National Concrete Consortium (NCC) E-News April 2017

In association with the CP Road Map Program

The **NCC E-News** is the newsletter of the Long-Term Plan for Concrete Pavement Research and Technology (CP Road Map), a national research plan developed and jointly implemented by the concrete pavement stakeholder community. If you'd like to find out more about the CP Road Map or learn how you can get involved, contact Program Manager Steve Klocke (sklocke@snyder-associates.com, 515-964-2020) or Dale Harrington (dharrington@snyder-associates.com, 515-964-2020).

Moving Advancements into Practice (MAP) Brief

Moving Advancements into Practice (MAP) Briefs describe promising research and technologies that can be used now to enhance concrete paving practices.

The April 2017 MAP Brief, *Performance Engineered Concrete Pavement Mixtures*, explains the process of designing concrete mixtures to provide the performance properties desired rather than just using a "recipe" mix.

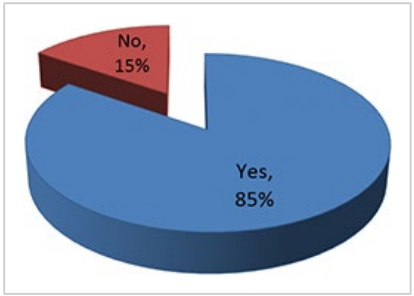
Download the April 2017 MAP Brief.

NCC State Survey Summaries

NATIONAL CONCRETE CONSORTIUM

Member states of the National Concrete Consortium (NCC) have the ability to poll other member states regarding specifications, materials, construction, research, or other issues related to concrete paving. This section highlights some of the questions posed and answers received through the NCC's ListServ feature.

Agencies' Use of Keyways to Tie Multiple Lanes Together



The Minnesota Department of Transportation polled the NCC group regarding the use of keyways when tying multiple lanes together. Twenty-six agencies responded. A vast majority (22) of the agencies responded that they do not typically use keyways between lanes. Several agencies cited a tendency to shear off or fail over time as a reason. Of the four that do currently use keyways, two indicated that they are looking to eliminate them.

News from the Road

News from the Road highlights research around the country that is helping the concrete pavement

community meet the research objectives outlined in the CP Road Map.

Lightweight Concrete for Reducing Bridge Deck Cracking

The Virginia Department of Transportation has been constructing bridge decks with lightweight concrete (LWC) for a number of years. VDOT recently constructed several bridges with LWC to examine the potential benefits that LWC may provide in reducing bridge deck cracking. Unlike most projects that replace a portion of the fine aggregate with water-saturated lightweight fine aggregate to provide internal curing, the VDOT utilized lightweight coarse aggregate.

Compared to normal weight concrete, the LWC had a lower modulus of elasticity, higher inelastic strains, lower coefficient of thermal expansion, more continuous contact zone between the aggregate and the paste, and more water in the pores of the aggregates to provide for continued internal curing. All of these properties tend to reduce cracking in concrete and are highly desirable in bridge decks.

LWC bridged deck on Route 29 after 34 years

The concrete mixes used in the study used various combinations of Portland cement and supplemental cementitious materials (fly ash and slag). Expanded slate was utilized as the lightweight coarse aggregate. The use of this material reduced the weight of the concrete from a value of 150 lb/yd^3 for normal concrete to only 115 to 120 lb/yd^3 for the LWC. This property helps to reduce the dead load of the structure. A total of seven bridges were constructed with LWC from 2012 to 2014.

The results of the study indicated that properly air-entrained LWC can provide satisfactory resistance to freeze-thaw cycles, low-permeability LWC can be produced with supplementary cementitious materials, and the LWC mixture can be produced with cementitious content below 650 lb/yd^3. Bridge decks produced with LWC showed no cracks, or a significant reduction in cracks, over conventional concrete indicating the benefits of LWC.

This research was sponsored by the Virginia Department of Transportation and was completed by Harikrishnan, Ozyildirim, and Sprinkel. Click here to access the full document.

This research is contributing to objectives identified in CP Road Map Track 1: Materials and Mixes for Concrete Pavements.

Evaluating Bond Strength Between PCC and Asphalt Layers

The bond between pavement layers in a composite pavement is an important factor in the performance of the pavement. For bonded concrete overlays of asphalt, this bond contributes to the overall structural capacity of the pavement. Unfortunately, cracks can develop along the interface between the two pavement materials due to traffic loading and environmental stresses. This delamination between the layers can result in a loss of structural support and early failure of the pavement. Existing methods for testing bond strength require specialized equipment and elaborate setup procedures.

Loading setup for BSCB test

The purpose of this research was to investigate a new test method to evaluate the bond strength between PCC and asphalt under tensile, shear, and combination tensile/shear loads at different temperatures (-4°F and +68°F). The bi-material semi-circular bend (BSCB) test utilizes a semi-circular composite sample of PCC and HMA with a notch cut along the interface between the two materials. Sample preparation and test setup are simple and inexpensive. Fresh samples can be prepared in the lab utilizing concrete cylinder molds or field samples can be obtained from pavement cores.

The results of this study indicate that the BSCB can be successfully tested in an ordinary three-point bend fixture which is commonly available. Furthermore, the application of compressive loads in the BSCB makes it more suitable for conducting fracture tests on weak bond interfaces. The simple geometry, sample preparation, and loading set up can be completed with less time and cost while providing accurate test results.

This research was completed at Texas A&M University by Mirsayar, Shi, and Zollinger and was presented at the 2017 TRB Annual Meeting. Click here to access the full document.

This research is contributing to objectives identified in CP Road Map Track 8: Concrete Pavement Construction, Reconstruction, and Overlays.

Investigation of Roller Compacted Concrete in Virginia

The Virginia DOT investigated the properties and potential benefits of Roller Compacted Concrete. The project prepared laboratory mixtures utilizing locally available materials. Based upon this research, special provisions were developed and two field projects were constructed.

The research found that the compressive strength, tensile strength, modulus of rupture, and modulus of elasticity for RCC were similar to conventional concrete.

There was some concern that fly ash, which is used in conventional concrete to improve durability, could cause a delay in early strength gain, which was critical on this project. However, researchers found that concrete mixtures with fly ash substitution rates of 15% and 25% did not adversely affect strength gain of the RCC.

Vibrating hammer to prepare RCC cylinders

The research found that the primary benefit of RCC over conventional concrete is the significant reduction in opening time. RCC pavements can be opened to light traffic immediately and to full traffic in less than 24 hours. A section of one of the field projects was opened to traffic only 5 to 6 hours after placement and is performing well after two-years of service. Another benefit to RCC is potential cost savings. Since RCC utilizes readily available asphalt paving equipment, no additional investment in specialized equipment is required by contractors.

The study recommended that the VDOT consider the use of RCC for future field applications, particularly where fast construction of PCC pavement is needed. The study also recommended that VDOT implement the specifications developed as part of this research.

This project was sponsored by the Virginia Department of Transportation and completed at the Virginia Transportation Research Council by Hossain and Ozyildirim. Click here to access the full document.

This research is contributing to objectives identified in CP Road Map Track 8: Concrete Pavement Construction, Reconstruction, and Overlays.

Comparison of Slab Stabilization Using Cementitious Grout and Polyurethane Foam

This research paper compares the in situ test results of injected polyurethane foam and cementitious grout for stabilizing deteriorating concrete pavements supported on an open-graded aggregate subbase. The stabilization was performed to improve support conditions by filling voids, reducing deflections, and improving load transfer efficiency (LTE) near joints and cracks. Falling weight deflectometer (FWD) tests were performed before and after stabilization.

LTE measurements indicated significant improvement near cracks and joints in both sections. Deflections under loading only showed significant improvement near cracks (and not near joints) in the injected foam section and only near joints (and not near cracks) in the cementitious grout section. Faulting was reduced by 2–5 mm with the foam and by 1–2 mm after grout stabilization.

While improvements were evident in the FWD measurements with both sections, slab movements were still greater than allowed, suggesting a need for improved process control with vertical movement during the stabilization process.

This project was completed by Vennapusa, Zhang, and White and published in the *ASCE Journal of Performance of Constructed Facilities* (Volume 30, Issue 6), December 2016. Click here for the project abstract.

This research is contributing to objectives identified in CP Road Map Track 7: Concrete Pavement Maintenance and Preservation.

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