



Internally Cured Concrete for Pavement and Bridge Deck Applications

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Current Situation

High-strength-high-performance concrete (HSHPC) is used for rapid repair of concrete bridge decks and pavement. However, HSHPC has very high early shrinkage, often leading to cracking, made worse by high ambient temperatures and a large surface area that facilitates evaporation and high heat of hydration typical of this concrete. Cracks degrade repairs and can cause decks or pavements to fail.

Research Objectives

University of Florida researchers studied a possible solution to HSHPC cracking: internally cured concrete (ICC), produced by adding highly absorptive lightweight fine aggregates (LWA). Researchers examined the performance and usability of ICC in bridge decks and pavements under Florida conditions, hoping that LWA would provide more moisture to sustain the hydration process and consume all cementitious materials, producing a dense, durable concrete.

Project Activities

Three concrete mixes, composed of Portland cement, fly ash, and aggregates and approved by the Florida Department of Transportation (FDOT), served as controls. Based on each standard mix, an ICC mix was created by substituting LWA for some fine aggregate, giving a total of six mixes. The LWA was a manufactured expanded clay.

To design mixes, researchers studied all components used, including possible concrete admixtures. Standard testing of mixes was conducted to assure conformity with FDOT standards at the time of mixing and at 28 days. Even at this stage of testing, the ICC mixtures clearly demonstrated greater resistance to shrinkage cracking.

For each mix, researchers poured three slabs: one standard concrete slab; one made from the corresponding ICC at the same water-to-cementitious materials (w/cm) ratio; and one ICC slab with a lower w/cm ratio. Falling weight deflectometer (FWD) tests were used to characterize the structural behavior of the slabs. Also, repetitive wheel loading by the heavy vehicle simulator (HVS) at the FDOT State Materials Office was used to evaluate structural performance and to measure load-induced strains in the slabs. FWD and HVS results were used to calibrate 3-D finite element models of the slabs. With these models, researchers performed loading and temperature-differential simulations, from which stress-to-strength ratios were determined as a measure of the slabs' potential field performance. Generally, ICC slabs appeared to demonstrate better performance than standard concrete slabs.

Project Benefits

Performance of bridge decks and pavement is important to maintain the efficiency of Florida roadways. Concrete mixes which provide this service without cracking could reduce both maintenance costs and interference with traffic.

For more information, please see dot.state.fl.us/research-center



The heavy vehicle simulator allows accelerated testing of pavement samples by applying the equivalent of 29,000 vehicle passes in a 24-hour period.