



RESEARCH PROJECT CAPSULE [22-3ST]

June 2022

TECHNOLOGY TRANSFER PROGRAM

Evaluation of Embedded Pile Resistance of Scour Critical Bridges

JUST THE FACTS:

Start Date:
May 2, 2022

Duration:
36 months

End Date:
May 1, 2025

Funding:
SPR: TT-Fed/TT-Reg – 5

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POINTS OF INTEREST:

Problem Addressed / Objective of
Research / Methodology Used /
Implementation Potential

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PROBLEM

Scour events impacting safety of Louisiana bridges are of serious concern, especially after major flooding resulting from recent hurricanes. The Louisiana Department of Transportation and Development (DOTD) is reevaluating the safety of foundations for scour critical bridges. The pile resistance for some scour critical bridges has been evaluated, and an inconsistency between analysis results and field performance has been noticed. For example, many cases have been reported where a bridge is functioning properly without any evidence of pile capacity decrease due to scour events; however, static analysis methods show that pile resistance undermined by scour events is not enough to support the bridge.

It is suspected that this inconsistency may be attributed to the conservative nature of the static analysis methods, which are typically simplified on a theoretical basis to facilitate daily design. Another cause could be the change in pile resistance due to the environment, which is largely unknown. Hence, to assist DOTD to conduct proper reevaluation of pile foundation and bridge safety, LTRC will determine if any action is required to reinforce the foundation. An effective and efficient analysis approach for estimating existing pile resistance, considering environmental factors, needs to be developed.

OBJECTIVE

The main objective of this research study is to explore methods and techniques to accurately determine the capacity of in-place piles for in-service bridge structures, especially for those that are under severe scour conditions. Many existing scour critical bridges were built decades ago, and pile setup phenomenon is significant. Proposed methodologies will be based on effective Pile-CPT methods that have small variability in predicting pile capacity, considering scour as well as pile setup. These methodologies will be calibrated against field load test data (proof load tests of bridge structures plus single static pile load tests).



*Top: Proof load testing of a bridge foundation;
Bottom: Instrumented piles at a Louisiana bridge*

METHODOLOGY

To achieve the objectives of this study, the following tasks will be carried out:

- **Task 1:** A comprehensive literature review will be conducted. Literature relevant to evaluating the current capacity of in-place piles for in-service bridges will be reviewed.
- **Task 2:** At-proof load testing or a single static pile load test will be conducted on selected bridge locations.
- **Task 3:** Piezocone (CPTu) and seismic cone penetration test (CPT) soundings will be performed on all pile test locations.
- **Task 4:** Following the soundings in Task 3, the team will analyze the measurements of the field load tests and the in-situ data from CPTu and Seismic CPTu tests.
- **Task 5:** A complete load-settlement curves using finite element analysis and extrapolation techniques will be conducted.
- **Task 6:** The research team will calibrate the top-performed pile-CPT methods (and possible SCPT methods) for evaluating the current in-place piles within in-service bridge.
- **Task 7:** An instrumentation plan and interim report will be prepared, followed by a final report, implementation sheet, and delivery of a final presentation.

IMPLEMENTATION POTENTIAL

This research should provide a better understanding of the contributors to the variability of pile capacity estimation, especially for existing piles subject to severe scour. The results of this research are expected to be implemented in the assessment and evaluation of bridge foundation safety to assist DOTD in determining future maintenance plans for bridges.