

XIII Congreso Mexicano del Asfalto. 20, 21y 22 de agosto de 2025, Cancún, Quintana Roo, México



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<http://www.amaac.org.mx>



RECYCLING STRATEGIES: ROAD REHABILITATION USING ASPHALT EMULSIONS

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Asphalt Institute

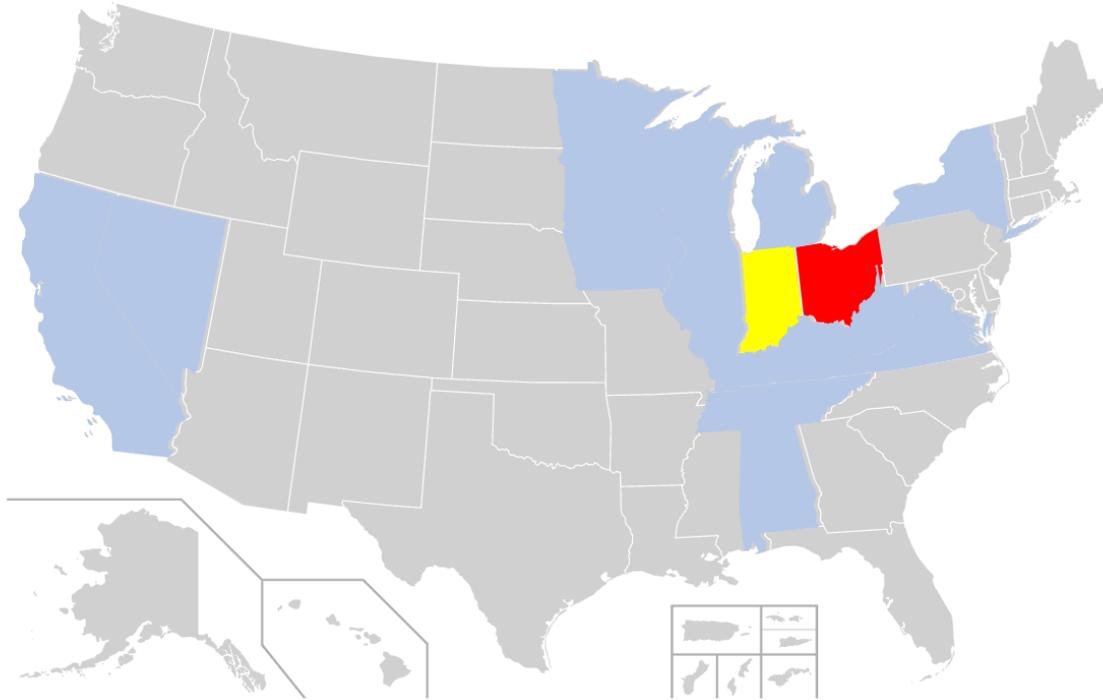
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The Asphalt Institute

- International association of 130 petroleum asphalt producers, manufacturers and affiliated businesses
- Members represent over 90% of the liquid asphalt produced in North America
- Founded in 1919
- *Promote the safe use, benefits and quality performance of petroleum asphalts in a unified voice for our membership.*



About me - Acerca de mí



- I live in Ohio



- I worked 14 years in Indiana



- I worked on projects across the United States

What is the goal?

¿Cuál es el objetivo?

- Typically, the same wherever the project resides

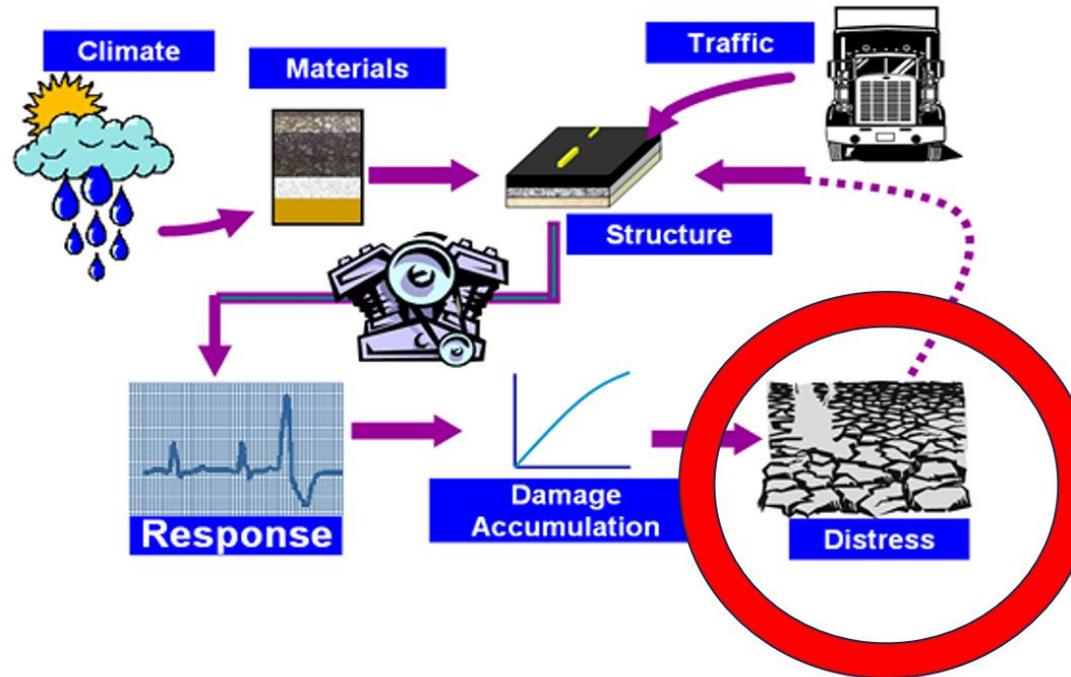
Por lo general, es lo mismo sin importar dónde se lleve a cabo el proyecto

- Maximize performance
 - Build roads that last
- Minimize costs
 - Funding for roads is limited
- Minimize User Delays
 - Traveling public
- Maximize safety
 - Protect our workers, protect our people

- Maximizar el rendimiento
 - Construir caminos que duren
- Minimizar el costo
 - El financiamiento para carreteras es limitado
- Minimizar los retazos del usuario
 - Viajeros
- Maximizar la seguridad
 - Proteger a nuestros trabajadores, proteger a nuestra gente



Asphalt Pavement and Materials Engineering



- Tools to evaluate distressed pavement
 - Forensics to diagnose the problem
 - Coring
 - Source of cracking
 - Stripping
 - Rutting
 - Strength Testing
 - Falling weight deflectometer (FWD)
 - Dynamic cone penetrometer (DCP)
 - Asphalt Layers
 - Aggregate Base
 - Subgrade

What do you see? ¿Qué ves?



What do you see?
¿Qué ves?



What do you see?
¿Qué ves?



What do you see?
¿Qué ves?



What do these pavements have in common?

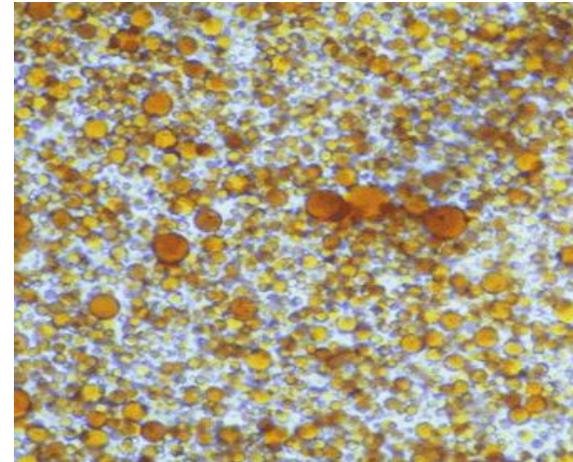


- Rehabilitated using asphalt recycling technologies
- Used asphalt emulsions as the primary stabilizer



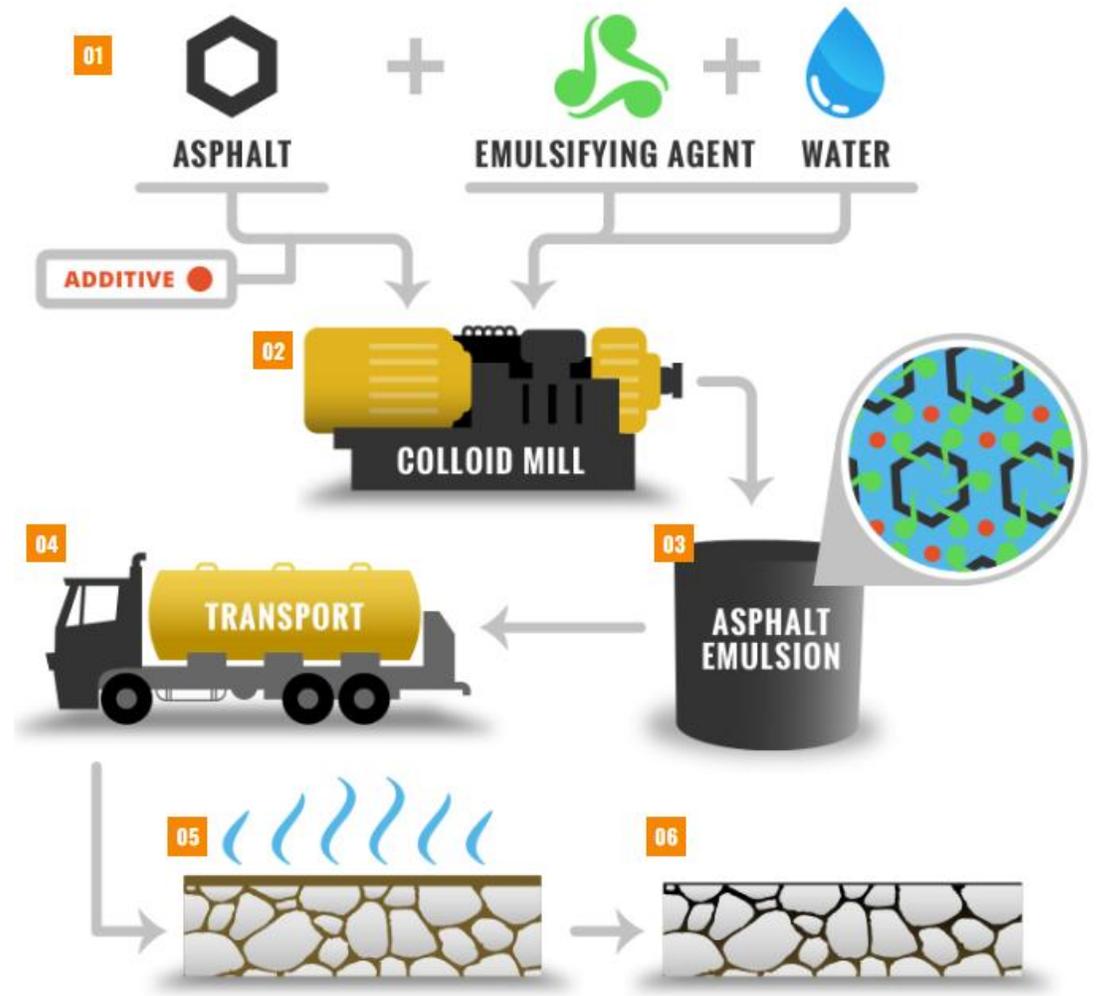
Asphalt Emulsion Basics

- Three primary ingredients
 - Solid (asphalt)
 - Water
 - Surfactant
- Facilitates the mixing of oil and water
- Asphalt droplets suspended in water
 - Temperature not needed to liquify the asphalt
 - Pumpable, sprayable and workable at low temperatures



Asphalt Emulsion Basics

- Formulate
 - Minimum percent of asphalt
 - Asphalt binder stiffness
- Mill
 - Emulsion manufacturing facility
- Emulsify
 - Ensure chemical stability
 - Minimize separation of asphalt and water
- Transport/ Apply
 - NO heat added during storage and transportation
- Break
 - Water separates from asphalt during mixing
- Cure
 - Asphalt droplets coalesce
 - Ultimate strength of mix is dev



Asphalt Emulsions in Road Construction

As Tack Coat to bond HMA Layers



As Sealant in Preservation Treatments



As Stabilizing Binder in RAP/ Recycle Treatments



Are these the same type of emulsions?

Advantages of Asphalt Emulsions in Pavement Recycling

- Very stable emulsion
 - Commonly > 60% asphalt binder
 - Can store for long periods of time
 - Can deliver over long distances
 - Typically, less than 50°C
- Controlled mixing and breaking
 - Formulate based on materials being recycled
 - Speed of the break, workability
- Safety
 - Low temperature material minimize the risk for severe burns



Construction Techniques

**Cold In-Place Recycling
(CIR)**



**Full Depth Reclamation
(FDR)**



**Cold Central Plant Recycling
(CCPR)**



Commonly referred as the “cold” recycling processes

Do not require heat to produce final mixture

Pavement Recycling Techniques

- Similarities
 - Crush asphalt pavement to produce a reclaimed asphalt pavement (RAP) aggregate
 - Computer controlled metering to add emulsion, water and additives
 - No heat is required during the process to produce a cold recycled mix
 - Engineered process: mix design, quality control, compaction
- Differences
 - Equipment types and “trains”
 - How the mixture is spread and placed
 - Direction of cutting drum
- Right Treatment, Right road
 - Determine which equipment/ process is best solution for roadway problem
 - Equipment availability

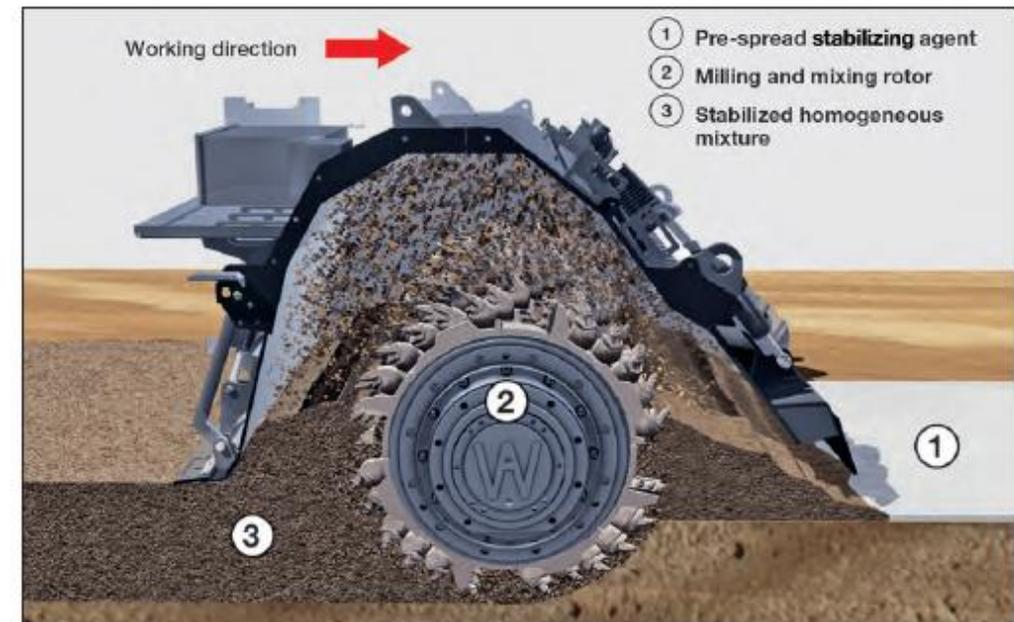
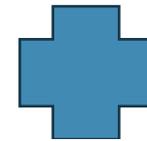


Figure 16-2: Sketch of cutting drum operating in up-cutting direction.

Source: ARRA: BARM



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CIR

- Remove and crush RAP from existing pavement
 - Down cut
 - Partial depth
- Add water, stabilizing agent and any additives in the mixing unit without the use of heat
- Deliver mix immediately into paver
- Spread and place mix using conventional paver
- Compact mix and then cure
- Apply final surfacing



FDR

- Crush, pulverize and/or blend full flexible pavement section and a pre-determined portion of the underlying materials
 - Up cut
 - Through all the HMA layers
- Regrade, shape and compact the pulverized material, resulting in a stabilized base course
- Achieve additional stabilization with additives
- Cover with single or multiple HMA courses or surface treatments



CCPR

- Remove RAP from a pavement
 - Milling machine
- Haul and process at a central location
- Mix with stabilizing agent and water in a mixing unit without heat
- Incorporate additional materials and additives to enhance performance if needed
- Load and Deliver CCPR mix to paving site
- Place and compact the CCPR with conventional paving equipment
- Cover CCPR with a surface layer or surface treatment once cured



Selecting the Recipe: Mix Design

- AASHTO developed standards for Cold Recycling Materials
 - Similar to ARRA Guidelines
 - Key Parameters in the Design Process
 - Moisture content to ensure coating
 - Optimize asphalt emulsion content with multiple RAP gradations based on:
 - Strength Testing
 - Either Marshall Stability and Retained Stability, or
 - Minimum Indirect Tensile and Conditioned ITS strength
 - Raveling Test
 - Predictor of emulsions ability to develop strength for early traffic
 - Based on emulsified asphalt content and speed of the emulsion break



RAP – Asphalt Emulsion: Cold Recycled Mix

- Cold recycled mix is an “evolving” material
- Requires curing to reach peak strength
 - Release of moisture in emulsion
 - Needs correct climate conditions
 - Coring not an option for QC
 - Density gauge for QC/QA
- Does not require to peak strength to receive traffic
- Given ~75% strength of HMA in pavement design applications
 - $a_{cir} = 0.30$ when $a_{hma} = 0.40$



HMA
CIR

Project Story – High Volume Road, CIR

- 6.7 Mile Section of US 30
- Near Plymouth, IN
- High Volume
 - 4 Lane Divided Highway
 - AADT 21,000
 - 35% Trucks
- Composite Pavement
 - IRI > 100 in/mi
 - Variable thickness HMA over PCC
 - Full depth transverse and longitudinal cracking

INDOT Utilizes Asphalt Emulsion CIR for Major Roadway Rehabilitation

Cold In-Place Recycling allowed INDOT to repair a major 4-lane divided highway in Northern Indiana. US 30 showed large cracks that, upon further investigation, extended deep into the pavement structure.

1,605 tons of engineered emulsion were utilized to recycle approximately 52,800 tons of existing asphalt pavement.

Nearly 7 miles of 4-lane divided highway were rehabilitated in 18 production days

Performing a Cold-In Place Recycling treatment on asphalt of a composite pavement allows for the majority of asphalt pavement distresses to be mitigated with CIR

https://roadresource.org/treatment_resources/cold_in_place_recycling/success_stories/story/118/success#tqm-main



2023 PAVEMENT
RECYCLING SUMMIT
INDIANAPOLIS, IN | OCTOBER 2-5

**INDOT SR 101 Performance Update & Other
Case Studies – A Virtual Road Trip and Review
of Pavement Condition Data**

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Project Story – High Volume Road, CIR



https://roadresource.org/treatment_resources/cold_in_place_recycling/success_stories/story/118/success#tqm-main

Project Story – High Volume Road, CIR

- Solution
- Phase approach
 - Passing lanes 1st, then travel lanes
- Remove top 25.0 mm
 - Maintain similar elevation
 - Establish 2.0% cross slope
- 100 mm CIR Treatment
 - 2.5% emulsion & 1.0% portland cement
 - ~200,000 sq m
 - ~53,000 tons of existing HMA
 - 18 days of CIR production
- 50 mm SMA Surface



Intersections needed to be opened to crossing traffic immediately after compaction

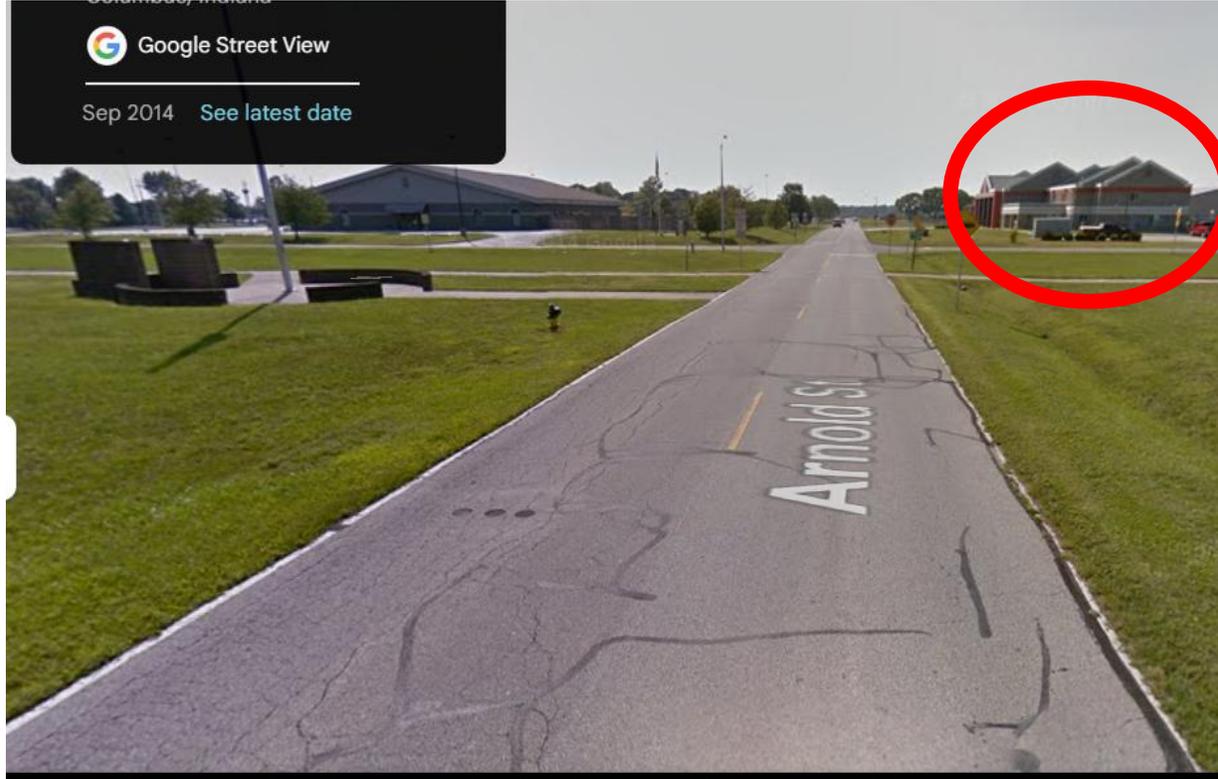


Project Story – High Volume Road, CIR

- Constructed in 2021
 - Final IRI between 0.31 and 0.79 mm/m
- Google Maps – August 2024
 - Three years of service
 - No reflective cracking
 - Maintaining excellent smoothness



Project Story – City Street Rehabilitation, FDR



- 2014 – Columbus, Indiana
- City street needed reconstruction
 - Fatigue cracking
- Problem – could not “remove and replace” existing pavement
- Needed ability to maintain traffic
 - Fire station
 - Airport

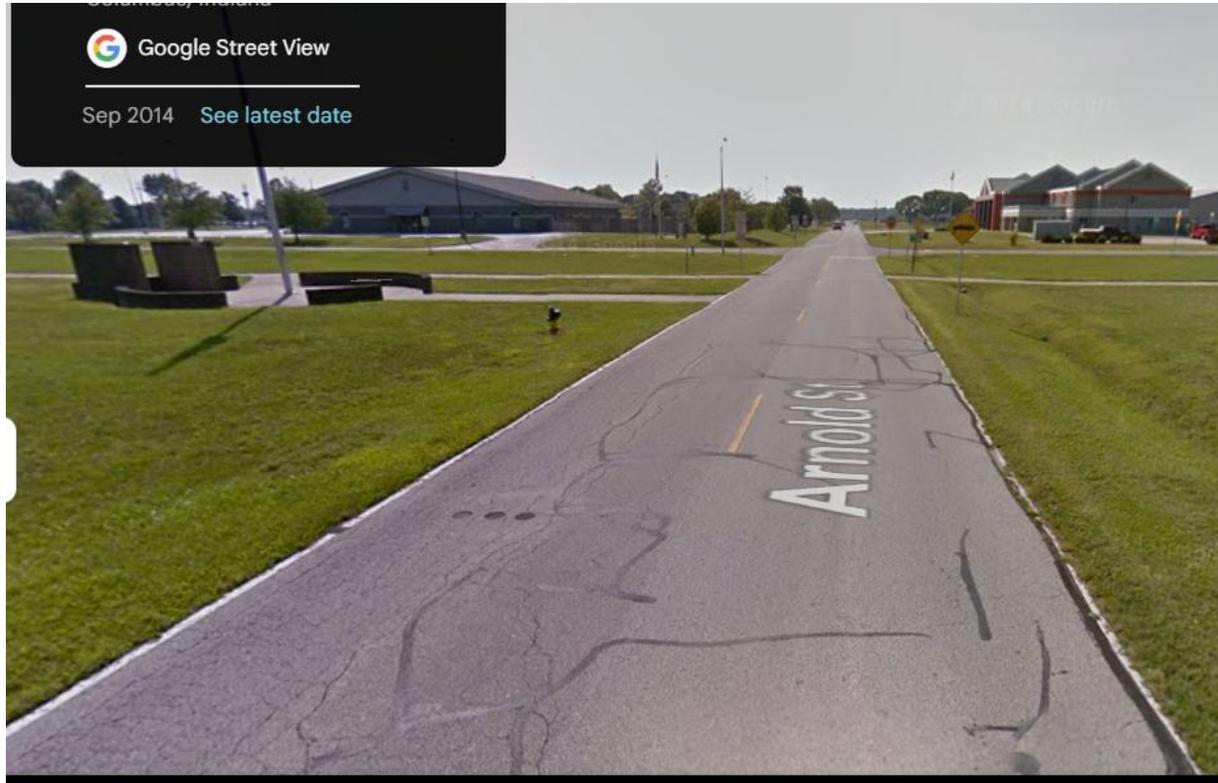
Project Story – City Street Rehabilitation, FDR

- Solution

- Perform 8-inch emulsion FDR
- Allow local traffic during construction
- Reclaim 6 inches of existing HMA pavement and 2 inches aggregate base
- 3.0% asphalt emulsion
- 75 mm of HMA on FDR
 - 2 lifts



Project Story – City Street Rehabilitation, FDR



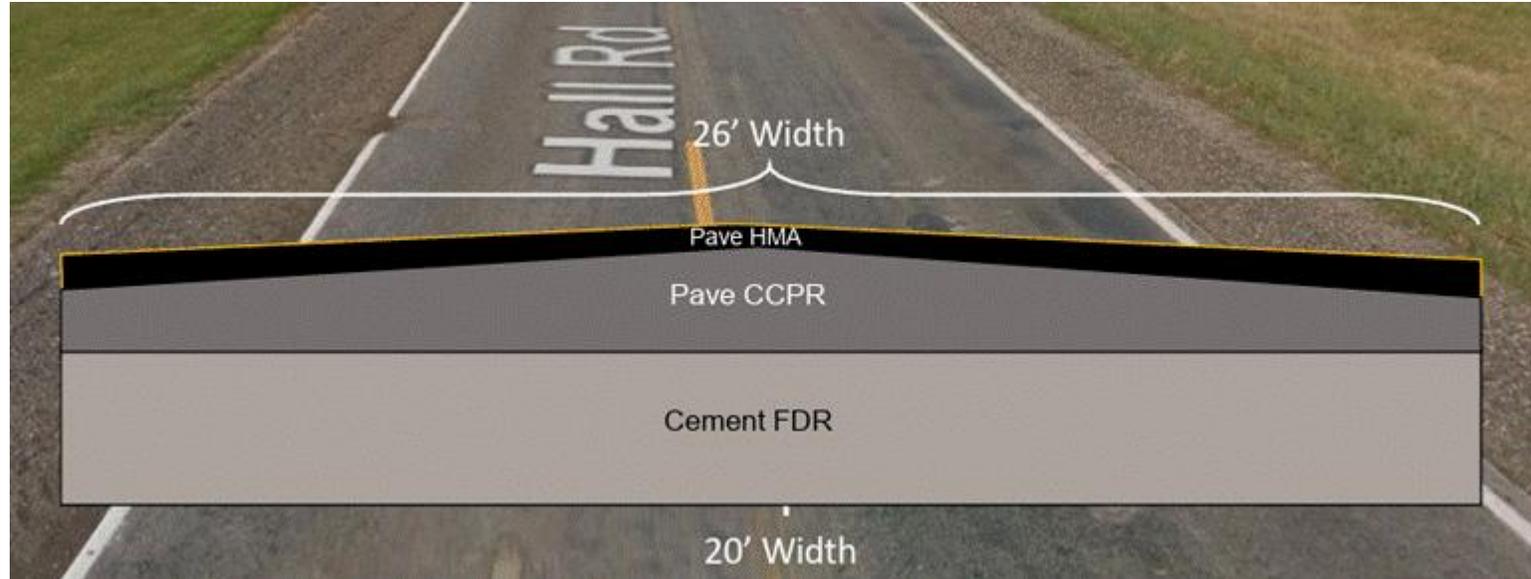
Project Story – Road Widening, CCPR

- Problem
 - Narrow two-lane state route
 - ~6 meter wide pavement
 - Surface defects
 - Cracking
 - Top down
 - Bottom-up fatigue cracking
 - Rutting
 - Poor subgrade strength
 - A-7-6 Soil with CBR < 4.0
 - Emulsions do not mix with subgrade clay!
- How would you address the issues?
 1. Subgrade needs widened and improved
 2. What to do with all that RAP?



From: Cosenza & Robinson: 2019 ARRA Semi-Annual Meeting

Project Story – Road Widening, CCPR



Solution

- Remove 200 mm of existing HMA pavement
- Perform 250 mm FDR with portland cement
 - Blending remaining pavement, base and subgrade at ~8 meter width
- Paved 150 mm CCPR lift (2.5% asphalt emulsion)
- HMA surface 50 mm

From: Cosenza & Robinson: 2019 ARRA Semi-Annual Meeting

Project Story – Road Widening, CCPR



Project Story – Road Widening, CCPR



Photo taken December 2024

Collection Year	Direction	2014	2015	2016	2017	2018	2019	2020	2021	2022
2022	Dec	113.2	126.5	131.5	132.8	70.1	52.9	56.7	56.8	56.0



Asociação M del Asfalto



Resources: Asphalt Recycling & Reclamation Association

- ARRA.org
 - Government/ Agency Membership - Free
 - Access to Basic Asphalt Recycling Manual (BARM) - pdf
 - Guidelines (Example Specifications)
 - Project Selection Guidance
 - Pocket Guides for Inspectors and Field Personnel



FREE GOVERNMENT MEMBERSHIPS



JOIN TODAY!

ASPHALT RECYCLING & RECLAIMING ASSOCIATION

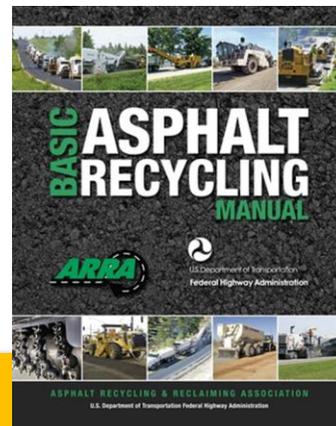
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Promote. Educate. Lead.

We are the independent voice of the pavement recycling and reclaiming industry.

Learn More
630.942.6578

www.rra.org



Additional Information: RoadResource.org



- Asphalt Preservation and Pavement Recycling Information
- Guidance on Project Selection
 - Based on Distress & Pavement Condition
- Structural Calculators
- Cost Comparison Calculator
- Success Stories
 - Learn from other agency's success

Closing remarks

- Additional tools in the toolbox
- Proven technologies
- Location of technical resources
- Right road, right treatment at the right time
- Goal: long lasting pavements



Thank you, members



¡ muchas gracias!

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