Updates from the States: Illinois (Nov-Dec 2011)

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In the State of Illinois, concrete pavement research is largely conducted as a joint effort between the Illinois Department of Transportation (IDOT) and the Illinois Center for Transportation (ICT). Illinois also collaborates with a number of organizations to meet its research needs, including the Concrete Pavement Technology Center (CP Tech Center), and is an active participant in various Transportation Pooled Fund (TPF) studies. The Physical Research Section of IDOT, which resides within the Central Bureau of Materials and Physical Research (BMPR), is responsible for pursuing the use of innovative technologies that provide high-quality facilities and reduce life-cycle costs. This is achieved by developing, testing, and implementing new technology in the areas of materials, new products, design, construction, and rehabilitation of transportation facilities; transferring information; and directing and administering an in-house and contract research program consistent with the Division of Highway's needs. The BMPR houses extensive testing facilities as well as non-destructive roadway testing equipment dedicated to the collection of data to determine the structural and surface properties of the highway network in Illinois. Three units primarily responsible for concrete pavement research are summarized below.

- Pavement Technology - studies and provides services related to the design and physical components of pavements and highways.
- Technical and Product Studies - serves as a one-stop shop for vendors, evaluating and developing new products, materials, and processes which appear to have potential for improvements in highway construction, maintenance, and operations, and also provides the vital link between research and engineering practice.
- Research Coordination - oversees IDOT's participation in the FHWA TPF program, coordinates departmental technology transfer activities, and administers the contract research program through ICT.

Under a cooperative agreement with the University of Illinois at Urbana-Champaign, the contract research program is administered by the ICT, one of the top transportation research facilities in the nation. The ICT is headquartered at the Advanced Transportation Research and Engineering Laboratory (ATREL), a unique and comprehensive transportation research, educational, and testing laboratory. The ATREL complex has 60,000 square feet of laboratories and three major buildings for testing pavement materials and transportation operations. In addition, the ATREL houses a full-scale pavement testing facility that utilizes an Accelerated Transportation Loading Assembly (ATLAS), capable of evaluating multiple transportation support systems under real environmental and vehicular loading conditions. To learn more about each of these research facilities, follow the links below:

- Illinois DOT (IDOT) Bureau of Materials & Physical Research: http://www.dot.state.il.us/materials/research/aboutus.html
- IDOT Research Reports: http://www.dot.state.il.us/materials/research/reports.html
- Illinois Center for Transportation (ICT): http://ict.illinois.edu/index.aspx
- ICT Research Reports: http://ict.illinois.edu/publications/
- Transportation Pooled Fund: http://www.pooledfund.org/

Highlights

In the following sections, three recently completed concrete pavement research projects are highlighted.

- High Plastic Concrete Temperature Specifications for Paving Mixtures
- Performance of Concrete Pavements with Optimized Slab Geometry
- Performance of I-57 Recycled Concrete Pavement

High Plastic Concrete Temperature Specifications for Paving Mixtures

The August 2011 report, *High Plastic Concrete Temperature Specifications for Paving Mixtures*, authored by John Popovics, Carrie Peterson, Andres Salas, Suyun Ham, and Jeffery Roesler, documents a study conducted to assess current IDOT specifications related to concrete pavement construction in hot weather conditions. The primary objective of this project was to develop improved specifications and procedures with respect to monitoring and maintaining plastic concrete temperatures, ultimately assuring a high level of near and long-term concrete quality. During this study, the researchers sought to better understand the effects of higher temperatures on fresh and hardened concrete properties. An initial survey of state practices indicated that Illinois is the only state that specifies two separate maximum plastic concrete temperatures; one at delivery before placement (90ºF) and one as placed (96ºF). The survey also suggested that states which have a maximum allowable placement temperature of 90ºF or lower report less occurrences of temperature-related concrete distresses. The researchers also conducted site visits to pavement sections that were known to have been placed in hot weather conditions and conducted lab testing on field samples. Test results indicated that the observed distresses were not significantly influenced by high plastic concrete temperatures alone. Instead, occasional placement, consolidating, and finishing issues were shown to arise when concrete temperatures approach or exceed 90ºF. The authors recommend changes to existing specification language regarding plastic concrete temperatures in order to reduce uncertainty and encourage innovation among contractors with respect to the use of improved cementitious materials. For more information about this research, follow the link below:

http://ict.illinois.edu/publications/report%20files/FHWA-ICT-11-087.pdf

This research can be categorized under CP Road Map Track 1: Materials and Mixes for Concrete Pavements.

Performance of Concrete Pavements with Optimized Slab Geometry

The 2009 report, Performance of Concrete Pavements with Optimized Slab Geometry, by authors Victor Cervantes and Jeffrey Roesler, highlights a new proprietary methodology for designing concrete pavements with optimized slab dimensions and slab thicknesses as low as 4 inches, known as Thin Concrete Pavements (TCP). These pavements utilize panel sizes as small as 6 ft by 6 ft, which have been shown to reduce stresses and enable a thinner concrete slab. In order to collect response and performance data, the research team conducted full-scale accelerated pavement testing for TCP in a variety of configurations. These configurations included different slab thicknesses, base types, fiber reinforcement, and loading configurations. Data collected during the experiment showed that all test sections were able to sustain a significant number of ESALs before cracking occurred, and in most cases, significant overloads were required before failure. Test results also confirmed that strong support conditions are much more important for TCP than conventional concrete pavements, as evidenced by the number of load repetitions before cracking occurred for sections with equivalent slab thicknesses and different base types. In addition, the exclusion of man-made load transfer devices showed that reliance on aggregate interlock in TCP can provide medium to high load transfer efficiency, which can be further improved through the use of fibers. To learn more about this study and obtain a copy of the final report, click on the following link:

http://ict.illinois.edu/publications/report%20files/ICT-09-053.pdf

This research is helping to fill knowledge gaps outlined in CP Road Map Track 6: Innovative Concrete

Pavement Joint Design, Materials, and Construction.

Performance of I-57 Recycled Concrete Pavement

In the 2009 report, *Performance of I-57 Recycled Concrete Pavement*, Illinois researchers investigate the performance of a continuously reinforced concrete pavement (CRCP) constructed using recycled concrete aggregate (RCA). This pavement section is located on I-57 in southern Illinois and consists of a 10-inch CRCP on a 7-inch cement stabilized subbase with an asphalt shoulder and 13.5-foot extended lane width. Functional and structural data has been conducted throughout the life of the pavement, including Falling Weight Deflectometer (FWD) testing, distress surveys, friction testing, and condition rating surveys. Structurally, the pavement has demonstrated excellent load carrying capacity and few distresses have been observed other than longitudinal cracking common to other CRCP sections in the state. In addition, friction and smoothness data has shown that the pavement exhibits good skid resistance and fair-to-good ride quality. In light of these results, the researchers strongly believe that RCA concrete pavements can be constructed in the future with confidence and optimism. However, design and material selection of this pavement type must be carefully considered in order to address its unique properties. For a copy of the final report, click on the link below:

http://ict.illinois.edu/publications/report%20files/FHWA-ICT-09-032.pdf

This project falls within CP Road Map Track 12: Concrete Pavement Sustainability.

CP Road Map Track Status

Concrete pavement research projects in Illinois that are currently ongoing and recently completed, in addition to Transportation Pooled Fund participation, are depicted in Figure 1. These projects are categorized according to the appropriate CP Road Map Track. Following Figure 1, each of the projects are listed and categorized.

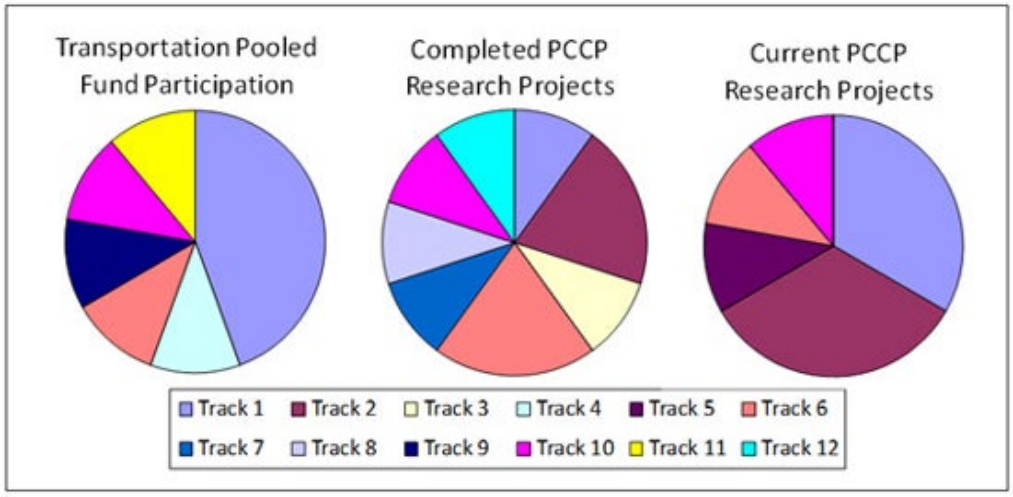

Figure 1. Concrete Pavement Research in Illinois Categorized by CP Road Map Track

Transportation Pooled Fund (TPF) Studies

Concrete pavement research work in Illinois includes work done under various TPF projects. These projects, and how they align under the CP Road Map, include the following.

Track 1: Materials and Mixes for Concrete Pavements

- TPF-5(042) Investigation of the Long-Term Effects of Magnesium Chloride and Other Concentrated Salt Solutions on Pavement and Structural Portland Cement Concrete
- TPF-5(117) Development of Performance Properties of Ternary Mixes
- TPF-5(179) Evaluation of Test Methods for Permeability (Transport) and Development of Performance

Guidelines for Durability

- TPF-5(014) Advanced Research of an Image Analysis System for Hardened Concrete

Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements
TPF-5(063) Improving the Quality of Pavement Profiler Measurement

Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction
TPF-5(188) Evaluation of Fiber Reinforced Composite Dowel Bars and Stainless Steel Dowel Bars

Track 9: Evaluation, Monitoring, and Strategies for Long Life Concrete Pavement
TPF-5(013) Effect of Multiple Freeze-Thaw Versus Deep Frost Penetration on Pavement Performance

Track 10: Concrete Pavement Foundations and Drainage
TPF-5(001) Soil Mixing Methods for Highway Applications

Track 11: Concrete Pavement Economics and Business Management
TPF-5(159) Technology Transfer Concrete Consortium

Currently Ongoing Research

Concrete pavement research projects that are currently ongoing, and how they align under the CP Road Map, are listed here.

Track 1: Materials and Mixes for Concrete Pavements

- Use of Coarse and Fine Recycled Concrete Aggregate for Airfield Pavement Applications
- Concrete with Ternary Blended Cement and Fractionated, Washed Reclaimed Asphalt Pavement
- Testing of Portland Cement (Current ASTM C 150) with Limestone & Process Addition (ASTM C 465)

Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements

- Mechanistic-Empirical Design, Implementation & Monitoring for Rigid Pavements
- Development of Numerical Tools to Analyze the Effects of Concrete Materials in Various Layers on Slab Response and Behavior
- Theoretical Solution for Temperature Profile in Multi-Layered Pavement Systems Subjected to Transient Thermal Loads

Track 5: Concrete Pavement Equipment Automation and Advancements
Evaluation of Concrete Cylinder Match Curing & Evaluation of 4"x 8" Cylinders

Track 10: Concrete Pavement Foundations and Drainage
Field Performance Evaluations of IL Aggregates for Subgrade Replacement & Subbase - Phase II

Recently Completed Research

Concrete pavement research projects completed since 2007 are listed below, in addition to how they align under the CP Road Map.

Track 1: Materials and Mixes for Concrete Pavements
High Plastic Concrete Temperature Specifications for Paving Mixtures

Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements
Evaluation and Implementation of Improved CRCP and JPCP Design

Track 3: Intelligent Construction Systems and Quality Assurance for Concrete Pavements
Evaluation of 3-D Laser Scanning for Construction Application

Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction

- Evaluation of the Long-Term Durability of Joints Cut Using Early-Entry Saws on Rigid Pavements
- Performance of Concrete Pavements with Optimized Slab Geometry

Track 7: Concrete Pavement Maintenance and Preservation
Update of Condition Rating Survey (CRS) Calculation/Prediction Models: Final Report

Track 8: Concrete Pavement Construction, Reconstruction, and Overlays

Design and Concrete Material Requirements for Ultra-Thin Whitetopping

Track 10: Concrete Pavement Foundations and Drainage
Characterization of Illinois Aggregates for Subgrade Replacement and Subbase

Track 12: Concrete Pavement Sustainability
Performance of I-57 Recycled Concrete Pavement

About the CP Road Map E-News

The ***CP Road Map 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. To find out more about the CP Road Map, or to get involved, contact Dale Harrington, dharrington@snyder-associates.com, 515-964-2020.

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