

**Quarterly Progress Report:**

**Project Number and Title:** 2.7 High Performance Concrete with Post-Tensioning Shrinking Fibers

**Research Area:** Thrust 3 Use new materials and systems to build longer-lasting bridges and accelerate construction

**PI:** Dryver Huston, University of Vermont

**Co-PI(s):** Ting Tan, University of Vermont

**Reporting Period:** 4/1/21 – 6/30/21

**Submission Date:** June 30, 2021

**Overview:**

For preliminary and learning purposes, beam and cylinder strength testing was conducted. Two concrete cylinders without shrinking fibers were broken and yielded expected stress/strain curves for concrete in compression. For shrinking fiber reinforced beams, unfortunately, test procedures were inappropriate and yielded difficult to interpret results, *Figure 1*.

Freeze/thaw testing procedures are being investigated and developed and will be a primary source of durability assessment for shrinking fiber reinforced beams. Small cylinders are lined up to be cast and tested with freeze thaw procedures as soon as they are finalized.

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

The overarching goal(s) of the project are:

1. Expand the range of tested shrinking fibers beyond the present chitosan and shape memory polymers to include preloaded steel, shape memory alloy (nitinol) and possibly other polymers
2. Test performance in larger laboratory specimens
3. Develop mechanical models to describe and predict enhanced performance due to port-tensioning shrinking fibers

**Accomplishments:**

*The primary accomplishment is to continue to refine the use of shrinking fibers in larger concrete test specimens.*

**Task Progress and Budget:**

<b>Table 1: Task Progress</b>			
<b>Task Number</b>	<b>Start Date</b>	<b>End Date</b>	<b>% Complete</b>
Task 1: Shrinking Fiber Development and Manufacture	6/1/19	12/31/21	70%
Task 2: Laboratory Performance Testing	6/1/19	5/30/21	40%
Task 3: Mechanical Modeling	6/1/19	5/30/21	50%
Overall Project:	6/1/19	5/30/21	55%

<b>Table 2: Budget Progress</b>		
<b>Project Budget</b>	<b>Spend – Project to Date</b>	<b>% Project to Date*</b>
\$220,000	\$192,067.62 – 6/30/21	87.3 %

**Professional Development/Training Opportunities:**

Graduate student Diarmuid Gregory underwent training and certification for American Concrete Institute Field Testing Technician Grade 1 Certification

**Technology Transfer:**

Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events				
Title	Event	Type	Location	Date(s)
Self-Prestressing Concrete with Shrinking Fibers	TIDC Research Showcase presentation	Student presentation scheduled	TIDC, U Maine	April 21, 2021

Table 4: Publications and Submitted Papers and Reports				
Type	Title	Citation	Date	Status
NA				

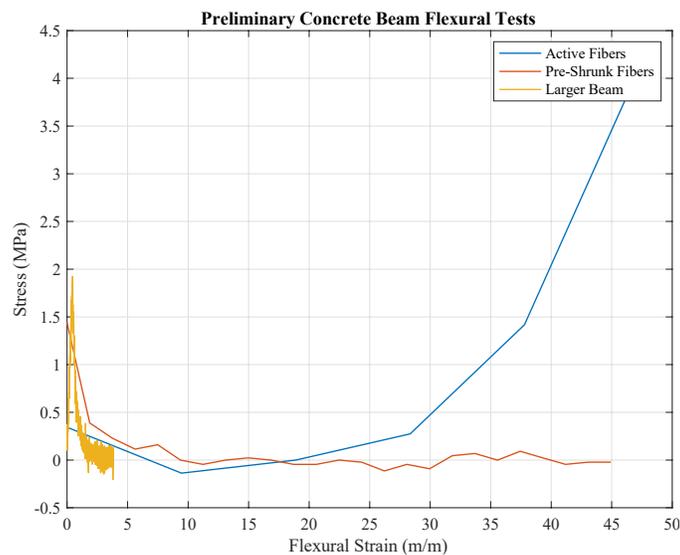


Figure 1 Data from concrete beam flexural tests

**Participants and Collaborators:**

Use the table below to list **all** individuals (compensated or not) 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
Dryver Huston	dryver.huston@uvm.edu	Mechanical Engineering	PI
Ting Tan	Ting.Tan@uvm.edu	Civil and Environmental Engineering	Co-PI

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

**Table 6: Student Participants during the reporting period**

Student Name	Email Address	Class	Major	Role in research
Diarmuid Gregory		M.S./Senior	Mechanical Engineering	Graduate research assistant

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

**Table 7: Students who Graduated During the Reporting Period**

Student Name	Degree	Graduation Date	Employment or continued degree
NA			

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
NA						

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.)

**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

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:**

There are no anticipated changes in the overall technical plan for the research.

**Planned Activities:**

The planned activities in the next quarter are:

1. Scale up production of improved shrinking chitosan fibers.
2. Use shrinking fibers in laboratory tests of performance on small cylinders and more standard sized beams and cylinders. Include freeze-thaw and durability tests into the performance tests as a supplement to strength testing.
3. Based on success with the above steps, interaction with VTrans Technical Champion Jim Wild to formulate a plan on moving the concept of self-prestressing concrete into a more durable high performance material that finds use in transportation structures.