

Quarterly Progress and Performance Indicators Report:

Project Number and Title: 3.7 Development of general guidelines related to the effects of factors such as the bridge span range, range of pile length, roadway profile grade, and skew angle range on integral abutment bridges (IABs)

Research Area: Trust 3: New systems for longevity and constructability

PI: Susan Faraji, University of Massachusetts Lowell

Reporting Period: 10/1/2021 - 12/31/2021

Submission Date: 12/30/2021

Overview:

Brief highlights of activities performed during the reporting period.

- Completed the teaching of a new graduate level bridge design course, CIVE.5580, at UMass Lowell with 35 graduate students. I created this course as a result of my ongoing research. It covered the analysis and design of non-skew integral abutment bridges (IABs) according to AASHTO, LRFD Bridge Design Specifications, 9th edition.
- Studied the variation, caused by using different finite element modeling techniques, in the values of forces/moments and the lateral displacements of steel piles at the abutments in non-skew IABs under thermal loading.
- Continued my discussions of the findings of the ongoing research project with the project champion through phone discussions and email exchanges.
- My research assistant, PhD student Harsh Gandhi, ranked second in the 2021 TIDC student poster contest.
- Invited a guest speaker, Anthony Diba, design engineer at AIT Bridges, to give a virtual presentation to my graduate bridge design course, CIVE.5580, on the design and testing of composite bridge systems and on the use of the newest FRP composite girders in recent bridge projects.

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.

- (i) Transfer of technology to graduate students (future and current engineers) on the design of IABs.
- (ii) Progress was made toward the overall goal of this research project.
- (iii) Updated the project champion on the progress of the project.
- (iv) Provided support for one doctoral student.
- (v) Transfer of technology to graduate students (future and current engineers), on the use of new composite material in bridge construction.

Accomplishments:

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

- Technology transfer
- Progress toward refined design guideline for IABs.

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
Year 3: Task 1.1: verifying the findings of the analytical study in Years 1 and 2 of skew IABs. Task 1.2: Guidelines for the finite–element modeling and assessing the impact of modeling techniques on the accuracy of analysis results for skew and non-skew IABs	1/1/2021	3/31/2022	80%
Years 4, 5 and 6:	9/1/2021	9/31/2024	

Task 1. Templates for skewed single span and three span sample IAB Task 2. Templates for non-skewed single span and three span sample IAB Task 3. Verification of the accuracy of finite element modeling analysis results Task 4. Design Guideline Task 5. Presentations and Final Report			15 %
Task 6. Training workshop	7/1/2024	9/30/2024	0%
Phase 1 Overall (Year 3)	1/1/2021	3/31/2022	80 %
Phase 2 Overall (Year 4)	7/1/2021	9/30/2024	10 %
Phase 3 Overall (Years 5 & 6)	7/1/2021	9/30/2024	5 %

Table 2: Milestone Progress

Milestone #: Description	Corresponding Deliverable	Start Date	End Date
#1: Creation of templates for skewed single span and three span sample IABs	Two full 3-D finite-element templates for skewed IABs	9/1/2021	9/1/2022
#2: Creation of templates for non-skew single span and three span IAB	Two full 3-D finite-element templates for non-skewed IABs	9/1/2021	9/1/2022
#3: Verification of the accuracy of finite element modeling analysis results	Parametric study of a sample skewed IAB	9/1/2021	9/1/2023
#4: Design Guideline	Refined design guidelines for the design of girders, the connection of girders to the abutment wall, and the design of HP piles	9/1/2021	9/1/2023
#5: Presentations and Final Report	Power Point presentations to DOTs and the submission of the final report	1/1/2023	6/30/2023

#6: Workshops	Virtual training workshops	7/1/2023	9/30/2024
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Table 3: Budget Progress			
Project Budget #	Spend – Project to Date	% Project to Date (include the date)	
Enter Phase 1 Year 3: \$125,625 (62,500 + 63,125)	Total years 1,2,3= \$86,579 (36,118.76+22,960+27,501)	Years 1 & 2 Year 3	100% 80% (12/31/21)
Enter Phase 2 Year 4: \$125,625 (62,500 + 63,125)	0 %		0 %
Enter Phase 3 Year 5: \$125,625 (62,500 + 63,125) Year 6: \$62,500 (31,250 + 31,250)	0 %		0 %

See the complete up to date budget expenditure provided by UMass below.

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
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.)
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 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)
Presentation by Harsh Gandhi, Research Assistant	The effect of various pile head displacement in the pile design of IAB bridges		TIDC Student *Recognition night - Poster Contest 2021	Virtual	12/1/2021
Presentation by Anthony Diba, Design engineer at AIT bridges	Composite Bridge Systems and the use of the newest FRP composite girders in recent bridge projects		Graduate students in bridge design class at UMass Lowell	Virtual	11/29/2021

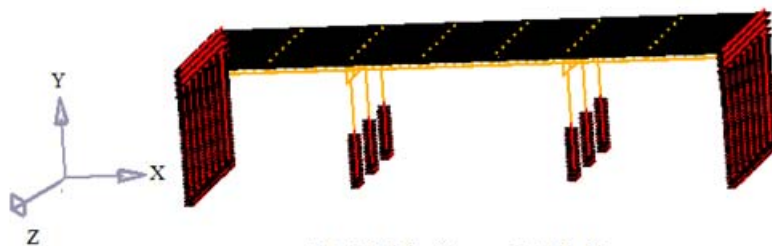
Use the table below to report any publications, technical reports, peer-reviewed articles, newspaper articles referencing your work, graduate papers, dissertations, etc. written as a result of the work you conducted on this project. Please list only completed items and exclude work in progress.

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

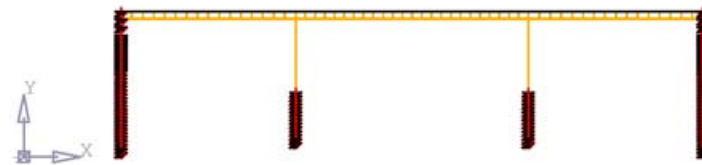
Answer the following questions (N/A if there is nothing to report):

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

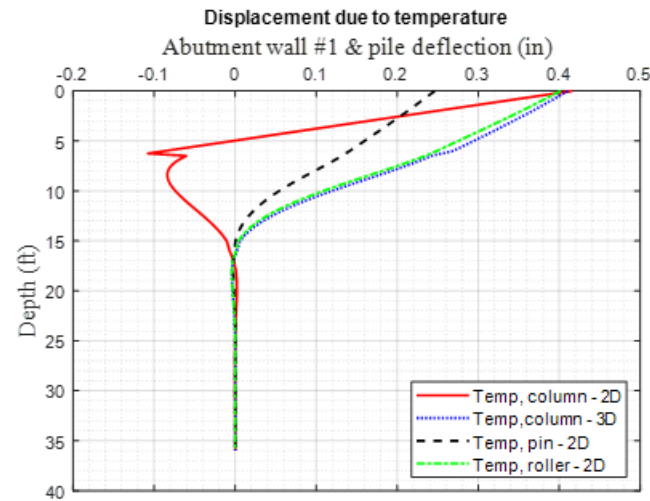
Please add figures/images that can be included on the website and/or in marketing/social media materials to further clarify your research to the general public. This is very important to our Technology Transfer initiatives.



3-D Model of 3-span IAB bridge



2-D Model of 3-span IAB bridge



Describe any additional activities involving the dissemination of research results not listed above under the following headings:

Outputs:

- Listed above

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:

- Creation of a new graduate level bridge design course-IABs, CIVE.5580

Impacts:

- Listed above

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

N/A				
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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
Harsh Gandhi	10/1/2021	12/31/2021	Dr. Susan Faraji		PhD	Civil Engineering	TIDC	Soil modeling and data analysis of finite element 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 (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			

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			

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
Vermont Agency of Transportation	Vermont		*		x	(Design of IABS)
Hexagon PPM/Intergraph Corporation	Alabama		** Educational Grant to University			x (Technical support)
ENSOFTE Inc.	Texas		***			x (Technical support)

* Exchanged ideas and provided material related to the design of IABS.

** Provided technical support on the use of GTSTRUDL software for the research project.

*** Provided technical support on the use of the LIPE and GROUP software for the research project.

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
Technical Champion of the project: Mr. James Lacroix, PE, State Bridge Design Engineer	James.Lacroix@vermont.gov Tel: 802-272-6862	Vermont Agency of Transportation	10/1/2021-12/31/2021	Discussion of progress of the research project and exchange of ideas on design of IABS

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
CIVE.5580	Bridge Design-IABS	Grad	UMass Lowell	S. Faraji	Fall, 2021	35

Changes:

No change

Planned Activities:

- Continue with the parametric study and data analysis of the sample IAB bridges.
- Continue with the documentations and presentations of the outcomes of the ongoing research.
- Continued discussions of the findings of the ongoing research project with the champion of the project through Zoom meetings, phone discussions, and email exchanges.

Up to date detailed budget expenditure-UMass Lowell:

1	UMass Lowell											
2	Cost Share Itemization											
3	Project: SS180000038472											
4	Cost Share Acct: R50190000042821											
5	Dept ID:L610300194											
6	Project Period: 06/05/19-09/30/23											
7		Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Sep-21	Oct-21	Nov-21	TOTAL	
8	CATEGORIES											
9	Salaries - Course Releases											
10	Tzuyang Yu	5,338.00		5,338.00	5,338.00	5,338.00	5,338.00	5,937.77	5,937.77	5,937.77	81,450.75	
11	Zhu Mao			3,985.84	3,985.84	3,985.84	3,985.84				31,569.28	
12	Susan Faraji			6,602.90	6,602.90	6,602.90	6,602.90				36,118.76	
13	Xingwei Wang			6,694.35	6,694.35	6,694.35	6,694.35				54,618.64	
14	Total Course Releases										203,757.43	
15												
16	Fringe	2,104.38		8,898.65	8,898.65	8,898.65	8,898.65	2,419.64	2,419.64	2,419.64	78,891.76	
17												

18	RA Tuition & Fees											
19	Ahmed Al-Zeyadi (SP19 & SP20)											12,931.06
20	A. Sarrafi (FA18 & SP19)											22,749.80
21	Ahmed Al-Zeyadi (FA19) HOLD for Credit											-
22	Andres Biondi Vaccariello (FA19, SP20, FA20, SP21, FA21)	13,439.97		2,859.99	2,193.33	2,193.33	2,193.33	2,873.74	2,873.74	2,873.74	55,279.21	
23	Celso Tadeu Do Cabo (FA19, SP20, FA20, SP21)	13,439.97		2,859.99	2,193.33	2,193.33	2,193.33				46,657.99	
24	Hamed Abshari (FA19 & SP20)										22,960.24	
25	Qixiang Tang (FA19)										701.66	
26	Sanjana Vinayaka (FA19 & SP20)										23,778.04	
27	Jianing Wang (SP20)										11,103.10	
28	Harsh Gandhi (FA20, SP21, FA21)	13,439.97		2,359.99	1,026.66	1,026.66	1,026.66	2,873.74	2,873.74	2,873.74	27,501.16	
29	Rui Wu (FA20, SP21, FA21)	13,439.97		2,859.99	2,193.33	2,193.33	2,193.33	2,873.74	2,873.74	2,873.74	31,501.17	
30	Lidan Cao (FA21)							2,873.74	2,873.74	2,873.74	8,621.22	
31	Aiyad Kadair Alshimaysawee (FA21)								5,747.48	2,623.74	8,371.22	
32	Total Tuition/Fee Waivers										272,155.87	
33												
34	Indirect Costs	4,204.94	-	17,808.65	17,808.65	17,808.65	17,808.65	4,721.94	4,721.94	4,721.94	159,696.77	
35												
36	Total Cost Share	65,407.20	-	60,268.35	56,935.04	56,935.04	56,935.04	24,574.31	30,321.79	27,198.05	714,501.83	