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

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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)**

5 design factors

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

3 site factors

Statistical Design of SPS-2 Experiment

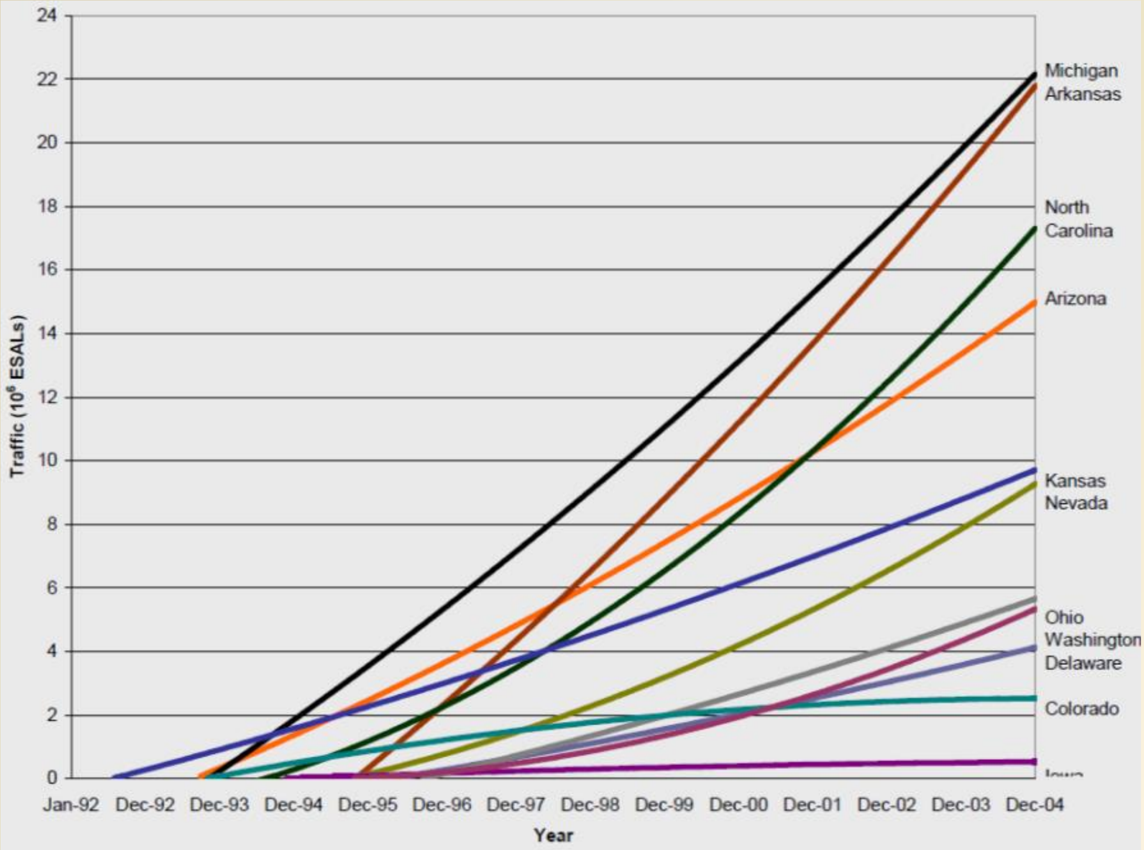
- **Final Experiment was a one-half fractional factorial experiment based on construction of <u>16 experimental locations, with 12 test sections each</u>.**

- **<u>Only 14 experiments were constructed, not 16</u> and one failed early on so <u>only 13 experiments were available</u> for most of the evaluation period.**

Table 5. Current status of SPS-2 experiment.

Pavement Structure				Climate Zones, Subgrade, Site															
				Wet								Dry							
Base Type/ Edge Drain	PCC		Lane Width m	Freeze				No-Freeze				Freeze				No-Freeze			
	Thick mm	Flexural Strength MPa		Fine		Coarse		Fine		Coarse		Fine		Coarse		Fine		Coarse	
				J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
AGG	203	3.8	3.66	OH, KS		DE		NC						NV, WA				CA[1]	
			4.27		MI, IA		WI		AR				ND		CO				AZ
		6.2	3.66		MI, IA		WI		AR				ND		CO				AZ
			4.27	OH, KS		DE		NC						NV, WA				CA[1]	
	279	3.8	3.66		MI, IA		WI		AR				ND		CO				AZ
			4.27	OH, KS		DE		NC						NV, WA				CA[1]	
		6.2	3.66	OH, KS		DE		NC						NV, WA				CA[1]	
			4.27		MI, IA		WI		AR				ND		CO				AZ

Traffic Levels on SPS-2 Experiments

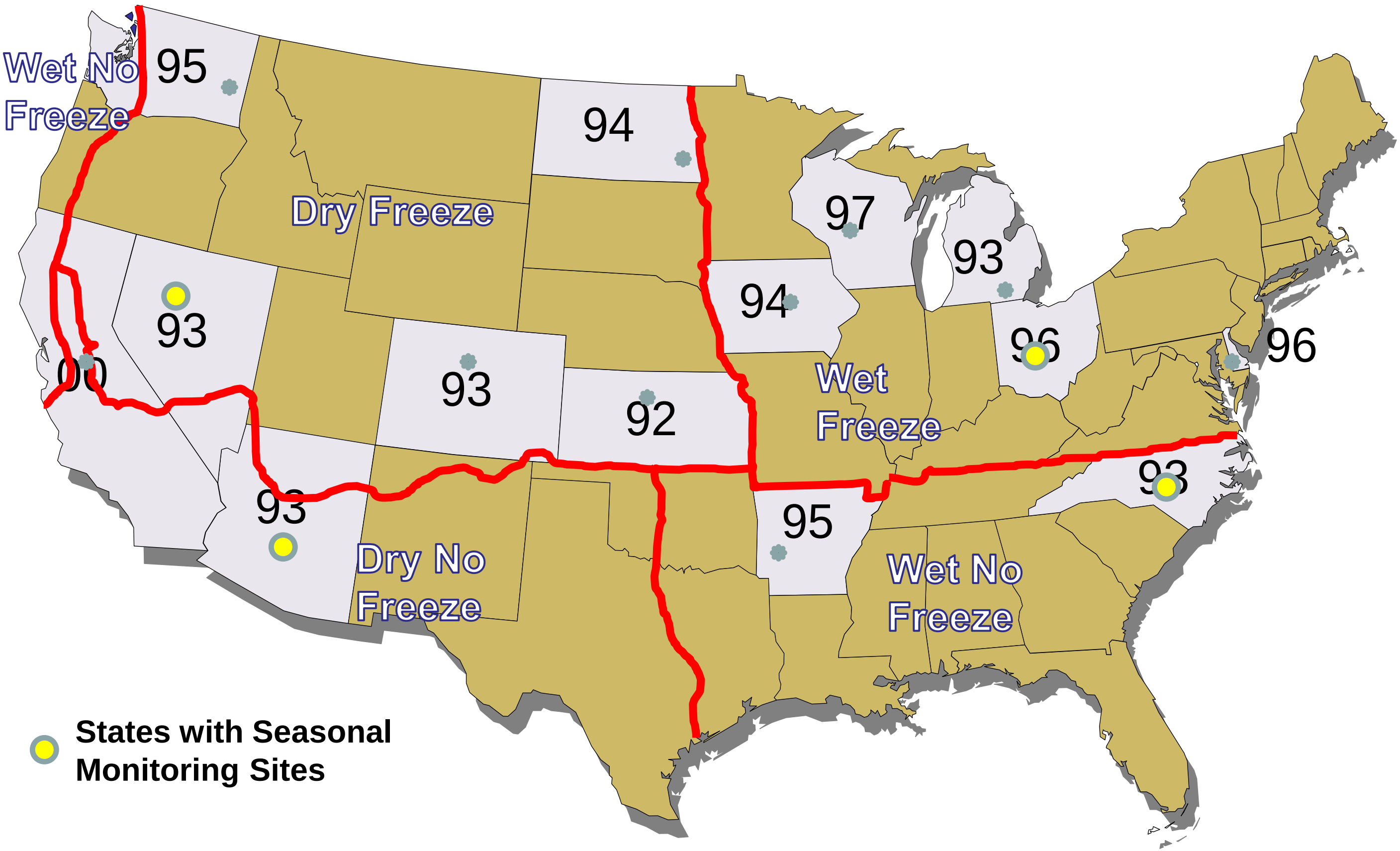


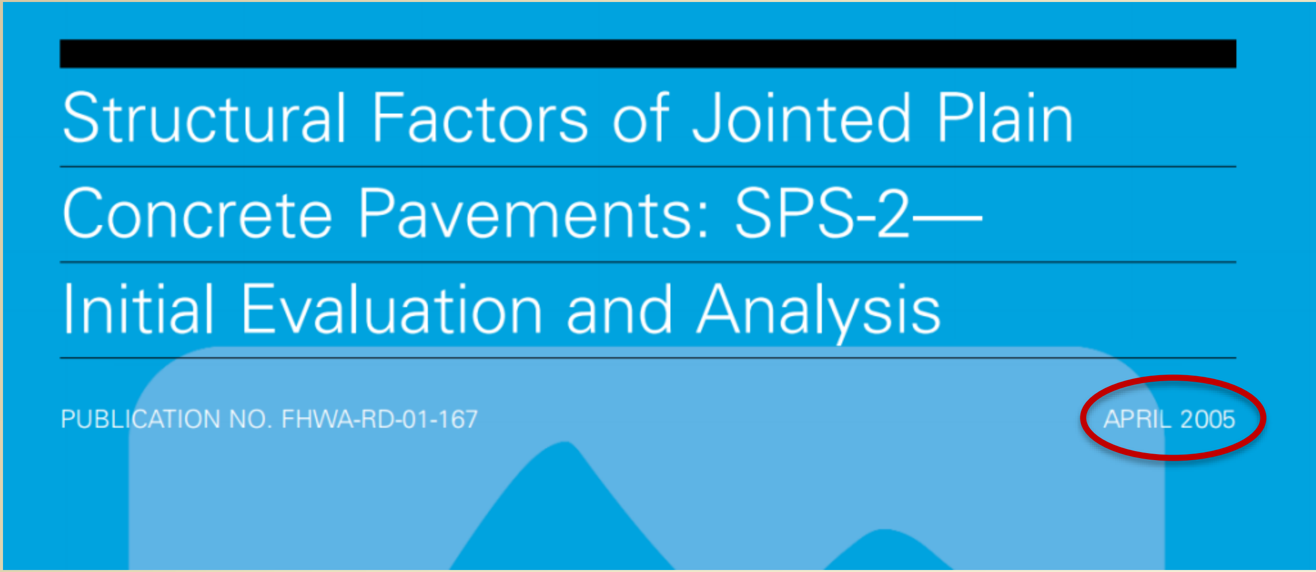
Seasonal Monitoring Sites and SPS-8 Experiment

- **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





Structural Factors of Jointed Plain Concrete Pavements: SPS-2— Initial Evaluation and Analysis

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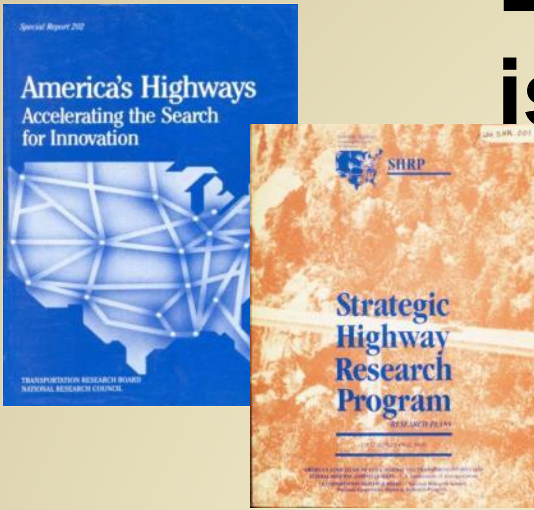
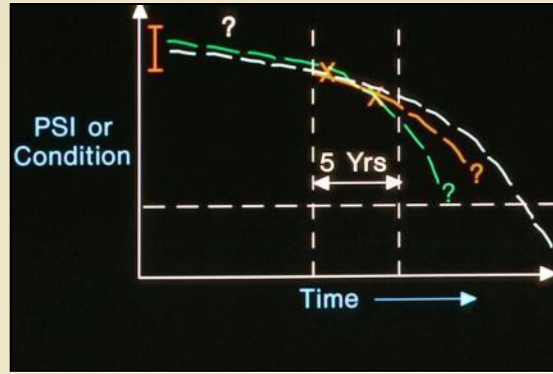
Authored by Y. Jane Jiang and Michael I. Darter, ERES Consultants

LTPP's GOAL is…





to provide answers to

HOW and ***WHY***

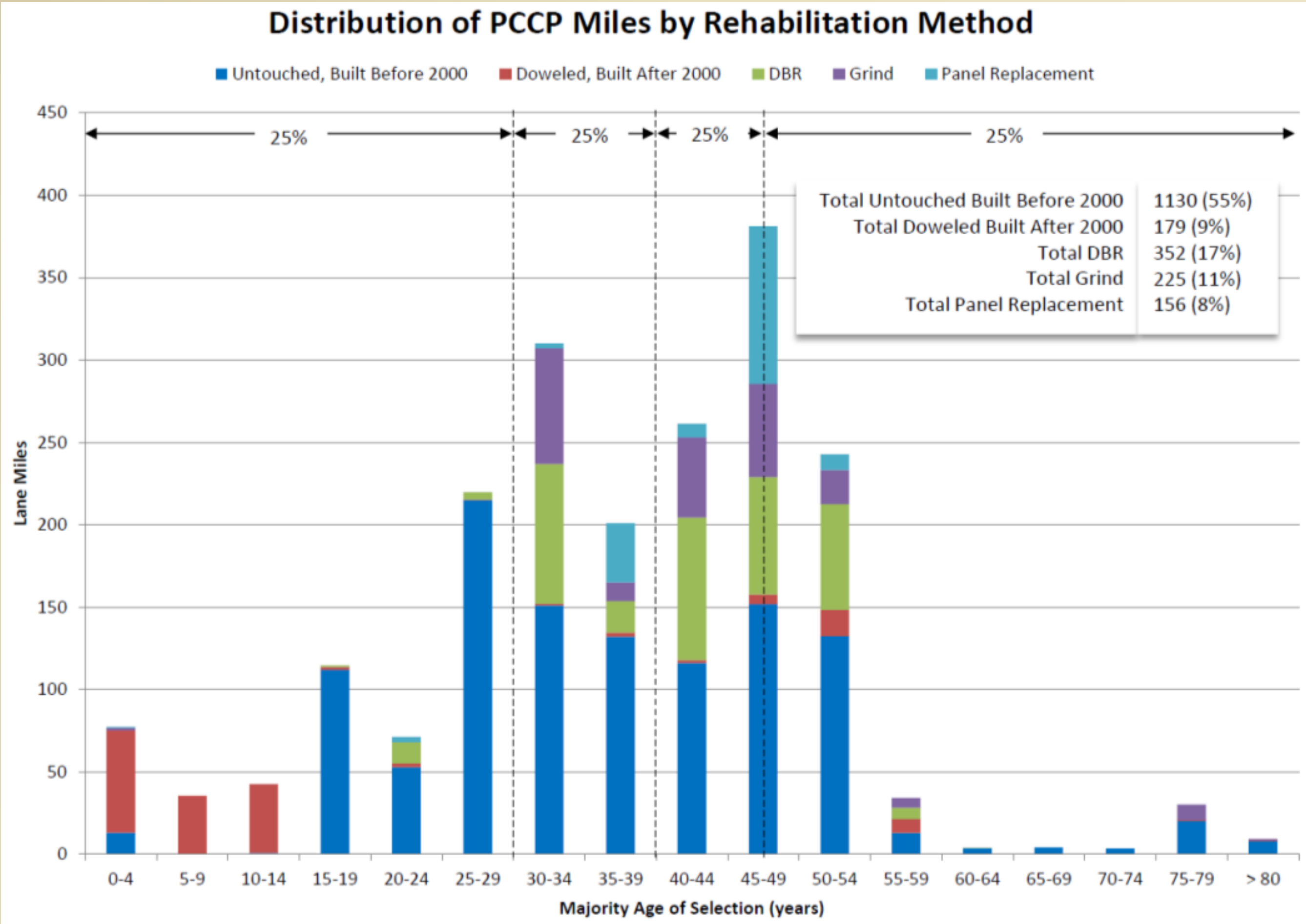
pavements perform as they do!

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



Long Term Pavement Performance (LTPP)

FHWA Evaluation Criteria

Measure	Assessment					
IRI (in/mi)	Population Consideration					
	Population < 1 Million			Population > 1 Million		
	Good	Fair	Poor	Good	Fair	Poor
	<95	95 - 170	>170	<95	95 - 220	>220
	No Population Considerations					
Cracking Percent	Good	Fair	Poor			
	<5	5 - 10	> 10			
Faulting (in)	No Population Considerations					
	Good	Fair	Poor			
	< 0.05	0.05-0.15	> 0.15			

FHWA Roughness Criteria

Pavement Structure					Climatic Zones, Subgrade															
Drainage	Base Type	PCCP		Lane Width (ft)	WET								DRY							
		Thickness (inches)	Flexural Strength 14-D (psi)		FREEZE				NO FREEZE				FREEZE				NO FREEZE			
					Fine		Coarse		Fine		Coarse		Fine		Coarse		Fine		Coarse	
					KS	ND	DE	WI	NC	AR			WA	CO					CA	AZ
No	DGAB	8	550	12	8				7										4	
				14						5										3
			900	12		18				0										16
				14					4										10	
		11	550	12		0		13		7				14						5
				14	8				0										0	
			900	12			9		9										1	
				14		0		0		5				18						18
No	LCB	8	550	12	10				0											
				14		10				6				0						
			900	12		13				12				12						
				14	5				5				3						13	
		11	550	12		10				13				0						13
				14	0		10		0				13						12	
			900	12	0		0		0				8						1	
				14				12		0				0						
Yes	PATB	8	550	12									16							
				14				15						15						
			900	12				0		13				18						
				14																
		11	550	12										0						15
				14															0	
			900	12	0		2												12	
				14		0				0				0						18

FHWA Cracking Criteria

Pavement Structure					Climatic Zones, Subgrade															
		PCCP			WET								DRY							
					FREEZE				NO FREEZE				FREEZE				NO FREEZE			
Drainage	Base Type	Thicknes (inches)	Flexural Strength 14-D (psi)	Lane Width (ft)	Fine		Coarse		Fine		Coarse		Fine		Coarse		Fine		Coarse	
					KS	ND	DE	WI	NC	AR			WA	CO					CA	AZ
No	DGAB	8	550	12	7														1	
				14						7										
			900	12																
				14	12								12						1	
		11	550	12																
				14																
			900	12																
				14										9						
No	LCB	8	550	12			1		6				4						1	
				14		0				5										4
			900	12						5										4
				14									1						1	
		11	550	12																9
				14									7						4	
			900	12	20														3	
				14																
Yes	PATB	8	550	12																
				14						12										
			900	12																17
				14																
		11	550	12										18						
				14																
			900	12																
				14																

FHWA Faulting Criteria

Pavement Structure					Climatic Zones, Subgrade															
		PCCP			WET								DRY							
					FREEZE				NO FREEZE				FREEZE				NO FREEZE			
Drainage	Base Type	Thickness (inches)	Flexural Strength 14-D (psi)	Lane Width (ft)	Fine		Coarse		Fine		Coarse		Fine		Coarse		Fine		Coarse	
					KS	ND	DE	WI	NC	AR			WA	CO					CA	AZ
No	DGAB	8	550	12	9														8	
				14						7										
			900	12						15				15						18
				14	17														8	
		11	550	12						7										
				14																
			900	12																
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No	LCB	8	550	12																
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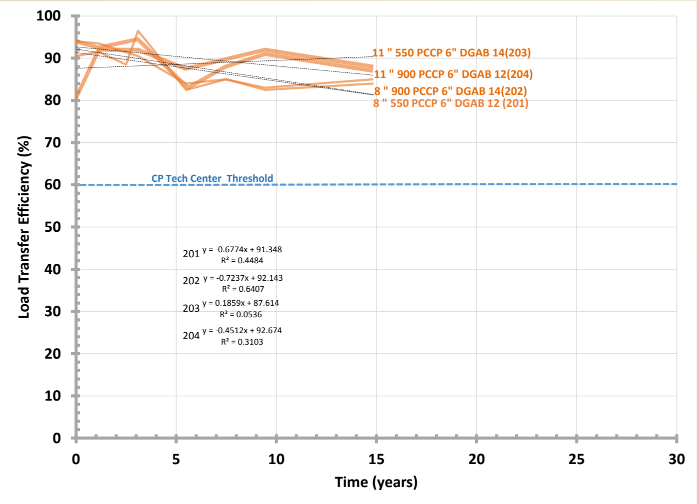
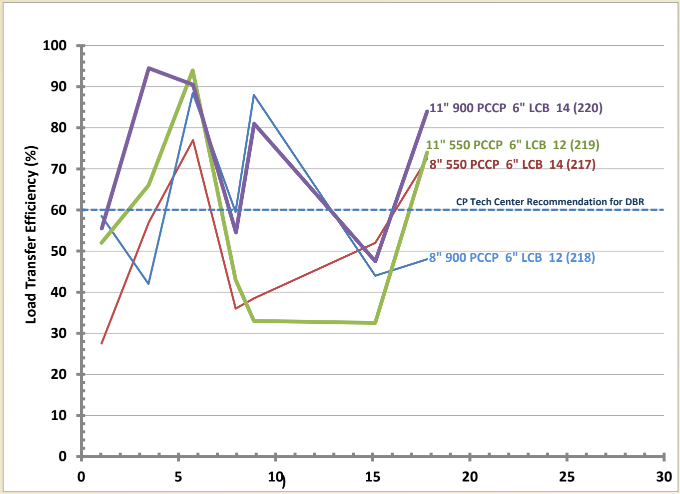
				14																
		11	550	12		16														
				14																
			900	12																
				14																
Yes	PATB	8	550	12																
				14						16										
			900	12						16										
				14																
		11	550	12																
				14																
			900	12																
				14																

Issues with LTE as Performance Measure





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

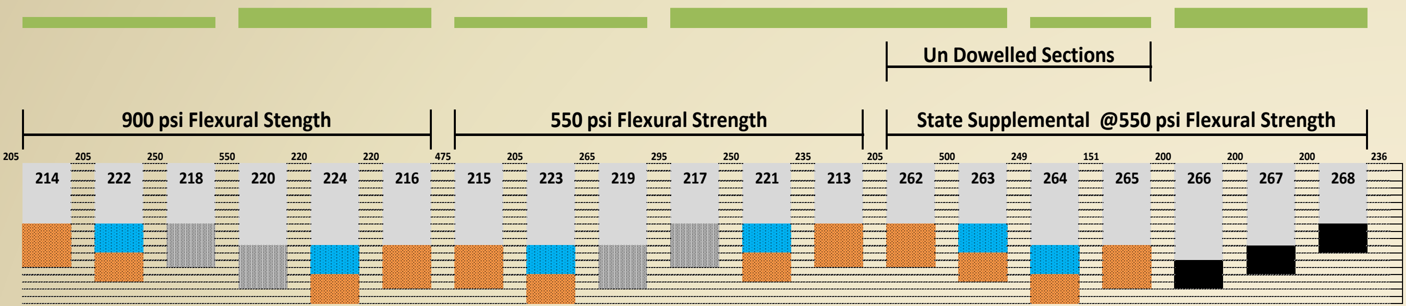
Non Traditional Phase 2 Opportunities

- 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

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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.