AAPTP

Airport Asphalt Pavement Technology Program

Improving Performance of Longitudinal Joints in Airfield Asphalt Pavements

July 2022 to June 2024

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

STATE

applied pavement TECHNOLOGY

Project Background

- The most common performance issue of airport asphalt pavements is premature deterioration at longitudinal joints (LJ) due to cracking and raveling
- Studies have addressed the issue of LJ for highway pavements, but few have focused on airfield applications
- FAA specifications rely on crack sealing and partial or full depth repair methods to address cracking without identifying a method to treat cracking of LJs

Typical FAA Joint Construction Sequence

Airfield Longitudinal Joints

Project Objectives

Overall Objective

- Develop guidance on the construction and maintenance of LJs to ensure improved performance

Specific Objectives

1. Evaluate the potential for using VRAM or similar procedures to obtain better performance of LJs
2. Develop a best practices manual for treating/maintaining LJs to minimized cracking and raveling
3. Develop a specification for applying VRAM and for verifying its effectiveness if VRAM is promising (subjected to panel approval)

Tasks

1. Literature review of VRAM
2. Field Inspection of VRAM projects
3. Recommended Guidance on Using VRAM for Airfield LJ Construction
4. Literature review of practices to maintain LJs on airport pavements
5. Field Inspection with treatment/maintenance of LJs at airports
6. Develop best practices manual for treating/maintaining LJs at airports
7. Develop specification for VRAM

Deliverable #1-Task 1 and Task 4

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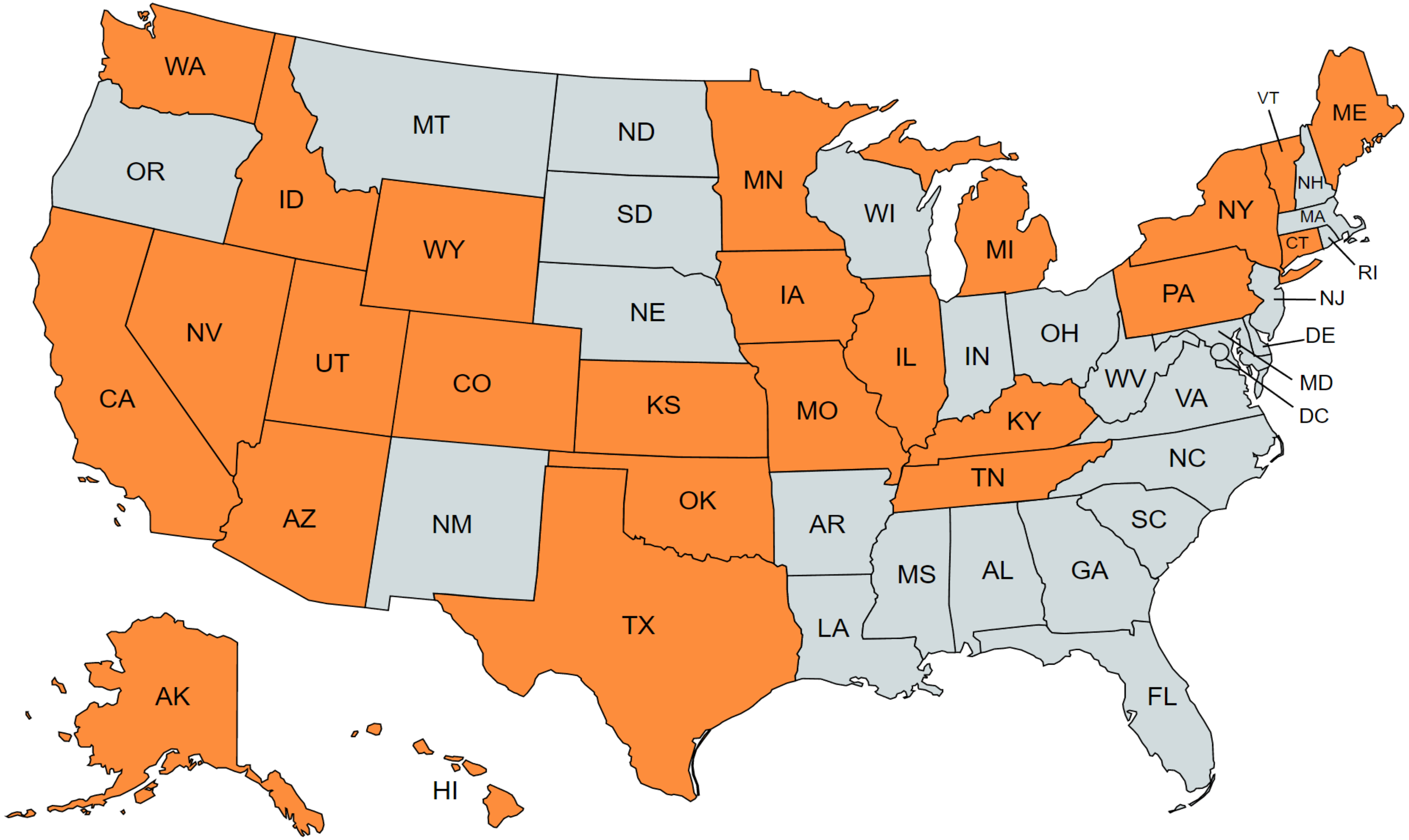
applied pavement TECHNOLOGY

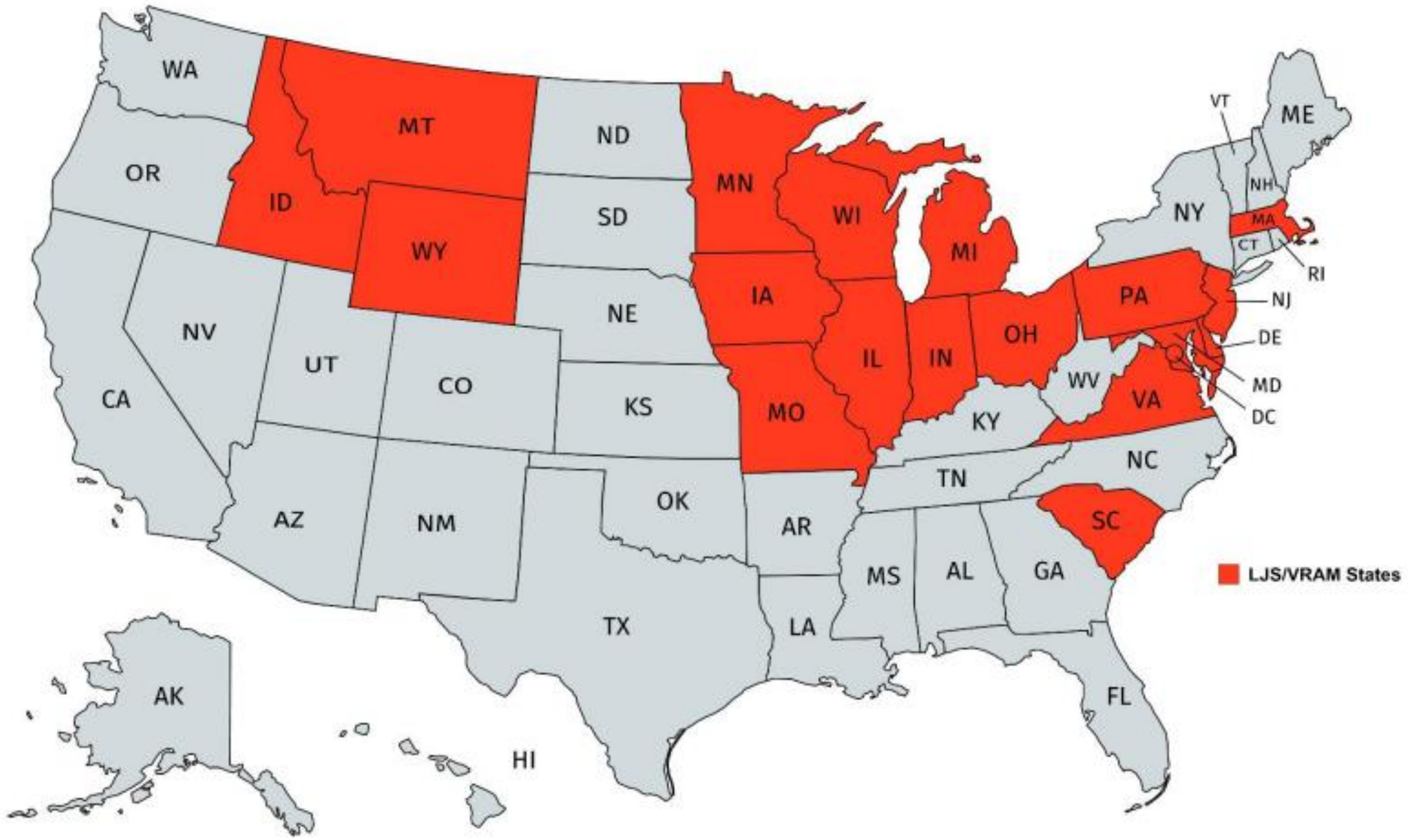
I STATE

January 23, 2023

State DOTs with LJ Specifications



State DOTs with VRAM Experience



Key Findings from Lit. Review of VRAM

- Illinois DOT
  - Refers to VRAM as Longitudinal Joint Sealant (LJS)
  - Most experience; analysis of projects
    - For projects > 12 years old, LJS provides 3 to 5 year life extension of the joint
    - Life cycle benefit is 3 to 5 times the initial cost of LJS
    - Fully implemented in 2018
    - Estimated cost is about $2 per linear foot
- Indiana DOT
  - Began specifying VRAM September 2022
  - LCCA suggests that for every $1 spent on VRAM would save $2 in maintenance over 20 years.

Other Joint Construction Methods & Treatments

- Numerous other longitudinal joint studies on highways from 1992 to 2011 in Arkansas, Colorado, New York, Michigan, Pennsylvania, Tennessee, and Wisconsin
  - Field studies included a variety of joint construction methods and products
  - Most studies did not include a performance long-term evaluation
- After a 6-year field performance evaluation, the Colorado and Pennsylvania sections with rubberized joint sealant were most durable with no significant cracking.
  - rubberized joint sealant applied at ~1/8 inch thick
  - second best performing joints were cut-back joints

Project List for Task 2, VRAM Field Inspections

#	Location	Date Const	Control Joint Type
1	Pekin, IL Municipal County Airport	June 2019	None
2	Decatur, IL Airport	May 2020	None
3	Coles County, IL Airport	June 2021	Cut-back
4	TH 22, Beauford, Minnesota	October 2018	Multiple (no cut-back)
5	US 51, Decatur, Illinois	2002	Butt
6	IL 17, Mercer County, Illinois	2016	Cut-back
7	US 24/IL 9, S. of Peoria, Illinois (D4)	2016	Cut-back
8	IL 18, Henry, Marshall County, Illinois	2017	Cut-back
9	US 20, Jo Davies County, Illinois	2019	Cut-back
10	I-280, Rock Island, Illinois	2020	Cut-back
11	IL 5, Moline, Illinois	2020	Cut-back
12	IA-57, Ackley, Iowa	2016	Butt or notched wedge

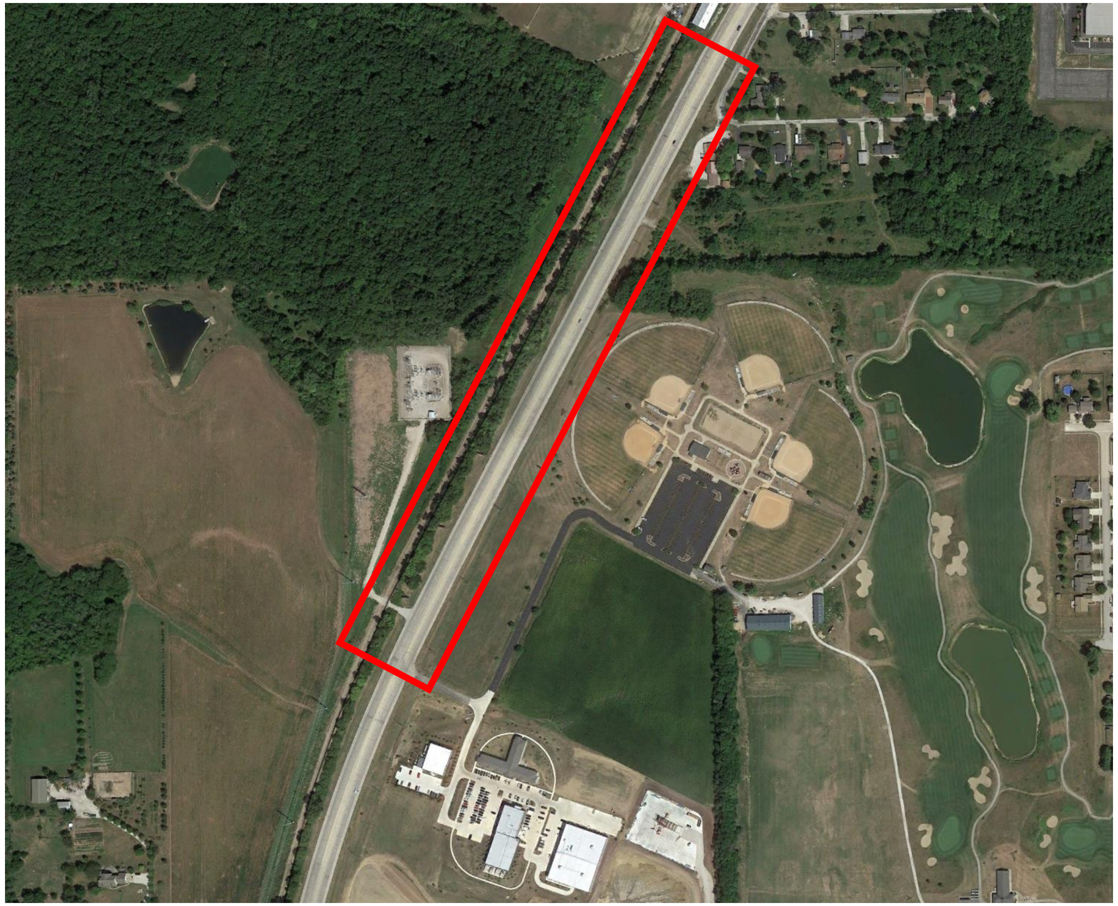
*ILDOT and MNDOT have agreed to provide traffic control for data collection and coring.

Business US-51, Decatur, Illinois

Business US-51, Decatur, IL

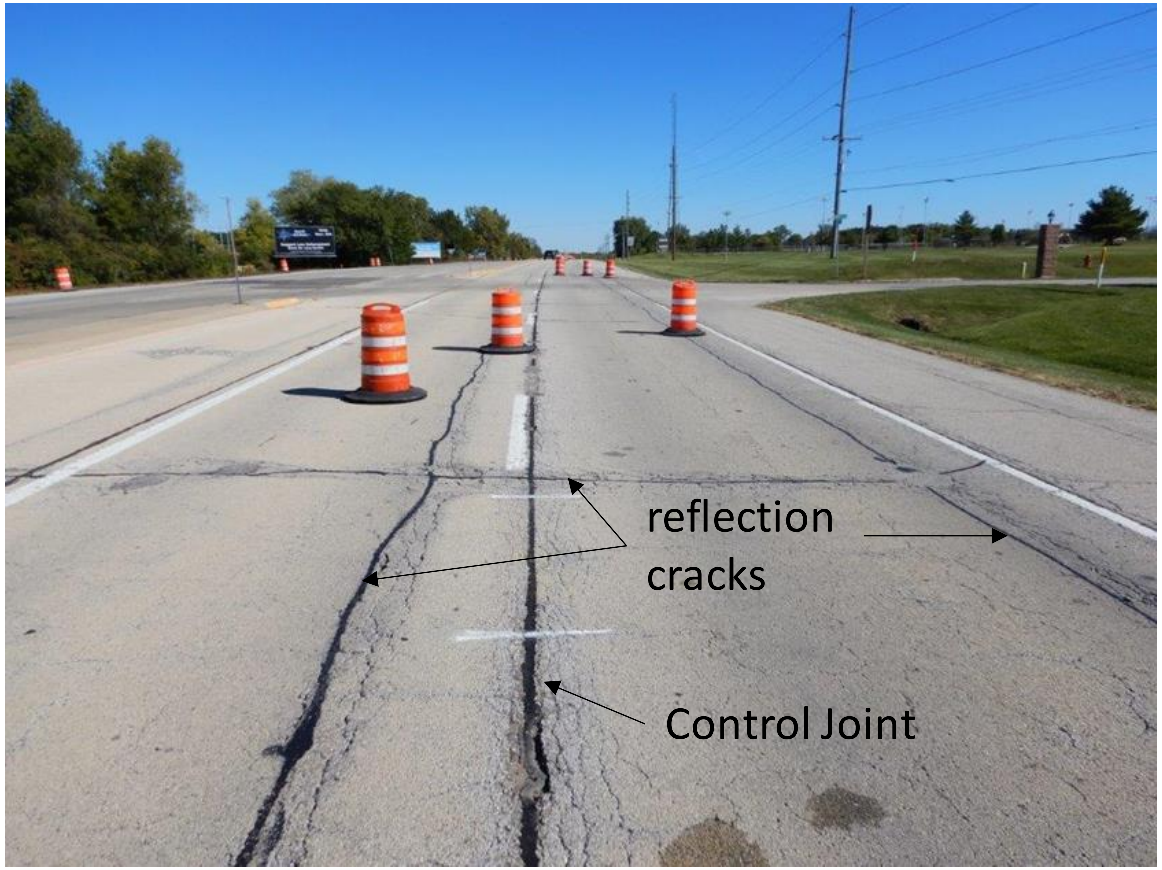
Project Overview

- Mill and overlay of existing pavement
- Multiple treatment and control sections
- Two VRAM applications: 12-inch wide and 18-inch wide
- VRAM applied prior to surface lift
- Constructed September 2002
- Inspected October 2022



Business US-51, Decatur, IL

12-inch wide VRAM and Control Section 1



Business US-51, Decatur, IL

18-inch wide VRAM and Control Section 2

Business US-51, Decatur, IL

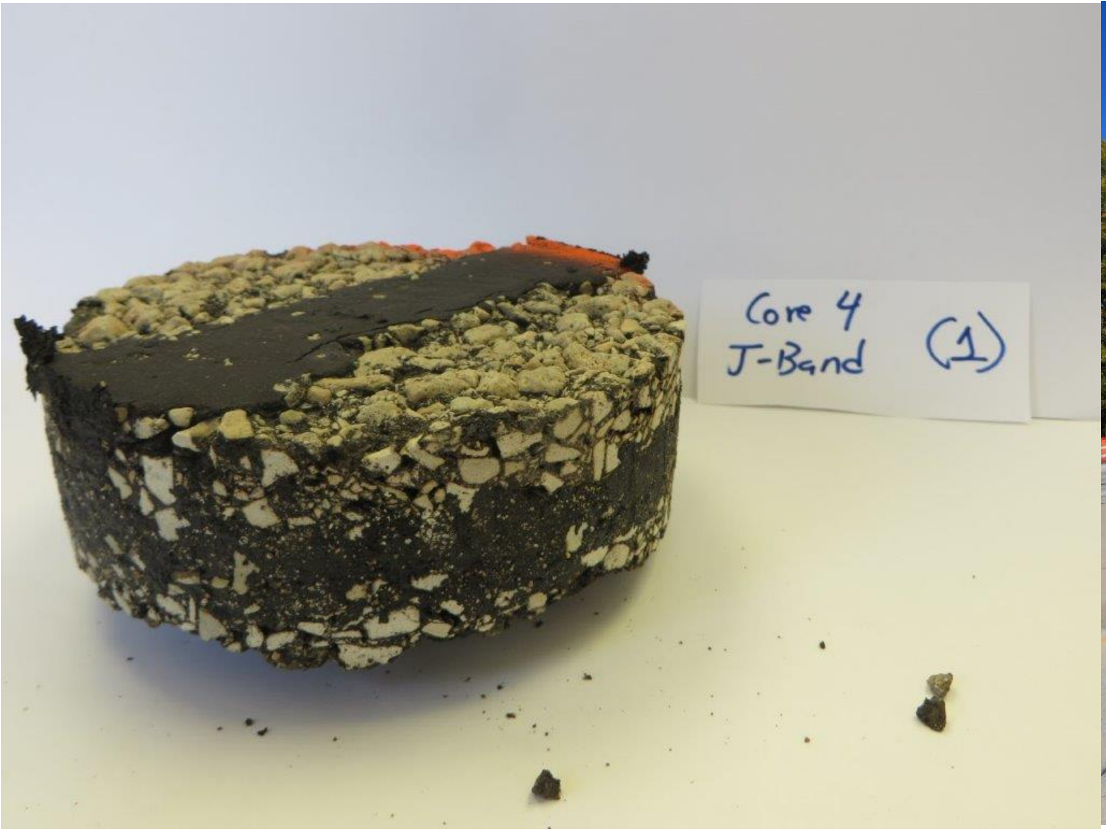
12-inch wide VRAM and Control Section 1

VRAM Joint

Control Joint

Business US-51, Decatur, IL

18-inch wide VRAM and Control Section 2



VRAM Joint

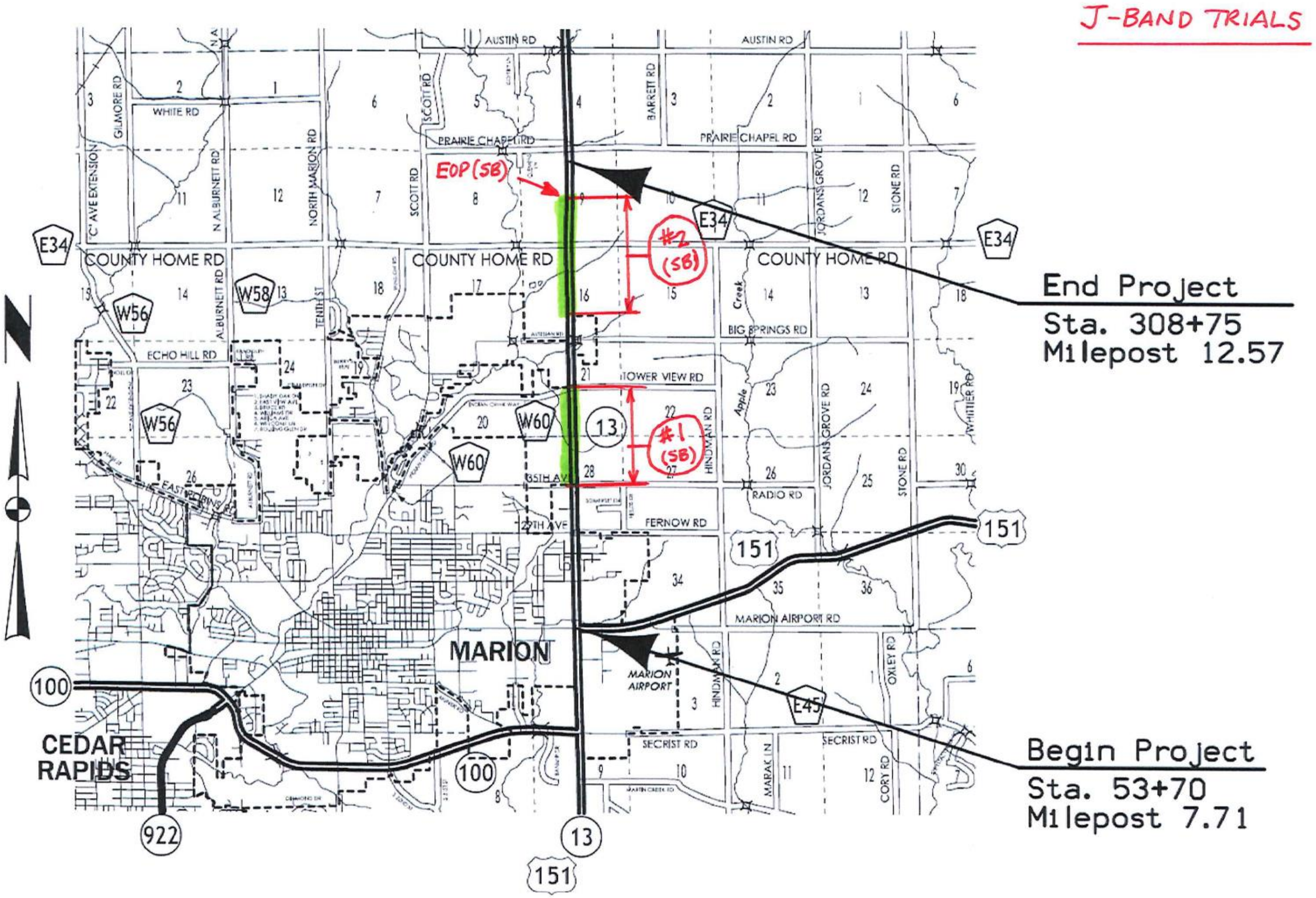
Control Joint (no core)

Business US-51, Decatur, IL

Density and Permeability Testing

IA 13, Marion County, Iowa

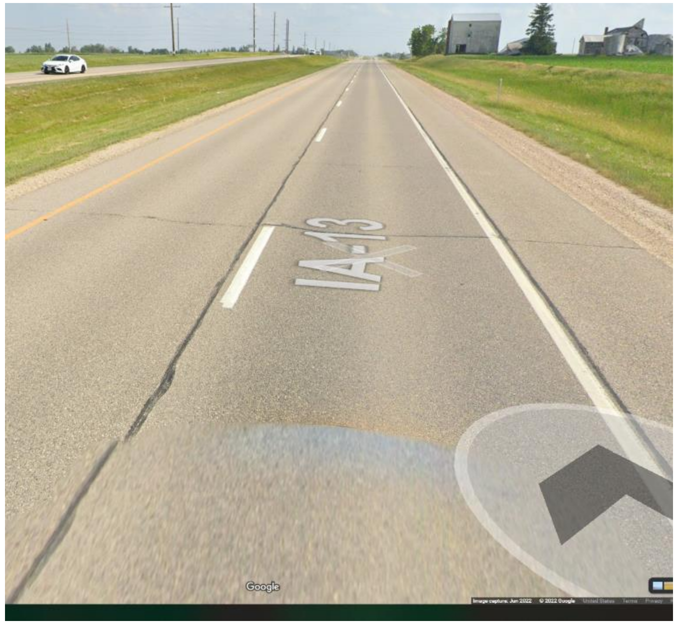
IA 13 Marion- Project Location Map



IA 13, Marion Co., IA

- Construction date was 7/28/2016. 6.5 years old at time of inspection
- Butt joint used for both sections
- Segment 1 is 3” HMA over existing PCC, southbound, VRAM applied at 1.47 lb./ft
- Segment 2 is 0.5” mill with 2” HMA overlay, southbound, VRAM applied at 1.80 lb./ft
- Segment 2 control is similar work completed without VRAM in the adjacent northbound lanes of Section 2
- Unable to complete field permeability, rescheduled for Spring 2023.

Project Joint Images

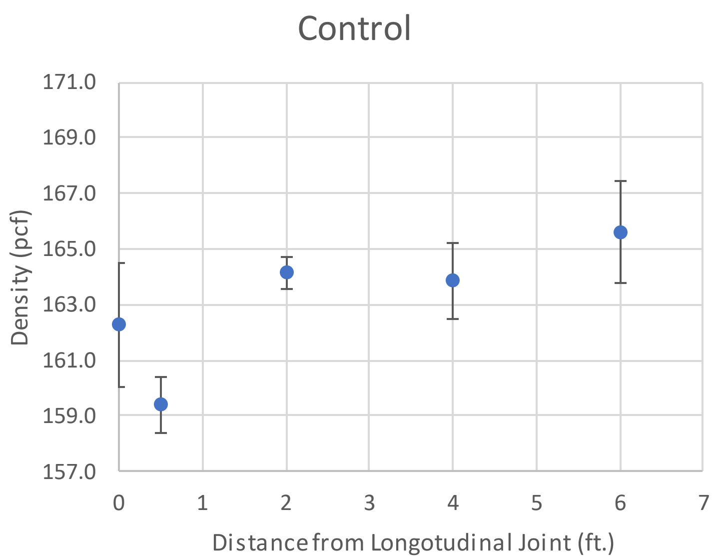


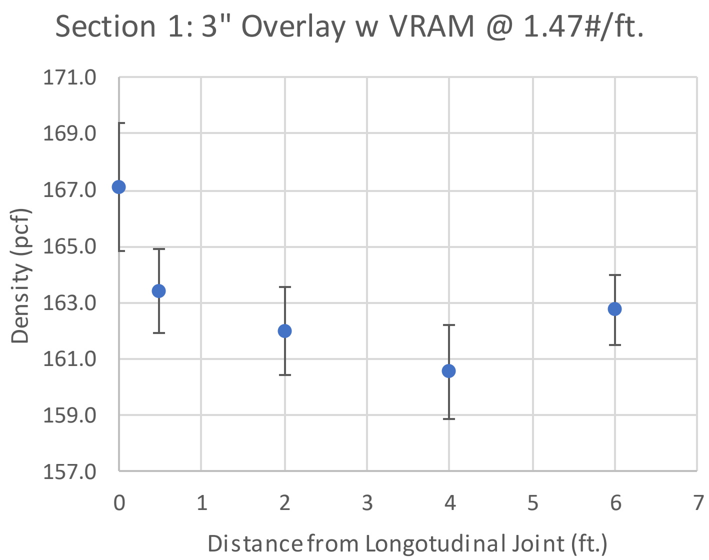
Segment 1 Southbound

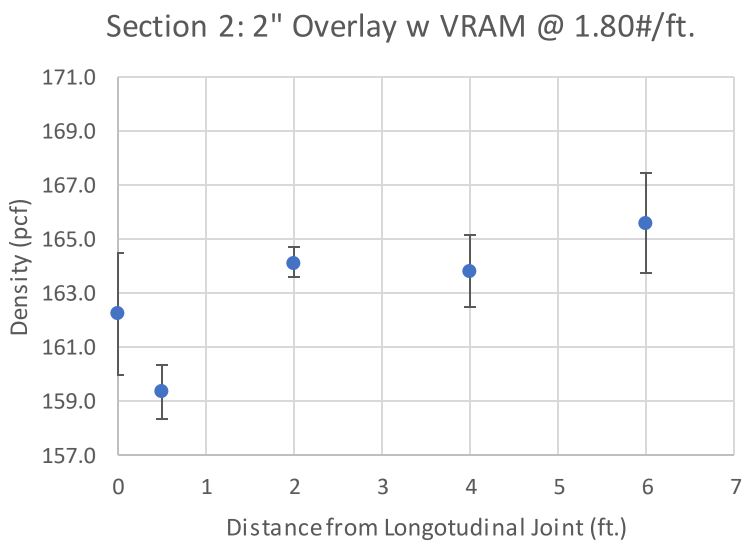
Segment 2 Control Northbound

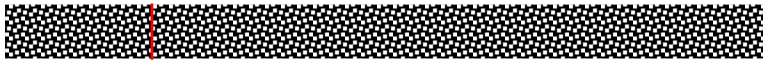
Segment 2 Southbound

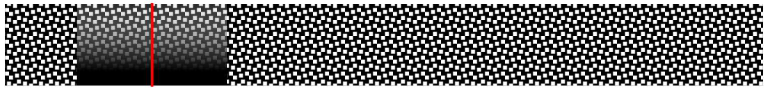
In-Place Density Results







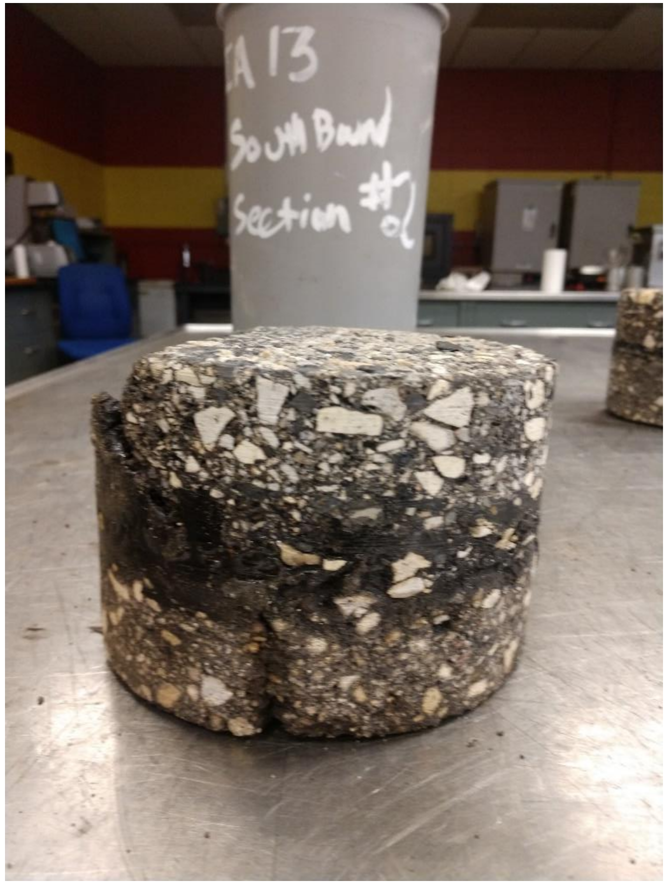




Cores Segment #2 Control

Cores Segment #1 VRAM @ 1.47#/ft., 3" overlay

Cores Segment #2 VRAM, 1.80#/ft., 2” overlay



Available Treatments to Prevent and Correct Deterioration of LJs: ***Rapid Penetrating Emulsion (RPE)***

RPE used as a longitudinal joint preventative treatment immediately following application (left), after penetrating joint (center), and after cure (right).

Treated joint during Spring melt event showing water resistance.

Trepanier et al. (2021) A Materials Approach to Improving Asphalt Pavement Longitudinal Joint Performance.

Available Treatments to Prevent and Correct Deterioration of LJs: ***Rapid Penetrating Emulsion (RPE)***

- Dilute asphalt emulsion containing surface-tension reduction additives designed to penetrate the existing surface.
- Typically applied at 0.10 gal/yd^2 over an 18” width centered at the joint.
- Can be applied at any time following construction, but restriping is commonly required if applied over paint markings.
- Curing time is dependent on ambient conditions.
  - It is usually non-tracking within one-half hour, and water resistance is achieved within one hour.

Available Treatments to Prevent and Correct Deterioration of LJs: ***Rapid Penetrating Emulsion (RPE)***

- The cured treatment is expected to fill the voids and reduces air void content at and near the joint, reducing mixture permeability.
  - Because the treatment changes the G_{mm} of the mixture, nuclear density testing following treatment can be misleading.

- Can be used on any mixture type/design scenario, although penetration is affected by mix design variables.
  - New pavement surfaces allow higher penetration because they exhibit the lowest density and have minimal surface contamination from dust and debris.

Maintenance of Longitudinal Joints

LJ Maintenance and Repair

- Crack sealing
- Crack Filling with Mastics
- Partial or full-depth repair by saw-cut or milling and filling with HMA
- Infrared heating
- Microsurfacing
- Fog seals and rejuvenating seals
- Rapid Penetrating Emulsions

Treatments to Prevent and Correct Deterioration of LJs: ***Asphalt Emulsion Fog Seal***

- Undiluted or diluted asphalt emulsion is applied at pre-determined width and rate on or over the joint using a standard asphalt distributor.

- Limited penetration of asphalt residue is expected.

- Typically applied at 0.03 to 0.15 gal/yd^2.

- Can improve the performance of the longitudinal joints with respect to permeability.
  - No significant difference observed between different types of fog seal materials.

Treatments to Prevent and Correct Deterioration of LJs: *Rejuvenating Fog Seal*

- Undiluted or diluted materials that may or may not be emulsified and may or may not contain residual asphalt binder and/or polymer.
- Examples include emulsified bio-oils or aromatic extract materials.
- Application rates can vary from 0.015 to 0.10 gal/yd^2.
- Can reduce the permeability of areas with and without mixture segregation.
- Can reduce the retroreflectivity of pavements.
- Can cause a temporary reduction in friction.

Calvert. Fog Seal Application of Rejuvenators and Seal Coats.

Treatments to Prevent and Correct Deterioration of LJs: *Micro Surfacing*

- Used successfully on highway projects (IL, MN, PA, WV)
  - Medium to high severity LJ deterioration
  - Lower cost and faster construction than mill & fill (25% of the cost, 60% of the time as per PennDOT)

- Not used in airports for joint repair, only as a treatment for entire surface
  - FOD potential
  - Uneven surface

Source: WV DOH

Treatments to Prevent and Correct Deterioration of LJs: *Infrared Heating*

- Can be used to repair low to medium severity cracks
  - Cracked area is heated to soften asphalt
  - Asphalt is scarified until cracks are no longer visible
  - New hot mix is added – relatively fine and rich in asphalt
  - Material is compacted
- Faster than mill & fill
- Cost comparable or less than other alternatives
- Infrared heaters are used more during construction than repair for airports

Source: Uzarowski et al. (2011)

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Questions?

Iowa DOT Draft Specification for VRAM

- Material criteria based on DSR, BBR, elastic recovery, ash content, and separation of polymer as specified below.

TEST	CRITERIA	TEST METHOD
Dynamic shear @ 88°C (unaged), G*/sin δ	1.00 kPa minimum	AASHTO T 315
Creep stiffness @ -18°C (unaged)		AASHTO T 313
Stiffness (S)	300 MPa maximum	
m-value	0.300 MPa minimum	
Ash, %	1.0% - 4.0%	AASHTO T 111
Elastic Recovery, 100 mm elongation, cut immediately, 25°C	70% minimum	ASTM D6084 Method A
Separation of Polymer, difference in ring and ball	3°C maximum	ASTM D7173

- Construction requirement in terms of equipment, material handling, surface preparation, application of VRAM, and quality control/quality assurance based on certification by the manufacturer that the VRAM meets material criteria.
- Method of measurement and payment based on linear foot for both full width and half width applications