Updates from the States: Oklahoma (December 2014)

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In the State of Oklahoma, concrete pavement research is coordinated through the Oklahoma Department of Transportation (ODOT) Research, Development, and Technology Transfer (RDTT) Program. This program identifies research needs, arranges for the conduct of research, and secures appropriate funding for research projects with specific objectives and prescribed timeframes. Research projects with well-defined objectives are selected by Department personnel with the aim of providing a coordinated and balanced effort among the various technical, socioeconomic, and environmental subject areas. Furthermore, research results are implemented through new specifications, standard plans, test methods, new or revised procedures, computer programs, manual changes, or policy and procedure directives.

Although the RDTT Program conducts work through in-house research, the majority of projects are conducted for the ODOT under contract by universities, other governmental agencies, or private organizations. Collaborative research also offers the Department the ability to further leverage State funds and includes partners such as the Transportation Research Board (TRB), Transportation Pooled Fund (TPF) Program, state highway agencies, and the Oklahoma Transportation Center (OkTC). The OkTC is a nationally designated university transportation center (UTC) composed of researchers at the University of Oklahoma, Oklahoma State University, and Langston University. To learn more about each of these research facilities, follow the links below:

- Oklahoma DOT State Planning and Research Program: http://www.okladot.state.ok.us/hqdiv/p-r-div/spr-rip/index.htm
- Oklahoma DOT Planning & Research Library: http://www.okladot.state.ok.us/hqdiv/p-r-div/spr-rip/online.htm
- Oklahoma Transportation Center: http://www.oktc.org
- Oklahoma Transportation Center Final Reports: http://www.oktc.org/otc/View.aspx?Type=Content&Name=FinalReports
- Transportation Pooled Fund: http://www.pooledfund.org/

Recently Completed Research

Investigation of Optimized Graded Concrete for Oklahoma
The goal of this research was to develop tools to understand the complex relationship between the workability of concrete and the aggregate's gradation and characteristics in concrete mixture design. This work investigated the potential of three different tools to help understand this relationship. The tools included a Box Test to investigate the response of a concrete mixture to vibration, the use of a concrete pan-mixer to evaluate the rheology (flow) of a mixture, and use of the Aggregate Imaging Measurement System 2 (AIMS II) unit to investigate the characteristics of approved aggregate sources from around the State.

The results show that the box test is a useful and repeatable tool to evaluate different concrete mixtures for slip form paving. The box test was able to show that the gradation of a mixture influenced the response to vibration. The box test even proved useful for low slump concrete where the slump test is generally

ineffective.

The results of the pan-mixer based rheometer were poor. Additional work is required to study the flow properties of low-slump concrete.




The AIMS II tests indicated the texture of aggregates vary considerably from one source to another. Additional work is now required to determine how the aggregate textures impact concrete mixture proportions and performance.

While not all of these studies were a success, some of this work shows a great deal of promise in the future. This work is an outstanding foundation for ongoing research for the Oklahoma Department of Transportation to develop new aggregate gradation standards for the State of Oklahoma.

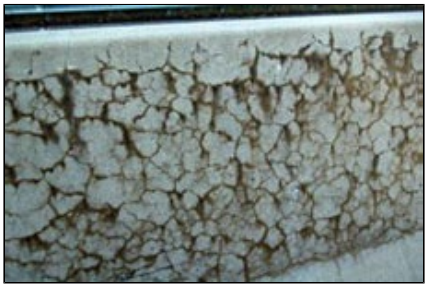
This research was completed by Cook, Ghaeezadeh, and Ley at Oklahoma State University for the Oklahoma Transportation Center. Click here to read the full report.

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

Suppression of ASR through Aggregate Coatings

Some concrete pavements suffer from premature deterioration due to alkali silica reaction (ASR) that takes place between the alkalis contributed primarily by the cement and a reactive form of silica from specific silicon-containing aggregates utilized in concrete production. This produces an alkali/silica gel that, in the presence of sufficient moisture, will expand and produce stresses that damage the concrete. With time, the expansion of the gel generates internal pressure that can lead to cracking of the concrete, which provides pathways for ingress of deleterious materials such as water, sulfates, and chlorides to the interior of the concrete matrix. This can lead to serious durability issues, such as freeze/thaw damage, sulfate attack, or corrosion of reinforcing steel.

While several ASR mitigation methods are available, current methods apply the treatment globally, while the root cause of the ASR problem is localized only to the aggregate-cement interface. These methods add considerable cost to each cubic yard of concrete. This investigation identifies several ASR mitigation treatments that target the aggregate-cement interface as a cost-effective pre-treatment process for problematic aggregates.



This project was completed by Apblett, Materer, & Ley at the University of Oklahoma for the Oklahoma Transportation Center. Click here to read the full report.

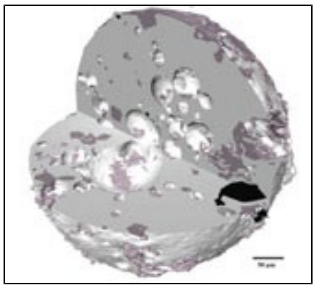
This research is contributing to objectives identified in CP Road Map Track 1: Materials and Mixes for Concrete Pavements.

Innovative Prediction of Fly Ash Performance in Concrete

Fly ash is widely known for its use in the concrete industry as a supplementary cementitious material capable of enhancing some properties of concrete. Fly ash in concrete mixtures has the ability to improve strength, reduce permeability, improve the workability of fresh concrete, and provide resistance to a number of common durability problems. However, because fly ash is not a manufactured material, not all sources have the same properties, which leads to limited substitution levels for portland cement in concrete mixtures.

Fly ash is characterized primarily by its chemical makeup as either a Class C or Class F material according to ASTM C618. It is recognized, however, that two fly ash samples can have very similar chemical makeup yet their performance in concrete mixtures may produce very different results.

This research project utilized new analysis techniques including an Automated Scanning Electron Microscope (ASEM) and Tomography Assisted Chemical Correlation (TACCo) to investigate particle properties and chemical composition and better define a particular fly ash's makeup. These new analysis techniques were able to identify differences in the particle properties that may be able to further classify fly ash properties and better predict concrete performance.



This research was completed by Aboustait, et al. at Oklahoma State University for the Oklahoma Transportation Center. Click here to read the full report.

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

Dimensional Stability of Concrete Slabs on Grade

A major problem with slab-on-grade pavement is drying shrinkage leading to cracking, warping, and curling of the slab. Shrinkage can continue in the slab for years and is difficult to predict because many factors affect this phenomenon. To date, little research has been conducted representing field conditions using actual slabs on grade. This study aimed to characterize the shrinkage of various types of concrete mixtures using slabs on grade with a constant source of moisture below the slab. The concrete mixes included normal portland cement based concrete, normal concrete with two types of shrinkage reducing admixtures, high performance concrete (HPC), and "Type K" which uses calcium sulfoaluminate cement.

The results of this study found that normal portland cement and HPC mixes continued to experience long-term shrinkage, even at an age of two years. The use of shrinkage reducing admixtures has a minor impact at an early age, but does not impact long term stability. Type K concrete was found to be very stable with only minor shrinkage at an early age and no long-term shrinkage.

This project was completed by Ramseyer et al. at the University of Oklahoma for the Oklahoma Transportation Center. Click here to read the full report.

This research is contributing to objectives identified in CP Road Map Track 1: Materials and Mixes for Concrete 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 Steve Klocke, 515-964-2020.

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