

WYOMING DEPARTMENT OF TRANSPORTATION

PROGRESS REPORT

Project title: Comprehensive Field Load Test and Geotechnical Investigation Program for Development of LRFD Recommendations of Driven Piles on Intermediate GeoMaterials

Project Number: RS05219 (TPF 5-391)

Progress period: January 1st, 2021 to March 31st, 2021

Principal Investigator and all others who have worked on the project: Kam Ng (0000-0001-5099-5454); Shaun S. Wulff (0000-0002-5695-4925); Rasika Rajapakshage (postdoc); Nafis Masud (PhD student); Opeyemi Oluwatuyi (PhD student); Shafiqul Islam (MS student); Harish Kalauni (Master student), Rebecca Holt (MS student), Tyler Johnson (MS student), and Chooi Kim Lau (Undergraduate student)

1. Please state whether the project is ahead of schedule, on time, or behind schedule: On time.
2. Percentage of overall work completed: 41.77%.
3. Activities and Accomplishments: The information provided in this section allows WYDOT to assess whether satisfactory progress has been made during the reporting period. Please be as detailed as possible, but try to keep your report to three to four pages in length, if possible.

a. What are the major goals and objectives of the project?

The overall goal of the research project is to develop LRFD recommendations for driven piles on IGMs. The research objectives are (1) determine representative engineering properties of soil and IGM; (2) evaluate the variability of soil and IGM properties; (3) recommend best geotechnical investigation practices for IGM; (4) develop advanced static analysis methods for pile resistance estimation on IGM; (5) validate and improve the accuracy of dynamic analysis methods; (6) investigate pile setup and/or relaxation; (7) develop LRFD resistance factors for piles on IGM; and (8) recommend changes and improvements to current pile design and construction practices. The research plan has two phases (I and II) and total 14 tasks. Their proposed completion dates, scheduled percent completion and actual percent completion are summarized in the following table.

Task	Description	Proposed Completion Date	Scheduled Percent Completion	Actual Percent Completion
I-1	Historical Pile Data Collection	31-Dec-19	100.00%	100.00%
I-2	Expand Electronic Database	31-Dec-22	46.08%	64.29%
I-3	Identify Bridge Projects for Field Test	31-Dec-19	100.00%	66.67%
I-4	Detailed Geotechnical Investigation	31-Dec-20	100.00%	50.00%
I-5	Innovative Static Load Tests	30-Jun-21	87.53%	23.08%
I-6	Reporting for Phase I	31-Dec-21	0.00%	0.00%
II-1	Geotechnical and Pile Data Interpretation	31-Dec-20	100.00%	92.86%
II-2	Pile Resistance Estimation	30-Jun-22	37.45%	92.86%
II-3	Pile Setup/Relaxation Investigation	30-Sep-22	0.00%	5.00%
II-4	Variability Analysis	31-Dec-22	12.21%	30.00%
II-5	Development of LRFD Resistance Factors	31-Mar-23	0.00%	60.00%
II-6	Cost-Benefit Analysis	30-Jun-23	0.00%	0.00%
II-7	Outcomes and Recommendations	30-Sep-23	0.00%	0.00%
II-8	Reporting for Phase II	31-Dec-23	0.00%	0.00%
Average Percent Completion			41.66%	41.77%

b. Describe what was accomplished under these goals.

1. Major activities.

Agency	Major Activities by Research Team
WYDOT	<ul style="list-style-type: none"> • Developed an electronic database. • Completed the static pile load test for the Lodgepole Creek bridge project. • Finalized the static pile load test plan for the I-80 bridge project. • Conducted analysis on geological and variable uncertainties on the Lodgepole Creek bridge project. • Complete triaxial tests on IGM samples from Lodgepole Creek and I-80 projects. • Conducted a finite element analysis to simulate the pile load test of the Lodgepole Creek bridge project.
IADOT	<ul style="list-style-type: none"> • Completed pile load tests for Wapello and Adair bridge projects. • Collected three PDA/CAPWAP test results from six bridge projects. • Conducted inherent variability study of Wapello project. • Conducted a finite element analysis to simulate the pile load test of the Adair County bridge project.
CDOT	<ul style="list-style-type: none"> • Evaluated historical test pile reports and reported missing information. • Identified two bridge projects for pile load testing. • Conducted triaxial rock tests on shales. • Collected IGM samples for the York bridge project. • Prepared a guidance for dynamic testing. • Provided comments to pile load test plans and specifications.
KDOT	<ul style="list-style-type: none"> • Evaluated historical pile data. • Developed electronic database. • Completed historical pile data interpretation. • Conducted regression analysis to develop static analysis methods for piles in

	shale. <ul style="list-style-type: none"> • Performed wave equation analysis program on historical test pile data. • Completed the calibration of LRFD resistance factors for piles in shales.
ITD	<ul style="list-style-type: none"> • Evaluated historical pile data. • Developed electronic database. • Completed historical pile data interpretation. • Conducted regression analysis to develop static analysis methods for piles in IGMs.
MDT	<ul style="list-style-type: none"> • Received and evaluated historical pile data from MDT. • Conducted geotechnical and pile data interpretation. • Conducted regression analysis to develop static analysis methods. • Identified two sites for pile load testing.
NDDOT	<ul style="list-style-type: none"> • Collected and evaluated historical pile data. • Identified a bridge site for static pile load test. • Attended several project meetings with NDDOT. • Completed triaxial tests on IGM samples from the bridge site.
University of Wyoming	<ul style="list-style-type: none"> • Ninth TAC conference meeting was conducted on February 3rd, 2021. • Preparing five journal manuscripts for submissions. • Submitted a journal manuscript to Georisk Journal for review. • Three abstracts submitted to 2022 ASCE Geocongress conference were accepted for the full paper submission. • An abstract submitted for the Deep Foundation Institute (DFI) student paper competition was accepted for a full paper submission.

2. Specific objectives. Too early to report.
3. Significant results (both positive and negative). Too early to report.
4. Key outcomes and other achievements. Too early to report.
5. Goals not met. Not applicable.

c. What opportunities for training and professional development has the project provided? Nothing to Report.

d. How have the results been disseminated to communities of interest?
 We submitted a manuscript for review and are preparing five manuscripts for the dissemination of our findings to the communities. We are preparing papers for the 2021 DFI conference and 2022 ASCE conference.

e. What do you plan to do during the next reporting period to accomplish the goals and objectives? The research team will conduct the following works:

- Work with MDT, KDOT and CDOT to finalize bridge sites for static pile load tests.
- Complete wave equation analysis on piles from ITD, KDOT, MDT and NDDOT.
- Develop LRFD resistance factors.
- Expand the variability study to other states.

- Submit journal manuscripts.
 - Expand the electronic database to include pile data from CDOT and IADOT.
- f. List any products resulting from the project during the reporting period. Include in this list:
1. Publications, conference papers, and presentations. In progress.
 2. Website(s) or other internet sites (List the URL). Too early to report.
 3. Technologies or techniques. Too early to report.
 4. Inventions, patent applications, and/or licenses. Too early to report.
 5. Other products. Too early to report.
- g. Impact:
1. How will this project impact WYDOT? Too early to report.
 2. How will this project impact other agencies? Too early to report.
- h. Changes to Scope of Work. Provide the following changes, if applicable:
1. Scope of work or objectives of the project. No change.
 2. Changes in key persons. No change.
 3. Disengagement from the project for more than three (3) months, or a twenty five (25) percent reduction in time devoted to the project. Not applicable.
 4. The inclusion of costs that require prior approval. Not applicable.
 5. The transfer of funds between line items in the budget. Not applicable.
 6. The subawarding, transferring or contracting of work. No change.
 7. Changes in the approved cost-sharing or match. Not applicable.