



Targeted Overlay Pavement Solutions



Highly (Polymer) Modified Asphalt Binder
SMA Pilot Projects in Pennsylvania



Alan Leonori, PE

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Highly (Polymer) Modified Asphalt (HiMA)

What is Highly Modified Asphalt (HiMA)?

- Material Properties
 - Highly Modified Asphalts – polymer content (~7.5%)
 - Normal polymer content (~3.5%)
 - MSCR Performance grade PG76E-28HP (~PG82-28)
 - Normal Polymer Modified – PG 64E-22 (PG76-22)
 - Elastic Recovery Minimum = 90%
 - Elastic Recovery Minimum,
Normal Polymer Modified – As low as 40%

Highly (Polymer) Modified Asphalt (HiMA)

Benefits of Highly Polymerized asphalt?

- Less Rutting
- Less Cracking
- Less Maintenance
- Longer Life



Highly (Polymer) Modified Asphalt (HiMA)

Research has shown: Virginia DOT

- Does not delay reflective cracking significantly. (Working cracks)
- Virginia 5-year study indicates a 34% **projected** increase in pavement life.
- Benefit / Cost was not determined because there is not enough distress data from either the control or experimental sections.
 - Additional cost for HPA is ~\$15.00 per ton, ~\$1.25 per SY
 - Assuming PG64E-22 Normally ~\$10 per SY → Say 10% to 15% increase in cost.

FHWA - Accelerated Innovation Deployment (AID) Demonstration Program

- **Projects submitted for demonstration funding: (\$700,000 total request)**

- District 2-0 SR 70-A18
- District 2-0 SR 70-021
- District 10-0 SR 28-118
- District 11-0 SR 28-A62
- District 12-0 SR 70-E10

- District 2-0 SR 80-B42 (ECMS 88579)
- District 5-0 SR 78-22M (ECMS 72807)
- District 9-0 SR 219-047 (ECMS 23478)
- District 11-0 SR 376-A79 (ECMS 74454)

- **Grant application submitted September 28, 2021.**
- **Original Grant approval originally scheduled for March 31, 2022.**
- **Actual Grant approval – August 31, 2024.**

Bid Prices

	ECMS	Project	SMA Unit Price	HiMA Unit Price	Difference in Unit Price	% Increase	HiMA Qty	AID Funding Used
D2	88579	I-80/B42	\$11.50	\$12.50	\$1.00	8.7 %	49,280	\$49,280.00
D5	72807	I-78/22M	\$15.50	\$17.50	\$2.00	12.9 %	83,963	\$167,926.00
D9	23478	SR 219/047	\$11.37	\$13.95	\$2.58	22.7 %	92,204	\$237,886.32
D11	74454	SR 376/A79	\$20.00	\$25.00	\$5.00	25.0 %	28,687	\$143,435.00
						Ave. 17.3 %		\$598,527.32

- These are all SMA wearing course projects that will incorporate HiMA.

District 2-0 Interstate 80 (SR 80-B42)



49,280 SY HiMA SMA

- HRI, Inc.
- Placed in August/September 2024.
- HiMA placed in WB lanes (both travel and passing).
- Control placed in adjacent section of WB lanes.
- “No noticeable changes to the material or construction” compared to standard mix.

District 5-0 Interstate 78 (SR 78-22M)



83,963 SY HiMA SMA

- J.D. Eckman, Inc.
- Placed in September/October 2025.
- Approximately 3.5 miles of HiMA placed in EB and WB lanes (both travel and passing).
- Approximately 3.0 miles of standard SMA (control) placed in adjacent section of EB and WB lanes.
- 10 of 78 lots did not meet ride quality ($IRI > 70$).
- Difficulty conveying material through MTV to paver.

District 9-0 Route 219 (SR 219-047)



92,204 SY HiMA SMA

- New Enterprise Stone & Lime
- Placed in July - September 2025.
- Approximately 2.75 miles of HiMA placed in NB and SB lanes (both travel and passing).
- Approximately 3.0 miles of standard SMA (control) placed or will be placed in adjacent section of NB and SB lanes.
- Field crews noted no major differences or issues compared to standard mix.

District 11-0 Interstate 376 (SR 376-A79)



28,687 SY HiMA SMA

- Eurovia Atlantic Coast LLC
- Placed in August/September 2025.
- Approximately 1.75 miles of HiMA placed in EB passing lane and median shoulder and 1.75 miles in WB passing lane and median shoulder.
- Standard SMA (control) placed in parallel EB and WB travel lanes for the same lengths.
- Field crews noted no major differences or issues compared to standard mix.

Project Work Plan

- **Originally prepared prior to grant application**
 - Neal Fannin (June 2020)
 - Modified to reflect current projects
 - Jay Sengoz
 - Kevin Gnegy
 - Tim Ramirez
 - Living document – updated regularly to reflect:
 - Actual locations of material (HiMA and control) placed
 - SLD with HiMA and control sections highlighted
 - Pavement history tables

Project Work Plan – RMS Straight Line Diagrams

EXTRACT DATE: 12/18/2023
PRINT DATE: 12/19/2023
DIR: E TOTAL I
LEFT MUN: BRADFORD T

HMA Material
9000-0008 STONE MATRIX ASPHALT
MIXTURE DESIGN WITH HIGHLY
MODIFIED ASPHALT (PG76E-28HP)
RPS CONSTRUCTION OF
PLANT-MIXED WMA WEARING

Control Material
0419-0007 STONE MATRIX ASPHALT
MIXTURE DESIGN WEARING COURSE
RPS PG 64E-22 LTS ACCEPTANCE 8.5
MM MIX 1 1/2" DEPTH SRLE

EXTRACT DATE: 12/18/2023
PRINT DATE: 12/19/2023
DIR: E TOTAL LEN: 41.844 MI.
LEFT MUN: LAWRENCE T

ROADWAY MANAGEMENT SYSTEM PAGE NUMBER: 45
SLD COUNTY/SR - ANNUAL PRINT COUNTY: CLEARFIELD
DIST: 02-2 SR: 80
RIGHT MUN: LAWRENCE T

1 0 01009 0 01 1198+78 120655 FT
MILEPOST 119.00
LENGTH(AH 2462 BK 2415) 1191/0000

1190/2040 RAMP L RD
(SR8010 SEG 0010/0000)

120106 FT 1 0 01009 0 01 1198+78
MILEPOST 119.00
1190/0000 LENGTH(AH 2773 BK 2599)
WOLF RUN
STRUCTURE LENGTH 12 FT
BMSID 17/0080/1184/2194

STOP CONTROL 1185 / 1600

1 0 01009 0 01 1172+47 118240 FT
LENGTH(AH 2415 BK 2872) 1185/0000

117507 FT 1 0 01009 0 01 1172+47
1184/0000 LENGTH(AH 2599 BK 2660)

BRADFORD
LAWRENCE T
1 0 01009 0 01 1252+66 12
W RR SUSQUEHANNA RIVER
BMSBG 17/0080/1201/0190 12
1 0 01009 0 01 1251+58 12
MILEPOST 120.00
LENGTH(AH 2682 BK 2704) 12

1 0 01009 0 01 1146+07 115368 FT
MILEPOST 118.00
LENGTH(AH 2872 BK 2939) 1181/0000

114847 FT 1 0 01009 0 01 1146+07
MILEPOST 118.00
1180/0000 LENGTH(AH 2660 BK 2658)

START CONTROL 1175 / 2679 END HIMA 1175 / 2679 TRAVEL LANE

END HIMA 1175 / 2432 PASSING LANE

RAMP K RD
(SR8010 SEG 0500/0000) 11

LR 17051
OP ID 17/1006/0070/0408 1175/1328

1174/0927 OP ID 17/1006/0070/0000

BMSBN 17/0080/1195/0712 11
0 0 00000 0 00 0000+00
LR 17052
BMSBG 17/0080/1195/0712 11

1 0 01009 0 01 1117+70 112429 FT
LENGTH(AH 2939 BK 2342) 1175/0000

112189 FT 1 0 01009 0 01 1119+96
1174/0000 LENGTH(AH 2658 BK 2631)

1 0 01009 0 01 1224+49 123
LENGTH(AH 2704 BK 2462) 11

RAMP J RD
(SR8010 SEG 0250/1105) 11

Project Work Plan – Pavement History

SR 80-B42 EXISTING PAVEMENT HISTORY																			
SEG	BEGIN OFFSET	END OFFSET	TOTAL DEPTH	PAVED DEPTH	LAYER DESCRIPTION	LAYER YEAR	LAYER DEPTH	LAYER WIDTH		SEG	BEGIN OFFSET	END OFFSET	TOTAL DEPTH	PAVED DEPTH	LAYER DESCRIPTION	LAYER YEAR	LAYER DEPTH	LAYER WIDTH	
1175	0000	0009	36.0	28.5	SPAV/HMA BNDL 76-22 19 MM	2010	2.5	24		1174	0000	0020	25.5	17.5	SPAV/HMA BNDL 76-22 19 MM	2009	2.0	24	
1175	0000	0009	36.0	28.0	SPAV/HMA WRGLVL 76-22 9 S/L	2010	8.5	24		1174	0000	0020	25.5	17.5	SPAV/HMA WRGLVL 76-22 9 S/L	2009	0.0	24	
1175	0000	0009	36.0	28.0	CONC PAVT RESTORATION (CPR)	2010	0	24		1174	0000	0020	25.5	17.5	CONC PAVT RESTORATION (CPR)	2009	0	24	
1175	0000	0009	36.0	28.5	CPR (WITH DIAMOND GRINDING)	1999	0	24		1174	0000	0020	25.5	17.5	CPR (WITH DIAMOND GRINDING)	1999	0	24	
1175	0000	0009	36.0	28.5	PCCP 20' INT SP DOWEL/SKEW	1999	10	24		1174	0000	0020	25.5	17.5	PCCP 20' INT SP DOWEL/SKEW	1999	13	24	
1175	0000	0009	36.0	29.5	BITUMINOUS WEARING CRSE ID-2	1997	1.5	24		1174	0000	0020	25.5	17.5	DGS SUBBASE	1999	4	24	
1175	0000	0009	36.0	26.5	ID-2 BINDER COURSE	1997	2	24		1174	0000	0020	25.5	17.5	2A SUBBASE	1999	4	24	
1175	0000	0009	36.0	29.5	RCOP #1.5' INT SPACING DOWEL	1997	10	24		1174	0000	0020	25.5	17.5	OUT OF SERVICE RECONSTRUCTED	1999	0	24	
1175	0000	0009	36.0	28.0	UNKNOWN SUBBASE	1997	8	24		1174	0000	0020	25.5	17.5	OUT OF SERVICE RECONSTRUCTED	1999	0	24	
1175	0000	0009	32	18	STONE MATRIX WMA .35MM	2024	2.5	24	STONE MATRIX WMA .35MM	1174	0020	2009	30	20	STONE MATRIX WMA .35MM	2024	1.5	24	
1175	0009	0009	32	18	SPAV ASP BINDER 345-22 18MM	2024	6.5	24	SPAV ASP BINDER 345-22 18MM	1174	0020	2009	30	20	SPAV ASP W/ROSCRIC 345-22 9.5	2024	1	24	
1175	0009	0009	32	18	SPAV ASP BASE 345-22 25	2024	10	24	MILLING (AVERAGE DEPTHS)	1174	0020	2009	30	20	MILLING (AVERAGE DEPTHS)	2024	-2.5	24	
1175	0009	0009	32	18	2A SUBBASE	2024	14	24	SPAV/HMA WRG 76-22 9.5MM E	1174	0020	2009	30	20	SPAV/HMA WRG 76-22 9.5MM E	2009	1.5	24	
1175	0009	0009	32	18	GEOTEXTILE	2024	0	24	SPAV/HMA BNDL 76-22 19 MM	1174	0020	2009	30	20	SPAV/HMA BNDL 76-22 19 MM	2009	2.0	24	
1175	0009	0009	32	18	OUT OF SERVICE RECONSTRUCTED	2024	0	24	SPAV/HMA WRGLVL 76-22 9 S/L	1174	0020	2009	30	20	SPAV/HMA WRGLVL 76-22 9 S/L	2009	0.0	24	
1175	0009	0009	36.0	29.5	STONE MATRIX WMA .35MM	2024	1.5	24	1175/2025 - End HMA - Size Control	1174	0020	2009	30	20	CPR (WITH DIAMOND GRINDING)	1999	0	24	
1175	0009	0009	36.0	28.5	SPAV ASP W/ROSCRIC 345-22 9.5	2024	1	24	Shrub between road and 6' Play Hazy	1174	0020	2009	30	20	PCCP 20' INT SP DOWEL/SKEW	1999	10	24	
1175	0009	0009	36.0	28.5	MILLING (AVERAGE DEPTHS)	2024	-2	24		1174	0020	2009	30	20	CONC PAVT RESTORATION (CPR)	2009	0	24	
1175	0009	0009	36.0	29.5	SPAV/HMA WRG 76-22 9.5MM E	2010	1.5	24		1174	0020	2009	30	20	CPR (WITH DIAMOND GRINDING)	1999	0	24	
1175	0009	0009	36.0	28.5	SPAV/HMA BNDL 76-22 19 MM	2010	2.5	24		1174	0020	2009	30	20	ID-2 BINDER COURSE	1997	2	24	
1175	0009	0009	36.0	28.5	SPAV/HMA WRGLVL 76-22 9 S/L	2010	9.5	24		1174	0020	2009	30	20	RCOP #1.5' INT SPACING DOWEL	1997	10	24	
1175	0009	0009	36.0	28.5	CONC PAVT RESTORATION (CPR)	2010	0	24		1174	0020	2009	30	20	UNKNOWN SUBBASE	1997	8	24	
1175	0009	0009	36.0	28.5	CPR (WITH DIAMOND GRINDING)	1999	0	24											
1175	0009	0009	36.0	28.5	PCCP 20' INT SP DOWEL/SKEW	1999	10	24											
1175	0009	0009	36.0	28.5	BITUMINOUS WEARING CRSE ID-2	1997	1.5	24											
1175	0009	0009	36.0	28.5	ID-2 BINDER COURSE	1997	2	24											
1175	0009	0009	36.0	28.5	RCOP #1.5' INT SPACING DOWEL	1997	10	24											
1175	0009	0009	36.0	29.5	UNKNOWN SUBBASE	1997	8	24											
1181	0000	0072	36.0	28.5	STONE MATRIX WMA .35MM	2024	1.5	24	STONE MATRIX WMA .35MM	1180	0000	0000	30	20	STONE MATRIX WMA .35MM	2024	1.5	24	
1181	0000	0072	36.0	28.5	SPAV ASP W/ROSCRIC 345-22 9.5	2024	1	24	SPAV ASP W/ROSCRIC 345-22 9.5	1180	0000	0000	30	20	SPAV ASP W/ROSCRIC 345-22 9.5	2024	1	24	
1181	0000	0072	36.0	28.5	MILLING (AVERAGE DEPTHS)	2024	-2	24	MILLING (AVERAGE DEPTHS)	1180	0000	0000	30	20	MILLING (AVERAGE DEPTHS)	2024	-2.5	24	
1181	0000	0072	36.0	29.5	SPAV/HMA WRG 76-22 9.5MM E	2010	1.5	24	SPAV/HMA WRG 76-22 9.5MM E	1180	0000	0000	30	20	SPAV/HMA WRG 76-22 9.5MM E	2009	1.5	24	
1181	0000	0072	36.0	28.5	SPAV/HMA BNDL 76-22 19 MM	2010	2.5	24	SPAV/HMA BNDL 76-22 19 MM	1180	0000	0000	30	20	SPAV/HMA BNDL 76-22 19 MM	2009	2.0	24	
1181	0000	0072	36.0	28.5	SPAV/HMA WRGLVL 76-22 9 S/L	2010	9.5	24	SPAV/HMA WRGLVL 76-22 9 S/L	1180	0000	0000	30	20	SPAV/HMA WRGLVL 76-22 9 S/L	2009	0.0	24	
1181	0000	0072	36.0	29.0	CONC PAVT RESTORATION (CPR)	2010	0	24	CONC PAVT RESTORATION (CPR)	1180	0000	0000	30	20	CONC PAVT RESTORATION (CPR)	2009	0	24	
1181	0000	0072	36.0	28.5	CPR (WITH DIAMOND GRINDING)	1999	0	24	CPR (WITH DIAMOND GRINDING)	1180	0000	0000	30	20	CPR (WITH DIAMOND GRINDING)	1999	0	24	
1181	0000	0072	36.0	28.5	PCCP 20' INT SP DOWEL/SKEW	1999	10	24	PCCP 20' INT SP DOWEL/SKEW	1180	0000	0000	30	20	PCCP 20' INT SP DOWEL/SKEW	1999	10	24	
1181	0000	0072	36.0	29.0	BITUMINOUS WEARING CRSE ID-2	1997	1.5	24	BITUMINOUS WEARING CRSE ID-2	1180	0000	0000	30	20	BITUMINOUS WEARING CRSE ID-2	1997	1.5	24	
1181	0000	0072	36.0	28.5	ID-2 BINDER COURSE	1997	2	24	ID-2 BINDER COURSE	1180	0000	0000	30	20	ID-2 BINDER COURSE	1997	2	24	
1181	0000	0072	36.0	28.5	RCOP #1.5' INT SPACING DOWEL	1997	10	24	RCOP #1.5' INT SPACING DOWEL	1180	0000	0000	30	20	RCOP #1.5' INT SPACING DOWEL	1997	10	24	
1181	0000	0072	36.0	28.5	UNKNOWN SUBBASE	1997	8	24	UNKNOWN SUBBASE	1180	0000	0000	30	20	UNKNOWN SUBBASE	1997	8	24	
1185	0000	0000	36.0	28.5	STONE MATRIX WMA .35MM	2024	1.5	24	STONE MATRIX WMA .35MM	1184	0000	0000	30	20	STONE MATRIX WMA .35MM	2024	1.5	24	
1185	0000	0000	36.0	28.5	SPAV ASP W/ROSCRIC 345-22 9.5	2024	1	24	SPAV ASP W/ROSCRIC 345-22 9.5	1184	0000	0000	30	20	SPAV ASP W/ROSCRIC 345-22 9.5	2024	1	24	
1185	0000	0000	36.0	28.5	MILLING (AVERAGE DEPTHS)	2024	-2	24	MILLING (AVERAGE DEPTHS)	1184	0000	0000	30	20	MILLING (AVERAGE DEPTHS)	2024	-2.5	24	
1185	0000	0000	36.0	29.5	SPAV/HMA WRG 76-22 9.5MM E	2010	1.5	24	SPAV/HMA WRG 76-22 9.5MM E	1184	0000	0000	30	20	SPAV/HMA WRG 76-22 9.5MM E	2009	1.0	24	
1185	0000	0000	36.0	28.5	SPAV/HMA BNDL 76-22 19 MM	2010	2.5	24	SPAV/HMA BNDL 76-22 19 MM	1184	0000	0000	30	20	SPAV/HMA BNDL 76-22 19 MM	2009	2.0	24	
1185	0000	0000	36.0	28.5	SPAV/HMA WRGLVL 76-22 9 S/L	2010	9.5	24	SPAV/HMA WRGLVL 76-22 9 S/L	1184	0000	0000	30	20	SPAV/HMA WRGLVL 76-22 9 S/L	2009	0.0	24	

FHWA Grant Project Reporting

- **Semi-annual reports submitted to FHWA every January and July**
 - Paving progress to date
 - JMFs and delivery summaries
 - Testing results
 - Noted issues
 - Updates or changes to original work plan
- **Final Report to be submitted to FHWA within six months of completion of all projects.**

FHWA Grant Project Reporting – Performance Testing

Done on BOTH HiMA and Control

- **Rutting Potential**
 - Hamburg Wheel-Track Testing (AASHTO T 324)
- **Cracking Potential**
 - CT-Index Testing (ASTM D8225)
- **Asphalt Binder Property Evaluation**
 - ΔT_c (Standard Practice for Characterizing the Relaxation Behavior of Asphalt Binders – AASHTO PP 113-21)

FHWA Grant Project Reporting – Performance Testing

Hamburg Wheel-Track Testing

Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures

AASHTO Designation: T 324-17

Technical Section: 2c, Asphalt–Aggregate Mixtures

Release: Group 3 (August 2017)



Project Name: PennDOT HWT & IDEAL-CT 2024

Mix ID: WS9543VE1

Project ID:

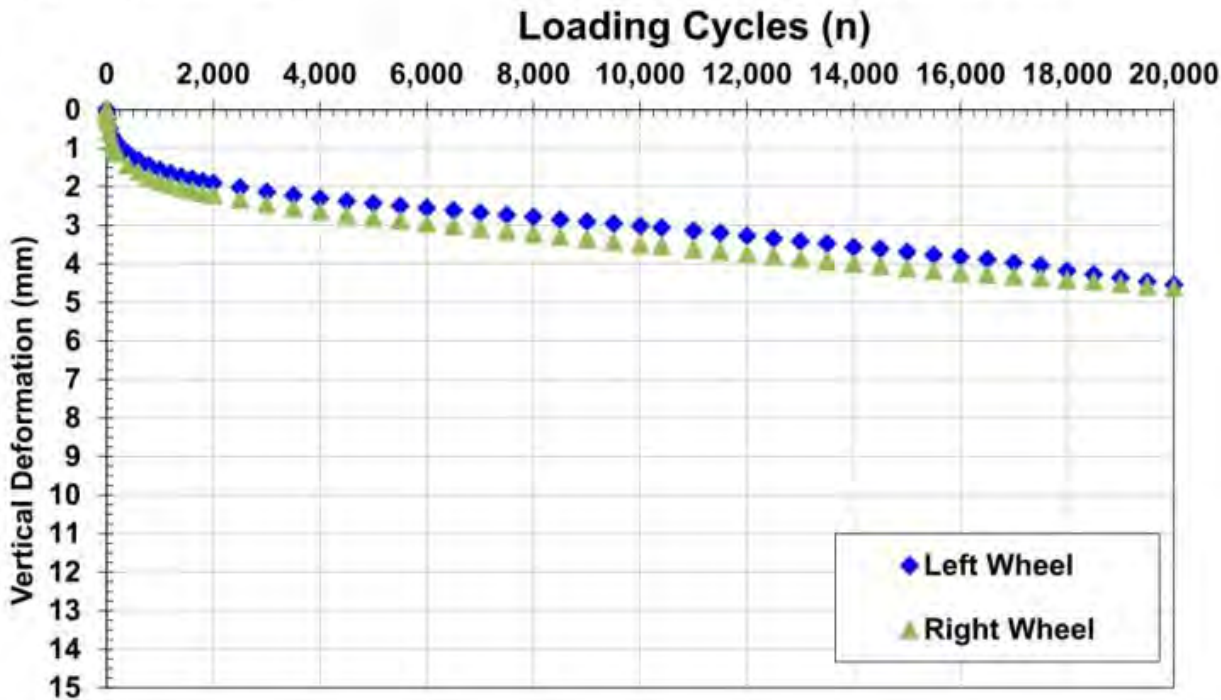
Plant ID:

Date Tested: 8/14/2024

Test Temperature: 50C

Asphalt Producer: HRI

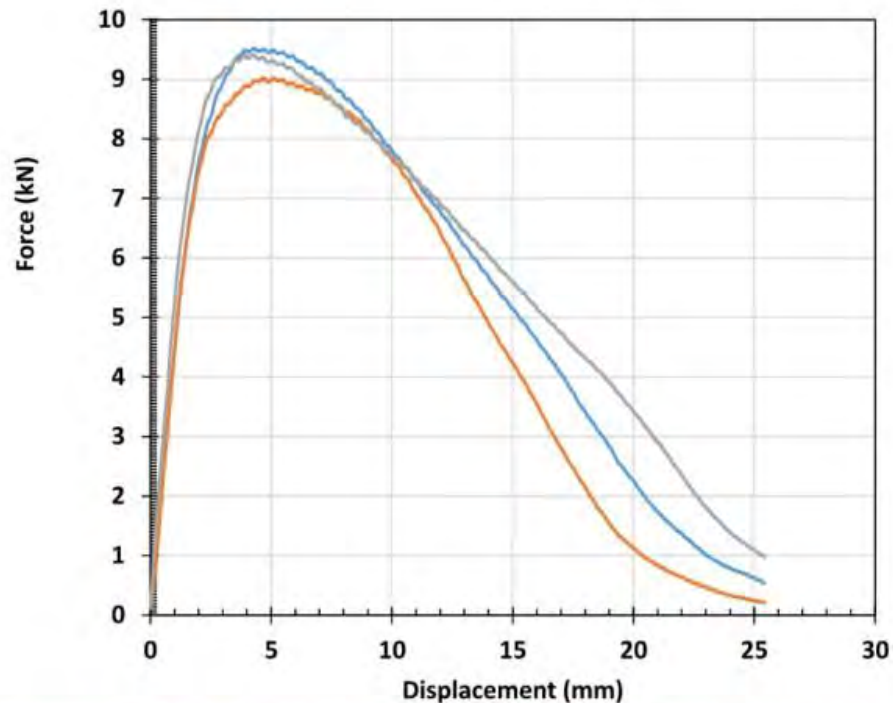
Test Method: AASHTO T-324



FHWA Grant Project Reporting – Performance Testing

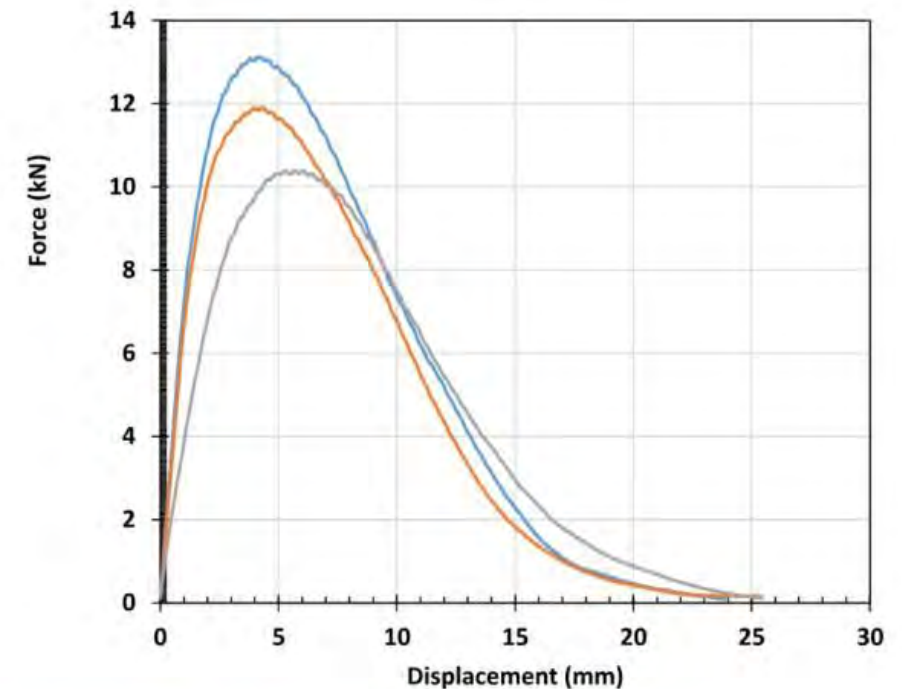
Cracking Potential Ideal TC Index

IDEAL-CT



9000-0008 STONE MATRIX ASPHALT MIXTURE DESIGN WITH HIGHLY MODIFIED ASPHALT (PG76E-28HP), RPS CONSTRUCTION OF PLANT-MIXED WMA WEARING (HiMA MATERIAL)

IDEAL-CT



0419-0007 STONE MATRIX ASPHALT MIXTURE DESIGN, WEARING COURSE, RPS PG 64E-22, LTS ACCEPTANCE 9.5 MM MIX, 1 1/2" DEPTH, SRL-E (CONTROL MATERIAL)

FHWA Grant Project Reporting – Performance Testing

Asphalt Binder Property Evaluation - ΔT_c

R 28, PAV @ 100 C Residue

Dynamic Shear ($G \cdot \sin \delta$, 10 rad/sec)	T315	6000 Max @ 28.0C	951	kPa
Creep Stiffness, S Mpa @ 60 seconds	T313	300 Max @ -18C	213	Mpa
Creep Stiffness, m-value @ 60 seconds	T313	0.300 Min @ -18C	0.325	
delta Tc - 40 hour PAV		-5.0 Min	-1.8	C

Sample meets current AASHTO M332 Specifications for PG 76E-28 HP.



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