Updates from the States: Ohio (March-April 2012)

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The Ohio Department of Transportation (ODOT) administers concrete pavement research through the Office of Statewide Planning & Research. The research program is structured to be responsive to the department's business plan and strategic initiatives, as well as emerging topics and emergency concerns. Furthermore, concrete pavement research is structured to maximize investments, take advantage of new technologies, and produce practical results that have a strong possibility of implementation. All ODOT divisions, districts, and offices can submit strategic research plan problem statements that address specific needs within ODOT, relate to one or more of the strategic research focus areas, and are included in an approved division/office strategic research plan.

However, ODOT recognizes that tremendous benefits can be realized from considering innovative ideas developed by the concrete pavement research community that align with ODOT's strategic focus areas. As a result, ODOT's Partnered Research Exploration Program (OPREP) was created to capitalize on these opportunities and allow researchers an avenue to propose unique, unsolicited projects. Research partnerships have been established with the Transportation Pooled Fund (TPF) Program, various state highway agencies, and universities. To learn more, follow the links below:

- ODOT Office of Statewide Planning & Research: http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/Pages/default.aspx
- ODOT Office of Pavement Engineering Final Reports: http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/Pages/default.aspx
- ODOT Office of Materials Management Final Reports: http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/reportsandplans/Pages/MaterialsReports.aspx
- Ohio Research Institute for Transportation and the Environment (ORITE): http://www.ohio.edu/orite/index.cfm
- Transportation Pooled Fund: http://www.pooledfund.org/

Highlights

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

- Evaluation of Alternative Dowel Bar Materials and Coatings
- Review of ODOT's Overlay Design Procedures: PCC Overlays of Existing Composite Pavements
- Determination of Mechanical Properties of Materials Used in WAY-30 Test Pavements
- Effectiveness of Noise Barriers Installed Adjacent to Transverse Grooved Concrete Pavement

Evaluation of Alternative Dowel Bar Materials and Coatings

In the November 2011 report, *Evaluation of Alternative Dowel Bar Materials and Coatings*, the long-term performance and cost effectiveness of alternative dowel bar materials is examined in detail. This research was completed under pooled fund study TPF-5(188) and was a collaborative effort between Ohio, Kansas, Illinois, Wisconsin, and Dr. Max Porter of Iowa State University, with ODOT serving as the lead agency. Various materials were compared to conventional epoxy-coated steel dowels including fiber reinforced polymer (FRP) bars, Type 304 stainless steel solid dowels or concrete-filled tubes, and plastic-coated dowels. Field performance data, including Falling Weight Deflectometer (FWD) testing, coring analysis, and overall roughness and faulting measurements, were collected for a variety of in-service concrete pavement projects. It was found that compared to conventional steel dowels, FRP dowels manufactured with polyester

resin exhibited unacceptably low load transfer efficiency (LTE) values. Performance of the stainless steel dowel alternatives was inconclusive due to the small sample size and relatively short (14 years maximum) evaluation period, although initial results are promising. In addition, projects constructed with plastic-coated dowels were in excellent condition after over 30 years of traffic and appear to be a cost-effective alternative to epoxy-coated dowels, especially considering their increased resistance to damage during handling and construction. Conventional epoxy-coated steel dowels were also found to provide a high level of service for up to 30 years, but in some cases, debonding of the coating resulted in early corrosion. In the future, the researchers recommend that state highway agencies carefully evaluate the long-term performance of epoxy-coated dowels to determine if the use of alternative materials is necessary, in addition to improving existing materials specifications, construction specifications, and quality assurance procedures.

http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/reportsandplans/Reports/2011/Pavements/134411_FR.pd

This research can be categorized under CP Road Map Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction.

Review of ODOT's Overlay Design Procedures: PCC Overlays of Existing Composite Pavements

ODOT's existing unbonded PCC overlay design procedure was evaluated in the report, *Review of ODOT's Overlay Design Procedures: PCC Overlays of Existing Composite Pavements*. This design procedure uses pavement deflections obtained during nondestructive deflection testing to characterize the structural capacity of the existing composite pavement and compute the concrete overlay thickness. However, the effect of milling the existing pavement prior to the overlay is not accounted for, and as a result, this study aims to understand and quantify the impact of this operation. In this investigation, detailed analyses of field deflection data were conducted to determine the effect of milling on the composite elastic modulus (EP), modulus of subgrade reaction (k-value), and effective overlay thickness (Deff). It was found that although some expectations were met, such as a general decrease in structural capacity after milling, large changes in deflection values were deemed unreasonable as a result of milling alone. In the future, the researchers recommend that ODOT closely evaluate testing equipment to reduce the risk of measurement anomalies and expand their project database to include more unbonded concrete overlay projects. In addition, it is recommended that ODOT adopt the 1993 AASHTO Guide for Design of Pavement Structures approach for overlay design and develop a design catalog of unbonded overlay designs based on local conditions.

http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/reportsandplans/Reports/2008/Pavement/SJN%20134226%20Final%20Report%20Volume%202%20of%202.pdf

This research is helping to fill knowledge gaps outlined in CP Road Map Track 8: Concrete Pavement Construction, Reconstruction, and Overlays.

Determination of Mechanical Properties of Materials Used in WAY-30 Test Pavements

The May 2010 report, *Determination of Mechanical Properties of Materials Used in WAY-30 Test Pavements*, documents a study by Ohio University researchers that evaluates pavement test sections constructed on the US Route 30 bypass in Wayne County, Ohio. Eight miles of the two eastbound lanes were constructed with long-lasting jointed plain concrete pavement (JPCP) designed to provide 50 years of service with minimal maintenance. Two separate mix designs were used, each with different partial cement substitutes. Mix Design A featured 30% Ground Granulated Blast Furnace Slag (GGBFS), while Mix Design B utilized 20% Type F Fly Ash. These pavements, which had 15 ft joint spacing with 1.5 inch dowel bars spaced at 12 inches, were constructed on 3 inches of asphalt concrete base, 4 inch densely graded granular subbase, and moderately plastic silty subgrade. Samples of all materials were tested in the laboratory to determine material parameters. Concrete tests included static modulus of elasticity, Poisson's ratio, compressive strength, maturity, and coefficient of thermal expansion (CTE). Results and data from this study have been used to validate or calibrate long life pavement design procedures, including the Mechanistic-Empirical Pavement Design Guide (M-E PDG). This research has also aided in the revision of Ohio DOT specifications, standard drawings, and the Pavement Design and Rehabilitation Manual.

http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/reportsandplans/Reports/2010/Pavement/437046_FR.pdf

This project is meeting research needs identified in CP Road Map Track 1: Materials and Mixes for Concrete Pavements.

Effectiveness of Noise Barriers Installed Adjacent to Transverse Grooved Concrete Pavement

In the September 2009 report, *Effectiveness of Noise Barriers Installed Adjacent to Transverse Grooved Concrete Pavement*, a study was undertaken to address complaints of increased noise levels where asphalt pavements had been replaced with random transversely tined concrete pavements. This research was initiated to address noise barrier design issues associated with the abatement of traffic noise, as outlined in the Federal Highway Administration (FHWA) Traffic Noise Model (TNM) currently used by ODOT. The TNM, as it is currently configured, simulates traffic noise as if the traffic were operating on an "average" pavement. In order to evaluate its accuracy in evaluating transversely tined concrete pavements, the researchers thoroughly reviewed ODOT traffic noise analysis procedures and selected three sites for analysis. Two of the sites were located in residential areas where sound barriers were constructed, while the third site was in a rural area with no noise barrier. Noise level measurements at each site using 37 microphone positions revealed that the TNM, even when configured to accommodate the ODOT transversely tined pavement, consistently under-predicted traffic noise levels. As a result, the researchers recommend further refinement to the TNM and an improved ODOT specification for concrete pavements in order to reduce tire-pavement noise levels while maintaining desired safety and durability characteristics.

http://www.dot.state.oh.us/Divisions/Planning/SPR/Research/reportsandplans/Reports/2009/Safety/134365_FR.pdf

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.

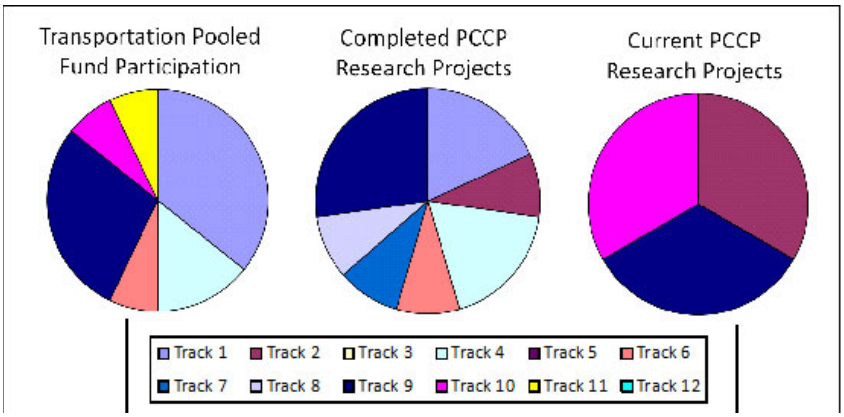

Figure 1. Concrete Pavement Research in Ohio Categorized by CP Road Map Track

Transportation Pooled Fund (TPF) Studies

Concrete pavement research work in Ohio 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(100) Deicer Scaling Resistance of Concrete Pavements, Bridge Decks and Other Structures Containing Slag Cement
- TPF-5(129) Recycled Unbound Pavement Materials (Mn/ROAD Study)
- TPF-5(014) Advanced Research of an Image Analysis System for Hardened Concrete
- TPF-5(101) Evaluations and Applications of Mechanistic Performance Prediction Modeling Tools

Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements

- TPF-5(063) Improving the Quality of Pavement Profiler Measurement

- TPF-5(135) Tire/Pavement Noise Research Consortium

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(070) International Conference on Accelerated Pavement Testing
- TPF-5(121) Monitoring and Modeling of Pavement Response and Performance
- TPF-5(013) Effect of Multiple Freeze-Thaw Versus Deep Frost Penetration on Pavement Performance
- TPF-5(127) Consortium of Accelerated Pavement Testing (CAPT) and Technical Exchange Partnership

Track 10: Concrete Pavement Foundations and Drainage
SPR-2(208) Pavement Subgrade Performance Study

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 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements
Improved Characterization of Truck Traffic Volumes and Axle Loads for Mechanistic Empirical Pavement Design

Track 9: Evaluation, Monitoring, and Strategies for Long Life Concrete Pavement
Pavement Condition Rating (PCR) Evaluation

Track 10: Concrete Pavement Foundations and Drainage
Incorporating Chemical Stabilization of the Subgrade in Pavement Design and Construction Practices

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
- Forensic Investigation of AC and PCC Pavements with Extended Service Life
- Determination of Mechanical Properties of Materials used in WAY-30 Test Pavements

Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements
Guidelines for Implementing NCHRP 1-37A M-E Design Procedures in Ohio

Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements
- Relationship Between Skid Resistance Numbers Measured With Ribbed And Smooth Tire And Wet-Accident Locations
- Effectiveness of Noise Barriers Installed Adjacent to Transverse Grooved Concrete Pavement

Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction
Evaluation of Alternative Dowel Bar Materials and Coatings

Track 7: Concrete Pavement Maintenance and Preservation
Investigate Feasibility of Using Ground Penetrating Radar In QC/QA of Rubblization Projects

Track 8: Concrete Pavement Construction, Reconstruction, and Overlays
Review of ODOT's Overlay Design Procedure: Volume 2 - PCC Overlays of Existing Composite Pavements

Track 9: Evaluation, Monitoring, and Strategies for Long Life Concrete Pavement
- Monitoring and Modeling of Pavement Response and Performance Task A: Ohio
- Long Term Monitoring of Moisture Under Pavements
- Instrumentation of the WAY-30 Test Pavements

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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