Florida Department of Transportation Research

Drilled Shaft Resistance Based on Diameter, Torque and Crowd (Drilling Resistance vs. Rock Strength) Phase II

May 2016

Project Number
BDV31-977-20

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Current Situation

Over the past 20 years, drilled shafts have demonstrated increasing popularity over driven precast piles. Drilled shafts can accommodate a wider range of sizes, and noise and vibration during construction are significantly reduced. On the other hand, when installing driven piles, a large amount of data is collected which gives engineers greater knowledge of the soil and rock that the pile is being set in. This allows them to adjust designs to create a more secure foundation. Obtaining this information when using drilled shafts is more complicated and expensive. Because structure and strength of bearing layers vary so much in Florida, increased knowledge of the material that will support a drilled shaft, acquired as part of the drilling process, would be very helpful for designers and construction.

Research Objectives

In field and laboratory investigations, University of Florida researchers focused on developing and evaluating drilling parameter data as a means of estimating rock strength.

Project Activities

The drilling process invovled in the construction of a drilled shaft is governed by several parameters, such as the torque and rotational speed of the drill bit, its diameter, the resulting penetration rate, and the "crowd" (downward force on the drill).

With drilling completed, a rebar reinforcing cage has been placed in this shaft in preparation for concrete.

To begin to understand the relationship between drilling parameters and rock strength, the researchers created large blocks of synthetic limestone for laboratory testing. The synthetic limestone is a very homogeneous material, which can be made in a range of strengths. Once the blocks had sufficiently hardened, they were drilled using rock augers of two different diameters. Several penetration rates and rotational speeds were used, and torque and crowd were measured during each drilling operation.

The literature had provided two approaches to relating drilling parameters to rock strength. The laboratory testing revealed that Teale's specific energy approach was more useful in the range of bit diameters expected in actual field drilling.

Field operations at three Florida sites represented a range of soil and rock types. Drilled shafts were installed at these sites while drilling parameters were carefully monitored. Rock strength and shaft side shear were calculated for each site, using a variety of tests and analytical methods to determine the best procedures. The monitored drilled shafts were load tested; measurements were confirmed by instrumentation embedded in the drilled shafts. Results suggested that useful estimates of rock strength and shaft side shear can be acquired during drilling operations.

Project Benefits

Better understanding of rock strength while drilling foundation shafts will allow engineers to adjust designs and create more reliable, efficient foundations. Real-time monitoring of drilling will also provide construction inspectors a tool to more accurately assess rock quality and strength during construction of drilled shafts to ensure the as-built conditions match or exceed the design.

For more information, please see dot.state.fl.us/research-center