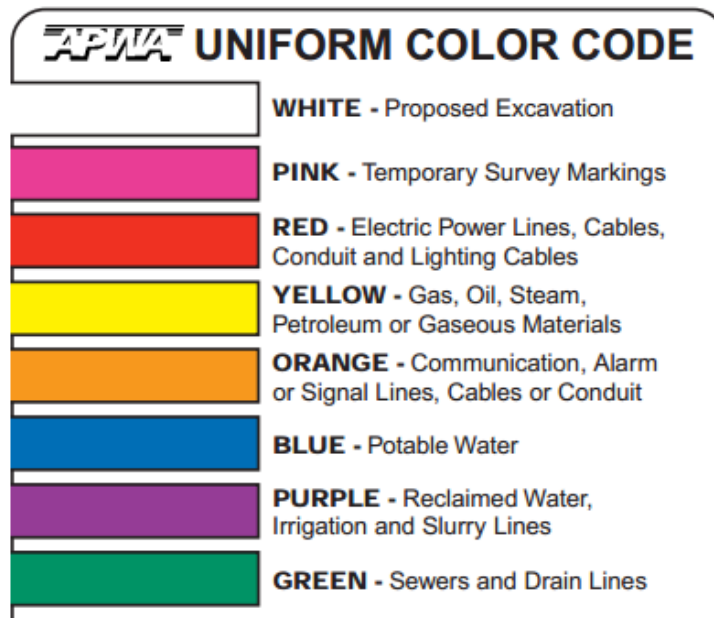


Figure 4: APWA Uniform Color Code for the marking/depiction of subsurface utilities

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4. Utility Investigation

To mark out utilities underground in non-concrete related investigations, this CSDA Best Practice shall remain consistent with the established Common Ground Alliance Best Practice (CGA BP). This Best Practice is the most widely accepted and used in the depiction of marking underground utilities. The CGA BP also follows the established American Public Works Association (APWA) Uniform Color Code [ANSI Z535.1] (Figure 4).

As mentioned in Section 3, GPR does not specifically identify the buried utility. Because of this, the imaging contractor must use reasonable assessment for the identification of the utility. This may include using as-built drawings, scanning the utility back to an originating point and/or using a separate technology to tone or trace a specific utility. In the event an unknown embedment/utility has been identified from a GPR signal, an agreed upon color shall be used to properly mark the embedment/utility. This color must be agreed upon by both the GPR contractor and the appropriate owner/on-site contractor in the pre-job walkthrough. During the post-job walkthrough, any specific unidentified embedments/utilities must again be identified.

Any depths required for particular embedments/utilities shall be marked using the corresponding color as the embedment/utility. These depths must be marked so as not to be confused with other surrounding marks.

In the event collection of data is required for the imaging of utilities, the collection and depiction of utilities shall remain consistent with the CI/ASCE 38-02: Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data.

5. Phase II Environmental Site Assessments (ESAs)

Phase II ESAs are the physical tests performed if a Phase I ESA identifies potential contamination of a site by hazardous materials. Many skilled imaging contractors are asked to perform locates on ESAs for the presence of embedments that may contribute to the contamination of a site. Other locates may be performed to prevent damage to utilities prior to physical test, which typically involves destructive methods such as drilling or boring. Such embedments commonly include underground storage tanks (USTs), waste oil drums and the burial of certain debris. No appropriate color in the APWA Uniform Color Code properly associates with the identification of these types of embedments. In most situations, both private and public utility locates will be, or have been, performed on the site. To avoid confusion with other markings on the site, the preference is to use yellow, as this most closely relates to the use of USTs in the petroleum industry.

6. Other Investigation Not Categorized Above

For any investigations using GPR not previously discussed, any markings will be agreed upon with the contracting agency/owner and be specifically noted to the appropriate contractor in the pre-job and post-job walkthroughs. The markings made by the imaging contractor should be documented for other trades subsequently entering the jobsite.

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Examples of other investigations include, but are not limited to:

- Cemeteries
- Voids
- Delaminations/deterioration
- Buried debris/waste filled sites
- Forensic investigation
- Archeological (chambers, tunnels)
- Geophysical (sinkholes)

7. Scanned Areas Free of Identified Embedments

It is the responsibility of the owner/contracting agency to pre-mark and clearly identify the boundaries of the area to be imaged. In the event that a designated area identified by the contracting agency and/or owner is interpreted by the imaging contractor to be free of embedments, the imaging contractor is to indicate this accordingly. The preferred method of indication is to mark "OK" within the identified area. If no identified boundaries are established by the contracting agency/owner, the imaging contractor should identify the extents of the area scanned.

8. Ownership of Markings

Due to changing jobsite conditions and environments, it is impossible for an imaging contractor to leave markings of embedments and have them remain for a guaranteed length of time. Once an imaging contractor leaves a jobsite, that person cannot control the environment to assure the longevity of a marking. Once an imaging contractor has scanned and marked an embedment location, the ownership of those markings shall immediately transfer to the contracting agency and/or owner. It is the responsibility of the contracting agency and/or owner to maintain the condition of the markings as long as they are required. It is recommended that the imaging contractor discusses this with the contracting agency and/or owner in the pre-job and post-job walkthrough.

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