Tech Brief

U.S. Department of Transportation
Federal Highway Administration

PAVEMENT PRESERVATION HOW

The fourth round of Every Day Counts (EDC-4) innovations promoted quality construction and materials practices that apply to both flexible and rigid pavements. For flexible pavements, these include using improved specifications for thin asphalt surfacings such as chip seals, scrub seals, slurry seals, micro surfacing, and ultrathin bonded wearing courses; following improved construction practices; and using the right equipment to place these treatments. Rigid pavement treatments include the rapid retrofitting of dowel bars to reduce future faulting; the use of new, fast-setting partial- and full-depth patching materials to create a long-lasting surface; advanced pavement removal techniques to accelerate patching construction times; and advancements in diamond grinding that contribute to smoother and quieter pavement surfaces with enhanced friction.

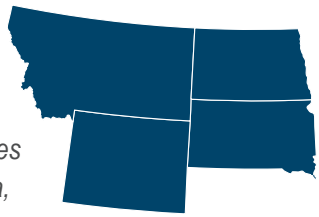
BACKGROUND

Regional peer-to-peer exchanges between states were initiated to exchange knowledge on "How" to effectively implement pavement preservation. Adoption of a comprehensive pavement preservation program will ultimately result in an improved pavement condition and safety rating for the overall network, reduced agency and user delay costs, and decreased environmental impact. In order to achieve these objectives, an understanding of the concepts, capabilities, and applications relevant to constructing pavement preservation treatments with quality materials must be implemented via a technology program aimed at transportation agencies, contractors, consultants, and Federal Highway Administration (FHWA) staff.

PAVEMENT PRESERVATION HOW: NORTH DAKOTA, MONTANA, SOUTH DAKOTA, AND WYOMING

EDC-4 PEER-TO-PEER EXCHANGES

INTRODUCTION



On December 5th, 2018, an FHWA-sponsored EDC-4 "How" Pavement Preservation State Peer-to-Peer Exchange was conducted in Bismarck, North Dakota, with 13 department of transportation (DOT) representatives from North Dakota, 9 from Montana, 8 from South Dakota, and 2 from Wyoming; 67 attendees from local agencies representing 4 counties and 6 cities; 4 attendees from academia; 6 consultants; and 1 FHWA representative. Larry Galehouse with the National Center for Pavement Preservation and Larry Scofield with the International Grooving & Grinding Association and American Concrete Pavement Association facilitated the day-and-a-half-long meeting. North Dakota was the host state and provided meeting room facilities at the North Dakota Local Technical Assistance Program (ND LTAP) center. ND LTAP used its remote learning network to broadcast the event to connected agencies, significantly expanding the outreach. Dale Heglund of ND LTAP introduced the attendees, and Larry Galehouse provided the meeting background and kicked off the meeting.

The meeting format consisted of each of the states identifying their current procedures, issues, and successes for each of the topics discussed. Table 1 indicates the discussion topics.

Table 1. List of pavement preservation treatments discussed

Asphalt pavement preservation treatments	Concrete pavement preservation treatments
Crack seal	Partial-depth repair
Micro surfacing	Dowel bar retrofit
Asphalt patching	—
Scrub seal	—

SUMMARY OF IMPORTANT ISSUES OR SUCCESSES

Asphalt Concrete Pavement Preservation

Crack sealing: All four states use this treatment routinely, as do the local agencies. Three of the states route cracks before sealing and one state does not. It was reported that cracks in new asphalt concrete (AC) pavements begin forming between two and five years after construction, and it is important to keep them sealed. One state has a program to seal new pavements three years after construction, while another state has no scheduled program but leaves crack sealing to the districts.

Water penetrating into cracks is a concern because it results in pavement depression/tenting at crack locations. To counter these crack-related distresses, mastic materials and slurry seals are seeing increased use to level the area over the crack. Mastics are also used for cracks wider than ¾ in. by one state. Three of the four states sample and test the sealants. One state uses MC-3000 because it believes this material bonds to the sides of the cracks better.

Stripping of the AC has been a problem for all states in this region, and cracks provide the opportunity for this to occur when depressions form at the crack locations and increase road roughness. See Table 2.

Micro surfacing: All four states report successfully using this treatment, with its use ranging from high-volume roadways to rural roads. This treatment is commonly applied on rutted surfaces in lieu of chip seals. It was noted that cracks quickly reflect through the micro surface and that construction quality issues persist. Typical performance issues are debonding and cracking of the micro surface. Some local agencies prefer this treatment to chip seals in urban areas. One state instituted a smoothness specification involving micro surfacing to improve ride quality. See Table 3.

Asphalt patching: All four states report successfully using this treatment. Techniques include digging out and replacing problematic areas with aggregate and AC, spray application, using mastics, and using maintenance recyclers. The type of existing distress often determines the patching technique and materials, with fatigue cracking often requiring removal and replacement.

Because commercial AC is not available in some locations due to their remoteness, the use of mastics has been increasing. Thin caps of mastics have performed very well over aggregate bases. Specialized equipment can similarly serve remote areas. North Dakota Department of Transportation (NDDOT) maintenance personnel are using specialized, commercially produced equipment that allows winter patch placement. This equipment is also useful throughout the year in remote areas that do not have access to hot plants. See Table 4.

Table 2. Crack sealing

State	Sealant type			Crack preparation			Installation procedures				
	Hot pour	Mastic	Other	Route cracks	Air blow cracks	Vacuum cracks	Temperature requirements	Overband	Flush fill	Detackifier	Workforce
North Dakota	Polmer modified	Yes	MC 3000	No	Yes, per Section 156.01	NA	NA	NA	NA	NA	Maint.
South Dakota	Type 4	Yes	NA	Yes	Minimum 125 ft³/minute, maximum ¾ in. nozzle	NA	Pavement temperature minimum 35°F and rising, ambient air temperature at 40°F–85°F	Yes	No	NA	Maint. and contractor
Wyoming	AASHTO M 324 Type I WY Modified or AASHTO M 324 Type IV WY Modified as specified. AASHTO M 324 WY Modified if the sealant type is not specified. See Table 807.2-1.	NA	Recycled rubber and fillers (such as calcium carbonate) may be blended for enhanced performance	Yes	Minimum 125 ft³/minute, maximum ¾ in. nozzle	NA	Pavement inside the crack is minimum 40°F unless the manufacturer requires a higher temperature	NA	If specified	NA	Maint.
Montana	Yes, low modulus	Yes	NA	Yes	NA	NA	Apply when surface temperature is at 35°F–120°F	Maint.	Contractor	Toilet paper or an approved liquid blotter material	Maint. and contractor

Table 3. Micro surfacing

State	Design method	Material type				Construction procedures						
		Aggregate	Binder	Type	Cement	Application rate	Crack seal in advance	Tack in advance	Sweeping in advance	Test section	Number of courses	Calibration verification
North Dakota	Contractor mix design	Manufactured crushed stone: granite, slag, limestone, or other high-quality aggregate or combination	See Table 421-01	NA	Maximum 3% mineral filler per ASTM D242	NA	NA	NA	Clean surface, sweeping not specified	Yes, 1,000 ft	1 and 2	Yes, per ISSA-MA 1
South Dakota	Accredited lab	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	NA
Wyoming	Independent lab	Provide aggregate in accordance with Subsection 803.7	Hydrated lime, see Section 820	NA	See Section 801	NA	NA	NA	NA	Yes, size by engineer	2	NA
Montana	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 4. Asphalt patching

State	Repair material				Preparation			Installation procedures			
	AC	Mastic	Maintenance recyclers	Spray applied	Cleaned	Air blow	Tack coat	Temperature requirements	Skim patches	Overlay	Contractor or in-house
North Dakota	Yes	NA	Yes	Yes	Dig out and compact	Remove existing broken or unstable surface material	Yes	Temp. <185°F before placing additional material	NA	NA	Maint.
South Dakota	NA	NA	NA	Yes	NA	NA	NA	NA	NA	NA	Maint.
Wyoming	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Montana	Yes	Yes	NA	NA	Yes	Yes	Yes	NA	NA	NA	Maint.

Table 5. Scrub sealing

State	Material type			Construction procedures					
	Emulsion spec	Aggregate type	Binder type	Crack seal in advance	Blow out cracks in advance	Binder rate	Fog seal	Commerical broom	Contract work
North Dakota	NA	NA	NA	NA	NA	NA	NA	NA	NA
South Dakota	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wyoming	NA	NA	NA	NA	NA	NA	NA	NA	NA
Montana	NA	NA	NA	NA	Yes	0.43	Yes	NA	NA

Table 6. Partial-depth repair

State	Distress type		Design		Construction practices					
	Materials-related distress	Spall repair	Repair material specs	Coring in advance	Defining patch limits	Use of milling equipment	Repair materials	Bonding agent	Grouting edges	Warranty
North Dakota	NA	Yes	Hot mix	No	NA	No	Hot mix	Yes	NA	NA
South Dakota	NA	Yes	Yes	NA	Yes	Yes	Rapid hardening or MnDOT 3U18	Yes	NA	NA
Wyoming	NA	Yes	Yes	NA	Yes	Yes	DOT horizontal patch material	Yes	NA	NA
Montana	NA	Yes	NA	NA	NA	NA	HP cold patch and easy patch	Yes	NA	NA

Scrub sealing: Two states have used this treatment, but only one uses it regularly. That state indicated that project selection is critical for the success of this application. The state has found the treatment effective for addressing pavement oxidation, alligator cracking, and raveling and targets pavements that exhibit 100 cracks per mile or more. A typical binder application rate is 0.43 gal/yd with an aggregate spread rate of 27 lb/yd². It was recognized that maintaining the proper bow wave in front of the brooms is critical to a successful scrub seal. It was also noted that local agencies use scrub seals more frequently than state agencies. See Table 5.

Concrete Pavement Preservation

Partial-depth repair: Three states conduct partial-depth repairs but are trying to move to full-depth slab replacement when possible due to the better performance of the latter treatment. One state has a limited number of concrete pavements and therefore uses mastic material. States regularly conducting partial-depth repairs use materials ranging from the Minnesota Department of Transportation's (MnDOT's) 3U18 to HP Concrete Cold Patch. Spall repairs are typically performed by construction contractors, but maintenance crews occasionally perform this repair, and when they do they typically use mastics or Techcrete products. Removal is typically by sawing and jackhammering, with removal by milling only recently being considered. See Table 6.

Dowel bar retrofit: All four states have successfully used this treatment. However, most of the undoweled concrete pavements in these states have already been retrofitted, and there is now limited need for this treatment. One state uses 1¼ in. inch dowels, while another uses 1½ in. dowels. All four states install three dowels per wheel path. The oldest dowel bar retrofit installation for one state was in 1994, and today that pavement is 50 years old. See Table 7.

Table 7. Dowel bar retrofit

State	Design				Construction practices			
	Does state use	Number of dowels	Dowel size	Dowel length	Backfill type	Test strip	Cores retrieved	Cylinders made
North Dakota	Yes	3 per WP	NA	NA	MnDOT 3U18	NA	NA	NA
South Dakota	Yes	3 per WP	1¼ in.	NA	NA	NA	NA	NA
Wyoming	Yes	3 per WP	1½ in.	18 in.	DOT dowel bar retrofit concrete	Contain at least 24 retrofits	Three 6 in. diameter from test section	3 per 300 dowels placed
Montana	Yes	3 per WP	NA	NA	NA	NA	NA	NA

KEY OBSERVATIONS

During this peer-to-peer exchange meeting, agency personnel representing 4 state and 10 local agencies identified and discussed their pavement preservation successes and challenges. The state and local representatives reported the following successes and challenges.

Preservation Successes

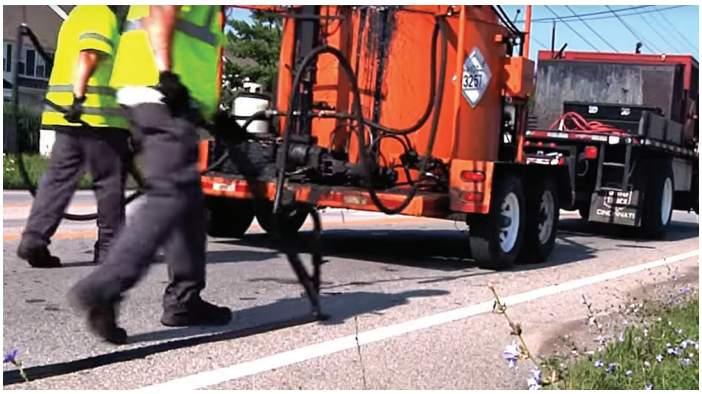
- Crack sealing in this region should occur sooner than in other regions, and somewhat aggressive crack sealing programs are maintained.
- Mastics are being used more commonly on wider cracks and as rut filling over cracks.
- Micro surfacing has successfully been used for rut filling, and one state has developed a smoothness specification involving micro surfacing to improve ride quality.
- Mastic and pavement recyclers have successfully been used to patch AC pavements in remote areas that lack access to hot plants. Thin lifts of mastic material have been placed on aggregate bases for AC patch repairs. Commercial pavement recycling equipment allows for wintertime AC patching.
- It was noted that maintaining the proper bow wave in front of the broom is critical to a successful scrub seal.
- The oldest dowel bar retrofit project in this region is 26 years old (for a pavement that is 50 years old) and is still performing satisfactorily.

Preservation Challenges

- Tenting and cupping of cracked pavements is a serious concern and contributes to accelerated pavement deterioration and rougher ride quality.
- Cracks reflect through a micro surface rather quickly.
- It is very important to verify that the distributor truck has been calibrated, but this verification is often not done.

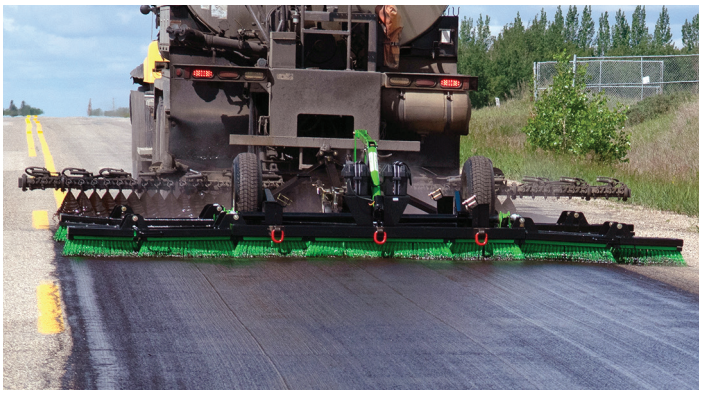
SUMMARY

Four asphalt and two concrete pavement preservation treatments were discussed in depth (see Figures 1–6). Crack sealing is the predominate preservation treatment used in this region. Micro surfacing for rut filling applications is the next most commonly used, followed by scrub seals, which are beginning to see consideration and/or use in three of the states in this region. Concrete preservation applications such as dowel bar retrofits or partial-depth repairs are minimally used due to the limited amount of concrete pavement that exists in these states and the fact that most undoweled pavements have already received dowel bar retrofits.



National Center for Pavement Preservation

Figure 1. Crack sealing



Saskatchewan Ministry of Highways and Infrastructure

Figure 4. Scrub sealing

National Center for Pavement Preservation

Figure 2. Micro surfacing

ACPA

Figure 5. Partial-depth repair

City of El Paso

Figure 3. Asphalt patching

ACPA

Figure 6. Dowel bar retrofit

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DISTRIBUTION AND AVAILABILITY
This tech brief can be found at https://www.fhwa.dot.gov/pavement/preservation/.

KEY WORDS
pavement, preservation, peer-to-peer

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AGENCY SPECIFICATIONS

The relevant agency specifications are available at the following websites:

North Dakota: http://www.dot.nd.gov/dotnet/supplspecs/standardspecs.aspx

Montana: https://www.mdt.mt.gov/business/contracting/standard_specs.shtml

Wyoming: http://www.dot.state.wy.us/home/engineering_technical_programs/manuals_publications/2010_Standard_Specifications.html

South Dakota: http://www.sddot.com/business/contractors/Specs/default.aspx

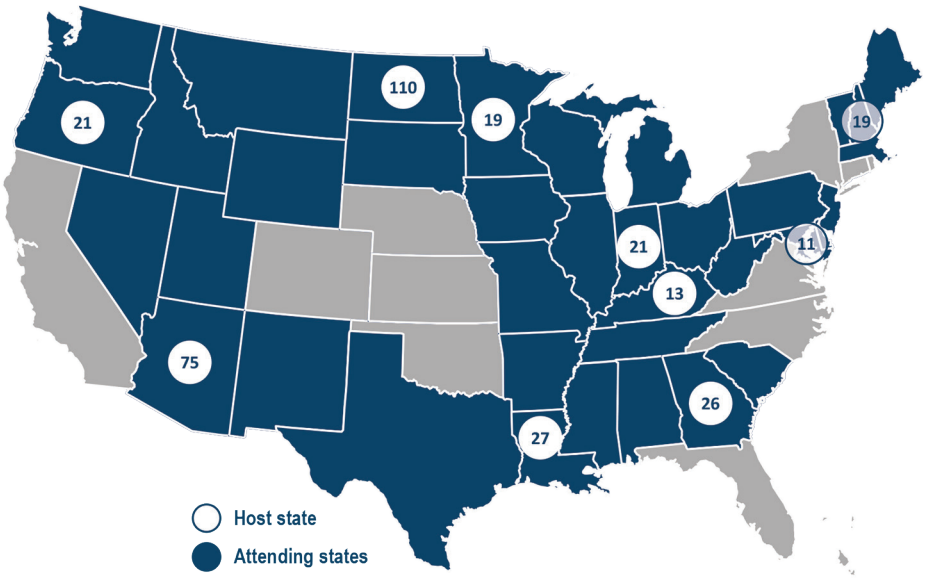
ONLINE RESOURCES

National Center for Pavement Preservation (https://www.pavementpreservation.org/)

National Concrete Pavement Technology Center (https://cptechcenter.org/)

Federal Highway Administration (https://www.fhwa.dot.gov/pavement/preservation/)

Pavement Preservation & Recycling Alliance (https://roadresource.org/)



Host state	AZ	DE	GA	IN	KY	LA	MN	NH	ND	OR
Attending states	NM	MD	AL	IL	TN	AR	IA	ME	MT	ID
	TX	NJ	SC	OH	WV	MS	MO	MA	SD	NV
	UT	PA	—	MI	—	—	WI	VT	WY	WA
Number of attendees	75	11	26	21	13	27	19	19	110	21

Regional state peer-to-peer exchanges were held in 10 states with 342 total attendees from 37 states