

## **Quarterly Progress 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:** 7/1/2020 - 9/30/2020

**Submission Date:** 9/30/2020

### **Overview:**

The overall objective of this research is to improve the guidelines for the modeling, design, and construction of integral abutment bridges (IABs) by completing the following tasks:

**Task 1:** Literature review and gathering of information

**Task 2:** Improve the guidelines for the modeling, design, and construction of IABs

Based on the input from a number of state DOTs (Mass, Vermont, and Maine), the following tasks have been undertaken:

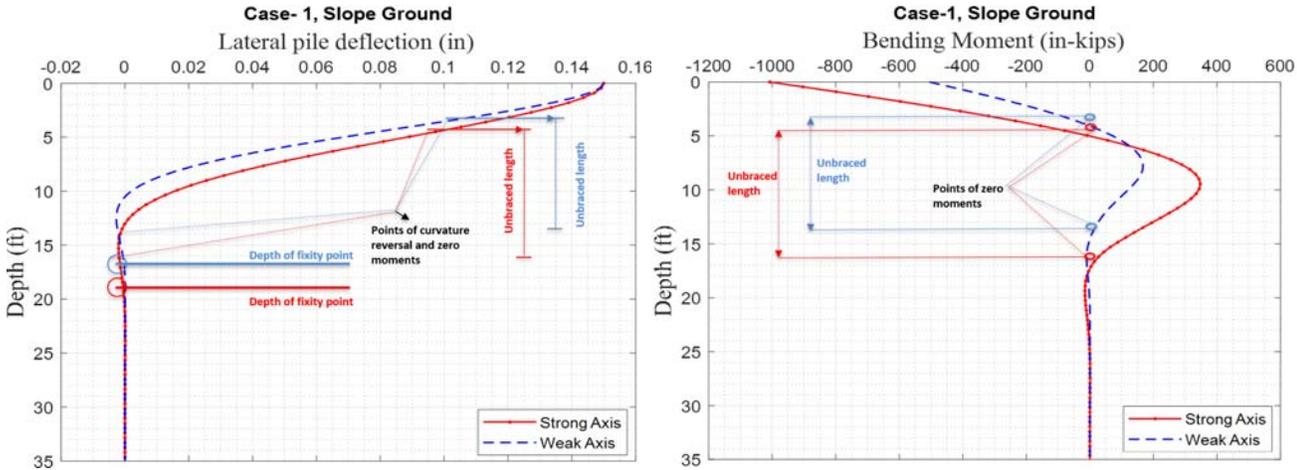
- (a) A study of the effect of the roadway profile grade on substructure;
- (b) A study of the constructability of pile-supported IABs at a site with shallow bedrock;
- (c) A study of the effect of skew angle along with other factors such as bridge span to width ratio, relative stiffness of substructure with respect to superstructure on the distribution of forces between superstructure and substructure;
- (d) Improve the finite–element modeling and analysis of IABs.

**Task 3:** Provide general guidelines in a final report regarding the topics studied.

### **Summary of the activities performed during the reporting period:**

#### **Tasks 2(a) and 2(b):**

- Using the LPILE version 2019 software ( ENSOFT, INC.), an input file template was created to be used to determine the fixity point for a HP pile. The connection between the pile head and the abutment wall was assumed to be fixed. The displacement profiles and moment profiles of the HP pile were created for an axial load combined with the lateral deflection that was calculated based on the thermal expansion of the superstructure.
- The input file template was used to compare the impact of the density of the soil surrounding the pile with that of the orientation of the pile and that of the ground slope grade on the fixity point of the pile.



**Task 2(c):**

- The abstract, ‘The Effect of Different Conditions at the Abutments on the Behavior of Skew Integral Abutment Bridges (IABs) under Thermal Loading,’ was selected for presentation at the August 12, 2020, TIDC Annual Conference.

**Task 3:**

- The preparation of the report on the topics studied during the 1<sup>st</sup> two years of the research project will continue.

All the research done to date falls within the parameters of the tasks listed.

Table 1: Task Progress			
Task Number	Start Date	End Date	% Complete
Task 1:	7/1/2018	12/31/2020	95%
Task 2:	11/1/2019	12/31/2020	80%
Task 3:	11/1/2019	12/31/2020	50%
Overall Project:	1/1/2019	12/31/2020	80%

Table 2: Budget Progress		
Project Budget	Spend – Project to Date	% Project to Date*
\$200,943	\$98,432	80%

**Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events**

<b>Title</b>	<b>Event</b>	<b>Type</b>	<b>Location</b>	<b>Date(s)</b>
Behavior of skewed integral abutment bridges under thermal loading	A Presentation to Maine DOT	Seminar	Virtual	August 3, 2020
The effect of different conditions at the abutments on the behavior of skew integral abutment bridges (IABs) under thermal loading	A Presentation at TIDC Conference	Conference	Virtual	August 12, 2020

**Table 4: Publications and Submitted Papers and Reports**

<b>Type</b>	<b>Title</b>	<b>Citation</b>	<b>Date</b>	<b>Status</b>
*				

\* After the comparison of the analytical research findings with the data from the sample bridges, papers will be submitted to refereed journals.

**Table 5: Active Principal Investigators, faculty, administrators, and Management Team Members**

<b>Individual Name</b>	<b>Email Address</b>	<b>Department</b>	<b>Role in Research</b>
Dr. Susan Faraji, Professor	Susan_Faraji@uml.edu	Civil and Environmental Engineering	Project Principal Investigator

**Table 6: Student Participants during the reporting period**

<b>Student Name</b>	<b>Email Address</b>	<b>Class</b>	<b>Major</b>	<b>Role in research</b>
Harsh Gandhi		Doctoral Candidate	Civil and Environmental Engineering	Computer Modeling and Data Analysis

<b>Student Name</b>	<b>Role in Research</b>	<b>Degree</b>	<b>Graduation Date</b>
Harsh Gandhi *	Use of LPILE Software for Data Analysis	Doctoral Candidate	2023

\* Harsh Gandhi joined the project in September of 2020.

**Table 8: 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 (Bridge design)			X (Technical Champion)
Hexagon PPM/Intergraph Corporation	Alabama		X (Computer software)			X (Technical support)

**Technical Champion for this project:**

Mr. James Lacroix PE  
 State Bridge Design Engineer  
 Vermont Agency of Transportation  
[James.Lacroix@vermont.gov](mailto:James.Lacroix@vermont.gov)  
 802-272-6862

**Changes:**

Hired a new graduate student in September 2020 to work on the project with me; this will speed up the research progress.

**Planned Activities:**

- Virtual presentations to DOTs of the findings of the 1<sup>st</sup> two years of the research.
- Writing the report on the findings of the 1<sup>st</sup> two years of the research.