TECHSUMMARY *May 2013*

SIO No. 30000201 / LTRC Project No. 10-2GT

Geotechnical Information Database – Phase 2

INTRODUCTION

The Louisiana Department of Transportation (LADOTD) has collected geotechnical data for many years in a variety of different formats. Accessing this data and combining it with new data for the purpose of design, analysis, visualization, and reporting is difficult because the data has been generated by disparate systems and stored as hard copies, scanned images, various digital formats, or other non-digital formats such as microfilm. Essentially, there is 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 LADOTD each year. With advances in computing capabilities, software tools are now available that streamline the entire data management process from data collection through reporting, archiving, and map-based retrieval/reporting.

OBJECTIVE

The objective of this project was to create an enterprise Global Information System (GIS)-based geotechnical data management system that allows for the integration of historically acquired (likely in non-digital format), recently acquired (likely in digital format), and future-acquired data (in digital format) to create a composite database for a particular project that not only benefits that project, but also becomes part of a larger knowledge base available for use on other future projects undertaken by LADOTD.

Secondary objectives were to create a system to track the progress of deep boring geotechnical data collection from start to finish that is accessible by involved LADOTD sections. The tracking system goal was to improve transparency and accountability within the process, aid in planning and scheduling, and research, import, and catalog deep boring historical data (prior to 1998) located in the LADOTD general files (hardcopy, microfiche, microfilm, CD, and DVD formats) into Content Manager, LADOTD's Enterprise Document Management System, and then create a customized GIS-based website to allow LADOTD personnel to easily visualize and report the data in the geotechnical data management system.

SCOPE

The scope focused on the creation of a comprehensive database structure and reports that facilitate the data management process for geotechnical data, including borehole data, cone penetration test (CPT) data, vane shear data, test pile load test data, and laboratory testing data. The work incorporated tasks and strategies that required expertise in geotechnical engineering, database systems, GIS technologies, process flow, as well as software development and integration.

The type of data included in this database structure is limited to:

- Borehole and laboratory data, which are often generated as a result of samples obtained from the borehole.
- Data types for which LADOTD has access to in a nonproprietary, digital format (i.e., CPT data or test pile load test data) so it can be easily imported.
- Data from proprietary data formats such as Geocomp lab testing files and binary data associated with test pile information CAPWAP, WEEP, etc. are not imported into the database as they require the proprietary software to read these files.

METHODOLOGY

A typical engineering project consists of many phases including a review of historical information, a field investigation, a laboratory testing program, office-based analysis and design studies, full-scale test programs of selected components, construction supervision, and post-construction performance monitoring. With the exception of the analysis and design studies phase, all other phases typically resulted in the generation of information and associated reports, which were integrated to complete the project. Too often, however, these phases are regarded as relatively discrete activities, leading to the type of inefficiencies and error sources previously noted.

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Dataforensics created a plan to integrate and implement a customized data management system to fulfill the needs of LADOTD. This enterprise GIS-based geotechnical data management system is comprised of various off-the-shelf software packages including PLog Enterprise, RAPID CPT, gINT, ArcGIS, and ArcGIS Server. It enables LADOTD to store geotechnical data in a consistent database format while improving the reliability and accessibility to key stakeholders.

CONCLUSIONS

This project developed a comprehensive geotechnical data management system that will allow LADOTD to streamline the data management process for borehole, lab testing, CPT, in-situ vane, and test pile load test data while providing long-term availability of the data via a web-based GIS portal. By standardizing the database structure, incorporating validation rules, and creating custom reports, LADOTD personnel in various sections can more easily access and report their geotechnical data while simultaneously improving the quality and reliability of the data. The GIS interface can access many different sources and types of data within and outside the Department. The quick and easy access to valuable data, including the mapping applications in the GIS, will streamline and facilitate the analysis of data.

This project builds upon the work completed in project 03-1GT to create a reference resource that will continue to grow over time that will aid in the evaluation of specific geotechnical site data, which will allow for more accurate and cost effective design decisions. Additionally, this project archived data compiled in the 03-1GT project and the 06-6GT project as the first data loaded into the system. If LADOTD were to try to re-create this same data by re-investigating the same sites, the cost would be at least $16,000,000 ($10,000 per borehole/CPT sounding). Accordingly, the return on investment for this task is extraordinary as approximately $20,000 was expended to turn $16,000,000 worth of data into a usable asset.

Since the project kickoff and throughout the development, a number of meetings and demonstrations of the system have been given to various members of the project review committee (PRC). The website link is located on the LADOTD GIS page and is ready to serve the Geotechnical Design section and others in the Department.

RECOMMENDATIONS

Website and Server Maintenance: Perpetual licenses were included with research, meaning LADOTD can use the software indefinitely. Maintenance and periodic updates should be applied to the software in order to ensure proper function with an optimal performance. This will require combined efforts and ongoing support of both the GIS Team at LADOTD and Dataforensics. One year of support for RAPID CPT and PLog Enterprise is included in the current contract.

Personnel and Access: It is recommended that a Geotechnical Design section employee manage the PLog Enterprise system (i.e., upload the gINT projects whether developed by consultants or in-house), so that records are kept timely and accurate in digital format.

The website will be located on the LADOTD Intranet. A goal for a follow-on project should be to open the website to the public. Additional efforts regarding security firewalls will need to be implemented for this to occur.

Site/Materials Manager: The incorporation of data from the Site/Materials Manager is unknown at this time. Dataforensics believes that incorporating borehole and lab test data from shallow boreholes into the PLog Enterprise system should be accomplished in order to maximize the value of the LADOTD database. The data types for the basic laboratory testing have been implemented already within the database structure, but reporting capabilities in gINT likely need to be enhanced and tailored to LADOTD's specific requirements. This was outside the scope of this project since it focused on deep boreholes.

Loading Additional Historical Data: LADOTD now has a platform on which a tremendous amount of historical data can be easily loaded into the system . The difficulty involved with loading historical data is obtaining/finding the historical data and/or converting it into the standard format. For historical data that consists of scanned images, there is no conversion necessary. For this type of historical data, it simply requires creating a gINT project and filling in the appropriate project and borehole metadata to identify the project/hole and associating the scanned image with the point(s). This is a task that a student worker could perform with minimal guidance from Dataforensics.

Dataforensics recommends a follow-up project where a budget can be explicitly allocated to pay for consultants to compile the gINT projects and provide to Dataforensics for the work they have performed for the LADOTD in the last few years. This would then provide datasets that can be cleansed and converted into the new LADOTD format.

Workflow Application: Dataforensics recommends a follow-up project to complete the workflow application using Sharepoint functionality since it is an internally supported platform that is now deemed to be the platform on which to manage the workflow related data and documents.

Future Modules: All current and future data should be recorded and stored digitally within PLog Enterprise so that as the data grows it can be accessed easily via the map-based GIS interface. Enhancements to the system such as incorporating additional data types (i.e., extracting binary data from CAPWAP, WEEP, or the Geocomp systems) could prove to be useful from a data mining perspective over the long term.

Additionally, LADOTD may consider adding spatial and non-spatial data mining algorithms into the system to automatically search for and identify trends in the data that are not obvious until they are specifically examined. Data mining allows users to gain a better understanding of their data by discovering new patterns in their large datasets. PLog Enterprise provides the foundation for this to occur.