



SHRP2 R07 - Burlington, Vermont Workshop



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- **Missouri DOT**
- **September 20, 2016**



U.S. Department of Transportation
Federal Highway Administration

AMERICAN ASSOCIATION
OF STATE HIGHWAY AND
TRANSPORTATION OFFICIALS

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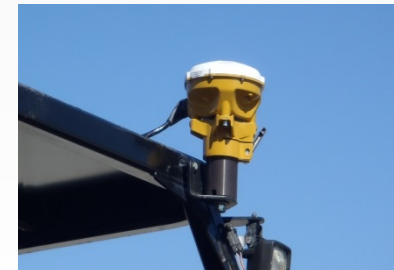


MoDOT participation in SHRP2 R07 Research

2010 Pilot Research Project



- Developing Model specifications for Section 200 (Grading) of the MoDOT spec book
- Route 141, St. Louis County
- Intelligent Compaction (IC)



Equipment Used-Caterpillar

- Aggregate Base Compaction



Equipment Used-Caterpillar

- Compaction of Earth Subgrade

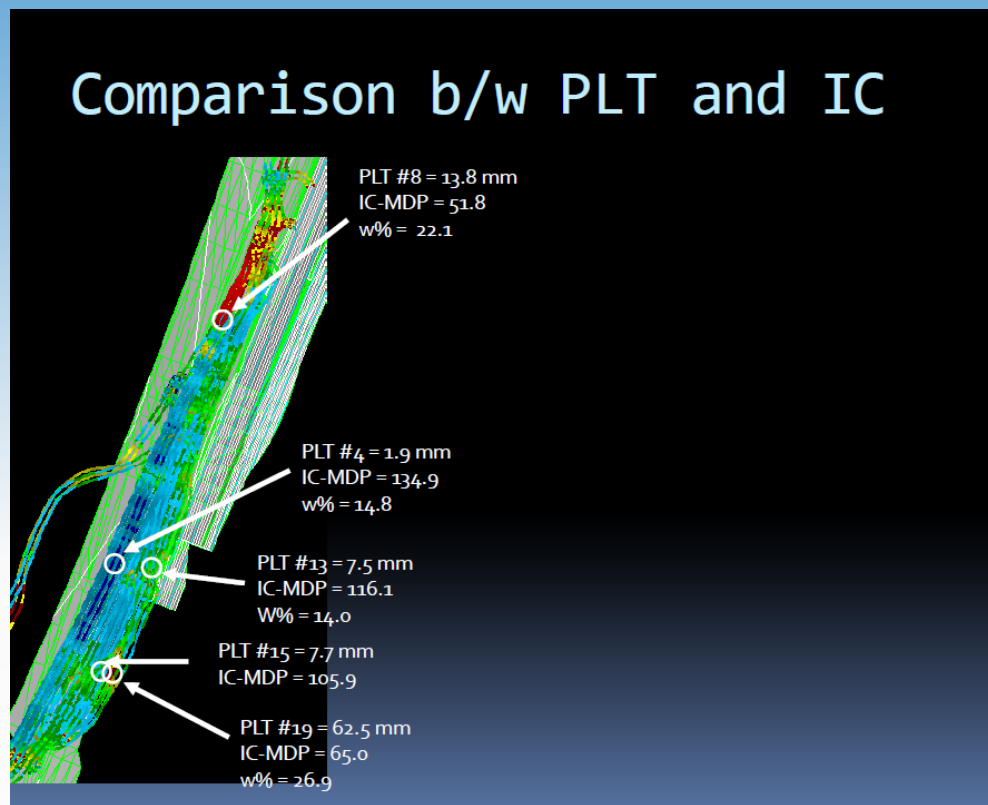


Test Trailer – Plate Load Testing



IC Results from Route 141

Results from Pilot Testing



IC Workshop and Equipment Demo

- **Intelligent Compaction Data Management (ICDM) Workshop March 19, 2014**
 - Overall IC presentation
 - VEDA Intelligent Compaction Software training
- **Equipment Demonstration, March 20, 2014**
 - Caterpillar and Hamm Roller
 - Trimble Demonstration
 - 60 Attendees-Contractors, Consultants and MoDOT Staff



IC Workshop and Equipment Demo





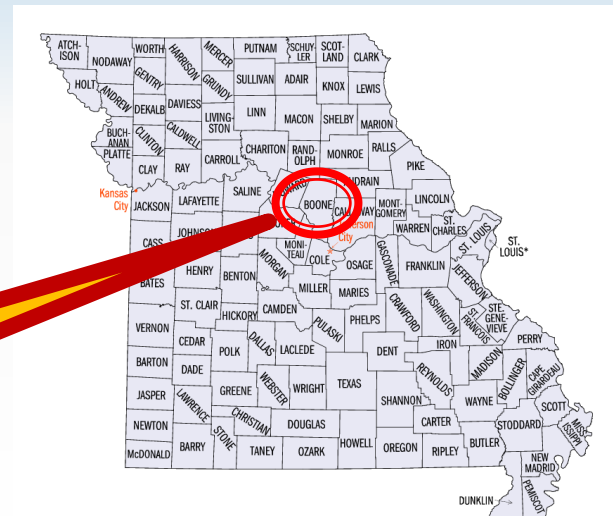
Proof of Concept IC project (4 day test)

Route 63 – Northbound and Southbound lanes

- **Intelligent Compaction System / Rollers**
 - 2 Breakdown Rollers and Finish Roller w/IC
 - Finish Roller with Temperature Sensors
- **MOBA Infrared Technology at Paver**
 - On loan for one week
 - Collects real time thermal profile of 100% mat



**2014,
US 63**



SHRP2 – MoDOT Implementation Efforts



- Implementing Eco-Logical (C06) – User Incentive
- Tools to Organize for Reliability (L01/L06) – Lead Adopter
- Innovative Bridge Designs for Rapid Renewal (R04) – Lead Adopter
- Guidelines for the Preservation of High-Traffic-Volume Roadways (R26) – Lead Adopter
- **Performance Specifications for Rapid Renewal (R07)**
- GeoTechTools (R02) -- User Incentive
- Nondestructive Testing for Concrete Bridge Decks (R06A)
- **Technologies to Enhance Quality Control on Asphalt Pavements (R06C)**

MoDOT History with Scanner

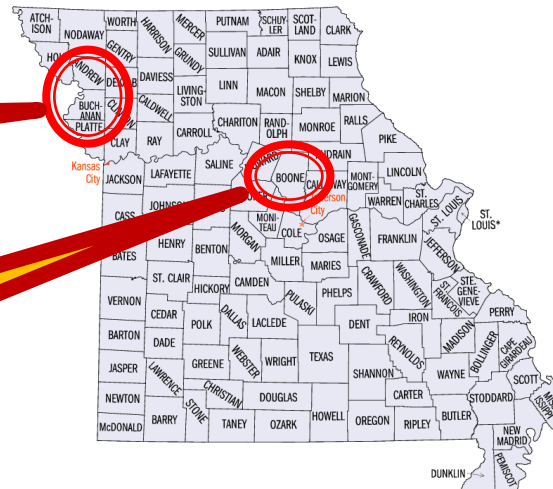


- Demoed Unit in Conjunction with the IC proof of Concept study on US 63 South of Columbia with APAC in 2014.
- In 2015 MoDOT acquired a unit through the SHPR 2 Implementation Program, Utilized in 2015 on I-29



2015, I-29

2014,
US 63



Infrared Scanning Showcase



St. Joseph, MO
June 1, 2016

States Presenting

- Alaska
- Minnesota
- Texas
- Missouri



Field Visits included

- Asphalt Plant
- Paver





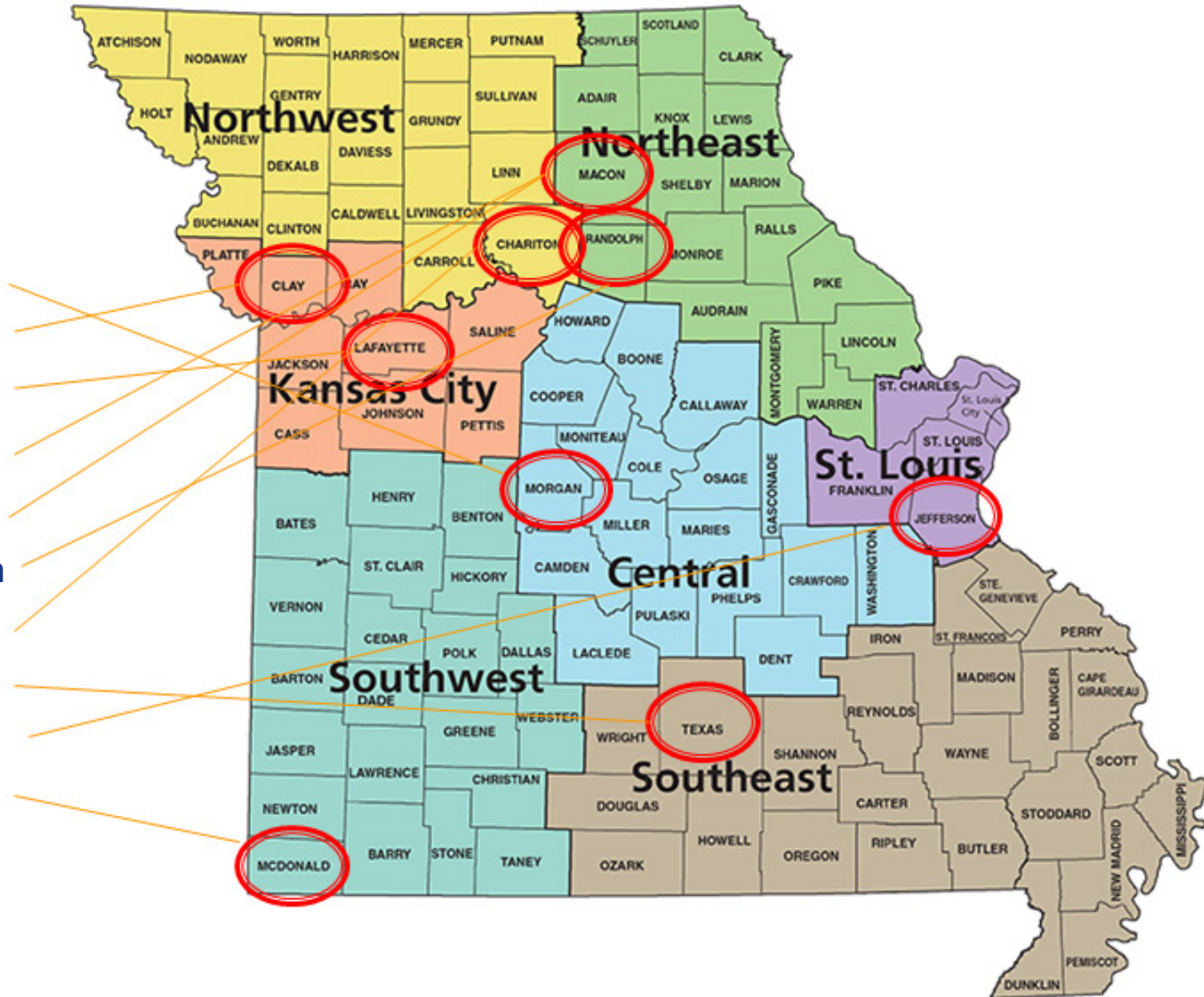
MoDOT receives Accelerated Innovation and Deployment (AID) Grant

AID Grant Details

- Approximately \$750k in grant funding-requires 20% match
- Incorporates Intelligent Compaction and Infrared Scanning in up to 10 projects
- Consultant to be hired to provide on-site evaluation during the IC/IR projects

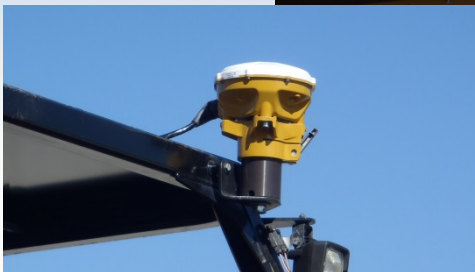
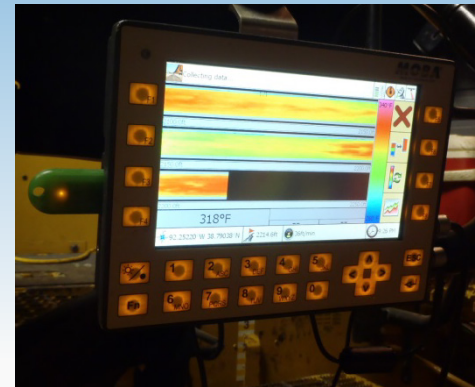
AID Grant Projects

1. MO 52, Morgan
2. I-29, Clay
3. I-70, Lafayette
4. US 36, Macon
5. US 36, Macon
6. US 24, Randolph
7. US 24, Chariton
8. MO 17, Texas
9. US 61, Jefferson
10. I-49, McDonald



Projects Require both...

Intelligent Compaction & Infrared (IR) Scanning



IC Requirements



- Submittals (by Contractor)
 - IC Quality Control Plan
 - Unfiltered Raw Data – Twice per Day
 - Formatted Raw Data – Daily
 - Veta File – Daily
 - Cumulative Report – Every 2 weeks
- Mandatory Training (MoDOT Provided)
- Trial Section
- Determination of Optimum Pass Count
- Survey of Paving Boundaries
- \$50 Incentive/Disincentive per 1000 Feet of Lane.
- Pay Item Included

INTELLIGENT COMPACTION	
1.0 Description. This work shall consist of collecting location, temperature, speed and resistance measurements from properly instrumented rollers within the mainline paving limits and then submitting the data to the Intelligent Compaction (IC) Data Base. The provisions shall apply for the general paving sections.	(c) Cloud Storage and computing is recommended but not required.
2.0 IC Asphalt rollers shall be mounted to and between the roller known as the Plate or Plate is established consistent with the completed demonstrating.	6.0 Global Positioning System (GPS). Radio and receiver units shall be mounted on each IC roller to monitor system shall be accurate.
3.0 Equipment	(a) Set all No. 15 or (c) of Plate or Plate is established consistent with the completed demonstrating.
4.0 Onboard that is capable stiffness, resp temperatures for roller speed shall have the transferring the	5.1 Unfiltered Raw Data. Shall be downloaded twice per day and forwarded to the Engineer before the start of the next day's production.
5.0 Software computing, as much as possible computing if it	5.2 Formatted start of the later. The boundaries, labeled with if applicable.
(a) Filtering (b) Calculate roller, to limits)	5.3 Veta 4 File within 36 hours contain all the at a minimum
6.0 Control submitting the 3,000 feet, or Engineer data segment. The	5.4 Report, 1st and 15th cumulative V report.
7.0 Data Man	5.5 Daily V recorded at the established position with be submitted next day's pr
	6.0 Global Positioning System (GPS). Radio and receiver units shall be mounted on each IC roller to monitor system shall be accurate.
	(a) Set all No. 15 or (c) of Plate or Plate is established consistent with the completed demonstrating.
	(b) Provide Station accurate.
	(c) Provide VRS in the f
	(d) Provide in the f
	(i)
	(ii)
	(iii)
	7.0 Rover. Th with RTK for contractor bed
	7.1 Rover Sp and Class s 1 ppm RMS at Network RTK, Baseline RTK, ensure the GPS rover.
	8.0 Control submitting the 3,000 feet, or Engineer data segment. The
	9.0 Data Man
	10.0 Daily V recorded at the established position with be submitted next day's pr
	11.0 IC Segr
	12.0 Techni site technical the duration shall provide
	13.0 Trainin possess the appendix X1 provided by completion of attend. The li who have no certifications to bring 64-bit installed, s downloaded
	14.0 IC Quality Control Plan. A pre-activity meeting shall be required prior to mainline paving. The IC Quality Control Plan shall be submitted to the Engineer at least 2 weeks prior to the mainline paving per activity meeting. The plan at minimum shall include the following:
	(a) Complete (b) Roller P (c) Details and rov (d) Proceed compa (e) Proceed (f) A list of operator (g) Details (h) The net (i) Proceed (j) Contact (k) A list of contact
	15.0 Corrig. for acceptance accuracy of +1
	16.0 Daily Pr collected with at least every 7 used to define
	17.0 Software Intelligent Com after completed supplied one i
	18.0 Trial Sec max type. The progression ar used on the tr section shall be section shall be one lane and r one Evaluation positioned and compaction. A nuclear gauge pavement den passes are with constructed by passes and op or from the E Evaluation Loc
	19.0 Segment Classification. Passing Segments shall have a minimum of 90% coverage at or above the optimum number of passes. Segments with between 80% and 70% coverage will be called moderate segments. Any segment with less than 70% coverage at the optimum number of passes shall be a Deficient Segment. This includes areas where data is lost. If 70% of the target IC/MV is not obtained, the segment shall be flagged accordingly in the Veta 4 file. All qualifying passes shall have been completed on material which is at or above the minimum temperature specified in Section 403.15.
	20.0 Basis of Payment. Payment for compliance with this provision will be made at the contract unit price for Item No. 401.99.01, Intelligent Compaction, lump sum. In addition, an incentive payment of \$50 per 1000 feet will be made on all Passing Segments and a disincentive deduct of \$50 per 1000 feet will be made on all Deficient Segments. No additional payment will be made for the equipment, software, training, survey, analysis, trial section, trial section cores or any other incidentals necessary to complete the work.
	Incentive or Disincentive Payment = (Length of Days Run) / 1000 x \$50

IR Requirements



- Submittals (by Contractor)
 - Daily MOBA IR Segment Report
- Mandatory Training (MoDOT Provided)
- \$5 Incentive/Disincentive per 150 Feet of Lane.
- Pay Item Included

INFRARED SCANNING - CONTRACTOR SUPPLIED EQUIPMENT

1.0 Description. This work shall consist of collecting the paving location, surface temperature and paver stops with a Contractor supplied, Contractor retained MOBA Pave-IR Infrared Scanner System for the each lift of mainline asphalt pavement. The Infrared (IR) scanner shall be used to continually monitor the surface temperature of the mat immediately behind the paver screed during paving operations in order to determine the temperature differential for each segment. The scanner itself mounts overhead at the back of the paver. Data from the scanner shall be automatically uploaded and processed through a wireless data connection.

2.0 IR Scanning Equipment. The system shall include a speed sensor, GPS antenna, control panel to measure the surface temperature over the course of the run. The control panel shall be recorded via the GPS antenna. The control panel shall be necessary to control the system as well as to provide visualization during the paving process. The system shall also upload the data directly to e-Record and shall be supplied by the contractor for use on the project.

3.0 Pave-IR Training. A 2 - 4 hour training session shall be provided to the contractor staff on the set-up, operational interpretation of output report staff shall be on site when the IR scanner is used for scanning and mainline paving shall not be performed.

4.0 IR Segments. The pavement will be divided into segments that are 150 feet in length and of multiple days or runs.

5.0 Temperature Differentials. The temperature and low surface temperatures in each 150-foot segment shall determine the temperature differential of each segment as shown in the table below.

RANGE
Range ≤ 25.0 F
25.0 F < Range ≤ 50.0 F
Range > 50.0 F

6.0 Data Management. All of the header information shall be included in the automatic MOBA IR report and electronically submitted to the engineer for review. Each file shall be labeled with the contractor name and ending log mile, and lane if applicable (e.g., 100+000, Lane 1).

7.0 Incentive/Disincentive. The Engineer will calculate the incentive/disincentive according to the following table.

Thermal Segregation Category	Adjustment per 150 foot IR Segment
Low	\$5 incentive
Moderate	No Pay Adjustment
Severe	\$5 disincentive

8.0 Basis of Payment. Payment for compliance with this provision will be made at the contract unit price for Item No. 401-99.02, Infrared Scanning, lump sum. No additional compensation will be provided to the contractor for any direct or indirect cost, including scheduling delays, installation, equipment, training or the affiliated data processing.

Coming Soon...

**Rte. 24 Randolph to begin in one week
Starting – Monday, September 26th.**



Performance Testing of Asphalt Mixtures



Balancing Asphalt Mix Design



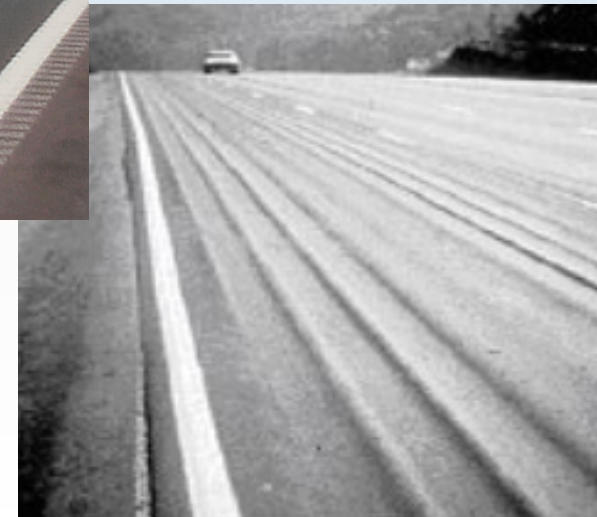
Optimal Design



Cracking



Rutting

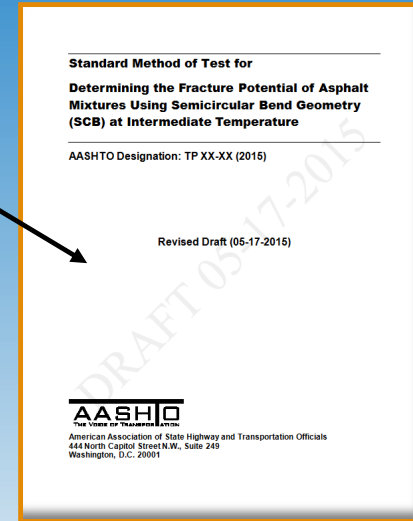


Cracking Tests



AASHTO Semicircular Bend Geometry (SCB) Report

- DCT
- SCB at Low Temperature
- IDT for Low Temp Cracking
- TSRST/UTSST
- Texas Overlay
- Bending Beam
- **SCB at Intermediate Temp (Illinois)**
- IDT for Top Down Cracking
- S-VECD
- Repeated Direct Tension
- **SCB at Intermediate Temp (Louisiana)**

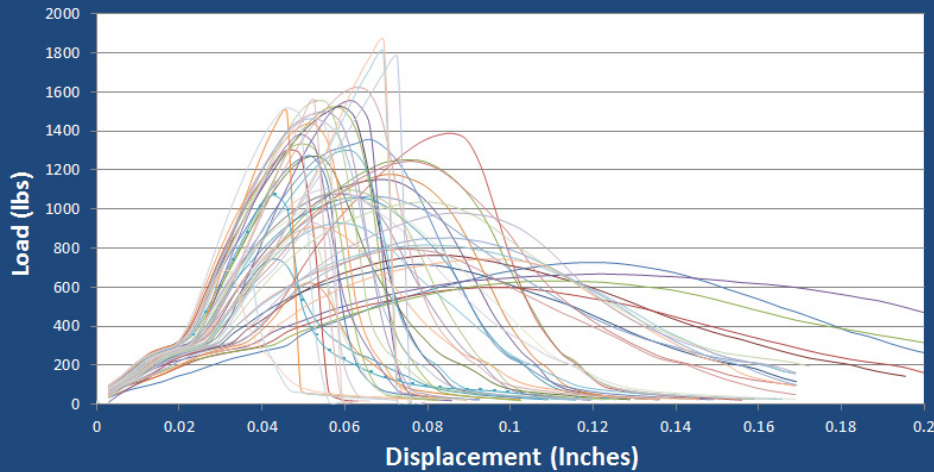


Asphalt Mixture Performance Testing



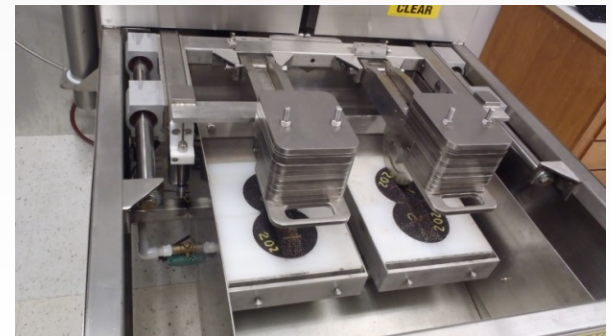
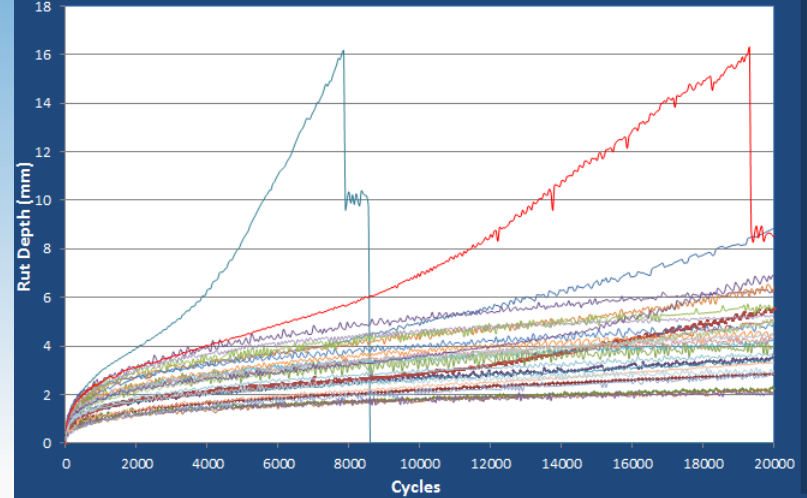
Cracking

0.6 Inch Notch Depth Samples



Rutting

Hamburg Results



Mixture Performance Testing

- Mix Design Acceptance



SMA Designs with RAP - Value Engineering Proposals



Performance Testing

- SCB - -> Cracking
- Hamburg -> Rutting
- TSR -> Stripping

State Emblems



State Bird: Bluebird



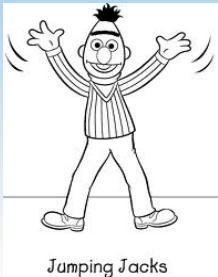
State Insect: Honey Bee



State Musical Instrument: Fiddle



State Dinosaur: Hypsibema Missouriensis Dinosaur



Official State exercise-Jumping Jacks



State Official Animal: Missouri Mule



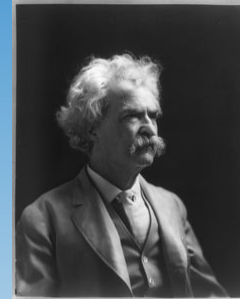
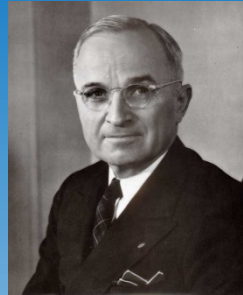
Official State Reptile: Three-toed box turtle



Official State Dessert: ice cream cone



Thank You!



Dan Oesch, PE
Field Materials Engineer
Construction and Materials
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