The Long Term Pavement Performance (LTTP) Program Warm Mix Asphalt Experiment and Arizona’s Participation

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Presentation Outline

- Overview of LTPP
- LTPP Projects in Arizona
- LTPP Warm Mix Asphalt Experiment
- Arizona’s Warm Mix Mix Projects
Introduction

- The LTPP program began in 1987 as the Strategic Highway Research Program (SHRP)
- The longest running highway research program in history
- $200+ Million study
- Over 2,500 test sections—over 700 still active
- 16 data modules, 430 tables, 8,000 data elements
LTPP’s GOAL is....

to provide answers to **HOW** and **WHY**
pavements perform as they do!
LTPP’s CORE FUNCTIONS

- Data Collection and Management
- Data Analysis
- Product Development
LTPP Data Collection

Climate → Material Properties

Traffic

Pavement Structure

Pavement Condition
The LTPP program has generated a wide range of benefits all across the pavement engineering and performance spectrum.
## Return on Investment

**LTPP by the Numbers**

<table>
<thead>
<tr>
<th>LTPP Resource</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requests for Data</td>
<td>48,000 Requests</td>
</tr>
<tr>
<td>Registered LTPP Website Users</td>
<td>3,000 Users (in 75 Countries)</td>
</tr>
<tr>
<td>Published Documents Resulting from LTPP Data</td>
<td>500+ Publications</td>
</tr>
<tr>
<td>ASCE Paper Contest</td>
<td>60 Entries</td>
</tr>
<tr>
<td>Distress Manuals</td>
<td>20+ State Agencies</td>
</tr>
<tr>
<td>FWD Calibration Centers</td>
<td>500+ Calibrations</td>
</tr>
<tr>
<td>WIM Systems</td>
<td>550+ Installations</td>
</tr>
<tr>
<td>SPS Traffic Pooled Fund Study Installations</td>
<td>21 WIM Sites Installed</td>
</tr>
<tr>
<td>MRL Materials</td>
<td>2,000,000 Pounds Available</td>
</tr>
<tr>
<td>MRL Shipments</td>
<td>17,000 Pounds Delivered</td>
</tr>
</tbody>
</table>

The numerous innovations that have directly resulted from the LTPP program include procedures, tools, manuals, and research findings that have been implemented across the United States and abroad.
LTPP has already realized $2 Billion in savings, with the potential for even greater future savings.

<table>
<thead>
<tr>
<th>Savings To Date</th>
<th>Projected Cumulative Future Savings (2015-2024)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Additional Monitoring</td>
</tr>
<tr>
<td></td>
<td>Continued Monitoring</td>
</tr>
<tr>
<td>$2 Billion</td>
<td>$2.28 Billion</td>
</tr>
<tr>
<td></td>
<td>$4.56 Billion</td>
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</tbody>
</table>
LTPP Test Sections In Arizona
General Pavement Studies (GPS)

- Focus on most commonly used pavement designs
- Experimental design: full factorial
- One 500 foot section per location

<table>
<thead>
<tr>
<th>Primary Factors</th>
<th>Secondary Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgrade: fine &amp; course</td>
<td>AC thickness</td>
</tr>
<tr>
<td>Traffic: medium &amp; heavy</td>
<td>AC stiffness</td>
</tr>
<tr>
<td>Temp: freeze and non-freeze</td>
<td>SN of base and subgrade</td>
</tr>
<tr>
<td>Moistures: wet and dry</td>
<td>PCC thickness</td>
</tr>
<tr>
<td></td>
<td>Joint spacing</td>
</tr>
</tbody>
</table>
GPS Projects in Arizona
A Total of 25 Projects*

GPS-1  →  Asphalt Concrete (AC) on Granular Base (16)
GPS-2  →  Asphalt Concrete on Bound Base (2)
GPS-3  →  Jointed Plain Concrete (JPC) (2)
GPS-5  →  Continuously Reinforced Concrete (CRC) (1)
GPS-6  →  Asphalt Concrete Overlay on AC (17)

*Overlay projects can be in two experiments
Specific Pavement Studies (SPS)

Focus on certain pavement engineering factors
Experimental design: half factorial
Multiple 500 foot sections per location

Primary Factors
- Subgrade: fine & course
- Traffic: medium & heavy
- Temp: freeze and non-freeze
- Moistures: wet and dry

Secondary Factors
- AC drainage - yes, no
- AC thickness
- AC base type and thickness
- PCCP drainage - yes, no
- PCC strength and thickness
- Lane width
- Base type
SPS Projects in Arizona
A Total of 12 Projects (121 Test Sections)

- **SPS-1** → Strategic Study of Structural Factors for Flexible Pavements (1)
- **SPS-2** → Strategic Study of Structural Factors for Rigid Pavements (1)
- **SPS-3** → Preventative Maintenance Effectiveness for Flexible Pavements (4)
- **SPS-4** → Preventative Maintenance Effectiveness for Rigid Pavements (1)
- **SPS-5** → Rehabilitation of Asphalt Concrete Pavements (1)
- **SPS-6** → Rehabilitation of Jointed Portland Cement Concrete Pavements (1)
- **SPS-9** → Superpave Asphalt Binder Study (3)
Accessing LTPP Data

www.infopave.com
LTPP Warm Mix Asphalt Experiment: Why WMA?

- 356 million tons of WMA produced in 2012
  - 24% of all plant mix produced in US was WMA
- 35 different WMA technologies
- WMA is a priority innovation under FHWA’s Every Day Counts (EDC) Initiative
SPS-10 Objectives

- Long-term performance of WMA relative to HMA
- Capture data on WMA with RAP
SPS-10 Benefits to Agencies

- Detailed construction information including a construction report
- Rigorous materials testing (over multiple intervals) using latest testing technology
- Ongoing FWD, distress, profile, and texture monitoring to study short and long term performance
- Ability to study Agency-specific issues related to WMA
SPS-10 Requirements

Overview

- AC overlay of existing AC pavements
- 2” to 4” overlay thickness
- Dense graded mix
- RAP content 10-25% (binder replacement)
- 1 HMA control test section
- 2 WMA test sections
  - Foaming Process
  - Chemical Additive
- Tack Coats between lifts
WMA:

- Production of $\leq 275^\circ$F or
- Production at least 30°F less than HMA
Agencies can build additional test sections that will be monitored as part of the LTPP program.

- Varying levels of RAP
- Additional WMA technologies
- Layer thickness variation
- Open or gap graded mixtures
- Varying aggregate sources/absorption levels
- Other variables of interest to Agency
SPS-10 Materials Testing Goals

- Investigate changes in WMA performance-related properties during initial aging period
  - What are these properties after initial aging
  - When do they stabilize
  - How can we predict them from initial state

- Provide inputs for MEPDG modeling
  - Must include existing pavement layers

- Provide data set for the development of future models
Tracking changes in properties under field conditions requires field-aged specimens.

Potential bias between field specimens and laboratory-created specimens and test procedures means cores are required even for initial round of testing.
SPS-10 Tests on Experiment Layer

- Dynamic Modulus – Small-scale AMPT (TP 79)
  - 0, 3-6, 12 and 18 months after construction
- 38 mm diameter x 110 mm height specimens
  - Re-cored horizontally from 6” diameter core
  - Otherwise in accordance with AASHTO TP79
SPS-10 Tests on Experiment Layer (cont.)

- **Binder Testing** – DSR, BBR, MSCR
  - Tank Binder
  - Extracted binder at 0, 3-6, 12, and 18 months

- **Hamburg Wheel Tracker**
  - Initial time period only

- **Basic Mix Characterization**
  - BSG, $G_{mm}$, $P_b$, $G_{se}$, $G_b$, aggregate gradation
SPS-10 Tests on Existing AC Layers

- Dynamic Modulus – Small-scale AMPT (TP 79)
- Binder Testing – DSR, BBR, MSCR
- Hamburg Wheel Tracker
- Basic Mix Characterization
  - BSG, $G_{mm}$, $P_b$, $G_{se}$, $G_b$, aggregate gradation

All tests performed at initial time period only
SPS-10 Tests on Unbound Layers

- Sieve Analysis
- Atterberg Limits
- Classification
- Natural Moisture Content
- Dynamic Cone Penetrometer
Arizona’s SPS-10 Projects

- Two Projects
  - La Paz
  - Navajo
La Paz SPS-10

- 4 " Mill and Overlay
- 2.9 Million ESALs/Yr
- 10-13" AC/ARAC
- 4” Aggregate Base
- Dry-No Freeze
- 15-20% RAP
La Paz SPS-10 (cont.)

Core Test Sections
- HMA Control (PG76-16)
- Foaming
- Evotherm
Supplemental Test Sections

- Wet Process ARAC, no RAP
- Wet Process ARAC w/ Evotherm, no RAP
- Conventional Fiber Modified (polyolefin, Aramid)
- Evotherm Fiber Modified (polyolefin, Aramid)
- Conventional w/ 30% RAP
- Foaming w/ 30% RAP
- Evotherm w/ 30% RAP
Navajo SPS-10

- 4 " Mill and Overlay
- 2.5 Million ESALs/Yr
- 12-14” AC/ARAC
- 3.5” Aggregate Base
- Dry-Freeze
- 15-20% RAP
Navajo SPS-10 (cont.)

Core Test Sections
  – HMA Control (PG70-22)
  – Foaming
  – Evotherm
Supplemental Test Sections

- Wet Process ARAC, no RAP
- Wet Process ARAC w/ Evotherm, no RAP
- Conventional Fiber Modified (polyolefin, Aramid)
- Evotherm Fiber Modified (polyolefin, Aramid)
- Conventional w/ 30% RAP
- Foaming w/ 30% RAP
- Evotherm w/ 30% RAP
Arizona’s SPS-10’s Looking Forward

La Paz Timeline Estimate
– Contract Letting: April 2015
– Construction Start: July 2015
– Construction Completion: November 2015

Navajo Timeline Estimate
– Contract Letting: April 2015
– Construction Start: June 2015
– Construction Completion: October 2015
Questions?
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Thank You!