INVESTIGATION OF THE EFFICACY OF HELICAL PILE FOUNDATION IMPLEMENTATION IN ACCELERATED BRIDGE CONSTRUCTION PROJECTS – PHASE I

Quarterly Progress Report
For the period ending February 28, 2021

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1. Background and Introduction

Accelerated Bridge Construction (ABC) has been used in an increasing rate by transportation agencies over the past decade as the need to reduce impact to the traveling public and increase the safety of laborers has become of greater importance. Many advances have been made in the construction methodology especially with respect to bridge decks, superstructures, and, to a lesser extent, substructures. Of the many advances that have been made, few have specifically been directed at the accelerated construction of foundations of bridge structures. For this reason, there are still opportunities to decrease project duration and reduce disruption to the road users with the adoption of newer foundation technologies.

One such technology is helical piles. Research is needed to identify the efficacy of using helical pile foundations for ABC projects. Helical pile installers tout the simplicity and speed of installation along with the ability to work within areas of limited size with smaller equipment.

2. Problem Statement

The number of current standard foundation options for bridge substructures is limited thus reducing the potential time savings afforded through newer, less-common technologies. Though acceleration of bridge projects has greatly progressed, the potential for additional time savings still exists through the use of other methods such as helical piles. In addition to their fast installation, the use of helical piles offers immediate capacity determination upon installation through capacity to torque ratios, and the use of small maneuverable equipment for installation.

Helical pile foundations have become commonplace in new commercial building construction and foundation repair applications with many foundation installers now offering this technology as one of their services. However, few bridge projects have been completed using helical piles despite their high capacities and speed of installation. The required equipment for installation (skid steer, back hoe, or excavator) lends itself to quick deployment and being an economical solution (i.e., excavator vs. crane), an advantage for any bridge project, but particularly for low-volume roads where budgetary considerations tend to be of specific priority.

3. Objectives and Research Approach

The main objective of this project is to evaluate the efficacy of the use of helical pile foundations in accelerated bridge construction projects.

4. Description of Research Project Tasks

The following is a description of tasks carried out to date.

Task 1 – Literature Review

Proposed task description

For Task 1 of this project, the research team will compile all related information available in journals, conference proceedings, technical reports, and online resources in a concise and comprehensive summary. The main objective of this task is to obtain an exhaustive understanding of helical pile use and its potential application to ABC projects.

Description of work performed to this period

Numerous documents and technical guidance regarding helical pile foundation history, use, and application have been gathered. Some of this information was delivered during the ABC-UTC Research Day. This includes the history of use in industries other than transportation; advantages of helical pile foundations (speed of installation, ability to work within areas of limited space, installation with smaller equipment, and installation in many soil strata types); disadvantages of helical pile foundations (bidding difficulties, unfavorable in rocky sites, and undeveloped installation standards); and an overview of the principals on which the helical piles function (helical bearing and perimeter shear).

Task 2 – Information Collection and System Comparison

Proposed task description

While Task 1 focuses upon extracting relevant material from documented sources, Task 2 will involve reaching out to helical pile foundation system designers, installers, and contractors with surveys and follow-up interviews. The goal will be to gather information primarily on capacity (vertical and lateral), speed of installation, and cost associated with helical pile installation.

In addition, similar information will be gathered on completed ABC project foundation systems for the sake of comparison. There have been numerous ABC projects completed over the past several years in diverse geographical areas, the information from which sufficient detail can be gathered to assess the cost of their respective foundation systems. In any case of comparison, efforts will be made to determine the equivalent helical pile system for sake of accuracy.

Other entities will also be contacted to ensure all relevant information is collected. In addition to gathering important project-specific information, the research team will also communicate with agencies who have implemented ABC projects to determine how they might benefit from additional foundation solutions.

Task 2 is of particular importance since the information gathered here will weigh heavily on the decision-making framework guiding the advancement or delay of this technology on ABC projects.

Description of work performed to this period

Helical pile contractors have been engaged in conversation and a demonstration installation of helical piles was observed. Additionally, the contractor has provided valuable information to better define the best use and capabilities of helical piles. Foundation information has been gathered for several ABC projects for sake of comparison to the as-built foundations.

Task 3- Decision Making Framework

Proposed task description

Using the information gathered in Tasks 1 and 2, a comparative analysis (capacity and costs) between helical piles and foundation systems currently used for ABC projects will be completed and a decision-making framework for using helical piles versus another foundation system will be created. The framework will be two-fold in format: First, a high-level basic flowchart or matrix guiding the consideration of helical pile use will be provided resulting in a “yes”, “no”, or “maybe” decision to proceed; second, an extended question and discussion section will be created to provide greater detail of the factors to consider when selecting foundation type. The intended user of each may be the same or different based on the responsibility one holds to the

project (i.e., preliminary concept vs. design details). For the sake of project efficiency, it is intended this tool would be used at the beginning of a new ABC project. However, the guidance would hold true throughout the project and could be used even beyond contract award in the case of value engineering.

Description of work performed to this period

The decision-making framework for helical pile use has been drafted providing direction to high-level and low-level decisions.

Task 4- Summary of Information

Proposed task description

The efforts associated with Tasks 1, 2, and 3 will be summarized to define the benefits and drawbacks of helical pile technology and highlight the overall project discoveries, specifically how ABC projects may be affected by implementing additional foundation strategies. It is anticipated this effort will generally give direction to the efficacy of helical pile foundation use on ABC projects.

Description of work performed to this period

The summary of information is being completed in conjunction with the final report.

Task 5- Final Report

Proposed task description

The project findings from the previously identified tasks will be prepared by means of a final report. This document will include the identified current state-of-the-practice of helical piles, the potential adoption to ABC projects, recommendations for further study/research, and other key project discoveries.

Description of work performed to this period

The final report is 50 percent complete.

5. Expected Results and Specific Deliverables

A study regarding the use of helical piles in bridge foundations of ABC projects will be completed and preliminary guidance provided. The guidance will be based on information collected to assess the expediency, adequacy, and use of helical piles.

6. Schedule

Progress of tasks in this project is shown in the tables below.

Item	% Completed
Percentage of Completion of this project to Date	80%

	Month											
	A	M	J	J	A	S	O	N	D	J	F	M
Task 1												
Task 2												
Task 3												
Task 4												
Task 5												

Work Performed
Work to be Performed