Fast and accurate concrete scanning before cutting & coring

Introduction

Construction projects are increasing globally and getting more complex with construction, renovation and refurbishment. Concrete can disguise many elements that are potentially threatening to construction projects. Identifying those potentials are becoming extremely important.

The ideal scenario is to investigate these concrete structures in a non-destructive way to minimize cost and damages. Several standards are defying the procedures needed to be followed when non-destructive testing is applied [1, 2, 3, 4].

There are several scanning techniques [5, 6, 7, 8] that can identify different objects and characteristics of a concrete structure like rebar, post tension cables, voids, and delamination to name a few. The list of the most popular techniques includes Ground Penetrating Radar (GPR), Eddy current (Cover meter) and Ultrasound Tomography.

Thanks to significant innovations in both GPR hardware and software [9,10], the method seems to gain pace against others. Concrete GPR presents a fast and effective way to detect objects and characteristics inside concrete. Before cutting, coring, and drilling concrete it is necessary to scan with GPR Scan for accurate and fast results in 2D or 3D.

Challenge

Concrete scanning large areas can take lots of time collecting data on the field and significant time of post-processing in the office. However, time is limited, and contractors need solutions that will be accurate and lessen time on site.

Traditional GPR:

- **Radar performance** - trade-off between penetration & resolution with limited frequencies
- **Usability** - Carrying multiple antennas of traditional pulse radar, big blue cables and boxes, dragging across a busy job site are quite common in the past.

- **Data quality** - Concrete scanning with GPR is not infallible, especially scanning on the thicker slabs which may be scanned from both sides if available when dealing with pulsed radar.

Solution

With the Proceq GP8100, the advanced Stepped Frequency Continuous Wave (SFCW) antenna and wireless hardware design and intelligent app, concrete scanning becomes faster and more accurate. Advantages of SFCW include improved signal-to-noise ratio, enhanced dynamic range and ultrawide bandwidth. The GP8100 is an array GPR system, which can collect six times more data and can achieve a clear picture of the subsurface with no or minor post-processing.

Proceq GPR:

- **Radar performance:** Achieves both penetration depth and high resolution with stepped frequency
- **Usability:** Ultra-portable sensor with easy-to-use iPad app for real-time data visualization and management
- **Data quality:** With Proceq GPR technology users are not just having an intuitive user experience, but also seeing data clarity to the bottom of the slab.

The GP8100 completes 6 parallel scans in a single pass, and the subsurface findings are shown in real-time. Each scan covers about 25cm in width; hence, a total of 6 cross scans are needed to cover approximately an area of one square meter, with 3 scans in the x-direction and 3 in the y-direction.

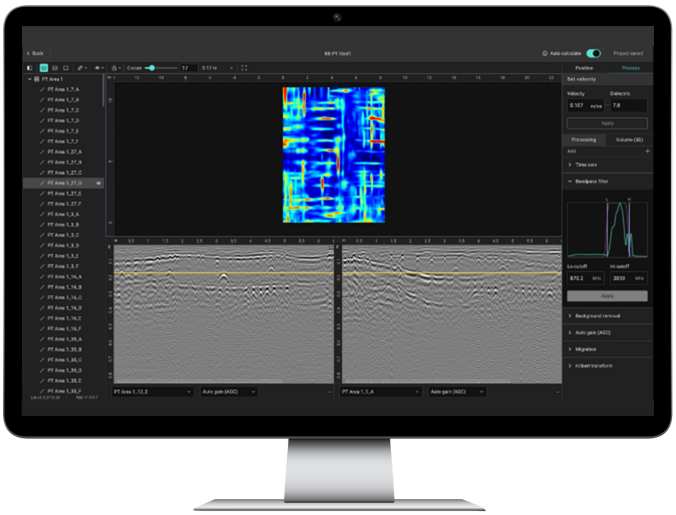
With the use of powerful data collection software, the GP8100, visualizes 3D data in real-time and the results can be presented in different views, like time-slice or as Augmented Reality (AR) view on the scanned area. Embedding the 2D or 3D results on the site using AR, allows us to capture the subsurface reality as is and create an intuitive report.

Several engineers and contractors need to post-process their data to keep a detailed archive of the work they have conducted and to reveal any hidden elements that passed undetectable on site. Using post processing analytics software gives deeper insights into the findings and is key for efficient data-driven decision-making. Screening Eagle Technologies offers two complementary software packages, the GPR Insights and GPR Slice.

GPR Insights is an intelligent data analysis web-app for GPR users to increase productivity, profit and scalability with an intuitive, platform-agnostic software for advanced analysis of any GPR data. Processing is done in comprehensive steps, and one can export reports and data easily.

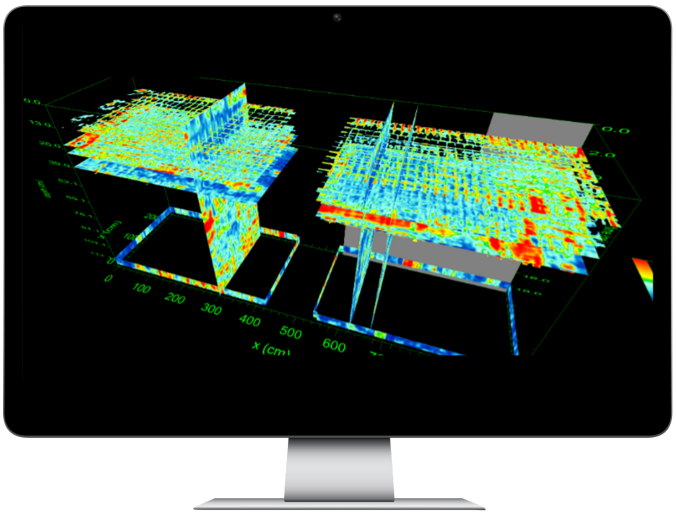
Data post-processing with GPR Insights

GPR Insights is an intelligent data analysis web-app, reduces the workflow of data processing by up to 80%. GPR Insights provides automation processing in 2D and 3D. You can use GPR Insights from anywhere, on any device and independently of your operating system. The only thing you need is a web browser. After uploading the project, entire processing done automatically, only thing is needed to take care of using the concrete processing package as default item to enjoy the automatic decoupled gridding.



Data post-processing with GPR Slice

For this application, the GPR data was downloaded onto a PC and processed using GPR Slice v7.MT software, the most comprehensive post processing software commercially available. The following steps were conducted in GPR SLICE: 1D and 2D filtering steps including: auto gain correction, migration and Hilbert transform. The processed 2D image was displayed as a continuous line. The data was sliced and gridded to obtain 40 horizontal slices. In OpenGL, time-slices and 3D results were presented, results can be exported into different format for reporting and other purpose, like .dxf file and point cloud formats.



References

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