

**Quarterly Progress and Performance Indicators Report:**

**Project Number and Title:** Flexural Strength of Micropile Threaded Connections

**Research Area:** Civil Engineering

**PI:** Aaron Gallant, Department of Civil and Environmental Engineering

**Co-PI(s):** Bill Davids, Department of Civil and Environmental Engineering

**Reporting Period:** 04/01/2023-06/30/2023

**Submission Date:** June/2023

**Overview:**

During the reporting period the following activities were performed:

- Partial execution of testing program.
- Test instrumentation setup.
- Divulcation in conference.
- Technical article drafting.

**Meeting the Overarching Goals of the Project:**

- Execution of the testing program provides the data for analysis. Special attention has been given to the instrumentation setup which presents specific challenges related to the use of digital image correlation (DIC) technique. The rounded surface of the micropiles (testing specimens) requires more elaborated test setup than the typical DIC applications on flat surfaces, this includes a higher number of cameras (4 cameras) and lighting sources to ensure uniformity on illumination. Preliminary analysis indicates satisfactory quality on the data.
- Academic products (articles) are being prepared.
- Divulcation of results among industry and practitioners is part of the products of this project.

**Accomplishments:**

- 10 out of 60 tests had been performed.
- Data acquisition system has been prepared.
- Presentation on conference.

**Task Progress and Budget:**

<b>Table 1: Task Progress</b>			
<b>Task Number: Title</b>	<b>Start Date</b>	<b>End Date</b>	<b>% Complete</b>
Task 1.1: Phase 1 – Numerical modeling	09/01/2019	09/30/2021	100
Task 1.2: Phase 1 – Data analysis	09/01/2019	09/30/2021	100
Task 1.3: Phase 1 – Final Technical report (phase I)	09/01/2019	09/30/2021	100
Task 1.4: Phase 1 – Conference paper	01/01/2021	09/30/2021	100
Task 2.1: Phase 2 – Experimental program design	07/01/2021	03/31/2022	100
Task 2.2: Phase 2 – Experimental program execution	03/01/2022	07/31/2022	38
Task 2.3: Phase 2 – Literature review	01/01/2022	05/30/2023	80
Task 2.4: Phase 2 – Data Analysis	04/15/2022	08/30/2022	15
Task 2.5: Phase 2 – Code programming	01/01/2022	03/01/2023	20
Task 2.6: Phase 2 – Final project technical report	08/01/2022	10/30/2022	10
Task 2.7: Phase 2 – Paper 1	07/01/2022	09/30/2022	30
Task 2.8: Phase 2 – Paper 2	10/01/2022	02/30/2023	0
Task 2.9: Phase 2 – Paper 3	03/01/2023	05/30/2023	0
etc.			
Phase 1 Overall	09/01/2019	09/30/2021	100
Phase 2 Overall	07/01/2021	05/30/2023	50
Phase 3 Overall	Enter Phase 3 Actual Start Date	Enter Phase 3 Planned/Actual End Date	Enter Phase 3 % Complete

<b>Table 2: Budget Progress</b>		
<b>Project Budget</b>	<b>Spend – Project to Date</b>	<b>% Project to Date (include the date)</b>
Enter Phase 1 Full Budget	Enter Phase 1 Full Spend Amount (Federal + Cost Share)	Enter Phase 1 % Spent
Enter Phase 2 Full Budget	Enter Phase 2 Full Spend Amount (Federal + Cost Share)	Enter Phase 2 % Spent
Enter Phase 3 Full Budget	Enter Phase 3 Full Spend Amount (Federal + Cost Share)	Enter Phase 3 % Spent

**Is your Research Project Applied or Advanced?**

**Applied** (The systematic study to gain knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.) Applicable to Phase I.

**Advanced** (An intermediate research effort between basic research and applied research. This study bridges basic (study to understand fundamental aspects of phenomena without specific applications in mind) and applied research and includes transformative change rather than incremental advances. The investigation into the use of basic research results to an area of application without a specific problem to resolve.) Applicable to Phase 2.

**Professional Development/Training Opportunities:**

Describe any opportunities for training/professional development that have been provided. Did you provide a training to a State DOT/AOT or industry organization? What was the training? When was it offered? How many people attended? Did you meet with a State DOT/AOT or industry organization to inform them of your findings and how these findings could help their organization? When? How many attended the meeting?

- N/A

**Technology Transfer:**

Use the table below to complete information about conference sessions, workshops, webinars, seminars, or other events you led/attended where you shared findings as a result of the work you conducted on this project:

<b>Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events</b>					
<b>Type</b>	<b>Title</b>	<b>Citation</b>	<b>Event</b>	<b>Location</b>	<b>Date(s)</b>
Poster	Flexural Strength of Micropile Threaded Connections	-	TIDC 2020 Student Poster Contest	Online	September/2020
Poster	Flexural Strength of Micropile Threaded Connections	-	TIDC 2021 Student Poster Contest	Online	December/2021
Presentation	Flexural Strength of Micropile Threaded Joints		TIDC Showcase Presentatons	Online	June / 2021
Presentation	Flexural Strength of Micropile Threaded Joints		GEO-CONGRESS 2022	Charlotte, NC	March 21 <sup>st</sup> 2022
Poster	Structural Testing of Micropile Threaded Connections	-	TIDC 2022 Student Poster Contest	Online	November/2022
Presentation	Four point bending test on micropile threaded connections		15 <sup>th</sup> International Workshop on Micropiles	Vail, CO	June 2023

Use the table below to report any publications, technical reports, peer-reviewed articles, newspaper articles referencing your work, graduate papers, dissertations, etc. written as a result of the work you conducted on this project. Please list only completed items and exclude work in progress.

<b>Table 4: Publications and Submitted Papers and Reports</b>				
<b>Type</b>	<b>Title</b>	<b>Citation</b>	<b>Date</b>	<b>Status</b>
Conference paper	Flexural Strength of Micropile Threaded Connections	Montoya-Vargas, S., Gallant, A., & Davids, W. G. Flexural Strength of Micropile Threaded Connections. In Geo-Congress 2022 (pp. 218-227). Doi: 10.1061/9780784484029.021	March/2022	Published.
Technical Report	Assessment of Micropile-Supported Integral Abutment Bridges	Montoya-Vargas, S., Gallant, A., Davids, W.G. (2021). "Assessment of Micropile Supported Integral Abutment Bridges". <i>Final Report</i> , MaineDOT, Under review.	September, 2022	Submitted.

Answer the following questions (N/A if there is nothing to report):

1. Did you deploy any technology during the reporting period through pilot or demonstration studies as a result of this work? If so, what was the technology? When was it deployed?  
R/: NA
2. Was any technology adopted by industry or transportation agencies as a result of this work? If so, what was the technology? When was is adopted? Who adopted the technology?  
R/: NA
3. Did findings from this research project result in changing industry or transportation agency practices, decision making, or policies? If so, what was the change? When was the change implemented? Who adopted the change?  
R/: NA
4. Were any licenses granted to industry as a result of findings from this work? If so, when? To whom was the license granted?  
R/: NA
5. Were any patent applications submitted as a result of findings from this research? If so, please provide a copy of the patent application with your report.  
R/: NA

6. Were any industrial contracts awarded base on furthering planned research and development activities as a result of findings from this work? If so, when? How much was awarded? Who awarded the contract?

The Association of Drilling Contractors and International Association of Foundation Drillers (ADSC-IAFD) have sponsored, in part, the full-scale testing of micropiles to understand flexural weaknesses at the pipe joint connections.

*Please add figures/images that can be included on the website and/or in marketing/social media materials to further clarify your research to the general public.*



*Figure 1 Four-point bending test*



Figure 2 Detail of failed connections

*Describe any additional activities involving the dissemination of research results not listed above under the following headings:*

**Outputs:**

*Definition: Any new or improved process, practice, technology, software, training aid, or other tangible product resulting from research and development activities. They are used to improve the efficiency, effectiveness, and safety of transportation systems. List any outputs accomplished during this reporting period:*

**Outcomes:**

*Definition: The application of outputs; any changes made to the transportation system, or its regulatory, legislative, or policy framework resulting from research and development activities. List any outcomes accomplished during this reporting period:*

**Impacts:**

*Definition: The effects of the outcomes on the transportation system such as reduced fatalities, decreased capital or operating costs, community impacts, or environmental benefits. The reported impacts from UTCs are used for the assessment of each UTC and to make a case for Federal funding of research and education by demonstrating the impacts that UTC funding has had on technology and education. NOTE: The U.S. DOT uses this information to assess how the research and education programs (a) improve the operation and safety of the transportation system; (b) increase the body of knowledge and technologies; (c) enlarge the pool of people trained to develop knowledge and utilize technologies; and (d) improves the physical, institutional, and information resources that enable people to have access to training and new technologies. List any outcomes accomplished during this reporting period:*

- NA

**Participants and Collaborators:**

Use the table below to list **all** individuals (compensated or not) who have worked on the project.

<b>Table 5: Active Principal Investigators, faculty, administrators, and Management Team Members</b>				
<b>Individual Name &amp; Title</b>	<b>Dates involved</b>	<b>Email Address</b>	<b>Department</b>	<b>Role in Research</b>
Aaron Gallant	09/01/2019-12/31/2022	<a href="mailto:aaron.gallant@maine.edu">aaron.gallant@maine.edu</a>	CIE	PI
Bill Davids	09/01/2020-12/31/2022	<a href="mailto:william.davids@maine.edu">william.davids@maine.edu</a>	CIE	Co-PI

Use the table below to list **all** students who have participated in the project during the reporting period. (This includes all paid, unpaid, intern, independent study, or any other student that participated in this project.) **ALL FIELDS ARE REQUIRED.**

<b>Table 6: Student Participants during the reporting period</b>								
<b>Student Name</b>	<b>Start Date</b>	<b>End Date</b>	<b>Advisor</b>	<b>Email Address</b>	<b>Level</b>	<b>Major</b>	<b>Funding Source</b>	<b>Role in research</b>
Sebastian Montoya	09/01/2019	05/30/2024	Aaron Gallant		Ph.D.	Civil Engineering	TIDC, ADSC-IAFD	Literature review, algorithm development and programming, technical documents writing

Use the table below to list any students who worked on this project and graduated or received a certificate during this reporting period. Include information about the student's accepted employment (i.e. the student is now working at MaineDOT) or if they are continuing their students through an advanced degree (list the degree and where they are attending).

<b>Table 7: Students who Graduated During the Reporting Period</b>			
<b>Student Name</b>	<b>Degree/Certificate Earned</b>	<b>Graduation/Certification Date</b>	<b>Did the student enter the transportation field or continue another degree at your university?</b>
Sebastian Montoya	Master	August 2022	Ph.D. Civil Engineering

Use the table below to list any students that participated in Industrial Internships:

Table 8: Industrial Internships			
Student Name	Degree/Certificate Earned	Graduation/Certification Date	Did the student enter the transportation field or continue another degree at your university?
			Please list the organization or degree

Use the table below to list **organizations** that have been involved as partners on this project and their contribution to the project.

Table 9: Research Project Collaborators during the reporting period						
Organization	Location	Contribution to the Project				
		Financial Support	In-Kind Support	Facilities	Collaborative Research	Personnel Exchanges
		List the amount	List the amount	Mark with an "x" where appropriate		
The International of Foundation Drilling (ADSC-IAFD)	Pennsylvania	X				
GMS Piling Solutions	Pennsylvania		X			
OCI	Pennsylvania		X			
Nucor	Pennsylvania		X			

Use the table below to list **individuals** that have been involved as partners on this project and their contribution to the project.

*(List your technical champion(s) in this table. This also includes collaborations within the lead or partner universities who are not already listed as PIs; especially interdepartmental or interdisciplinary collaborations.)*

Table 10: Other Collaborators				
Collaborator Name and Title	Contact Information	Organization and Department	Date(s) Involved	Contribution to Research
ADSC-IAFD team	(Peggy Hagerty Duffy) peggy@hagertyengineering.com	ADSC-IAFD	December 2020- December 2022	Revision of testing program



Use the following table to list any transportation related course that were taught or led by researchers associated with this research project:

Table 11: Course List						
Course Code	Course Title	Level	University	Professor	Semester	# of Students
i.e. CE 123		Grad or undergrad?	Where was the course taught?	Who taught the course?	Enter Spring, Fall, Summer, Winter and the year	How many students were enrolled in the class?
	N/A					

**Changes:**

List any actual or anticipated problems or delays and actions or plans to resolve them (list no-cost extension requests here)...

List any changes in approach and the reasons for the change...

Redesign of the experimental program was performed along with the technical champions of this project. Initially, the fabrication of the testing specimens was not considering the application of torque. After consideration and active discussion with ADSC the specimens will be torqued. Additionally, the number of specimens was extended from 40 to 50 to include casing diameters of 13.625 inches. Material that was already delivered to the ASCC facilities was discarded due to the lack of material characterization. New material was sent in replacement.

**Planned Activities:**

List the activities planned during the next quarter.

- Continue the testing program at the ASCC.
- Drafting papers and reports.