Case Study | Internal Curing Used in Multiple Bridges in New York

By Bill Wolfe, Norlite, LLC

Placing internally cured concrete on Court Street Overpass above Interstate 81, Syracuse, NY

Internally cured concrete placement on Interstate 81, Whitney Point, NY

Over the past couple of years numerous bridges have incorporated into their design internally cured normal weight concrete in the state of New York. The bridges are located in different regions throughout the state and are exposed to very different traffic loadings as well as different deicing chemical loadings depending on where they are located. Internal curing (IC) was used in an effort to reduce the cracking tendency of high performance concrete (HPC) that is commonly used for bridge decks. Reducing the number of cracks in bridge decks will extend the service life and greatly reduce the life-cycle costs of these structures. In addition, longer service life corresponds with a reduced carbon footprint and lower embodied energy profile for the life of the structure.

Internal curing is defined by the American Concrete Institute (ACI) as “supplying water throughout a freshly placed cementitious mixture using reservoirs, via pre-wetted lightweight aggregates, that readily release water as needed for hydration or to replace moisture lost through evaporation or self-desiccation.”

HPC and the commonly used supplemental cementious materials that are used with it can have considerable shrinkage. There is often a shortage of water to fully hydrate or react with the cementious materials. This leads to shrinkage and the corresponding stresses that develop inside the concrete. If the stresses get high enough, the concrete cracks, first as micro cracks then as visible cracks. The use of internal curing will provide the needed water to the cementitious material thereby greatly reducing or even eliminating early age shrinkage and cracking. After the hydrating cement consumes the mix water during initial set, additional water will be drawn from the prewetted pores of expanded shale, clay, or slate (ESCS) lightweight aggregates through capillary action. The water from the prewetted lightweight aggregate has been shown to travel up to 2mm from the lightweight aggregate particle. Small amounts of prewetted internal curing aggregate distributed throughout the concrete mixture can provide the additional water needed to reduce or eliminate the stresses caused by shrinkage.

Fine Lightweight aggregate has been supplied by multiple ESCS producers throughout the Northeast for these bridge decks. New York State specifications requires that the lightweight aggregate be placed under a sprinkler for a minimum of 48 hours to sufficiently prewet the aggregate to a minimum absorbed moisture content of 15%. The aggregate is then drained for 12 to 15 hours prior to use which is usually accomplished by turning off the sprinklers at the end of the day prior to batching. In the morning the aggregate has sufficiently drained and the absorbed and surface moisture can be tested to determine batching quantities and verify the moisture content, which has typically been around 20%. Currently the projects have replaced 30%, by volume, of the normal weight sand with prewetted fine ESCS lightweight aggregate. This small amount of fine ESCS placed into the batch is providing around 5 additional gallons of internal curing water per yard of concrete.

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The following bridges have been completed or are currently under construction utilizing internally cured concrete in the state of New York.

NY Route 9W over Vineyard Avenue
NY Route 96 over Owego Creek
Interstate 81 at Whitney Point Southbound
Interstate 81 at Whitney Point Northbound
Court Street over Interstate 81
Bartell Road over Interstate 81
Interstate 86 over NY Route 415
Interstate 84 over Route 6
Interstate 290 Ramp B over Interstate 190
Interstate 290 Ramp D Over Interstate 190
Interstate 81 over East Hill Road
NY Route 17 Exit 90 Ramp over East Branch Delaware River
NY Route 38B over Crocker Creek
NY Route 353 over Allegheny River
Interstate 87 over Route 9 and Trout Brook
Interstate 81 Connectors near Fort Drum

This fall, the New York State Department of Transportation will complete their evaluation of internally cured concrete. A final report will be submitted to the Federal Highway Administration that describes their experiences and compares similar structures that have been constructed with and without internal curing. Many other states have begun using prewetted ESCS for internal curing in both bridge decks and pavements. Other internal curing projects are being constructed where eliminating concrete cracks and protecting the reinforcement are especially important such as water tanks. As more demands are placed on construction schedules and concrete performance, internal curing will be a valuable component in improving the durability and life cycle of these structures.