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TRANSPORTATION RESEARCH BOARD

# Centering Seams – Maintaining Centerline Joints in Asphalt Pavements

**February 17, 2021**
**2:00-3:30 PM Eastern**

**@NASEMTRB**
**#TRBwebinar**

# PDH Certification Information:

- 1.5 Professional Development Hours (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Reggie Gillum at RGillum@nas.edu

**#TRBwebinar**

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RCEP

REGISTERED CONTINUING EDUCATION PROGRAM

# Learning Objectives

1. Identify ways to reduce the need for maintenance of centerline joints

2. Discuss innovative practices to improve centerline joint performance and maintenance

**#TRBwebinar**

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# Material Solutions to Improving Centerline Joint Performance

Todd Thomas, P.E.
Technical Director – Specialty Products
Asphalt Materials, Inc.

# Agenda

Hot-applied treatment – under the joint

Emulsion products – over the joint

# Condition of joint vs. rest of the pavement

# Longitudinal Construction Joints


Photo courtesy of Asphalt Institute

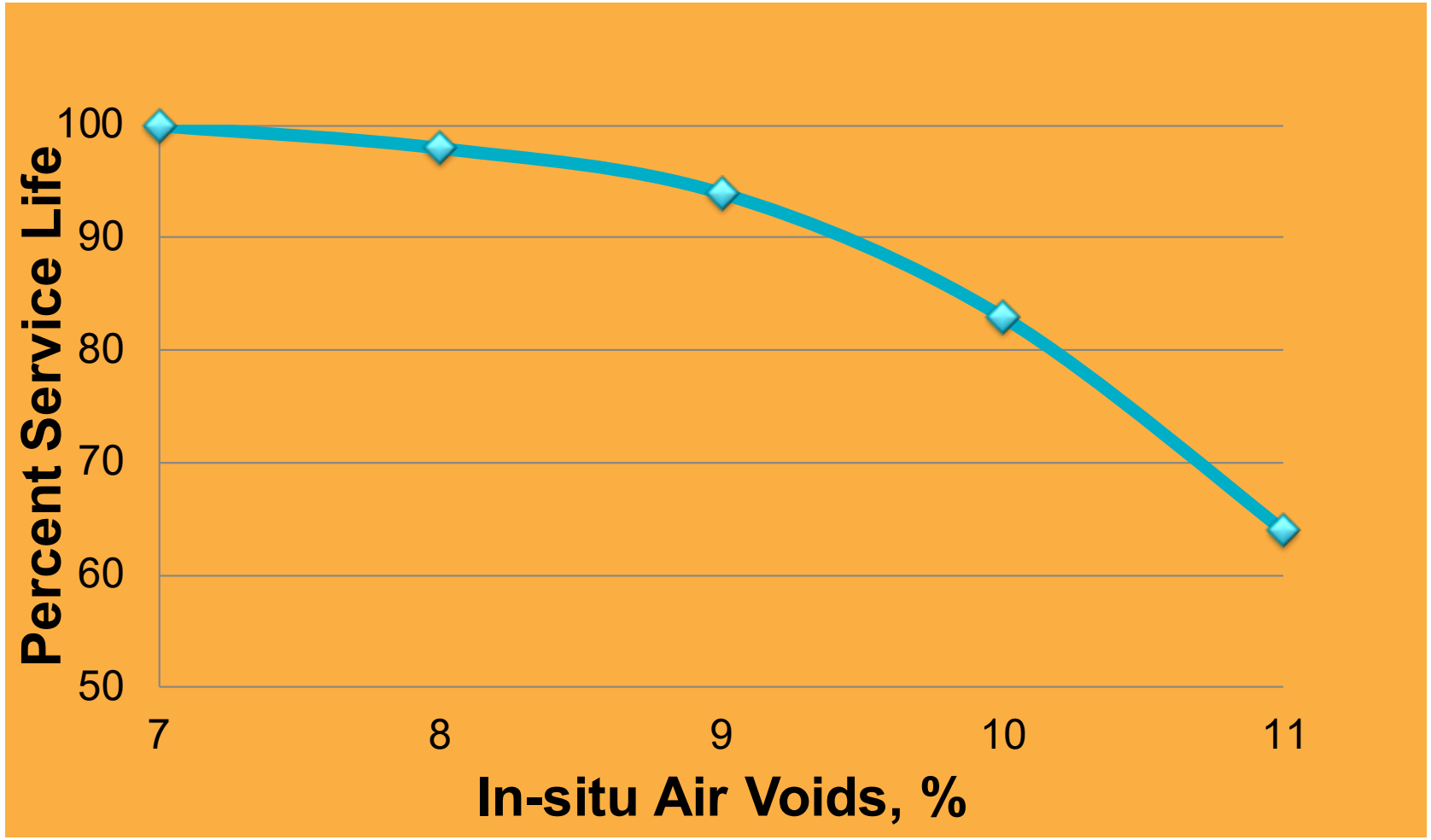
- Longitudinal construction joints
  - Commonly, the first area requiring maintenance on a pavement
- Issues
  - Cannot achieve the same density at the joint / edge as in the mat
  - Permeable void structure near joint
  - Water and air intrusion accelerates damage

# Longitudinal Construction Joints

Mechanical 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)
- Cut off lower density unconfined edge
- Mill and inlay (confinement)
- Notched wedge joint (safety)

# Why do joints fail early?




*Washington State DOT Study

"Effect of In-Place Voids on Service Life*

# Longitudinal Joint Improvement Plan – Hot Applied

- Early 2000's timeframe
- Illinois DOT recognized need for better joint performance
- Mechanical methods didn't always work consistently
- Failure due to permeability
- Concept – fill a portion of the voids with an asphalt product from bottom up


Falling head permeameter

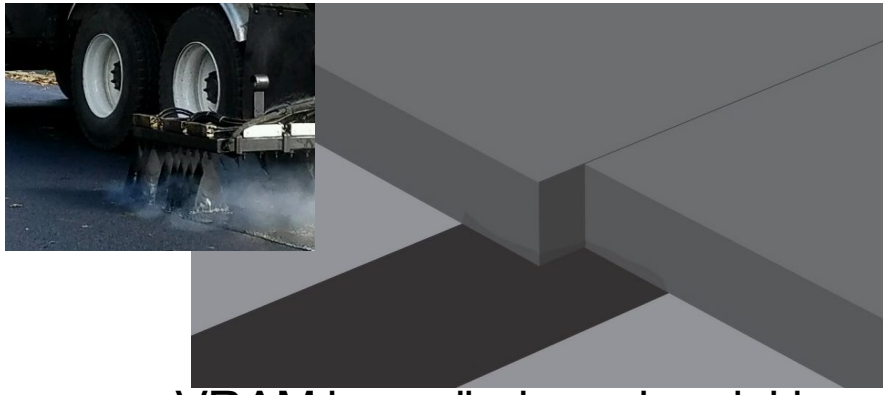
# Longitudinal Joint Seal Development

- IDOT worked w/ 2 companies to develop a Longitudinal Joint Sealant (LJS) – needed improved application equipment; needed formula to have limited lateral flow and also to migrate
- Called Void-Reducing Asphalt Membrane (VRAM) by some states

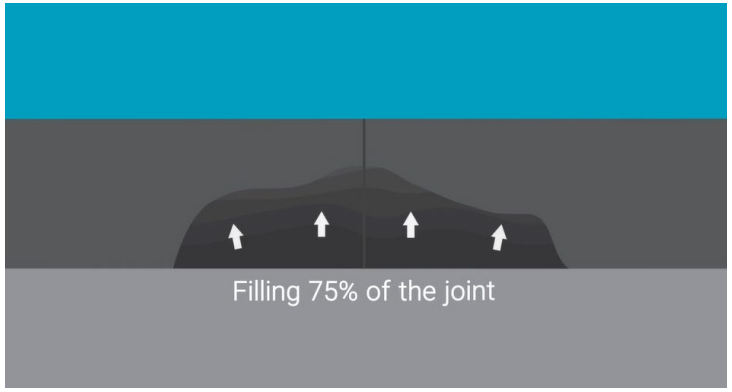
Hot-applied

Rolled material

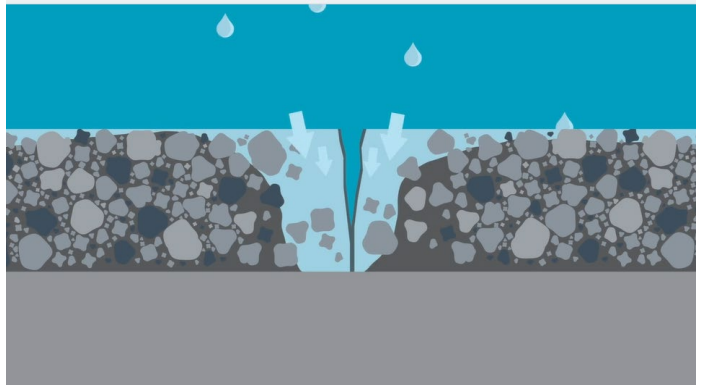
# How it works



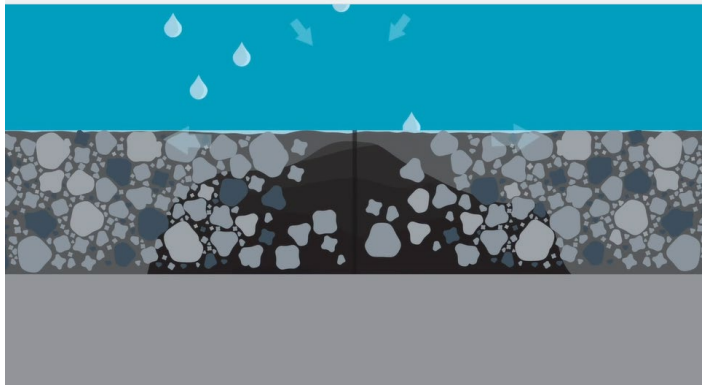
VRAM is applied, cools quickly, paved over




HMA softens VRAM, melts, migrates 50 to 75% of thickness



Without VRAM in a permeable mix, water over time damages the mix



With VRAM, voids in lower portion of mix are sealed, protecting mix

# VRAM Field Performance

## IDOT US-51 after 15 Years – One of three projects cored

VRAM joint transition to control

VRAM section

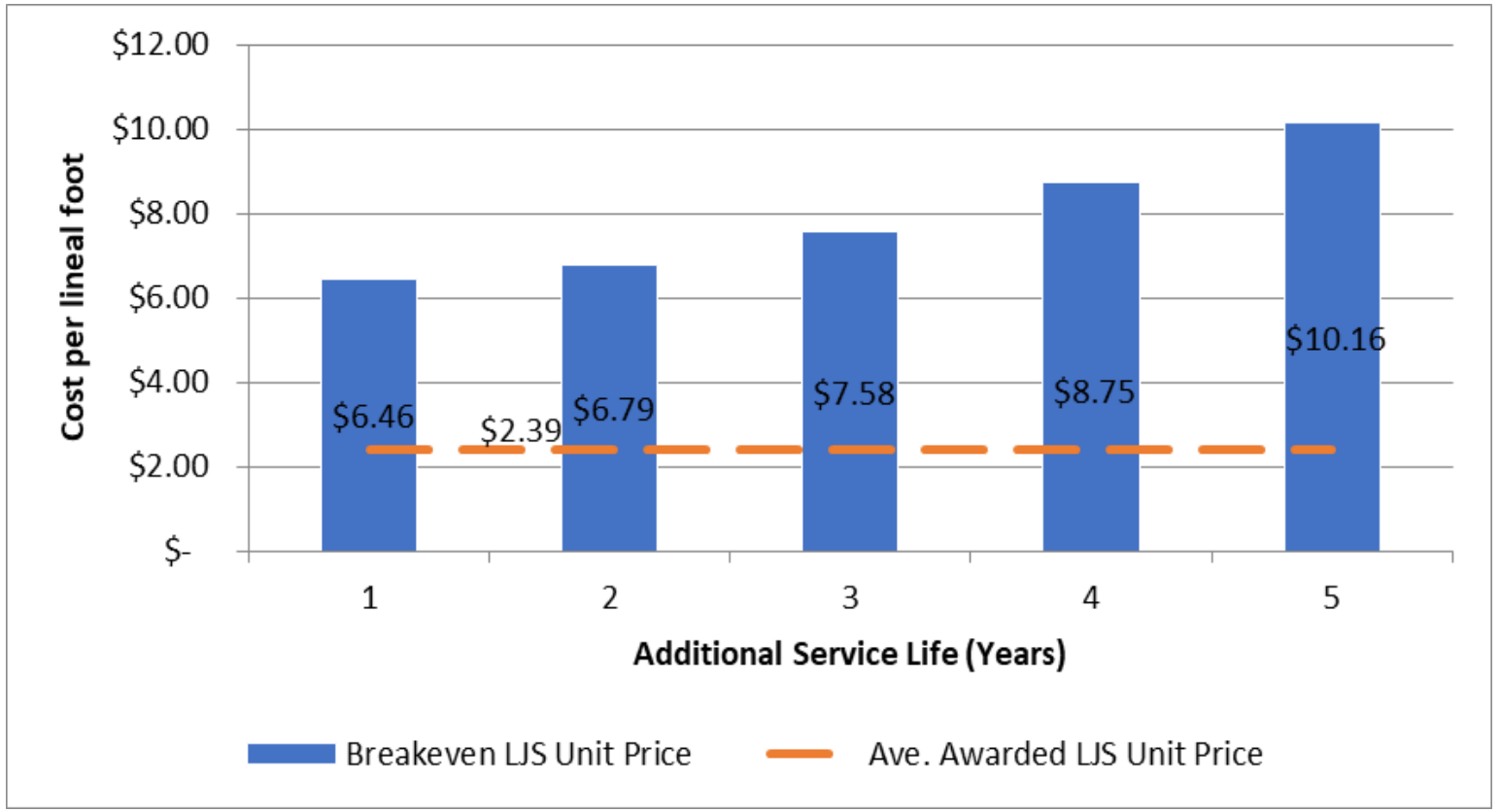
# 2017 Evaluation – IDOT Core Testing of Original Projects

- Asphalt content nearly double for LJS cores
- Migration 26 to 66 % of layer height
- Lab permeability testing (vertical flow)
  - Top half:
    - All cores had nearly equal lab perm.
  - Bottom half:
    - Control: 110 to 372 x $10^{-5}$ cm/sec
    - LJS: zero
- I-FIT flexibility index (FI) values
  (IDOT long-term aged lab FI ≥ 4.0)
  - Controls: 0.2 to 0.8
  - LJS: 1.9 to 23

# VRAM / LJS Specification Features

- Materials specification (PG testing)
- Application – multiple methods
- Construction – rate, width, no pick-up, paving over
- An option under rumble strip(e)s (Ohio DOT)
- Paid for in linear feet

# VRAM / LJS - Life Cycle Cost Analysis
# Two Lane Road




- 2021 TRB paper
- Graph starts at year 16
- 3 to 5 years added life expected
- Pays for itself with just one year added life

# Hot-applied summary

- Bottom-up solution applied at time of construction
- No permeability in bottom half of layer by partially filling voids
- Various methods of applying
- Extends life by three to five years

# Topical Surface Treatments for Centerline Joints

Rapid penetrating asphalt emulsion (RPE)

Emulsified rejuvenator

# Surface Treatment of HMA Centerline Joints

- Materials
  - Fog seal emulsions
  - Rejuvenating fog seal emulsions
  - Penetrating asphalt emulsions
- Treatments are spray-applied, post-construction to the surface of the pavement
- Treatments may address permeability or aging of the binder or both
- 1.5 to 2 feet wide spray width

# Materials for Treatment of Centerline Joints

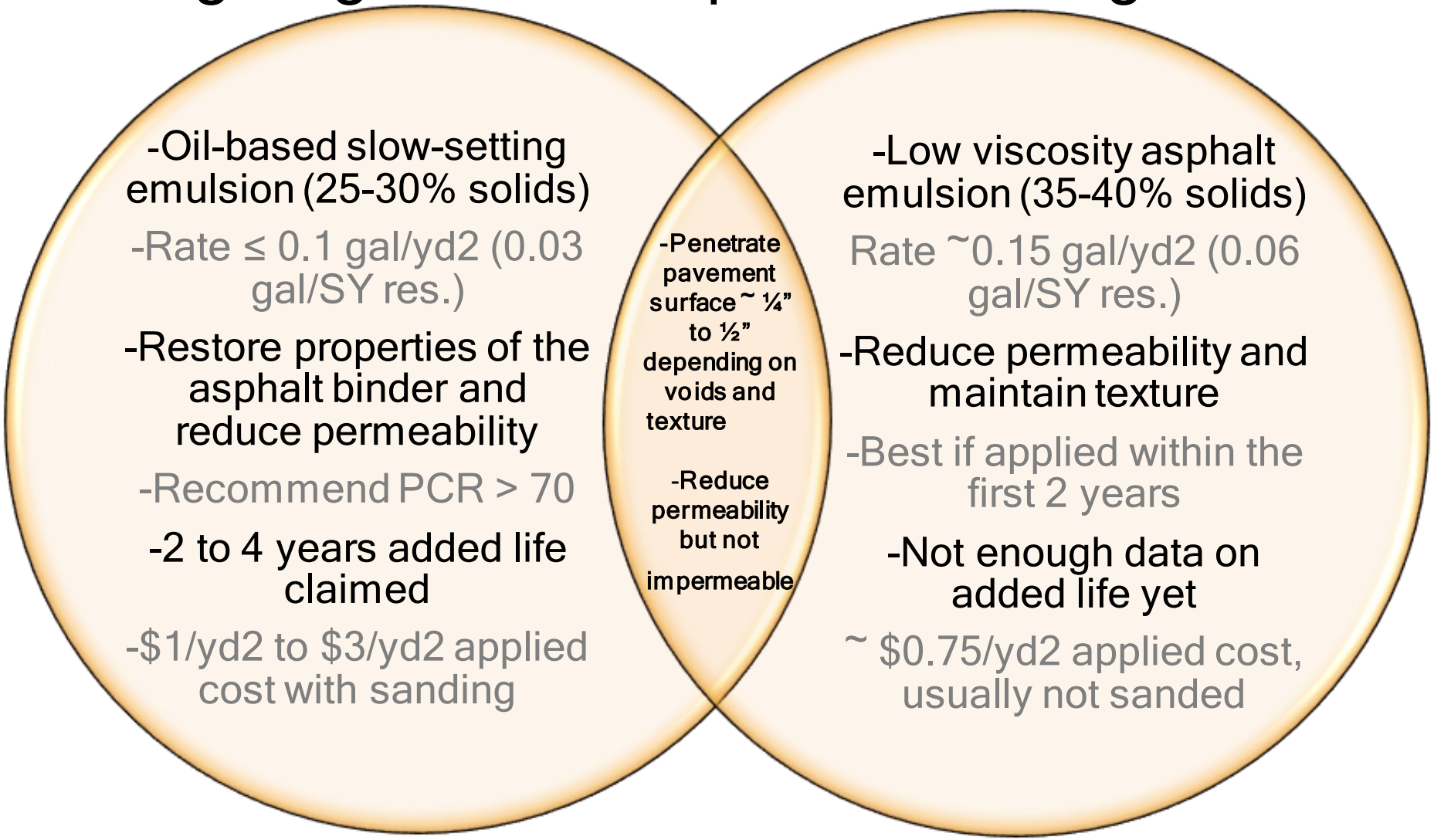
- Fog seal emulsions - Slow-setting asphalt emulsions (SS or CSS), usually diluted 1:1 and applied at ~ 0.1 gal/yd$^2$
- Rejuvenating fog seal emulsions - Similar rate as or less than traditional fog seal emulsions
  - The asphalt component is replaced by either bio-oil or petroleum oil or a combination of asphalt and oil

# Materials for Treatment of Centerline Joints

- Rapid Penetrating Emulsions (RPE) - Asphalt emulsions designed to penetrate deeper and faster than traditional asphalt emulsions
  - Supplied at 35 - 40% solids, typically applied at 0.08 to 0.15 gal/yd2
  - Different from slow set emulsions:
    - Ability to pass through No. 500 sieve
    - Improved water resistance test (early rainfall test)

Water won't pass but RPE will

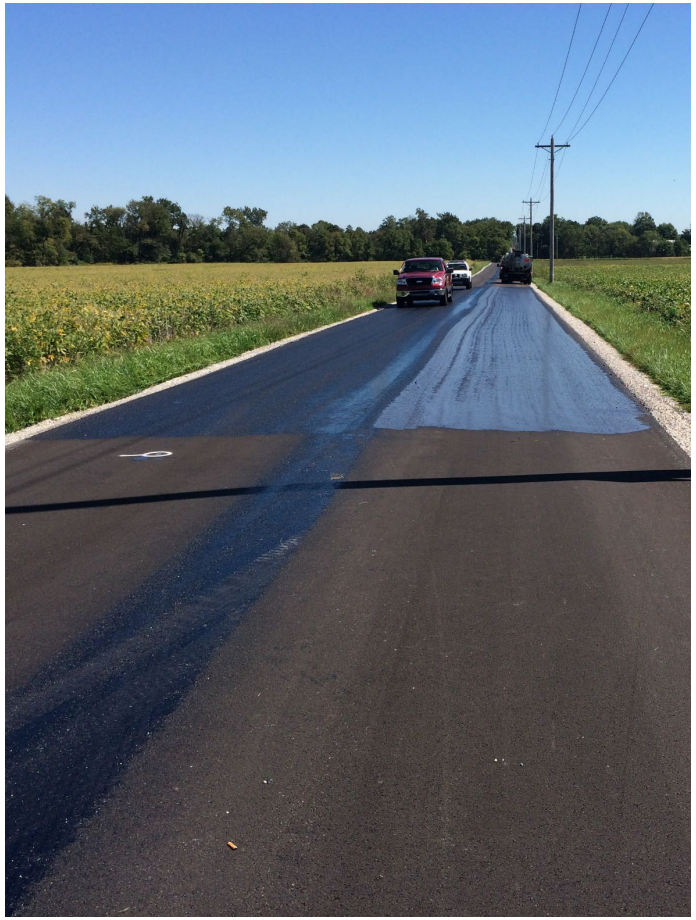
# Rejuvenating Fog Seal vs Rapid Penetrating Emulsion (RPE)



# RPE Centerline Treatment Effect

Reduced permeability allows the treated centerline to dry faster than other parts of the pavement

# Hendricks County, IN CR 700S RPE Centerline and Full Width



2016 Day of Construction

2020

# Spray-applied rejuvenator in MN

Day of application

6 years later

Photos courtesy of Pavement Technology, Inc.

# Summary

| Feature | VRAM treatment | Topical treatment |
|---|---|---|
| Application rate | ~1 gal/SY | Rejuvenator ~0.03 gal/SY residual<br>RPE ~ 0.06 gal/SY residual |
| Permeability | Bottom half impermeable | Reduce permeability but not impermeable |
| Thickness affected | ≥ 50% of overlay height filled | Penetrate top ¼" to ½" |
| Combined | Some agencies have combined VRAM/LJS and topical | |

The selection depends on the environmental conditions and distress.

# Questions?

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# Practical Longitudinal Joint Repair Techniques

Practice: Centering Seams – Maintaining Centerline Joints in Asphalt Pavements

February 17, 2021

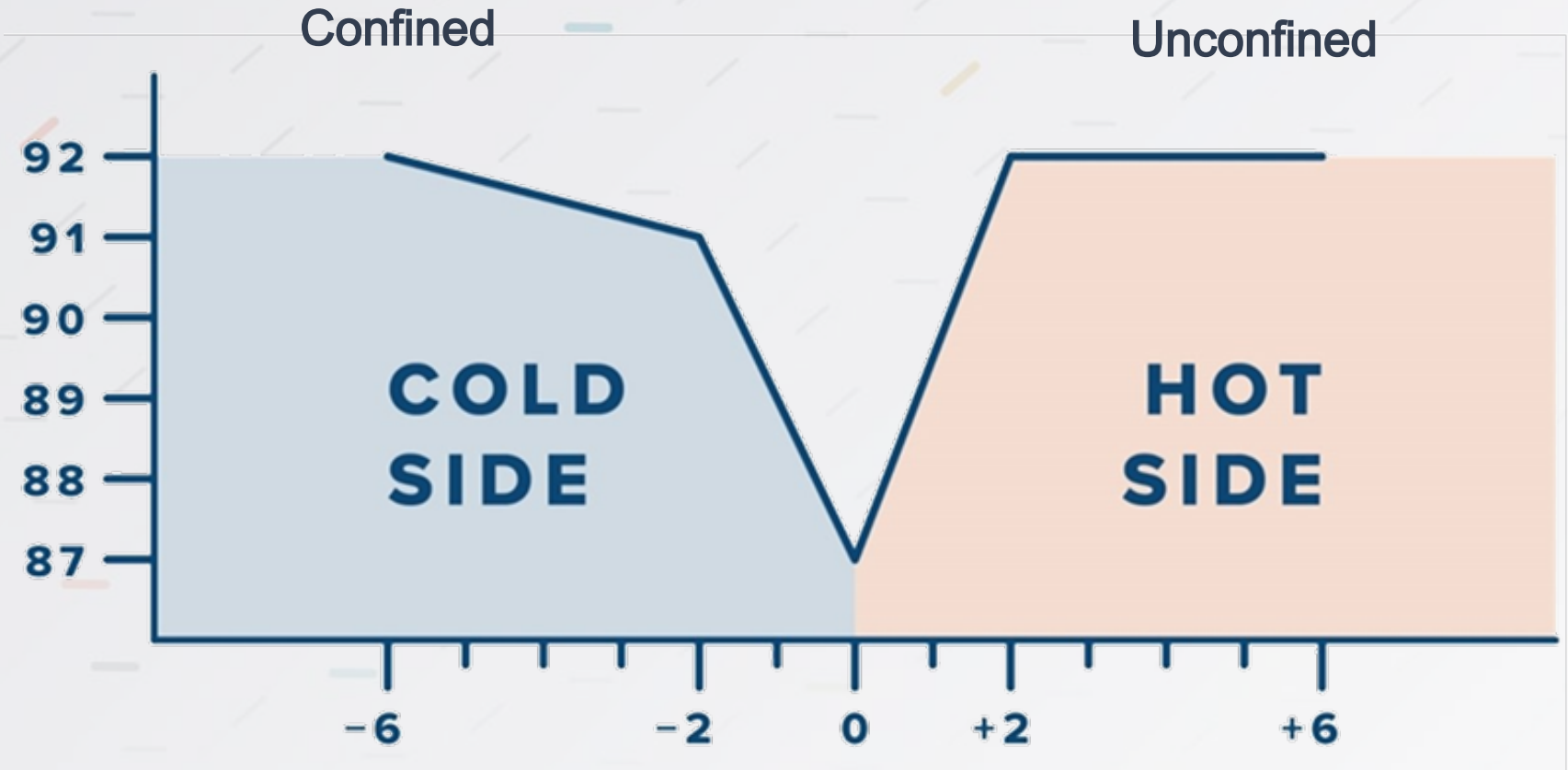
Greg Duncan – Senior Engineer
Applied Pavement Technology, Inc

# Overview

- The challenge
- Construction and repair practices in other states
- Repair practices in Ohio
  - Slot paving
  - Spray injection
  - Crack sealing
- Repair life expectations

Source: APTech

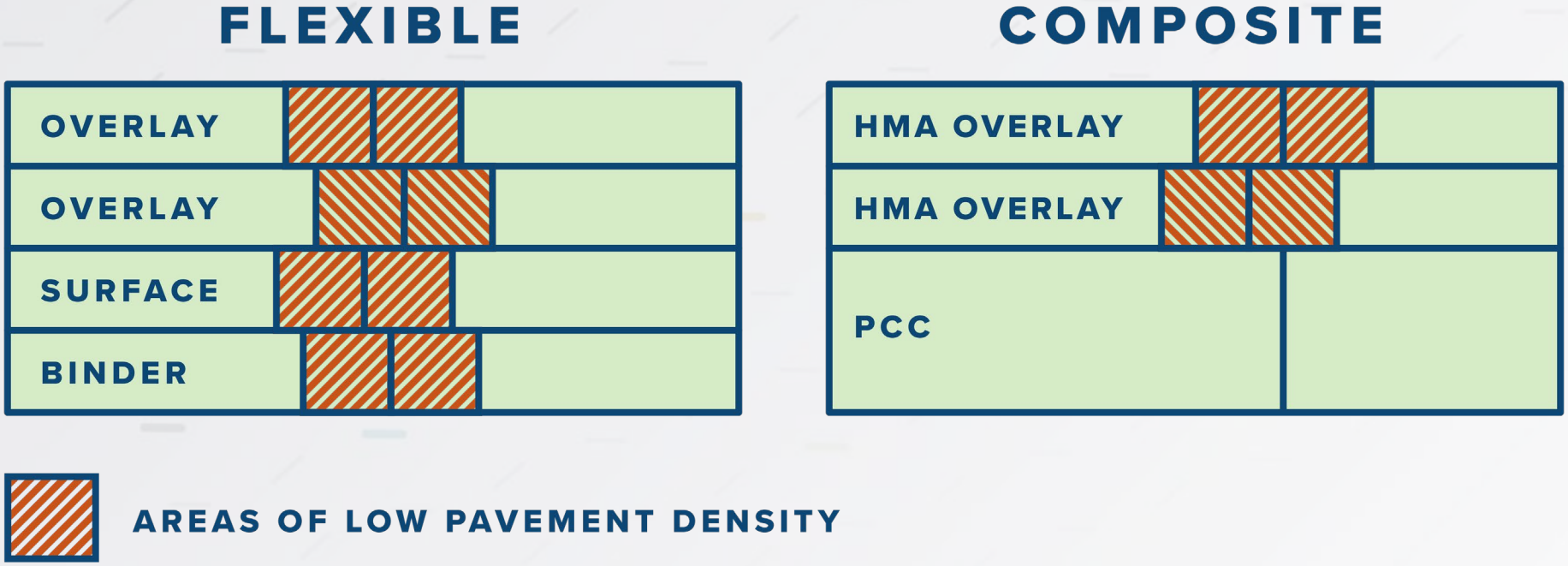
# Density Profile Across the LJ




Source: APTech based on Cooper

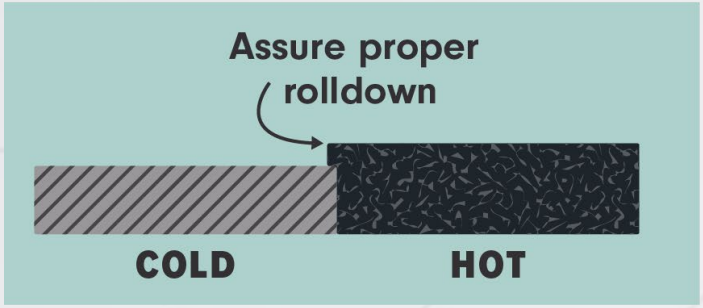
# Longitudinal Joints: The Challenge

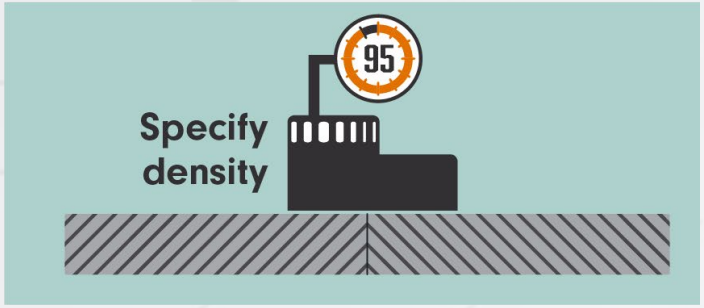
## STACKED JOINTS

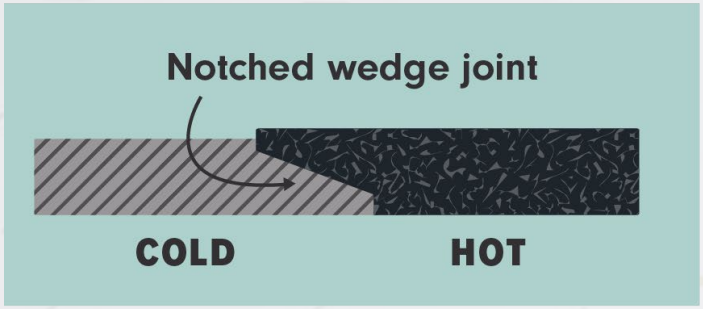


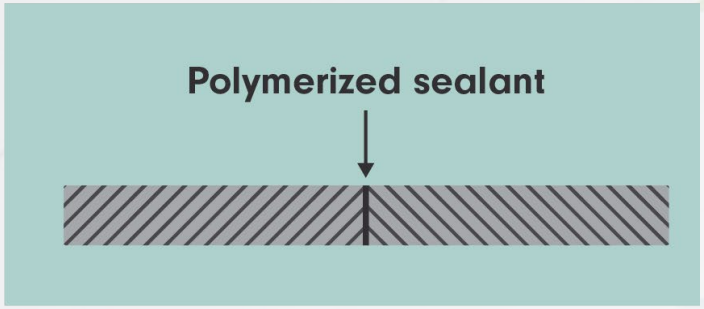

Source: APTech

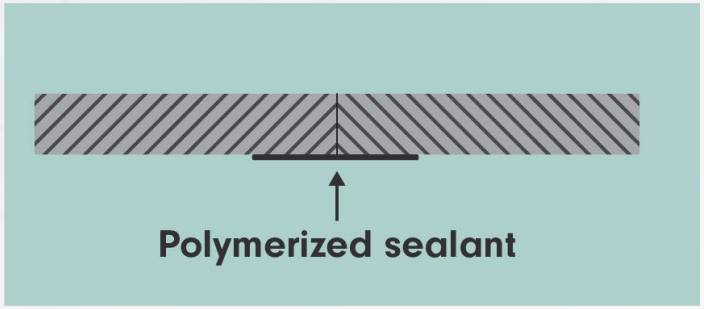
# Best Construction Practices



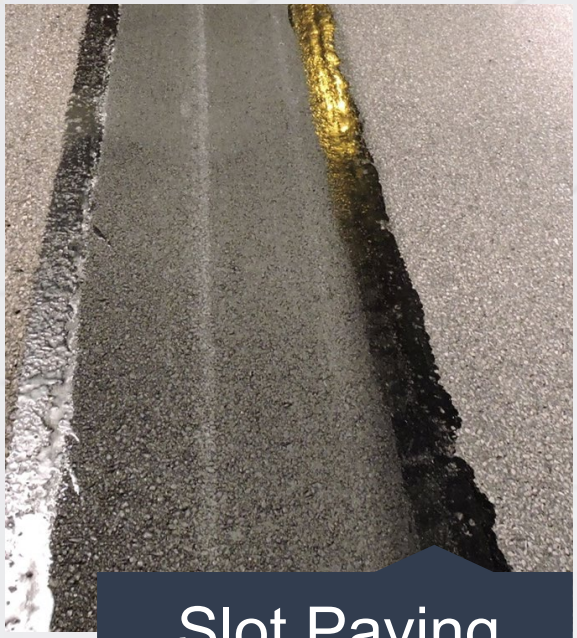




Source: APTech

# Micro surfacing

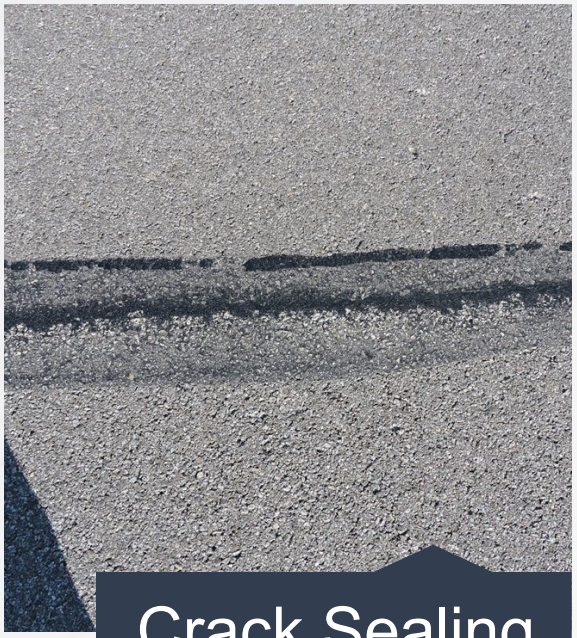
Source: Illinois,WVDOT

# ODOT Repair Techniques



Slot Paving

Spray Injection



Crack Sealing

Source: APTech

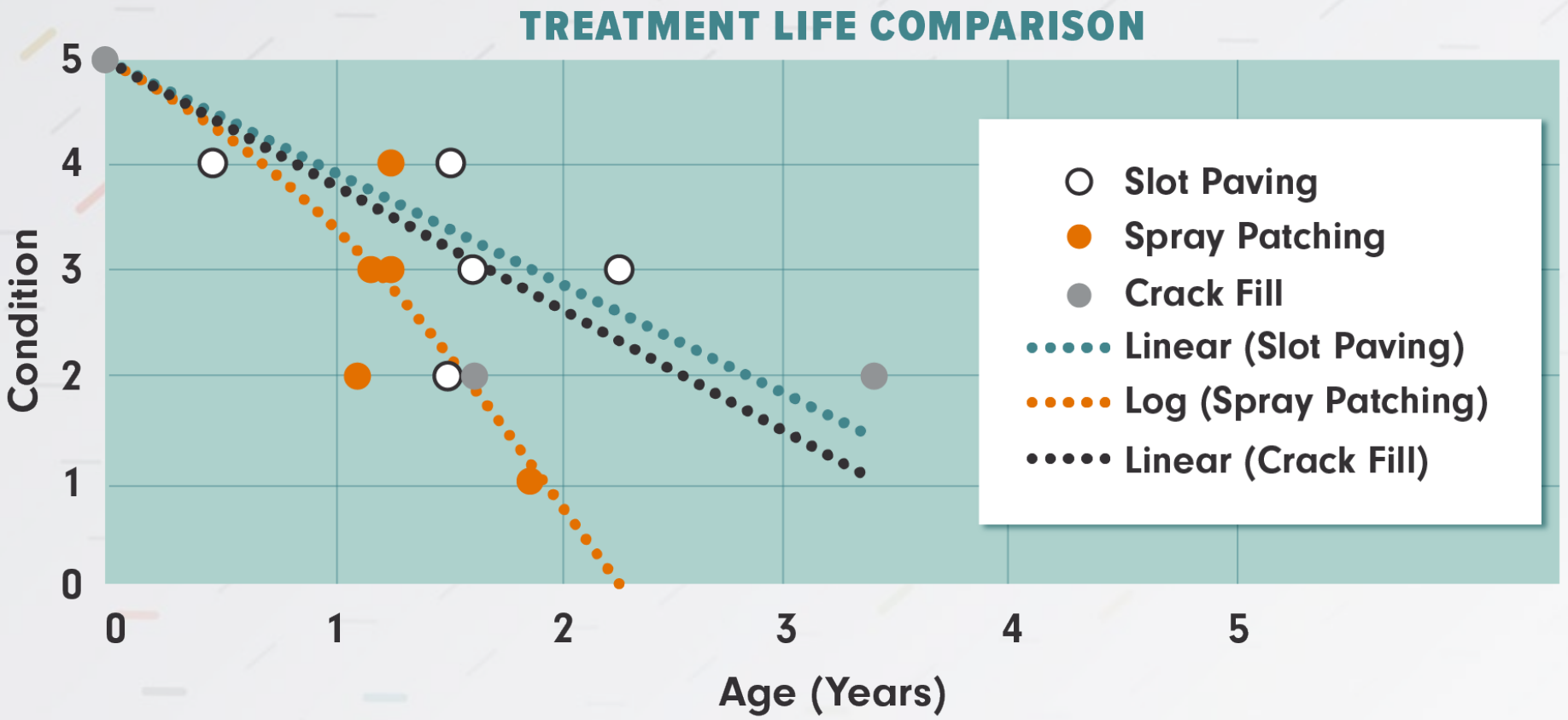
# Spray Injection

Source: Abbas

# Distress Evaluated

- Created a repair scoring scale for the repair condition
- Compared the conditions to repair age
- Projected where repair failure would occur

# Repair Deterioration



# Repair Life Expectations

| Repair | Treatment Life, Years | Cost per mile, $ | Cost per mile per year, $ |
|---|---|---|---|
| Slot Paving | 4.3 | $104,464 | $24,294 |
| Spray Injection | 2.2 | $12,764 | $5,802 |
| Crack Sealing | 4.5 | $3,363 | $747 |

# Recommendations

- Because crack sealing is the most economical treatment, it should be applied as soon as 0.25-inch opening occurs.
- Spray Injection
  - 2.2-year life expectation
  - Significantly cheaper than slot paving
  - Implement specification

# Recommendations

- Slot Paving
  - Slot paving for severe LJ distress with next treatment scheduled more than 4 years in the future
  - Add density specifications
  - Use 3-ft standard width and a uniform thickness
  - Select sections for the repair that are continuous and coincide with one night's production

# Recommendations

| Treatment | Joint Width (in) | | |
|---|---|---|---|
| | 0.125 to 1 | 1 to 3 | >3 |
| Crack Filling | ✓ | | |
| Spray Injection | | ✓ | ✓* |
| Slot Paving | | | ✓** |

*if less than 4 years remaining
**if expected life >4 years

# Thank you!

## For more information:

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ODOT Research Report
http://cdm16007.contentdm.oclc.org/cdm/ref/collection/p267401ccp2/id/15768

# MAINTAINING ILLINOIS' CENTERLINE JOINTS

John Senger
Engineer of Pavement Technology
Illinois Department of Transportation

# Does this look familiar?



"We cannot solve our problems with the same thinking we used when we created them" – Albert Einstein

# First one to the party….

# Quick lesson on CRS

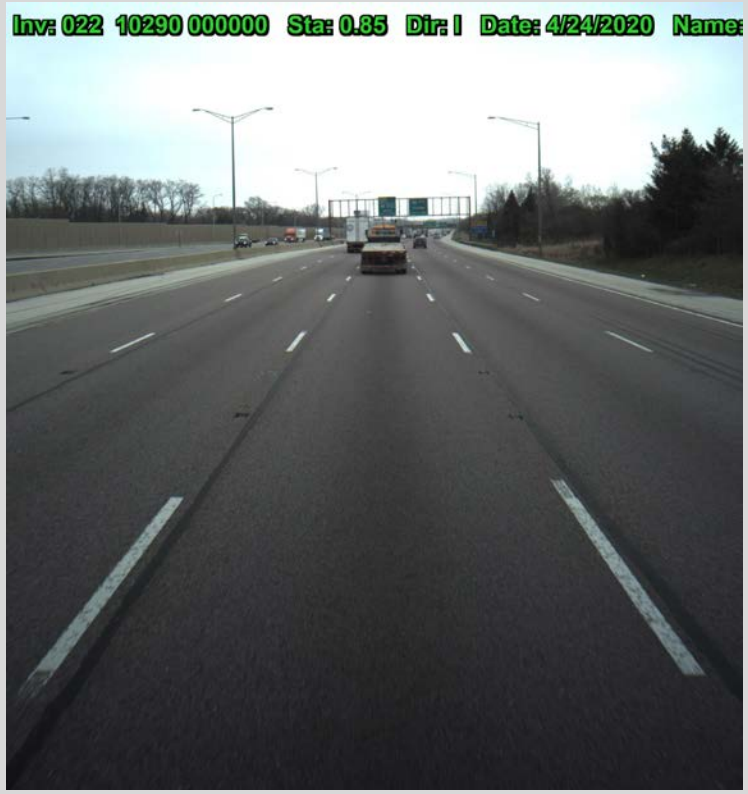
- CRS = Condition Rating Survey
- Scale from 9.0 to 1.0
- 9.0 = Brand new pavement
- 1.0 = Impassable roadway
- 9.0 – 7.6 Excellent
- 7.5 – 6.1 Good
- 6.0 – 4.6 Fair
- 4.5 – 1.0 Poor
- Composite Index comprising of the 5 prominent distresses, IRI, Rutting and/or Faulting

**Centerline Joint Deterioration**

- S1 – Tight Cracking with little or no spalling
- S2 – Cracking with low to medium spalling
- S3 – Infrequent occurrence: Cracks are open with medium to severe spalling
- S4 –Frequent occurrence: Cracks are open with medium to severe spalling

# S1 and S2

# Treatments for S1 and S2

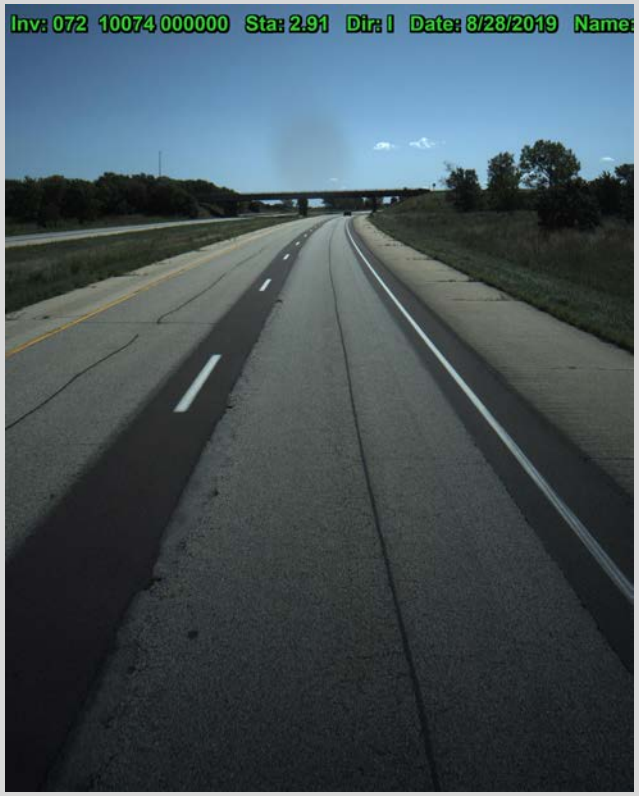



# Before and After CL Micro


# CL Micro – 4 years later

# S3 and S4

# Treatment for S3 and S4

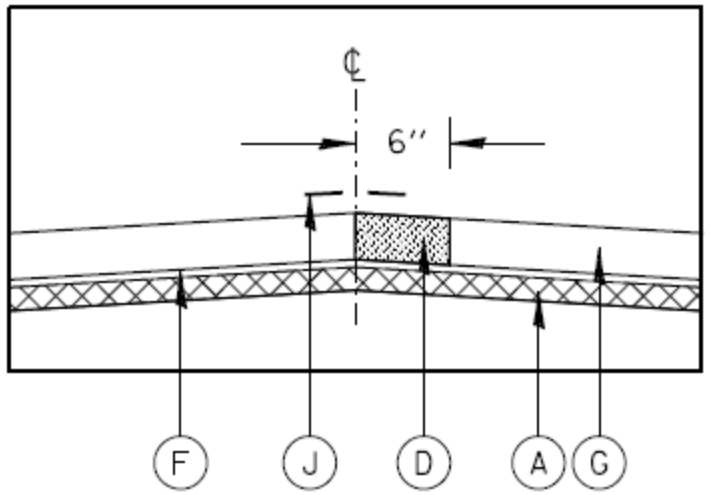



# 2’ Mill and Fill at Long. Joint

# Longitudinal Joint Seal (LJS)

# LJS Video

# Joint Trimming




NOTE:

SEE CONSTRUCTION SEQUENCE FOR MILLING AND PAVING SPECIAL PROVISION

# Joint Trimming


# Joint Trimming

# Current Research Project

- Bureau of Research has contracted with AP Tech to help with a research project into these various treatments
- Objective is to evaluate cost effectiveness of different strategies by evaluating performance, benefit, and cost of different strategies.
- Sections built with both LJS and Joint Trimming.
- Our designers need many tools in their toolboxes.

- Existing reports
- PRR #168 Evaluation of Longitudinal Joint Sealant in Illinois
- PRR #169 Experimental Joint Sealants for Hot Mix Asphalt Pavements and Overlays

# Contact Information

"The only way to do great work is to love what you do. If you haven't found it yet, keep looking. Don't settle. As with all matters of the heart, you'll know when you find it." – Steve Jobs

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- *March 3:* TRB Webinar: Chemical Treatments on Low-Volume Roads
- *March 31:* TRB Webinar: Evaluating Tack Coat Materials' Durability in Asphalt Pavements

https://www.nationalacademies.org/trb/events