Michigan
Department of Transportation
Paver-Placed Surface Seal

January, 2003

Paver-Placed Surface Seal

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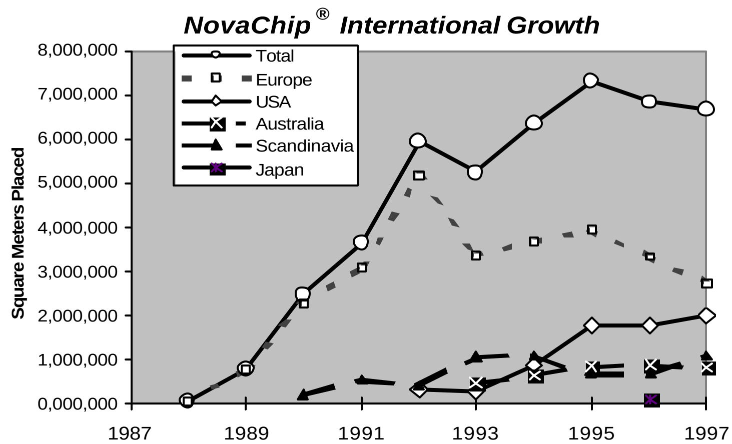
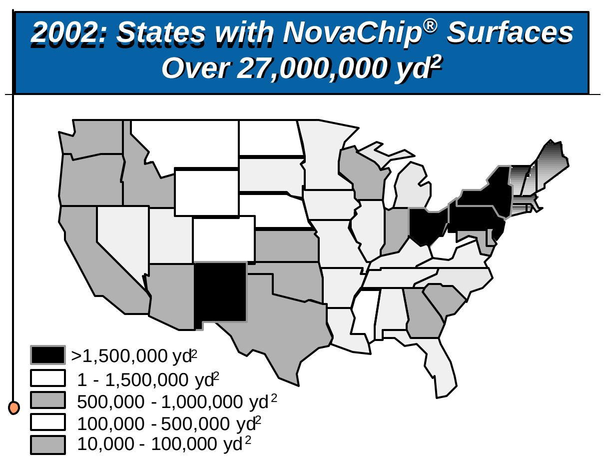
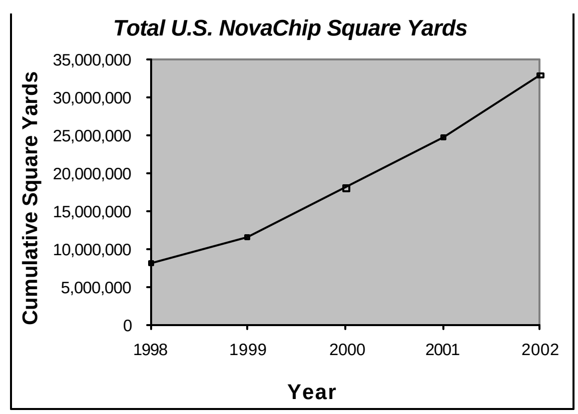
NovaChip® Historical Development

An Award Winning French Public/Private Partnership
In 1986, Pierre Bense of the French Roads Administration (Laboratoire Centrale des Ponts et Chausees, LCPC) proposed the NovaChip® process in LCPC's newsletter. Screg Routes (now a subsidiary of Colas, Inc.) partnered with the government lab in developing the process, with the first machinery feasibility tests in 1988 and numerous experimental projects placed in France in 1989. After a period of development, the process was fully commercialized under the name as Euroduit® in France in 1990, as SafePave® in the United Kingdom, and as NovaChip® in the rest of the world. In 1991, the NovaChip process was awarded the first place prize for Innovative Technology by the French Road Federation.

Worldwide Growth and U.S. Debut
The Societe Internationale Routiere (SIR), a Screg subsidiary, commercializes the process internationally. By the end of 1992, 14 million square yards had been placed throughout the world, with projects in Sweden, Norway, Finland, the U.K. Ireland, Germany, Belgium, the Netherlands and the U.S. The first projects were placed in Australia in 1993 and Japan in 1996. By 1997, almost 40 million square yards had been placed around the world. A U.S. patent was obtained in 1990 for the process, including the materials, process and equipment used for placement. The first projects in the U.S. were constructed under the supervision of Screg in Texas and Alabama in 1992, and New Jersey, New York and Pennsylvania in 1993. Favorable technical reports and publications on these projects were written by the National Center for Asphalt Technology, the Texas Transportation Institute, the Garden State Parkway authority, and the Pennsylvania Department of Transportation. As of September, 2002, the first U.S. projects were still exhibiting excellent performance. Screg licensed the NovaChip process to Midland Asphalt Company in parts of New York, All States Asphalt in New England, and to Shore Slurry Seal, Inc. for the rest of the U.S. During this period, numerous projects (a total of 6 million square yards) were placed in New England, New York, Pennsylvania, New Jersey and Texas by the licensees and Shore's sublicensees Russell Standard Corporation and Bay Construction.







A Koch System
In 1998, Koch Materials Company acquired Shore's license for NovaChip in the U.S. Koch Pavement Solutions technologists adapted the process for U.S. streets, roads and highways. Koch developed a special NovaBond™ emulsion to optimize construction and bonding performance, wrote new aggregate specifications to make the best use of materials available in the U.S. while maintaining system performance, and used performance-graded binders for the hot mix for local climates and longer durability. Koch is also working with the equipment manufacturers to continuously improve equipment performance, construction quality and worker safety. Koch has spread the process to more than 40 states to provide a long lasting surface treatment to its customers. As of November 2002, Koch has been responsible for more than 27 million square yards in more than 35 states.

NovaChip®
Ultrathin Bonded Wearing Course

NovaChip® Projects

Where can NovaChip ultrathin bonded wearing course be placed? Wherever there is a need for the quick, durable, ultrathin, open, quiet hot mix surface—over flexible and rigid pavements, as preventive maintenance or as a wearing course over new construction. Below are just a few of the recent NovaChip jobs. The NovaChip surfaces are still performing after as many as 10 years on pavements as diverse as the Garden State Parkway, the main highway on Padre Island outside of Corpus Christi, Texas, numerous rural roads in Pennsylvania, and on major highways in Europe.

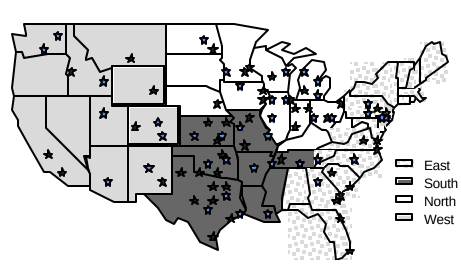
State	Agency	Road	Year	Existing Surface	Project Length	ADT	% Trucks
AL	ALDOT	I-65, Cullman				60,000	
AL	ALDOT	I-29, Birmingham	2001	PCC		165,000	
AR	Pulaski County	Ironton, Bingham, Colornel Glen, Hilaro Springs, Faulkner, & Lawson	1999 2000	New HMA	20 ln-mi	300-1000	10%
CO	Glenwood Springs	6th St., Glenwood Springs	1999	HMA	3.3 ln-mi	23,000	10%
CO	CDOT	SH 285, Lakewood	2002	Milled HMA	21 ln-mi	38,500-67,000	7%
IL	Knox county	Knox County Hwy. 25 (Galesburg)				5000	5%
IL	Brookfield Twp.	19th Avenue, (Morris)				1000	<1%
IL	York Township	IL & 16th Street, Lombard	1999	HMA	5 mi	1000	1%
IL	Knox County	County Hwy 25	1999	HMA	10 ln-mi	1400	1%
IN	INDOT	Randolph County SR 28	2002	Chip Sealed HMA	6 mi	3000	<5%
KS	City of Wichita	Various Locations	1999 2002	HMA, PCC, Bridges, Brick		Up to 25,000	15%
IA	IDOT	I-69, Ames				8000	
LA	Calcasieu Parish	Project No. 2000-11				3500	
MD	MSHA	Route 12				17,000	
MD	MSHA	Route 80				5000	
MI	Jackson County	McDevitt Dr.	1998	35-yr old PCC	1.8 mi	13,500	10%
MI	Bay County	State Park Dr.	1998	Composite	2.2 mi	11,000	6%
MI	Saginaw County	Tittabawassee Road	1998	HMA	1.0 mi	30,000	15%
MI	Kent County	West River Dr.	1998	Composite	1.5 mi	25,000	5-10%
MI	Calhoun County	17½ Mile Road,	1999	HMA	2.5 mi	1,500	1%
MI	Saginaw County	Tittabawassee Road/ Adams Dr.	1999	HMA	2.4 mi	5,000	5%
MI	MDOT Bay Region	M-54, Flint	2000	Composite	1.4 mi	10,200	5.2%
MI	MDOT Grand Region	M-91, Greenville	2000	Composite	2.1 mi	7,051	10%
MI	MDOT Bay Region	M-25, Caseville	2000	Composite	11.5 mi	2,500	4.4%
MI	MDOT Univ Region	I-96, Lansing	2000	HMA	5.5 mi	42,000	14%
MI	Bay County	Garfield / 7 Mile	2000	HMA	2.0 mi	1950	1%
MI	Jackson County	Page Ave.	2000	Composite	2.5 mi	2400	1%
MI	MDOT Grand Region	M-37, Middleville	2001	HMA	4.2 mi	11,400	8%
MI	MDOT Univ. Region	M-60, Jackson	2001	Composite	12.5 mi	10,200	8%
MI	MDOT Bay Region	M-46, Saginaw	2001	HMA	2 mi	8,600	6.6%
MN	Mn/DOT	TH 35 From TH 251 to I-90	2001	New HMA Overlay	2 mi		
MN	Mn/DOT	I-35, Minneapolis-St. Paul				35,000	15%
MN	Mn/DOT	TH 169, Princeton, MN				14,477	4%
MO	MoDOT	I-35 Kansas City	2002	HMA	18 ln-mi.		
NV	Clark County	Sloan Road, Las Vegas				250	95%
NJ	Garden State Pkwy	Garden State Parkway				150,000	
NJ	NJDOT	I-95				145,000	
NY	New York Thruway	New York Thruway				80,000	
NC	NCDOT Division 13	I-40, Ashville	2000	PCC	111 ln-mi		
NC	NCDOT Division 5	US 1/64, Durham	1996		25 ln-mi		
NC	NCDOT Division 5	I-440, Durham	2001		37 ln-mi	60,000	
NC	NCDOT Division 9	I-85, Winston-Salem	2001		33 ln-mi		
NC	NCDOT Division 9	US 52, Winston-Salem	2000		38 ln-mi		
NC	NCDOT Division 12	US 70, Shelby	2002		20 ln-mi		

State	Agency	Road	Year	Existing Surface	Project Length	ADT	% Trucks
OH	Cincinnati	Western Ave.	2002	12 yr old HMA	10 ln-mi	20,000	15%
OH	ODOT District 9	US 50	2002	13 yr old HMA	13 ln-mi	16,000	18%
OH	ODOT District 10	SR 7	2002	11 yr old HMA	16 ln-mi	20,000	15%
OH	ODOT District 4	I-77	2002	10 yr old composite	17ln-mi	60,000	22%
OH	ODOT District 7	US 33	2001	13 yr. old HMA	18 ln-mi	30,000	25%
OH	ODOT District 10	SR 7	2001	12yr old HMA	17 ln-mi	22,000	18%
OH	ODOT Distrct 4	SR 44	2001	13yr old HMA	4 ln-mi	15,000	12%
OH	ODOT District 12	I-90 Cuyahoga	2001	9-yr old HMA	16 ln-mi	180,000	22%
OH	ODOT 5	SR 13	2000	14 yr old HMA	18 ln-mi	25,000	15%
OH	ODOT District 3	SR 421	2000	13 yr old HMA	6 ln-mi	15,000	20%
OH	ODOT District 4	SR 11	2000	8 yr old composite	16 ln-mi	33,000	18%
OH	ODOT District 10	US 50 Vinton	2000	11-yr old HMA	43 ln-mi		30%
OH	ODOT District 4	SR14	1999	9 yr old HMA	12 ln-mi	30,000	20%
OH	ODOT District 4	SR261	1999	10 yr old HMA	1 ln-mi	10,000	10%
OH	ODOT District 4	I-76	1999	9 yr old composite	4.4 mile	60,000	25%
OH	ODOT District 10	SR124	1999	11 yr old HMA	5 ln-mi	10,000	40%
OH	ODOT District 4	Mahoning Interchanges	1999	10 yr old HMA		10-20,000	10%
OH	Cuyahoga Falls	Howe Road	1999	11 yr old composite	I mi	15,000	25%
OK	OKDOT	I-244	2000	PCC	12 ln-mi	67,000	15%
OK	OKDOT	HWY 51, Broken Arrow Expressway	2000	PCC	6 ln-mi	70,000	5.5%
OK	OKDOT	I-244	2002	Composite	15 ln-mi	63,000	9.5%
PA	PennDOT	Route 476				120,000	30%
PA	PennDOT	I-95, Philadelphia				85,000	35%
PA	PennDOT	Route 100				10,000	10-15%
PA	PennDOT	Rt. 422, Reading				50,000	45%
SD	SDDOT	I-29, Mennehaha County	1999		3.4 mi	27,500	12%
SD	SDDOT	I-90 East of Murdo	2001	Chipsealed HMA	12 mi		
SD	SDDOT	Highway 16 Pennington County	2000		2 mi	15,000	
SD	City of Sioux Falls	landfill road	1999		1mi		
TX	TXDOT	US 380 (near Denton)				15-20,000	35%
TX	TXDOT	SH-6, Houston	2002	Patched CRCP	23.8 ln-mi	46,600	
TX	TXDOT	US 90, Beaumont	2000	CCP	17.6 ln-mi	7,700	
VA	VMSI	I-81 near Wytheville, VA	2000	Weathered HMA	13.2 ln-mi	24,000-43,000	14-17%
WI		Field St., Muskogee				500	10%
WI		Hwy 18				5000	20%
WI		Valley View Dr., Menomonee Falls				700	15%

For more information about NovaChip ultrathin bonded wearing course, contact your local Koch Pavement Solutions representative, or our regional NovaChip leaders:

Koch's NovaChip Leaders

Western Region - Charlie Atherton (303/793-0980)
Northern Region – Chip Ray (614-856-3989)
Southern Region – Andrew Fox (512/695-5899)
Eastern Region - Bob Dalton (803/722-7001)
National - Dan Staebell (651/480-3830)



www.kochpavementsolutions.com

Michigan NovaChip/Paver Placed Surface Seal Projects

In Michigan, the first projects were constructed in 1998 with over 1.1 million square yards placed as of late 2002. Of the 1.1 million square yards, nearly 770,000 of these have been constructed on state trunklines and an interstate highway since 2000. The table gives a summary of the Michigan projects through 2002.

1998 NovaChip Projects	**Square Yards**
Bay County	43,715
Jackson County	48,098
Kent County	36,100
Saginaw County	34,026
1999 Projects	
Calhoun County	28,549
Saginaw County	45,028
2000 Projects	
Bay County	32,407
MDOT - M-54, Bay Region	50,831
MDOT - M-25, Bay Region	223,717
MDOT - I-96, University Region	91,006
MDOT - M-91, Grand Region	40,752
Jackson County	70,400
2001 Projects	
MDOT - M-37, Southwest Region	79,455
MDOT - M-46, Bay Region	49,376
MDOT - M-60, University Region	225,000
Total	**1,098,360**

Michigan NovaChip/Paver Placed Surface Seal Job Map

- M-46 – From Townline Rd. West
- Tittabawassee Rd - From Bay Rd West
- Tittabawassee Rd - From Michigan Ave West
- Adams Rd – From Kochville Rd South

- M-60 – From West Jackson County Line East
- McDevitt Rd. – From US 127 West
- Page Ave. – From 5th St. West

- West River Rd – From US 131 Northeast

- M-37 – From Middleville North

- M-54 - From I-75 North

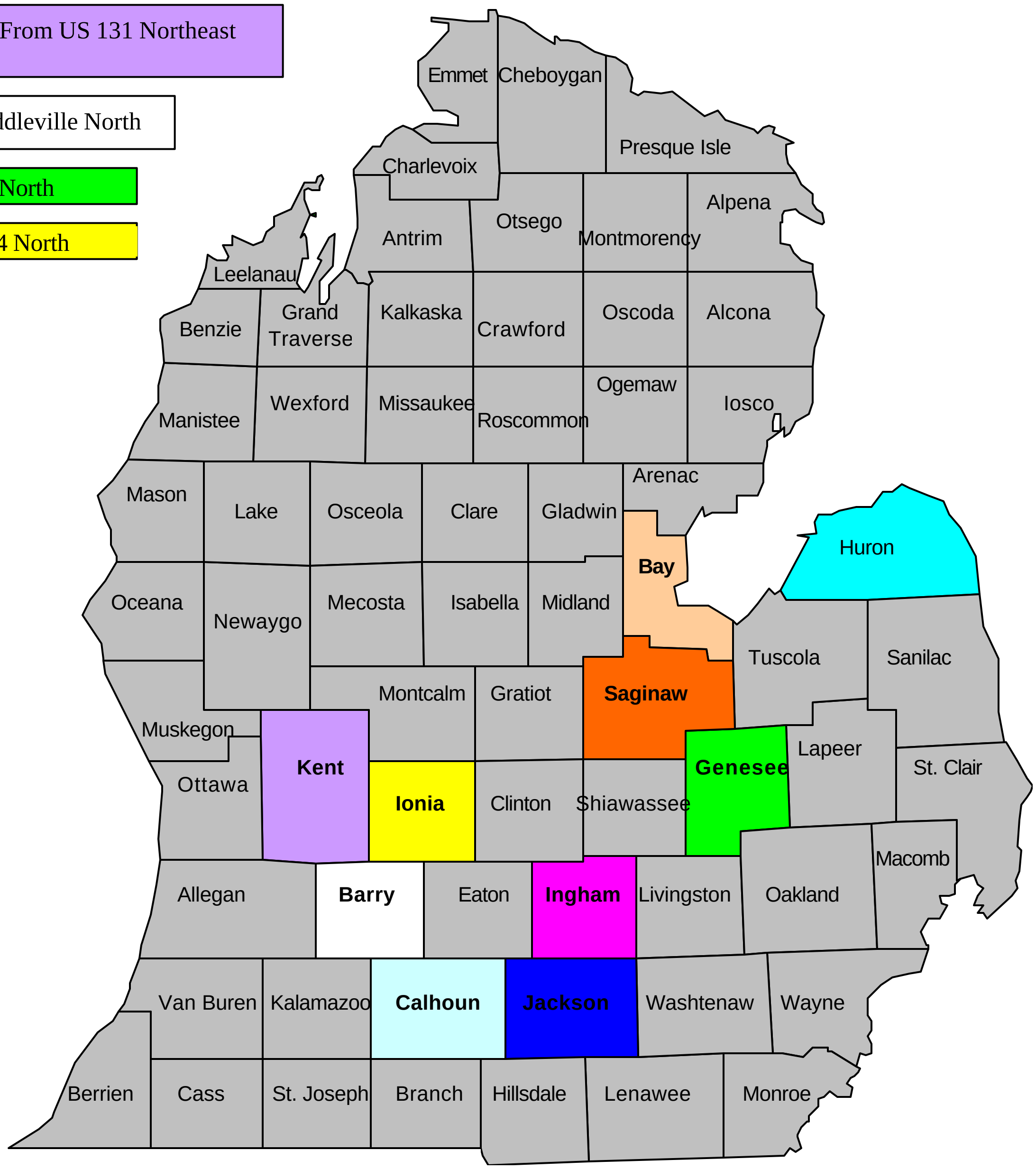
- M-91 - From M-44 North

- State Park Dr – From M-247 South
- Garfield Rd. – From River Rd. South
- Seven Mile Rd – From Salzgurg South

- 17 ½ Mile Rd. – From Old 27 South

- I-96 - From M-52 West

- M-25 - From Caseville East



Project: State Park Drive, Bay County
Owner: Bay County Road Commission
Construction Date: August, 1998

Project Description:

Location, Size & Traffic:
- M-247 south to Wheeler Road
- 2.5 miles
- 2 – 12 ft. lanes with 5 ft. shoulders
- 43,715 square yards
- 11,000 ADT with 6% commercial

Pre Existing Condition:
- Composite pavement
- Exposed cracks up to ½”
- Hot Pour Rubber crack filler in cracks > ½”

Pre Job Preparation:
- None

Project Contractor, Surface Type & Cost Information:
- Midland Contracting
- NovaChip – Type C mix using PG 70-28P
- $3.00 per square yard

Project Evaluation:

Date: October, 2002

Distress & Severity:
- Cracking – Moderate severity, tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride - Good

Project: Seven Mile Road, Bay County
Owner: Bay County, Road Commission
Construction Date: September, 2000

Project Description:

Location, Size & Traffic:

- Salzburg to Hotchkiss
- 1 mile long
- 31' wide including the paved shoulders
- 18,187 square yards
- 2,000 ADT with 1% commerical

Pre Existing Condition:

- Flexible pavement
- Oxidized
- Cracks > ½" have been routed and filled with a hot pour rubber

Pre Job Preparation:

- None

Project Contractor, Surface Type & Cost Information:

- Saginaw Asphalt
- NovaChip – Type B mix using PG 70-28P
- $3.00 per square yard

Project Evaluation:

Date: October, 2002

Distress & Severity:

- Cracking – Low severity, tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride - Good

Project: Garfield Road, Bay County
Owner: Bay County Road Commission
Construction Date: September, 2000

Project Description:

Location, Size & Traffic:

- River Road south to Seidlers Road
- 1 mile long
- 24' wide with no paved shoulders
- 14,220 square yards
- 2000 ADT with 1% commercial

Pre Existing Condition:

- Flexible pavement
- Oxidized
- Cracks > ½" have been routed and filled with a hot pour rubber
- Some minor pitting in the pavement

Pre Job Preparation:

- None

Project Contractor, Surface Type & Cost Information:

- Saginaw Asphalt
- NovaChip – Type B mix using PG 70-28P
- $3.00 per square yard

Project Evaluation:

Date: October, 2000

Distress & Severity:

- Cracking – Low to moderate severity, tight, no spalling
- Raveling – none
- Delamination/Debonding – None
- Flushing – None
- Ride - Good

Project: 17 ½ Mile Road, Calhoun County
Owner: Calhoun County Road Commission
Construction Date: August, 1999

Project Description:

Location, Size & Traffic:

- Old 27 south to North Drive E
- 2.4 miles
- 2 –10 ft. lanes
- 28,549 square yards
- 1,500 ADT with 1% commercial

Pre Existing Condition:

- Flexible Pavement
- Minimal cracking

Pre Job Preparation:

- HMA skip patching

Project Contractor, Surface Type & Cost Information:

- Thompson McCully (Battle Creek)
- NovaChip – Type B mix using PG 70-28P
- $2.95 per square yard

Project Evaluation:

Date: October, 2002

Distress & Severity:

- Cracking – Low severity, tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride - Good

Project: McDevitt Road, Jackson County
Owner: Jackson County Road Commission
Construction Date: September, 1998

Project Description:

Location, Size & Traffic:

- Francis Road east to railroad tracks
- 1.8 miles
- 4 – 12 ft. lanes
- 48,098 square yards
- 13,500 ADT with 10% commercial

Pre Existing Condition:

- Rigid pavement
- Curb & gutter
- Seal patched
- Exposed cracks up to ½”
- Hot pour rubber in cracks > ½”

Pre Job Preparation:

- Full depth concrete repairs

Project Contractor, Surface Type & Cost Information:

- Thompson McCully (Jackson)
- NovaChip – Type C mix using PG 70-28P
- $3.00 per square yard

Project Evaluation:

Date: October, 2002

Distress & Severity:

- Cracking – Moderate severity, crack sealed, some joints seal patched
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride - Good

Project: Page Avenue, Jackson County
Owner: Jackson County Road Commission
Construction Date: August, 2000

Project Description:

Location, Size & Traffic:

- Jackson City limits east to 6th Street
- 2.67 miles
- 4 –12 ft. lanes
- 70,400 square yards
- 2.400 ADT with 1% commercial

Pre Existing Condition:

- Composite pavement
- Curb & gutter
- Some exposed cracks up to ¼"

Pre Job Preparation:

- None

Project Contractor, Surface Type & Cost Information:

- Thompson-McCully (Jackson)
- NovaChip – Type C mix using PG 70-28P
- $3.89 per square yard

Project Evaluation:

Date: October, 2002

Distress & Severity:

- Cracking – Low severity, tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flush – None
- Ride – Very good

Project: West River Drive, Kent County
Owner: Kent County Road Commission
Construction Date: September, 1998

Project Description:

Location, Size & Traffic:

- Abrigador Trail northeasterly to Buth Drive
- 1.5 miles
- 4 – 12 ft. lanes
- 36,100 square yards
- 25,000 ADT with 7.5% commercial

Pre - Existing Condition:

- Composite pavement
- Curb & gutter
- Exposed cracks up to ½”
- Minimal rutting
- Hot pour rubber in cracks > ½”

Pre Job Preparation:

- None

Project Contractor, Surface Type & Cost Information:

- Thompson McCully (Grand Rapids)
- NovaChip – Type C mix using PG 70-28P
- $3.00 per square yard

Project Evaluation:

Date: October, 2002

Distress & Severity:

- Cracking – Moderate severity, tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flush – None
- Ride - Good

Project: Tittabawassee Road, Saginaw County
Owner: Saginaw County Road Commission
Construction Date: September, 1998

Project Description:

Location, Size & Traffic:

- Mackinaw Rd. east to Bay Rd.
- 1 mile
- 5 – 12 ft lanes
- 34,026 square yards
- 30,000 ADT with 15% commercial

Pre Existing Condition:

- Flexible pavement
- Curb & gutter
- Exposed cracks up to ½”
- Hot Pour Rubber in cracks > ½”. Some cracks >1”
- Hot mix patches

Pre Job Preparation:

- None

Project Contractor, Surface Type & Cost Information:

- Midland Contracting
- NovaChip – Type C mix using PG 70-28P
- $3.00 per square yard

Project Evaluation:

Date: October 2002

Distress & Severity:

- Cracking – Moderate severity, tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride - Good

Project: Tittabawassee Rd., Saginaw Co.
Owner: Saginaw County Road Commission
Construction Date: August 1999

Project Description:

Location, Size & Traffic:

- Michigan Avenue east to Westervelt Rd.
- 1 mile
- 2 – 12 ft. lanes with 3 ft. shoulders
- 17,600 square yards
- 5,000 ADT with 5% Commercial

Pre Existing Condition:

- Flexible pavement
- Exposed cracks up to ¼"
- Hot Pour Rubber in cracks > ¼"
- Some hot mix patches

Pre Job Preparation:

- None

Project Contractor, Surface Type & Cost Information:

- Saginaw Asphalt
- NovaChip - Type B mix using PG 70-28P
- $3.00 per square yard

Project Evaluation:

Date: October 2002

Distress & Severity:

- Cracking – Low severity, tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride – Very good

Project: Adams Road, Saginaw County
Owner: Saginaw County Road Commission
Construction Date: August, 1999

Project Description:

Location, Size & Traffic:

- Tittabawasee North to Kochville Road
- 1 mile
- 4 – 12 ft. lanes
- 27,428 square yards
- 5,000 ADT with 5% commercial

Pre Existing Condition:

- Flexible pavement
- Curb & gutter
- Exposed cracks up to ½"
- Routed w/Hot Pour Rubber in cracks > ¼ "

Pre Job Preparation:

- None

Project Contractor, Surface Type & Cost Information:

- Saginaw Asphalt
- NovaChip – Type B mix using PG 70-28P
- $3.00 per square yard

Project Evaluation:

Date: October, 2002

Distress & Severity:

- Cracking – Very low severity, tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride – Very good

Project: M-25, Huron County
Owner: MDOT, Bay Region
Construction Date: September, 2000

Project Description:

Location, Size & Traffic:

- NVL of Caseville east to Weaver Road
- 11.3 miles long
- Two 12 ft. lanes with 5 ft. shoulders
- 223,717 square yards
- 2,500 ADT with 4.4% Commercial

Pre Existing Condition:

- Composite pavement? (cracks seem to be spaced at equal intervals)
- Oxidized
- Cracks filled with hot pour rubber, ¾" to 1 ¼"

Pre Job Preparation:

- None

Project Contractor, Surface Type & Cost Information:

- Saginaw Asphalt
- Paver-Placed Surface Seal – Type C mix using PG 70-28P
- $3.13 per square yard

Project Evaluation:

Date: October, 2002
Distress & Severity:

- Cracking – Low to moderate severity, tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride - Good

Project: M-54, Genesee County
Owner: MDOT, Bay Region
Construction Date: September, 2000

Project Description:

Location, Size & Traffic:

- I-75 north to Reid Rd.
- 1.3 miles long
- Four 12' lanes
- 8' shoulders
- 50,831 square yards
- 10,200 ADT with 5.2% commercial

Pre Existing Condition:

- Composite pavement
- Surface is pitted
- Extensive over-band

Pre Job Preparation:

- None

Project Contractor, Surface Type & Cost Information:

- Saginaw Asphalt
- Paver-Placed Surface Seal – Type B mix using PG 70-28P
- $3.13 per square yard

Project Evaluation:

Date: October, 2002

Distress & Severity:

- Cracking – Low to moderate severity; tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flush – None
- Ride - Good

Project: M-46, Saginaw County
Owner: MDOT, Bay Region
Construction Date: September, 2001

Project Description:

Location, Size & Traffic:

- Townline Road east to Portsmouth Road
- 2 miles
- 2 – 12 ft. lanes with 3 ft. shoulders
- 49,376 square yards
- 8,600 ADT with 6.6% commercial

Pre Existing Condition:

- Composite pavement
- Cracking > ½"
- Small pot holes

Pre Job Preparation:

- Over-banded
- Joint repair detail 7 & 8
- Hand patching

Project Contractor, Surface Type & Cost Information:

- Saginaw Asphalt
- Paver – Placed Surface Seal – Type C mix using PG 70-28P
- $3.44 square yard

Project Evaluation:

Date: October, 2002

Distress & Severity:

- Cracking – None
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride – Very good

Project: M-91, Ionia County
Owner: MDOT, Grand Region
Construction Date: August, 2000

Project Description:

Location, Size & Traffic:

- Approximately 1 mile north of M-44, north to Wabasis Creek
- 2 miles
- Flexible Pavement
- 2 – 12' lanes 3' shoulders
- 40,752 square yards
- 7,051 ADT with 10% commercial

Pre Existing Condition:

- Flexible Pavement
- Northern 1 mile in worse shape then southern 2 mile
- Exposed cracks up to ½"

Pre Job Preparation:

- None

Project Contractor, Surface Type & Cost Information:

- Rieth-Riley (Ada)
- Paver-Placed Surface Seal – Type B mix PG 70-28P
- $3.17 per square yard

Project Evaluation:

Date: October, 2002

Distress & Severity:

- Cracking – Moderate severity, tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride - Good

Project: M-37, Barry County
Owner: MDOT, Southwest Region
Construction Date: August, 2001

Project Description:

Location, Size & Traffic:

- Edward St (Middleville) north to Kent County Line
- 4.1 miles have 8 ft. shoulders
- 2.3 miles have 3 ft. shoulders
- 12' lanes
- 79,455 square yards
- 11,400 ADT with 8% commercial

Pre Existing Condition:

- Flexible pavement
- Northern 0.6 mile has no over-band but looks newer then rest of road
- Balance of road has been over-banded

Pre Job Preparation:

- None

Project Contractor, Surface Type & Cost Information:

- Reith-Riley (Ada)
- Paver-Placed Surface Seal – Type B mix using PG 70-28P
- $3.34 per square yard

Project Evaluation:

Date: October, 2002
Distress & Severity:

- Cracking – low severity, tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride - Good

Project: I-96 Westbound , Ingham County
Owner: MDOT, University Region
Construction Date: September 2000

Project Description:

Location, Size & Traffic:

- M-52 exit west to1 mile west of Williamson exit
- 6 miles long
- 12 ft. driving lanes, 8 ft. outside and 3 ft. inside shoulders
- 91, 006 square yards
- 42,999 ADT with 14% commercial

Pre Existing Condition:

- Flexible pavement
- Very little cracking
- SMA in driving lanes and it is pitted

Pre Job Preparation:

- Over banding cracks > ¼"

Project Contractor, Surface Type & Cost Information:

- Ajax Paving
- Paver-Placed Surface Seal - Type B mix using PG 76-28P
- $3.62 per square yard (includes over-band crack sealing and nighttime paving)

Project Evaluation:

Date: October, 2002

Distress & Severity:

- Cracking – None
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride - Excellent

Project: M-60, Jackson County
Owner: MDOT, University Region
Construction Date: August, 2001

Project Description:

Location, Size & Traffic:

- West Jackson Co. Line easterly to divided highway
- 12.6 miles
- 2 – 12 ft. lanes with 3 ft shoulders
- 225,000 square yards
- 10,200 ADT with 8% commercial

Pre Existing Condition:

- Composite pavement
- Pop outs in mat
- Over-banded
- Longitudinal cracking
- Transverse cracking 7’ – 10’ apart

Pre Job Preparation:

- None

Project Contractor, Surface Type & Cost Information:

- Thompson-McCully (Jackson)
- Paver-Placed Surface Seal – Type B mix using PG 70-28P
- $3.73/sq. yd. (Restricted paving hours)

Project Evaluation:

Date: October, 2002

Distress & Severity:

- Cracking – Low severity, tight, no spalling
- Raveling – None
- Delamination/Debonding – None
- Flushing – None
- Ride – Very good

Draft

RIGID PAVEMENT TREATMENT

PAVER PLACED SURFACE SEAL

Description: A special paver places a polymer modified asphalt emulsion followed immediately by a gap-graded ultra-thin bituminous surface course.

Purpose: A paver placed surface seal is a non-structural bituminous overlay in combination with a bonding/sealing polymer modified asphalt emulsion. It will help seal the existing pavement surface to reduce the intrusion of water entering the pavement structure, slow the rate of pavement deterioration, correct minor pavement surface deficiencies and improve the ride, noise and skid qualities of the pavement.

Existing pavement condition: The concrete pavement should be in good condition and deteriorating at a slow rate. The existing pavement should have a good base and exhibit a uniform cross section. The visible surface distress may include severe polishing, moderate severity longitudinal and transverse cracks, low severity "D" cracking, rut depths less than ½ inch, moderate severity corner breaks and moderate spalling. Map cracking and scaling should not exceed 12 y^2 in any 120 y^2 area. Joint and crack faults should not exceed 1/3 inch.

Pavement	D.I.	R.Q.I.
Rigid	**<10**	**<54**

Existing pavement surface preparation: Repairs should be made prior to placement of paver placed surface seal. This preparation work should be limited to minor repairs. Ruts greater than ½ inch depth should be filled with suitable material prior to placement of the paver placed surface seal. Cracks greater than ¼ inch wide should be sealed using an approved crack sealing method. The maximum sealant "film" thickness allowed will be 2/10 inch. Paver placed surface seal should be considered when the average friction number is 30 or less.

Performance: This treatment corrects minor rutting and low friction. As a secondary benefit this treatment reduces tire noise. Paver placed surface seal performs well on high volume roadways to correct the pavement surface conditions described above.

Life Extension

Pavement	Years
Rigid	5 to 9**

*** We acknowledge that a paver placed surface seal will provide a life extension to a pavement, however, data are not available to quantify the life extension.*

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Draft

Performance Limitations: Paver placed surface seal should not be placed on the following existing concrete pavement conditions: severely distressed concrete pavement, rut depths greater than, ½ inch pavement with a weak base or where faulting is greater than1/3 inch. The paver placed surface seal construction season may start in early May, but should be discontinued by no later than mid October. Paver placed surface seal should not be used as a one step solution to treating the deficiencies of the concrete pavement.

DRAFT

FLEXIBLE & COMPOSITE PAVEMENT SURFACE TREATMENT

PAVER PLACED SURFACE SEAL

Description: A special paver places a polymer modified asphalt emulsion followed immediately by a gap-graded ultra-thin bituminous surface course.

Purpose: A paver placed surface seal is a non-structural bituminous overlay in combination with a bonding/sealing polymer modified asphalt emulsion. It will help seal the existing pavement surface to reduce the intrusion of water into the pavement structure, slow the rate of pavement deterioration, correct minor pavement surface deficiencies and improve the ride, noise and skid qualities of the pavement.

Existing pavement condition: The existing pavement should exhibit a good base condition and a uniform cross section. The visible surface distress may include severe raveling, moderate severity longitudinal and transverse cracks, moderate block cracking, moderate patching, or moderate bleeding. Reflection cracking at joints should not exceed moderate severity level.

Pavement	D.I.	R.Q.I.	Rut
Flexible	**<40**	**<70**	**<½ inch**
Composite	**<25**	**<70**	**<½ inch**

Existing pavement surface preparation: This preparation work should be limited to minor repairs. Ruts or other depressions greater than ½ inch depth should be filled with suitable material prior to placement of the paver placed surface seal. Cracks greater than ¼ inch wide should be sealed using an approved crack sealing method. The maximum sealant "film" thickness allowed will be ¼ inch.

Performance: This treatment corrects minor rutting and low friction. The process may be used in lieu of extensive stand alone overband crack fill when the cracking meets the criteria described above. Paver placed surface seal performs well on high volume roadways to correct the pavement surface conditions described above.

Life Extension

Pavement	Years
Flexible	7 to 10**
Composite	5 to 9**
** *We acknowledge that a paver placed surface seal will provide a life extension to a pavement, however, data are not available to quantify the life extension.*	

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

Performance Limitations: Paver placed surface seal should not be placed on the following existing pavement conditions: severely distressed composite pavement, severe rutted bituminous pavement, pavement with a weak base, a bituminous surface that is debonding or severe bleeding bituminous surface. Paver placed surface seal will not stop reflective cracking. The construction season may start in early May, but should be discontinued by no later than mid October

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
PAVER PLACED SURFACE SEAL

a. Description. This work consists of furnishing all materials, equipment, labor and preparation necessary for an application of a polymer modified asphalt emulsion followed immediately with an ultra-thin HMA surface course. The polymer modified asphalt emulsion shall be applied immediately prior to the application of the HMA surface course so that no contact with the paving machine is made with the polymer modified asphalt emulsion before the HMA surface course is applied. The process of applying the polymer modified asphalt emulsion, spreading the HMA surface course and compaction, shall result in a homogeneous Paver Placed Surface Seal that can be opened to traffic immediately upon sufficient cooling.

b. Materials.

1. **Aggregate Physical Properties.** The physical properties of the aggregate shall be within the limits of Table 1 and Table 2.

Table 1: Physical Requirements for Coarse Aggregate

Tests	Method	Value
L.A. Abrasion Resistance:	MTM-102	35% max loss
Aggregate Wear Index (AWI)	MTM-111	260 min
Percentage of Crushed Particles, Two Faced	MTM-117	90% min
Deleterious Particles in Aggregate	MTM-110 (1)	5.0% max
Flat and Elongated Ratio, 3:1	ASTM D4791(2)	25% max
Water Absorption	ASTM C127	<3.0% max

(1) Includes the sum of shale, siltstone, structurally weak and clay ironstone.
(2) As determined in accordance with ASTM D4791 retained on the #4 sieve material. The ratio between length to width or length to thickness or any combination greater than, 3:1 and shall not be more than 25% of the material.

Table 2: Physical Requirements for Fine Aggregate

Tests	Method	Value
Sand Equivalent	ASTM D 2419	45% min.
Uncompacted Void Content	ASTM C 1252	40% min.

2. **Performance Grade Asphalt Binder.** Binders must conform to the certification procedures described in the MDOT Materials Quality Assurance Manual and shall meet all the requirements of the Special Provision for Polymer Modified Performance Grade Binders Table 1. Selection of Asphalt Binders are listed in Table 3.

Table 3: Performance Graded Asphalt Binder	
Location	PG Asphalt Binder
North of M-72 in lower peninsula and the upper peninsula	PG 64-28P
South of M-72 (including M-72)	PG 70-28P
Metro Region only	PG 70-22P

3. **Asphalt Emulsion.** A polymer modified asphalt emulsion shall meet the requirements listed on Table 4. The emulsified asphalt must conform to certification procedures described in the MDOT Materials Quality Assurance Manual.

Table 4: Polymer Modified Asphalt Emulsion for Paver Placed Surface Seal			
Test on Emulsion	Method	Min.	Max.
Viscosity @ 25°C, SFS	ASTM D88	20	100
Sieve Test, %	ASTM D244		0.05
24-Hour Storage Stability, % Diff. (1)	ASTM D244		1
Residue from Distillation @ 204°C, % (2)	ASTM D244	63	
Oil Distillate, ml	ASTM D244		2
Demulsibility 35 ml, 0.02 N CaCl 2	ASTM D244	60	
Test on Residue from Distillation	Method	Min.	Max.
Solubility in TCE, % (3)	ASTM D2042	97.5	
Elastic Recovery, %	AASHTO T301	60	
Penetration @ 25°C, 100 g, 5 sec. dmm	ASTM D5	80	150

4. **HMA Mixture Design.** The Contractor will submit a completed mix design from an MDOT approved laboratory to the Engineer, five working days prior to the start of construction. All material sources used for the mix design will be identified. The mixture will be designed so that the asphalt binder content produces a minimum film thickness of 9 microns and sufficient to satisfy the moisture sensitivity minimum without exceeding the maximum draindown requirement. The film thickness will be computed consistent with the method defined in “Hot Mix Asphalt Materials, Mixture Design and Construction,” 2nd Edition, National Center for Asphalt Technology. The designed mixture must meet all requirements of Table 5 and minimum film thickness. Test results, from Table 5, and film thickness will be presented to MDOT as part of the completed mix design.

Table 5: Mixture Requirements

Percent Passing Indicated Sieves	Type B Mix	Type C Mix
3/4"		100
½"	100	85-100
3/8"	85-100	55-80
#4	22-38	22-38
#8	19-32	19-32
#16	15-24	15-24
#30	11-18	11-18
#50	8-14	8-14
#100	5-10	5-10
#200	4-7	4-7
Asphalt Binder Content, %	4.8-6.2	4.6-6.2
Draindown Test AASHTO T305	0.10% max.	0.10% max.
Moisture Sensitivity, AASHTO T283 (1)	80% min.	80% min.

(1) Specimens for T-283 testing are to be compacted by using the Superpave Gyratory Compactor (SGC) at 100 gyrations with a target volume of either 150 mm diameter x 95 mm (±3mm) height or 100 mm diameter x 63 mm (±3mm) height. No adjustment is made to the number of revolutions to target an air void range. Cure the loose HMA surface course mix 1 hour at the specified application temperature. Minimum time for vacuum saturation: 20 minutes. Specimens subject to freeze - thaw conditioning. If an anti-stripping agent is needed, amount and type must be reported with the mix design.

A. **Mix Design Documentation.**

1. MDOT Form 1820 - Contractor Hot Mix Design Communication
2. MDOT Form 1923 - Sample Identification
3. Average max. percent draindown for each test temperature (Report)
4. Moisture sensitivity for specimen tests (Report)
5. Computation of film thickness (Report)

c. Construction.

1. Equipment.

A. **Self-Priming Machine.** The self-priming machine will spray a polymer modified emulsion membrane and place a HMA surface course over the membrane in a continuous one pass application. No part of the self-priming machine shall come in contact with the polymer modified emulsion membrane before the HMA surface course is applied. The self-priming machine will have:

1. A receiving hopper with at least two heated - twin screw, mix feed augers.
2. An integral storage tank for the polymer modified asphalt emulsion.
3. Twin expandable emulsion spray bars located immediately in front of the HMA feed augers and ironing screed. The spray bars will be metered to accurately apply the polymer modified asphalt emulsion and monitor the rate of spray across the entire width of the paving pass.
4. A variable width vibratory heated ironing screed. The screed will be adjustable and capable of providing both positive and negative crowns to the desired thickness and cross section.

B. **Compacting Equipment.** At least two steel wheel roller each weighing a minimum of 10 tons will be used. The rollers will meet Section 502.03A.5 of the Standard Specifications for Construction.

2. Pre-Paving Meeting. A pre-paving meeting between the Engineer and Contractor will be held on-site prior to beginning work. The agenda for this meeting includes:

A. Review of a work schedule.

B. Examine traffic control plan.

C. Review equipment calibrations and adjustments.

D. Inspect condition of equipment for safety criteria.

E. Discussion of the quality control plan.

F. Designation of Contractor's authorized representative.

3. Weather / Seasonal Limitations. The Paver Placed Surface Seal shall be placed on dry pavement. Placement is not permitted when the air temperature is below 50 °F. Seasonal limitations for placing Paver Placed Surface Seal will be from May 1 to October 15.

4. General Placement.

A. **Emulsion Membrane.** The target application rate for the polymer modified asphalt emulsion membrane will be 0.20 gal/ yd^2. A field adjustment of the emulsion application rate is allowed to account for changes in existing pavement surface conditions.

B. **HMA Surface Course.** The target application rate is 73 lbs/ yd^2 for Type B surface course mixture and 83 lbs/ yd^2 for Type C surface course mixture. In no case will the application rate be thin enough to fracture aggregate by the screed.

5. Quality Control. The following measures shall be taken by the Contractor to maintain quality control and uniformity. If a condition is identified below that causes an unsatisfactory Paver Placed Surface Seal, all production work shall stop and corrective action must immediately be taken.

A. **Placing HMA Surface Course.** The application rate of the HMA surface course is determined by three yield checks daily. The yield shall not exceed a tolerance of ±5 lbs/yd^2 from the target application rate.

B. **HMA Mixture.** A sample of the HMA mixture will be taken in the area just before the screed of the self-priming machine. One daily sample will be taken and tested prior to the following day's production. The test results must fall within the tolerances listed in Table 6.

Table 6: Quality Control Tolerances

Percent Passing Indicated Sieves	Type B Mix	Type C Mix
SIZE	Tolerance, %	Tolerance, %
3/4"		
½"		±5
3/8"	±5	±5
#4	±5	±5
#8	±4	±4
#200	±1	±1
PG Asphalt Binder Content, %	±0.4	
Film Thickness	9 microns (Min.)	

C. **Material Temperature.** The polymer modified asphalt emulsion membrane will be applied at a temperature of 140 °F to 175 °F. The HMA mixture will be applied at a temperature of 300 °F to 330 °F and compaction will be completed before the mat has cooled to 185 °F.

D. **Rough Joints.** Transverse or longitudinal construction joints created from a Paver Placed Surface Seal operation that causes a bump or poor riding joint is unsatisfactory and must be repaired by a mutually agreed upon method.

6. **Ride Quality.** Prior to the placement of the Paver Placed Surface Seal, the Department will determine the ride quality of the pavement surface in terms of the Michigan Ride Quality Index (RQI). The plots of the original roadway profiles will be retained by the Department. Shoulder work is exempt from ride quality measures.

The ride quality of the pavement shall not diminish after the application of Paver Placed Surface Seal. The finished pavement surface may be accepted without measuring the new roadway profile if, in the opinion of the Engineer, the final quality of the ride is at least as good as that of the original pavement prior to construction.

When the ride quality appears to have diminished after the Paver Placed Surface Seal, the ride quality shall be corrected by the Contractor. If a dispute arises based on a diminished ride quality, the Department will then re-measure the pavement profile and compare the ride quality index values for the finished pavement surface to the original ride quality index values for the pavement documented prior to construction. Any reductions in the ride quality shall be corrected by the Contractor, as directed by the Engineer, so as to produce a finished pavement surface with an RQI at least as good as that of the original pavement documented prior to construction.

7. **Initial Acceptance.** At the construction completion of the Paver Placed Surface Seal, or a portion as determined by the Department, the Department and Contractor shall review the Paver Placed Surface Seal for compliance with the project specifications. If the Paver Placed Surface Seal is determined by the Department to not be in compliance, then the Contractor shall repair and make good at its own expense any and all defects. The Department and the Contractor shall document and execute the initial acceptance on a form furnished by the department when the Paver Placed Surface Seal is determined by the Department to be in compliance.

d. Measurement and Payment. The completed work as measured will be paid for at the contract unit price for the following contract item.

Contact Item (Pay Item)	**Pay Unit**
Paver Placed Surface Seal, Type B	Square Yard
Paver Placed Surface Seal, Type C	Square Yard

Payment for **Paver Placed Surface Seal, Type B and Type C** includes all materials, equipment, labor for preparing the surface, placing temporary pavement markings, placing the Paver Placed Surface Seal mixture. The placement includes placement of a membrane and HMA surface course of mixture for full width coverage as specified in the contract documents.

DRAFT

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
PAVEMENT PERFORMANCE WARRANTY FOR PAVER PLACED SURFACE SEAL
(Capital Preventive Maintenance)

a. Description. The pavement performance warranty shall consist of satisfying the warranty requirements of the work contained in the appendices. This special provision establishes the common terms and definitions applied to the pavement requiring warranted work. The pavement performance warranty assures and protects the Department from specific defects found in the pavement.

b. Definitions.

1. Initial Acceptance - The date when the warranted work is complete and has been determined by the Department to be in compliance with the contract specifications and is continuously open to traffic. This is the start date for the warranty period. There may be more than one initial acceptance for a project.

2. Warranty Bond - A surety which guarantees that the warranty requirements will be met.

3. Driving Lane(s) - The delineated pavement surface used by traffic including adjacent shoulders. Each of the following is considered a separate driving lane,

   - Each individual mainline lane
   - The sum of all ramp lanes and the associated acceleration/deceleration lanes
   - The sum of all auxiliary lanes, such as passing lanes and turn lanes

   Approaches and driveways are not considered driving lanes for the purpose of this provision.

4. Warranted Work - Work that is guaranteed that will not exceed the specified thresholds of the performance criteria during the warranty period.

5. Warranty Work - If the thresholds are exceeded during the warranty period, corrective action will be completed by the Contractor to bring the warranted work back into compliance for release of the warranty. All costs will be borne by the Contractor including traffic control, mobilization, pavement marking and/or other related work.

c. Initial Acceptance. The Department and the Contractor shall jointly review all completed warranted work, or a portion thereof, as determined by the Department. If the work does not meet contract requirements, the Contractor shall make all necessary corrections, at their expense, prior to initial acceptance. Initial acceptance will occur as soon as the Department determines that all contract requirements have been met for the warranted work and is continuously open to traffic.

Initial acceptance will be documented and executed jointly by the Department and the Contractor on a form furnished by the Department. A copy of the form will be sent to the Contractor's warranty bond surety agent by the Department. Neither the initial acceptance nor any prior inspection, acceptance or approval by the Department diminishes the Contractor's responsibility under this warranty.

The Department may accept any portion of the work and begin the warranty period to accommodate seasonal limitations or staged construction, excluding any area needing corrective work.

d. Warranty Bond. The Contractor shall furnish a single term warranty bond of the amount stipulated in the appendix prior to contract award. The effective starting date of the warranty bond shall be the Initial acceptance. The warranty bond will be released at the end of the warranty period, or after all warranty work has been satisfactorily completed, whichever is latest.

e. Rights and Responsibilities of the Department. The Department:

1. Reserves the right to approve the time, traffic control and methods for performing any warranty work by permit through the Region utilities and permit process.

2. Reserves the right to approve the schedule proposed by the Contractor to perform warranty work.

3. Reserves the right to approve all materials and specifications used in warranty work.

4. Reserves the right to determine if warranty work performed by the Contractor meets the contract specifications.

5. Reserves the right to perform, or have performed, routine maintenance during the warranty period, which routine maintenance will not diminish the Contractor's responsibility under the warranty.

6. Reserves the right, if the Contractor is unable, to make immediate emergency repairs to the pavement to prevent an unsafe road condition caused by defective warranted work as determined by the Department. The Department will attempt to notify the Contractor that action is required to address an unsafe condition. The Department will record the time and date of the attempts for Contractor notification. However, should the Contractor be unable to comply with this requirement, to the Department's satisfaction and within the required time frame specified by the Department, the Department will perform, or have performed any emergency repairs deemed necessary. Any such emergency repairs undertaken will not relieve the Contractor from meeting the warranty requirements of this Special Provision. Any costs associated with such emergency repairs will be paid by the Contractor.

7. Is responsible for monitoring the pavement throughout the warranty period and will provide

the Contractor any written reports of the surface condition and/or maintenance activities related to pavement performance.

8. Is responsible for notifying the Contractor, in writing, of any corrective action required to meet the warranty requirements.

f. Rights and Responsibilities of the Contractor. The Contractor:

1. Shall warrant to the Department that the warranted work will be free of defects as measured by the performance parameters and specified threshold values for each. The warranty bond shall be described on a form furnished by the Department. The completed form shall be submitted to the Department prior to award of contract.

2. Is responsible for performing all warranty work including, but not limited to, maintaining traffic and restoring all associated pavement features, at the Contractor's expense.

3. Is responsible for performing all temporary or emergency repairs, resulting from being in non-compliance with the warranty requirements, using Department approved materials and methods.

4. Shall notify the Department and submit a written course of action for performing the needed warranty work, ten calender days prior to commencement of said warranty work, except in the case of emergency repairs as detailed in this special provision. The submittal must propose a schedule for performing the warranty work and the materials and methods to be used.

5. Shall follow a Department approved maintaining traffic plan when performing warranty work.

6. Is required to supply to the Department original documentation that all insurance required by the contract is in effect during the period(s) that warranty work is being performed, as required by subsection 107.10 of the standard specifications.

7. Shall furnish to the Department, in addition to the regular performance and lien bond for the contract, supplemental performance and lien bonds covering any warranty work being performed. These supplemental bonds shall be furnished prior to beginning any warranty work, using Department approved forms. These supplemental bonds shall be in the amount required by the Department to cover the costs of warranty work.

8. Shall complete all warranty work required by this special provision and prior to conclusion of the warranty period, or as otherwise agreed to by the Department.

9. Shall be liable during the warranty period in the same manner as Contractors currently are liable for their construction related activities with the Department pursuant to the standard specifications, including, but not limited to subsections 103.06, 107.10 and 107.11. This liability shall arise and continue only during the period when the Contractor is performing warranty work. This liability is in addition to the Contractor performing and/or paying for any required warranty work, and shall include liability for injuries and/or damages and any expenses resulting therefrom which are not attributable to normal wear and tear of traffic and weather, but are due to non-compliant materials, faulty workmanship, and to the

operations of the Contractor as set forth more fully in subsections 103.06, 107.10 and 107.11 of the standard specifications.

g. Evaluation Method. The Department will conduct pavement evaluations by dividing the project into segments. Each individual driving lane will be divided into segments of 528 feet for measuring and quantifying the condition parameters. Evaluation may include use of both the Department's Pavement Management System and/or field pavement condition reviews. This evaluation may be waived in emergency situations.

The beginning point for laying out segments will be the Point of Beginning (POB) of the project. Segments will be laid out consecutively to the Point of Ending (POE) of the project. The original segmentation of the project will be used for all successive reviews throughout the warranty period.

h. Warranty Requirements. Warranty work will be required when the following two criteria are both met as a result of a failure to meet the performance parameters.

Criteria 1 -The threshold limit for a performance parameter is exceeded, and

Criteria 2 - The maximum allowable number of defective segments is exceeded for one or more performance parameters for a driving lane, unless otherwise noted in the appendices.

Specific threshold limits and segment limits are covered in the appendices.

During the warranty period, the Contractor will not be held responsible for pre-existing conditions and by factors beyond his control. These include, but are not limited to: chemical and fuel spills, vehicle fires, snow plowing, and any testing by the Department, such as coring. Other factors considered to be beyond the control of the Contractor which may contribute to pavement distress will be considered by the Engineer on a case by case basis upon receipt of a written request from the Contractor.

i. Conflict Resolution Team. The sole responsibility of the Conflict Resolution Team (CRT) is to provide a decision on disputes between the Department and the Contractor regarding application or fulfillment of the warranty requirements. The CRT will consist of five members:

1. Two members selected and compensated by the Department.

2. Two members selected and compensated by the Contractor.

3. One member mutually selected by the Department and the Contractor. Compensation for the third party member will be equally shared by the Department and the Contractor.

If a dispute arises on the application or fulfillment of the terms of this warranty, either party may serve written notice that appointment of a CRT is required.

At least three members of the CRT must vote in favor of a motion to make a decision. If agreement cannot be reached, the CRT may decide to conduct a forensic investigation. The CRT will determine the scope of work and select the party to conduct the investigation. All costs related to the forensic investigation will be shared proportionally between the Contractor and the Department based on the determined cause of the condition.

j. Emergency Repairs. If the Department determines that emergency repairs are necessary for public safety, the Department or it's agent may take repair action. Emergency repairs will be authorized by the Engineer.

Prior to emergency repairs, the Department will document the basis for the emergency action. In addition, the Department will preserve evidence of the defective condition.

k. Non-extension of Contract. This Special Provision shall not be construed as extending or otherwise affecting the claim process and statute of limitation applicable to this Contract.

l. Measurement and Payment. All costs, including engineering and maintaining traffic costs, associated with meeting the requirements of this Special Provision are considered to be included in the contract unit prices for the warranted work regardless of when such costs are incurred throughout the warranty period. These costs include but are not limited to, all materials, labor and equipment necessary to complete required warranty work.

DRAFT

PAVEMENT PERFORMANCE WARRANTY APPENDIX FOR PAVER PLACED SURFACE SEAL

A1. Application. This appendix is applicable for surface treatment performance warranties on Paver Placed Surface Seals. The work consists of furnishing all labor, equipment, and materials necessary to place a warm polymer modified asphalt emulsion followed by a Hot Mix Asphalt (HMA) thin overlay.

A2. Limits of Warranted Work. The warranted work includes all Paver Placed Surface Seal applications on driving lanes and shoulders within the project limits unless otherwise indicated on the proposal.

A3. Warranty Period. The length of warranty will be three years from the Initial Acceptance.

A4. Amount of Warranty Bond. The Contractor will supply a warranty bond equal to 100% of the warranted work for Paver Placed Surface Seal.

A5. Materials.

1. Aggregate Physical Properties. The physical properties of the aggregate shall be within the limits of Table 1 and Table 2.

Table 1: Physical Requirements for Coarse Aggregate

Tests	Method	Value
L.A. Abrasion Resistance:	MTM-102	35% max loss
Aggregate Wear Index (AWI)	MTM-111	260 min
Percentage of Crushed Particles, Two Faced	MTM-117	90% min
Deleterious Particles in Aggregate	MTM-110 (1)	5.0% max
Flat and Elongated Ratio, 3:1	ASTM D4791(2)	25% max
Water Absorption	ASTM C127	<3.0% max
Micro-Deval, % loss	AASHTO TP58-99	18 max

(1) Includes the sum of shale, siltstone, structurally weak and clay ironstone.
(2) As determined in accordance with ASTM D4791 retained on the #4 sieve material. The ratio between length to width or length to thickness or any combination greater than, 3:1 and shall not be more than 25% of the material.

Table 2: Physical Requirements for Fine Aggregate		
Tests	Method	Value
Sand Equivalent	ASTM D 2419	45% min.
Uncompacted Void Content	ASTM C 1252	40% min.

2. Performance Graded (PG) Asphalt Binder. Binders shall meet all the requirements of the Special Provision for Polymer Modified Performance Grade Binders Table 1. Selection of Asphalt Binders are listed in Table 3.

Table 3: Performance Graded Asphalt Binder	
~~Location~~	~~PG Asphalt Binder~~
North of M-72 in lower peninsula and the upper peninsula	PG 64-28P
South of M-72 (including M-72)	PG 70-28P
Metro Region only	PG 70-22P

3. Asphalt Emulsion. A polymer modified asphalt emulsion shall meet the requirements listed on Table 4.

Table 4: Polymer Modified Asphalt Emulsion			
Test on Emulsion	Method	Min.	Max.
Viscosity @ 25_C, SFS	ASTM D88	20	100
Sieve Test, %	ASTM D244		0.05
24-Hour Storage Stability, % Diff. (1)	ASTM D244		1
Residue from Distillation @ 204_C, % (2)	ASTM D244	63	
Oil Distillate, ml	ASTM D244		2
Demulsibility 35 ml, 0.02 N CaCl 2	ASTM D244	60	

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Test on Residue from Distillation	Method	Min.	Max.
Solubility in TCE, % (3)	ASTM D2042	97.5	
Elastic Recovery, %	AASHTO T301	60	
Penetration @ 25_C, 100 g, 5 sec. dmm	ASTM D5	80	150

1. **HMA Mixture Design.** The Contractor will submit a completed mix design from an MDOT approved laboratory to the Engineer, five working days prior to the start of construction. All material sources used for the mix design will be identified. The mixture will be designed so that the asphalt binder produces a minimum film thickness of 9 microns. The film thickness will be computed consistent with the method defined in "Hot Mix Asphalt Materials, Mixture Design and Construction," 2nd Edition, National Center for Asphalt Technology. The designed mixture must meet all requirements of Table 5 and minimum film thickness. Test results, from Table 5, and film thickness will be presented to MDOT as part of the completed mix design.

Table 5: Mixture Requirements

Percent Passing Indicated Sieves	Type B Mix	Type C Mix
3/4"		100
1/2"	100	85-100
3/8"	85-100	55-80
#4	22-38	22-38
#8	19-32	19-32
#16	15-24	15-24
#30	11-18	11-18
#50	8-14	8-14
#100	5-10	5-10
#200	4-7	4-7
Asphalt Binder Content, %	4.8-6.2	4.6-6.2
Draindown Test AASHTO T305	0.10% max.	0.10% max.
Moisture Sensitivity, AASHTO T283 (1)	80% min.	80% min.

(1) Specimens for T-283 testing are to be compacted by using the Superpave Gyratory Compactor (SGC) at 100 gyrations with a target volume of either 150 mm diameter x 95 mm (±3mm) height or 100 mm diameter x 63 mm (±3mm) height. No adjustment is made to the number of revolutions to target an air void range. Cure the loose bituminous surface course mix 1 hour at the specified application temperature. Minimum time for vacuum saturation: 20 minutes. Specimens subject to freeze - thaw conditioning. If an anti-stripping agent is needed, amount and type must be reported with the mix design.

A. **Mix Design Documentation.**

1. MDOT Form 1820 - Contractor Bituminous Mix Design Communication
2. MDOT Form 1923 - Sample Identification
3. Average max. percent draindown for each test temperature (Report)
4. Moisture sensitivity for specimen tests (Report)
5. Computation of film thickness (Report)

A6. Construction.

5. Equipment.

   1. **Self-Priming Machine.** The self-priming machine will spray a polymer modified emulsion membrane and place a HMA surface course over the membrane in a continuous one pass application. No part of the self-priming machine shall come in contact with the polymer modified emulsion membrane before the HMA surface course is applied. The self-priming machine will have:

      1. A receiving hopper with at least two heated - twin screw, mix feed augers.
      2. An integral storage tank for the polymer modified asphalt emulsion.
      3. Twin expandable emulsion spray bars located immediately in front of the HMA feed augers and ironing screed. The spray bars will be metered to accurately apply the polymer modified asphalt emulsion and monitor the rate of spray across the entire width of the paving pass.
      4. A variable width vibratory heated ironing screed. The screed will be adjustable and capable of providing both positive and negative crowns to the desired thickness and cross section.

   2. **Compacting Equipment.** At least two steel wheel roller each weighing a minimum of 10 tons will be used. The rollers will meet Section 502.03A.5 of the Standard Specifications for Construction.

2. Pre-Paving Meeting. A pre-paving meeting between the Engineer and Contractor will be held on-site prior to beginning work. The agenda for this meeting includes:

   1. Review of a work schedule.

   2. Examine traffic control plan.

   3. Review equipment calibrations and adjustments.

   4. Inspect condition of equipment for safety criteria.

   5. Discussion of the quality control plan.

   6. Designation of Contractor’s authorized representative.

3. Weather / Seasonal Limitations. The Paver Placed Surface Seal shall be placed on dry pavement. Placement is not permitted if the air temperature is below 50°F at the time of placement. Seasonal limitations for placing Paver Placed Surface Seal will be from May 1 to October 15.

4. General Placement.

   1. **Emulsion Membrane.** The target application rate for the polymer modified asphalt emulsion membrane will be 0.20 gal/ yd^2. A field adjustment of the emulsion application rate is allowed for changes in existing pavement surface conditions or limitation of the HMA Mixture Design.

   2. **HMA Surface Course.** The target application rate is 73 lbs/ yd^2 for Type B surface course mixture and 83 lbs/ yd^2 for Type C surface course mixture. In no case will the application rate be thin enough to fracture aggregate by the screed.

5. Quality Control. The following measures shall be taken by the Contractor to maintain quality control and uniformity. If a condition is identified below that causes an unsatisfactory Paver Placed Surface Seal, all production work shall stop and corrective action must immediately be taken.

   1. **Placing HMA Surface Course.** The application rate of the HMA surface course is determined by three yield checks daily. The yield shall not exceed a tolerance of ±5 lbs/ yd^2 from the target application rate.

   2. **HMA Mixture.** A sample of the HMA mixture will be taken in the area just before the screed of the self-priming machine. One daily sample will be taken and tested prior to the following day's production. The test results must fall within the tolerances listed in Table 6.

Table 6: Quality Control Tolerances

Percent Passing Indicated Sieves SIZE	Type B Mix Tolerance, %	Type C Mix Tolerance, %
3/4"		
1/2"		±5
3/8"	±5	±5
#4	±5	±5
#8	±4	±4
#200	±1	±1

PG Asphalt Binder Content, %	±0.4
Film Thickness	9 microns (Min.)

3. **Material Temperature.** The polymer modified asphalt emulsion membrane will be applied at a temperature of 140° to 175°F. The HMA mixture will be applied at a temperature of 300° to 330°F and compaction will be completed before the mat has cooled to 185°F.

4. **Rough Joints.** Transverse or longitudinal construction joints created from a Paver Placed Surface Seal operation that causes a bump or poor riding joint is unsatisfactory and must be repaired by a mutually agreed upon method.

2. Ride Quality. Prior to the placement of the Paver Placed Surface Seal, the Department will determine the ride quality of the pavement surface in terms of the Michigan Ride Quality Index (RQI). The plots of the original roadway profiles will be retained by the Department. Shoulder work is exempt from ride quality measures.

   The ride quality of the pavement shall not diminish after the application of Paver Placed Surface Seal. The finished pavement surface may be accepted without measuring the new roadway profile if, in the opinion of the Engineer, the final quality of the ride is at least as good as that of the original pavement prior to construction.

   When the ride quality appears to have diminished after the Paver Placed Surface Seal, the ride quality shall be corrected by the Contractor. If a dispute arises based on a diminished ride quality, the Department will then re-measure the pavement profile and compare the ride quality index values for the finished pavement surface to the original ride quality index values for the pavement documented prior to construction. Any reductions in the ride quality shall be corrected by the Contractor, as directed by the Engineer, so as to produce a finished pavement surface with an RQI at least as good as that of the original pavement documented prior to construction.

7. Initial Acceptance. At the construction completion of the Paver Placed Surface Seal, or a portion as determined by the Department, the Department and Contractor shall review the Paver Placed Surface Seal for compliance with the project specifications. If the Paver Placed Surface Seal is determined by the Department to not be in compliance, then the Contractor shall repair and make good at its own expense any and all defects. The Department and the Contractor shall document and execute the initial acceptance on a form furnished by the department when the Paver Placed Surface Seal is determined by the Department to be in compliance. A copy of initial acceptance shall be sent to the Contractor's Warranty Bond surety agent by the Department.

A7. Measurement and Payment.

The completed work as measured will be paid for at the contract unit price for the following contract item.

Contact Item (Pay Item)	**Pay Unit**
Paver Placed Surface Seal, Type B, Warranty	Square Yard
Paver Placed Surface Seal, Type C, Warranty	Square Yard

Payment for **Paver Placed Surface Seal, Type B and Type C, Warranty** includes all materials, equipment, labor for preparing the surface, placing temporary pavement markings, placing the Paver Placed Surface Seal mixture and complying with all requirements including the warranty. The placement includes placement of a membrane and HMA surface course of mixture for full width coverage as specified in the contract documents.

A8. Warranty Parameters. Condition parameters are used to measure the performance of the Paver Placed Surface Seal treatment during the warranty period. Each condition parameter has a threshold level applied to each segment and defines the number of defective segments allowed before corrective action (warranty work) is required. Shoulders are included in the segments when designated as warranted work.

Definitions

Segment. Each segment is 528 feet conforming to Section g. “Evaluation Method.”

Rutting. Longitudinal surface depressions in the wheel path of a HMA pavement caused by inadequate compaction or plastic movement of the asphalt mixture.

Raveling. Surface disintegration, due to the loss of aggregate material, that occurs over an area or in a continuous longitudinal strip. Wear caused by snowplow abrasion is not considered raveling.

Bleeding/Flushing. Bleeding and flushing is an excessive amount of asphalt binder on the surface that changes the acceptable texture of the Paver Placed Surface Seal. Both bleeding and flushing are characterized by a black sheen over the entire surface or at localized areas such as wheel paths. The accumulation of excess asphalt binder on the pavement surface becomes tacky to the touch at high temperatures.

Debonding. A physical separation of the new pavement surface from the previous pavement surface. Debonding will be visually present as the loss of the new surface course. Surface potholes, regardless of depth, will also be classified as debonding, if the condition was derived from debonding of the new Paver Placed Surface Seal course.

A9. Warranty Requirements. If any of the following performance thresholds are exceeded, warranty work is required. The warranty work shall be performed prior to conclusion of the warranty period or within such other time frame as agreed to by the Department and the Contractor, unless safety concerns dictate otherwise.

4 Segments - A combination of one or more surface deficiencies exceeding the allowable threshold limit for rutting, raveling, bleeding/flushing, and debonding.

1 Segment - Rutting exceeding the allowable threshold limit.

1 Segment - Any single surface deficiency for raveling, bleeding/flushing, and debonding, exceeding 10 percent of the segment length.

1. Rutting. A single measure of rut depth shall not exceed 1/4 inch for any 528 feet (0.1 mile) segment during the first 120 days after initial project acceptance. During the entire warranty period rut depths that average in excess of 3/8 inch are deficient. The average rut depth will be defined by 5 measurements at 100 foot intervals in the segment as determined by the Engineer. Pavement segments where the original pavement rut depth exceeds 1/2 inch are excluded from the warranty for rutting threshold level. The Contractor will define locations where rutting exceeds 1/2 inch and provide the information to the Engineer. Work shall not begin until the Engineer has verified and accepted the Contractor’s list of warranty exceptions. Any subsequent rutting caused from movement of the underlying pavement layers is excluded from the warranty.

   Corrective action is required for any one segment deficiency. Correction of this parameter requires the Contractor to reapply a Paver Placed Surface Seal treatment on the deficient portion of the segment. The Engineer may accept alternative corrective measures, based on unique conditions.

   The measurement will be done using a straight rigid device that is a minimum of 7 feet long and of sufficient stiffness that it will not deflect from its own weight, or a wire under sufficient tension to prevent sag when extended 7 feet. Measurements will be taken by placing this “straightedge” across the pavement surface perpendicular to the direction of travel. The straightedge shall contact the surface on at least two bearing points with one located on either side of the rut. The straightedge is properly located when sliding the straightedge along its axis does not change the location of the contact points. Rut depth is then measured at the point of greatest perpendicular distance from the bottom of the straightedge to the pavement surface.

2. Raveling. The allowable threshold limit for raveling shall not exceed 8% of the segment length. All segments in the driving lane or shoulder (528 feet in length) will be measured where the raveling is evident.

   Corrective action for this parameter requires the Contractor to reapply Paver Placed Surface Seal (full-width) to the deficient portion of the segment, including shoulders if part of the Paver Placed Surface Seal work. The Engineer may accept alternative corrective measures, based on unique conditions.

3. **Bleeding/Flushing.** The allowable threshold limit for bleeding or flushing shall not exceed 5% of the segment length. All segments in the driving lane or shoulder (528 feet in length) will be measured where the bleeding or flushing is evident.

   Corrective action for this parameter requires the Contractor to either reapply Paver Placed Surface Seal (full-width), diamond grind, or remove and replace (full-width) the Paver Placed Surface Seal treatment on the deficient portion of the segment, including shoulders if part of the Paver Placed Surface Seal work. The Engineer may accept alternative corrective measures, based on unique conditions.

4. **Debonding.** The allowable threshold limit for debonding shall not exceed 5% of the segment length. All segments in the driving lane or shoulder (528 feet in length) will be measured where the debonding is evident.

   Corrective action for this parameter requires the Contractor to either reapply Paver Placed Surface Seal (full-width) or remove and replace the Paver Placed Surface Seal (full-width) on the deficient portion of the segment, including shoulders if part of the Paver Placed Surface Seal work. The Engineer may accept alternative corrective measures, based on unique conditions.

Reports and Articles

Any documents that have been condensed are available in their entirety upon request

NovaChip®
Ultrathin Bonded Wearing Course

Information on the NovaChip® System on the Internet

Research Reports:

National Center for Asphalt Technology (NCAT) research report on NovaChip® performance:
"Construction And Performance Of Ultrathin Asphalt Friction Course"
by Prithvi S. Kandhal and Larry Lockett
http://www.eng.auburn.edu/center/ncat/reports/rep97-5.pdf

French Research Report:
"Road-Vehicle Interaction - Comparison Of Two Surfacings In Terms Of Rolling Resistance, Vibrational Comfort And Noise"
http://www.aipcr.inrets.fr/pub/0105.i/trifr1-e.htm

FHWA Policy Memorandums - Office of Engineering:
"Surface Finishing of Portland Cement Concrete Pavements - Final Report FHWA-SA-96-068, Tire Pavement Noise and Safety Performance", May 1996
http://www.fhwa.dot.gov/legsregs/directives/policy/sa_96_06.htm

Articles:

Ultrathin Wearing Course Lengthens Pavement Life
http://betterroads.com/articles/jan02d.htm

Nation's Largest NovaChip Project Buys Failing pcc Pavement Some Time. By Jill Dunlap.
http://www.asphalt.com/maintenance/failpcc.html

Trumpet Interchange Gets a Fresh Coat of Asphalt Mix. By Sandy Lender
http://www.asphalt.com/maintenance/trumpet.html

NovaChip Meets Cold In-Place Recycling. Ontario considers the idea of pairing up the two processes. By T.J. Kaxmierowski, A. Bradbury and Jean-Martin Croteau.
http://www.asphalt.com/recycling/nova.html

NovaChip 101 by John DeMartino
http://www.asphalt.com/maintenance/novachip.html

Plan Ahead for a Successful NovaChip Project
http://www.asphalt.com/maintenance/planahead.html

More NovaChip® information on the Web:

Koch Pavement Solutions Site:
http://www.kochpavementsolutions.com/Solutions/novachip.htm

E.J. Breneman:
http://www.ejbreneman.com/nova.html

Russell Standard:
http://www.russellstandard.com/novachip.html

Midland Machinery, manufacturer of the NovaPaver:
http://www.midlandmachinery.com/nova-paver.htm

Performance Evaluation of NOVACHIP: Ultrathin Friction Course

February 1997

Summary of Texas Department of Transportation Research Project 553

Problem Statement:

In many urban and high-volume traffic areas, conventional pavement rehabilitation or preventative maintenance materials pose problems to highway engineers. For example, rock sometimes loosens on chip seals, or unacceptable traffic congestion results from crews waiting for materials to cure. In addition, some conventional surface rehabilitation materials can sacrifice skid resistance or do not adequately protect the underlying pavement from surface water.

Highway departments facing tighter budgets must develop new methods to cost-effectively and efficiently repair roadway damage. A promising alternative to traditional roadway rehabilitation treatments is a French-developed process, NOVACHIP, sometimes known as ultrathin friction course.

The process consists of placing a layer of hot-mix material over a polymer-modified asphalt tack coat with a special paving machine. Layer thickness ranges from 10 to 20 mm, depending on the maximum size of the stone (typically 1.5 times the diameter of the largest stone).

The hot-mix material is a gap-graded mixture and includes a large portion (70 to 80 percent) of single-sized crushed aggregate bound with a mastic composed of sand, filler (if needed), and asphalt binder. Engineers describe this mixture as "hot, coated chippings."

The binder content of the asphalt-aggregate mixture ranges from 5.3 to 6.0 percent. The heavy tack coat consists of a polymer-modified emulsified asphalt, and the application rate commonly varies between 0.7 and 1.0 liters per square meter.

A specifically designed paving machine applies the NOVACHIP surface. This machine combines the functions of an asphalt distributor and a laydown machine. The paver applies both the tack coat and hot asphalt mixture in a single pass. This heavy application of tack helps to ensure adhesion of the friction course to the underlying pavement and reduces the possibility of surface water intruding into the pavement substrate.

Although 11 countries report the successful application of 15 million square meters of NOVACHIP over the past five years, the technology is unproven in the U.S.

Objectives

The Texas Transportation Institute (TTI) conducted study 9-553, Performance Evaluation of NOVACHIP: Ultrathin Friction Course, in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA), to thoroughly investigate and evaluate the NOVACHIP construction process and its performance over a period of three years.

To accomplish this, the San Antonio District of TxDOT selected 14 km of SH 46 in Comal County and 6 km of US 281 in Bexar County for a surface rehabilitation project using the NOVACHIP process. In addition, a 3 km pavement section on US 281 served as a control, or "no treatment," section.

Prior to construction, researchers visually evaluated the sites to document existing conditions and measure ride quality and skid resistance. The surface of US 281 was a double chip seal that was in relatively good condition. The primary types of distress observed were some slight to moderate bleeding in places and slight raveling. SH 46 was also in good condition. The primary surface distress was longitudinal cracking and some slight raveling. The cracks showed signs of previous sealing, but at the time of the survey, were partially sealed.

Following construction, researchers conducted semi-annual evaluations of the pavements and documented the performance. Additionally, researchers collected friction data semi-annually and measured ride quality annually.

Findings

Field performance of NOVACHIP was excellent throughout the study. Three years following the rehabilitation project, the surface was essentially in the same condition as it was immediately after construction, showing no signs of significant distress.

The NOVACHIP surface significantly increased the skid resistance of the pavement and had a higher skid resistance than the control section. In addition, researchers observed a slight improvement in ride quality.

Evaluation of the process revealed several distinct advantages. The process is suitable for use on high-volume pavements because there is no chip loss. It is also resistant to mat damage caused by turning and braking maneuvers. Researchers found that NOVACHIP cures quickly and has the ability to reshape minor surface irregularities. The process also appears to offer:

excellent aggregate retention;

excellent sealing of the old surface to prevent or minimize the intrusion of surface water;

superior surface macrotexture;

strong adhesion to underlying surface that minimizes delamination; and

low rolling noise characteristics.

Implementation

NOVACHIP is a promising preventive maintenance treatment or surface rehabilitation technique for asphalt concrete pavements with distinct advantages over conventional surfacing methods. This treatment offers engineers an alternative to chip seals, microsurfacing, open-graded friction courses, or thin asphalt concrete overlays.

The NOVACHIP process is ideal for use in urban areas and high-traffic volume areas where other preventive maintenance treatments pose problems. Researchers recommend using NOVACHIP as a skid-resistant surface layer. They also suggest that further study be conducted to determine the cost effectiveness of the process.

While this is a relatively new treatment, the availability of NOVACHIP is improving and its use is becoming more prevalent. Two contractors in the U.S. are now distributing the process. In addition, during the past three years, crews installed more than 1 million square meters of NOVACHIP in the northeastern part of the country.

Prepared by Gary Lobaugh, Texas Transportation Institute, Information & Technology Exchange Center (ITEC)

The contents of this summary are reported in detail in the following TTI Research Reports:

553-1, "Evaluation of NOVACHIP - Construction Report," Cindy K. Estakhri and Joe W. Button, September 1994.

553-2F, "Performance Evaluation of NOVACHIP: Ultrathin Friction Course," Cindy K. Estakhri and Joe W. Button, November 1995.

Australian Asphalt Pavement Association Asphalt Review
Vol. 16 No. 1 March 1997

NOVACHIP – the ultra-thin asphalt surface

Ken Wonson, *General Manager Technology, Boral Asphalt, reports on recent successful trials of NOVACHIP, a new proprietary ultra-thin asphalt surfacing.*

John Bethune, AAPA's Technical Director, comments:

'In 1993, the NOVACHIP process was introduced into Australia using imported special purpose equipment developed in France in the mid-eighties. Trial sections were placed .in ten locations throughout New South Wales, Victoria and South Australia to assess the process.

As a result of these trials, AUSTROADS Pavement Research Group Technical Note 3 - Ultra Thin Asphalt Surfacing NOVACHIP, was issued in May 1994, describing the process and listing the advantages and disadvantages. As described in this paper, Boral Asphalt have since purchased two pavers to service the Australian market.

This product is one of a range of ultra-thin surfacings available from asphalt companies in Australia to meet customers' requirements. These products fill a niche in the market in that they provide a very thin asphalt surfacing, with the capability of minor surface correction.

The textured surface achieved provides good skid resistance and reduced water spray. The noise level is between that of a dense-graded and open-graded asphalt and less than that of a sprayed seal.'

*NOVACHIP is a registered trademark

1. **INTRODUCTION**

Early in 1993, Boral Asphalt introduced a new paving/sealing process known as NOVACH I P* to Australia. Extensive trials (over 500,000 sq. metres) were carried out in Queensland, NSW, Victoria and South Australia.

NOVACHIP is a thin surfacing consisting of a thick bitumen emulsion tack/seal coat covered with a layer of gap graded asphalt. It can be considered as an ultra thin asphalt friction course or as a paver laid spray seal. It combines the sealing properties of a spray seal with performance properties similar to those of an open graded asphalt friction course.

NOVACHIP is used for preventative maintenance or surface rehabilitation of roads. The main objectives are to restore surface impermeability, skid resistance and to provide some improvement in rideability and noise reduction. NOVACH IP has no structural effect and must therefore be applied on structurally sound pavements. It is important to bear in mind that any open graded asphalt surfacing should be laid on an even, non deformed, impermeable base with a crossfall such that water will drain to the edge of the road.

NOVACHIP is applied with a purpose built machine that spreads both the tack/seal coat and the hot mix asphalt in a single pass. The heavy application of the tack/seal coat helps to ensure adhesion of the friction course to the underlying pavement and reduces the possibility of water entering into the pavement.

Following the success and acceptance of the trials, Boral Asphalt purchased a NOVACHIP paver in 1994 and later a second one, to service the Australian market.

The process has now been in use for over seven years and it has been placed on various types of pavements in Europe, Australia and the USA. Since the first application, over 3 million square metres have been laid in Australia.

7. CONCLUSION

NOVACHIP:

(a) is a very thin surface able to restore surface characteristics of pavements that are structurally sound.

(b) can be applied very quickly so as to minimise inconvenience to road users when carrying out maintenance work (immediate resumption of traffic, only a short length of road put out of action, no extra thickness of material required, no throwing up of material).

(c) can be applied with a single machine simultaneously applying the tack/seal coat and spreading and smoothing the asphalt:

(d) the asphalt is manufactured in a conventional asphalt plant, ensuring a high degree of consistency

(e) provides very **good adhesion to the** underlying surface ensuring no **loose** aggregate (and no broken windscreens)

(f) provides good surface drainage to improve wet weather skid resistance and spray reduction

(g) waterproofs the existing surface

(h) improves rideability and is capable of improving transverse and longitudinal evenness

(i) results in noise levels that are about 40 % less than that of a spray seal

0) has an attractive and uniform surface appearance

NOVACHIP is the ultimate development of the technique of ultrathin layers of hot mix asphalt. It is the product of research on materials and equipment, and of the experience acquired with the tried and tested techniques that led up to its development - those of spray sealing and hot mix asphalt.

REFERENCES:

1 Samanos, J. and Roffe, J.L., 'New Chip Seal System' - Proceedings of 35th Annual Conference of the Canadian Technical Asphalt Association.

2 Serfass, J., Bense, P, and Samanos, J., 'Ultra-thin Friction Courses'.

3 Unpublished NOVACHIP - A New Type of Pavement Surfacing'.

4 Bense, P, Bonner, **J.,** BarouK, R. and Serfass, J.P,'Novachip - A New Concept for Surface Dressing' - Routes and Aerodromes No 668.

5 Heather, W. P F., 'Safepave - A Process for the Nineties' - Highways and Transportation, January 1992.

6 Bellanger, J., Brosseaud, Y, Gourdon, J., 'Thinner and Thinner Asphalt Layers for the Maintenance of French Roads', LCPC.

Region 3 Technology Implementation Newsletter

Vol. 1 No. 1
May 21, 1997

European Pavement Technology Comes to Pennsylvania

Pennsylvania Department of Transportation has constructed several projects using an innovative pavement surfacing material developed in Europe. NOVACHIP is an ultra-thin hot mix surfacing. It is intended to be used in similar applications to microsurfacing, except it may have application to higher traffic levels.

Where it differs from microsurfacing is in the materials. NOVACHIP is applied using a polymer-modified emulsion sprayed on the surface immediately ahead of a laydown machine, which places conventional Hot Mix Asphalt (HMA) microsurfacing, on the other hand, is a cold mixture of polymer-modified emulsion and aggregate.

In 1993, Pennsylvania constructed NOVACHIP projects in three locations. After three winter seasons the projects were evaluated and a report written documenting PennDOT's construction experiences and their performance assessment. The bottom line is, compared to dense graded asphalt surfacing and microsurfacing, NOVACHIP performed equal to conventional HMA surfacing and better than microsurfacing in the high traffic locations evaluated. Cost-wise NOVACHIP is comparable to 25mm HMA overlays and microsurfacing.

Based on its performance, PennDOT considers NOVACHIP to be a viable pavement maintenance option for preventive maintenance and surface rehabilitation, especially on roads which have high traffic.

For more information or a copy of the complete construction report or performance evaluation report contact Ted Keiter, PennDOT, Maintenance Division, at 717-783-8594.

T2 MINNESOTA TECHNOLOGY TRANSFER PROGRAM
Technology Exchange Newsletter
October - December 1998 : Volume 6, No. 4
A Newsletter of the
Minnesota Technology Transfer (T^2) Program, Local Technical Assistance Program (LTAP)

Bon Jour! NovaChip European Technology Introduced to Minnesota

A European paving process, NovaChip®, was demonstrated to Minnesota maintenance personnel during Mn/DOT's Smooth Pavement Repair Information Demo Day. *[See above for more about this demo.]* Initially developed in France and used widely throughout Europe since the late 1980s, the advanced NovaChip system is a paving process that places a thin, coarse aggregate hot mix over a special asphalt membrane.

How the Process Works

Although appearing similar to traditional American paving processes, the NovaChip process includes a noticeably larger paver that includes a tank for NovaBond, a polymer-modified emulsion used as a membrane. As the paver travels, it applies the NovaBond membrane immediately before an ultrathin lift of hot-mix asphalt. The NovaChip process accomplishes several important design elements:

Picture at right: With the NovaChip paver, work zones can be re-opened in under an hour.

Strong bond between the old and new material. The NovaBond is placed almost simultaneously with the hot-mix asphalt, allowing a much thicker application than a typical tack coat.

Special membrane prevents moisture intrusion. The thicker polymer-modified Novabond membrane seals the entire pavement surface, including low- to medium-severity cracks, preventing water from entering the pavement structure.

Integral membrane allows for ultrathin surface. During the single-pass process, the heat from the hot mix wicks the emulsion-based NovaBond up into the hot-mix material, creating the strong bond and allowing an ultrathin hot-mix wearing surface layer.

Durable hot-mix asphalt surfacing has no loose chips. Because the NovaChip wearing surface is a hot-mix asphalt, there are no loose chips. The high-quality aggregate used for NovaChip is skid and wear resistant. Additionally, the thin, open mix is designed to allow water to escape, reducing hydroplaning and backspray.

Significant reduction in user delays. The NovaChip machine applies the thin hot-mix such that compaction is not a main concern. Rolling is necessary only to orient the mix into the NovaBond. The result is a short, quickly moving work zone. The road can be re-opened to traffic in less than an hour. Additionally, the NovaChip system is designed to last up to 10 years, reducing future user delays.

Where Is It Applicable

Preventive maintenance treatments should be selected based on pavement condition and traffic volumes. The NovaChip system is designed to preserve structurally sound pavements exhibiting low-severity cracks, low- to medium-severity wheel rutting, and raveling.

According to Mike Marti of Koch Materials Company, "NovaChip combines the strength of a hot mix with the flexibility of a thin maintenance treatment. The NovaChip system was designed to incorporate the best aspects of thin overlays and chip seals while eliminating the concerns of loose stones, tracking, delamination, and user delays."

Results

Numerous pavements have been rehabilitated using the NovaChip system throughout the United States and are being evaluated by DOTs, research centers, and universities. Locally Mn/DOT and Iowa State University are evaluating the NovaChip system on two independent projects.

[For information on the NovaChip process contact Roger Olson of Mn/DOT, 651-779-5517, or Mike Marti of Koch Materials Company, 651-480-3834; e-mail ***Error! Bookmark not defined.*** *]*

CONSTRUCTION AND PERFORMANCE

OF

ULTRA-THIN BONDED HMA WEARING COURSE

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August 1, 2000

CONSTRUCTION AND PERFORMANCE OF ULTRA-THIN BONDED HMA WEARING COURSE

ABSTRACT

In recent years the need for preserving our investment in the Nation's highway system has received increased emphasis. An effective pavement preservation program includes a number of maintenance strategies that are applied in a cost-effective and efficient manner. There have been a number of new technologies developed to address these problems. One of the more promising technologies is the use of an ultra-thin bonded HMA wearing course (UTBWC). It consists of a layer of hot mix asphalt (HMA) laid over a heavy asphalt emulsion layer or membrane. The thickness of the ultra-thin surface ranges from 9.5 mm (3/8 in) to 19 mm (3/4 in). The system is placed on a structurally sound rigid or flexible pavement, which may exhibit minor surface distresses. The process was developed in France in 1986 and has been in use in the United States since 1992. Both a review of published experimental project reports and inspections of recently completed projects in many locations indicate good performance of the UTBWC. The UTBWC provides a surface with excellent macro texture qualities, good aggregate retention, and excellent bonding of the very thin surfacing to the underlying pavement.

INTRODUCTION

In recent years the need for preserving our investment in the Nation's highway system has received increased emphasis. An effective pavement preservation program includes a number of maintenance strategies that are applied in a cost-effective and efficient manner.(1) There have been a number of new technologies developed to address these problems.(2) One of the more promising technologies is the use of an ultra-thin bonded HMA wearing course.(3)(4)(5)

OBJECTIVE AND SCOPE

The objective of this report is to document the materials needed and the construction procedures used for the ultra-thin bonded wearing course (UTBWC) and to evaluate the performance of the process. This report is based on a review of the literature and interviews with industry and DOT personnel on the use and performance of UTBWC.

GENERAL OVERVIEW OF THE CONSTRUCTION PROCESS

An ultra-thin--less than 25 mm (1 inch)—hot mix asphalt (HMA) bonded wearing course is a hot mix asphalt overlay that is used in a pavement preservation program and is generally placed on a structurally sound base. One type of ultra-thin bonded HMA wearing course was developed in Europe (France) in 1998 and introduced in the United States in the early 1990's with projects in Alabama and Texas in 1992.(6) It consists of a layer of hot mix asphalt (HMA) laid over a heavy asphalt emulsion layer or membrane. The thickness ranges from 9.5 mm (3/8 in) to 19 mm (3/4 in). The layer thickness is determined by the maximum aggregate size in the HMA. The asphalt emulsion is usually a polymer modified emulsion applied at 0.85 $\pm$ 0.3 liters/square meter (0.20 $\pm$ 0.07 gallons per square yard). The HMA is a gap-graded mix using a crushed aggregate bound together with a mastic made of sand, filler and asphalt binder. The maximum aggregate size ranges from 6.2 mm (1/4 in) to 12.5 mm (1/2 in). Generally a 9.5 mm (3/8 in) mix is used. The grade of the asphalt binder is chosen based on the climate and traffic conditions for the project. Both unmodified and modified binders have been used in the construction of an ultra-thin bonded HMA course. The binder content generally ranges from 5.0 to 6.0 percent depending on the traffic, climate and the condition of the existing pavement.

The ultra-thin bonded HMA is placed with a specially built machine that places the asphalt emulsion membrane and the HMA in a single pass. The heavy application of the membrane seals small cracks in the existing pavement and helps to ensure the adhesion of the HMA to the underlying pavement.

CONCLUSIONS

Based on a review of the literature, conversations with DOT and industry personnel, and personal inspection of a number of ultra-thin bonded HMA overlays, the following conclusions are drawn:

1. The system provides excellent aggregate retention.
2. The system has excellent bond to the underlying surface. Delamination of the system from the surface is generally not a problem.
3. The ultra-thin bonded HMA wearing course surface has excellent macro texture qualities. Thus, the system will provide a surface with a high level of skid resistance. And, because of its high macro texture surface, it should also provide a surface that will reduce hydroplaning problems ..
4. Cracks in the existing pavement will reflect through the surface. But, it appears that cracks sealed prior to placement of the UTBWC present no performance problems.

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Looking for New Ways to Reduce Collisions

Ottawa-Carleton -- Traffic collisions have been on the decline in the Ottawa-Carleton Region since 1993, according to the Region’s 1996 statistics released in July.

One of the contributing factors to these encouraging statistics is the introduction of new pavement technologies. A new form of "micro-surfacing" and "high friction" technology called NOVACHIP(R) is being implemented at locations where a high number of rear-end collisions occur under slippery road surface conditions.

The NOVACHIP® application is a new "high friction surface" product, proven successful in Europe and the United States. Now in Canada for the first time this application is being utilized on Ottawa-Carleton Regional Road intersections improving traffic safety while cutting down road resurfacing costs.

"We are always on the look out for new products and technologies that will help us in our fight to make Regional Roads and intersections as safe as possible. We’ve enjoyed a great deal of success with traffic signal technologies we’ve put in place and now we’ve discovered this exciting new product that we feel has great potential to further reduce collisions", says Doug Brousseau, Director of Mobility Services for Ottawa-Carleton.

The important feature of NOVACHIP® is it’s capacity to increase friction between vehicle tires and the road thus deterring vehicles from slipping under various road conditions. It also provides added features of lower traffic noise, less water spray and has a longer life span potential. Locations which are identified for this type of road resurfacing application are intersections that experience a higher than average number of rear-end traffic collisions. Candidates for this application are tested for frictional deficiency and then implemented as required.

This new technology costs about half as much as conventional resurfacing products and has a longer life span in both urban and rural areas. As Stephen Lee, Pavement & Material Engineer for the Environment and Transportation Department, says "NOVACHIP is attracting significant interest from other road agencies and government departments. As applications are expanded it will be the way of the future for maintaining safe and structurally sound roads".

Tire/Pavement Noise Study

For
Michigan Department of Transportation

Conducted by
National Center for Asphalt Technology

In
October 2002

PAVEMENT/TIRE NOISE STUDY
MICHIGAN DOT

INTRODUCTION

Traffic noise is a serious problem. Engine, exhaust, aerodynamic (power train) noise and pavement/tire noise contribute to traffic noise. The FHWA Noise Abatement Criteria states that noise abatement must be considered for residential areas when the traffic noise levels approach or exceed 67 dB (A). To accomplish this level, many areas in the United States are building large sound barrier walls at a cost of one to five million dollars per roadway mile (1). Research in Europe and in the United States has indicated that it is possible to build pavement surfaces that will provide low noise roadways (1). In January of 2002, the National Center for Asphalt Technology initiated a research study with the objective to develop safe, quiet and durable asphalt pavement surfaces. The first step towards accomplishing this objective was to develop a fast and scientifically reliable method for measuring the acoustical characteristics of pavement surfaces.

BACKGROUND ON NOISE

Noise measurements use the decibel scale to describe the intensity of noise. Human hearing begins at a decibel level of 0. A whisper is approximately 20 decibels and the normal background noise in a living room is about 40. Conversation occurs in the region of 50 to 60 decibels. Usually, discomfort begins around 70 decibels. A chain saw produces about 100 decibels. Standing in front of speakers at a rock concert would give about 120, and this is about the loudest sound that can be tolerated. For highway noise, we'll focus on the range of 60 to 90 decibels. The decibel is abbreviated dB(A). For most people an increase in the decibel level by 10 is perceived as doubling the noise. So 70 dB(A) is twice as loud as 60 dB(A), and 80 dB(A) is twice as loud as 70. Simply reducing the decibel level by 3 dB(A) provides the same effect as doubling the distance between the source of the noise and the person hearing it. Therefore, reducing the noise level by 3 dB(A) would be equivalent to moving from 50 feet to 100 feet away from the source of the noise.

MEASUREMENT OF ROAD NOISE

Two general methods have been developed for measuring pavement noise levels in the field: the statistical by-pass approach as defined by International Standards Organization (ISO) Standard 11819-1 (2) and the close proximity method (CPX) as defined by ISO Standard 11819-2 (3). This study utilized the CPX procedure.

Close-Proximity Method (CPX)

This method consists of placing microphones near the tire/pavement interface to directly measure the tire/pavement noise levels. In the CPX method, sound pressure is measured using microphones mounted inside an acoustical chamber (each side of the chamber is covered with acoustical sound deadening material) as shown in Figure 1. The purpose of the acoustical chamber is to eliminate the noise from other sources of sound while testing.

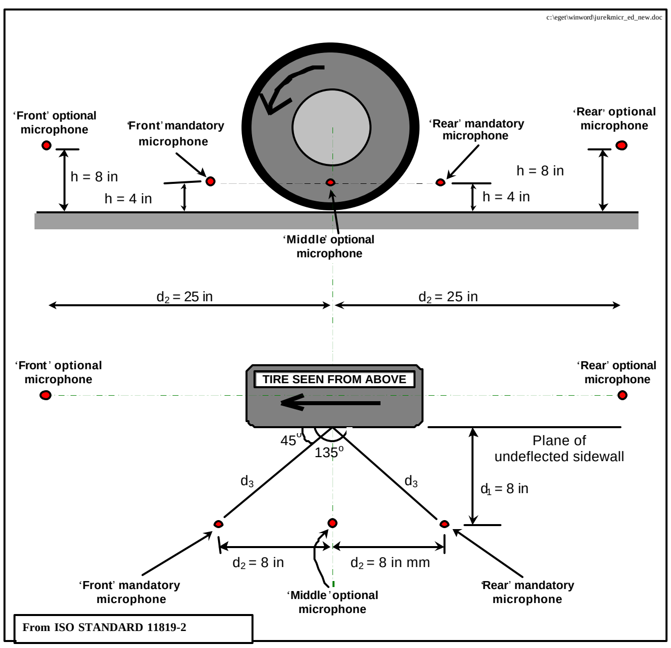


Figure 1 - Microphone Layout for Close-Proximity Trailer (3)

The National Center for Asphalt Technology has designed and built two CPX noise trailers. The first was built for the Arizona Department of Transportation (ADOT) and was delivered in late January 2002. This trailer is now being used by ADOT to evaluate a number of pavement surfaces in Arizona. In September 2002, the second trailer was delivered to NCAT. Figure 2 presents a picture of the trailer. This trailer was used to accomplish the work described in this report.

Figure 2 – NCAT CPX Trailer

During October 2002, NCAT used the NCAT CPX trailer to test nine pavement surfaces for the Michigan DOT. At all of the sites, noise measurements were made at three different speeds: 45, 60 and 70 mph. At all sites, testing was done with two different tires, see Figure 3 and 4 for a picture of the tread pattern for the two tires: a MasterCraft and a UniRoyal tire. They were chosen to provide a range of tread pattern. The tread patterns for the two tires are illustrated in Figures 3 and 4. As can be seen from these figures the MasterCraft tire has the more aggressive tire tread pattern.

Figure 3 – UniRoyal Tire

Figure 4- MasterCraft Tire

TEST RESULTS

The test program consisted of testing nine surfaces for the Michigan DOT and at the request of Koch Materials three Nova Chip sections were included in the study. Table 1 presents the results of the Michigan DOT and the Nova Chip testing. The comparison of the different sections is based on the data at 60 mph. 60 mph data is available at all of the test sections.

TABLE 1 - Noise Data

	City	Route	Surface Type	Noise Levels (dB(A)			
				Tire	45 mph	60 mph	70 mph
1	Lansing	I-96 E	Concrete	MasterCraft	97.0	100.8	102.3
				UniRoyal	95.2	98.8	100.8
				UniRoyal	96.0	99.1	100.5
2	Coldwater	I-69 S	SMA	MasterCraft	95.1	98.2	100.2
				UniRoyal	94.0	97.8	98.7
3	Coldwater	I-69 S	Longitudinal Tined Concrete	MasterCraft	97.0	100.5	102.7
				UniRoyal	95.8	99.9	101.7
4	Coldwater	I-69 S	Transverse Tined Concrete	MasterCraft	97.5	100.6	102.8
				UniRoyal	96.8	100.6	102.2
5	Detroit	I-96 E	Concrete	MasterCraft	95.1	99.3	101.06
				UniRoyal	93.8	97.2	99.3
6	Detroit	I-96 E	SMA	MasterCraft	94.4	98.4	100.3
				UniRoyal	93.8	96.7	98.5
7	Detroit	I-96 E	Dense Graded Asphalt	MasterCraft	94.8	98.8	100.6
				UniRoyal	94.1	97.2	99.2
8	Detroit	I-275 N	Superpave	MasterCraft	96.1	99.9	101.1
				UniRoyal	95.1	98.7	100.7
9	Detroit	I-275 N	Concrete	MasterCraft	94.6	98.9	100.4
				UniRoyal	93.6	96.6	98.7
10	Jackson	M-60 E	Nova Chip	MasterCraft	93.9	97.2	-
				UniRoyal	92.8	95.7	-
11	Lansing	I-96W	Nova Chip	MasterCraft	95.1	98.5	-
				UniRoyal	93.6	97.0	-
12	Saginaw	M- 46 E	Nova Chip	MasterCraft	94.2	97.5	98.8
				UniRoyal	92.8	95.5	97.2

Comparison of surfaces

Figure 5 shows a graphical result of noise levels for all of the sections. It ranks the pavements from the quietest to the noisiest. Four types of pavement were tested: dense-graded asphalt, SMA, Portland cement concrete and Nova Chip For each pavement section, the noise level used for comparison purposes was an average noise level for the two tires. The average noise values for the three surfaces at 60 mph was:

- Nova Chip 96.9 dB(A)
- Stone Matrix Asphalt (SMA) – 97.6 dB(A)
- Dense Graded Asphalt – 98.6 dB(A)
- Portland Cement Concrete – 99.4 dB (A)

For the Portland Cement Concrete surface, the nosiest surface was the transverse tined surface (100.6 dB(A)) and the quietest section was the diamond ground surface (97.7 dB(A)). The diamond grinding of the surface brought the noise level for the concrete pavement down to the average level of a dense graded asphalt pavement.

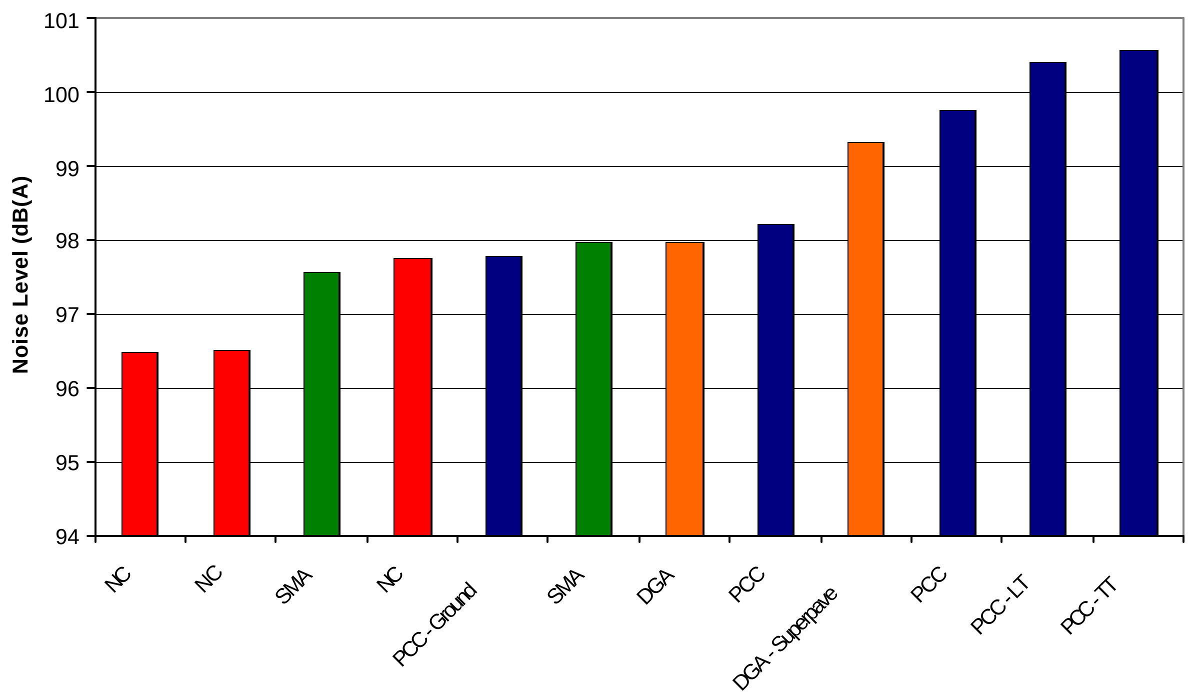


Figure 5 – Comparison of Noise Levels for Different Surfaces

Comparison of tires

The average noise level for all the pavements at 60 mph was 98.1 dB(A). The average noise level for the MasterCraft tire was 99.4 dB(A) and for the UniRoyal tire was 97.9 dB(A). This is logical in that the MasterCraft tire had the most aggressive tire pattern. Figure 6 shows graphically the noise levels for each of sections for each tire. The chart shows the noise levels for each of the sections by tire type. The two tires result in a different ranking for the pavements. It is felt that the cause of this is the interaction of the pavement texture and the tire tread pattern. Because of this, it is felt that it may continue to be necessary to conduct noise testing using at least two tires Work will be done using the NCAT test track surfaces and additional tires to evaluate this concept.

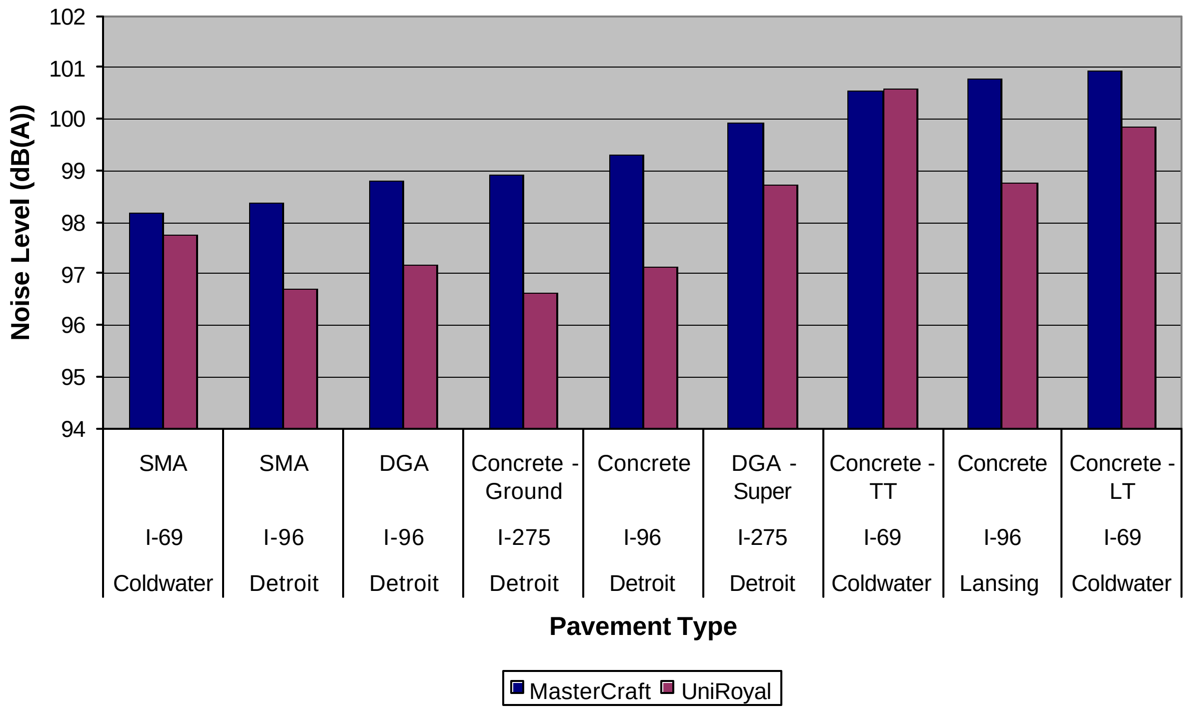


Figure 6 – Comparison of Noise Levels for each of the tires

Effect of Speed on Noise

The testing on all but three sections was done at three speeds – 45 mph, 60 mph and 70 mph. Three sections were not tested at either the high or low speed due to safety concerns. All of the sections were tested at 60 mph. Figure 7 presents the results of the speed versus noise for three pavement types. There was insufficient data to show results for the Nova Chip sections. The speed versus noise relationship for the PCC had a slightly steeper slope than the two HMA surfaces (0.22 vs 0.20). Note also that for both the SMA and the DGA the slope for speed versus noise was about the same.

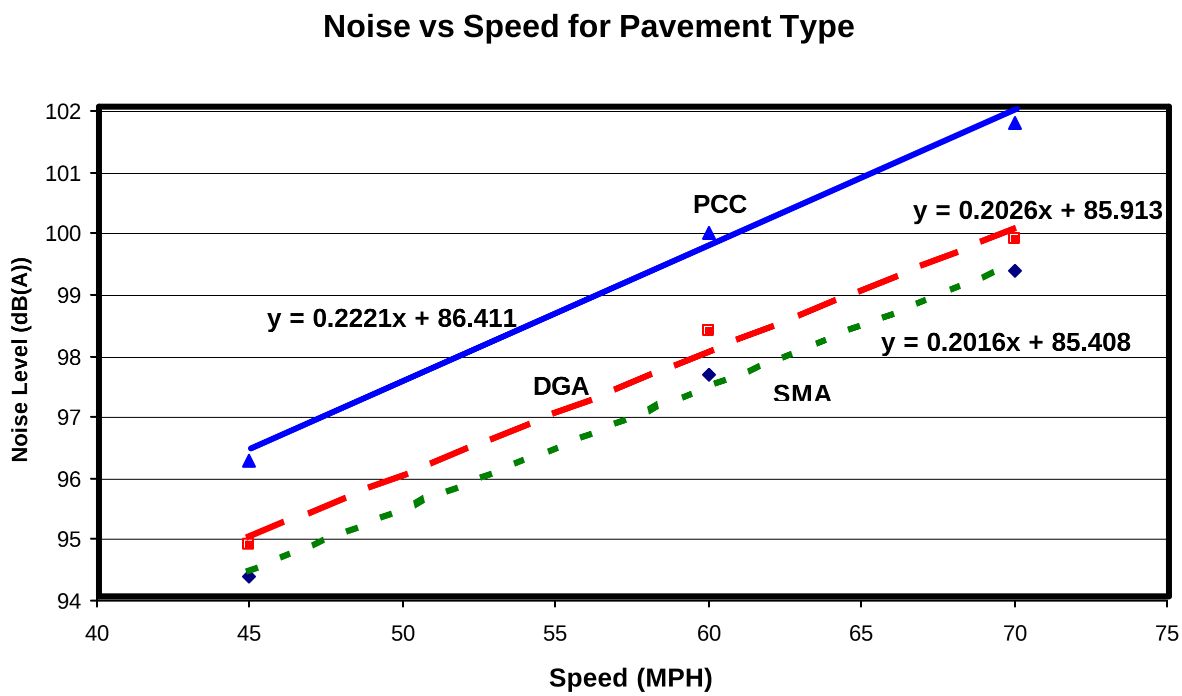


Figure 7 – Noise versus speed

Noise Spectrum Analysis

The noise spectrum (frequency vs noise level) was evaluated to determine characteristics of the noise for each of the pavement surfaces types and to compare the noise generated by the tires.

An analysis (Figure 7) of the transverse PCC sections shows the MasterCraft tire was the most aggressive at the low frequencies and that the UniRoyal tire creates a whine at a frequency of about 1400 cps. A comparison (figure 8) of the noise spectrum for the three concrete surfaces (Longitudinally Tined (LT), Transverse Tined (TT) and Ground) shows that the longitudinal and transverse tined surfaces have similar noise spectrum. The noise levels were 100.5 dB(A) and 100.6 dB(A) respectively. The ground concrete had a lower noise level 98.9 dB(A). The process of grinding reduced the noise level in the 800 cps to 1200 cps range but had little effect in the range where the pavement whine is usually noted (1300 cps to 1500 cps).

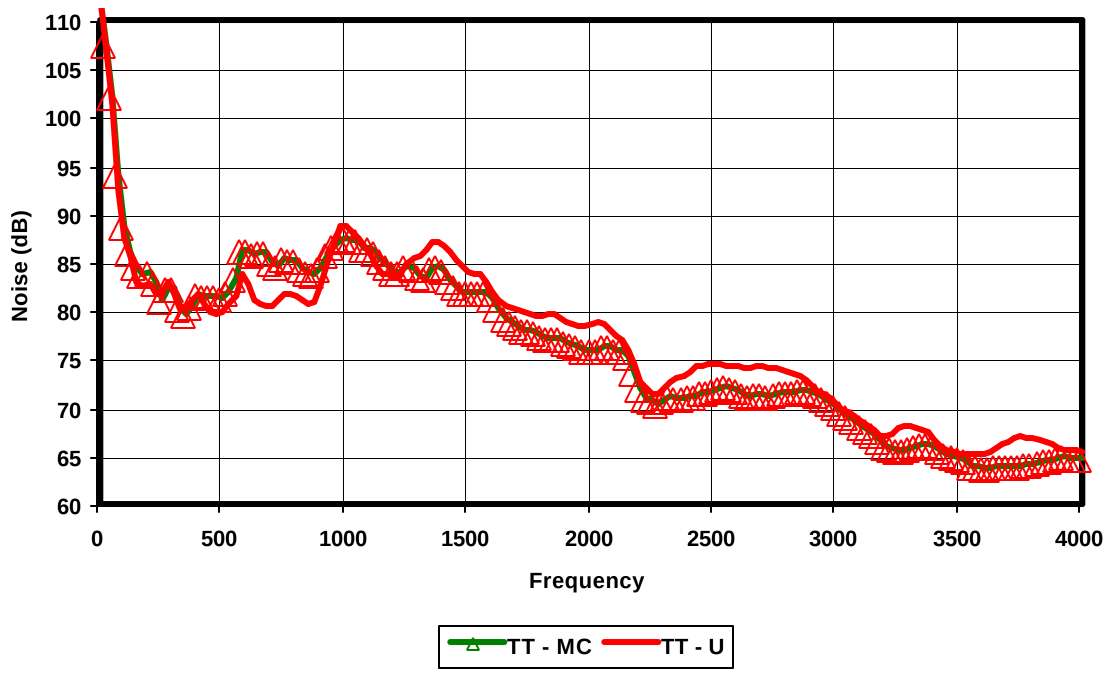


Figure 7. Noise Spectrum – MasterCraft and UniRoyal Tires on Transverse Tined PCC

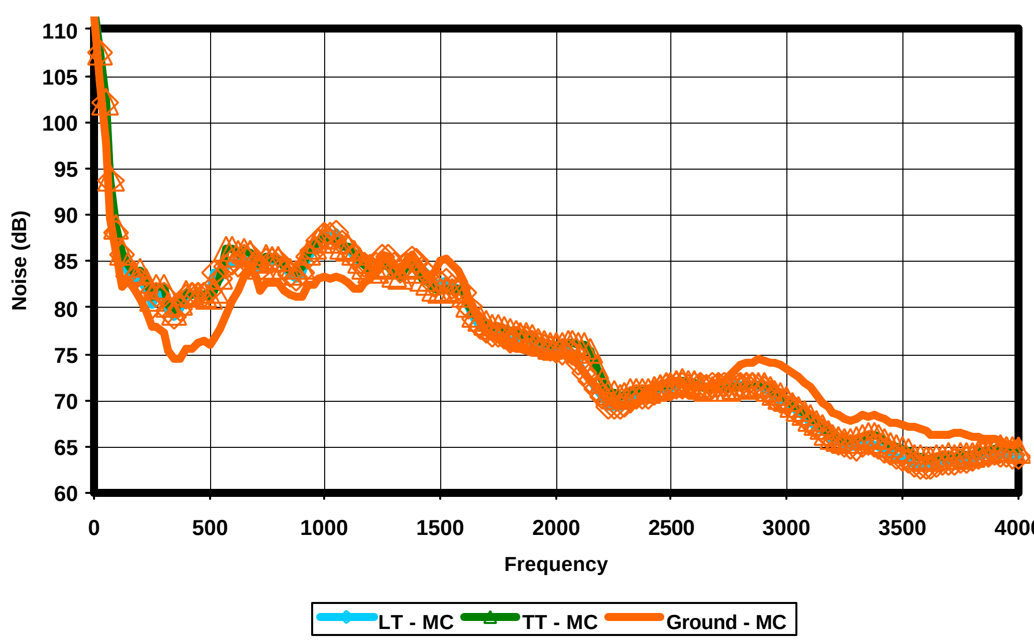
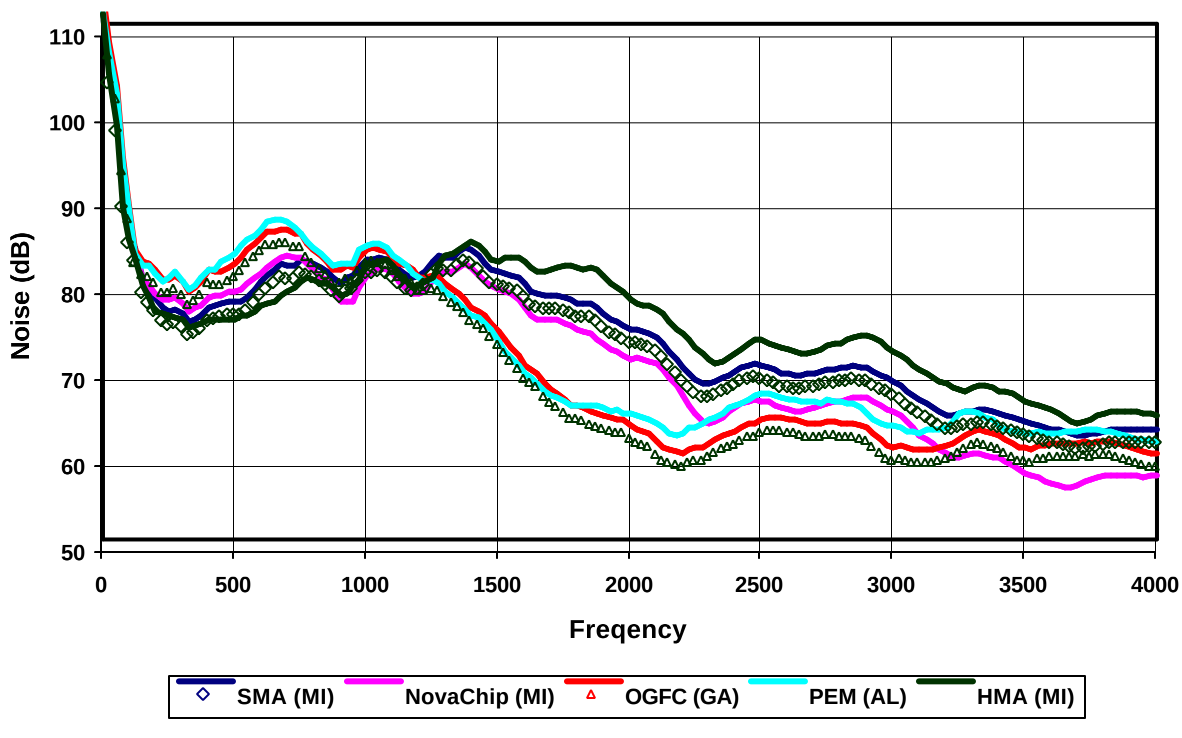


Figure 8 – Noise Spectrum – Different Concrete Pavement Surfaces – MasterCraft Tire

For the asphalt pavements, a noise spectrum is shown that also includes two sections of I-85 in Alabama and Georgia that were tested with the UniRoyal tire in October 2002 just prior to the testing in Michigan.   This was done to provide a ready comparison with other types of HMA mixes.   The SMA (MI), NovaChip (MI) and HMA (MI) are averages of the SMA, NovaChip and hot mix asphalt (HMA (MI) sections tested in Michigan. The OGFC is located at MP 3 in Georgia and is about two years old.   It is no longer used by the GA DOT as pavement surface – they are now using the Porus European Mix (PEM) technology. The PEM is the porous European mix being placed by a number of states in the Southeastern US and is located at MP 63 in Alabama. It was placed a few weeks prior to the noise testing.

Figure 9 shows that at low frequencies all five of the mixes behave in a similar manner with the OGFC, PEM and HMA being lower. In the 1200 to 2200 cps frequency ranges the OGFC and PEM have lower noise levels. The average noise level for the SMA (MI) mix was 98.3 dB(A), for the NovaChip (MI) was 97.7 dB(A), for the HMA (MI) was 97.9 dB(A), for the PEM was 95.7 dB(A) and the OGFC was 99.0 dB(A).



CONCLUSIONS

Based on the testing conducted in Michigan, it is concluded that the pavement type does affect the noise level of the tire and that the use of different tires does affect the noise characteristics of the pavement tested. Additional work is needed to develop the parameters necessary for the development of a quiet pavement surface.

The testing in Michigan rated the surfaces tested as follows with regard to noise levels. This ranking is based on using an average of the results from the two tires. It is felt that to develop a true understanding of the noise characteristics of the pavement, that more than one tire will need to be used to conduct noise testing. Work is now underway at NCAT to further define the differences between tires. The ranking is different for each tire. It is thought that the reason for this is the interaction between the texture of the tire and the texture of the pavement surface.

1. NovaChip
2. SMA
3. Dense Graded Asphalt
4. PCC

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