Quarterly Progress Report:
Project Number and Title:
Research Area:
PI: *PI and home institution*
Co-PI(s): *Co-PIs and home institution(s)*
Reporting Period: *Period start and end dates*
Submission Date: *Date*

Overview: (Please answer each question individually)

*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 **no more than 3 bullet points no more than 1 sentence each** ….*

- Carried out weekly meetings with Superior Concrete regarding the design of the bridge pier cap formworks.
- Carried out design sessions with the team to generate suitable initial geometric design of the formwork and potential toolpath for manufacture.
- Developed finite element analysis model for the 3D printed formwork and improved the design of the formwork to reduce the stresses and deformations in the formwork due to hydrostatic loads from fresh concrete.

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

- The design sessions and the FE model helped with Task 2 to define the geometry of the formwork and to ensure that the stresses and deformation in the part were within allowable limits.

Describe any accomplishments achieved under the project goals…

Table 1: Task Progress

Task Number	Start Date	End Date	Percent Complete
Task 1: Review of the state-of the-art	01/01/2019	11/30/2019	100%
Task 2: Optimize forms and tooling for selected precast concrete part	12/01/2019	05/01/2020	80%
Task 3: Select materials and manufacturing process	02/01/2020	07/01/2020	20%
Task 4: Demonstrate the 3D printing tooling for a project	04/01/2020	08/31/2020	0%
Task 5: Recycle and reprint the tooling material	09/01/2020	08/31/2021	0%

Table 2: Budget Progress

Project Budget	Spend – Project to Date	% Project to Date*
$149,912	$76,890	51.3% (3/31/2020)

Include the date the budget is current to.

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

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				

Table 4: Publications and Submitted Papers and Reports				
Type	**Title**	**Citation**	**Date**	**Status**
N/A				

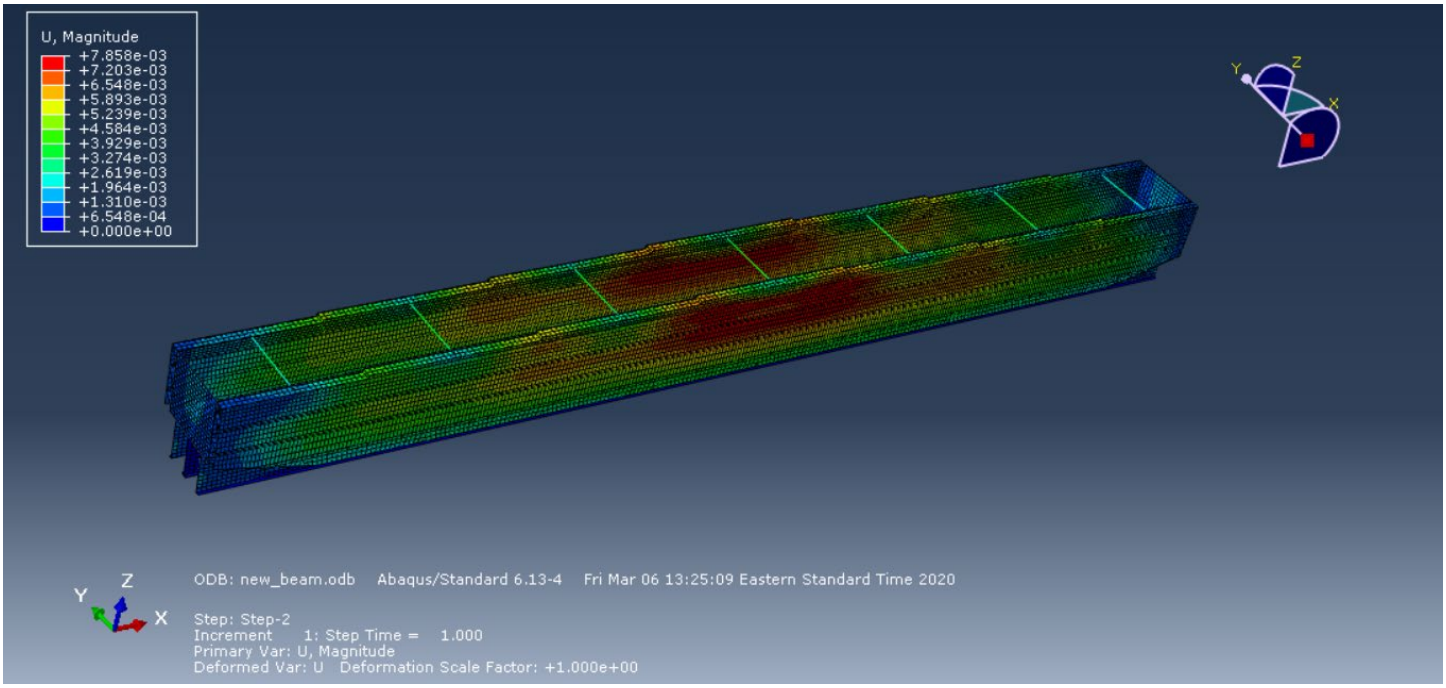

Figure 1: FEA model of the 3D-printed formwork showing deformations due to fresh concrete loads.

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**
Roberto Lopez-Anido	rla@maine.edu	Civil and Environmental Engineering	P.I.
Douglas Gardner	douglasg@maine.edu	School of Forest Resources	Co P.I.
James Anderson	James.m.anderson@maine.edu	Advanced Structures and Composites Center	Co PI
Yooshoo Han	Yooshoo.han@maine.edu	Advanced Structures and Composites Center	Co PI
James Bryce	James.bryce@maine.edu	Advanced Structures and Composites Center	Project Manager

Use the table below to list all students who have participated in the project during the reporting. (This includes all paid, unpaid, intern, independent study, or any other student that participated in this project.)

Table 6: Student Participants during the reporting period

Student Name	Email Address	Class	Major	Role in research
Sunil Bhandari		Ph.D.	Civil Engineering	Design the 3D printed formwork, conduct Finite Element Analysis of stresses and deformations, optimize the formwork.

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**
N/A			

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**
N/A						

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.

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.)

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**
Superior Concrete	Auburn, Maine	x		x	x	
MaineDOT	Augusta, Maine				x	
PCI-NE		x			x	
Oak Ridge National Laboratory (ORNL)	Oak Ridge, Tennessee	x			x	

Who is the Technical Champion for this project?
Name: Rita L. Seraderian
Title: PCI Northeast Chapter Executive Director
Organization: PCI-NE
Location (City & State): Belmont, MA
Email Address: rseraderian@pcine.org

Changes:

The schedule has been affected by disruption of day-to-day laboratory and office work due to the University shutdown in response to COVID-19 health safety precautions.

Remote work will continue for design and analysis of the 3D-printed formwork.

Planned Activities:

We will finalize the design of the formwork and manufacture the formwork for casting a pier cap. Finalizing the design involves changing designed geometry to minimize material usage, selecting the printing toolpath to improve formwork mechanical properties, and numerically validating the design to ensure mechanical performance. Manufacturing the formwork involves 3D printing the formwork, carrying out machining work, and assembling the 3D printed components.