Florida Department of Transportation Research

Implementation of Measuring While Drilling Shafts in Florida (FLMWDS)

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Current Situation

Drilled shafts are often used as foundations in Florida's sandy soils and limestone. The first step is drilling a hole of the correct diameter and depth. A steel reinforcing frame (cage) is then placed in the hole, and concrete is added. Designs for drilled shafts must make assumptions about the composition of the ground into which the shaft will be placed, but drilling encounters the real composition and its variability, thus providing an opportunity for better knowledge of the soil and rock and refinement of shaft design. An emerging approach, measuring while drilling (MWD), uses real-time data from drill rig sensors and provides a detailed record of geological formations which can be used to assess the strength and resistance (load capacity) of the soil and rock. Information gained from MWD can also be used to optimize drilling performance, improve production drilling rates, and select the proper drilling tools for the geological conditions.

Research Objectives

University of Florida researchers investigated MWD, validated methods to obtain the drilling parameters, and compared MWD with load test results and conventional site investigation techniques to assess the strength and resistance (load capacity) of rock.

A construction crew operates a drill rig at night on the Selmon Parkway in Tampa.

Project Activities

In a previous project (BDV31-977-20), the researchers developed a new method to use sensors to estimate the rock strength of Florida limestone and intermediate geomaterials during drilling with a rock auger. Among other findings, they found that the correlation between unconfined compression strength, a key drilled shaft design parameter, and specific energy derived from data obtained while drilling.

Drilled shaft construction on the Selmon Parkway in Tampa and work on the CR-250 bridge over the Suwannee River provided sites for further investigation of MWD, including five additional load tests for varying limestone formations encountered, drill rigs used to install the shafts, shaft diameters, drilling crews, and drilling tool configurations.

The drilling equipment at both sites was fully instrumented. A data acquisition module was used to collect data from drill rig sensors, especially hydraulic torque and crowd which measure respectively soil resistance to drill rotation and the force needed to advance the drill into the ground. Together with operational settings, torque and crowd can be used to derive specific energy. Individual data points from this mechanical process had to be carefully verified. Also, because the previously developed method applies to auger drilling, the researchers adapted the method for analysis of data from operations that used the rock drilling bucket.

In addition to refining the methods for determining unconfined compression strength, the researchers showed the utility of MWD, which is collected at the exact location of the drilled shaft, for characterizing the underground variability at construction sites. The centimeter-scale resolution of MWD allows more precise interpretation of underground strength profiles. This has a direct impact on design accuracy and, therefore, cost per foundation by optimizing designs and providing more confidence in the final as-built drilled shaft.

Project Benefits

MWD offers both advantages and unique capabilities, compared to traditional methods of providing field-based feedback for drilled shaft design. This project advances the tools and understanding of this promising new technique.

For more information, please see www.fdot.gov/research/.