New York State DOT's Experience with Internally Cured Concrete

Over the past two decades the New York State Department of Transportation (NYSDOT) has pursued a program to reduce early-age cracking and extend the service life of concrete bridge decks. One of the principal tools in that program has been internally cured concrete (ICC or HPIC — high-performance internally cured concrete). NYSDOT's field trials, specification updates, and monitoring have produced a relatively clear picture: internally cured mixtures substantially reduce early-age shrinkage cracking, are constructible within normal operations, and can be deployed without a lifecycle cost penalty while improving durability.

What is internal curing and why NYSDOT adopted it

Internal curing addresses autogenous shrinkage and self-desiccation that occur in low-water-to-cement (w/c) concrete mixtures — the same mixtures often used for high-performance bridge decks that incorporate supplementary cementitious materials. Rather than relying solely on surface wetting or external curing, internal curing supplies additional water stored inside the mixture (commonly within pre-wetted fine lightweight aggregates) that becomes available to hydrate cement as the paste consumes mixing water. This lowers internal tensile stresses during early-age hydration and reduces the formation of micro- and macro-cracks that act as preferential paths for chlorides and other aggressive agents.

Field evaluation program and technical approach

The NYSDOT launched a formal evaluation program in the late 2000s and through the 2010s applied HPIC on multiple experimental bridge decks across a range of structural types, climates and exposure conditions. The program used a consistent technical approach: replace a targeted fraction of the normal fine aggregate with high-absorption lightweight fine aggregate (LWFA) — the NYSDOT's common design uses roughly 30% LWFA by volume of the sand fraction — and control paste volume, resistivity and constituent proportions to meet established durability targets. The evaluation combined laboratory testing, controlled field placements, and long-term monitoring of cracking, permeability/resistivity, and surface condition.

Performance outcomes — cracking, durability and constructability

Arguably the most consequential result reported by the NYSDOT is the reduction in early-age cracking observed on decks constructed with internally cured mixes. Program findings indicate reductions in cracking on the order of 70% relative to comparable high-performance concrete decks without internal curing; a number of monitored multi-span decks exhibited minimal or no observable cracking attributable to restrained shrinkage. These reductions translate directly to improved protection of reinforcing steel and longer intervals before major deck rehabilitation is required.

From a constructability perspective, NYSDOT's experience has been positive: contractors reported no meaningful difference in placement, finishing or finishing quality when using internally cured mixtures versus conventional high-performance mixes. Plant handling does require attention to the moisture conditioning and absorption of the LWFA (plant batching sometimes needs an additional bin and batch adjustment to account for absorbed water), but in-field finishing, consolidation and finishing operations remain routine. Importantly, the NYSDOT and contractor reports indicate there was no material increase in total project cost attributable solely to the use of internal curing; any marginal material cost is generally offset by reduced curing labor or shortened wet-curing requirements and longer lifecycle savings.

From experimental use to specification adoption

NYSDOT's experimental program and the positive performance data culminated in specification changes. In May 2018 NYSDOT incorporated internal curing into its standard practice for multispan bridge decks, and the department has since mandated internal curing for many continuous and high-exposure structures. The materials and procedural guidance accompanying this adoption codifies the 30% LWFA replacement approach and sets companion requirements for low chloride ion permeability (e.g., resistivity targets), paste factors, and quality control testing for plant and field operations. These changes

made internal curing an accepted and predictable option for designers and contractors working on NYSDOT bridge projects.

Operational benefits observed by the NYSDOT

NYSDOT's reports emphasize three operational benefits that make ICC attractive at scale:

1. **Reduced early-age crack incidence and severity.** The department's monitoring shows a substantial reduction in cracking events, which improves long-term durability and reduces chloride ingress.
2. **Potential to shorten external curing times.** Because internal reservoirs supply ongoing hydration water, NYSDOT has been able to shorten wet surface curing windows for some high-performance decks (examples in later guidance cite reductions from 14 days to 7 days for HPIC under certain conditions), improving schedule flexibility.
3. **Improved lifecycle performance without operational disruption.** There is consistent evidence that ICC placements are compatible with routine bridge construction operations and quality control frameworks; long-term condition surveys indicate improved deck condition ratings relative to historical baselines.

Lessons learned and practical recommendations

NYSDOT's experience surfaces a number of lessons for agencies and contractors considering ICC adoption:

- **Material control at the plant matters.** Accurately accounting for LWFA absorbed moisture and adjusting batch water are essential to achieve target w/c and workability. Pre-wetting procedures and an additional aggregate bin at plants simplify logistics.
- **Testing and specification clarity reduce risk.** Clear acceptance criteria for resistivity/permeability and required mix proportions (for example, the NYSDOT 30% LWFA by sand volume guidance) allow design teams to predict performance and reduce contractor uncertainty.
- **Train crews on finishing timing.** Workability and finishing windows are similar to standard mixes, but crews benefit from guidance regarding bleed water behavior and timing for final finishing.

- **Monitor long-term performance.** While short-term cracking data is compelling, continued deck condition monitoring is necessary to quantify lifecycle benefits and refine specification thresholds for local materials. NYSDOT's multi-year inspections provide an important body of evidence for long-term durability improvements.

Broader context and implications

NYSDOT's outcomes echo findings from other state DOT studies and FHWA-supported field programs: internal curing is a robust material solution for reducing early-age cracking in low w/c, high cementitious content bridge decks and pavements. As agencies pursue asset preservation strategies that emphasize durability and lifecycle cost, internal curing represents a design-time choice that mitigates a primary driver of premature deterioration — shrinkage cracking — without disrupting construction practices. NYSDOT's transition from experimental deployments to standard specification language demonstrates that the technique can scale from field trials to routine practice when guided by clear material control, contractor training and long-term monitoring.

Conclusion

NYSDOT's multi-year experience with internally cured concrete demonstrates substantial, measurable benefits: large reductions in early-age cracking, maintainable constructability, and the prospect of extended bridge deck service life without an appreciable increase in construction cost. For departments of transportation and owners seeking durable bridge deck solutions, NYSDOT's program offers a tested roadmap — defined mix strategies (notably the 30% LWFA approach), plant and field controls, specification integration, and ongoing monitoring — to realize durable, longer-lived concrete decks. Continued data collection and interagency knowledge sharing will refine best practices, but NYSDOT's results already make a strong case for internal curing as a mainstream durability strategy.