RESEARCH
PROJECT CAPSULE [17-2GT]
July 2017
TECHNOLOGY TRANSFER PROGRAM

Update the Pile Design by CPT Software to Incorporate Newly Developed Pile-CPT Methods and Other Design Features

JUST THE FACTS:

Start Date:
June 1, 2017

Duration:
24 Months

End Date:
May 31, 2019

Funding:
SPR: TT-Fed/TT-Reg

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Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

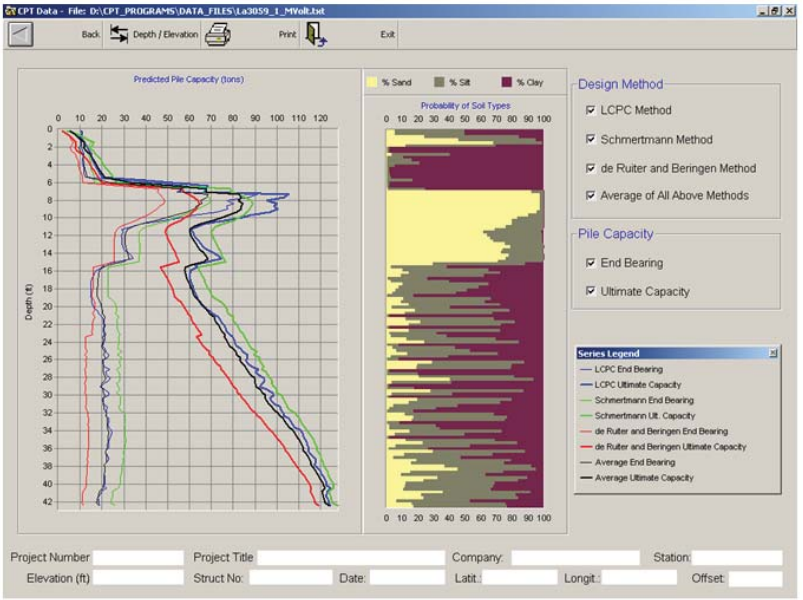
POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used Implementation Potential

PROBLEM

Pile foundations are usually used to carry infrastructure loads deep into the ground when the subsurface soil condition is weak and unable to safely support the loads. Therefore, an accurate assessment of pile resistance is crucial for safe and economical designs of pile foundations and the performance of pile supported infrastructures. This assessment can be achieved using different methods, including static methods, dynamic methods, pile load tests, and utilizing cone penetration tests (CPTs).

The CPT is an excellent and cost-effective in-situ test for subsurface investigation and evaluation of soil properties. Due to similarities between the cone and the pile, the determination of pile resistance from CPT data was among the earliest applications of the CPT. Many direct methods were developed to estimate pile resistance from CPT data. Eight direct CPT methods were evaluated in a prior LTRC study. Based on that evaluation, three methods were selected and coded into a useful computer program for pile design (Louisiana Pile Design by CPT, LPD-CPT).



Since the prior study, many more pile load tests have been conducted and new CPT design methods have been developed. Information from these tests, along with corresponding CPT data, can now be used to re-evaluate existing CPT methods and/or develop/modify new CPT methods for better estimation of pile resistance.

OBJECTIVE

The primary objectives of this research project are to collect available data from all pile load tests, along with corresponding CPTs and soil borings near the test pile locations;

compare pile resistance measured with load tests and pile resistance predicted with CPT data; and perform statistical analyses to evaluate and rank the different CPT pile design methods.

Additional objectives are to select, modify, and/or develop new CPT pile methods for Louisiana pile design; to re-calibrate the design resistance factor (ø) for selected CPT methods; and to update the LPD-CPT software accordingly, including pile set-up equations, scour effects, and generating synthetic CPT profiles.

METHODOLOGY

After a comprehensive literature review of all available CPT design methods for estimating pile resistance, a database of Louisiana pile load test information, CPT data, and soil borings will be compiled. The research team will also try to obtain data from neighboring states with similar soil conditions. For best evaluation of the CPT prediction methods, it is important to collect load tests for piles of different lengths and sizes.

Newly-developed and old CPT methods will be evaluated (or re-evaluated) for accuracy in estimating pile load resistance. Recalibration of the design resistance factor (ø) for selected CPT methods will be performed using information from the aforementioned pile load test database. A ranking scheme will be adopted for screening the CPT methods, and a ranking index will be used to quantify their overall performance.

Piles driven into Louisiana saturated cohesive soils experience setup, a time-dependent increase in resistance after installation. Three models were recently developed at LTRC for estimating the magnitude of pile setup. Incorporation of these models in pile design will result in significant cost savings.

The effect of scour on long-term resistance of piles will also be investigated. Scour is a process where submerged soil near a bridge abutment or pile is eroded and washed away.

A rational and scientific approach for evaluating the spatial distribution of the subsurface soil profile is known as the Kriging technique. Based on available data, this geostatistical interpolation tool can be used to generate a synthetic soil/CPT profile for any pile location.

The LPD-CPT software will be modified to facilitate calculation of pile resistance, pile setup, and scour effects. The ability to generate synthetic soil profiles will also be included. Prior to completion of this work, a benefit/cost analysis will be conducted comparing the various pile design methods.

IMPLEMENTATION POTENTIAL

A method for predicting/estimating the capacity of piles driven into Louisiana soil will be recommended. The LPD-CPT software will be completely updated to include each of the beneficial pile design elements from this study.