Quarterly Progress Report:
Project Number and Title: 2.13: Performance Structural Concrete Optimized for Cost, Durability and Manufacturability
Research Area: Thrust 2 – New Materials for Longevity and Constructability
PI: Dryver Huston, University of Vermont
Co-PI(s): Ting Tan, University of Vermont
Reporting Period: 1/1/21 – 3/31/21
Submission Date: March 31, 2021

Overview: (Please answer each question individually)

This was the first quarter of the project. The activities addressed planning and initiating the project. These activities included:

1. Met with technical personnel at VTrans (Jim Wild and Nick van den Berg) to plan the project. The overall direction is to formulate and evaluate a prescriptive mix design for perfomance concrete for use in transportation structures. The concrete mix must perform in term of strength, cost and durability, and be readily made of materials largely found in New England. An additional concern is to consider of 'green design' for the mix so that it reduces the life-cycle carbon and environmental footprint of the material.

2. Began a literature review of prescriptive mix designs. Of particular note is the work by Missouri Department of Transportation (MoDOT) in Reports cmr17-007 and cmr 19-004 and methods of using machine learning in concrete mix design.

3. A set of ring shrinkage test equipment was ordered and received by VTrans. This equipment measures the propensity of concrete to shrink and crack according to ASTM C1581. Plans are in progress to transfer this equipment as a long-term loan for testing HP concrete mixes.

4. Communicated with the VTrans concrete suppliers and Northern New England Concrete Association regarding support for the research project. A first request is to obtain samples of the aggregates that they produce and are used in highway structures. These samples will be used in initial tests to down select to promising aggregates for use in the prescriptive performance concrete mixes.

Table 1: Task Progress

Task Number	Start Date	End Date	% Complete
Task 1: Develop and verify laboratory testing procedures	9/1/20	6/1/21	10%
Task 2: Identify and test prototype HPC mix	9/1/20	8/31/21	10%
Task 3: Meet with concrete suppliers	9/1/20	8/31/21	10%
Task 4 Develop plan for pilot test, including partner participation.	10/1/20	8/31/21	
Task 5 Conduct pilot test batch run of HPC at industrial partner's facility	9/1/21	1/31/22	

Task 6 Evaluate performance of HPC prepared at industrial partner's facility	2/1/22	8/31/22	
Task 7 Test large planar structural elements	2/1/22	8/31/22	
Task 8 Reporting	9/1/22	8/31/23	
Overall Project:	9/1/21	8/31/23	5%

Table 2: Budget Progress

Project Budget	Spend – Project to Date	% Project to Date*
$503,744	$13,875.03 – 03/27/21	5.51%

Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events

Title	Event	Type	Location	Date(s)
High Performance Concrete with Post-Tensioning Shrinking Fibers	2020 TIDC Annual Student Poster Contest	Student Poster Contest	TIDC, U Maine	October 2020

Table 4: Publications and Submitted Papers and Reports

Type	Title	Citation	Date	Status
NA				

Participants and Collaborators:

Table 5: Active Principal Investigators, faculty, administrators, and Management Team Members

Individual Name	Email Address	Department	Role in Research
Dryver Huston	dryver.huston@uvm.edu	Mechanical Engineering	PI
Ting Tan	Ting.Tan@uvm.edu	Civil and Environmental Engineering	Co-PI

Table 6: Student Participants during the reporting period

Student Name	Email Address	Class	Major	Role in research
TBD				

Table 7: Student Graduates			
Student Name	**Role in Research**	**Degree**	**Graduation Date**
NA			

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**
VTrans	Montpelier, VT		Ring shrinkage test equipment			

Table 9: Other Collaborators			
Collaborator Name and Title	**Contact Information**	**Organization and Department**	**Contribution to Research**
James Wild	Vermont Agency of Transportation	Materials	Technical Champion
Nick van den Berg	Vermont Agency of Transportation	Materials	Advised planning

Who is the Technical Champion for this project?
Name: James Wild
Title: Concrete Materials Manager
Organization: Vermont Agency of Transportation
Location (City & State): Montpelier, VT
Email Address: Jim.Wild@vermont.gov

Changes:

The project started in January 2021, which is later than originally proposed. The project schedule will have to be shifted accordingly.

The performance specifications for the prescriptive mix will aim to include a 'green design' that takes steps to reduce the carbon footprint and other environmental costs of the concrete, while not adversely affecting the strength, durability and cost.

Planned Activities:

The planned activities in the next quarter are:

1. Recruit graduate student.
2. Acquire aggregate stones from local suppliers. Examine stones for compaction ratios.

3. Continue with literature survey.
4. Set up and evaluate the use of the test equipment on samples of conventional concrete.