

**Quarterly Progress and Performance Indicators Report:**

**Project Number and Title:** 3.16 CT Bridge Girder Sections with Precast Decks and FRP Girder-Deck Shear Connectors

**Research Area:** Thrust Area 3

**PI:** W. Davids, UMaine

**Co-PI(s):** NA

**Reporting Period:** 6/1/22 – 9/30/22

**Submission Date:** 9/30/22

**\*\*\*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](mailto:tidc@maine.edu).**

**Overview:**

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

All shear connector specimens have either been fatigue and failure tested or disqualified from testing

- Girder specimen composite sections have been fabricated and instrumented internally and one concrete deck section has been cast

**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.*

- Completed shear connector testing showed that the current FRP shear connectors do not have adequate fatigue or strength capacity, and the girder specimens will be fabricated with A325 or equivalent threaded rod
- Internal instrumentation of the test girder will include monitoring of connector tension during load to aid in design of future FRP connectors

**Accomplishments:**

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

- Shear connector tests have provided vital information for moving forward with current and future development of a 100% steel free GBeam girder

**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)...*

Updated progress and milestone dates are given where possible with original dates struck through for clarity. Shear block testing posed many challenges, and the research approach as well as specimen fabrication have been subsequently revised. The length of time required to complete the girder fatigue test cannot be estimated until this test commences, hence some start and end dates are to be determined.

**Table 1: Task Progress**

Task Number: Title	Start Date	End Date	% Complete
Task 1: <i>Specimen Design and Fabrication</i>	11/1/21	2/1/22	100%
Task 2: <i>Shear Connector Testing</i>	11/1/21	2/15/21	100%
Task 3: <i>Girder Strength Testing</i>	<del>2/15/22</del> 11/1/2022	<del>4/15/22</del> 1/31/2023	0%
Task 4: <i>Girder Fatigue Testing</i>	<del>4/15/22</del> 2/1/2022	<del>8/31/22</del> 8/30/2023	0%
Task 5: <i>Reporting</i>	9/1/22	<del>12/31/22</del> TBD	10%
Phase 1 Overall	11/1/21	<del>12/31/22</del> TBD	40%

**Table 2: Milestone Progress**

Milestone #: Description	Corresponding Deliverable	Start Date	End Date
1.1: Shear block fabrication	Deliver specimens to ASCC	NA	12/15/21
1.2: Girder fabrication with PC deck	Deliver specimens to ASCC	NA	<del>3/15/21</del> 9/15/22
2.1: Shear connector fatigue testing	Complete fatigue tests	NA	<del>7/15/21</del> 7/30/22
2.2: Shear connector strength testing	Complete connector strength tests	NA	<del>9/31/22</del> 8/30/22
3.1: Girder 1 strength test	Complete girder 1 strength test	NA	<del>12/31/22</del> 1/31/23
4.1: Girder 2 fatigue test	Complete girder 2 fatigue test	NA	<del>8/31/22</del> TBD
4.2: Girder 2 strength test	Complete girder 2 strength test	NA	<del>10/15/22</del> TBD
5.1: Complete data analysis, final report	Final project report	NA	<del>12/31/22</del> TBD

**Table 3: Budget Progress**

Project Budget	Spend – Project to Date	% Project to Date (include the date)
Enter Phase 1 Full Budget	\$265,057	

**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.)

N/A

- 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? (i.e. The research team held a meeting with MaineDOT to update them on the progress of the research findings and how the findings can be implemented on 3/31/2021. 15 DOT maintenance members were present at the meeting.)

N/A

- 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 8<sup>th</sup> 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.)

N/A

**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:*

<b>Table 4: Presentations at Conferences, Workshops, Seminars, and Other Events</b>					
<b>Type</b>	<b>Title</b>	<b>Citation</b>	<b>Event &amp; Intended Audience</b>	<b>Location</b>	<b>Date(s)</b>
NA					

*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.*

<b>Table 5: Submitted/Accepted Publications, Technical Reports, Theses, Dissertations, Papers, and Reports</b>				
<b>Type</b>	<b>Title</b>	<b>Citation</b>	<b>Date</b>	<b>Status</b>
N/A				

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

- 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 it 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).  
Advanced Infrastructure Technologies has provided in-kind support

*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.*

### **Insert figures here**

*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:*

- N/A

#### **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:*

- N/A

**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:*

- N/A

**Participants and Collaborators:**

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

<b>Table 6: Active Principal Investigators, faculty, administrators, and Management Team Members</b>				
<b>Individual Name &amp; Title</b>	<b>Dates involved</b>	<b>Email Address</b>	<b>Department</b>	<b>Role in Research</b>
W. Davids	11/1/21-present	william.davids@maine.edu	Civil Engineering	PI

*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.***

<b>Table 7: Student Participants during the reporting period</b>								
<b>Student Name</b>	<b>Start Date</b>	<b>End Date</b>	<b>Advisor</b>	<b>Email Address</b>	<b>Level</b>	<b>Major</b>	<b>Funding Source</b>	<b>Role in research</b>
				Email is not included in the external report and is only used for internal purposes.	(i.e. UG, MS, PhD)		(i.e. TIDC, Other university funds, , unpaid intern, etc.	What work are they conducting? Please be descriptive. Student research assistant is not enough info.
Jacob Clark	1/1/22	3/31/22	W. Davids		MS	Civil Engineering	TIDC	Jacob is a coursework MS student and a FT employee of the ASCC, not a thesis student. He conducted the shear block tests.

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			Please list the organization or degree

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			Please list the organization or degree

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
		List the amount	List the amount	Mark with an “x” where appropriate		
AIT Bridges	Brewer, ME	See budget	See budget	X	X	

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
	For internal use only			(i.e. technical champion, technical advisory board, test samples, on-site equipment, data, etc.)
Ken Sweeney		AIT Bridges	11/1/12 - present	Technical champion

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
i.e. CE 123		Grad or undergrad?	Where was the course taught?	Who taught the course?	Enter Spring, Fall, Summer, Winter and the year	How many students were enrolled in the class?
N/A						

**Changes:**

The results of shear connector testing led to the decision not to use FRP shear connectors in the two, full-scale girder specimens to be tested. It has also prompted the use of additional instrumentation on the steel shear connectors to be used instead of FRP. This will allow us to quantify the tensile forces these connectors must carry when the girder is loaded, an in turn inform the design of new FRP connectors to be assessed in the future. An important high-level objective of our GBeam research program remains the development of a steel-free girder system, which will include FRP girder-deck connectors.

**Planned Activities:**

List the activities planned during the next quarter.

- Full-scale fatigue girder specimen will be internally instrumented and the deck cast.
- Full-scale girder strength specimen will be delivered to the ASCC
- One girder specimen will be instrumented
- One girder specimen will be tested to failure