TECHSUMMARY *June 2020*

SIO Number: DOTLT1000048 / LTRC Project No. 15-1GT

Geotechnical Database, Phase III - pLog Enterprise - Enterprise GIS-Based Geotechnical Data Management System Enhancements

INTRODUCTION

The Louisiana Department of Transportation (DOTD) has been collecting geotechnical data in its District laboratories for many years in a variety of different formats. In many cases, District personnel are inputting the same data repeatedly in different systems because there are various different users of geotechnical data (construction, design, and pavement management) that need this data in different software. Accessing this data and combining it with new data for the purpose of design, analysis, visualization, and reporting was difficult because the data has been generated by disparate systems and stored in various digital and non-digital formats. Essentially, there was no single system or repository nor an integrated, systematic approach for collecting, managing, reporting, archiving, and retrieving the vast amount of geotechnical data that is collected or generated by District labs each year.

OBJECTIVE

This project was designed to (1) address needs of the District laboratories to develop a system they could utilize to manage their data, eliminate redundant entry, and standardize shallow subgrade soil surveys; and (2) address the need of the HQ Geotechnical Section to incorporate Pile Load Test data into the DOTD Geotechnical Database.

SCOPE

The project includes all District lab data for shallow boring, DCP, borrow pit, and HQ pile load test data. It does not include deep borehole data because that would have to be configured as part of a follow on project since it was not part of the initial scope.

METHODOLOGY

The methodology utilized for this project can be divided into four main tasks with a deliverable associated with each task:

1. **Shallow borehole database design and report configuration.** Dataforensics compiled questionnaire results regarding the current processes and systems used for managing subgrade soil survey and shallow borehole related data across each District lab. Dataforensics also performed in-person interviews and held many web meetings with District lab personnel to identify similarities and differences between the District labs. Members of each District lab shared examples of the types of reports used in their existing data management processes.
2. **Laboratory test sheet configuration.** The questionnaire results highlighted redundant data entry, that no standardized method existed across districts for managing shallow borehole and subgrade soil survey data, nor was there any standardized method for managing the laboratory testing data associated with these investigations. Accordingly, the work performed in this project accounts for differences across each District assembled into a standardized methodology for managing this data.
3. **Pile load test database configuration, data migration**; and
4. **Pile load test report configuration.** Dataforensics reviewed the work performed in previous related projects from 03-1GT, 10-2GT, and 14-1GT. Ultimately, the recommendation to move to the Keynetix software (HoleBASE and KeyLAB) was recommended to provide future growth opportunities and continued enhancements to the data management process for both shallow borehole, deep borehole, in-situ testing, and pile load test related data.

Based on feedback from DOTD personnel regarding limitations of the gINT-based system configured in the 10-1GT project, Bentley/gINT's lack of support for geotechnical data interchange (DIGGS), and the lack of innovation and new capabilities in

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the gINT product line over the last decade, a minor but significant change in the project objective was discussed with the PRC. Several alternative solutions were provided along with pros and cons of each approach, risks of each approach, and costs associated with each approach. The PRC determined which alternative they wanted Dataforensics to implement as part of this research.

With advances in computing capabilities, software tools are available that streamline the entire data management process from data collection through reporting, archiving, and map-based retrieval/reporting. Dataforensics configured an off-the-shelf Geotechnical Data Management System to fulfill the needs of the DOTD District labs. It enables the District labs to store their geotechnical data in a consistent database format while improving the reliability and making it more accessible to key stakeholders by integrating directly with SiteManager (construction) and dTIMS (CoreLog for pavement management) eliminating the need to re-input the same data repeatedly in different systems.

Having the data (instead of having copies of the scanned reports) provides DOTD with the ability to generate reports, find and reuse the shallow borehole data, and a potential future project could migrate the capabilities configured in the 10-1GT project into this new platform based on the Keynetix products.

This decision (to shift to Keynetix products) was prophetic from the standpoint that Bentley acquired the Keynetix products in May 2019 and that the future of geotechnical data management revolves around the Keynetix Cloud. However, they have indicated that development of both gINT and Keynetix desktop-based products will continue at the same pace. Accordingly, getting HoleBASE and KeyLAB configured for the Keynetix product line is the first step for DOTD to potentially move to the cloud-based solution as part of a follow-on project.

Additionally, Dataforensics has incorporated the DOTD Pile Load Test Data into this enterprise geotechnical data management system for the Geotechnical Design Section. This involved significant data cleaning and conversion from its native format Access database into the database structure configured for DOTD as part of this project. This database replaces an in-house built system and one configured as part of the 14-1GT project while providing nearly identical functionality in an enterprise environment, making it more accessible and providing a basis for a potential future research project where all the Site Investigation and Laboratory Testing data from the 10-2GT project can be managed within this environment. This will then provide a comprehensive Geotechnical Data Management System with all borehole data (shallow and deep), in-situ tests, laboratory tests for shallow and deep boreholes, and pile load test spatially referenced with a built-in GIS environment.

CONCLUSIONS

This project builds upon the work completed in the 03-1GT and 10-2GT projects that created a reference resource, a Geotechnical Database, which will continue to grow over time aiding in the evaluation of specific geotechnical site data for Louisiana.

This project developed a consistent approach, a modern and comprehensive Enterprise Geotechnical Data Management system, for the District labs to collect, manage, and report their geotechnical data for shallow boreholes, DCP, and the associated laboratory testing. This project will allow DOTD to streamline their data management process for borehole lab testing, while providing long-term availability of the data. By standardizing the database structure, standardizing the workflow process, and configuring custom reports, DOTD personnel in various districts can more easily access and report their geotechnical data while simultaneously improving the quality and reliability of the data. The data management system configured for this project incorporates borehole data, lab testing data, and pile load test data using the HoleBASE SI and KeyLAB software as its core components.

Additionally, by having all shallow borehole data in one environment that facilitates their complete workflow, it eliminates the repetitive and redundant data entry that was occurring in at least three different software packages. This single entry will reduce the potential of errors due to human error, transcribing the same data from one system to others.

The HoleBASE built-in GIS interface (map) allows the districts and Design Section access to the boring logs, and other geotechnical data via the system. The quick and easy access to the valuable historical data, including the mapping applications in the GIS will streamline and facilitate finding and analyzing the data. This will allow for more accurate and cost-effective design decisions. Providing this mechanism for finding and reusing existing historical data, potentially reduces the exposure of District personnel to the hazards of drilling boreholes through pavement—particularly important on busy roadways that have resulted in DOTD personnel being struck by cars.

This project migrated pile load test data compiled in the 14-1GT project into the system, in order to provide a more reliable and accessible data store for the pile load test data. Ultimately, combining the pile load test data with deep borehole data will provide tremendous data mining opportunities where performance of specific pile foundations can be assessed and compared to expected performance based on actual soil properties in the database. The system potentially helps DOTD improve their understanding of pile behavior by providing the basis for combining this valuable data with existing site investigation data.

Furthermore, being able to eventually incorporate all the deep borehole data will enable DOTD to have a better picture of all subsurface conditions that they may encounter on future projects or where projects are expanding the capabilities of existing infrastructure.

Various meetings and demonstrations of the system have been conducted with various members of the PRC as well as the District lab users. The technology utilized in the system described herein uses off-the-shelf software products HoleBASE and KeyLAB with no custom development required. Training was conducted and help resources provided to the districts and HQ via the intranet.

RECOMMENDATIONS

The author recommends the districts and HQ utilize the HoleBASE and KeyLAB systems for shallow boring applications, Pile Load test data, and for deep boring information (as a separate project). Other recommendations that include website and server maintenance, personnel and access, migration to Keynetix Cloud, and future modules are included in the full report. Tutorials and training documents are also provided as part of this report for the District Laboratories and HQ design personnel and are recommended as a help resource.