

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: July 01, 2022, to September 30, 2022

Submission Date: October 07, 2022

*****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.

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:

- More refined eye-bar detailed Finite Element model of the Devon Bridge, CT (Figure 1) is developed.
- Static and Dynamic analysis is performed under the service loading of Metro North train to understand the behavior of eye bar.
- Meeting with the Technical Champions of the project and other representatives from CT DOT; Metro-North Railroad; Polytec Inc.; Amtrak, NH DOT; and Genesee & Wyoming on June 27th, August 12th, August 25th, and September 28, 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.

- Eye-bar detailed Finite Element model of the Devon bridge will be used to study the eye bar response under the service loading of Metro North and Amtrak trains.
- Displacement and stress results from different nodes and members after validation from the field test help to identify the critical members and connection.
- Dissemination of research results and get feedback from the meeting with the technical champion.

Accomplishments:

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

- Modeling and analysis of critical members, e.g. eyebars, of truss railroad bridges.
- Addition of one more bridge (Tilton – Belmont Railroad Bridge, NH) for analysis after the meeting with representative from New Hampshire Department of Transportation. Problem is observed in joints for this bridge (Fig. 2).

- Continue to maintain strong collaboration with State DoTs (CT DOT and NH DOT), national and regional railroad management companies and operators (Amtrak and Metro North), device manufacturer (Polytec, Inc.) as well as Class 1 railroad industries, Genesee & Wyoming, Inc. having business nationally and internationally...

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) ...

Table 1: Task Progress			
Task Number: Title	Start Date	End Date	% Complete
Task 1: Literature search and existing data review	Oct 01, 2021	May 01, 2023	60%
Task 2: Global Analysis to Identify critical members and connections	Feb 01, 2022	May 01, 2022	50%
Task 3: Local Analysis to understand the Behavior of critical members and connections	May 01, 2022	Oct 01, 2022	40%
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 closely represent task items listed above	Quarterly and final reports	Milestones start dates follow closely task dates (See Table 1 above)	Milestones end dates follow closely 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>
Will be provided separately	Will be provided separately	Will be provided separately

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.)
 - Meeting held on June 27, 2022 (virtual), with 3 members of the Amtrak’s Structures Maintenance & Inspection department, provide Amtrak’s equipment details and bridge analysis methodology. (This item was missed to report in last quarterly report.)
 - Meeting held on August 12, 2022 (virtual), with the Polytec Inc. application engineer to get feedback on data processing methodology.
 - Meeting held on August 25, 2022 (virtual), with the New Hemisphere Department of Transportation rail engineering division to discuss collaborations and typical bridge issues in the Tilton-Belmont RR Bridge located in between Concord and Woodsville, NH.
 - The research held the quarterly meeting (virtual) with the project Technical Champions and other representatives on September 28, 2022. Total of 8 individuals attended the meeting, besides 4 research team members. Attendees included one from CT DOT, three from Metro-North Railroad Co., three from Amtrak, and one from Genesee & Wyoming Inc.. The meeting served to provide the 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:

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:

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>		
Poster	Field Testing and Finite Element Analysis of Two Old Truss Railroad Bridges	de Oliveira, C., Dhakal, S., Raha, M., and Malla, R. B., "Field Testing and Finite Element Analysis of Two Old Truss Railroad Bridges", 2022 TIDC Annual Conference, Poster Sessions, Orono, ME, August 9-12, 2022	4 th Annual Transportation Infrastructure Durability Conference	Orono, ME	August 9-12, 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 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

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

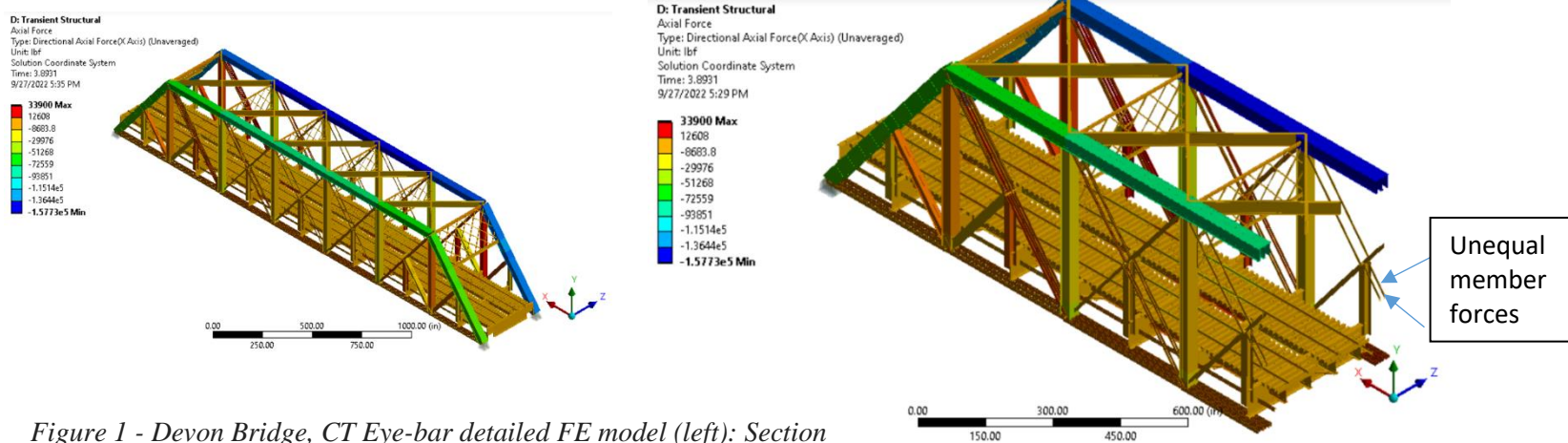


Figure 1 - Devon Bridge, CT Eye-bar detailed FE model (left): Section showing the uneven distribution of the axial force on the Eye-bars during service load (right).



Figure 2. – Tilton Belmont RR Bridge, NH

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, 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)	Jul.-Sep. 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	Jul. 01, 2022	Sep. 30, 2022	Dr. Ramesh Malla		Ph.D.	Structural Engineering/Civil Eng.	U.S. DOT UTC-TIDC & UConn	Literature Search and Review, FEM Modeling (Devon Bridge, CT)
Sachin Tripathi	Aug. 23, 2022	Sep. 30, 2022	Dr. Ramesh Malla		Ph.D.	Structural Engineering /Civil Eng..	U.S. DOT UTC-TIDC & UConn	Literature Search and Review, FEM Modeling (Tilton-Belmont RR Bridge, NH)
Santosh Dhakal	Jul. 01, 2022	Sep. 30, 2022	Dr. Ramesh Malla		M.S.	Structural Engineering /Civil Eng.	U.S. DOT UTC-TIDC & UConn	Literature Search and Review, FEM modeling (Cos Cob Bridge, CT)
Max Raha	Jul. 01, 2022	Aug. 19, 2022	Dr. Ramesh Malla		B.S.	Civil Eng.	U.S. DOT UTC-TIDC & UConn	Literature Search and Review, survey questionnaires and form development for New England DOTs

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?
			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		
Connecticut Department of Transportation (CT DOT) Contact persons: (1) Hareesh Dholakia, P.E., Transportation Engineering Supervisor, Rail Design (<i>Technical Champion</i>)	Newington, CT				X	

(2) Manesh Dodia, P.E., Supervising Rail Officer, Rail Construction <i>(Technical Champion)</i>						
Metro-North Railroad Co. Contact persons: (1) Warren Best-,P.E. Deputy Director- Structures <i>(Technical Champion)</i> (2) Hong McConnell, P.E., Senior Structural Engineer	Bridgeport, CT				X	
Polytec, Inc., Contact Person: Mr. Mario Pineda, Territory Manager <i>(Technical Champion)</i>	Hudson, MA				X	
Amtrak Contact Person: Paul DelSignore,P .E., Deputy Chief Engineer – Structures	Philadelphia, PA				X	
Genesee & Wyoming Inc. Contact Person: Chad R. Boutet, P.E., Assistant Vice President - Engineering	Indianapolis, IN				X	
New Hampshire Department of Transportation (NHDOT) Contact Person: Chuck Corliss, P.E. Railroad Operations Engineer	Concordia, NH				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
	<i>For internal use only</i>			<i>(i.e. technical champion, technical advisory board, test samples, on-site equipment, data, etc.)</i>
Haresh Dholakia, P.E. Transportation Engineering Supervisor, Rail Design		Connecticut Department of Transportation (Conn DOT), Newington, CT	Jul.-Sep. 2022	Technical Champion
Manesh Dodia, P.E., Supervising Rail Officer, Rail Construction		Connecticut Department of Transportation (Conn DOT), Newington, CT	Jul.-Sep. 2022	Technical Champion
Warren Best, P.E. Deputy Director- Structures		Metro-North Railroad Company, Bridgeport, CT	Jul.-Sep. 2022	Technical Champion
Mario Pineda, Territory Manager		Polytec Inc., Hudson, MA	Jul.-Sep. 2022	Technical Champion
Paul DelSignore, P.E., Deputy Chief Engineer – Structures		Amtrak, Philadelphia, PA	Jul.-Sep. 2022	Technical Champion
Chad R. Boutet, P.E., Assistant Vice President - Engineering		Genesee & Wyoming Inc., Indianapolis, IN	Jul.-Sep. 2022	Technical Champion
Chuck Corliss, Railroad Operations Engineer		New Hampshire Department of transportation, Concord, NH	Aug-Sep, 2022	Advice, collaboration and logistic contact, information sharing
McConnell Hong, Sr. Structural Engineer		Metro-North Railroad Company, Bridgeport, CT	Jul.-Sep. 2022	Senior Engineer/Logistic contact

Rene Asuncion, Jr., P.E., Senior Principal Engineer - Structures Maintenance & Inspection		Amtrak, Philadelphia, PA	July- Sept. 2022	Advice and logistic contact, information sharing
David Inman, Senior Engineer, Structures- Movable Bridges		Amtrak, Philadelphia, PA	July- Sept. 2022	Advice and logistic contact, information sharing

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 2110-020	Applied Mechanics I	Undergrad	UConn	Dr. Ramesh B. Malla	Fall 2022	98
CE 5010-001	Seminar in Structures and Applied Mechanics	Grad	UConn	Dr. Ramesh B. Malla	Fall 2022	18
CE 3110-002	Mechanics of Materials	Undergrad	UConn	Sachin Tripathi (Teaching Assistant)	Fall 2022	118
CE 3520-001	Civil Engineering Material Laboratory	Undergrad	UConn	Santosh Dhakal (Teaching Assistant)	Fall 2022	29

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:

- Literature search to find more project relevant information.
- Continue performing analysis on critical members like eye bars using the developed Finite Element (FE) model of Devon RR bridge, CT under the service loading of Metro North and Amtrak trains.
- Develop FE model of gusset plates in Cos Cob Bridge, CT
- Begin work to develop FE model of Tilton – Belmont Railroad Bridge, NH
- Prepare logistics for railroad bridge field testing and if time and weather permit next 3 months, conduct preliminary tests with focus on critical members and connections, and collect data to validate the results from FE model.