EVALUATION OF EXISTING DEEP FOUNDATION PREFORMANCE USING THE FDOT DATABASE TO IMPROVE CURRENT DESIGN METHODOLIGIES

PROBLEM STATEMENT

Reports generated during design, construction, and even maintenance for all Florida Department of Transportation (FDOT) projects often contain valuable subsurface and geotechnical data. On bridge-related projects, FDOT often pays for subsurface explorations, insitu tests, laboratory tests, and deep foundation load tests. Currently, this data is preserved with either paper copies or electronic images (tiff, etc.) of the project reports and archived in a manner that severely limits the future availability and value of the data. This data is pertinent to rehabilitation, maintenance, research developments and other future projects. Digital preservation of the data will make it both more accessible and more usable.

OBJECTIVES

This study focused on the development of an infrastructure to digitally preserve bridge foundation data. This infrastructure included a web-based database, hierarchical database security and administrative features, an XML data schema, and Excel sheets for data entry. It was also necessary for this database system to handle queries. Accordingly, the following were developed:

- A geotechnical XML schema
- A web-based database
- A web-based interface for database administrative and retrieval tasks
- Excel sheets for data entry and database interaction
- A security protocol for sending and retrieving data from the database

A secondary goal of this study was to verify the functionality of the database with available pile load tests. This data was then used to recalibrate LRFD (Load and Resistance based Factor Design) resistance factors used with FB-Deep software analysis results. This study also required the assimilation of available Adobe PDF project report files from District 5.

FINDINGS

A schema was developed to create digital instances of the data in an XML (Extensible Markup Language) file. The intention of the schema was to completely cover all aspects (design, construction, etc.) dealing with bridge deep foundations as well as relevant insitu and laboratory results; however, it is expandable if additional features are deemed necessary. The application of XML allows quick validity checking of the recorded data through files that are readable (i.e., by persons rather than machines) and the use of well developed programming components for interfacing with existing software. It also provides a means by which to communicate with the

new database. A dynamically linked library (DLL) file for existing or new software was created to handle database communication functions. This file provides a means by which programs can retrieve and transmit valid XML files to the web-based database.

Excel was chosen as an initial platform for the creation of valid XML files. Excel sheets were developed using VBA (Visual Basic for Applications) to handle the input and output of data contained within the XML files. The Excel sheets also contain references to the DLL file in order to provide the functionality to interact with the database. This web-based database was created to store all of the required geotechnical data in one location while making it accessible across the state. It receives and transmits data in an XML format that adheres to the developed schema. Various web-based interfaces (e.g., FB-Deep) have been developed to interact with the database.

The database was developed with security as a paramount concern. The developed security system protects the data by controlling read and write access privileges on an individual project and user account basis. The security system is hierarchical, so FDOT personal can grant project access to project managers, who can then grant specialized access to individual employees, consultants, or contractors.

CONCLUSIONS

The database system was delivered and is currently being populated with District 5 Bridge Insitu SPT data. The database also was populated with prior available FDOT pile projects completed within the state of Florida. The uploading was accomplished using the available Excel sheets. The database was subsequently used to calibrate LRFD resistance factors, ϕ, for prestressed concrete pile design using FB-Deep software. Resistance Factors, ϕ, of 0.68, 0.54, and 0.43 are recommended for FB-Deep for reliability, β, values of 2.0, 2.5, and 3.0, respectively.

BENEFITS

FDOT stands to benefit significantly from the digital preservation of the data in a web-based database. This data can be used for years in rehabilitation, maintenance, research, and other future projects. The reusability of the data can potentially reduce the cost of future projects while providing a more complete subsurface profile. The security protocols will protect the data from malicious or unauthorized manipulations. This system also provides a non-intrusive way for FDOT to observe the progress of ongoing projects on a daily basis. The recalibration of LRFD resistance factors for FB-Deep provides immediate benefit, and the maintenance of the database will provide the necessary data for future recalibrations.

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