

Executive Summary and Research Readiness Level Assessment

Application of Internal Curing to Improve Concrete Bridge Deck

Research Benefits

Internal curing has been found to greatly reduce the chance of early age cracking as well as concrete deterioration. In addition, the success of internal curing could reduce the current required extensive wet curing period, which is expensive and difficult to enforce and monitor. Even though internal curing could lead to an increase in materials cost to some extents due to the use of LWFA, there is a great potential to save life cycle costs by extending service life and shortening external curing.

This research provided NDOT with a cost-effective practice for internal curing, allowing NDOT to apply the internal curing concept in various concrete projects, particularly for bridge deck construction, which will bring significant benefits to both short-term and long-term performance of concrete structures.

Background

Due to the relatively high cement content and low water-to-cement ratio (w/c) used, bridge deck concrete is more prone to early age cracking. Bridge deck cracking and deterioration coupled with the application of deicing chemicals during winter operations have been a primary concern. Nebraska Department of Transportation (NDOT) has employed mitigating reactionary strategies such as crack sealing and overlay to address early age deck cracking. However, these strategies are costly and have impacts on traffic operations. NDOT would clearly benefit if concrete decks are free from premature cracking associated with initial construction.

Research Objectives

The overall goal of this study was to identify a cost-effective practice for internal curing of bridge deck concrete for NDOT.

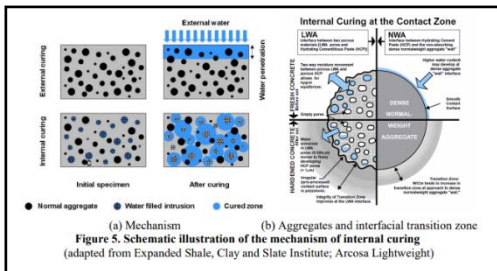
To achieve the goal, three specific objectives of this study were to:

- Summarize the best practice of internal curing concrete for bridge deck application through an extensive literature review and survey;
- Determine appropriate source and addition rate of LWFA for internal curing of Nebraska concrete bridge decks; and
- Evaluate the technical feasibility and benefits of internal curing for Nebraska bridge deck construction.

Conclusion

The research study demonstrated that it was possible to develop a local internally cured concrete mix that was both technical and economically feasible. Even though the replacement of fine aggregates by LWFAs results in decreases of 28-day modulus of elasticity, and modulus of rupture, the overall mechanical properties still meet bridge deck criteria. As the curing age decreases, internally cured mixes were found to be less affected owing to the curing water from within the concrete matrix provided by the saturated LWFAs, which demonstrated that internal curing could potentially decrease the required amount of curing period in the field.

The developed internally curing mixes were also found to have comparable chloride penetrability compared to the control mix and were also categorized as either very low or low chloride ion penetrability based on lab study.



Mechanism of Internal Curing

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Interested in finding out more?

Final report is available at:
[NDOT Research Website](#)

NDOT Recommendations Based Off of Research Project

After some discussion with the Bridge Division, the Department will be looking for a project to try the internal curing on. The goal will be to cut back on the number of days of wet curing in the field from 10 days to 7 days. Further discussion is required on what additional testing NDOT Materials & Research will perform during the placement the internal curing.

NDOT will not move forward with the permanent implementation of the internal curing until a bridge deck is installed and it is successful. Bridge Division is looking for a feasible bridge location to implement the internal curing for 2021 Construction season.

- *As provided by Fouad Jaber and Wally Heyen, Lead TAC Members*

Research Readiness Level (RRL) Assessment

Level 3: Development – Field Level

Research/Technology developed in an operational environment (real-world situation).

RRL 3

**This brief summarizes Project SPR-P1 (19) M083
“Application of Internal Curing to Improve Concrete Bridge Deck”
Nebraska Department of Transportation Research Program**