LOUISIANA TRANSPORTATION RESEARCH CENTER

Technical Summary

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Geotechnical Database - Phase IV

Introduction

The Louisiana Department of Transportation and Development (DOTD) has made great strides in developing a Geotechnical Database over the years. Three prior LTRC research projects focused on standardizing and organizing geotechnical data. However, some challenges have also occurred over the years. For example, the GIS platform developed during Phase I was beneficial, but the LTRC code for ArcGIS did not age well with updated versions of the software. The DOTD document management software (Content Manager) was also phased out and moved to a newer platform (File.NET). Additionally, increased computing power has changed the expectations for how geotechnical data should be stored and utilized.

DOTD geotechnical data was historically managed through gINT software, a Bentley product. DOTD customized gINT with an enterprise solution via Phase II. DOTD wanted to move away from gINT as it became outdated, was not integrated with an enterprise database, and was cumbersome for data entry and retrieval. Another geotechnical software from Keynetix, HoleBASE, existed as a competitor to gINT. HoleBASE provided a newer, more robust interface with georeferencing features. DOTD explored those HoleBASE capabilities through Phase III of LTRC's Geotechnical Database research, but that phase was limited to shallow subgrade soil surveys and dynamic cone penetrometer (DCP) data.

Objective

The objectives of this project included:

- Upgrading the DOTD Geotechnical Database deep boring log templates and structure to the newer HoleBASE platform, which was already owned by DOTD;
- Ensuring DOTD data is compatible with the Data Interchange for Geotechnical and Geoenvironmental Specialists (DIGGS) to allow easy transfer from Consultants;
- Retrieving DOTD geotechnical data from Consultants via the DIGGS platform (historical and newer retainer contracts); and
- Using the Geographic Information System (GIS) services of HoleBASE and the Department to share soil boring information graphically, both internally at HQ and externally to the general public.

Methodology

This research project began with the intent of implementing HoleBASE and KeyLAB from Keynetix as the DOTD geotechnical software of choice, moving away from gINT for a more robust solution. Soon after the project started, however, Bentley, the owner of gINT, acquired Keynetix. Bentley then upgraded and rebranded HoleBASE to match other Bentley products as Open Ground Cloud (OpenGround). The shift to OpenGround slightly modified the direction of the project toward a more future-forward, cloud-based option.

Since DOTD has an account with Bentley for many other software programs (MicroStation, OpenBridge, OpenRoad, etc.), acquiring OpenGround for use by DOTD geotechnical groups was easier than anticipated. Researchers met with the Louisiana Office of Technology Services (OTS) representatives housed within DOTD to discuss options and installation. OpenGround was subsequently approved for this project and for use within the Department.

LTRC discussed the transition to OpenGround with Dataforensics, who assisted with LTRC research Phases II & III, were instrumental with upgrades to gINT, Boring Log Templates, and the pile load test database, and were familiar with DOTD geotechnical data, its structure, and its workflow. Researchers included Dataforensics along with other stakeholders in the Project Review Committee (PRC) for the project.

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Dataforensics agreed to assist on the PRC, and through its business relationship with Bentley after the Keynetix acquisition, allowed DOTD to choose Dataforensics as its OpenGround technical implementation representative. LTRC held bi-weekly meetings with DOTD Geotechnical and monthly meetings with Dataforensics to discuss, develop, and implement a strategy to move forward, and address any issues that may arise along the way.

Conclusions

DOTD started its digital geotechnical data management journey over 20 years ago. Previous projects set the stage for this project, which focused on updating the current Geotechnical Database to modern platforms to stand the test of time and allow user-friendly GIS display of the data. The project researched and assisted with DOTD's implementation of OpenGround, the cloud-based version of HoleBASE. The timing of the Bentley acquisition of Keynetix and their release of OpenGround was fortuitous in that it sped the implementation of OpenGround Cloud because DOTD was already a Bentley state. The related sunset of gINT began a series of changes for many in the geotechnical realm. DOTD is implementing OpenGround and KeyLAB products and plans to remain software agnostic for its contract consultants, as DIGGS is a way to exchange data moving forward.

LTRC uploaded historical boring logs in .pdf form to OGC. Newer technologies using Artificial Intelligence (AI) and Machine Learning (ML) can digitize data from .pdf soil boring logs and hard copy reports to expand the database. LTRC also converted and uploaded multiple digital gINT files that existed within DOTD and established a procedure for new digital project creation within OpenGround. LTRC used Excel spreadsheets to manage different data types, or baskets, to ensure all data were uploaded properly to OpenGround.

KeyLAB is Excel based and allows digital entry of laboratory data digestible by OpenGround. This research included KeyLAB customization and training for DOTD Section 22, the Materials Laboratory, which conducts some drilling and testing for DOTD Section 67, Geotechnical Design.

The DOTD Geotechnical group developed special tools via the OpenGround Excel extension to connect OpenGround to analysis spreadsheets for DOTD staff. These tools create data-driven plots, which were previously hand-drawn, to speed engineering design decisions. The immediate value of these digital tools benefits the designer, but the digital data also adds to the long-term value of the database for future reference, correlations, and design efforts (e.g., quick access to data, possibly fewer borings, etc.), fostering functional effectiveness and efficiencies.

The OpenGround PowerBI Connector allows comparisons across all projects, regions, parameters, drillers, etc. for expanded insight, correlations, and QA/QC. Connecting data sources (e.g., pile load data, retaining wall locations, slope repair sites, geological data, soil subgrade survey maps, satellite maps, and other layer information through web mapping services) will provide designers with one-stop resources to help with succession planning and knowledge retention.

Data is an asset! DOTD continues to advance in its geotechnical data management journey. This research helped implement OpenGround, a GIS database, and facilitate access to geotechnical data in over 2,500 projects across Louisiana within DOTD. The OpenGround database will assist DOTD with succession planning, knowledge transfer, and data retention. The leadership and vision of Jesse Rauser, P.E., DOTD Geotechnical Unit Supervisor, was critical to the advancement of the research and geotechnical data management. The LTRC and DOTD efforts have been lauded in the geotechnical community. The author hopes to continue the trend and advance geotechnical data management further into the future.

Recommendations

The DOTD geotechnical data management journey should continue. There are more efficiencies that can be developed as the industry enters the digital age. Artificial Intelligence and Machine Learning will not only aid with the import and digitization of data (e.g., .pdf boring logs and reports to digital data), but also aid quick access and allow for correlations that will improve our calculations, analyses, design decisions, and research correlations.

Deep borings and CPTs represent the majority of geotechnical data used by DOTD. The move to an all-in-one database/mapping/management solution should continue. Expanded OpenGround use in these target areas are recommended:

- Continue to add geotechnical data (e.g., deep boring, CPT, shallow boring, DCP, pile load test, design and slope repair information, notes, plan sheets, photos, etc.) to OpenGround, a single unified database designed specifically for geotechnical data, to preserve this information for future DOTD generations.
- Review the easily accessible OpenGround GIS interface prior to new borings on projects. Soil boring information and data may already exist in the area and save exploration efforts in terms of funds and time.
- Use the Excel extension tables to save time generating boring requests, soil boring logs, figures, and profiles for geotechnical design.
- Reduce the possibility for data input errors by streamlining the laboratory test reporting process through increased use of field tablets and DIGGS compatible equipment.
- Require Geotechnical Data Reports (GDRs) and digital data (DIGGS compatible files) from Consultants for upload to OpenGround, Falcon, and File.NET.
- Capitalize on other research like LTRC Project 24-2GT, which will further incorporate DIGGS and the upcoming AASHTO changes regarding site variability and statistical calculations.
- Begin projects based on the results of the recent RPIC process, specifically research directed toward a public interface to access borings and the digitization of soil boring logs through AI and ML. This will increase the usefulness of .pdfs from static images to digital data. These and other steps will continue to move the DOTD geotechnical efforts forward to allow more available and interactive data for designs and research.