

### **Quarterly Progress and Performance Indicators Report:**

**Project Number and Title:** Project C19.2020: Damage Modeling, Monitoring, and Assessment of Bridge Scour and Water Borne Debris Effects for Enhanced Structural Life

**Research Area: Thrust 1** -Transportation Infrastructure Monitoring & Assessment for Enhanced Life

**PI:** Wei Zhang, Ph.D., P.E., Associate Professor, Department of Civil & Environmental Engineering, University of Connecticut

**Co-PI(s):** Ramesh B. Malla, Ph.D., F. ASCE, F. EMI, Professor, Department of Civil & Environmental Engineering, University of Connecticut; and Nalini Ravishanker, Ph.D., Professor, Department of Statistics, University of Connecticut

**Reporting Period:** Jan. 01, 2022 to Mar. 31, 2022

**Submission Date:** Apr. 24, 2022

### **Overview:**

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

- An updated Phase II proposal was submitted and approved.
- A useful tool to aid DOTs in evaluating the safety and operability of bridges in extreme events will be established
- Collaboration with VTrans and Maine DOT has been maintained.
- A meeting with project technical champions Messrs. Jeff DeGraff of VTrans and Benjamin Foster of Maine DOT, and TIDC senior program manager James Bryce took place on March 4, 2022

### **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.

- Data and feature set from bridges in Vermont and Maine will be extracted to determine the key bridge and environmental parameters
- The research team has obtained the data from VTrans. The research team will conduct statistical analysis to get key parameters of the bridges.
- The research team has been working on waterborne debris dimensions and analysis for the lateral loading modeling for bridges.

### **Accomplishments:**

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

- One paper published in one of the top journals in this field. Ma, X., Zhang, W. (2022) “Dynamic Amplification Effects of Scour and Debris Impacts for Short Span Bridges”, *Engineering Structures*, 252(1), February 2022, 113644 <https://doi.org/10.1016/j.engstruct.2021.113644>

**Task, Milestone, and Budget Progress:**

Complete the following tables to document the work toward each task and budget

<b>Table 1: Task Progress</b>			
<b>Task Number: Title</b>	<b>Start Date</b>	<b>End Date</b>	<b>% Complete</b>
<b><u>PHASE I</u></b>			
Task 1: Literature Review and data collection.	Oct. 20, 2020	Jan. 31, 2021	100%
Task 2: Statistical Analysis	Dec. 1, 2020	Jun. 30, 2021	100%
Task 3: Debris Dimension analysis	Feb. 1, 2020	Sep. 30, 2021	100%
<b><u>PHASE II</u></b>			
Task 1: Data and feature extraction	Mar. 4, 2022	June. 30, 2022	10%
Task 2: Numerical modeling of bridges	July 1, 2022	Dec 31, 2022	0%
Task 3: Fragility analysis	Sep. 1, 2022	Mar. 31, 2023	0%
Task 4: Tool development	Apr. 1, 2023	Oct 31, 2023	0%
Overall Project:	<i>Oct. 20, 2020</i>	<i>Oct. 31, 2023</i>	
Phase 2 Overall	Mar. 3, 2022	Oct. 31, 2023	0%

<b>Table 3: Budget Progress</b>		
<b>Project Budget</b>	<b>Spend – Project to Date</b>	<b>% Project to Date (include the date)</b>
\$400,043	\$100,426	25.10%

**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?  
N/A

2. 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?  
N/A
  
3. 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?  
N/A

**Technology Transfer:**

*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>
N/A	N/A	N/A	N/A	N/A	N/A

*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>
Peer-reviewed journal	Dynamic Amplification Effects of Scour and Debris Impacts for Short Span Bridges	Ma, X., Zhang, W. (2022) “Dynamic Amplification Effects of Scour and Debris Impacts for Short Span Bridges”, <i>Engineering Structures</i> , 252(1), February 2022, 113644 <a href="https://doi.org/10.1016/j.engstruct.2021.113644">https://doi.org/10.1016/j.engstruct.2021.113644</a>	Feb. 2022	Published online.

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

1. 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).  
N/A

*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:*

As we are moving into the new scope of the work, there are no outputs from this project yet.

**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:*

As we are moving into the new scope of the work, there are no outputs from this project yet.

**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. List any outcomes accomplished during this reporting period:*

As we are moving into the new scope of the work, there are no outputs from this project yet.

**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>
Dr. Wei Zhang, Associate Professor	Jan. 1 – Mar. 31, 2022	wzhang@uconn.edu	Civil & Environmental Engineering, University of Connecticut, Storrs	Principal Investigator (PI)
Dr. Ramesh B. Malla, Professor	Jan. 1 – Mar. 31, 2022	Ramesh.Malla@UConn.EDU	Civil & Environmental Engineering, University of Connecticut, Storrs	Co-Principal Investigator (PI)/ TIDC Institutional Lead, UConn
Dr. Nalini Ravishanker	Jan. 1 – Mar. 31, 2022	Ravishanker, Nalini	Statistics, University of Connecticut, Storrs	Co-Principal Investigator (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>
William Hughes	Jan. 1, 2022	Mar. 31, 2022	Wei Zhang		Ph.D.	Civil Engr.	Department of Education	Graduate Assistant
Matthew Wendland	Jan 1, 2022	Mar. 31, 2022	Wei Zhang		Undergraduate	Civil Eng.		undergraduate Assistant

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).

<b>Table 8: Students who Graduated During the Reporting Period</b>			
<b>Student Name</b>	<b>Degree/Certificate Earned</b>	<b>Graduation/Certification Date</b>	<b>Did the student enter the transportation field or continue another degree at your university?</b>
N/A	N/A	N/A	N/A

Use the table below to list any students that participated in Industrial Internships during the reporting period:

<b>Table 9: Industrial Internships</b>			
<b>Student Name</b>	<b>Degree/Certificate Earned</b>	<b>Graduation/Certification Date</b>	<b>Did the student enter the transportation field or continue another degree at your university?</b>
N/A	N/A	N/A	N/A

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.

<b>Table 10: Research Project Collaborators during the reporting period</b>						
<b>Organization</b>	<b>Location</b>	<b>Contribution to the Project</b>				
		<b>Financial Support</b>	<b>In-Kind Support</b>	<b>Facilities</b>	<b>Collaborative Research</b>	<b>Personnel Exchanges</b>
Vermont Agency of Transportation (Contact Person: Jeff DeGraff, P.E.,Hydraulics Project Engineer )	Barre, VT		X			X
Maine Department of Transportations (Contact person: Ben Foster, Deputy Chief Engineer,	Augusta, ME		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.)

<b>Table 11: Other Collaborators</b>				
<b>Collaborator Name and Title</b>	<b>Contact Information</b>	<b>Organization and Department</b>	<b>Date(s) Involved</b>	<b>Contribution to Research</b>
Benjamin Foster, State Bridge & Structures Maintenance Engineer/ Deputy Chief Engineer,		Bureau of Maintenance & Operations, Maine Department of Transportation (Maine DOT),	Technical Champion	Benjamin Foster, State Bridge & Structures Maintenance Engineer/ Deputy Chief Engineer,
Mr. Jeff DeGraff, P.E., Hydraulics Project Engineer		Vermont Agency of Transportation (VTrans)	Technical Champion	Mr. Jeff DeGraff, P.E., Hydraulics Project Engineer

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:

<b>Table 12: Course List</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Level</b>	<b>University</b>	<b>Professor</b>	<b>Semester</b>	<b># of Students</b>
CE 5122-001	Advanced Mechanics of Materials	Grad	Storrs, CT	Prof. R. Malla	Spring 2022	9
CE 4510	Foundation Design	Undergrad	Storrs, CT	W. Zhang	Spring 2022	60

**Changes:**

List any actual or anticipated problems or delays and actions or plans to resolve them (list no-cost extension requests here)...

- The project's Phase II was delayed due to an extensive review of Phase I work and substantial modifications for Phase II objectives as suggested by the Technical Champions. We will follow the new project objectives to finish the project tasks.

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

- The project scope for Phase II is updated with the discussion with technical champions and the project manager.

**Planned Activities:**

List the activities planned during the next quarter.

- The research team will continue to maintain communication with DOTs and industry regarding potential future research topics so that the research will be relevant and of great importance to the DOTs and industry.
- With the new research plan, our team will work closely with our technical champions for waterborne debris analysis to get the tool ready for DOTs.