Quarterly Progress and Performance Indicators Report:
Project Number and Title: 2.14 - Implementation of UHPC Technology into the New England Construction Industry

Research Area New materials for longevity and constructability
PI: Kay Wille, Ph.D., Associate Professor, University of Connecticut, Department of Civil & Environmental Engineering, Storrs, CT
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Reporting Period: 07/01/2022– 09/30/2022
Submission Date: 09/30/2022

****IMPORTANT: Please fill out each section fully and reply with N/A for questions/sections with nothing to report. For ease of reporting to the USDOT, please do not remove, or change the order of, any sections/text. You may remove/add each rows in tables as needed. Thank you! ****
The report is due on the last day of the reporting period in .doc format to tidc@maine.edu.

Overview:

*Provide **BRIEF** highlights of activities performed during the reporting period.*

- Continued measuring freeze-thaw resistance and shrinkage in newly developed New England UHPCs
- Analyzed the durability data and preparing manuscript on the investigation of durability properties of new UHPCs
- Prepared final report for TIDC Project 2.5.

Meeting the Overarching Goals of the Project:

How did the previous items help you achieve the project goals and objects? Please give one bullet point for each bullet point listed above.

- As the overall goal of the project is to implement the UHPC technology in the New England area, investigation of durability properties will help to assure that newly developed New England UHPC will be sufficiently durable.

Accomplishments:

List any accomplishments achieved under the project goals in bullet point form…

- Relative dynamic modulus of freeze thaw beams even after 600 cycles did not decrease. In addition, mass of the beams under freeze-thaw cycles are actually increasing instead of decreasing due to deterioration.
- Total shrinkage values in the beams are found to be low, 1mm per 1000m of length and has almost stopped shrinking after more than 120 days.

Task, Milestone, and Budget Progress:

Complete the following tables to document the work toward each task and budget (add rows/remove rows as needed, make sure you complete the Overall Project progress row and include all tasks even if they have ended or have not been started)…

Table 1: Task Progress

Task Number: Title	Start Date	End Date	% Complete
Task 1.1: Mixing and Air Content Test	10/01/2021	02/28/2022	100%
Task 1.2: Freeze Thaw and Shrinkage Testing	11/01/2021	03/31/2022	70%

Task 1.3: Resistivity Testing	11/01/2021	03/31/2022	80%
Task 2.1: Preparation of Structural Slab connection	04/01/2022	07/31/2022	0%
Task 2.2: Testing of Structural Slab Connection	08/01/2022	10/31/2022	0%
Task 2.3: FE Analysis and Verification	11/01/2022	12/31/2022	0%
Task 3.1: Educating Personnel about UHPC Technology	01/01/2023	02/28/2023	0%
Task 3.2: Testing of Mixing UHPC at Large Volume	03/01/2023	06/30/2023	0%
Task 3.3: Quality Control and Test Analysis	07/01/2023	09/30/2023	0%
Phase 1 Overall: Durability test results	10/01/2021	03/31/2022	85%
Phase 2 Overall: Structural Component Testing	04/01/2022	12/31/2022	0%
Phase 3 Overall: Knowledge Transfer and Field Testing	01/01/2023	09/30/2023	0%

Table 2: Milestone Progress

Milestone #: Description	Corresponding Deliverable	Start Date	End Date
Milestone 1: Durability test results	summary report	10/01/2021	03/31/2022
Milestone 2: Structural Component Testing	summary report	04/01/2021	12/31/2022
Milestone 3: Knowledge Transfer and Field Testing	summary report, UHPC mix design	01/01/2023	09/30/2023

Table 3: Budget Progress

Project Budget	Spend – Project to Date	% Project to Date (include the date)
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.)*

☐ **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.)*

Education and Workforce Development:

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

1. Did you provide any workforce development or training opportunities to transportation professionals (already in the field)? If so, what was the training? When was it offered? How many people attended? (i.e. The research team provided an in the field training for the SAR technology for 3 maintenance crew members of the MassDOT on 3/31/2021. The members learned how to use the technology and interrupt the data.)
   Not this time.

2. Did you hold meetings with any transportation industry organizations or DOTs? If so, what was the meeting's purpose? When was it offered? How many people attended?

3. Did you host/participant in any K-12 education outreach activities? If so, what was the activity? What was the target age/grade level of the participants? How many students/teachers attended? When was the activity held? (i.e. 25 8th graders and 2 teachers visited the concrete lab and created small concrete trinkets like Legos on 3/31/2021. They learned about the different types of fibers that can be used in the concrete.)

   Our lab, Advanced Cementitious and Composites (ACMC) lab is conducting Engineering Explore 2022, an outreach program for high school teachers, first week of July 2022. They participated in the concrete mixing and casting specimen.
   Also, ACMC continues to support one of the undergraduate students in her concrete research. She is using powdered recycled plastics in concrete to see the changes in compressive strength.

Technology Transfer:

Complete all of the tables below and provide additional information where requested. Please provide ALL requested information as this is one of the most important sections for reporting to the USDOT. ***ONLY provide information relevant to this reporting period.***

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:

Table 4: Presentations at Conferences, Workshops, Seminars, and Other Events

Type	Title	Citation	Event & Intended Audience	Location	Date(s)
TIDC Annual Conference	Ultra-high-performance concrete - Opportunities for a more sustainable and environmentally friendly infrastructure		4th Annual Transportation Infrastructure Durability Conference	Wells Conference Center, University of Maine,	August 11th

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.

Table 5: Submitted/Accepted Publications, Technical Reports, Theses, Dissertations, Papers, and Reports				
Type	**Title**	**Citation**	**Date**	**Status**
Peer-reviewed journal	The Effects of Resonant Acoustic Mixing on the Microstructure of UHPC			Currently working on it
Peer-reviewed journal	Performance of Newly Developed UHPC based on locally available material			Currently working on it
Peer-reviewed journal	Investigation and characterization of durability properties of newly developed UHPC based on locally available material			Currently working on it

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?

   N/A

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?
   N/A

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?
   N/A

4. Were any licenses granted to industry as a result of findings from this work? If so, when? To whom was the license granted?
   N/A

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.
   N/A

6. Did industry organizations or DOTs provide cost-share (cash or in-kind) to your research during the reporting period? Who was the organization? Please provide an in-kind support invoice from the organization with your report (this is kept confidential and used for record keeping purposes only).
   N/A

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. This is very important to our Technology Transfer initiatives.

Fig 1:- 0.75 liter air meter

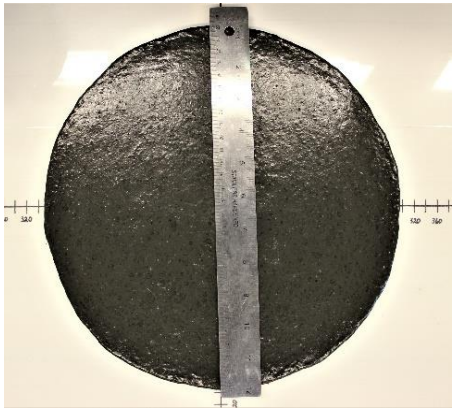

Fig 2:- Spread test with flow cone

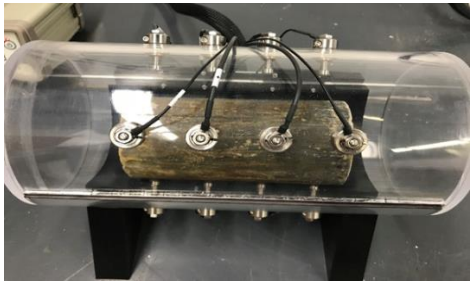

Fig 3:- Electrical surface resistivity test setup

Fig 4:- Freeze thaw table

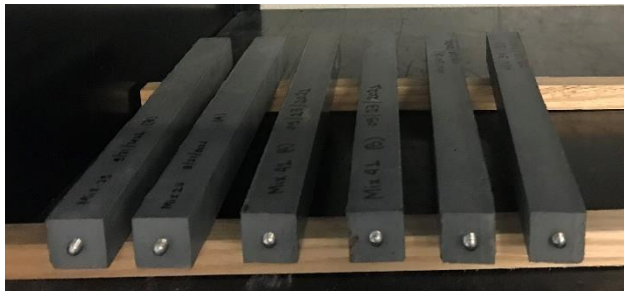

Fig 5:- Shrinkage beams

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:
Not applicable at this time.

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:
Not applicable at this time.

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:
Not applicable at this time.

Participants and Collaborators:

Use the table below to list individuals (compensated or not) who have worked on the project other than students.

Table 6: Active Principal Investigators, faculty, administrators, and Management Team Members				
Individual Name & Title	**Dates involved**	**Email Address**	**Department**	**Role in Research**
Kay Wille, Ph.D., Associate Professor	Oct. 2021-Present	kay.wille@uconn.edu	Civil Engineering	Principal Investigator
Ramesh Malla, Ph.D., F. ASCE, Professor	Oct. 2021-Present	ramesh.malla@uconn.edu	Civil Engineering	Co-Principal Investigator

*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.***

Table 7: Student Participants during the reporting period								
Student Name	**Start Date**	**End Date**	**Advisor**	**Email Address**	**Level**	**Major**	**Funding Source**	**Role in research**
Bijaya Rai	Jan. 2019	TBD	Kay Wille		PhD	Civil Engineering	TIDC	Lead
Dominic Parciasepe	Summer 2019	TBD	Kay Wille		Undergrad	Environmental Engineering	Work-study and ACMC	Undergrad-RA
Cameron Larkin	Fall 2021	TBD	Kay Wille		Undergrad	Civil Engineering	ACMC	Undergrad-RA
Nathan Comment	Fall 2021	TBD	Kay Wille		Undergrad	Civil Engineering	ACMC	Undergrad-RA
Harley Jeanty	Spring 2022	TBD	Kay Wille		Undergrad	Civil Engineering	ACMC	Undergrad-RA

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 during the reporting period (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).

Table 8: Students who Graduated During the Reporting Period			
Student Name	**Degree/Certificate Earned**	**Graduation/Certification Date**	**Did the student enter the transportation field or continue another degree at your university?**
N/A			

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

Table 9: Industrial Internships			
Student Name	**Degree/Certificate Earned**	**Graduation/Certification Date**	**Did the student enter the transportation field or continue another degree at your university?**
N/A			

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

Table 10: Research Project Collaborators during the reporting period						
Organization	**Location**	**Contribution to the Project**				
		Financial Support	**In-Kind Support**	**Facilities**	**Collaborative Research**	**Personnel Exchanges**
N/A						

*Use the table below to list **individuals** that have been involved as partners on this project and their contribution to the project during the reporting period. (**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 11: Other Collaborators

Collaborator Name and Title	Contact Information	Organization and Department	Date(s) Involved	Contribution to Research
Bao Chuong, PE		Connecticut DOT - Bridge Design	Since 10/01/2021	Feedback during advisory and research update meetings
Andy Cardinali, PE		Connecticut DOT - Bridge Design	Since 10/01/2021	Feedback during advisory and research update meetings

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

Table 12: Course List

Course Code	Course Title	Level	University	Professor	Semester	# of Students
CE	CE 3640 Reinforced Concrete Structures	Undergrad	UConn	Kay Wille	Fall 2022	43
CE	CE 2110-020 – Applied Mechanics I	Undergrad	UConn	R. Malla	Fall 2022	98
CE	CE 5010-001 – Seminar in Structures and Applied Mechanics	Graduate	UConn	R. Malla	Fall 2022	18

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…
There are no changes in the research approach in this reporting period.

Planned Activities:

List the activities planned during the next quarter.
In this reporting period, the research has been primarily focused on measurement, investigation, and data analysis of the durability properties of the promising New UHPCs.

In future, emphasis will be placed to continue studying the durability properties of UHPC mixes as well as finalizing the manuscript of the draft based on this research project.