SPS-2 Concrete Pavement Preservation Experiment
TPF-5-(291)

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State Pavement Engineer
Washington State DOT
LTPP SPS Program Areas

- SPS-1: Structural Factors for AC Pavements
- **SPS-2: Structural Factors for Concrete Pavements**
- SPS-3: Preventive Maintenance for AC Pavements
- SPS-4: Preventive Maintenance for Concrete Pavements
- SPS-5: Rehabilitation of AC Pavements
- SPS-6 Rehabilitation of Concrete Pavements
- SPS-7: Bonded Concrete Overlays
- SPS-8: Study of Environmental Factors
- SPS-9: SuperPave Mixes
SPS-2: Strategic Study of Structural Factors for Rigid Pavement

- Concrete Thickness (8” & 11”)
- Base Type (LCB, DGAB, PATB)
- Flexural Strength (550 psi & 900 psi)
- Slab Width (12’ & 14’)
- Edge Drains (with PATB)

Site Factors
- Temperature (freeze & no-freeze)
- Precipitation (wet & dry)
- Subgrade (fine & coarse)

5 design factors
3 site factors
Final Experiment was a one-half fractional factorial experiment based on construction of 16 experimental locations, with 12 test sections each.

Only 14 experiments were constructed, not 16 and one failed early on so only 13 experiments were available for most of the evaluation period.
Table 5. Current status of SPS-2 experiment.

<table>
<thead>
<tr>
<th>Base Type/Edge Drain</th>
<th>PCC</th>
<th>Lane Width</th>
<th>Climate Zones, Subgrade, Site</th>
<th>Climate Zones, Subgrade, Site</th>
<th>Climate Zones, Subgrade, Site</th>
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<td>MI, IA</td>
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</table>

Note: The table continues with similar entries for other combinations of PCC, Lane Width, and Base Type/Edge Drain.
Traffic Levels on SPS-2 Experiments
Seasonal Monitoring Sites and SPS-8 Experiment

- **Seasonal Monitoring Sites:** “…variations in pavement response and material properties due to the separate and combined effects of temperature, moisture and frost/thaw variations.”
  - Four SPS-2/SM Projects: AZ, NC, NV, OH:

- **SPS-8:** The effect of climatic factors and subgrade type on pavement sections incorporating different designs and subjected to very limited traffic as measured by the ESAL accumulation
  - Six SPS-2/8 Projects: AR, CA, CO, OH, WA
States Constructing LTPP SPS-2 Experiments

- States with Seasonal Monitoring Sites

Map of the United States showing states with different seasonal freezing conditions and monitoring sites.
Structural Factors of Jointed Plain Concrete Pavements: SPS-2—Initial Evaluation and Analysis

PUBLICATION NO. FHWA-RD-01-167

APRIL 2005

Authored by Y. Jane Jiang and Michael I. Darter, ERES Consultants
LTPP’s GOAL is…

to provide answers to HOW and WHY pavements perform as they do!
Development of an SPS-2 Pavement Preservation Experiment: TPF-5-(291)

Arizona California Colorado Georgia Kansas North Carolina Washington
Washington - 1918 Concrete Slabs
WSDOT PCCP Preservation

Distribution of PCCP Miles by Rehabilitation Method

- Untouched, Built Before 2000
- Dowelled, Built After 2000
- DBR
- Grind
- Panel Replacement

25% 25% 25% 25%

Total Untouched Built Before 2000: 1130 (55%)
Total Dowelled Built After 2000: 179 (9%)
Total DBR: 352 (17%)
Total Grind: 225 (11%)
Total Panel Replacement: 156 (8%)

Lane Miles

Majority Age of Selection (years)

Long Term Pavement Performance (LTPP)
# FHWA Evaluation Criteria

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<th>Measure</th>
<th>Assessment</th>
<th>Population Consideration</th>
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# FHWA Cracking Criteria

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<th>Drainage Base Type</th>
<th>PCCP Thickness (inches)</th>
<th>Flexural Strength 14-D (psi)</th>
<th>Lane Width (ft)</th>
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<td>900</td>
<td>12</td>
<td>14</td>
<td>WET NO FREEZE</td>
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</tbody>
</table>

**Legend:**
- **WET**
  - FREEZE: KS, ND, DE, WI, NC, AR
  - NO FREEZE: WA, CO
- **DRY**
  - FREEZE: CA, AZ
  - NO FREEZE: CA, AZ

**Drainage:**
- Yes: PATB
- No: DGAB, LCB

**Base Type:**
- DGAB
- LCB
- PATB
## FHWA Faulting Criteria

<table>
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<tr>
<th>Drainage Type</th>
<th>Base Type</th>
<th>Thickness (inches)</th>
<th>Flexural Strength 14-D (psi)</th>
<th>Lane Width (ft)</th>
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</table>

**PCCP**

**FREEZE**

- Fine: KS ND DE WI NC AR
- Coarse: WA CO CA AZ

**NO FREEZE**

- Fine: WS
- Coarse: WS

**WET**

- Fine: WS
- Coarse: WS

**DRY**

- Fine: WS
- Coarse: WS
Issues with LTE as Performance Measure

\[
\begin{align*}
y &= -0.6774x + 91.348 \\
R^2 &= 0.4484 \\
y &= -0.7237x + 92.143 \\
R^2 &= 0.6407 \\
y &= 0.1859x + 87.614 \\
R^2 &= 0.0536 \\
y &= -0.4512x + \ldots \\
R^2 &= 0.3103
\end{align*}
\]
Conclusions

- Base Type the Most Significant Design Feature
- PATB is Best Performing Base (cracking and roughness)
- LTE Results Indicate PATB is Worst Performing Base
- Roughness Most Difficult FHWA Criteria to Meet
- Faulting Criteria is Easiest FHWA Criteria to Meet
- Both LTE and Cracking Should be Further Investigated in Terms of Suitability
Project Unfolds in Two Phases:

• Phase 1 focuses on assessing what sections exist, what data is available, and to identify what can and cannot be studied on the remaining test sections
  – Six Month Study by Nichols Consulting (11/1/15 to 4/2016)

• Phase 2 will be the development and implementation of the preservation experiment that will be developed after the conclusion of the Phase 1 effort
Phase 1 Opportunities

- Analyze selected SPS-2 sites with Pavement ME and compare predicted performance to actual performance
Non Traditional Phase 2 Opportunities

- Passing of the baton
- Great training opportunity
- Bring to bear the best minds on determining preservation strategies
- Renew and sustain interest in future SPS-2 evaluations
- Generate awareness of and Tech Transfer for SPS-2 performance—impact of design features
Non Traditional Phase 2 Opportunities

• Engage all of the industry to develop the best experiment
Test Section Layout

Base Types
- Dense Graded Aggregate Base (4" & 6")
- Permeable Bituminous Treated Base (4")  Note: These are the only Sections with Edge Drains
- Lean Concrete Base (6")
- Bituminous Treated Base (4")

Shoulder Types
- 12 ft Shoulder Width
- 14 ft Shoulder Width
Phase 2 Opportunities

• Conduct a Tech Day At Selected SPS-2 Location
  – Host workshop and field review of site
  – During field review all participants rate test sections and recommend strategies (ETG panel will participate in all field reviews)
Phase 2 Opportunities

• Conduct a Tech Day at Selected SPS-2 Location
  – Participants can compare their own evaluations to group evaluations and ETG
  – Each state identifies current and future Issues—living SPS-2 sites
What are Potential Opportunities?

• Life extension of concrete pavement
• Development of PMS triggers for concrete preservation
• Improved ride quality
• PCCP design life verification
What are Potential Opportunities?

- Comparison of structural capacity to remaining service life
- Sealant research
- Texture durability
- Changes in material properties over time
What are Potential Opportunities?

- Development of the best preservation techniques and materials
- US scanning tour of the SPS-2 performance
- Evaluation of non-destructive test devices
What are Potential Opportunities?

• Extending environmental monitoring test results
• Improving the current SPS-2 experiment
• Dowel bar retrofit (DBR)
• Implementing SHRP2 R26 “Preservation Approaches to High Traffic-Volume Roadways”
What are Potential Opportunities?

- Measurement of solar reflectance
- Rolling resistance measurement
- Evaluation of joint opening movement data from SMS sites
- Curl and warp analysis
Contacts:

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- Jeff Uhlmeyer, WSDOT, State Pavement Engineer, UhlmeyJ@wsdot.wa.gov, 360-709-5485

TPF-5-(291)

If you would like to participate or have questions regarding this pooled fund study, please contact Jeff Uhlmeyer or Lu Saechao.