

Quarterly Progress and Performance Indicators Report:

Project Number and Title: Project 1.13: Structural Integrity, Safety, and Durability of Critical Members and Connections of Old Railroad Bridges under Dynamic Service Loads and Conditions

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

PI: Ramesh B. Malla, Ph.D., F. ASCE, F. EMI, Professor, Department of Civil & Environmental Engineering, University of Connecticut, and **Institutional Lead** for US DOT Region 1 UTC-TIDC Program

Co-PI(s): N/A

Reporting Period: January 01, 2022, to March 31, 2022

Submission Date: March 31, 2022

Date Revised: May 11, 2022

Overview:

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

Research work performed over this reporting period has been aligned with task 1 to task 3 of the proposed task list:

- The research team has conducted literature search and reviewing different documents related to connection failures of existing bridges, such as bridge maintenance reports, papers, and books.
- The team has conducted a verification of the global Finite Element model (FEM) of Devon and Cos Cob bridges, using field test data results and maintenance reports to understand the bridge issues (figure 1).
- The team has developed a preliminary methodology to transfer the FEM output from a global response to a local model, allowing the research team to better understand the local connection issues (figure 3).
- The research team held a meeting with the Technical Champions of the project from CT DOT, Metro North Railroad and Polytec Inc. on March 28th, 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.

- Majority of the bridges in New England are around 100 years old or older, and many received poor ratings during their last inspection. Among these bridges, the Cos Cob Railroad Bridge, CT (built 1904) and the Devon Railroad Bridge, CT (built 1906) have been selected for the study. The bridges were selected based on age and the availability of the global response.
- The global FEM model will be used to extract interest parameters, such as force reaction, acceleration and/or displacement, for local FEM of the critical connections.

Accomplishments:

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

- Identify interest bridges and respective critical connections, such as Devon and cos Cob bridges.
- Establish the methodology to transfer global response to local analysis using FEM.

Task, Milestone, and Budget Progress:

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

Table 1: Task Progress			
Task Number: Title	Start Date	End Date	% Complete
Task 1: Literature search and existing data review	Oct 01, 2021	Feb 01, 2022	30%
Task 2: Global Analysis to Identify critical members and connections	Feb 01, 2022	May 01, 2022	15%
Task 3: Local Analysis to understand the Behavior of critical members and connections	May 01, 2022	Oct 01, 2022	10%
Task 4: Field tests to validate the FE model	Oct 01, 2022	Feb 01, 2023	0%
Task 5: Members and Connection strengthening and anti-wear methods	Feb 01, 2023	May 01, 2023	0%
Task 6: Final Report preparation and submission	May 01, 2023	Sep 30, 2023	0%

Table 2: Milestone Progress			
Milestone #: Description	Corresponding Deliverable	Start Date	End Date
Milestones will closely represent task items listed above	Quarterly and final reports	Will closely follow task dates (See Table 1 above)	Will closely follow task dates (See Table 1 above)

Table 3: Budget Progress		
Project Budget	Spend – Project to Date	% Project to Date (include the date)
<i>Enter Phase 1 Full Budget</i>	<i>Enter Phase 1 Full Spend Amount (Federal + Cost Share)</i>	<i>Enter Phase 1 % Spent</i>
\$356,945.80	\$44,500.00	12.47%

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 interpret the data.)
 - 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? (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.)
 - Virtual meeting held on with March 28th, 2022, at 10:30 AM to 12:00 PM with the CT DOT, Metro-North Railroad Co., and Polytec Inc., provide project update and receive feedback.
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? (i.e. 25 8th 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:

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:

Table 4: Presentations at Conferences, Workshops, Seminars, and Other Events					
Type	Title	Citation	Event & Intended Audience	Location	Date(s)
<i>i.e. Conference, Symposium, DOT/AOT presentation, Seminar, etc.</i>	<i>Presentation Title</i>	<i>Full Citation</i>	<i>Name of event (i.e. TIDC 1st Annual Conference) or who was the presentation given to?</i>		
Presentation	“Graduate Student, life and professional Experience at the”	Celso de Oliveira	Civil Engineering undergrad students (Figure 2)	University of Hartford, West Hartford CT	March 28 th , 2022

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.

Table 5: Submitted/Accepted Publications, Technical Reports, Theses, Dissertations, Papers, and Reports				
Type	Title	Citation	Date	Status
<i>i.e. Peer-reviewed journal, conference paper, book, policy paper, magazine/newspaper article</i>	<i>Publication title</i>	<i>Full citation</i>		<i>i.e. Submitted, accepted, under review (by org. submitted to)</i>
N/A	N/A	N/A	N/A	N/A

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 is 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
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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.

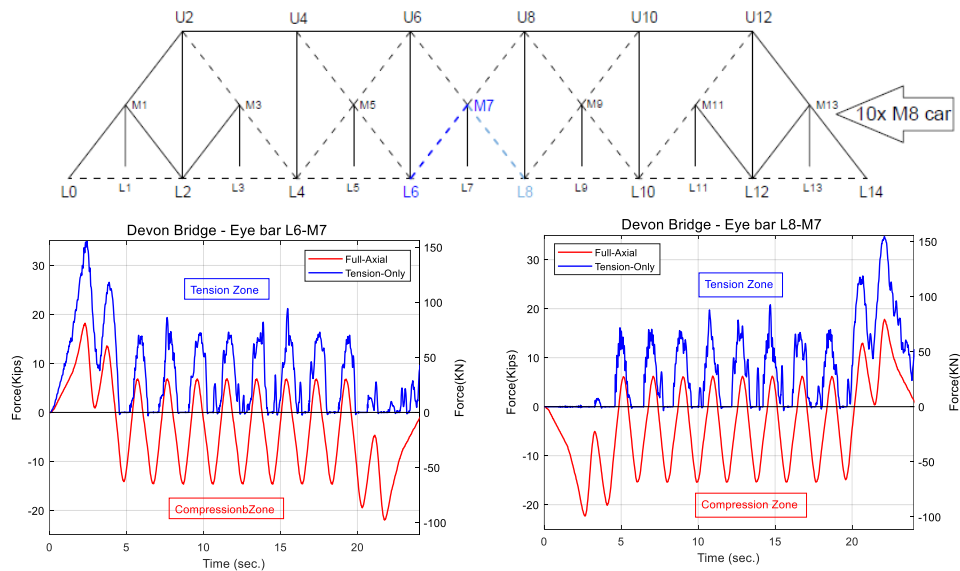


Figure 1 – Devon Bridge (CT) global model results output. Bridge nodes description (upper), Force vs time for eye bar L6-M7 and L8-M7 (lower)



Figure 2 – Presentation for the civil engineering undergrad students at the University of Hartford

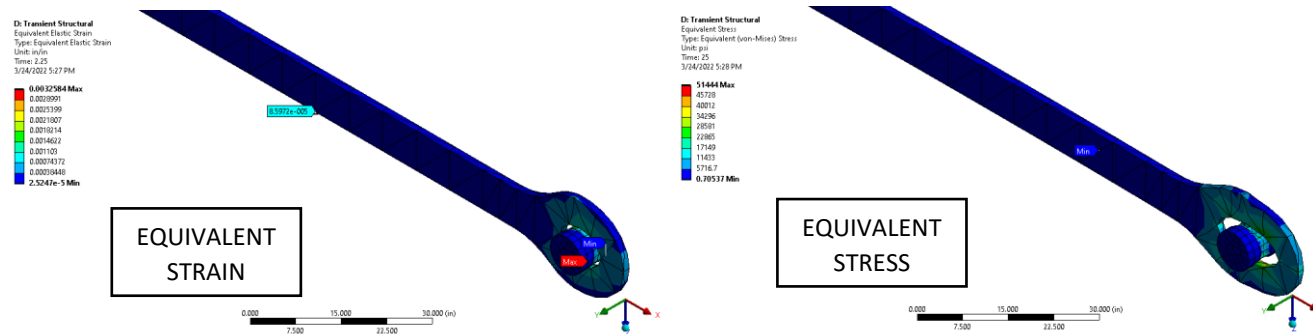


Figure 3 – Local FEM of assembly of eye bar L6-M7, and pin

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:

- Establish procedure to transfer global response to local response on Finite Element Modeling (FEM), this procedure will allow the research team to transfer forces and reaction from a global model to detailed local members and connections models.

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. List any outcomes accomplished during this reporting period:

- N/A, project still on earlier stage.

Participants and Collaborators:

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

Table 6: Active Principal Investigators, faculty, administrators, and Management Team Members				
Individual Name & Title	Dates involved	Email Address	Department	Role in Research
Dr. Ramesh B. Malla, Professor (Principal Investigator)	Jan.-Mar. 2022	Ramesh.Malla@UConn.EDU	Civil & Environmental Engineering, University of Connecticut, Storrs, CT	Principal Investigator (PI)/ TIDC Institutional Lead, UConn

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.**

Table 7: Student Participants during the reporting period								
Student Name	Start Date	End Date	Advisor	Email Address	Level	Major	Funding Source	Role in research
				<i>Email is not included in the external report and is only used for internal purposes.</i>	<i>(i.e. UG, MS, PhD)</i>		<i>(i.e. TIDC, Other university funds, unpaid intern, etc.</i>	<i>What work are they conducting? Please be descriptive. Student research assistant is not enough info.</i>
Celso de Oliveira	Jan. 01, 2022	Mar. 31, 2022	Dr. Ramesh Malla		Ph.D.	Civil Eng.	TIDC/UConn	Literature Search/FEM Modeling
Santosh Dhakal	Jan. 01, 2022	Mar. 31, 2022	Dr. Ramesh Malla		M.S.	Civil Eng.	TIDC/UConn	Literature Search/FEM modeling

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 or if they are continuing their students through an advanced degree.

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?
			Please list the organization or degree
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:

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?
			Please list the organization or degree
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.

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		
Conn DOT	Newington, CT		X	X	X	
Metro-North Railroad Co. Contact persons: Ms. Hong McConnell, Senior Structural Engineer	Bridgeport, CT		X	X	X	
Polytec, Inc.,	Hudson, MA		X	X	X	

Amtrak	Philadelphia, PA					
Genesee & Wyoming Inc.	Indianapolis, IN					

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
	<i>For internal use only</i>			<i>(i.e. technical champion, technical advisory board, test samples, on-site equipment, data, etc.)</i>
Haresh Dholakia, Transportation Engineering Supervisor, Rail Design		Connecticut Department of Transportation (Conn DOT), Newington, CT	Jan.-Mar. 2022	Technical Champion
Manesh Dodia, Supervising Rail Officer, Rail Construction		Connecticut Department of Transportation (Conn DOT), Newington, CT	Jan.-Mar. 2022	Technical Champion
Warren Best, Assistant Deputy Director - Structures		Metro-North Railroad Company, Bridgeport, CT	Jan.-Mar. 2022	Technical Champion
Mario Pineda, Territory Manager		Polytec Inc., Hudson, MA	Jan.-Mar. 2022	Technical Champion
Paul DelSignore, Deputy Chief Engineer – Structures		Amtrak, Philadelphia, PA	Jan.-Mar. 2022	Technical Champion
Chad R. Boutet, Assistant Vice President - Engineering		Indianapolis, IN	Jan.-Mar. 2022	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>i.e. CE 123</i>		<i>Grad or undergrad?</i>	<i>Where was the course taught?</i>	<i>Who taught the course?</i>	<i>Enter Spring, Fall, Summer, Winter and the year</i>	<i>How many students were enrolled in the class?</i>
CE 5122	Advance Mechanics of Material	Grad	Storrs, CT	Prof. R. Malla	Spring 2021	9
CE 3630	Design of Steel Structures	Undergrad / lab class	Storrs, CT	Celso de Oliveira (Teaching Assistant)	Spring 2022	45
CE 4510	Foundation Design	Undergrad	Storrs, CT	Santosh Dhakal (Teaching Assistant)	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) ...

- N/A

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

- N/A

Planned Activities:

List the activities planned during the next quarter.

Research activities planned for next quarter include the following:

- Continue to work on literature search to find more project relevant information.
- Develop a global FEM to mimic the bridges behavior under service load.
- Develop a local FEM to represent the critical connections.
- Prepare logistic for the field testing on selected bridge members, using strain-gauges, accelerometers, and Laser Doppler Vibrometer.