

IMPLEMENTATION SUMMARY

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PROJECT COST: \$35,000



GeoApp clusters data points when the scale of the map is too large to show each point individually.

Putting Research into Practice: GeoApp Gives Mobile Device Users Access to Decades of Geotechnical Data

What Was the Need?

Designing a transportation project often requires extensive evaluation of geotechnical conditions across the project's site. MnDOT collects data about the soil and rock properties on-site via exploration borings (also known as SPT borings from their use of the standard penetration test) and cone penetration test (CPT) soundings. Engineers use this information to design foundations for keeping structures, slopes and high embankment fills stable and performing well during their life spans.

These tests can cost several thousand dollars each. Geotechnical costs can consume 5 percent to 20 percent of a transportation project's predesign budget. Since 1959, MnDOT has collected data from more than 35,000 SPT borings and CPT soundings in its <u>Foundation Borings</u> <u>Database</u>. Geotechnical data generally don't change much over time, so even the oldest data are often still valuable. Accessing information from previous projects is faster, less costly and safer than redoing the tests.

The borings database has been available online in some form since 2003, but development of an easy-to-use Web application has been disjointed, and updates have been difThe newly developed GeoApp provides access to MnDOT's Foundation Borings Database via mobile devices. The database contains decades of geotechnical data that are valuable in designing transportation projects. The project also afforded an opportunity to modernize a pre-existing Web application providing database access.

ficult. Also, the Web application has been designed for access from a desktop computer, even though the information is valuable as well to engineers in the field. Mobile devices could provide a convenient way to access the database.

What Was Our Goal?

This project sought to develop a mobile app that would give remote users access to geotechnical data through their mobile devices. The project was also to serve as a proof of concept for potential future MnDOT app development.

What Did We Implement?

The project continued the development of MnDOT's Foundation Borings Database.

How Did We Do It?

Investigators developed GeoApp, the mobile app that allows database access, in two phases. The first phase improved an existing prototype database structure to make it easier for users to import data. Investigators also developed a method of clustering data points to improve how they are displayed when the map scale is too large to show each point individually.

The second phase completed development of the full GeoApp. The app uses the Google Maps JavaScript application programming interface to display each of the boreholes available in the database.

"Mobile platforms and technologies are more useful for business purposes than we might have appreciated previously, so there's a strong business case for making information readily available on these platforms."

— Derrick Dasenbrock, Foundations LRFD Engineer, MnDOT Office of Materials and Road Research

"The app easily shows what testing has been done in an area, so if the data are already available from a nearby project, there's no need to spend another \$5,000 to \$10,000 to conduct the testing again."

—Aaron Budge,

Professor, Minnesota State University, Mankato, Department of Mechanical and Civil Engineering

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With GeoApp and a mobile device's touch-screen and GPS functionality, engineers can remotely access geotechnical data from the Foundation Borings Database.

What Was the Impact?

GeoApp's map function allows users to find data in a specific location of interest. Users can also search for data by dozens of specific parameters related to borehole name, state project number, site properties or project type.

Metadata for projects in the database enhance the database's usefulness. Engineers or investigators interested in a specific project type can use the database to gain insight into the features of similar projects, such as the materials present, depth of borings, amount of testing and test data available, and presence of rock at the site.

Some of MnDOT's oldest logs have not yet been digitized. Most of the locations for those SPT borings and CPT soundings are represented in the app with summary metadata to help users find them in historical paper files.

One unanticipated benefit of this project was its impact on the original Web database. Since the last phase of the database's development, it has become possible to code it to be more mobile-friendly than its previous iteration. The Web application has also been updated to incorporate more modern code and supporting features such as Google Maps and other tools used in GeoApp.

GeoApp is currently available for Android-based mobile devices on the Google Play store. Developers are working to make the app available for Apple devices through iTunes, which has more stringent requirements for developers. Apple mobile device users can, however, access the improved Web application through MnDOT's <u>website</u>.

What's Next?

The mobile app and improved Web application are expected to improve database access and user experience. This can help engineers, inspectors, consultants and contractors save time and money in the design and construction phases by effectively reusing information from past projects.

In part because the Web application is now better suited for use on multiple platforms, no further development is currently planned for GeoApp. However, MnDOT has considered expanding the database by adding more types of assets or geophysical data.

One lesson learned that can be applied in future app or software development is the need to be alert to communication pitfalls. Computer programming terms and concepts that are familiar to a programmer are often unfamiliar to a geotechnical engineer, and vice versa. Having a project team member who can act as a liaison to ensure that terminology and project needs are clear to all parties may smooth future development efforts.

This Implementation Summary pertains to Report 2016-26, "Development of a MnDOT Foundation Boring Mobile Application Gateway, GeoApp," published August 2016. The full report can be accessed at mndot.gov/research/TS/2016/201626.pdf.