Florida Department of Transportation Research

Evaluation of Static Resistance of Deep Foundation

June 2017

Project Number
BDV31-977-05

Project Manager
Rodrigo Herrera
FDOT Structures Office

Principal Investigator
Michael C. McVay
University of Florida

Current Situation

In Florida, FB-Deep software is used to design drilled shafts and provide test pile length on driven pile projects for bridges and other structures. On projects where no test piles are required, FB-Deep is used to determine production pile length, and it is therefore critical to have reasonable estimates of required length to avoid costly revisions during construction. FB-Deep is based on correlations to the standard penetration test (SPT) and the cone penetrometer test (CPT) and was originally calibrated to static load tests developed in the late 1960s/early 1970s. For several years, the Structures Office has received reports indicating discrepancies between the predictions and what was encountered in the field, resulting in either excessive cut-off length or splices. In order to improve the estimates of pile length required in driven pile projects, the University of Florida was hired to analyze recent field data and evaluate the need to update the software correlations. The current effort aims to provide more accurate estimates that will result in material and time savings during construction.

Research Objectives

University of Florida researchers used field data to evaluate and improve the accuracy of FB-Deep predictions of pile nominal resistance. The project focused mainly on steel and concrete piles supported on limestone formations.

Piles loaded on a barge wait to be driven as a foundation for a Tampa-area pier.

Project Activities

Various types of deep foundations were investigated including steel H-piles, pre-stressed concrete piles, open cylindrical steel and concrete piles with diameters greater than 36 inches, and drilled shafts with partial length permanent casing.

The researchers collected a substantial amount of field data to use in evaluating FB-Deep's performance. Field data collection included standard penetration tests as well as static and dynamic load test results. Dynamic test data included many set-check records and a signal match analysis; from these, reasonable estimates of long-term static resistance were obtained. In addition to this testing, the researchers collected all available information for the subject sites and relevant pile types from local agencies, consultants, other state departments of transportation (DOTs), and the Federal Highway Administration database.

The researchers also studied unit skin friction versus deformation curves for cased drilled shafts embedded in Florida limestone. Data sources included a Florida Department of Transportation (FDOT) database, other FDOT research projects, and other state DOTs, among others.

Data related to pile performance, such as unit skin resistance and end bearing, were evaluated for a variety of soil and rock types, as appropriate to the pile type's intended use. The analysis of the extensive body of data collected in the project was used to recommend revisions to the FB-Deep software. The Bridge Software Institute implemented updated code to reflect the required revisions and provided validation examples to ensure stability of the analysis.

Project Benefits

The improved accuracy on the prediction of deep foundation nominal resistance produced by this project, offers the possibility of reducing the delays and added expense caused when pile design must be corrected during construction.

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