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Enhancing Performance with Internally Cured Concrete: Case Studies

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Concrete structures, especially bridge decks, are crucial components of transportation infrastructure, yet they often suffer from early-age cracking, which significantly shortens their lifespan and increases maintenance costs. To combat this challenge, the Enhancing Performance with Internally Cured Concrete (EPIC²) initiative has been leading the way in improving the durability of concrete. By incorporating a method called internal curing, which uses pre-wetted lightweight aggregates to supply moisture from within the concrete itself, this innovation helps reduce shrinkage cracking and extends the service life of concrete structures.

Piloted by transportation agencies across 14 states, including New York, Indiana, Louisiana, North Carolina, and Utah, the EPIC² initiative has shown promising results, including up to a two-thirds reduction in cracking and a potential increase in the lifespan of bridge decks by more than 75 years. With the promising results of initial research and testing, several transportation agencies across the United States have implemented pilot projects to test the effectiveness of internally cured concrete (ICC) in real-world conditions. These pilot projects have been crucial in showcasing the tangible benefits of ICC, from reducing early-age cracking to extending the lifespan of bridge decks. Agencies have piloted ICC in a variety of infrastructure projects, such as bridge decks, overlays, and repairs. Each project has contributed valuable insights into the performance of ICC under different environmental conditions.



Figure 1. Internally cured concrete being used for concrete pavement patching Source: CP Tech Center

Pilot Projects

Indiana: Bridge Decks with Internally Cured High-Performance Concrete (IC HPC)

In 2013, the Indiana Department of Transportation (INDOT) constructed four bridge decks using internally cured high-performance concrete (IC HPC). This initiative was based on findings from the FHWA/IN/JTRP-2010/10 report, which identified internal curing as a promising method for reducing shrinkage cracking. The performance of these IC HPC decks was compared to traditional high-performance concrete (HPC) decks that did not incorporate internal curing. Results showed that IC HPC could reduce early-age shrinkage by over 80%, significantly improving the durability of the bridge decks and extending their service life by up to three times compared to standard HPC.



Figure 2. Internally cured bridge deck being placed in 2013 on US 150 over Lost River in Orange County, Indiana. Source: Barrett, T. J., Miller, A. E., & Weiss, W. J. (2015).



Figure 3. Internally cured bridge deck placed in Louisiana. Source: LTRC & LDOT

North Carolina: NC 55 Alston Avenue Bridge

In North Carolina, the NC 55 Alston Avenue Bridge over the Durham Freeway incorporated ICC as part of an NCDOT study aimed at reducing early-age cracking. The bridge utilized a mix of pre-wetted lightweight aggregates to improve the performance of the concrete. Despite some initial cracking, the project demonstrated that ICC could successfully extend the lifespan of the structure and reduce long-term maintenance needs, offering a cost-effective solution for future NCDOT projects.

Louisiana: West Congress Street and US 80 at Ada Bridges

Louisiana has also embraced ICC in its transportation infrastructure, with successful pilot projects such as the West Congress Street Bridge and US 80 at Ada. These projects tested the application of ICC in bridge decks, using pre-wetted lightweight aggregates to reduce shrinkage and cracking. The results showed significant improvements in resistivity and a reduction in early-age cracking, demonstrating ICC's potential to enhance the durability of bridges in Louisiana's challenging climate.



Figure 4. Two-span steel multi-girder bridge located at Durham, North Carolina. Source: NCDOT

Puerto Rico: Exploring Internally Cured Concrete

In Puerto Rico, efforts are also underway to explore the potential benefits of internally cured concrete. As part of these efforts, both the concrete industry and the University of Puerto Rico at Mayagüez (UPRM) have received samples of one of the materials used for internal curing: a lightweight aggregate. This material is being studied to better understand its handling and integration into local concrete mixtures. The goal is to familiarize stakeholders with this material and assess its compatibility for use in the construction of infrastructure in Puerto Rico. This initiative represents one of the ongoing efforts in Puerto Rico to enhance the durability and sustainability of the island's infrastructure, and it is expected that the insights gained from these tests could inform future projects and lead to broader adoption of ICC in the region.

The success of the pilot projects previously mentioned, has spurred interest in implementing internally cured concrete across the United States, with many state departments of transportation (DOTs) now considering it for future infrastructure projects. The demonstrated benefits of ICC—such as reduced shrinkage cracking, extended service life, and cost savings from fewer repairs—make it an appealing option for enhancing the durability of concrete structures, especially in regions with extreme environmental conditions. The EPIC² initiative is proving to be a game-changer for creating more sustainable, long-lasting transportation infrastructure.

Moreover, the adoption of ICC is expected to lead to cost savings over time. By reducing the need for frequent rehabilitation or replacement, ICC has the potential to lower life-cycle costs for infrastructure projects. The ability to extend the lifespan of bridge decks and other concrete structures also provides long-term value for taxpayers and reduces the overall environmental impact of concrete production.

While the pilot projects have shown great promise, the implementation of ICC is not without its challenges. One of the key considerations is the need for careful mix design and the selection of appropriate pre-wetted lightweight aggregates. Additionally, as agencies begin to adopt ICC on a larger scale, training and knowledge-sharing across departments will be crucial to ensure that the proper methods and specifications are followed. Agencies are refining their approaches and developing more robust specifications for future use.

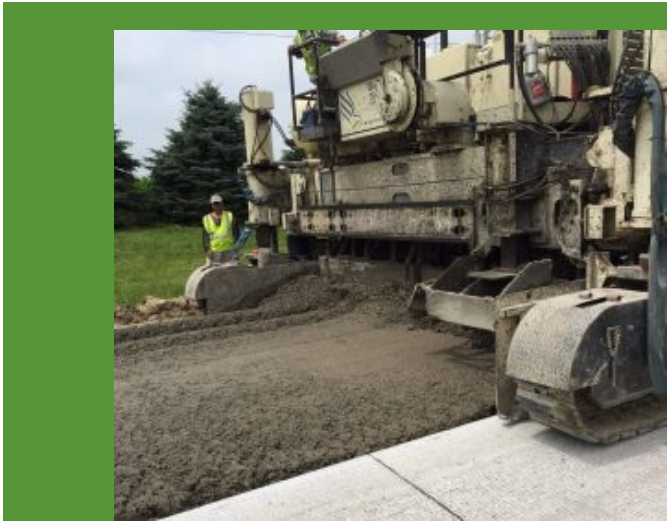


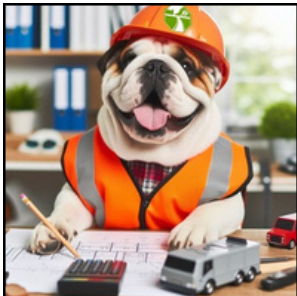
Figure 5. Example of internally cured concrete being poured for concrete pavement patching. Source: CP Tech Center

The future of internally cured concrete looks promising, as the growing body of evidence from pilot projects continues to build momentum. The success of EPIC² projects in various states has set the stage for broader implementation of ICC, not only in bridge decks but also in paving, overlays, and even repair projects. Agencies are increasingly recognizing the value of ICC for improving the durability and sustainability of concrete infrastructure.

As more state and local agencies adopt ICC, the practice is expected to become a standard in high-performance concrete applications. Continued research and development will focus on optimizing mix designs, improving material availability, and refining construction practices to ensure even greater performance. Additionally, the environmental benefits of ICC, such as reducing embodied carbon by enabling the use of recycled materials, will likely play an important role in future infrastructure projects as sustainability continues to be a key focus. ICC will continue to shape the future of concrete construction, providing long-lasting, resilient infrastructure for generations to come.

The Puerto Rico Transportation Technology Transfer Center works with ACT and FHWA in the development of EDC-7 initiatives in Puerto Rico.

For more information on the advancements of the EDC-7 EPIC² initiative in Puerto Rico, visit the website of the [Puerto Rico Transportation Technology Transfer Center](#) (or use the QR code below). You can also receive our latest news by following us on our social media platforms: Facebook, LinkedIn or Instagram.



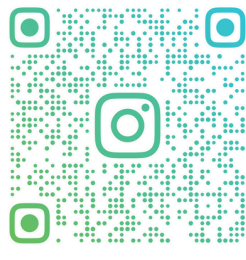
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