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: 1/1/2021 - 3/31/2021

Submission Date: 3/31/2021

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

(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.

(a) Modeling techniques to improve the analysis results of finite element models for IAB's;

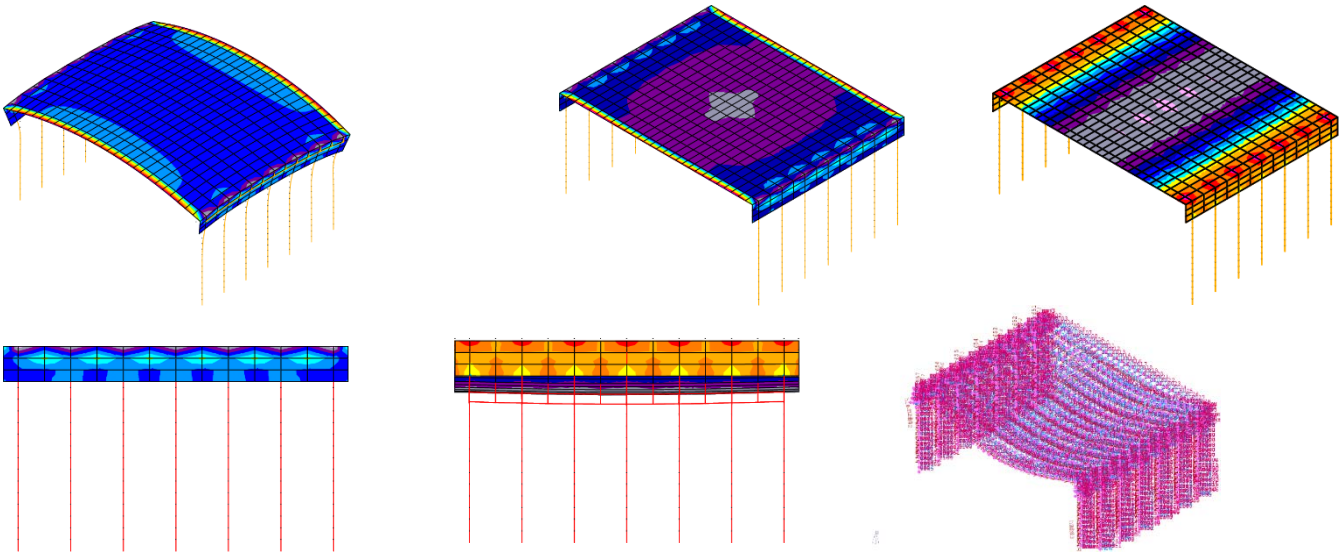
(b) Design guidelines will be provided for design of both superstructure and substructure of selected sample bridges following the latest/current AASHTO LRFD Bridge Design Specifications.

Summary of the activities performed during the reporting period:

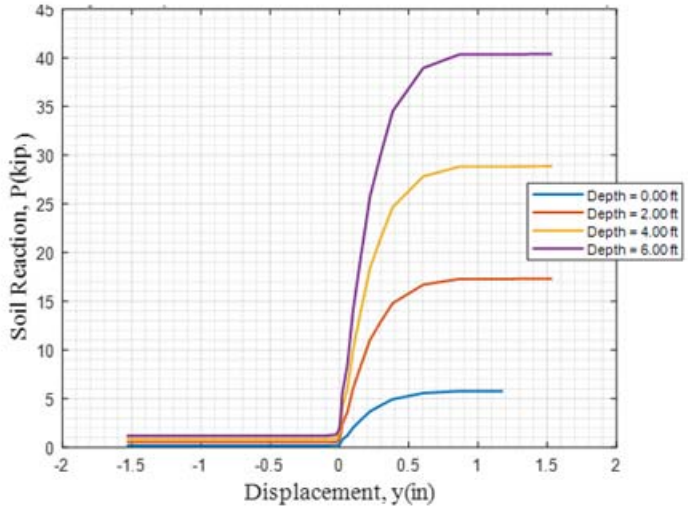
- Development of a new graduate bridge design course for Fall 2021 at UMass Lowell. The course covers the design of integral abutment bridges (IABs), using the latest design code (AASHTO, LRFD Bridge Design Specifications, 9th edition, 2020) and the latest modeling/analysis techniques, integrating the findings of my ongoing research, and discussing the many advantages IABs have over regular bridges.

- Work on the first draft of the final report of the project based on the findings of the 1st two years of research.
- Continued discussions, with feedback and collaboration from Vtrans and Maine DOT, regarding the design of IAB's.

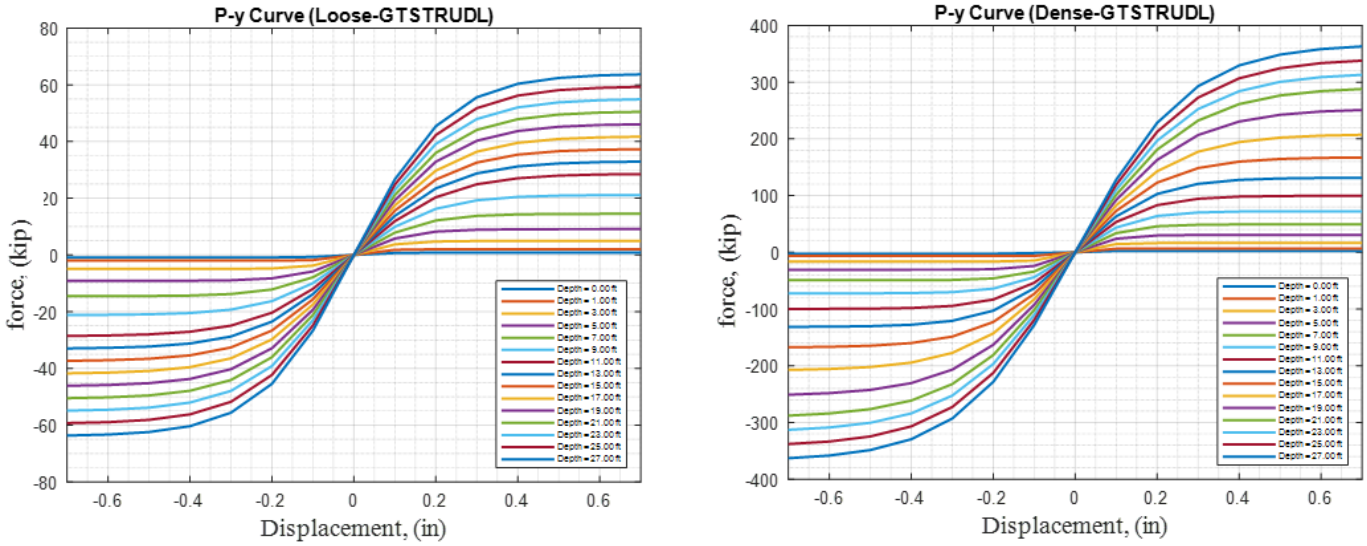
Task 2(d):
Documenting that the way we model (i) the soil behind the back wall and (ii) the soil around the HP piles impacts the bridge's responses, such as the abutment movements, pile forces, abutment/wingwall forces, and girder forces. A few representative samples are shown below.



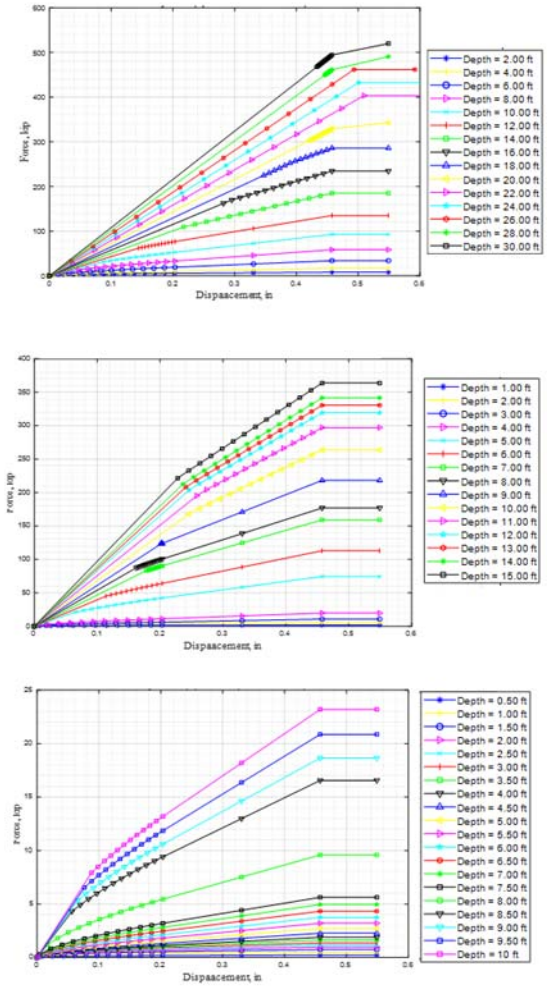
Contours for the sample single span IAB



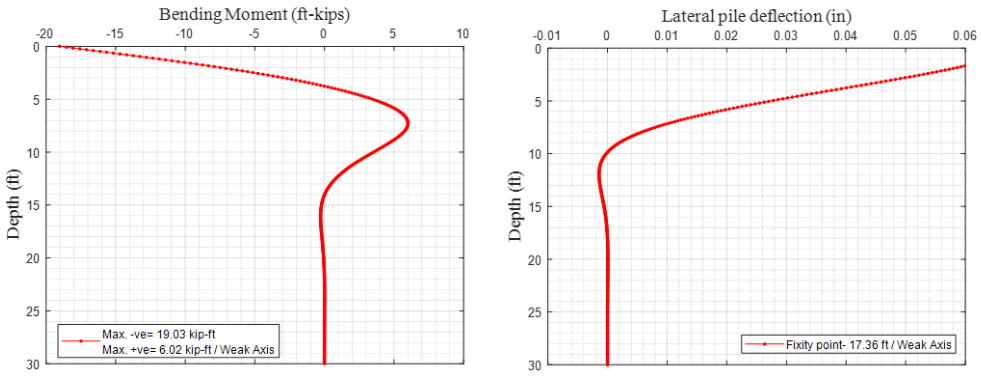
P-y Curves for the backfill of the sample IAB (GT STRUDL software)



P-y Curves for a typical HP pile of the sample IAB (GT STRUDL software)



P-y Curves for a typical HP pile of the sample IAB (LPILE software)



Bending and displacement profiles for a typical HP pile of the sample bridge (PILE software)

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

Table 1(a): Task Progress Years 1-2*			
Task Number	**Start Date**	**End Date**	**% Complete**
Task 1:	7/1/2018	12/31/2020	100%
Task 2:	11/1/2019	12/31/2020	100%
Task 3:	11/1/2019	12/31/2020	90%
Overall Project:	1/1/2019	12/31/2020	90%

*The project's end date has been extended to June 30, 2021, with no cost extension.

Table 1(b): Task Progress Year 3			
Task Number	**Start Date**	**End Date**	**% Complete**
Overall Project:	1/1/2021	12/31/2021	10%

Table 2: Budget Progress Year 3		
Project Budget	**Spend – Project to Date**	**% Project to Date***
$125,625 (62,500 + 63,125)	**0**	0 %

Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events				
Title	**Event**	**Type**	**Location**	**Date(s)**
Integral Abutment Bridge Research	A presentation to the Vermont Agency of Transportation	Webinar	Virtual	February 3, 2021

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

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

Table 6: Student Participants during the reporting period

Student Name	Email Address	Class	Major	Role in research
Harsh Gandhi		Ph.D.	Civil and Environmental Engineering	Use of LPILE software for soil modeling and literature search on instrumentation

* Harsh Gandhi has been ½ RA since 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	x (Technical Champion)
DOT	Maine					x
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

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Changes:
No change

Planned Activities:

- Completion of final report for the first two years of research.
- Continue with presentations and publications based on the outcomes of ongoing research.
- Continue with preparation of the new graduate bridge design course for Fall 2021 offering at UMass
- Comparing the sample bridge's response to different soil modeling techniques.