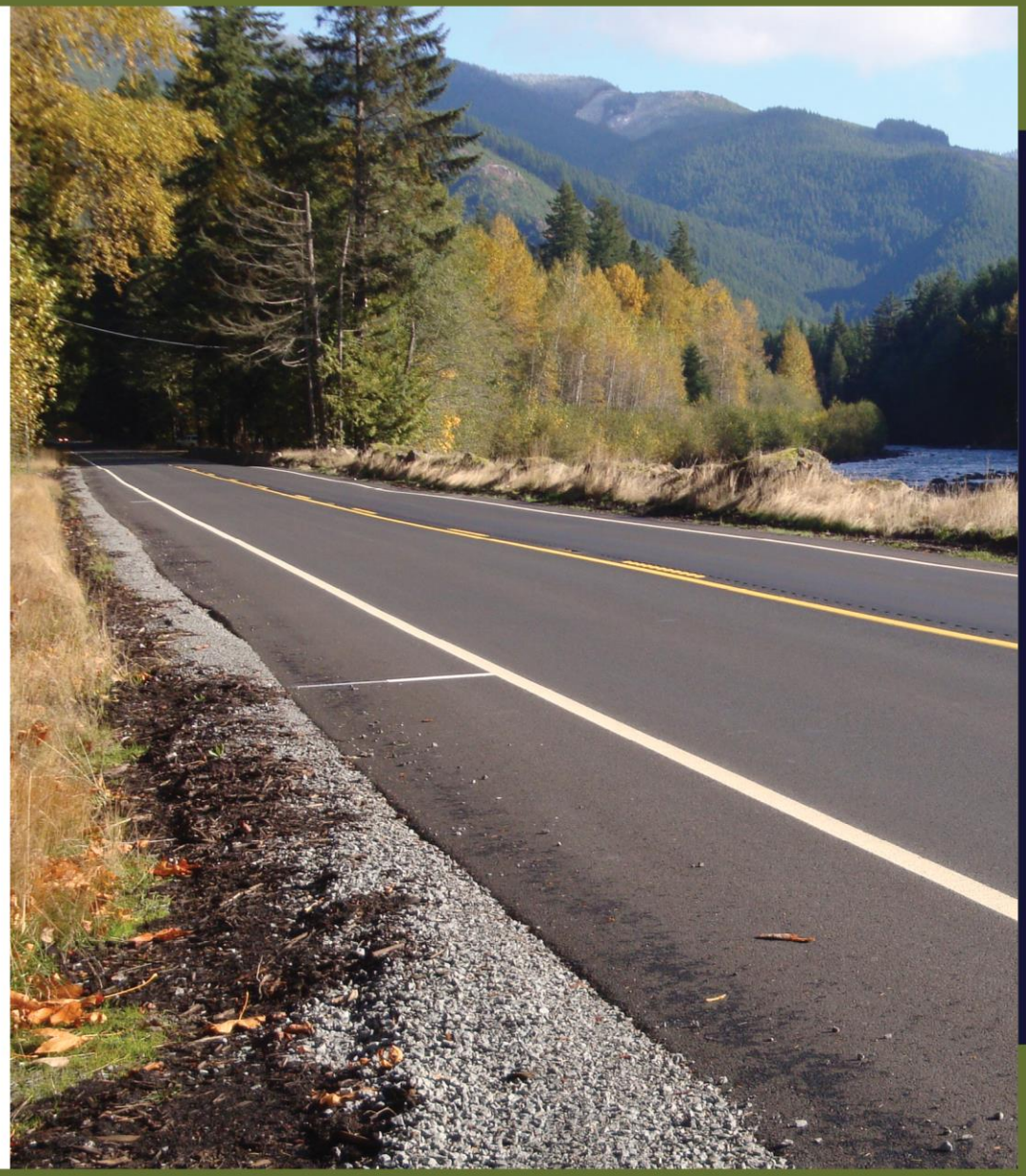
QES | Engineering Inspection

Pavement Design Peer Exchange Webinar

Summary of Five 2023–2024 Regional Events

Virtual Meeting
May 6, 2025



Outline

- Introduction
- Pavement Design Peer Exchange Overview
- Pavement Design Practices for New Construction, Rehabilitation and Preservation
- Recommendation for FHWA
- Questions

Introduction

Objective

- Summarize findings from five regional FHWA peer exchanges on pavement design practices
- Highlight challenges/weaknesses and changes that can improve pavement systems performance

Scope

- Pavement design practices for new construction, rehabilitation, and preservation
- Insights from five US regions: Southeast, Midwest, Northeast, Northwest, and Southwest regions

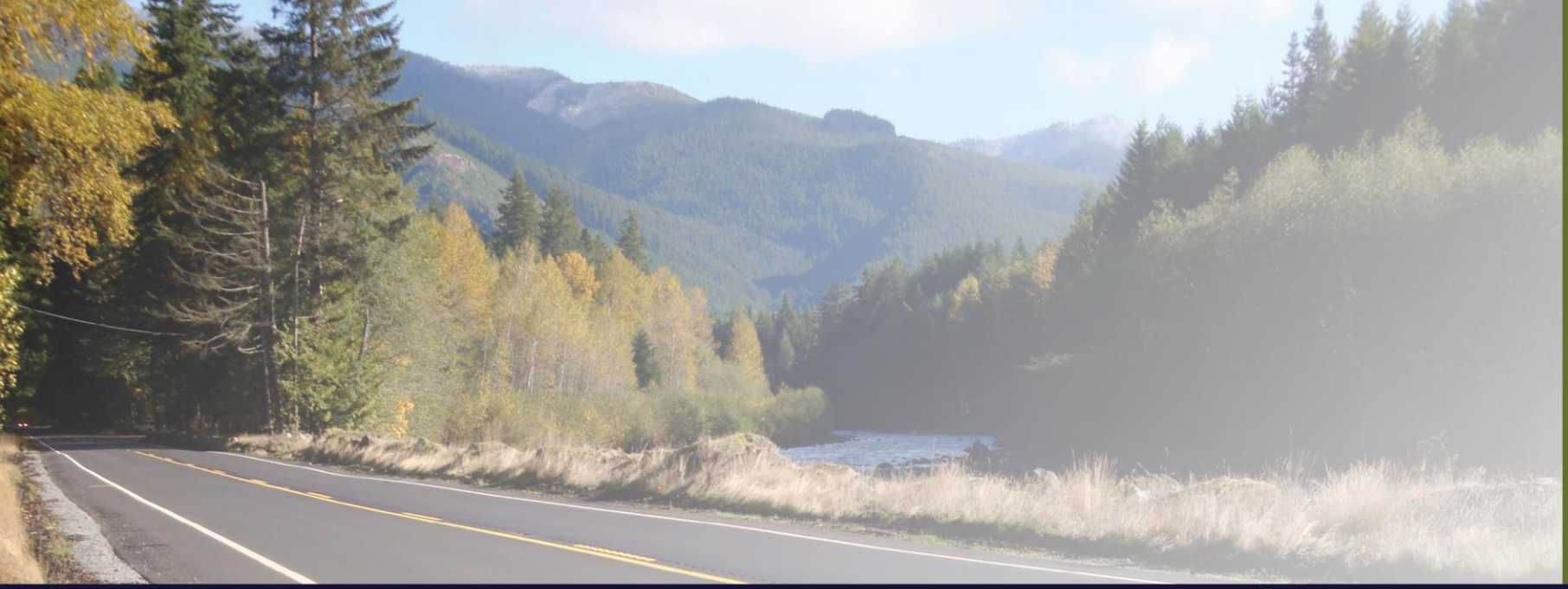
Peer Exchange Overview

Five Regional Events August 2023 – July 2024

- Each event was organized in two parts:
  - **Part 1** – Pavement design for new construction, rehabilitation, and preservation
  - **Part 2*** – Pavement design practices related to resilience and sustainability

** Part 2 will not be discussed as part of this webinar. Information regarding resilience and sustainability is available in the individual Regional Summary Reports sent to states participating in the five regional peer exchanges.*

QES



Pavement Design Practices for New Construction, Rehabilitation, and Preservation

QES | Engineering Inspection

Pavement Design Practices – New Construction

Pavement Design Methodologies for New Construction

- AASHTO 93
- Pavement ME
  - Pavement ME adoption varies by region (some with full implementation, others using it for design checks, and some evaluating it for potential use)
  - Challenges in implementing Pavement ME: local calibration, staffing, and organizational changes required
- AASHTO 72 used by some states
- State-developed software used by a few states
- Some states use a combination of design methodologies depending on pavement types (AC or PCC)

Pavement Design Practices – New Construction

DOT Use of Pavement ME and AASHTO 93

Region	Pavement ME	AASHTO 93
Southeast	3	4
Midwest	4	3
Northeast	2	6
Northwest	4	4
Southwest	5	6
Total	**18**	**23**

Data is based on states reporting and peer exchange attendance.

Pavement Design Practices – New Construction

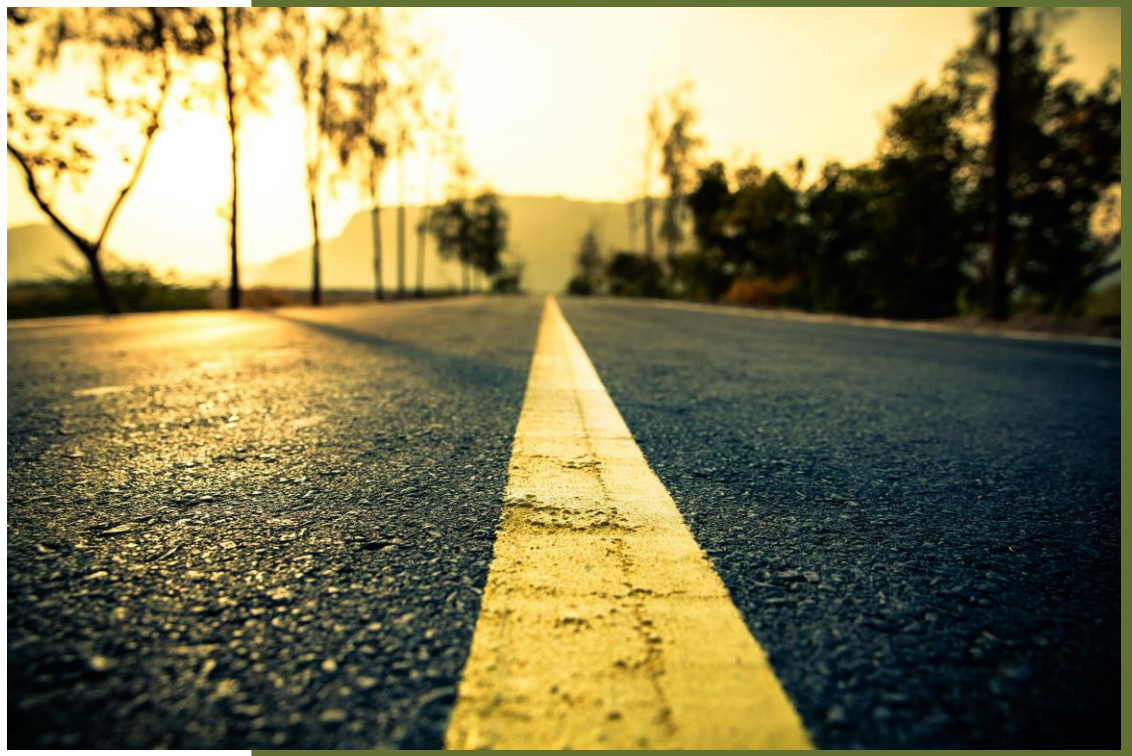
Breakdown of Pavement Design Software Used by DOTs

Pavement ME					
Region	Flexible and Rigid	Asphalt	Concrete	Design Check	Evaluating
SE	2		1	3	1
MW	3		1		
NE	2			1	
NW	2		2		2
SW	4		1		2
AASHTO 93					
SE	3	1			
MW	3				
NE	6				
NW	3	1			
SW	5	1			
AASHTO 72					
SE	2	1			
MW					
NE	1				
NW					
SW					
Other					
SE					
MW	3 (State Developed Software)				
NE					
NW		2 (State Developed Software)			
SW					

Pavement Design Practices – New Construction

Pavement Analysis Periods and Design Lifespans

- Asphalt Pavements
  - Analysis periods: 20-30 years
  - First rehabilitation: 12-15 years
- Concrete Pavements
  - Analysis periods: 20-40 years
  - Rehabilitation: Slab repairs (5-10 years); overlays (8-12 years)



QES

Pavement Design Practices – New Construction

Pavement Analysis Periods and Design Lifespans by Region

Southeast	Midwest	Northeast	Northwest	Southwest
Asphalt Analysis Periods • 20-30 years (interstate) • 20 years (secondary roadways) • 8-20 years (time to first rehabilitation) **Concrete Analysis Periods** • 20-40 years	**Asphalt Analysis Periods** • 20 years • 10-18 years (time to first rehabilitation) **Concrete Analysis Periods** • 20-35 years	**Asphalt Analysis Periods** • 20-50 years • 10-20 years (time to first rehabilitation) **Concrete Analysis Periods** • 20-50 years • Minimal use of concrete • Rehabilitation occurs at the 30-year mark	**Asphalt Analysis Periods** • 20-25 years • One DOT – 50 years • 10-20 years (time to first rehabilitation) **Concrete Analysis Periods** • 30-40 years • One DOT – 50 years	**Asphalt Analysis Periods** • 20 years • One DOT – 50 years • 10-20 years (time to first rehabilitation) **Concrete Analysis Periods** • 30-35 years • Periodic rehabilitation extends life to 50 years

QES

Pavement Design Practices – Lifecycle Cost Analysis

Life Cycle Cost Analysis

- Usage Across Regions
  - Mandatory in some states; selectively applied elsewhere based on project thresholds such as cost or size
  - Typical analysis periods: 30-50 years
- Tools and Updates
  - Many states use FHWA's RealCost software, some use in-house programs
  - FHWA has addressed computer compatibility issues with the release of RealCost (v3)
  - Challenges with user delay cost calculations has led to some states basing LCCA on materials and construction costs with no user costs included

QES

Pavement Design Practices – Lifecycle Cost Analysis

Lifecycle Cost Analysis by Region

Southeast	Midwest	Northeast	Northwest	Southwest

• Most states require LCCA
• 28–45-year analysis period
• Preferred software: RealCost
	• LCCA is widely used across the region
	• Rigorous process in one state to meet legislative requirements
	  • Required for reconstruction or new construction projects over 4,700 square yards or $0.5 million
	  • Focus on construction and material costs only
	• Another state requires for:
	  • Overlays greater than 4 inches
	  • 50-year analysis period
	• Additional state applies LCCA to nearly all contracts
		• Reported that LCCA is used to some degree
		  • One state uses LCCA on “large” projects only
		  • Another state uses LCCA on projects greater than 30,000 square yards with a 50-year analysis period
		  • An additional state uses LCCA on projects greater than one mile in length
		  • Some states do not use LCCA since concrete usage is low
			• LCCA has traditionally focused on high traffic locations
			• In one state some concrete roadways have been converted to asphalt
			  • Highlights the complexities of balancing immediate cost-savings with long-term economic efficiency
			• One state no longer uses concrete due to the state’s large land mass and higher concrete construction costs
			• One state reported more roundabouts are being built using asphalt instead of concrete, following updated cost-benefit analyses that account for safety and material costs.
				• LCCA used to varying degrees across the states
				  • One state uses a $3 million threshold, 40-year analysis period for concrete and a 20-year period for asphalt; projects that are within 10% of the cost of each other go to alternate bid
				  • Two states do not use LCCA

Pavement Design Practices – Rehabilitation

- Rehabilitation practices often mimic new construction methodologies but may include additional considerations such as:
  - Evaluation of structural integrity, material properties, pavement layer depths, load transfer efficiency, void detection, recycling methods, and geogrids
- States reported the use of AASHTO 93 mostly for rehabilitation pavement design
- States consistently use a combination of resources, testing/sampling, and tools such as:
  - Pavement condition from PMS
  - Field inspections
  - Historical records
  - Traffic analysis to determine ESALs
  - FWD, GPR, DCP
  - Coring and boring for asphalt and soil samples
  - Coring for concrete and asphalt thickness

Pavement Design Practices – Rehabilitation

Rehabilitation versus Preservation

- Distinctions between preservation and rehabilitation are common, typically based on overlay thickness or structural needs
  - 2 inches or less – pavement preservation
  - Greater than 2 inches – pavement rehabilitation

Rehabilitation Techniques

- Geogrids, soil stabilization, deep foundations to enhance support
- Structural overlays
- Recycling method: FDR, CIR, CCPR

Pavement Design Practices – Rehabilitation

Rehabilitation Practices Used by Region

Southeast	Midwest	Northeast	Northwest	Southwest
• One state identified top-down cracking as the primary failure mechanism, leading to a mill and fill rehabilitation strategy	• One state is finalizing a manual for pavement investigation • States reported that existing pavement structures are included in pavement • One state reported that overlays up to 3 inches are provided based on empirical experience • Subgrade stabilization and deeper foundation are used in rehabilitation projects as needed	• One state uses extensive use of geogrids and fabrics while another focuses on structural overlays and recycling methods	• States reported applying the same pavement design processes used for new pavement construction • Notable practice in one state is to core cracks to determine the state of distress	• Some states base their designs on field conditions, other states conduct thorough pavement design practices • Detailed designs are reserved for more complex pavement structures



Pavement Design Practices – Preservation

State DOTs Preservation Processes Include Formal and Informal Policies and Practices:

- Formal Policies and Guidelines
  - Some states have formal policies, manuals, or funding requirements to guide preservation selection (e.g., minimum funding allocations or performance expectations)
  - PMS data, including pavement condition indices, surface history, and inspection results, serves as the primary basis for identifying preservation needs and selecting treatments
  - Condition-based triggers, guidelines, and decision trees are commonly used to prioritize projects
- Informal Policies and Guidelines
  In regions lacking formal policies, decisions are often guided by:
  - Established practices and localized approaches
  - Historical treatment performance
  - Regional preferences
  - Engineering judgments and limited field investigations

Pavement Design Practices – Preservation

- Focus on Cost-effectiveness
  - States prioritize projects in fair to good condition for preservation and rely on a combination of performance data, visual inspections, and established trigger values to inform their selections
  - Projects in fair to good condition are prioritized for preservation to extend service life and prevent costly rehabilitation
  - Poorly performing treatments are avoided to ensure long-term success
- Agency Collaboration
  - Coordination occurs among regional/district offices, central offices, pavement management teams, and maintenance sections to finalize preservation strategies
  - In some states regional staff/maintenance staff select and document preservation treatments rather than more central office approaches

Pavement Design Practices – Preservation

Preservation Practices Used by Region

Midwest

- Regional/district staff select and document preservation treatments
- Processes include:
  - Collaboration between regional staff and central offices
  - District pavement specialists recommend treatments
  - Video log vehicles used to document and validate treatments ("ground truth")
- Decisions rely on:
  - Pavement cores, pavement condition data, past performance, and preventive maintenance manuals
- Pavement design methods are not typically used for treatment selection
- Common treatments:
  - Chip seals, thin overlays, micro-surfacing, cape seals, ultra-thin bonded wearing courses, crack sealing, patching, and joint repairs for concrete pavements

Pavement Design Practices – Preservation

Preservation Practices Used by Region

Northeast

- States use data-driven approaches based on periodically collected pavement condition data
- Treatment selection is often guided by:
  - Average daily traffic
  - Regional practices
  - Centralized vs. district-level decision-making
- Condition-based or time-base selection triggers
- Pavement Design, Pavement Management, and District/Regional staff often coordinate to select appropriate treatments
- Some state centralize treatment selection, while others allow for district-level decision making
- Common treatments:
  - Ultra-thin bonded overlay, microsurfacing, thin overlays, crack sealing, slurry seal, chip seal, high performance thin overlay, ultra-thin friction course, cape seal and other region-specific treatments

Pavement Design Practices – Preservation

Preservation Practices Used by Region

Southwest

- Pavement management condition data is widely used to guide treatment selection
- Several states have guidelines or policies for pavement preservation while three states reported no formal written policy or manual
- Funding allocated for preservation activities across most states
- One state mandates a minimum of 5% of pavement surface funds for preservation (based on a 4-year running average)
- Treatment decisions are supported by:
  - Trigger values, guidelines, and decision trees
  - Pavement quality indices provided to districts
  - Visual inspections and district level reviews
- Preservation strategies vary widely by state and region, including interventions such as:
  - Concrete preservation at year 20; joint seal repairs at year 14
  - Armor coat after an overlay within 3 years; crack sealing at year 3+; chip seals as needed
  - Crack seal at year 2; chip seal at year 3, or immediately at year 1 depending on region
  - Minor joint repairs at year 15 and major joint repairs at year 27 for concrete
  - Seal coating on a 4-year cycle; fog seals used occasionally
- Common treatments:
  - Crack Sealing, Nova chip, mill and fill, full depth reclamation, hot in placed recycling, cold in place recycling, polymer-modified asphalt, fog seals and chip seals

Pavement Design Practices – Preservation

Track Pavement Preservation Performance

- States use Pavement Management Systems (PMS), asset management systems, and pavement condition data to monitor performance
- Most states monitor treatment effectiveness through continuous assessments, tracking projects over their lifespan
- Methods include:
  - Annual evaluations of pavement condition, surface distress, and IRI tracking
  - Feedback loops with districts to identify ineffective treatments and revise specifications
  - Imaging and roadway condition assessments versus age to improve deterioration models
- “In-house” software and research activities (e.g., deterioration curves) are used by some states to track treatments and their life cycles

Pavement Design Practices – Preservation

Challenges with Tracking Pavement Preservation Performance

- Staffing shortages, inconsistent data tracking, and limited resources for research analysis
- Institutional knowledge often compensates for inadequate documentation but eventually knowledge is lost

QES

Pavement Design Practices – Preservation

Ensuring Treatments Meet State Performance Goals

- Monitoring and Reporting
  - States monitor pavement condition data annually and review project performance to identify effective and ineffective strategies
  - Asset management and pavement management systems track performance, costs, and outcomes
  - Some states prioritize quick treatments to minimize user delay and improve roadway quality

QES

Pavement Design Practices – Preservation

Ensuring Treatments Meet State Performance Goals

- Feedback Mechanisms
  - Reviews of past performance inform decisions to revise specifications and adopt new treatments
  - District-level feedback and collaboration ensure treatments align with performance goals
- Integration with TAMP
  - Better connections between preservation and rehabilitation activities with the state's Transportation Asset Management Plan (TAMP) are recommended for improved performance tracking and optimization

QES

Pavement Design Practices – Preservation

- Innovative Strategies
  - Hiring engineers for data analytics to improve pavement management insights
  - Developing tools, such as decision matrices, and aligning preservation treatments

QES

Pavement Design Practices – Preservation and Rehabilitation

Implementing New Technology in Preservation and Rehabilitation

- Research and Collaboration
  - Collaboration with universities, industry partners, and contractors helps advance technology adoption through research and testing
  - Participation in pooled fund studies, peer exchanges, and initiatives like State Transportation Innovation Council (STIC) and Everyday Counts (EDC) fosters innovation
- Advanced Tools and Technologies
  - DOTs are exploring advanced technologies such as:
    - LIDAR, 3-D Ground Penetrating Radar (GPR), traffic speed deflectometer devices (TSD), and continuous friction measurements for pavement condition assessment

Funding and Resource Challenges

Common Themes Across Regions

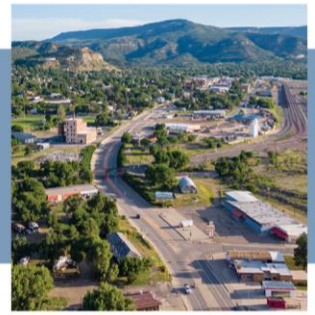
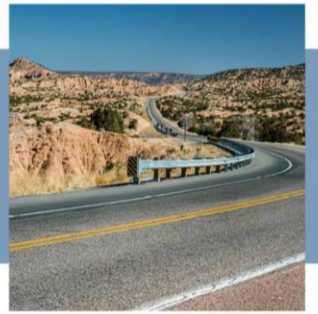
Funding Constraints	Competition for Resources	Staffing Shortages
Insufficient funding prioritizes short-term preservation over long-term rehabilitation. Budgetary limitations often dictate project choices, leading to suboptimal outcomes even when pavement conditions warrant more comprehensive repairs.	Pavement preservation and rehabilitation often compete with other DOT priorities, forcing difficult trade-offs in project selection and execution.	States report insufficient staff to implement innovative practices, perform in-depth evaluations, or manage preservation programs effectively.



Funding and Resource Challenges

Regional Highlights

Southeast	Midwest	Northeast	Northwest	Southwest
Calls for additional funding and staff to implement innovative practices effectively.	Funding gaps hinder adoption of advanced tools like GPR, TSD, and enhanced design processes.	Limited matching funds prevent full utilization of federal resources.	Emphasizes funding challenges in adopting advanced materials and technologies.	More dedicated pavement preservation funds are needed.


Challenges in Integration of Preservation and Rehabilitation with Pavement Design

- Preservation Strategies
  - States report the need to integrate preservation strategies into pavement design processes more effectively
  - States expressed a need for better alignment between pavement design, pavement management, construction and asset monitoring systems to ensure that treatments are both suitable and sustainable over time
  - Integrations allow feedback loops for better management
- Data-driven Decisions
  - States use condition and performance data to inform preservation and rehabilitation strategies but face challenges with data consistency and availability

Challenges in Integration of Preservation and Rehabilitation with Pavement Design

Regional Highlights

Southeast	Midwest	Northeast	Northwest	Southwest
States reported the absence of formal pavement preservation policies.	Reported the need to consider preservation during the pavement design process. Improve pavement design to account for underlying pavement conditions to reduce future preservation work.	States reported the absence of formal pavement preservation policies.	Highlights the need for consistent tracking of performance data and better integration with pavement management systems.	Calls for improved communication between pavement management and design teams to enhance coordination of pavement preservation activities.

Pavement Design – Standardization Barriers

- Inconsistent terminology, design practices, and performance metrics hinder collaboration and innovation across agencies

- States call for:
  - Clearer definitions
  - Improved post-construction feedback loops
  - Enhanced training for inspectors
  - Better evaluation of vendor products
  - Improved documentation to ensure quality control and continuous improvement in pavement preservation projects

Material Concerns and Availability

- Material Shortages: Limited availability of aggregates, cement, and other materials increases costs and complicates pavement design
  - Closure of local aggregate mines increases material transport costs
  - Cement shortages limit techniques like roadway base reclamation
- Recycled Materials: Adoption of RAP, RAS, and other recycled materials is growing, but states seek more research into performance impacts.
  - States are exploring new pavement materials and technologies, but implementation requires:
    - Additional material costs
    - New equipment
    - Training for personnel

QES

Material Concerns and Availability

Regional Highlights

Southeast	Midwest	Northeast	Northwest	Southwest
Rising material costs and long-distance aggregate sourcing impact pavement design.	Interest in researching alternative materials and refining BMD implementation.	Concerns about RAP availability and performance in addition to the use of recycled materials with unknown performance.	Increasing material costs and availability.	Emphasis on challenges in permitting new material plants and addressing contractor concerns about BMD.



QES

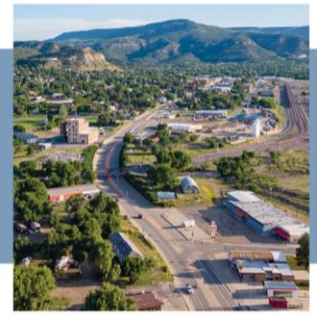
Research and Technical Support Needs

- Material Performance
  - States seek studies on alternative binders, subgrade stabilization, and recycled materials
- Environmental Impacts
  - Interest in models that evaluate deterioration, environmental effects, life extension and return on investment for various treatments
- Advanced Tools
  - Research on tools like TSD and GPR to improve condition assessments and decision-making
- Enhanced Data Integration
  - Enhanced data integration between pavement design, pavement management, construction, preservation, and asset management systems
- Adoption of New Technologies
  - States actively test innovations through pilot projects and research partnerships, with a focus on technologies such as Traffic Speed Deflectometer (TSD), geosynthetics, and 3-D GPR technology

Research and Technical Support Needs

Regional Highlights

Southeast	Midwest	Northeast	Northwest	Southwest
Additional resources for Pavement ME implementation. Alignment of pavement design, pavement management and TAMP practices.	Continued guidance for Pavement ME offered by the AASHTOWare Users Group. Best practices for the Geotechnical aspects of pavements.	Participation in pooled fund studies and exploring new tools for condition assessment.	Studies on fatigue cracking and geotechnical concerns to refine design models.	Incorporating the benefits of geosynthetics in pavement design, incorporating the use of FDR and CIR in Pavement ME.



Recommendation for FHWA

Common Themes Across Regions

- Overall Satisfaction with the Current FHWA Policy
  - States prefer policies that allow innovation while using practices tailored to their specific needs and challenges
- Recommendations to the FHWA from Participants
  - Consistent terminology for preservation and rehabilitation activities/requirements for TAMP reporting
  - Continue sponsoring peer exchanges
  - Enhanced LCCA support especially for user costs
  - Continued user group support for Pavement ME
  - Guidance on alternate bids and pavement type selection
  - Develop independent validation processes for vendor products used in rehabilitation and preservation projects

Questions?

QES | Engineering Inspection

THANK YOU FOR JOINING!

Jeff Uhlmeyer, PE
Sr. Engineer
Quality Engineering Solutions, Inc.

Email: juhlmeyer@qespavements.com
Phone: 360.628.2582