

NHDOT SPR2 PROGRAM RESEARCH PROGRESS REPORT

Project # 42372M	Report Period Year 2023 <input type="checkbox"/> Q1 (Jan-Mar) <input type="checkbox"/> Q2 (Apr-Jun) <input type="checkbox"/> Q3 (Jul-Sep) <input checked="" type="checkbox"/> Q4 (Oct-Dec)	
Project Title: Reduce Concrete Cracking through Mix Design		
Project Investigator: Eshan Dave, University of New Hampshire Phone: 603-862-5268 E-mail: eshan.dave@unh.edu		
Project Start Date: 4/12/2023	Project End Date: 12/31/2025	Project schedule status: <input type="checkbox"/> On schedule <input type="checkbox"/> Ahead of schedule <input checked="" type="checkbox"/> Behind schedule

Brief Project Description:

Concrete cracking affects the long-term condition and performance of both bridge and culvert structures. Shrinkage cracking is perceived to be a deterrent to placing exposed decks/slabs during bridge and culvert rehabilitation and replacement projects. Concrete cracking during bridge construction allows oxygen, moisture and salts into the structure accelerating corrosion and deterioration. Understanding methods to avoid cracking at the mix design level will allow exposed decks to be more often considered as a viable option. This is especially critical as more rapid bridge projects are proposed.

Different construction and specification methods have been previously explored to reduce concrete cracking at bridge curb locations. This research will explore alternates to current mix design practice including lightweight concrete, changes to PCC and pozzolan content, etc., to reduce concrete cracking. Stand alone, off structure concrete placement like sidewalks, concrete slabs, etc., could be used as test areas for observation. The Bureau of Bridge Maintenance will work with the researchers at those locations as well as considering placement in bureau projects.

Progress this Quarter (include meetings, installations, equipment purchases, significant progress, etc.):

During the reporting quarter, the research team focused their efforts on expanding the literature relevant to the study objectives as well as conducting a critical review of the literature that was gathered in the previous calendar quarter. The primary focus of review during the previous quarter was on techniques to lower cracking potential, primarily through changes to the concrete mix designs. During the reporting quarter the focus was expanded to include changes to structural designs, reinforcement details as well as on various computational techniques that can be adopted to conduct analysis that can predict the early age shrinkage in the decks. Below is an incomplete list of some of the resources that have been gathered and reviewed in the reporting quarter:

Chen, Huating; Li, Dewang; Zhu, Xiufu; Zhang, Wenxue. Short-term shrinkage stress in deck concrete of rail-cum-road truss bridge. Case Studies in Construction Materials, Volume 19, Issue 0, 2023, e02252

Deck Reinforcement Detailing and Concrete Mix Additives to Reduce Bridge Deck Cracking. [Ongoing Project]. Minnesota Department of Transportation, Local Road Research Board. Start date: 31 Jul. 2023.

Zhu, Jinsong; Wang, Cong; Yang, Yibo; Wang, Yanlei. Hygro-thermal-mechanical coupling analysis for early shrinkage of cast in situ concrete slabs of composite beams: Theory and experiment. Construction and Building Materials, Volume 372, Issue 0, 2023, 130774

Jeon, Sungil; Hossain, Mohammad Shakhawat; Han, Seungyeon; Choi, Pangil; Yun, Kyong-Ku. Self-Healing Characteristics of Cement Concrete containing Expansive Agent. Case Studies in Construction Materials, Volume 17, Issue 0, 2022, e01609

Tanner, Jennifer; Buenfil, Shamel Perez. Evaluation of Concrete Bridge Deck Mixtures Using Shrinkage-Ring Tests.

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University of Wyoming, Laramie; University of Wyoming, Laramie; Mountain-Plains Consortium; Office of the Assistant Secretary for Research and Technology, 2022, 34p

TRC2203 - Low-Shrinkage Concrete Mixtures for Arkansas. [Ongoing Project]. Federal Highway Administration, Arkansas Department of Transportation. Start date: 28 Mar. 2022.

Khajehdehi, Rouzbeh; Darwin, David; Feng, Muzai. Dominant Role of Cement Paste Content on Bridge Deck Cracking. Journal of Bridge Engineering, Volume 26, Issue 7, 2021, 04021037

Items needed from NHDOT (i.e., Concurrence, Sub-contract, Assignments, Samples, Testing, etc...):

During project kick-off meeting, the research team has requested following information from the project TAG:

- List of potential bridge maintenance construction projects for Fall and Winter for 2023 as well as Spring and Summer of 2024.
- List of bridge curb and deck replacement projects undertaken by bureau of bridge maintenance from last three years.
- Laboratory testing data (QC as well as mix design approval data) for NHDOT class A and AA concrete used on recent bridge maintenance curb and decks.
- Mix batching slips from bridge curb and deck replacement projects from last three years (when available).

The above information is essential; for research team to initiate the Task 2 activities of developing an experimental plan.

Anticipated research next three (3) months:

During the first part of the upcoming quarter, the research team will synthesize the review of literature into a brief report. Further, a presentation will also be prepared to summarize the key findings from the literature review. The literature review will aid in development of a texting plan for use in Task-2 of the study. Research team is also expecting various data and information from NHDOT, this will be documented in the Task-1 deliverable, and it will aid in finalizing experimental plan for Task-2.

Circumstances affecting project:

There is a delay in the Task 1 of the project and a minor delay in Task 2. The majority of it is associated with delay in arrival of the graduate student that was recruited to work on this effort. The graduate student was unable to arrive until the time of writing of this report. The project PI is now recruiting a different graduate student (already present at UNH) for working on this research study., Further there is also delay due to receipt of information and data from NHDOT. While tasks 1 and 2 are delayed, we do not expect an overall delay in project end date or timeline for other tasks.

Tasks (from Work Plan)	Planned % Complete	Actual % Complete
Task 1 Literature and Current Practice Review	100	75
Task 2 Mix Design and Lab Evaluation	15	0
Task 3 Survey of Study Sites for Cracking Performance	0	0
Task 4 Analysis of Results and Recommendation Development	0	0
Task-5 Final Report and Poster	0	0

Barriers or constraints to implementing research results

Nothing to report.