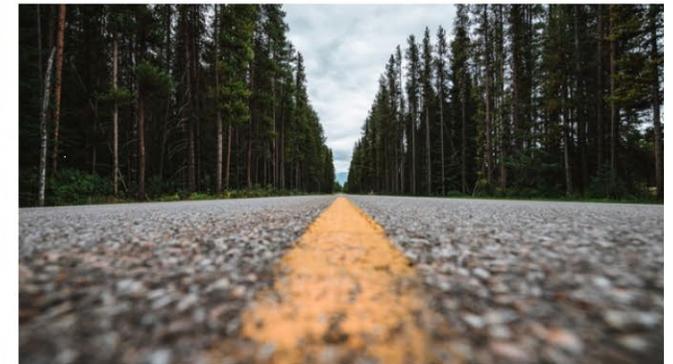


ASPHALT INSTITUTE



High Polymer Modified Asphalt Binders and Mixtures: *Virginia DOT Case Study*

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(AZ, CA, HI, NV, OR, and WA)

Western Transportation Research Consortium (WTRC) – Virtual Discussion
Day 1- Monday February 2nd, 2026

Why Modify Asphalt with Polymers?

- **Improved Rutting Resistance**

- High temperature Properties

- Softening point
 - Stiffness ($G^*/\sin \delta$)
 - Recovery (MSCR Jnr, %R)



PG 64-22 modified, no rutting



PG 67-22 unmodified, 15mm rut

- **Improved Cracking Resistance**

- Increased flexibility and energy dissipation at intermediate and low temperatures

- **Overall:**

- Extended UTI, (PGH – PGL) $\geq 92^{\circ}\text{C}$ → **modified**
 - Up to 10X resistance to rutting and fatigue cracking
 - Relative benefits dependent on polymer **type** and polymer **loading level**
 - Polymer loading limited by compatibility, viscosity, handling, etc..

poly • mer
“many parts”

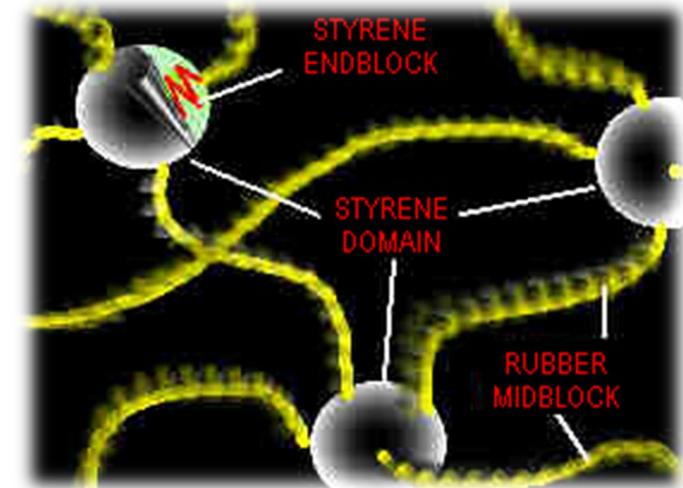
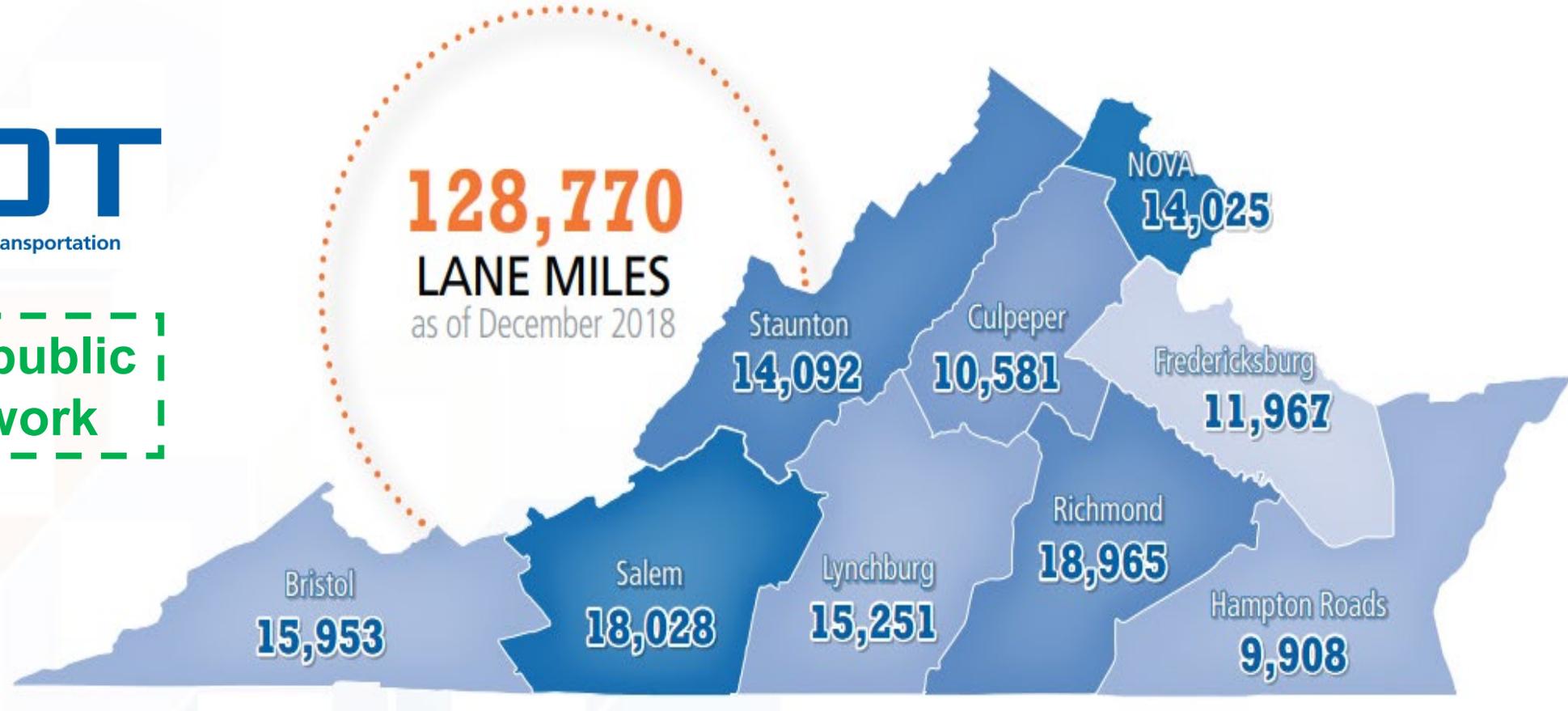


Image courtesy Infrapave

VDOT's Roadway Network



3rd largest US public roadway network



• Asphalt Over Jointed Concrete Pavement (JCP):

- Interstates: > 1,000 of 5,000 lane-miles of asphalt over JCP
- Primary Network: > 1,100 of 22,000 lane-miles of asphalt over JCP

- High Polymer (HP) asphalt mixtures may offer additional advantages in flexible pavements subjected to heavy & slow-moving traffic loads:
 - ❑ New Construction: Consideration to fatigue cracking, rutting & shoving in AC layer, total rutting, and top-down cracking.
 - ❑ Rehabilitation (Overlay): *Consideration to Reflective Cracking.*

HP Binders – **Why Are We Using It?**

- This material is highly elastic!



- Can be used in almost any mix → ***just replace the binder!***

Assess the viability of using HP AC mixtures in Virginia as a reflective cracking mitigation technique or as a tool for increased crack resistance on higher volume facilities:

- **Providing information on the state of practice in Northern America**
- **Evaluating the performance characteristics of PMA and HP plant produced mixtures placed in Virginia**
- **Compiling and analyzing PMS data for relevant in-service HP and several PMA pavements in Virginia**
- **Determining the life expectancy of HP AC overlays**

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Background – *Definition & Specifications*

- Definition and acceptance of HP is NOT related to SBS polymer content.
- *Performance-oriented viewpoint*: definition related to specific binder rheology-related parameters and characteristics.

Agency	Standard / Test Method	Properties / Comments
Virginia	AASHTO T 332 AASHTO T 350	PG 76E-28 $J_{nr, 3.2} \leq 0.1 \text{ kPa}^{-1}$ and $R_{3.2} \geq 90\%$ at 76C

Nomenclature !!!

**High modulus asphalt
(HIMOD or HMAC)**
Stiffness

**Highly polymer
modified binder (HiMA)**
Proprietary

High polymer binder (HP)
Non-proprietary (AI, VTRC, FDOT)

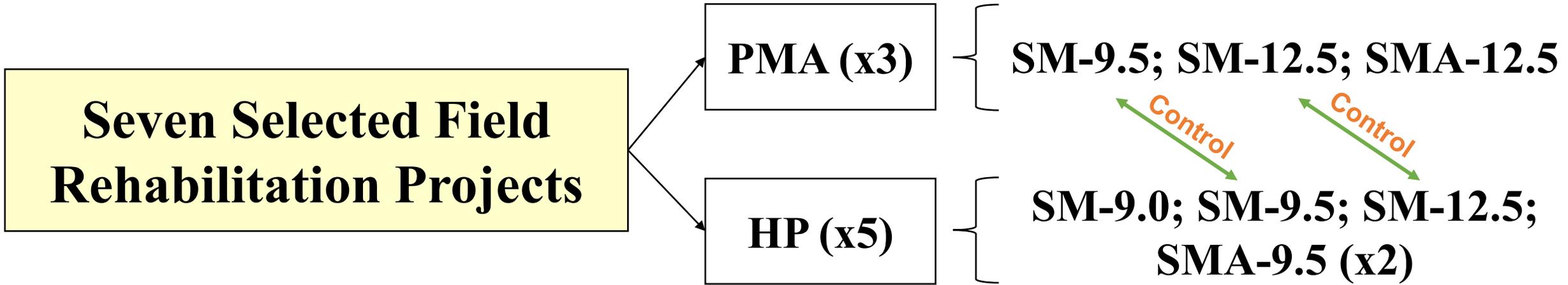
**High polymer grade
(HPG)**
TxAPA

**Highly-modified asphalt
mix (HiMod)**
UDOT

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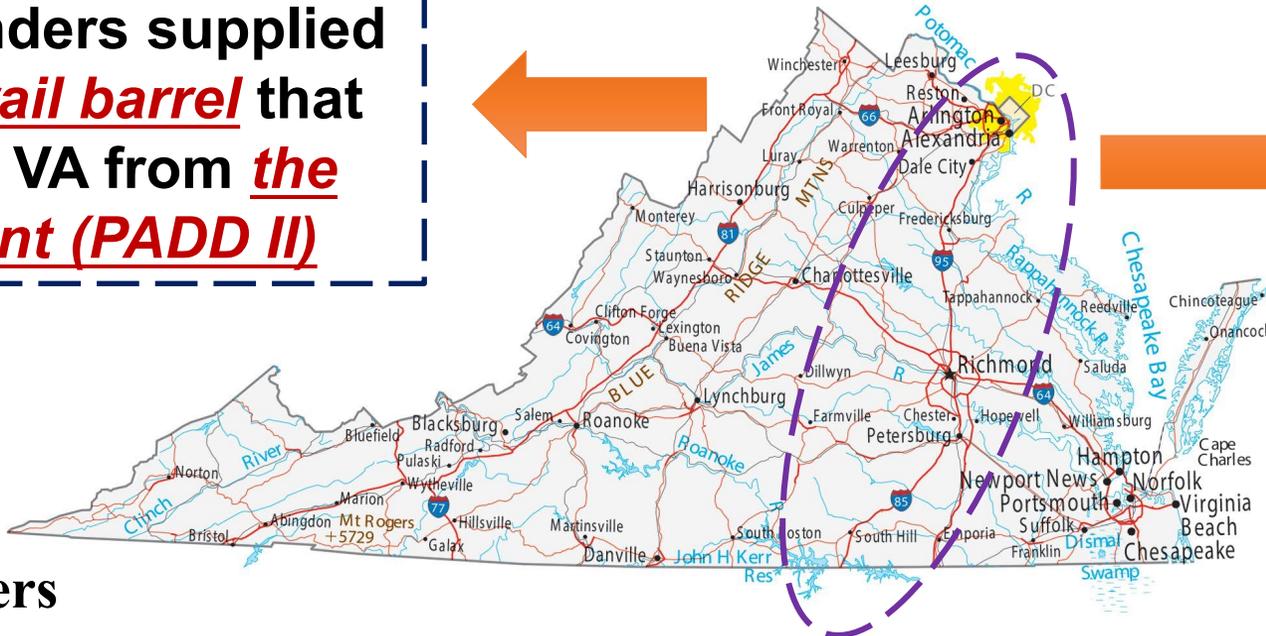
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Experimental Program



Asphalt binders supplied through a *rail barrel* that comes into VA from *the Midcontinent (PADD II)*

Asphalt binders supplied through a *water born vessel* barrel that is usually delivered from *offshore via boat (Canada, Europe, Caribbean, Med)*

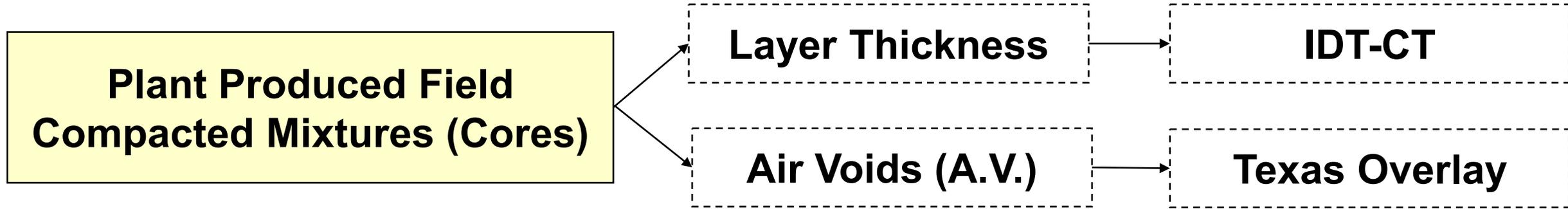


✓ x2 Suppliers

PMA and HP Asphalt Binders

Binder Source / ID	Continuous Grade based on AASHTO M 320 & M 332	
	PMA	HP
B1	<p>PG77.5-23.1 PG64E-22</p> <p>$J_{nr\ 3.2\ at\ 64^{\circ}C} = 0.349\ kPa^{-1}$ $\%R = 46.8\%$</p>	<p>PG84.9-30.5 PG76E-28</p> <p>$J_{nr\ 3.2\ at\ 76^{\circ}C} = 0.093\ kPa^{-1}$ $\%R = 91.5\%$</p>
B2	<p>PG78.6-23.0 PG64E-22</p> <p>$J_{nr\ 3.2\ at\ 64^{\circ}C} = 0.240\ kPa^{-1}$ $\%R = 53.3\%$</p>	<p>PG84.9-30.7 PG76E-28</p> <p>$J_{nr\ 3.2\ at\ 76^{\circ}C} = 0.059\ kPa^{-1}$ $\%R = 92.2\%$</p>

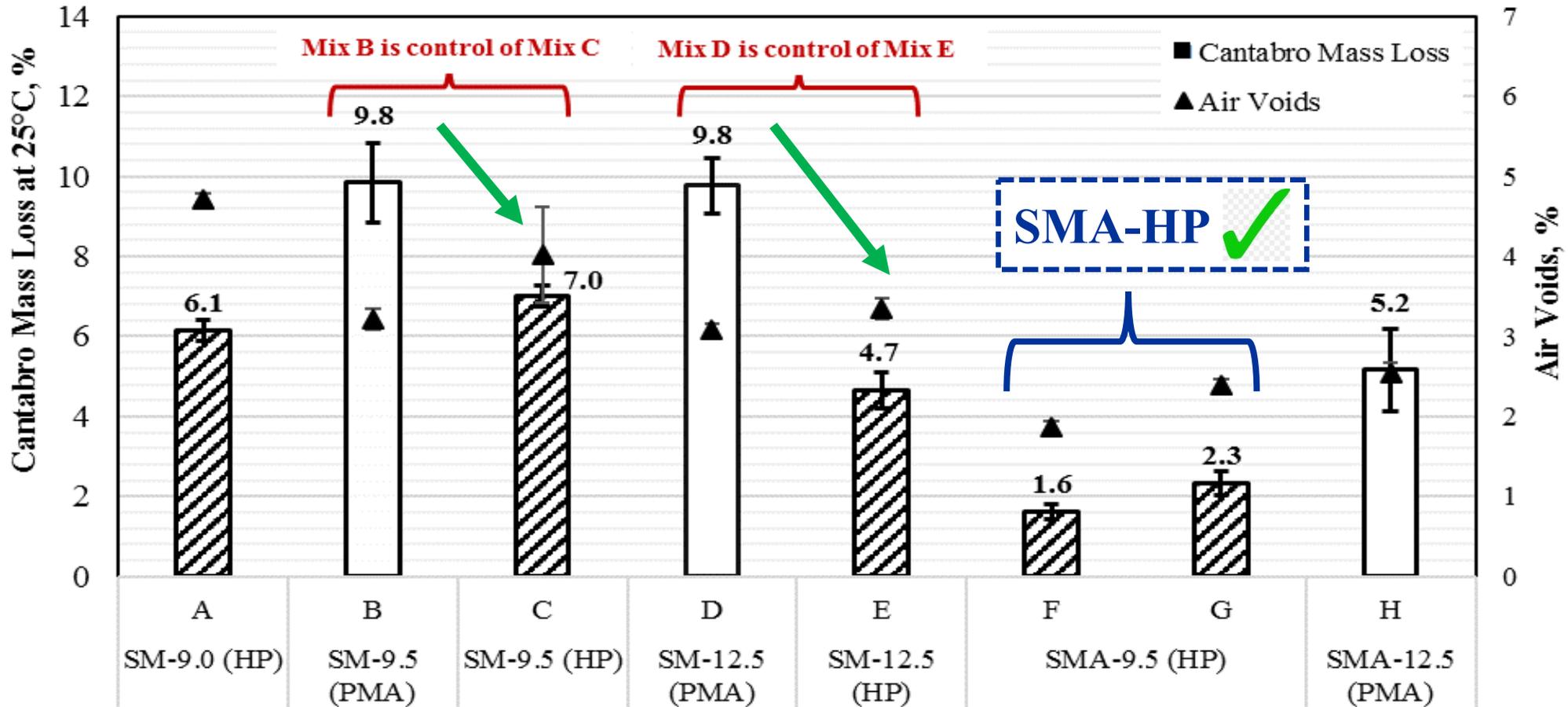
Experimental Program *(Cont'd)*



Mix ID	Mix Type	Layer Thickness (mm)			In-Place Air Voids (%)		
		Average	CI	Target	Average	CI	Range
A	SM-9.0 (HP)	20.3	1.7	25.4	7.3	0.6	6.8 to 7.9
B	SM-9.5 (PMA)	42.9	3.3	38.1	6.3	0.7	5.6 to 7.0
C	SM-9.5 (HP)	36.6	2.5	38.1	5.5	0.4	5.1 to 5.9
D	SM-12.5 (PMA)	28.1	2.5	25.4	6.1	0.4	5.7 to 6.5
E	SM-12.5 (HP)	--	--	--	--	--	6.5 to 7.5 ^a
F	SMA-9.5 (HP)	37.6	3.0	38.1	4.0	0.5	3.5 to 4.5
G	SMA-9.5 (HP)	42.7	3.1	50.8	4.8	0.6	4.2 to 5.4
H	SMA-12.5 (PMA)	51.7	4.4	50.8	5.1	0.7	4.3 to 5.8

Durability Performance Evaluation

Cantabro Test at 25C, Mass Loss



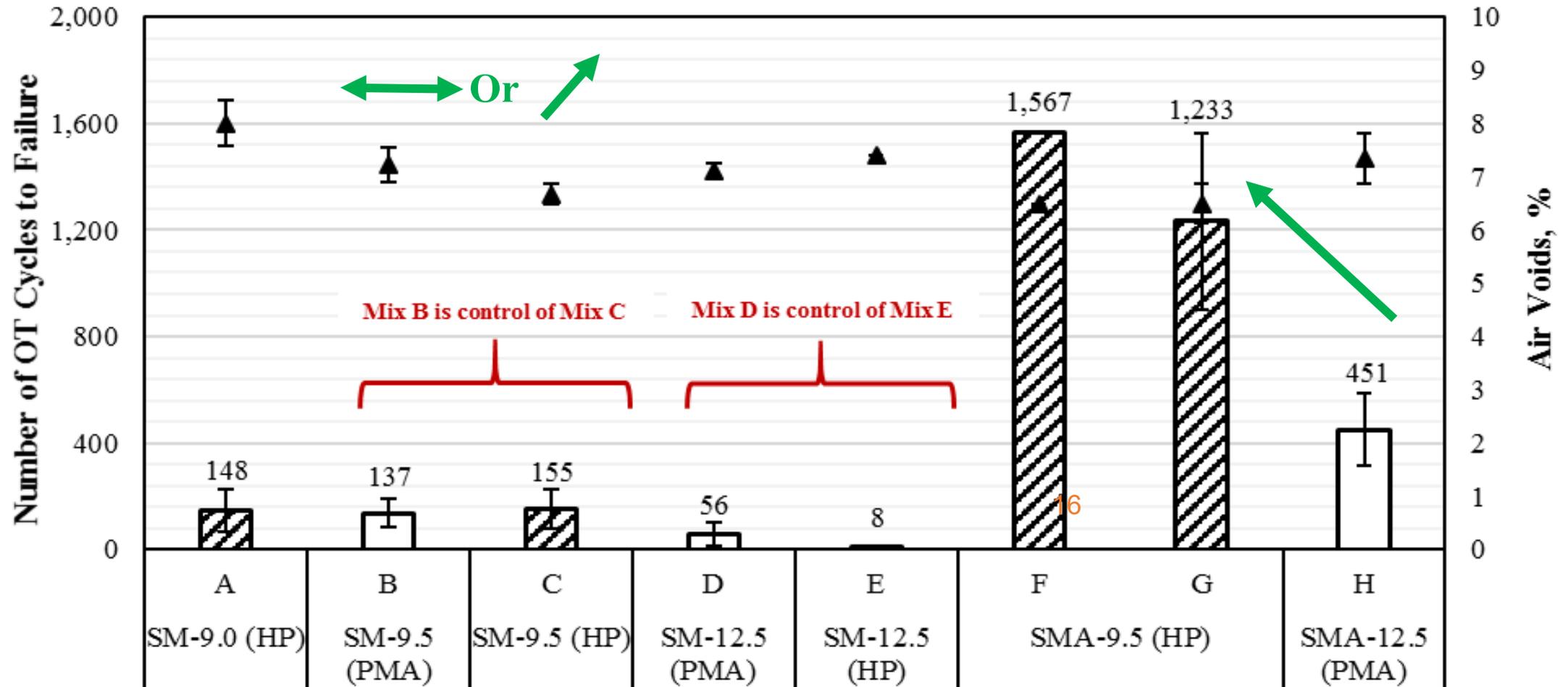
→ Lower Mass Loss for HP Mixes

Mix ID

→ Lower Mass Loss for SMA Mixes

Cracking Performance Evaluation

Texas Overlay at 10C, Number of Cycles



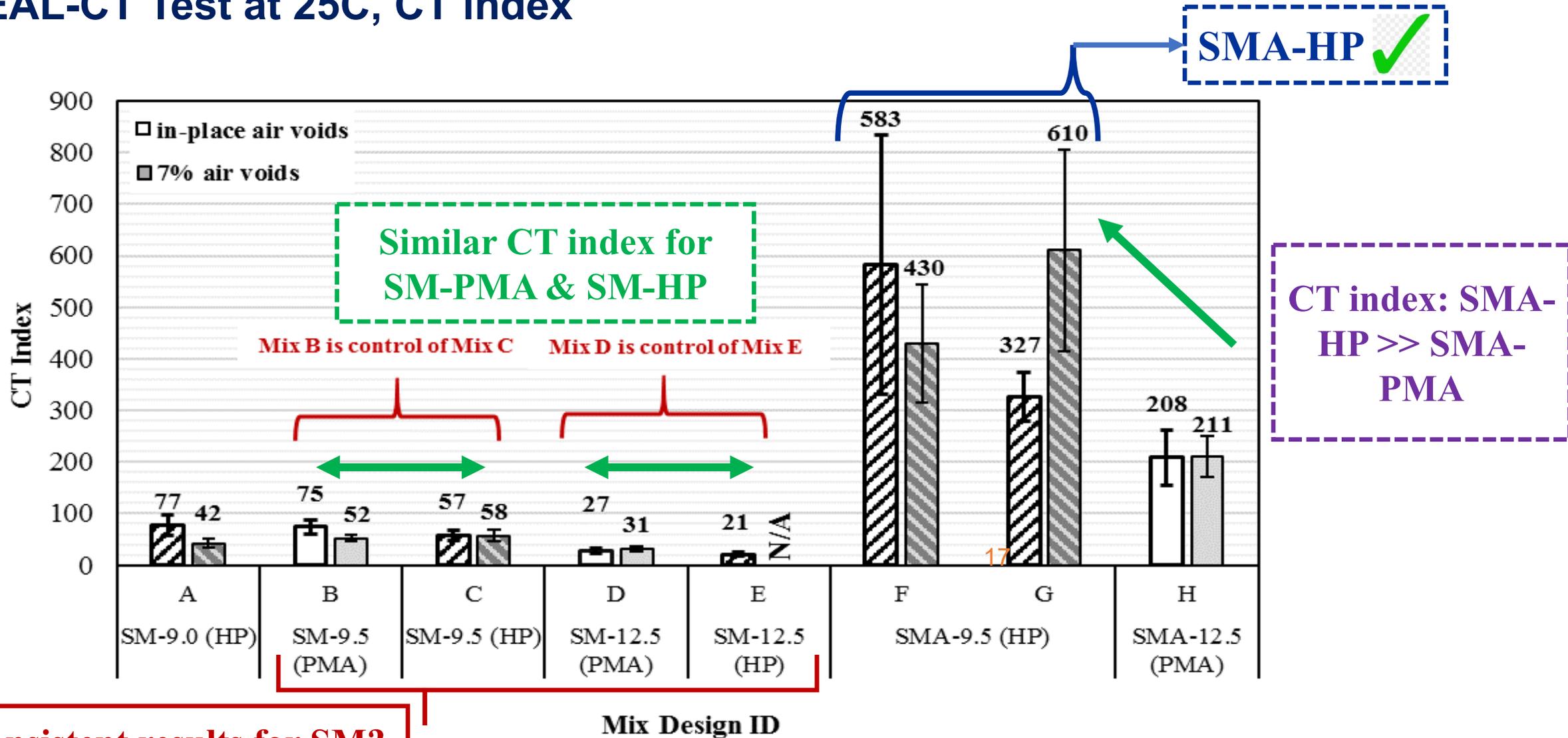
Similar or Greater for SM-HP Mixes

Mix ID

Greater for SMA-HP Mixes

Cracking Performance Evaluation

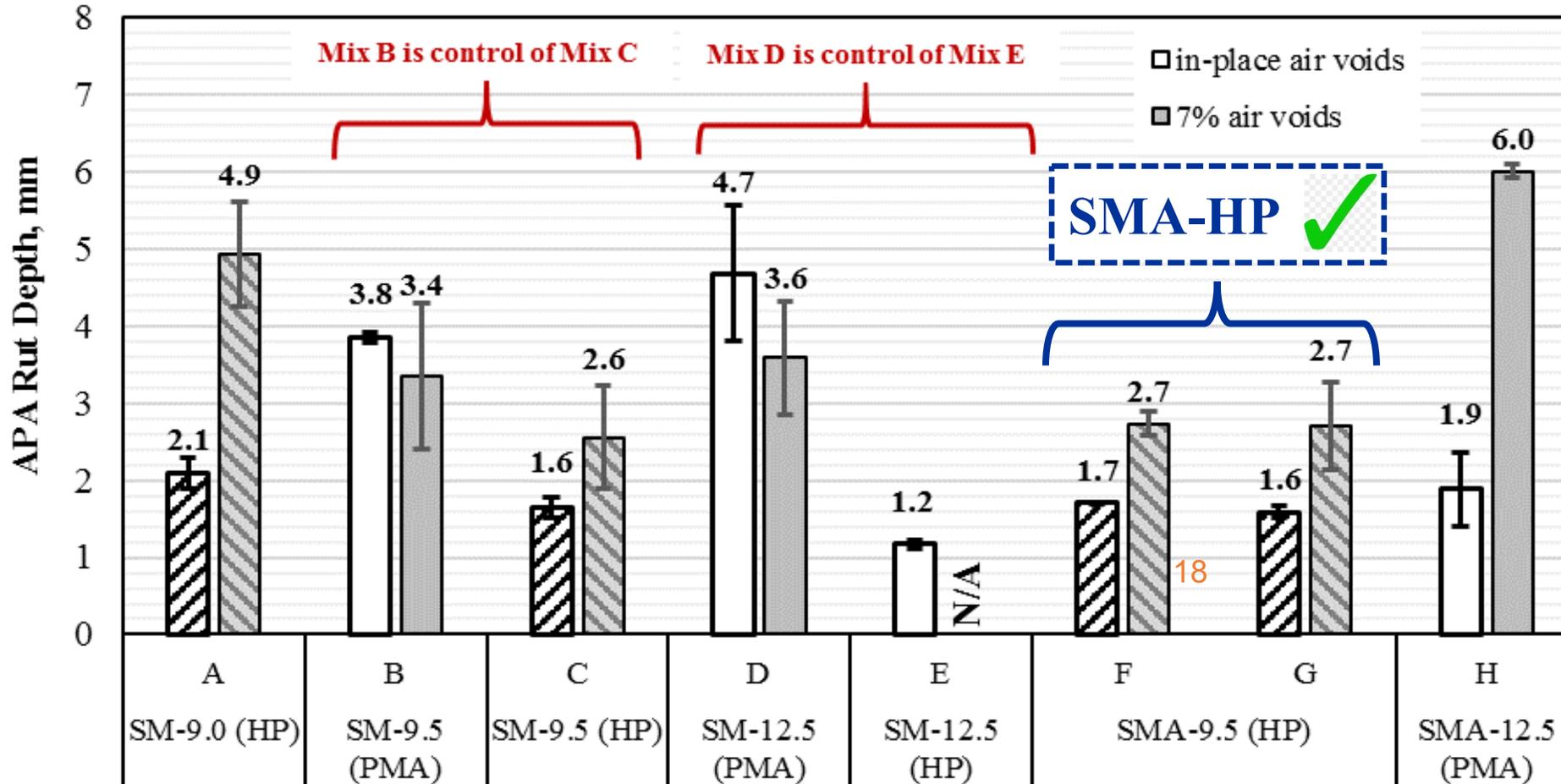
IDEAL-CT Test at 25C, CT index



Inconsistent results for SM?

Rutting Performance Evaluation

APA at 64C & 8000 cycles, Rut Depth



Lower rut depth for HP Mixes

Mix Design ID

Lower air voids → lower rut depth

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Viginia DOT – Practice & Usage

Year	Approximate quantity of HP mixtures placed (tons)	Approximate price for high mixtures placed (\$ per ton)	Approximate difference in price from conventional PMA mixtures (\$ per ton)
2015	6,627	135.00	+53.00
2015	31,622	100.00	+19.00
2015	6,627	135.00	+63.00
2017	3,297	110.00	+24.00
2017	1,126	121.00	+36.00
2020	6,504	127.00	+15.00
2020	11,819	130.00	+37.00
2020	31,815	141.50	+31.50
2023	1,483	155.00	+18.00

~ 94,293 tons

VA - Field Performance of HP Overlays

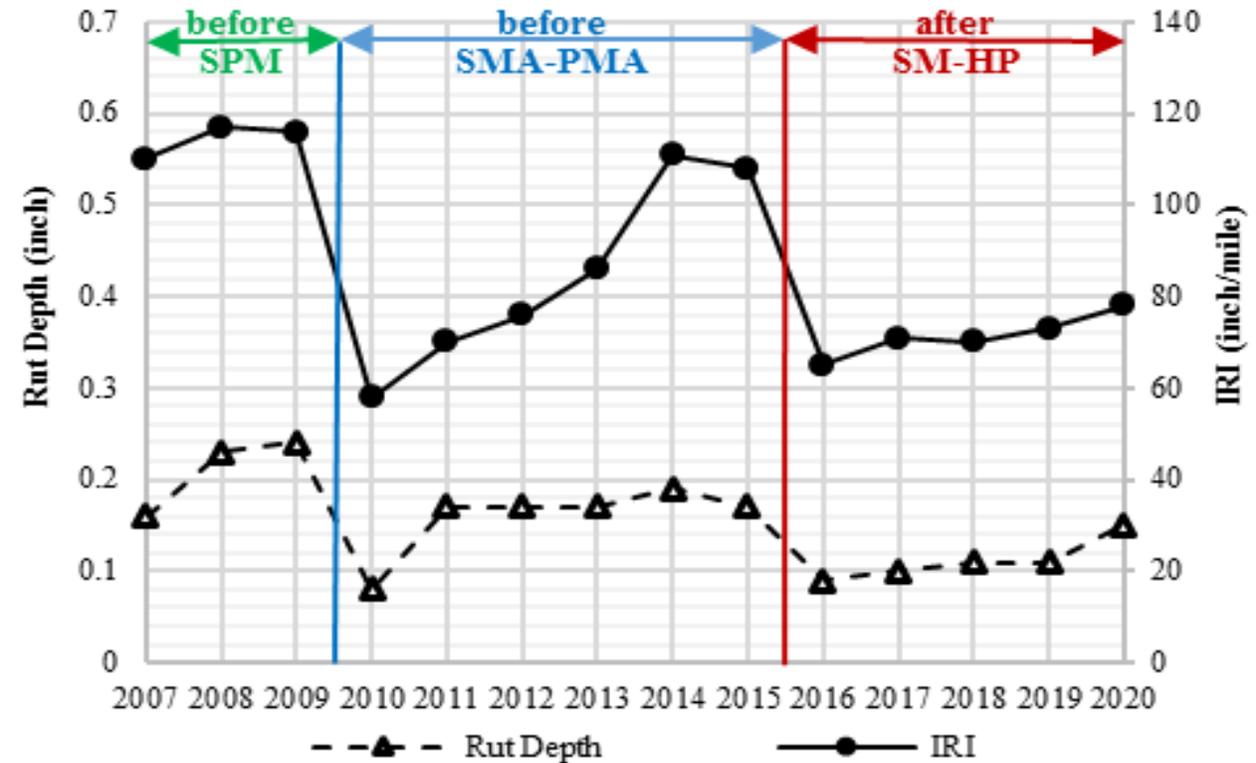
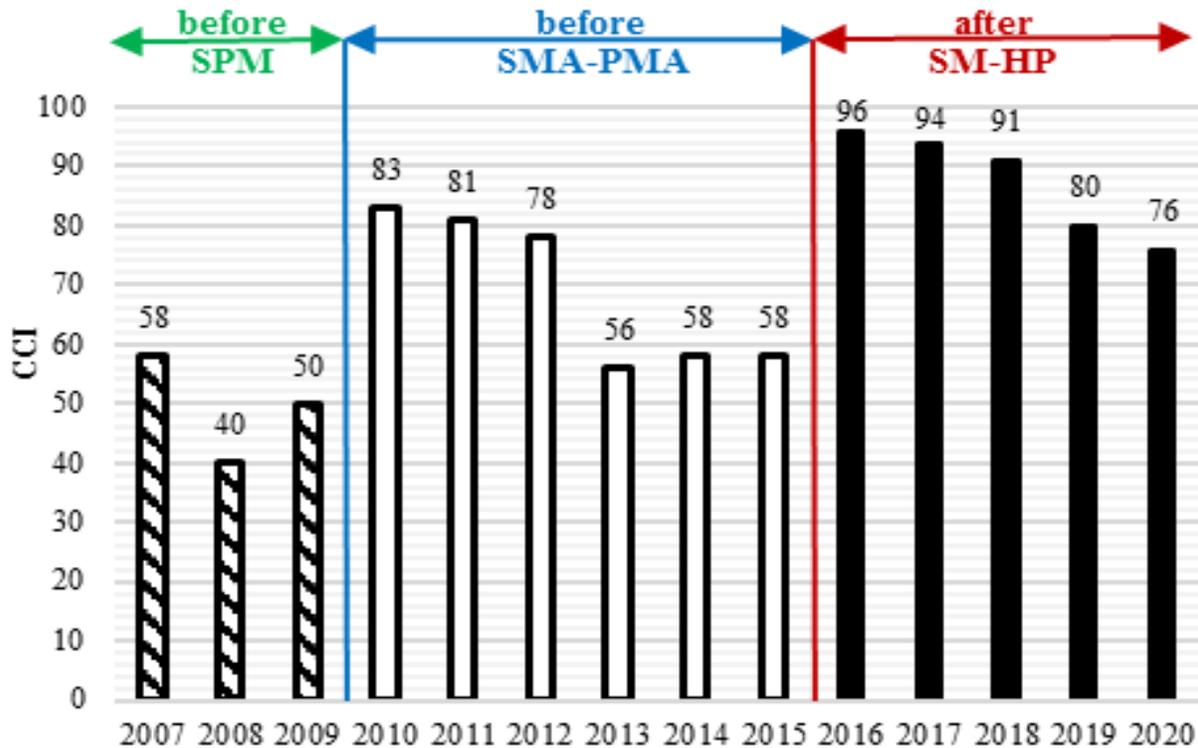


• HP and PMA Selected Routes *(as of 2018)*

No.	Route	County / County Mileposts	Pavement Type	Activity		Year of Prior Rehabilitation
				Details	Year	
1	I-95SB	Prince William, 0.02-3.89	BOJ	SM-12.5 E(HP) 2.0 in	2015	2009
2	I-95SB	Prince William, 10.98-13.12	BOJ	SMA-9.5 E(HP) 1.5 in SMA-9.0 E(HP) 1.0 in	2015	2007
3	I-95NB	Prince William, 0.07-3.92	BOJ	SM-12.5 E(HP) 2.0 in	2015	2008
4	I-495NB	Fairfax, 5.56-6.63	BOJ	SM-12.5 E(HP) 2.0 in	2016	2012
5	I-95SB	Hanover, 2.76-5.63	BOJ	SMA-19.0 E 2.0 in SMA-12.5 E(HP) 1.5 in	2016	2002
C6	I-95NB	Henrico, 7.33-9.55	BOJ	SMA-9.5 E 1.5 in SMA-19.0 E 2.0 in	2015	2004
7	I-64EB	York, 14.81-20.55	BOJ	THMACO 0.75 in SMA-12.5 E(HP) 2.0 in	2017	New Construction
8	I-64WB	York, 14.98-20.33	BOJ	THMACO 0.75 in SMA-12.5 E(HP) 2.0 in	2017	New Construction
9	I-95NB	Fairfax, 3.41-4.45	BIT	SM-12.5 E(HP) 2.0 in	2017	2010
10	I-495NB	Fairfax, 1.194-3.66	BOJ	SM-9.0 E(HP) 1.0 in SMA-9.5 E(HP) 1.5 in	2018	2014
11	I-95NB	Prince William, 11.121-12.64	BOJ	SM-12.5 E(HP) 2.0 in	2018	2011

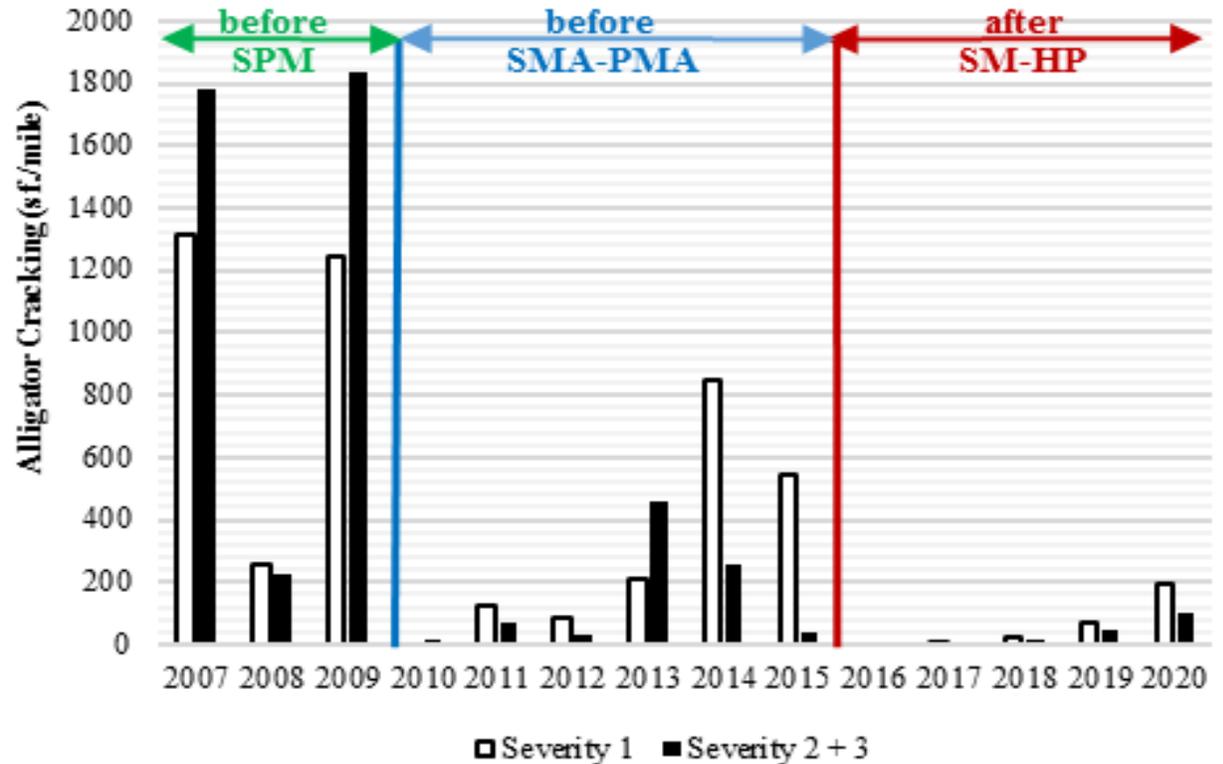
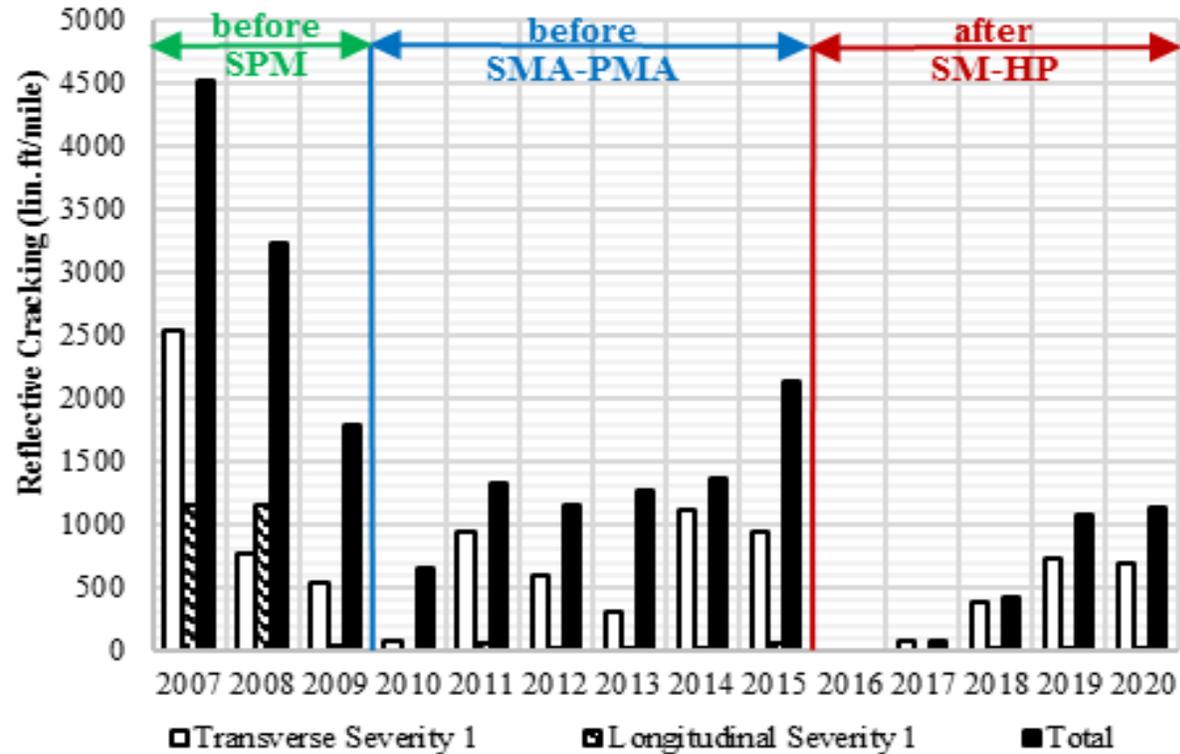
VA - Field Performance of HP Overlays

• I-95 SB (BOJ Section 1)



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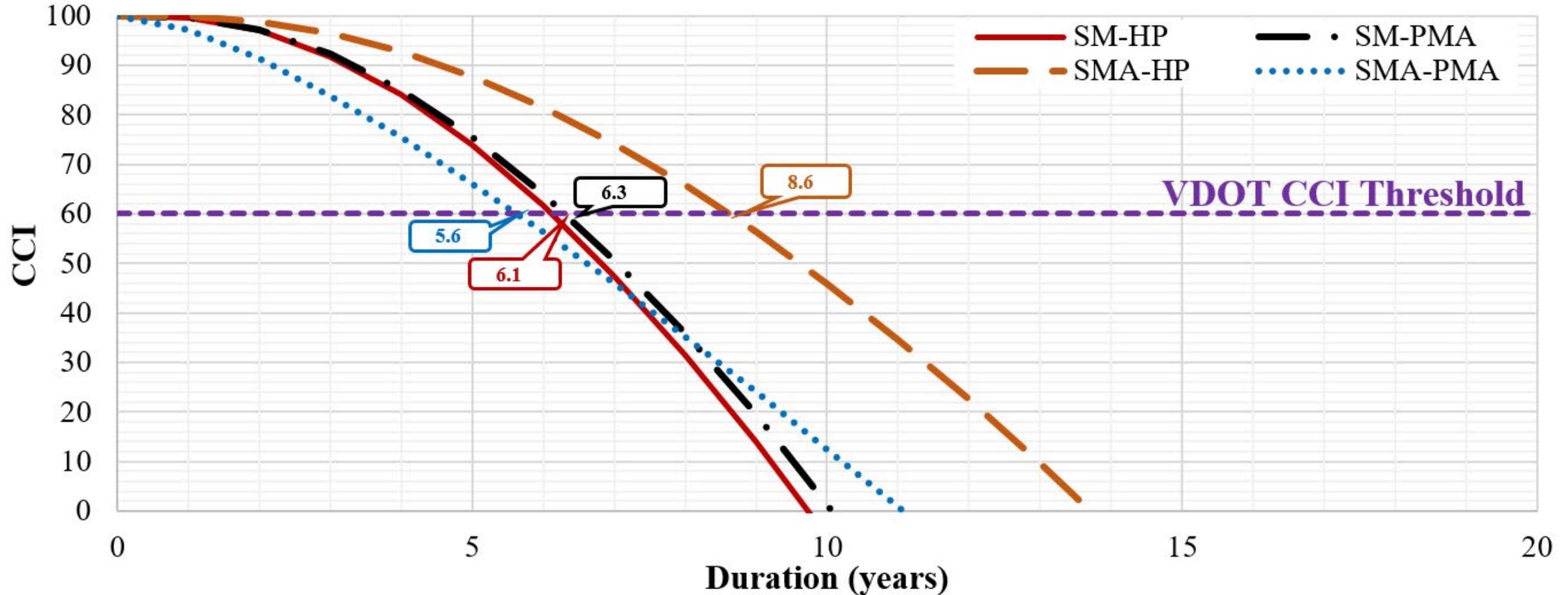


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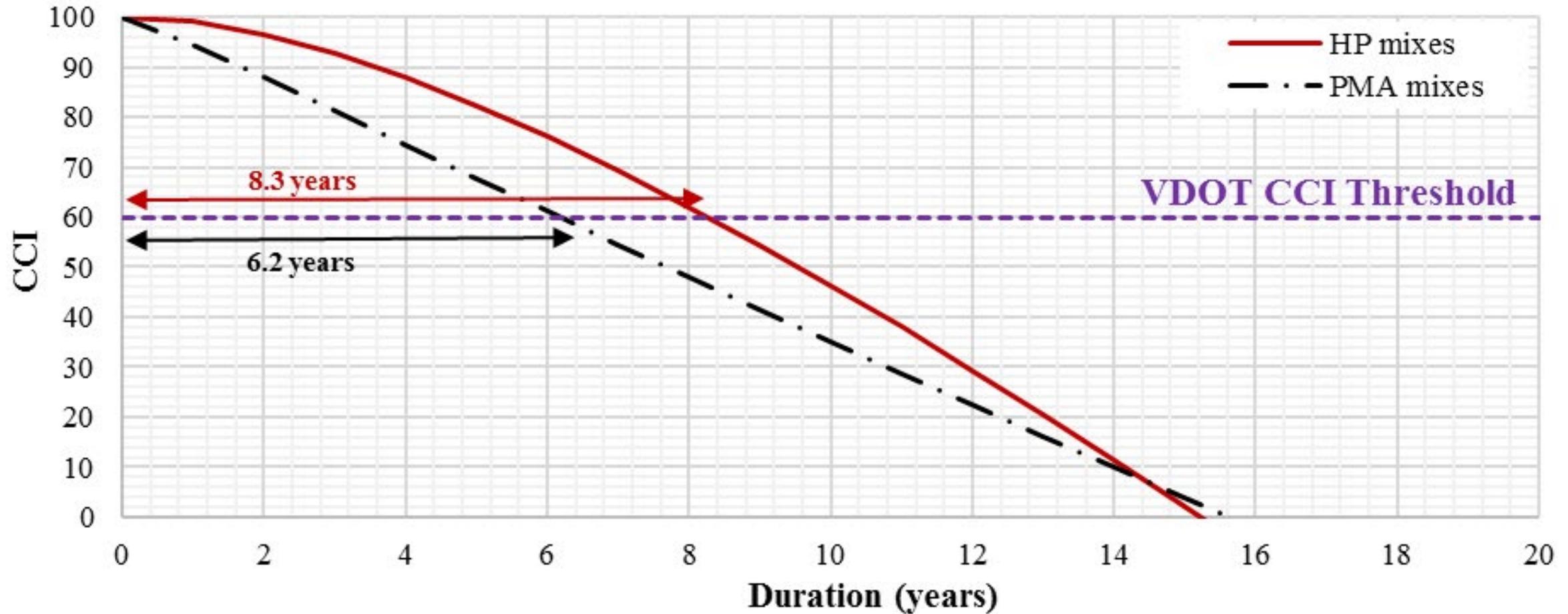
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VA - Field Performance of HP Overlays

- **Analysis (ii), SM-PMA vs. SM-HP vs. SMA-PMA vs. SMA-HP**



- **Analysis (iii), PMA vs. HP Mixtures**



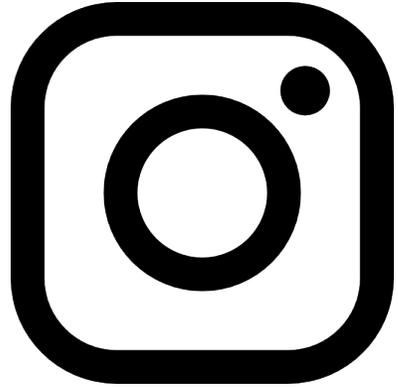
General Lessons Learned and Best Practices

- Consult with supplier regarding any handling instructions.
- If tank storage time exceeds recommended time (3 days), contractors should have a backup option for HP binders, such as blend down options.
- Wax-like products, typically used to reduce binder viscosity, are not recommended.
- Use an MTV to help establish a continuous paving process to produce higher quality/smooth mat.
- The quality of HP binder after delivery should always be checked according to specifications



- **Initial Use** – Began as pilot projects to reduce reflective cracking on JCPs.
- **Gradual Adoption** – No formal plan; projects treated as research unless bid as standard items.
- **Annual Projects** – Goal to construct at least 1 HP project / year.
- **Ongoing Challenges** – concern over high temperature limits and fiber burn in SMA; continued education needed.

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Thank You!

QUESTIONS?



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Laboratory and Field Performance Evaluation of Pavement Sections With High Polymer-Modified Asphalt Overlays

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