Quarterly Progress Report:

Project Number and Title: Development and Testing of High / Ultra-High Early Strength Concrete for durable Bridge Components and Connections

Research Area: New materials for longevity and constructability

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Reporting Period: 09/30/2019– 12/31/2019

Submission Date: 12/31/2019

Overview: (Please answer each question individually)

*Provide **BRIEF** overview and summary of activities performed during the reporting period. This summary should be written in lay terms for a general audience to understand. This should not be an extensive write up of findings (those are to be included in the final report), but a high-level overview of the activities conducted during the last three months….*

In this reporting period emphasis was placed on the evaluation of the performance of existing ultra-high performance concrete (UHPC) mixtures and the re-evaluation of the next research steps.
Hereby UHPC material, which was donated by two different suppliers, was tested in their workability and compressive strength performance. On Oct 28th 2919 Bijaya Rai and Kay Wille met with Raymond Basar, Mary Baker and Bao Chuong at ConnDOT to discuss the project direction and priorities to enhance the impact of the research towards product development, implementation and application. The lack in cost-efficient fiber reinforcement (produced in the United States) to provide sufficient tensile ductility and post-cracking strength was identified as one current major drawback in the application of UHPC. Another drawback is the lack of a mixture design with locally available materials and the transition of the UHPC technology into the field. Based on this discussion the following two research aims were defined:

1. Testing of fiber reinforcement efficiency while embedded in UHPC
2. Developing a Connecticut UHPC with locally available materials

To pursue aim Nr.1 a single fiber pull-put test setup was design and tested on a few samples. With regards to aim Nr.2 contacts has made with the suppliers for the cement, basalt and fibers.

Provide context as to how these activities are helping achieve the overarching goal(s) of the project…
The overarching goals of the research are developing and testing of high / ultra-high early strength concrete for durable bridge components and connections.
Up to now, the research emphasis had been placed on testing and enhancing the performance of the suggested concrete mixtures in the NETC 13-1 report, repeating the same mixture proportions with locally available materials, as well as other material constituent alternatives.
Emphasizing testing the fiber reinforcement efficiency and the developing of a UHPC with locally available materials as a next step will enhance the application of UHPC and thus significantly impact the sustainability of our infrastructure.

Describe any accomplishments achieved under the project goals…
In this report period emphasis has been placed on developing a single fiber pull out test setup. A few tests have successfully been performed. Contacts to material suppliers for developing a Connecticut UHPC have been made.
A next meeting with ConnDOT is planned to connect with local material concrete suppliers.

Complete the following tables to document the work toward each task and budget (add rows/remove rows as needed)…

Table 1: Task Progress

Task Number	Start Date	End Date	Percent Complete
Task 1: Testing and Investigating Performance of current HES	10/01/2018	12/31/2019	100%
Task 2 /3: Developing the next generation of HES mixture designs (Shifting towards Connecticut UHPC)	08/01/2019	08/31/2021	20%
Task 4: Knowledge transfer and practical application.	12/01/2019	05/31/2021	5%

Table 2: Budget Progress		
Entire Project Budget	**Spend Amount**	**Spend Percentage to Date**

Information in Table 2 is to be determined.

Describe any opportunities for training/professional development that have been provided…
Two undergraduate students, Jeet Rosa and Alex Distelman, continued to support the research activities.

Describe any activities involving the dissemination of research results (be sure to include outputs, outcomes, and the ways in which the outcomes/outputs have had an impact during the reporting period. Please use the tables below for any Publications and Presentations in addition to the description of any other technology transfer efforts that took place during the reporting period.)… Use the tables below to complete information about conferences, workshops, publications, etc. ***List all other outputs, outcomes, and impacts after the tables*** *(i.e. patent applications, technologies, techniques, licenses issued, and/or website addresses used to disseminate research findings).*

None in this reporting period.

Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events				
Title	**Event**	**Type**	**Location**	**Date(s)**

Table 4: Publications and Submitted Papers and Reports				
Type	**Title**	**Citation**	**Date**	**Status**
Abstract	Development and Characterization of High / Ultra High Strength Concrete	Full citation	10/19/2019	Submitted

Encouraged to add figures that may be useful (especially for the website)…

Insert figures here

Participants and Collaborators:

Use the table below to list all individuals who have worked on the project.

Table 5: Active Principal Investigators, faculty, administrators, and Management Team Members			
Individual Name	**Email Address**	**Department**	**Role in Research**
Kay Wille, Ph.D., Associate Professor	Kay.wille@uconn.edu	Civil Engineering	Principal Investigator
Ramesh Malla, Ph.D., F. ASCE, Professor	Ramesh.malla@uconn.edu	Civil Engineering	Co- Principal Investigator

Use the table below to list all students who have participated in the project.

Table 6: Student Participants during the reporting period				
Student Name	**Email Address**	**Class**	**Major**	**Role in research**
Alex Distelman	alex.distelman@uconn.edu	Undergraduate-Junior	Material Science	Undergrad-RA
Jeet Rosa	jeet.rosa@uconn.edu	Undergraduate-Junior	Material Science	Undergrad-RA

Use the table below to list any students who worked on this project and graduated during this reporting period.

Table 7: Student Graduates			
Student Name	**Role in Research**	**Degree**	**Graduation Date**
Bijaya Rai	Leading the research works	Ph.D.	TBD

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

Table 8: Research Project Collaborators during the reporting period						
Organization	**Location**	**Contribution to the Project**				
		Financial Support	**In-Kind Support**	**Facilities**	**Collaborative Research**	**Personnel Exchanges**
Connecticut DOT	Newington, CT	NO	Some Suggestions and indication towards research direction	NO		

List all other outputs, outcomes, and impacts here (i.e. patent applications, technologies, techniques, licenses issued, and/or website addresses used to disseminate research findings). Please be sure to provide detailed information about each item as with the tables above.

Have other collaborators or contacts been involved? If so, who and how? (This would include collaborations with others within the lead or partner universities; especially interdepartmental or interdisciplinary collaborations.

Contact to Steelike® Concrete, Lafarge Holcim and Lehigh Cement has been established and material for research purpose has been delivered free of charge.

Changes:

Discuss any actual or anticipated problems or delays and actions or plans to resolve them…
One mixer broke down and is in the process of getting repaired. Training to operate a high-shear intensity mixer has completed. In addition to that, frequency based resodyne mixer has successfully been used for smaller mixture quantities.

Discuss any changes in approach and the reasons for the change…
As the research progressed, it was found out that the nano silica inclusion in the mixture did not increase the compressive strength, potentially due to nano silica agglomeration in concrete environment. As for the alternative, the research had been advanced to partially replace Portland cement with CSA cement and followed by the addition of accelerating admixture. Moreover, the research had been partly directed to investigate the porosity in the concrete and mortar which is an important parameter for the mechanical and durability performance of the material.
The research has been shifted to identifying local suppliers for developing Ultra High Performance Concrete (UHPC) with local available materials. Contacts have been made with the suppliers for the cement, basalt and fibers.

Planned Activities:

Description of future activities over the coming months.
The research on concrete using different percentage of CSA cement replacement, addition of non-chloride accelerating admixture, investigating porosity, heat of hydration and linking those results with strength gain at 12 hours has been concluded. Now, the research has been shifted to identifying local suppliers for developing of a Connecticut Ultra High Performance Concrete (UHPC).

If applicable the results of the independent research project with Raymond Basar from Conn DOT titled “Ultra-High Performance Concrete for Highway Bridge Parapets” will be further disseminated.

References:

1. ASTM C109 Standard Test Method for Compressive Strength Testing of Hydraulic Cement Mortars Using 2” Cube Specimens