

Quarterly Progress Report:

Project Number and Title: C3. Condition Assessment of Corroded Prestressed Concrete Bridge Girders

Research Area: Thrust #1: Transportation Infrastructure Monitoring and Assessment for Enhanced Life

PI: Tzuyang Yu (UMass Lowell)

Co-PI(s): Susan Faraji (UMass Lowell), Chang Hoon Lee and Moochul Shin (Western New England University or WNEU)

Reporting Period: 07/01/2021 ~ 09/30/2021

Submission Date: 09/30/2021

Overview:

The objective of this project is to assess the condition of corroded prestressed concrete (PC) bridge girders in New England by performing multiphysical field inspection and developing an integrated assessment framework. During the reporting period, our focus is on i) radar data processing at UML for predicting corrosion level in reinforced concrete (RC) cylinders, and ii) experimental data collection at WNEU for calibrating a corrosion model for RC structures. During the period, COVID 19 significantly has disrupted the research activity at both UML and WNEU. While the university re-opened as resuming face-to-face classes on August 31, 2020, the lab activities with students is still significantly limited for holding the social distancing rule.

Under the given condition, the WNEU team is building a corrosion chamber to perform the accelerated corrosion experiment for Task 2, and the corrosion model to calibrate the temperature effect has been simultaneously developed on the basis of the collected data by UML. Figure 1 shows the preliminary resulting ((b), (c), and (d)) current and pH calibrated for the measured temperature (a). The model behind the calibration is based on the physical chemistry, and the postulated activation energy used for the analysis is 60 kJ/mol. Also, Figure 2 shows the corrosion chamber in a work in progress.

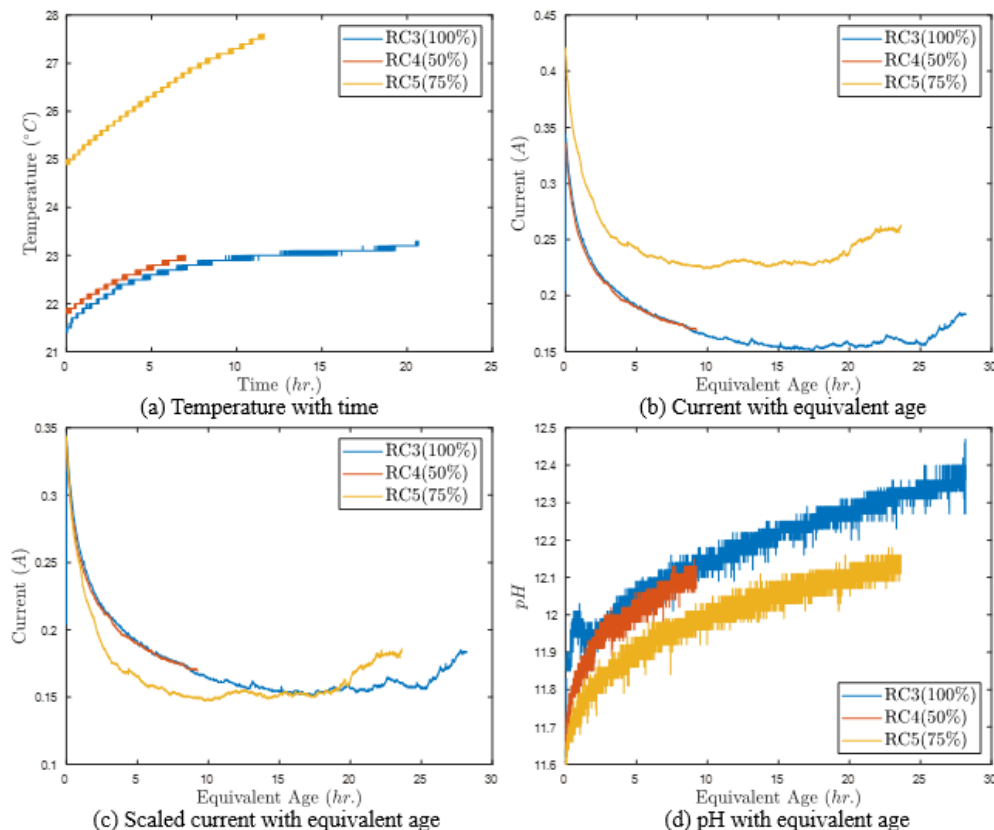


Fig. 1: Comparison of Failure modes expressed by a unified model

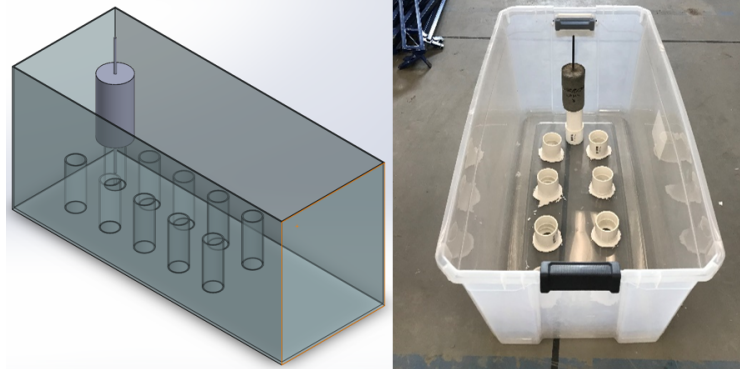


Fig. 2: WNEU corrosion chamber that has been assembled (work-in-progress)

Table 1: Task Progress

Task Number	Start Date	End Date	Percent Complete
Task 1	3/1/19	9/31/19	100%
Task 2	9/1/19	9/31/21	90%
Task 3	10/1/19	9/31/21	70%

Table 2: Budget Progress

Entire Project Budget	Spend Amount	Spend Percentage to Date
\$89,403 (UML)	\$87,373 (UML)	97%
\$85,000 (WNEU)	\$63,052.86(WNEU)	74.2%

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

Title	Event	Type	Location	Date(s)

Table 4: Publications and Submitted Papers and Reports

Type	Title	Citation	Date	Status
Peer-reviewed journal	Interrelation of Morphological Indices and 2-D Generalized Regularity for Coarse Aggregate in Cement-Based Materials	C. H. Lee, S. J. Lee, M. Shin, and S. Bhattacharya, "Interrelation of Morphological Indices and 2-D Generalized Regularity for Coarse Aggregate in Cement-Based Materials," Construction and Building Materials, 2020, 118984	08/10/2020	Published

Participants and Collaborators:

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

Individual Name	Email Address	Department	Role in Research
Tzuyang Yu	Tzuyang_Yu @UML.EDU	Civil and Environmental Engineering	Project principle investigator and Institutional Lead at UML; overseeing

			all projects and working on radar imaging and interpretation
Susan Faraji	Susan_Faraji @UML.EDU	Civil and Environmental Engineering	Structural analysis and design of bridge girders
Chang Hoon Lee	changhoon.lee@wne.edu	Civil & Environmental Engineering	Development of degradation model and design concrete for pull out test specimen.
Moochul Shin	moochul.shin@wne.edu	Civil and Environmental Engineering	Data analysis of the pull-out test results.

Table 6: Student Participants during the reporting period

Student Name	Email Address	Class	Major	Role in research
Aiyad Alshimaysawee		Ph.D.	Civil and Environmental Engineering	Laboratory radar imaging and data processing
Andrew Masullo		Senior	Civil and Environmental Engineering	Construction of a corrosion chamber
Cameron Cox		Senior	Civil and Environmental Engineering	Construction of a corrosion chamber
Nicholas Pantorno		Senior	Civil and Environmental Engineering	Construction of a corrosion chamber

Table 7: Student Graduates

Student Name	Role in Research	Degree	Graduation Date
Ronan Bates	Assisted in corrosion test	Master's degree in Civil Engineering	08/31/2021

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
Massachusetts Department of Transportation (MassDOT)	Boston, Massachusetts				X	X
City of Lowell	Lowell, Massachusetts			X	X	X

LeHigh Cement Company	Glen Falls, NY		X			
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Changes:

Planned Activities:

- The UML team will perform nondestructive inspection of intact and corroded concrete specimens produced by the WNEU team.
- The WNEU team will continue conducting the pull-out test of the corroded tendons by collaboration with the UMass-Lowell team if the laboratory of both institutions will be re-opened.

Task 2: (Meso-to-Macro Level) Development of Macro-Scale Mechanical Damage Model due to corrosion

Task 3. (System Level) Development of capacity reduction model for PC bridges due to corrosion