Updates from the States: Kansas (Sept-Oct 2011)

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The Kansas Department of Transportation (KDOT) performs concrete pavement research through the Bureau of Materials and Research, whose responsibilities are vested in a headquarters section and four units: Research, Geotechnical, Materials Test, and Regional Inspection. The Bureau supports concrete pavement construction and maintenance projects through regional laboratories and geology offices dedicated to inspection of materials, and support for analysis, testing, and research. All primary responsibilities of the Bureau of Materials and Research are listed at its website, shown below.

In addition, the Kansas Transportation Research and New Developments (K-TRAN) Program is an ongoing, cooperative, and comprehensive research program that addresses transportation needs of the State of Kansas by utilizing academic and research resources from KDOT, Kansas State University (KSU), and the University of Kansas (KU). Projects that fall within this program are jointly developed by professionals at all three institutions. Major benefits of the K-TRAN Program include:

- Development of a flow of high quality transportation research targeted to Kansas transportation needs,
- Financial support to engineering students contributing to the pool of transportation professionals in Kansas,
- Continuing education opportunities for KDOT personnel,
- Enhanced quality of faculty, staff, and graduates in the transportation area,
- Attracted federal research resources for use in Kansas, and
- A much expanded but efficiently organized transportation research resource.

Concrete pavement research needs are evaluated by K-TRAN Area Panels and prioritized by the Research Technical Committee (RTC). These research needs are then approved by the Research Program Council, based on input from the Area Panels and RTC, and placed in an annual research program. KDOT also participates in various Transportation Pooled Fund (TPF) studies. To learn more about each of these research facilities, follow the links below:

- KDOT Bureau of Materials and Research: http://www.ksdot.org/bureaus/burMatrRes/
- KDOT Research Reports Catalog: http://www.ksdot.org/burmatrres/kdotlib2.asp
- Kansas University Transportation Center: http://www.kutc.ku.edu/cgiwrap/kutc/ltap/index.php/index.html
- Kansas State University Transportation Center: http://transport.ksu.edu/
- TPF: http://www.pooledfund.org/

Highlights

The following sections highlight four recently completed concrete pavement research projects.

- Accelerated Testing for Studying Pavement Design and Performance - Thin Bonded Rigid Overlay on PCCP and HMA.

- Durability of Classed Limestone Coarse Aggregate Study, US-169, Johnson County, Kansas.
- Evaluation of Joint Sealant Materials, US-36, Doniphan County, Kansas.
- Control of Pavement Smoothness in Kansas.

Accelerated Testing for Studying Pavement Design and Performance - Thin Bonded Rigid Overlay on PCCP and HMA

The 2009 report, *Accelerated Testing for Studying Pavement Design and Performance - Thin Bonded Rigid Overlay on PCCP and HMA*, authored by Dr. Stefan Roamnoschi, Cristian Dumitru, Paul Lewis, and Dr. Mustaque Hossain, documents a full-scale Accelerated Pavement Test (APT) experiment designed to evaluate the performance and modes of failure of thin concrete overlays. Four pavement overlays were constructed as part of this experiment: two Thin Whitetopping (TWT) sections consisting of 4-inch and 6-inch concrete overlays on a 5-inch HMA pavement, and two Thin Concrete Overlay (TCO) sections consisting of 4-inch and 6-inch overlays on a 5-inch PCC pavement. To measure pavement performance, the overlays were instrumented with strain gages and thermocouples. Traffic loading was simulated using the APT loading device, which utilized a full-size truck axle to apply a load of 13,000 lbs to each pavement a total of 2,000,000 cycles. The results of this APT study were obtained over only a few months, compared with a much longer observation period associated with in-situ field tests. All pavement structures experienced a loss of support in the subgrade under loading, leading to an increase in maximum longitudinal strains, but no debonding occurred between the overlays and existing pavement. In addition, the commercial software program ANSYS was used to build three-dimensional finite element models (FEM) for each section. Computed strain values matched very well with the measured strains, proving that these models were able to predict the response of the overlays very effectively. However, more research is needed to examine environmental effects and long-term changes in material properties that cannot be reproduced in an APT test.

Click here to read the report.

This research can be categorized under CP Road Map Track 8: Concrete Pavement Construction, Reconstruction, and Overlays.

Durability of Classed Limestone Coarse Aggregate Study, US-169, Johnson County, Kansas

A study was undertaken by Kansas DOT researchers to evaluate the suitability of coarse aggregate for use in concrete pavement and documented in the 2008 report, *Durability of Classed Limestone Coarse Aggregate Study, US-169, Johnson County, Kansas*. This project involved the construction of four pavement test sections on US-169, comprised of 9-inch PCCP with skewed transverse joints spaced every 15 feet, and no use of dowel bars. A different class of limestone aggregate was used to construct each section and subjected to durability, expansion, and modified freeze-thaw testing before construction. These test results proved that two of the four aggregate types were Class I Aggregate, due to measured Durability Factors greater than 95 and expansions less than 0.025 percent, while the Durability Factors and expansions for the other aggregate types were lower, as predicted. Test sections 1 and 2 were constructed with Class I aggregate and were expected to provide at least 20 years of service before major rehabilitation, while test sections 3 and 4 were predicted to last at least 10 years before severe D-cracking would occur. After six years in service, Section 4 began to exhibit considerable D-cracking, ultimately requiring a complete reconstruction after only 13 years. The other test sections fared better, and eventually underwent a rehabilitation procedure after 14 years. Overall, this project demonstrated the rapid deterioration of concrete pavement once D-cracking begins to occur and the effectiveness of aggregate acceptance specifications currently employed by KDOT.

Click here to read the final report.

This research is helping to fill knowledge gaps outlined in CP Road Map Track 1: Materials and Mixes for Concrete Pavements.

Evaluation of Joint Sealant Materials, US-36, Doniphan County, Kansas

In the 2009 report, *Evaluation of Joint Sealant Materials, US-36, Doniphan County, Kansas*, authors Rodney Montney, Robert Heinen, and John Wojakowski investigate the long-term performance of a variety of joint sealants. In this study, 18 different joint sealants were installed on a 14-mile project on US-36. The pavement section for this project was comprised of an 8-inch PCCP layer built on a drainable base, with skewed transverse joints spaced every 15 feet and constructed without dowel bars. Joint sealant types utilized for this project included silicone, asphaltic, preformed compression, and a variety of experimental sealant types new to the market. The joint sealants were tested using a vacuum procedure and faulting measurements were taken over a 9-year period, after which all sealants were replaced with a low modulus hot pour sealant conforming to KDOT maintenance specifications. Test results showed that the silicone joint sealants demonstrated the least amount of vacuum "failure", while a cold applied polyurethane joint sealant proved to exhibit the least amount of faulting.

Click here to download the final report.

This project is meeting research needs identified in CP Road Map Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction.

Control of Pavement Smoothness in Kansas

The 2009 report, *Control of Pavement Smoothness in Kansas*, authored by William Parcells, highlights the development of KDOT smoothness specifications for PCCP. In the early 1980's, the KDOT Research Unit began investigating methods to measure concrete pavement smoothness for new construction. Ultimately, the California type profilograph, utilizing the 0.2-inch Blanking Band, was selected as the method used to record and measure smoothness. In addition, KDOT specified that the contractor would own and operate the profilograph, evaluate the profile trace, and report results to a local inspector. The first three pilot projects with a smoothness requirement were constructed in 1985, and over the next five years, a significant improvement was seen in as-constructed smoothness of PCCP. From this improvement, a special provision was created in 1990 that incorporated pay adjustments. However, although profilograph results continued to be quite acceptable, there was a noticeable high frequency vibration on certain pavement sections that was "hidden" by the 0.2-inch Blanking Band. KDOT began to specify the use of a Zero Blanking Band in 1991 and over the last 20 years, the special provision has undergone multiple revisions. These revisions have led to the measured smoothness of recently constructed pavements lower than all previous years and a significant increase in incentive payments.

Click here to download the report.

This project falls within CP Road Map Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements.

CP Road Map Track Status

Concrete pavement research projects 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.

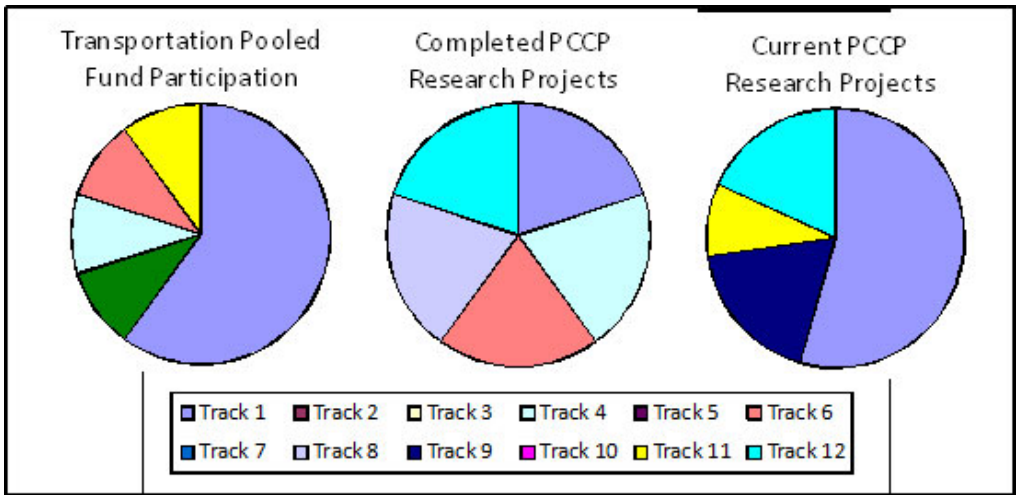

Figure 1. Concrete Pavement Research in Kansas Categorized by CP Road Map Track

Transportation Pooled Fund (TPF) Studies

Concrete pavement research work in Kansas 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(066) Material and Construction Optimization for Prevention of Premature Pavement Distress in PCC Pavements
- TPF-5(098) Self-Consolidating Concrete - Applications for Slip Form Paving
- TPF-5(100) Deicer Scaling Resistance of Concrete Pavements, Bridge Decks and Other Structures Containing Slag Cement
- 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(205) Implementation of Concrete Pavement Mixture Design and Analysis (MDA) Track of Concrete Pavement Road Map

Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements
TPF-5(001) Soil Mixing Methods for Highway Applications

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 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

- Measurement of the Pore Size Distribution of Limestone Aggregates in Concrete Pavement Cores
- Evaluation of Concrete Strength and Permeability
- Evaluation of Canadian Unconfined Aggregate Freeze-Thaw Tests for Identifying Nondurable Aggregates
- Characterizing KDOT's Chloride Permeability Testing Protocol: Reducing the Duration of the Rapid

Chloride Permeability Test
- AVA vs. ASTM C-457 Air Void Spacing
- Laboratory Investigation of the Use of Volcanic Ash

Track 9: Evaluation, Monitoring, and Strategies for Long Life Concrete Pavement
- Process to Automatically Rate Severity and Extent of D-Cracking of Concrete Pavement from Line-Scan Images
- D-Cracking Field Performance of Portland Cement Concrete Pavements Containing Limestone in Kansas

Track 11: Concrete Pavement Economics and Business Management
- Review of Data in CMS and QC/QA Databases to Improve Current Specifications for Superpave and Concrete Pavements in Kansas

Track 12: Concrete Pavement Sustainability
- Kansas Sustainable Concrete Pavements Initiative - Potential Use of Nanotechnology
- Sustainable and Durable Concrete Pavement Aggregates

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
Durability of Classed Limestone Coarse Aggregate Study on US-169 in Johnson County, Kansas

Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements
Control of Pavement Smoothness in Kansas

Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction
Evaluation of Joint Sealant Materials, US-36, Doniphan County, Kansas

Track 8: Concrete Pavement Construction, Reconstruction, and Overlays
Accelerated Testing for Studying Pavement Design and Performance - Thin Bonded Rigid Overlay on PCCP and HMA

Track 12: Concrete Pavement Sustainability
Construction of Two-Lift Concrete Pavement on I-70 in Saline County, Kansas

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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