

Internal Curing Concrete Bridge Decks in New York State

by Duane Carpenter, New York State Department of Transportation



*The inspection of Interstate 190 over Interstate 290.
All Photos: Duane Carpenter and Mathew Royce.*

In May 2018, the New York State Department of Transportation (NYSDOT) began using internal curing concrete on all multispan bridge decks as part of the NYSDOT *Standard Specifications*, Section 557-2.01. NYSDOT expects the internal curing concrete to dramatically reduce cracking and, by doing so, to increase the service life of these bridges.

NYSDOT has spent decades trying to improve bridge decks. It began using pozzolans in the 1990s to reduce the permeability of concrete. Unfortunately, one of the consequences of adding pozzolans was an increase in deck cracks. It has been jokingly said that, “Between the cracks, this is the best concrete available.” After years of studying the causes of deck cracking, NYSDOT concluded that the forces resisting the cracking were only slightly larger than the forces creating the cracking. Furthermore, if just one of the major factors that caused the cracking could be addressed, cracking could be reduced significantly. The easiest factor to address was concrete shrinkage.

As fresh concrete hardens, water is consumed by the chemical hydration process. These chemical reactions leave behind tiny voids in the concrete. Traditionally, concrete is soaked with water when curing, and this additional

water penetrates into the concrete to fill the tiny voids and promote further hydration. New concrete with added pozzolans is so impermeable that externally applied water cannot soak in. The voids created by the consumption of the mixture water result in a vacuum that shrinks the volume of the concrete. When the shrinkage is restrained by reinforcement or shear studs attached to girders, cracking results.

Internal curing concrete replaces about 30% (by volume) of the fine aggregate with a lightweight fine aggregate that has been prewetted. The lightweight fine aggregate used by NYSDOT is expanded shale. The water that is absorbed by the lightweight aggregate does not increase the water-to-cement ratio. As the concrete cures, the lightweight aggregate releases its stored water to the concrete. As this water fills the tiny voids, it reduces the vacuum, the forces due to the concrete volume shrinkage, and the tendency of the concrete to crack.

Around 2008, NYSDOT experimentally used internal curing concrete on 20 bridge decks. It took about four construction seasons to build the bridges. After a few years of service, these bridges were found to have a 70% reduction in cracking. As an example, the Route 353 Bridge over the Allegheny River was five spans and over 1000 ft long and had no cracks.

The material cost of internal curing concrete is marginally higher due to the extra work for the concrete supplier associated with prewetting the porous aggregate. However, the installed costs have been the same as for traditional concrete.

The internal curing concrete mixture is almost indistinguishable from traditional concrete, and it requires no changes to the concrete placement operations. The only difference that contractors report is that the mixture is a little easier to work with because it is not as sticky as traditional concrete. 

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EDITOR'S NOTE

The requirements for using internal curing for bridge decks and useful background information are found in Section 5.1.2.3 of the NYSDOT Bridge Manual (2019), which can be accessed at this link: https://www.dot.ny.gov/divisions/engineering/structures/repository/manuals/brman-usc/NYS DOT_bridge_manual_US_5-2019.pdf.