

**Quarterly Progress Report:**

**Project Number and Title:** 1.1 Field Live Load Testing and Advanced Analysis of Concrete T-Beam Bridges to Extend Service Life

**Research Area:** Thrust Area 1

**PI:** W. Davids, UMaine

**Co-PI(s):** (N/A)

**Reporting Period:** 9/30/19 – 12/31/19

**Submission Date:** 12/31/19

**Overview:**

*Provide **BRIEF** overview and summary of activities performed during the reporting period. This summary should be written in lay terms for a general audience to understand. This should not be an extensive write up of findings (those are to be included in the final report), but a high-level overview of the activities conducted during the last three months....*

During the past reporting period, much effort has been put forward in formulating the final report detailing tasks 2 and 3, as well as outside reporting and dissemination. The report outlines the results and conclusions made from live-load testing skewed T-beam bridges by comparison with similar results from un-skewed bridges (Task 2), and details the formulation and use of a novel finite-element analysis technique for rating analysis of T-beam (and other) bridges. A journal article on this research has been revised and accepted for publication, and a second journal article detailing the results of skewed bridge testing and extension of the nonlinear finite-element technique to other bridge types is in preparation.

*Provide context as to how these activities are helping achieve the overarching goal(s) of the project...*

The report written outlines the observed effects of skewness of concrete T-beam bridges as compared with un-skewed bridges based on field live-load testing and detailed, linear finite-element analysis, and describes the formulation, use, and results of a novel, nonlinear finite-element analysis technique which can be used to more accurately load-rate concrete T-beam bridges (among others). The information from this report will inform the Maine DOT on the actual capacity of concrete T-beam bridges. Of the 10 bridges tested and analyzed in this study, the rating factors for 6 were increased to above one based on test data, and finite-element analysis indicates that the rating factor for two additional bridges can be increased above one. These 6-8 bridges are no longer at risk for posting or closure, and do not require strengthening or replacement.

*Describe any accomplishments achieved under the project goals...*

The report describing the activities, results, and conclusions from Tasks 2 and 3 was written, reviewed, and submitted. One journal article has been accepted for publication, and a second is under development.

*Complete the following tables to document the work toward each task and budget (add rows/remove rows as needed)...*

<b>Table 1: Task Progress</b>			
<b>Task Number</b>	<b>Start Date</b>	<b>End Date</b>	<b>Percent Complete</b>
Task 1:	7/1/2018	8/31/2018	100
Task 2:	9/1/2018	5/31/2019	100
Task 3:	12/1/2018	12/31/2019	100

<b>Table 2: Budget Progress</b>		
<b>Entire Project Budget</b>	<b>Spend Amount</b>	<b>Spend Percentage to Date</b>
\$82,009	\$82,009	100%

Describe any opportunities for training/professional development that have been provided...

No opportunities for training or professional development have arisen as a result of activities during the reporting period.

Describe any activities involving the dissemination of research results (be sure to include outputs, outcomes, and the ways in which the outcomes/outputs have had an impact during the reporting period. Please use the tables below for any Publications and Presentations in addition to the description of any other technology transfer efforts that took place during the reporting period. )... Use the tables below to complete information about conferences, workshops, publications, etc. **List all other outputs, outcomes, and impacts after the tables** (i.e. patent applications, technologies, techniques, licenses issued, and/or website addresses used to disseminate research findings).

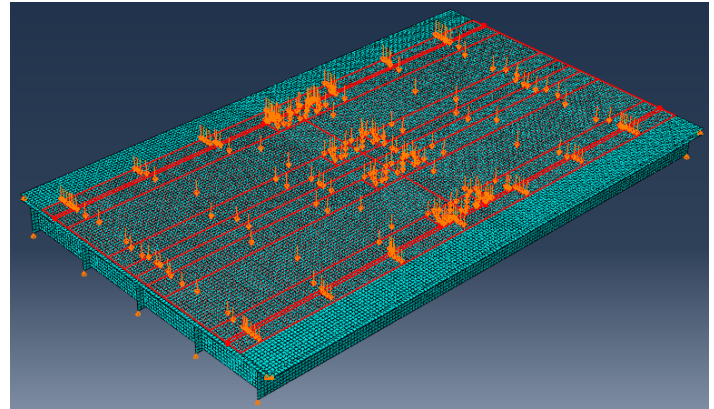
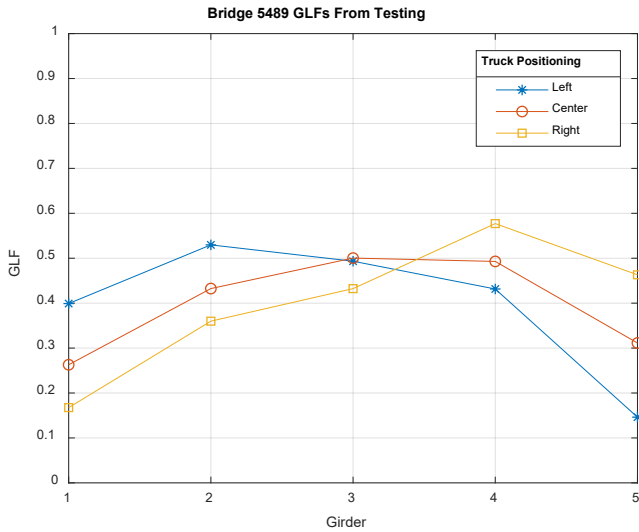
**Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events**

Title	Event	Type	Location	Date(s)
N/A	NA	NA	NA	NA

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

Type	Title	Citation	Date	Status
Report	Investigation of Behavior of Skewed and Un-Skewed Reinforced Concrete T-Beam Bridges and Load Rating Improvement Through Proxy Finite Element Analysis	Schanck, A. (2019). Investigation of Behavior of Skewed and Un-Skewed Reinforced Concrete T-Beam Bridges and Load Rating Improvement Through Proxy Finite Element Analysis. Orono, ME: University of Maine.	12/20/2019	Submitted to MaineDOT
Peer-reviewed journal	Capacity assessment of older concrete t-beam bridges by nonlinear proxy finite-element analysis	Schanck, A. & Davids, W. (2020). Capacity assessment of older t-beam bridges by nonlinear proxy finite-element analysis. <i>Structures</i> , 23 (2020) 267-278.	02/2020 (available online with full citation 12/2019)	Published
Peer-reviewed journal	Load rating of skewed concrete girder bridge superstructures using NDLLT and nonlinear proxy finite element analysis	Schanck, A. & Davids, W. (2020). Load rating of skewed concrete girder bridge superstructures using NDLLT and nonlinear proxy finite element analysis. (In preparation).	NA	In preparation

Encouraged to add figures that may be useful (especially for the website)...



(Left: Load distribution analysis of a skewed T-beam bridge showing non-uniform distribution as loads are shifted transversely; Right: Proxy Finite Element model of an un-skewed T-beam bridge showing finite element mesh and live-loading)

**Participants and Collaborators:**

Use the table below to list all individuals who have worked on the project.

Table 5: Active Principal Investigators, faculty, administrators, and Management Team Members			
Individual Name	Email Address	Department	Role in Research
William Davids	william.davids@maine.edu	Civil and Environmental Engineering	Principal investigator

Use the table below to list all students who have participated in the project.

Table 6: Student Participants during the reporting period				
Student Name	Email Address	Class	Major	Role in research
Andrew Schanck		Ph.D.	Civil Engineering	Testing, modeling

Use the table below to list any students who worked on this project and graduated during this reporting period.

Table 7: Student Graduates			
Student Name	Role in Research	Degree	Graduation Date
Andrew Schanck		MS in Civil Engineering	(May, 2019)

Use the table below to list organizations have been involved as partners on this project and their contribution to the project.

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

Maine Department of Transportation	Augusta, Maine	X	X	X		
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List all other outputs, outcomes, and impacts here (i.e. patent applications, technologies, techniques, licenses issued, and/or website addresses used to disseminate research findings). Please be sure to provide detailed information about each item as with the tables above.

All outputs and outcomes have been previously described.

Have other collaborators or contacts been involved? If so, who and how? (This would include collaborations with others within the lead or partner universities; especially interdepartmental or interdisciplinary collaborations.

No collaborators or contacts have been involved during the reporting period.

**Changes:**

Discuss any actual or anticipated problems or delays and actions or plans to resolve them...

No actual or anticipated problems or delays have arisen.

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

No significant changes in approach have been made.

**Planned Activities:**

Description of future activities over the coming months.

The end of this reporting period represents the end of the project, so no new activities will be performed. Ongoing work will be related to the review/revision process for the second peer-reviewed journal article associated with the project and possible continued development of the novel nonlinear finite element technique. These activities, however, are outside the project scope.