RESEARCH
PROJECT CAPSULE [14-2GT]
February 2014
TECHNOLOGY TRANSFER PROGRAM

Testing Protocol for Predicting Driven Pile Behavior within Pre-bored Soil

JUST THE FACTS:

Start Date:
November 1, 2013

Duration:
12 months

End Date:
October 31, 2014

Funding:
SPR: TT-Fed/TT-Reg

Principal Investigator:
Malay Ghose Hajra, Ph.D., P.E.
Department of Civil & Environmental Engineering
University of New Orleans
504-280-7062

Administrative Contact:
Mark Morvant, P.E.
Associate Director, Research
225-767-9124

Technical Contact:
Zhongjie "Doc" Zhang, Ph.D., P.E.
Pavement & Geotech
Research Administrator
225-767-9162

Louisiana Transportation Research Center
4101 Gourrier Ave
Baton Rouge, LA 70808

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

The Louisiana Department of Transportation and Development (DOTD) uses deep foundations, consisting of precast concrete piles, open- or closed-end steel pipe piles, steel H-piles, or auger-cast piles to support buildings, highway bridges, and other infrastructure systems. The piles at a project site derive their load carrying capacity from "side friction" along their embedded lengths as well as from "end resistance" when tipped firmly into dense sand or stiff/hard clays.

Pre-boring is a method used to facilitate driving of large displacement piles in hard/dense soils. A pilot hole, generally smaller in size compared to the pile to be installed, is first bored to a specified depth. By pre-boring a pilot hole, the "end bearing" and "side friction" within the pre-bore zone are reduced, thus aiding the driving of the pile. However, pre-boring complicates the prediction of long-term pile capacity (specifically side friction) within the pre-bored zone and the Wave Equation Analysis of Pile (WEAP) analysis, which aims to predict pile drivability. It is assumed that long-term end bearing within the pre-bored zone will not be an issue, as current DOTD specifications prohibit predrilling to the pile tip elevation. However, there are three major unknowns that accompany the pre-bored zone: (1) reduction of end bearing as it pertains to pile driving within the zone, (2) reduction of side friction as it pertains to pile driving within the zone, and (3) reduction of side friction as it pertains to long-term pile capacity within the zone.

It is expected that the relative strength of the soil as well as the diameter of the pilot hole relative to the pile will have an impact on pile drivability and its long-term load carrying capacity. Quantifying such an impact will greatly help geotechnical design engineers to understand the interactions among the factors of pre-boring, pile size, soil conditions, pile driving, etc., and improve the design and construction qualities of pile foundations in hard/dense soils.

OBJECTIVE

The objective of this project is to compile the state-of-the-art and best practice results available on the subject of pre-bored piles and develop a research and instrumentation testing plan for field data collection and select multiple pile driving sites representing different soil strengths (e.g., a "hard" site, a "very stiff" site, and a "medium stiff" site). The outcome of the research will include a plan for driving multiple test piles at each site using differently sized predrill holes with no predrilling as control for comparison, performing monitoring during driving, restrikes using pile dynamic analyzer (PDA), and static load tests as well as strain gauge instrumentation.

METHODOLOGY

The referenced research objectives will be accomplished by the performance of a literature review, survey with states highway and other agencies, and survey with Louisiana construction companies, investigating instrumentation protocol and site selection guidelines, developing specific guidelines for future data collection, and preparing a final report with recommendations.

IMPLEMENTATION POTENTIAL

The final report will contain an implementation plan, which will include the outcome of this research, a realistic assessment of impediments to successful implementation, the activities necessary for successful implementation, and the criteria for judging the progress and consequences of implementation. The plan will be presented in the form of test procedures, specifications, and design procedures that can be incorporated in the DOTD Standard Specifications for Roads and Bridges.

This research will benefit geotechnical, structural, and construction engineers involved in the design, construction, and installation of pile foundations for DOTD and other private projects. Furthermore, this study will benefit the pile driving contractors industry by advancing the knowledge related to predicting driven pile behavior within pre-bored soil.