



## The Value of VRAM

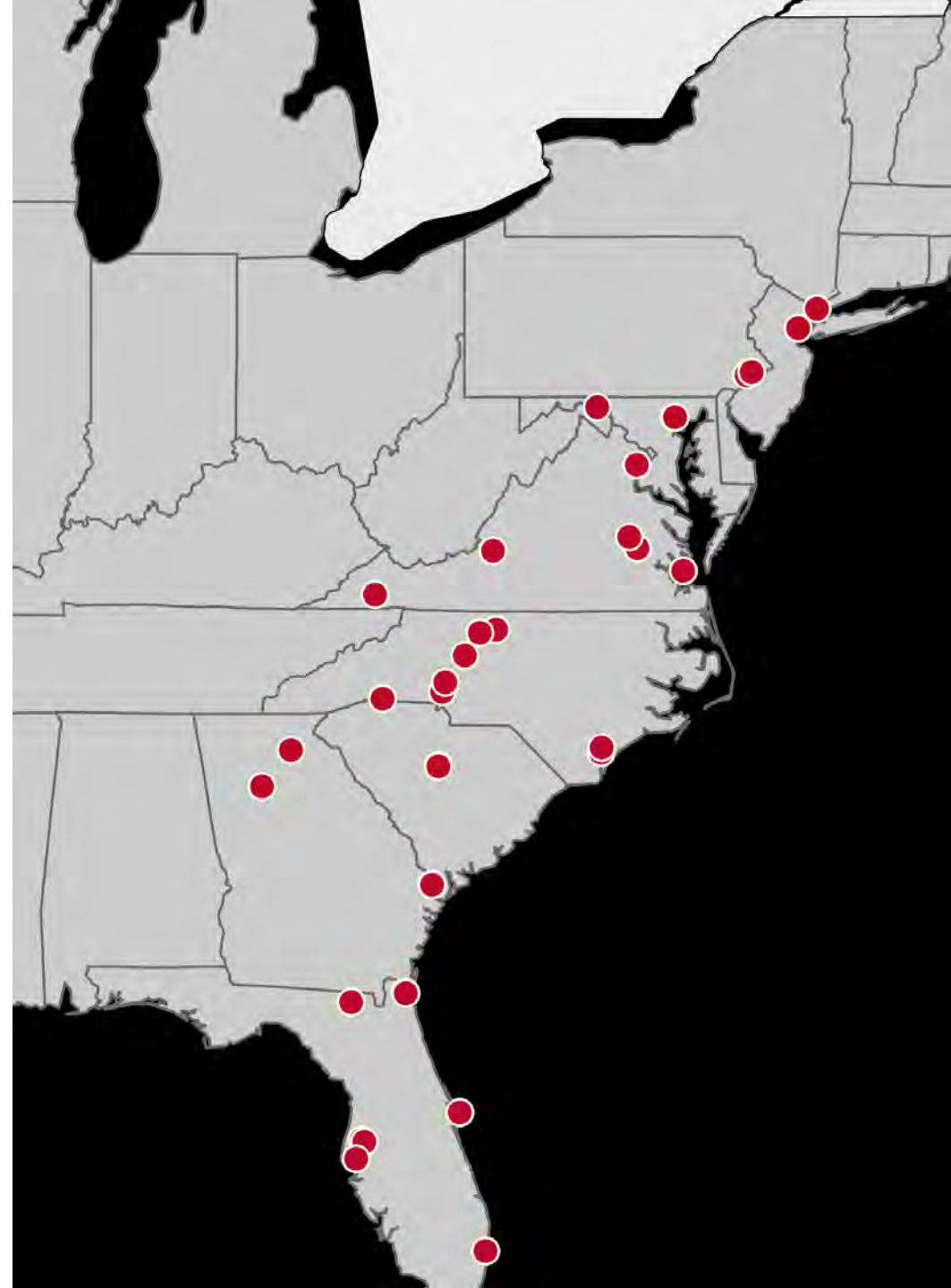
The results of a three-Year study on how to improve longitudinal joints in PA.

*\*Using a product with a 20-year history.*

David Powers- Associated Asphalt

# About Us

- Reputation
  - 70 Years
  - Core Values:  
Integrity, Safety, Relationships, Innovation and Excellence.
- Assets
  - 34 terminals
- Products
  - Emulsions
  - PG & PM
  - Roofing & Industrial
  - Performance
  - Lab Testing



# Safety First!

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- Pennsylvania Statistics
  - 1,800 work zone crashes per year.
  - Resulting in 36 deaths per year.
  - A total of 1,200 injuries per year.

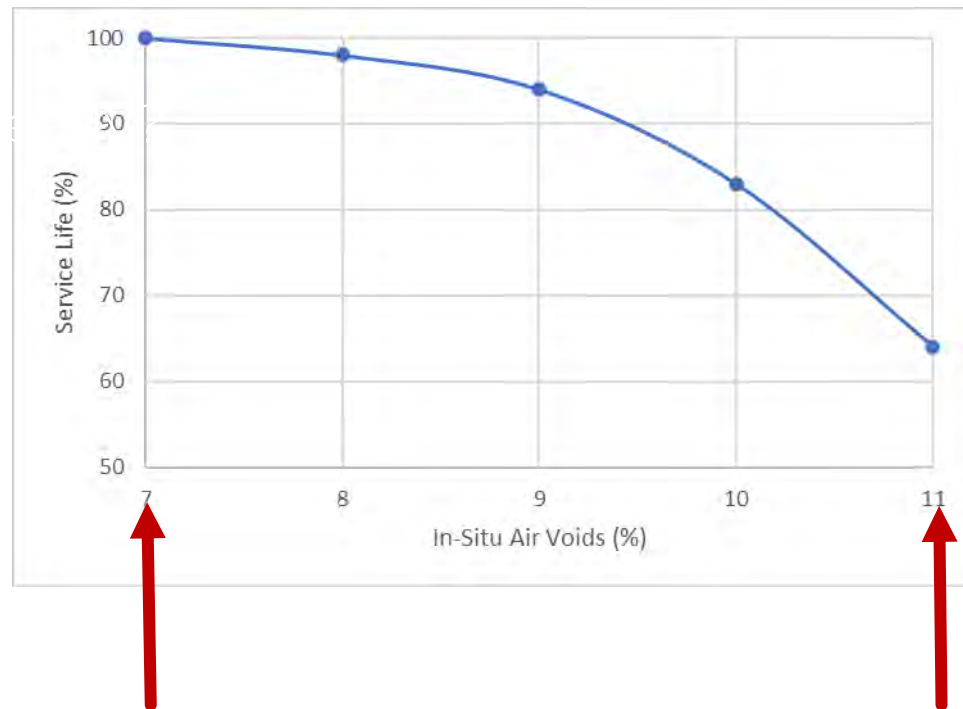
Provided by the  
National Work Zone  
Safety Information Clearing  
house.

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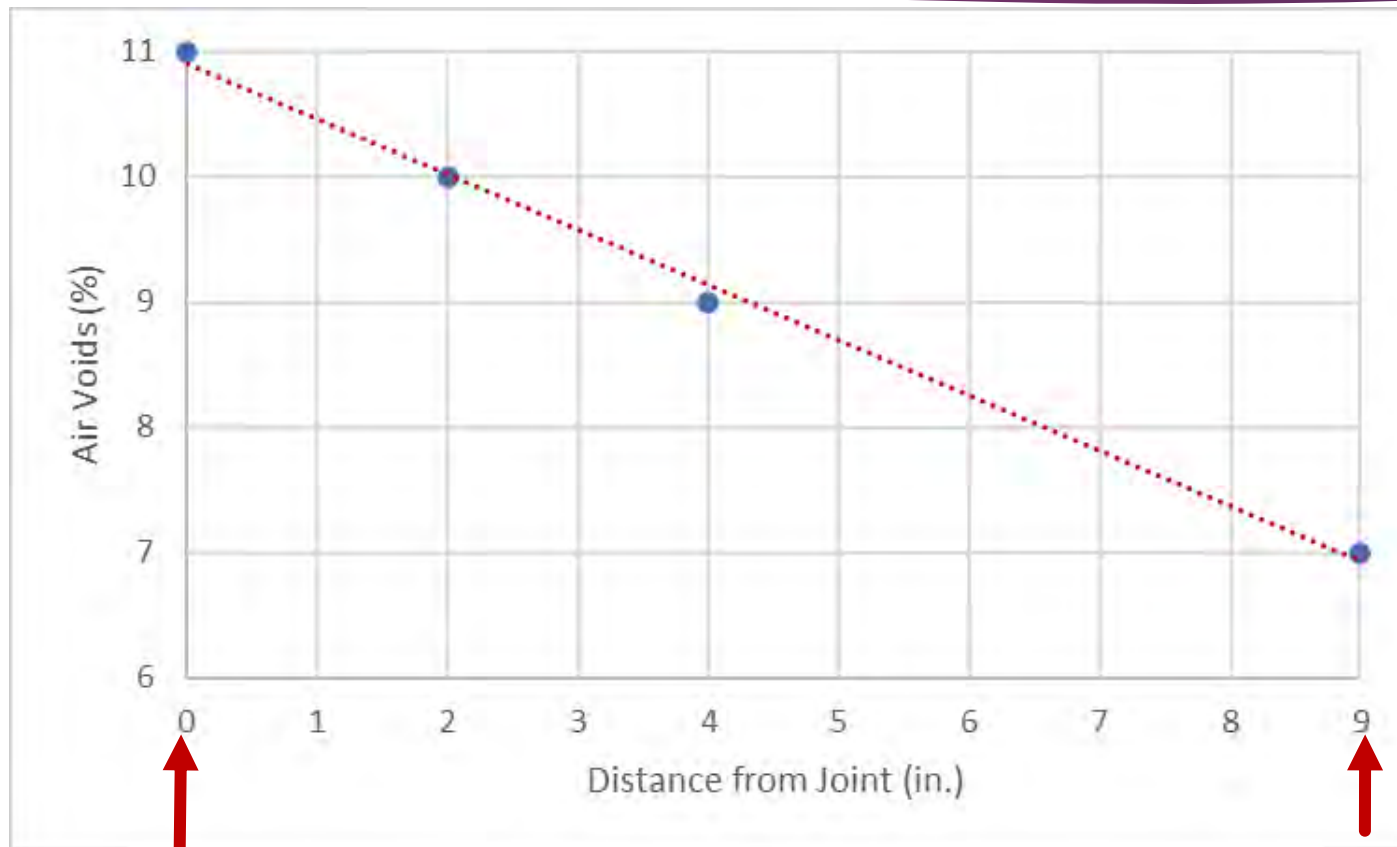


# Washington State DOT Study

## Why do joints fail early?



# Air Voids from Joint Towards Center of Lane



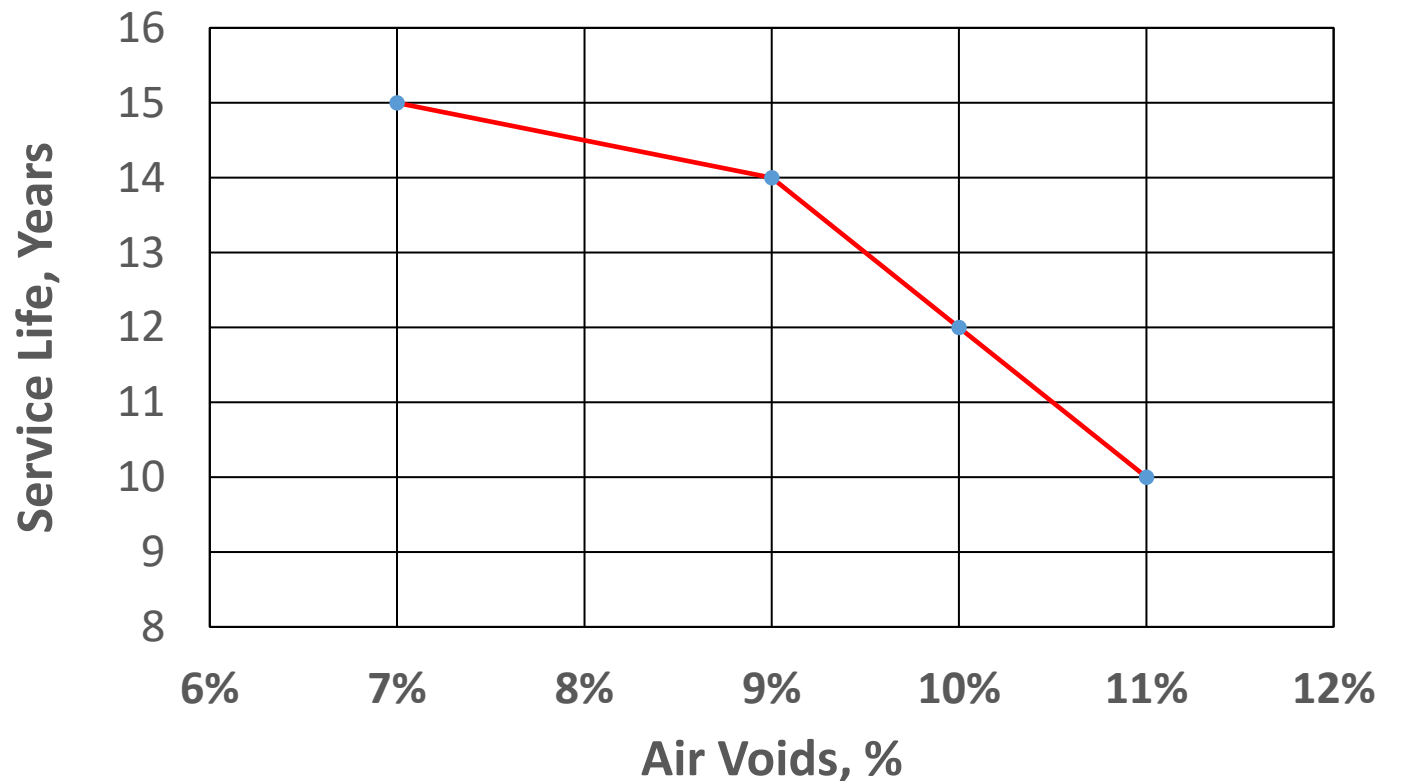
Centerline going towards interior of mat

Washington State DOT Study?

# Effect of Air Voids on Pavement Service Life

- If the center of the mat is at 7% voids or less, but the joint is at 11% voids, the joint fails 5 years earlier than the rest of the Pavement.

## Reduction in Expected Service Life



# Longitudinal Construction Joints

- Methods to improve joint performance
  - Joint density requirements (typically target voids at 4" from joint to within 2% of center mat voids)
  - Echelon paving (eliminate the joint)
  - Notched wedge joint
  - Cut off lower density unconfined edge
  - Mill and inlay
- All the above are “mechanical” solutions



# Longitudinal Joint Performance Plan

- + Early 2000 timeframe
- + Illinois DOT recognized need for better joint performance
- + Failure mechanism – permeability
- + **Concept** – fill a portion of the voids with an asphalt product from bottom up, a Void Reducing Asphalt Membrane (VRAM)



# VRAM

- What is VRAM? VRAM is a thick application of hot-applied, polymer-modified asphalt. VRAM is not an emulsion. True Grade 88-28 but with some additional properties added.
- The product is also referenced as:
  - LJS- Longitudinal Joint Sealant
  - VRAM – Void Reducing Asphalt Membrane
- Our VRAM/LJS is J-Band



**Associated  
Asphalt<sup>®</sup>**



# VRAM Special Provision

Test	Test Requirement	Test Method
Dynamic shear @ 88°C (unaged), $G^*/\sin \delta$ , kPa	1.00 min.	AASHTO T 315
Creep stiffness @ -18°C (unaged), Stiffness (S), MPa m-value	300 max. 0.300 min.	AASHTO T 313
Ash, %	1.0 – 4.0	AASHTO T 111
Elastic Recovery, 100 mm elongation, cut immediately, 25°C, %	70 min.	AASHTO T301
Separation of Polymer, Difference in °C of the softening point (ring and ball)	3 max.	ASTM D7173, AASHTO T53



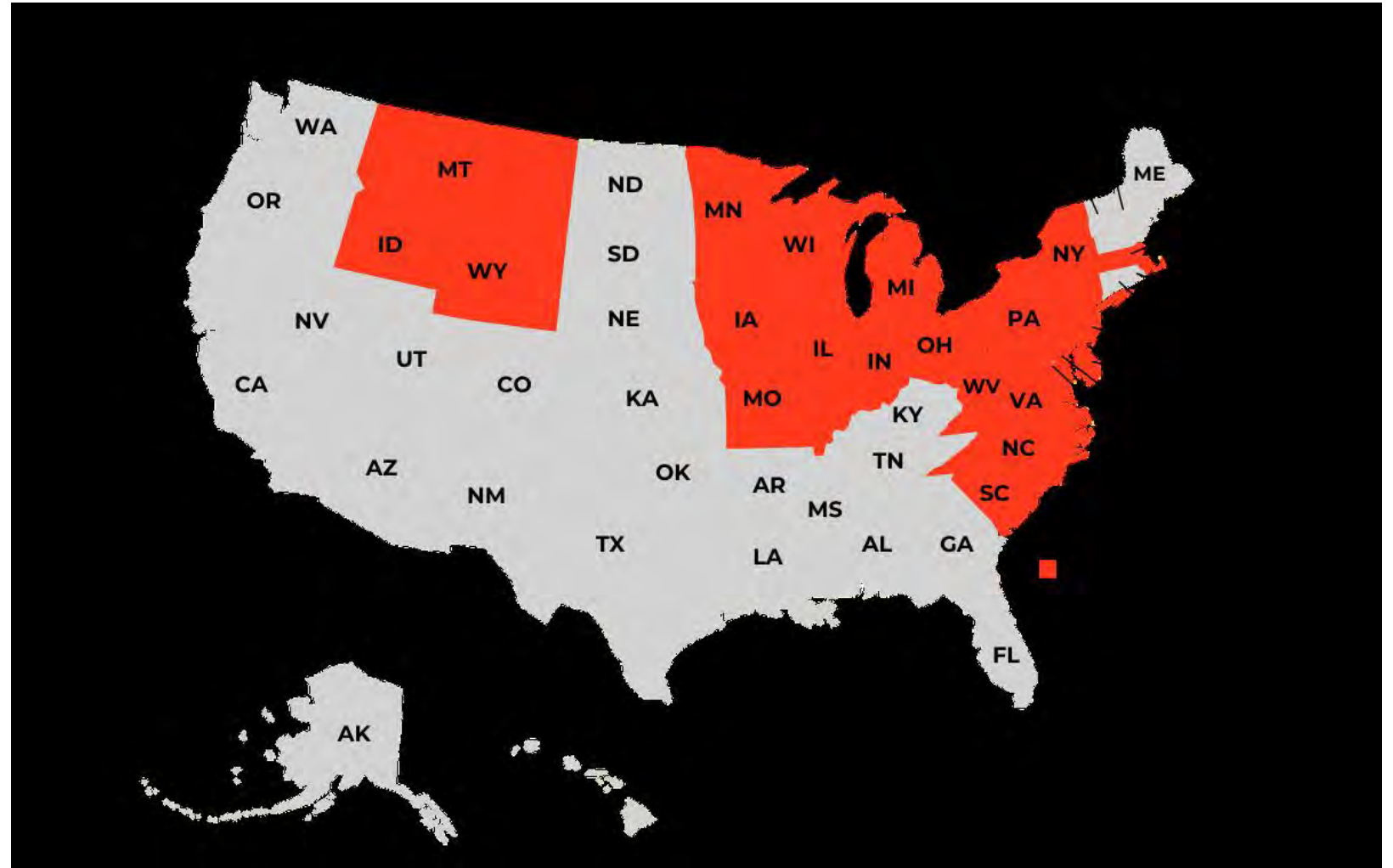
<b>VRAM Application Table</b>		
<b>Coarse-Graded HMA Mixtures</b>		
<b>Overlay Thickness, in</b>	<b>VRAM Width, in.</b>	<b>Application Rate, lb/ft</b>
1	18	1.15
1 ¼	18	1.31
1 ½	18	1.47
1 ¾	18	1.63
≥ 2	18	1.80
<b>Fine-Graded HMA Mixtures</b>		
<b>Overlay Thickness, in</b>	<b>VRAM Width, in.</b>	<b>Application Rate, lb/ft</b>
1	18	0.80
1 ¼	18	0.88
≥ 1 ½	18	0.95
<b>SMA Mixtures</b>		
<b>Overlay Thickness, in</b>	<b>VRAM Width, in.</b>	<b>Application Rate, lb/ft</b>
1 ½	18	1.26
1 ¾	18	1.39
≥ 2	18	1.51



# Current States with VRAM Experience

By specification, special provision, special feature, or change order

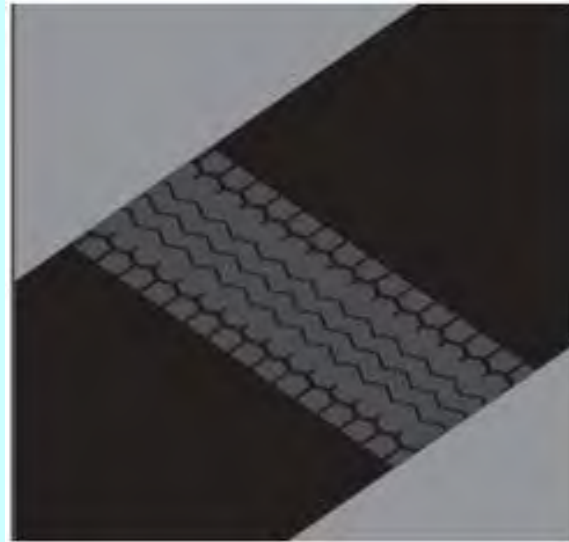
- Illinois
- Indiana
- Ohio
- Iowa
- Michigan
- Missouri
- Wisconsin
- Minnesota
- Wyoming
- Montana
- Idaho
- New Jersey
- New York
- Pennsylvania
- Massachusetts
- Maryland
- Virginia
- District of Columbia
- Delaware
- South Carolina
- West Virginia
- North Carolina



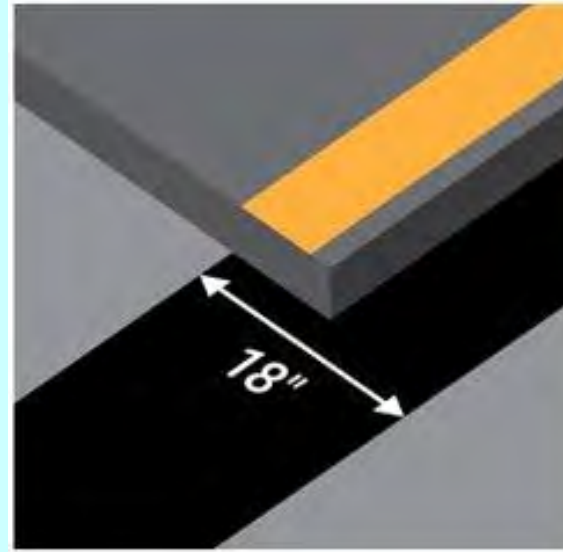
# How does VRAM Work



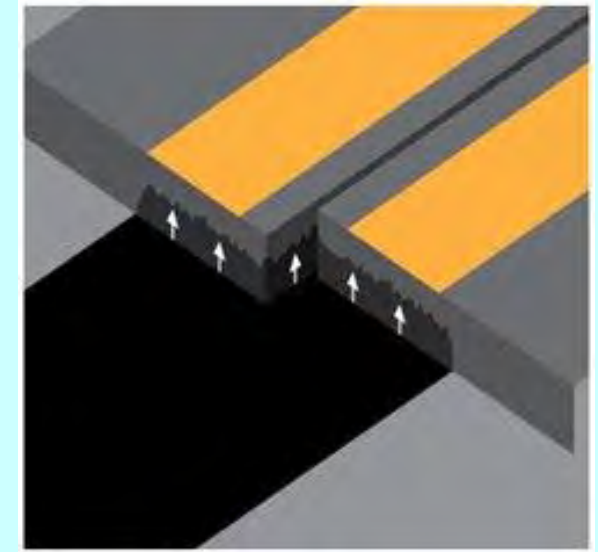
Apply a heavy band of polymer modified binder in the area where the new paving joint will be placed.



Fast acting, the road is ready for construction traffic, keeping the installation process efficient and traffic flowing.



Place the first paving pass over half the width of the band of polymer modified binder



Polymer modified binder migrates into the HMA at the joint



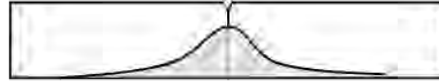
No J-Band

J-Band

New



1 - 3 years old



3 - 6 years old



Click to



6 - 10 years old



10 - 15 years old

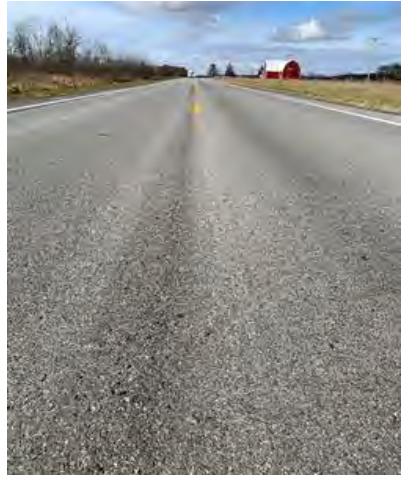


# Crack Progression

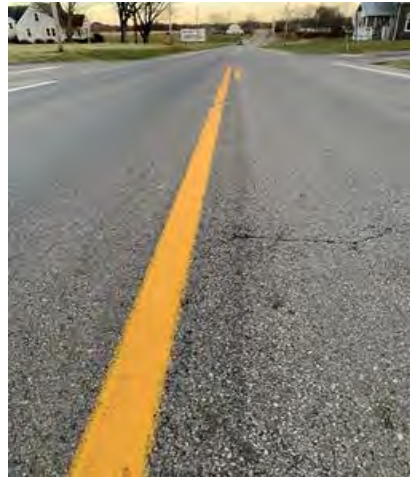


# Test (VRAM) vs Control (No VRAM)

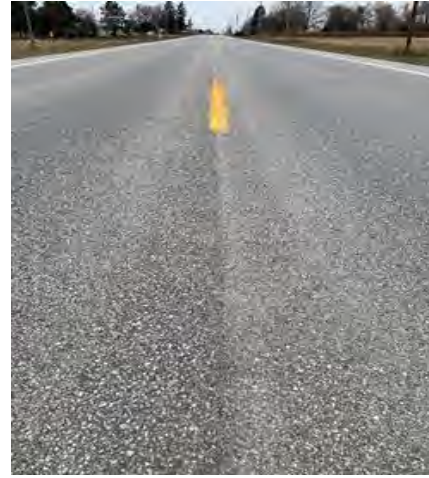
Test



After 2 Yrs.



After 4 Yrs.

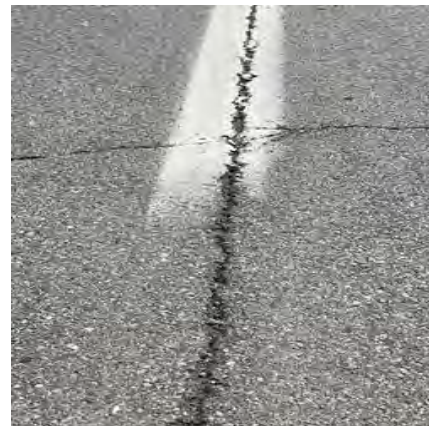


After 5 Yrs.



After 19 Yrs.

Control



# J-Band on the East Coast

- Penn Dot Field Test Site 1 & 2
  - Both projects paved late October 2018
    - ECMS #87661, I81-24
      - Placed under the Centerline joint for (2) miles in the I-81 Northbound lanes, between MM 132.0 and 134.0
      - SMA Mix
    - ECMS #111081, I-380-WD-2
      - Placed under the centerline joint for (1) mile in the Northbound lane of I-380, between MM 1.4 and 2.4
      - SMA Mix





# Penn Dot Project I-380 Nov. 2019 Field View

No VRAM



VRAM



# Penn Dot Project I-380 July 2020 Field View

**VRAM**



**No VRAM**



# Penn Dot Project I-380 Dec. 2021 Field View

- VRAM cores after 3 Years



- VRAM cores after 3 years

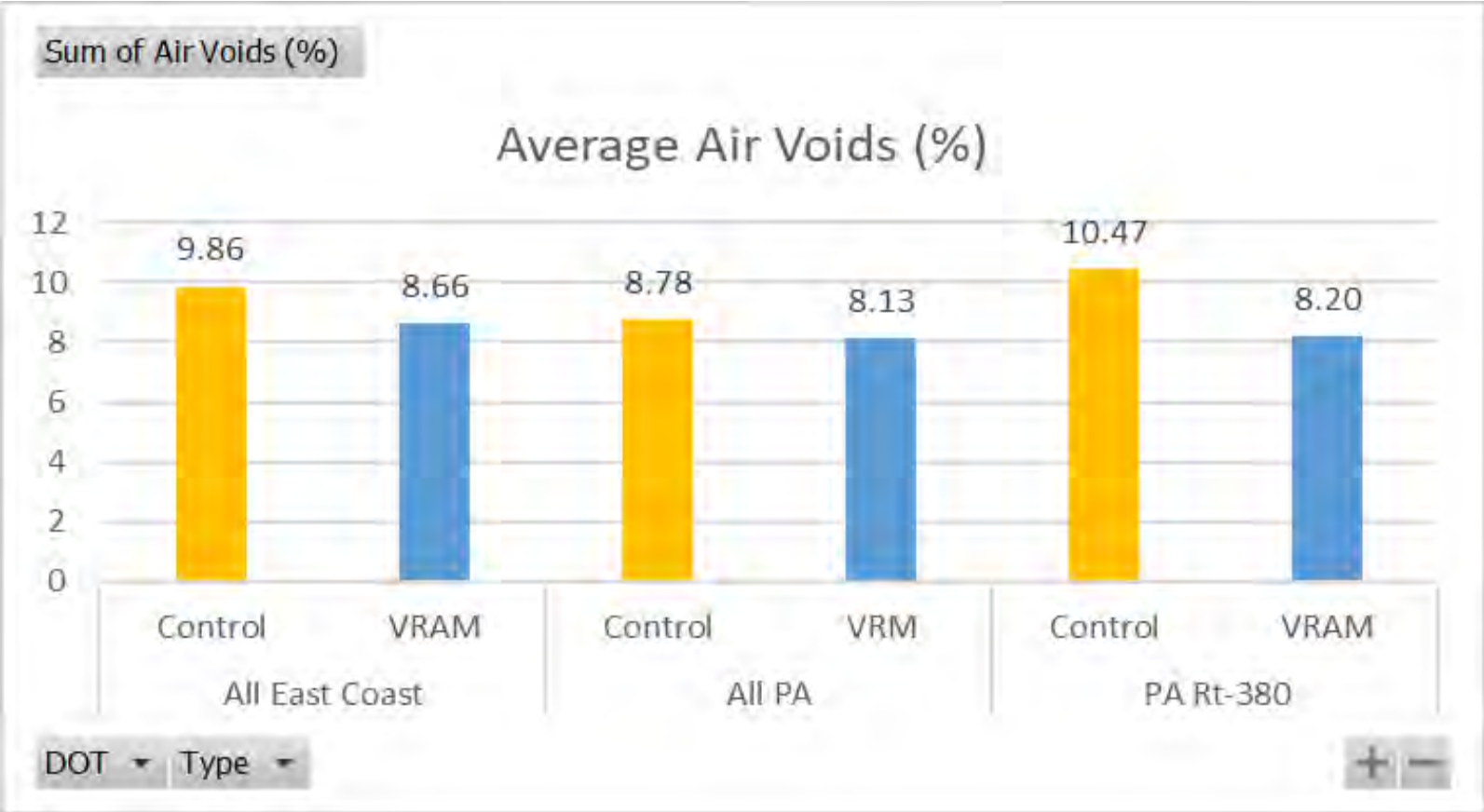


# What is the DATA showing us?

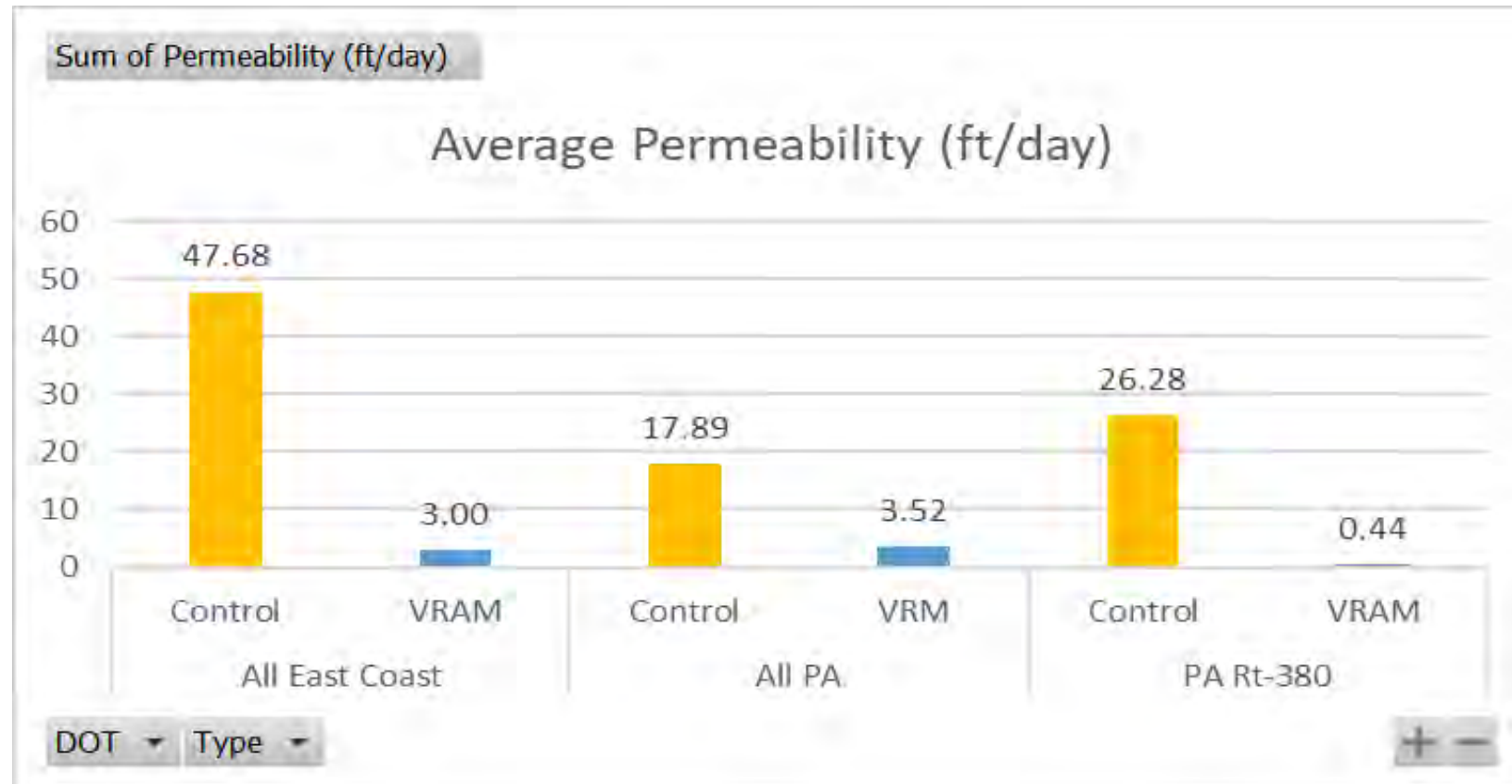
- Testing for East Coast project by 3<sup>rd</sup> Party Lab
  - Constructed Air Voids using AASHTO T166
  - Permeability using (FDOT) test method, FM 5-565
  - Tensile Strength using IDEAL-CT
- Results:
  - Air Voids average increase of **5%** improvement
  - Permeability on an average, showed improvements of **16X** control joint
  - Tensile Strength/Cracking Resistance increased by **90%-150%**
- Rutgers University- Thomas Bennert, PH.D.
- *The decrease in air voids, decrease in permeability and increase in tensile strength/IDEAL-CT Index of the longitudinal joint would suggest that the initial performance of the “Various Projects” VRAM longitudinal joint section is much greater than the conventional longitudinal joint section (Control).*



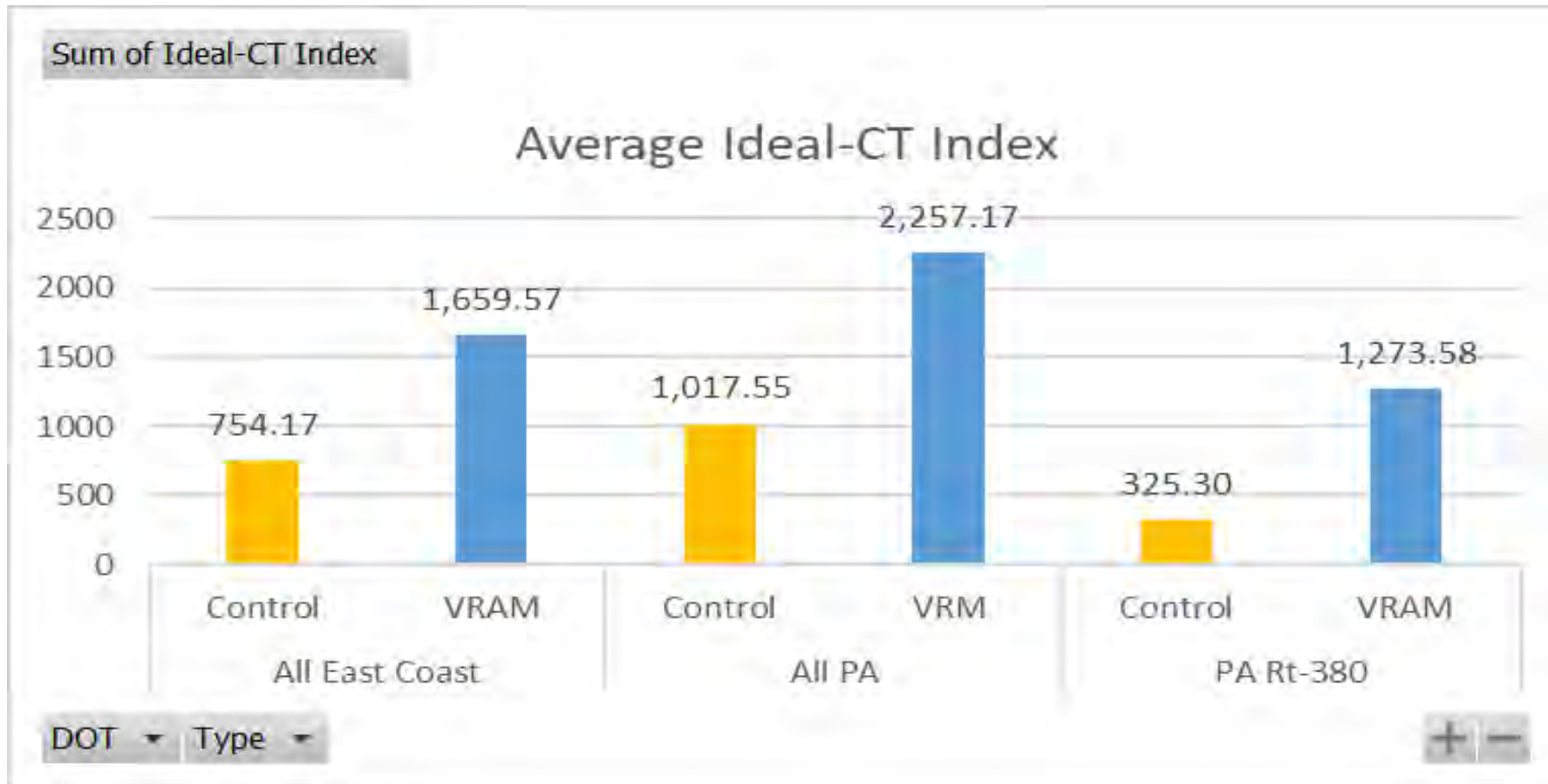
# Air Voids Results



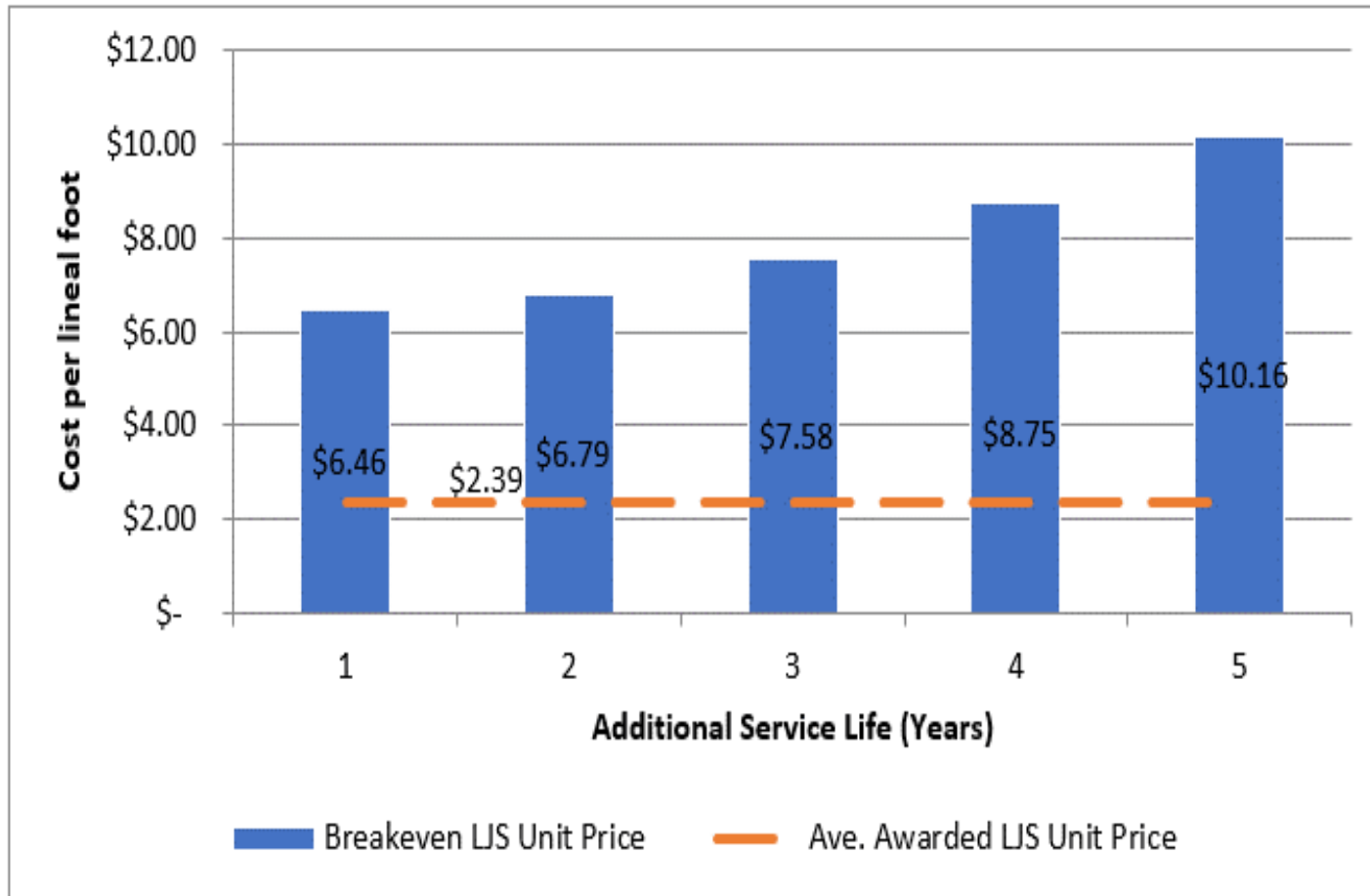
# Permeability Results



# IDEAL-CT Results



# Life Cycle Cost Analysis (2 lane roadway – 15 Year basis)



- Year 1 of ASL equals Year 16 of Pavement Life
- IDOT expects a life extension with the use of VRAM of 3 to 5 years
- The benefit of this construction practice is three to five times the cost of the material per IDOT
- **Typical East Coast numbers are = \$3.30 l.f**





# Rumble strips make weak links weaker

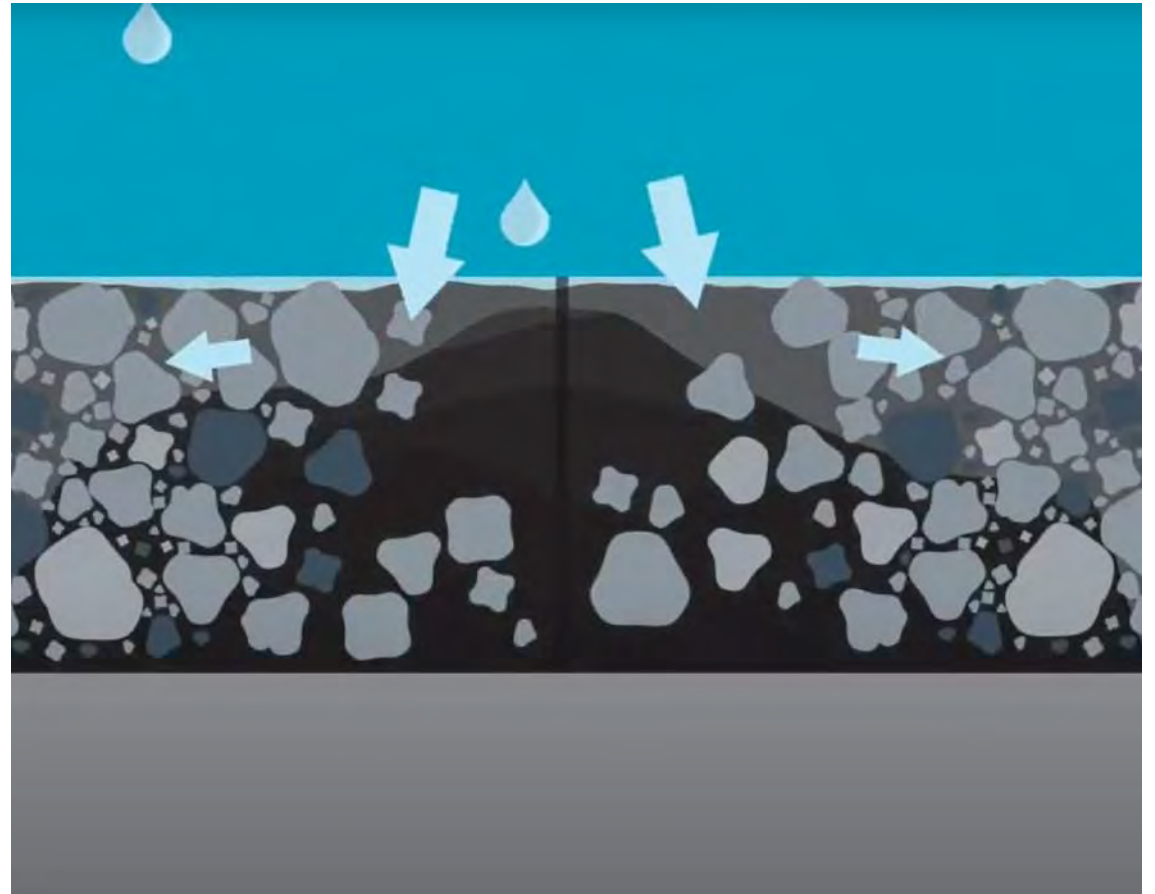
- Joints are the weak link of any road
- Rumble strips accelerate joint deterioration
- Water collects at the most permeable part of pavement



# Rumble strips make roads more vulnerable at the centerline

- High Voids are Bad
- Connected Voids are Worse
- Less Voids = Less Permeable Pavements
- Less Permeable = Higher Density





# Sustainability



There has been movement towards developing a framework for a **LEED-type system** for infrastructure. Greenroads and ENVISION were mentioned as ones to watch.





# Sustainability

## Greenhouse Gas

	GHG Emissions (kgCO2e)			
	JBand	Joint Adhesive	IR Heater	PWTB
Manufacture	458.6	35.6	-	3,042.4
Transport	136.3	160.0	-	58.1
Application	2.7	119.5	400.0	1,834.1
Maintenance trips	274.7	444.2	444.2	444.2
<b>Total over lifetime</b>	<b>872.3</b>	<b>759.3</b>	<b>844.2</b>	<b>5,378.8</b>
<b>Averaged per year emissions</b>	<b>48.5</b>	<b>50.6</b>	<b>52.8</b>	<b>358.6</b>

*Greenhouse Gas Emissions, in kilograms of CO2 equivalents, broken down by segments of the construction process. This is for a 1-mile project distance, 50 miles away from manufacturing site\**

*\*Distance only applies to J-Band and Joint Adhesive. Distance between the home base and project site for IR heater and PWTB is assumed to be 30 miles.*





# Sustainability

## Air Quality

	Lb Pollutant (VOC/CO/NOx/PM2.5)			
	JBand	Joint Adhesive	IR Heater	PWTB
Manufacture	0.00072	0.00004	-	12.60
Transport	1.8	3.7	-	1.6
Application	0.061	1.5	1.5	122.7
Maintenance trips	1.8	26.7	26.7	26.7
<b>Total over lifetime</b>	<b>3.7</b>	<b>31.8</b>	<b>28.2</b>	<b>163.6</b>
<b>Averaged per year emissions</b>	<b>0.2</b>	<b>2.1</b>	<b>1.8</b>	<b>10.9</b>

*Pounds of pollutants emitted during all phases (manufacture through maintenance) for a 1-mile project distance, 50 miles away from manufacturing site\**

*\*Distance only applies to J-Band and Joint Adhesive. Distance between the home base and project site for IR heater and PWTB is assumed to be 30 miles.*





# Sustainability

## Safety

Application	Injuries per million miles				Fatalities per million miles			
	JBand	Joint Adhesive	IR Heater	PWTB	JBand	Joint Adhesive	IR Heater	PWTB
Application	21	32	189	284	0.7	1.1	6.3	9.5
Maintenance Trips	44	837	837	837	1.5	28.0	28.0	28.0
<b>Total over lifetime</b>	<b>65</b>	<b>868</b>	<b>1026</b>	<b>1120</b>	<b>2.2</b>	<b>29.1</b>	<b>34.4</b>	<b>37.5</b>
<b>Average per year</b>	<b>4</b>	<b>58</b>	<b>64</b>	<b>75</b>	<b>0.1</b>	<b>1.9</b>	<b>2.1</b>	<b>2.5</b>

*Number of worker safety incidents. Safety metrics have been normalized to one million miles for ease of comprehension.*



# Takeaways

- 20-years of proven results with VRAM(J-Band)
- 9 + 9 = 18 The area that needs addressed
- Failure due to Permeability
- The Bottom-Up Solution
- DATA
- Sustainability
- **ROI**

**Questions?**

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