

**Quarterly Progress Report:**

**Project Number and Title:** 3.4 Testing, Monitoring and Analysis of FRP Girder Bridge with Concrete Deck

**Research Area:** Thrust Area 3

**PI:** W. Davids, UMaine

**Co-PI(s):** H. Dagher, UMaine

**Reporting Period:** 10/1/2019 – 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....*

During the reporting period, continued observations of manufacture and construction of the Hampden bridge has continued (Task 1) and additional development and analyses have been made with the 3D finite element model (Task 3). Three of the 5 girders have been manufactured with direct observation of the layup, preparation, infusion, and post-processing made. Additional analyses have been performed to predict the effects of lateral impact loading.

*Provide context as to how these activities are helping achieve the overarching goal(s) of the project...*

Observation of girder manufacture has enabled identification of problems which have arisen. These problems, and their possible solutions, will inform manufacture of future bridges, streamlining the process and increasing the bridge type's acceptance and competitiveness. Additionally, characterization of the bridge's response to lateral impact loading increases overall understanding of its behavior, improving its possible acceptance as a viable design option.

*Describe any accomplishments achieved under the project goals...*

Observations of the manufacturing process have been made and documented, including challenges that have arisen and solutions developed to overcome them. The finite-element model of the bridge has also been further developed, adding to its utility when live-load test data become available.

*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:	9/2019	10/2020	30%
Task 2:	10/2020	10/31/2020	0
Task 3:	9/2019	5/2021	30%

Table 2: Budget Progress		
Entire Project Budget	Spend Amount	Spend Percentage to Date
\$178,374	\$20,743	8.6%

*Describe any opportunities for training/professional development that have been provided...*

The project PI regularly provides input to the AIT engineers on design details and provides feedback on design assumptions and procedures employed by AIT.

*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).

<b>Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events</b>				
<b>Title</b>	<b>Event</b>	<b>Type</b>	<b>Location</b>	<b>Date(s)</b>
“Development and Implementation of a Hybrid FRP-Concrete Girder Bridge”	69 <sup>th</sup> Maine Transportation Conference	Conference Presentation	Augusta, ME	12/5/2019
“Design, Fabrication and Testing of Hybrid Composite-Concrete Bridge Girder System”	2019 International Accelerated Bridge Construction Conference	Conference Presentation	Miami, FL	12/13/2019

<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>
N/A				

No results have been disseminated due to the project’s current scheduling.

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



Fully infused and cured FRP tub-girder

**Participants and Collaborators:**

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

<b>Table 5: Active Principal Investigators, faculty, administrators, and Management Team Members</b>			
<b>Individual Name</b>	<b>Email Address</b>	<b>Department</b>	<b>Role in Research</b>
William Davids	william.davids@maine.edu	Civil and Environmental Engineering	Principal investigator
Habib Dagher	hd@maine.edu	Civil and Environmental 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
Andrew Schanck		Ph.D	Civil Engineering	Manufacture/construction observation, modeling

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
N/A			

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
Advanced Infrastructure Technologies	Brewer, Maine		x	x		x

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.

A patent for the FRP tub-girder bridge system has been applied for and accepted [I do not have any information on this other than that the patent exists]

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.

No other collaborators have been involved [to my knowledge]

### **Changes:**

Discuss any actual or anticipated problems or delays and actions or plans to resolve them...

Uncertainty in scheduling has led to significant delays in girder manufacture over initial estimates. This has required continued activity for Task 1 regarding observation of manufacturing, and diminished emphasis on Task 3 (Task 2 is unable to be started as the bridge has not yet been constructed). However, activity has continued on Task 3 as noted above.

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

No significant changes in approach have occurred.

## **Planned Activities:**

*Description of future activities over the coming months.*

In the coming months, Task 1 (observation of girder manufacture and bridge construction) will continue, focusing on challenges and the methods by which they are overcome. Additionally, continued development and analysis of 3D finite element models of the bridge (Task 3) will continue, and planning for live-load testing (Task 2) will begin. We note that the construction of the bridge was delayed by one year after the initiation of this project, which has delayed progress.