



Full Depth Reclamation for Urban and Suburban Street Application

City Engineers Annual Conference

January 27, 2022

The Local Road Research Board





NEW PROJECTS EACH YEAR







100+ TAP CITY/
COUNTY MEMBERS



Who is the Local Road Research Board?



Jim Foldesi (Chair) St. Louis County



Kristine Elwood MnDOT State Aid



Brian Giese Pope County



Duane Hill MnDOT D1



Katie Walker MnDOT Research



Kent Exner City of Hutchinson



Kyle Shelton MnDOT R&I



Lon Aune Marshall County



Paul Oehme City of Lakeville



Wayne Sandberg Washington County

Who is the Research Implementation Committee?



Will Manchester (Chair) City of Minnetonka



Kristine Elwood MnDOT State Aid



Ben Worel MnDOT Road Research



Fausto, Cabral MnDOT D1



Guy Kohlnhofer Dodge County



John Brunkhorst McLeod County



Kent Exner City of Hutchinson



Ryan Thilges
Blue Earth County



Stephanie Malinoff U of M CTS



Steve Bot City of St. Michael

WHAT WAS THE ISSUE?

- Full Depth Reclamation has been viewed as a RURAL application
- Some urban agencies have become experts

Other urban agencies want to explore feasibility



Technical Advisory Panel aka - the POWER TEAM



Name	Organization
Steve Bot (Chair)	City of St. Michael
Adam Nafstad	City of Albertville
Cory Slagle	Washington County
Dan Wegman	Braun Intertec
Dave Rettner	American Engineering Tech
Joe Triplett	Chisago County
Joseph Stadheim	City of New Ulm
Logan Vlasaty	City of Lakeville
Mark Maloney	City of Shoreview
Matt Leonard	City of Monticello
Mike Marti	SRF Consulting Group
Sue Miller	SRF Consulting Group
Nicole Bitzan	SRF Consulting Group
Paul Nolan	MnDOT
Thomas Johnson-Kaiser	MnDOT
Tom Wesoloski	City of Shoreview

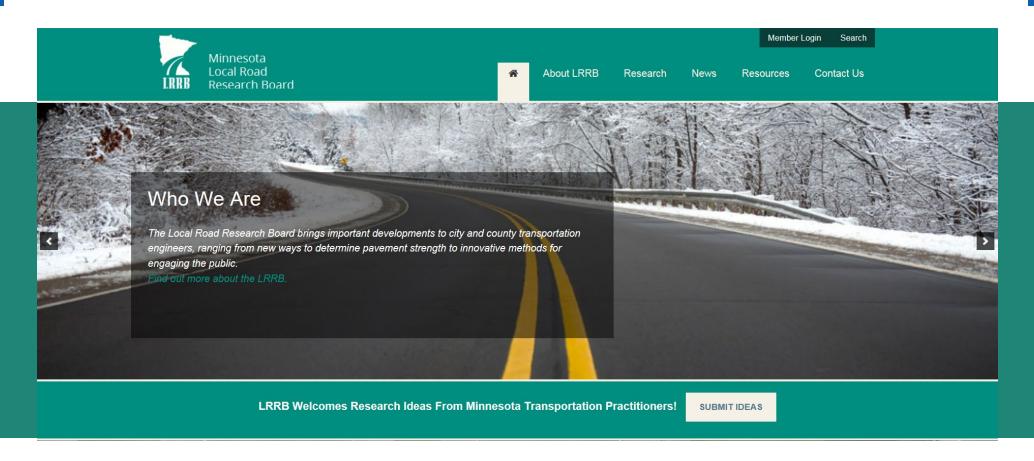


Full Depth Reclamation

For Urban and Suburban Street Application



Where to find the Resources



www.lrrb.org

Search: urban FDR





City of Shoreview

FDR Urbanized for Success

Shoreview Background

- Population of 27,000
- 93-miles of streets
 - 73-miles local
 - 20-miles MSA
- Fully developed
- Rapid growth in 1970's & 80's
- Prior to 1990's majority of street projects were reconstructions
 - Bring rural sections up to City standard
 - Concrete C & G, standard width, upgrade utilities
 - Scheduled to complete last reconstruction in 2023



Shoreview's Approach to Pavement Rehabilitation

Prior to 2007 - consisted of mill & overlays

- Typical section 3-½" of asphalt with 6" aggregate base
- Found out many roadways less than 3-½" of asphalt requiring full depth mill
- Issues with reflective cracking after a few years

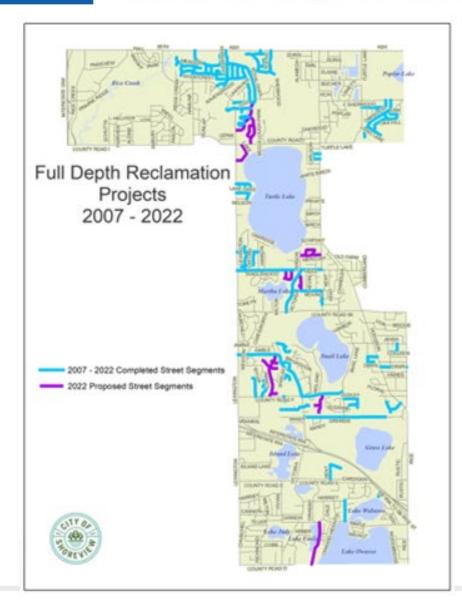
2007 – First stabilized full depth reclamation (SFDR) project

- 5-miles of local roads 7-ton design
 - 0.25-miles standard FDR
- Typical section
 - SFDR 2" asphalt with 4" emulsified base
 - FDR 6" reclamation w/3-½" asphalt
- Goals
 - Reduce/eliminate reflective cracking
 - Extend pavement life +25-years
- Emulsified base provided excellent results
 - Significantly reduced dust
 - Held up well during rain events rained 20-days in August

Full Depth Reclamation Background

- 2011 First SFDR on MSA roadways
 - 1.5-miles 10-ton design
 - ADT approx. 4000
 - Existing section 4.5" asphalt with 7" aggregate base
 - SFDR Typical section 3-½"" asphalt on 6" emulsified base
- Based on results from 2007 & 2011 projects, city continued with SFDR pavement rehabilitation projects for local & MSA roadways
 - 2013 5-miles local & MSA
 - 2016 1-mile MSA
 - 2017 1.5-miles local & MSA
 - 2018 & 19 5-miles local & MSA

Full Depth Reclamation Background



- From 2007 to 2019, rehabilitated a total of 20-miles SFDR w/emulsion
 - 14-miles of 7-ton (local)
 - 6-miles of 10-ton (MSA)
- In 2022 plan to rehabilitate 3-miles of local
 1-mile of MSA roadways
- Approximately 25% of Shoreview's roadways



Typical Pavement Condition

- Constructed in late 1970's to mid-1980's
- Concrete Curb & Gutter
- R Values 20 to 50
- PCI Values 30 to 50 (100)
- Typical Section Local
 - 6" Aggregate base
 - 3-1/2" Asphalt
- Typical Section MSA
 - 6" to 9" Aggregate base
 - 3-1/2" to 5" Asphalt

Coring and Mix Design

- Confirm existing typical section
- Determine optimum SFDR section
 - Depth of stabilized base
 - Modifications to reclaimed material add rock
 - Moisture content target prior to application of emulsion
 - Emulsion application rate
 - Asphalt thickness







- Condition of underground utilities
 - Keep replacement/repair to minimum to reduce surface disturbance
 - Leave pavement in place & reclaim after work is completed
 - Water main and services
 - Pipe burst existing water main
 - Bore new water main
 - Bore services or reuse existing
 - Sanitary Sewer
 - Issues with settlement around MH due to failure of rings & grout
 - Trenchless technologies such as lining pipe & MH
 - Replace MH covers & adjustment rings & install I&I barrier to reduce future settlement

- Excess Material
 - Elevation of roadway tied to curb & gutter
 - Typically removing 2" to 3" of material after initial reclaim
 - Mill, if possible, prior to initial reclamation
 - confirm w/mix design and coring
- Cul-de-sacs
 - Difficult to reclaim and add emulsion
 - Initial reclaim, sprayed emulsion, and mixed with reclaimer
 - Initial reclaim, moved to middle of cul-desac, emulsify in 6" layers then spread out
 - Best method is case by case



• Cul-de-sacs

- Difficult to reclaim and add emulsion Option 1:
 - Initial reclaim, sprayed emulsion, and mixed with reclaimer

Option 2:

- Initial reclaim, moved to middle of cul-de-sac, emulsify in 6" layers then spread out
- Still a challenge case by case to find better options





- Settlement around MHs & gate valves
 - Need to remove to allow for reclamation
 - Remove emulsified base to install
 - Settlement issues typically a year after paving
 - Beginning in 2016
 - Full depth asphalt patch
 - No settlement issues to date
 - Standard for raised MHs and gate valves

- Resident interaction
 - All work completed under traffic
 - Traffic control very important
 - Emulsified base provides excellent driving surface
 - Irrigation systems & invisible fences behind curb
 - Watering & sump pump discharge
 - Emulsified base holds up well
 - Never enough communication
 - Advanced signage
 - Newsletters & City webpage
 - Door hangers



Current Conditions — Local



- 2019 PCI Survey
 - SFDR streets high 80's
 - FDR streets low 80's
 - Minimal cupping at the joints
- Met initial goals
 - Significantly reduced reflective cracking
 - Based on current PCI expect +25-year pavement life
- Cost for emulsion offset by reducing asphalt required
 - Less excess material to remove
 - Asphalt section reduced from 3-½" to 2"

Current Conditions — MSA



- 2019 PCI Survey average 90
- Met initial goals
 - Significantly reduced reflective cracking
 - Based on current PCI expect +25-year pavement life
- Portion of additional cost for emulsion offset by reducing asphalt required
 - · Less excess material to be removed
 - Depending on ADT asphalt section reduced 1 to 1-½"

What does the future hold?

- Based on results and performance SFDR has become the city standard for pavement rehabilitation
- Annual maintenance with crack sealing and patching
 - Currently evaluating chip seal alternatives
- Continue to evaluate other pavement rehabilitation strategies



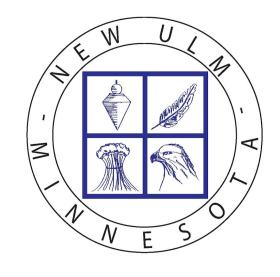


City of New Ulm

A Pathway to FDR

New Ulm Background

- Population of 14,120
- 88-miles of streets
 - 71-miles local
 - 17-miles MSA
- Average of 0.45 miles of new roadway per year since 2010
 - New Development
 - Gravel roadway to urban construction
- Majority of construction activity in the past 20 years has been dedicated to utility and roadway reconstruction.



Case Project - North Broadway

- Average Roadway Segment PCI is 21
- Existing Section:
 6" Bituminous Pavement, 8" Class 5 Aggregate Base, 12" Class 3 Aggregate Base
- 4,050 AADT
- Small Urban Funding for 2023 Construction
- Original Consideration of Mill & Overlay

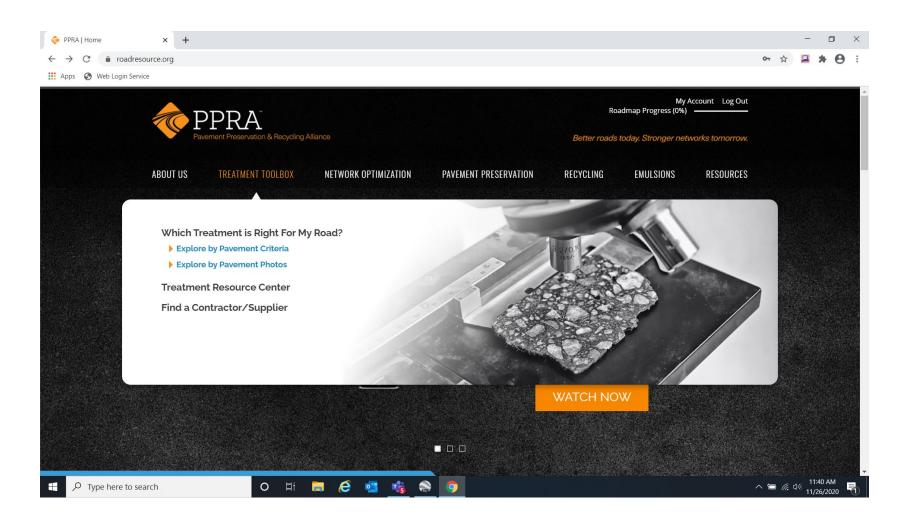


Alternative Research

- New to FDR Process
- Worked with Dan Wegman to introduce additional resources
- Pavement Preservation & Recycling Alliance (PPRA)
- Roadresource.org



Determine Options for Your Segment





Explore by Pavement Photos

Use this tool to explore potential solutions for various road conditions.

Though these tools use distress to identify potential treatment solutions, the savviest pavement managers are stretching budgets further by preventatively addressing deterioration before it starts. Link treatments together to make pavement last 40 years or more, or consider using innovative recycling methods to cost-effectively reengineering your pavement cross-section to meet increased load or traffic requirements and increase strength and longevity.

PRIMARY DISTRESS @

FATIGUE CRACKING - HIGH









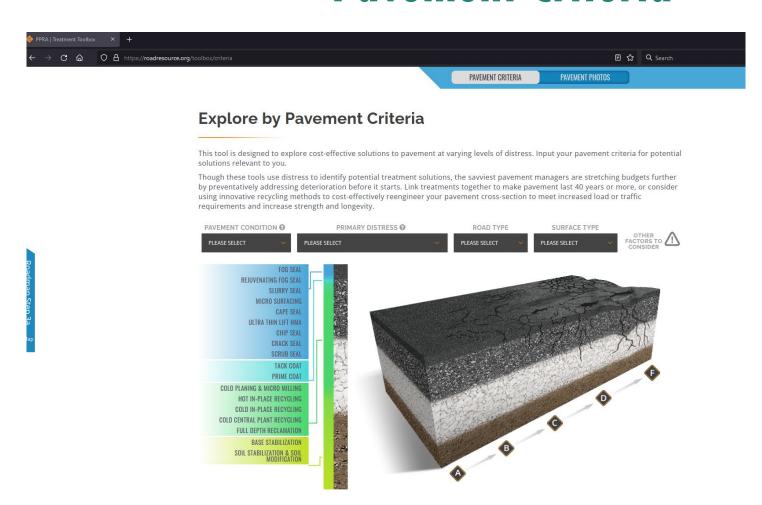






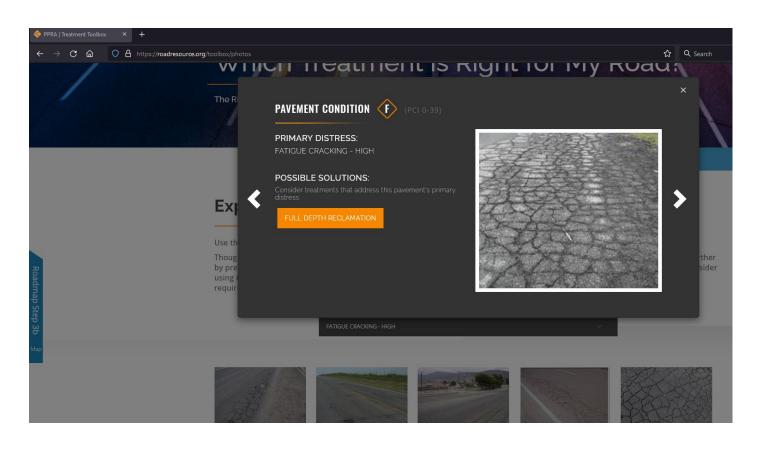


Input Roadway Condition Data — Pavement Criteria



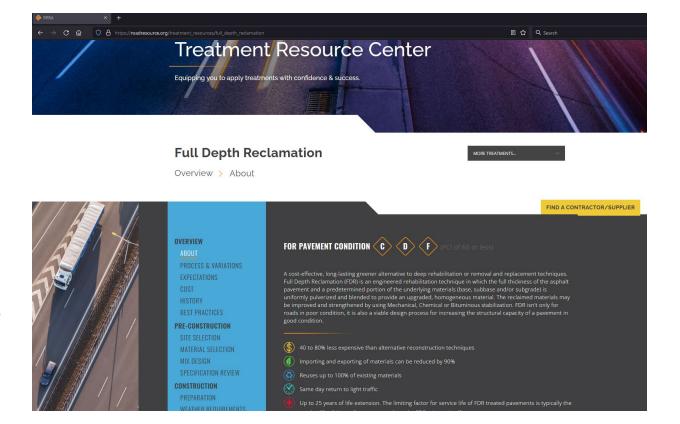
Input Roadway Condition Data — Selecting Photos

- Each distress photo give a pavement grade with possible solutions
- Select photo that most closely matches your segment

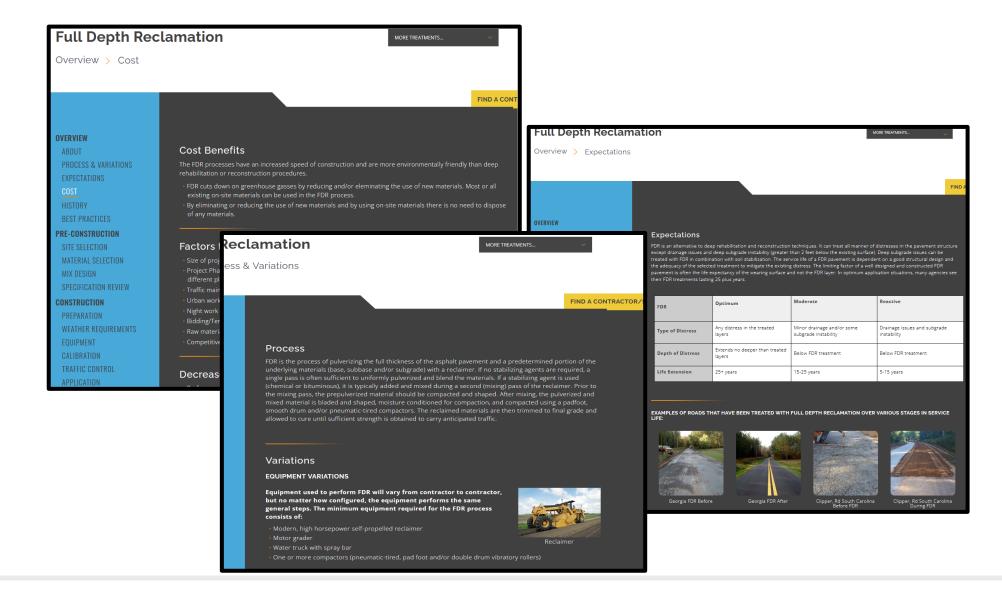


Treatment Resource Center

- Provides data and resources for different treatment types
- Explains the processes and variations within each treatment
- Section on expectations and life expectancy for each treatment.



Treatment Knowledge Resource



Network Optimization

"Provides guidance for a simple approach to optimize your pavement management system."

A How-To Guide

Make Your Resources Go the Distance

Roadway Owners face increasing pressure to manage deteriorating networks with insufficient resources. Proactive managers are using smart strategies to stretch their resources further. Here you'll find tools and concepts that agencies around the world are using to get the biggest bang for their buck.

A Simple Approach to Network Optimization

A robust pavement management system with data customized to your unique network will help you make the smartest choices for short and long-term impact. However, if your agency isn't ready for that step, here is a simplified framework for optimizing taxpayer dollars and maximizing pavement life.



- ☐ Assess Pavement Condition Where is your roadway network today?
- ☐ Optimize your Treatments Get the biggest bang for your buck.
- ☐ Measure Progress Are you getting to your goal? How can you improve?

Structure & Cost Comparison

Compares:

- Cost
- Environmental Benefit
- Structural Feasibility

For multiple pavement strategies:

- recycling
- conventional reconstruction
- mill & fill
- full depth reclamation

FDR vs. Reconstruction

Existing Road Condition	Existing Layer Type	Depth (in)	Co-Eff \varTheta	SN 😝	
	Existing HMA	4	0.20	0.80	Approximate SN (Structural Number)
	Existing Granular Base	8	0.10	0.80	1.60

Conventional: Reconstruction

Many agencies are learning that the use of limited funds toward a "worst first" approach accelerates the decline of their overall network, as miles of good roads go untreated each year.

Layer Type	Depth (in)	Co-Eff	\$/SY/in	Cost	SN
Cold Planing	4	0.00	\$1.00	\$4.00	0.00
Remove Granular Base	8	0.00	\$0.33	\$2.64	0.00
нма	4	0.44	\$4.65	\$18.60	1.76
Granular Base	8	0.14	\$1.88	\$15.04	1.12

Cost/SY: **9 \$40.28**

Overall Structural Number: ② 2.88

Optimized: Full Depth Reclamation

Consider an Optimized approach, which reallocates funds across more efficient strategies to keep good roads good and help you get ahead of the curve.

Layer Type	Depth (in)	Co-Eff	\$/\$Y/in	Cost	SN 1
НМА	2	0.44	\$4.65	\$9.30	0.88
Cementitious FDR	8	0.23	\$1.23	\$9.84	1.84
Existing Granular Base	4	0.10	-	-	0.40

Cost/SY: @ \$19.14

Overall Structural Number: 🕣 3.12

Structure & Cost Comparison

North Broadway example

recycling vs. conventional reconstruction

Compares:

- Cost
- Environmental Benefit
- Structural Feasibility

Structural Comparison Calculator

How to use this Tool

Use the calculator below to see how an optimized, recycling-first approach could help your road gain structure while generating significant savings, and reusing precious natural resources. See examples and learn more here.

* Data below is prepopulated using national averages. Click the gray figures below to enter your own data.

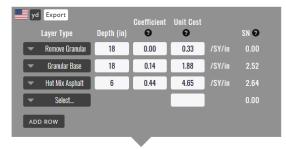
Total Sq. Yards To Be Treated:

23000

Conventional Approach



Optimized: Recycling First





Overall Structural Number: **9 5.16** 23.000 SY x **\$67.68** /SY = **\$1.556.640** total

Overall Structural Number: **9 2.72** 23,000 SY x **\$19.14** /SY = **\$440,220** total



Other Resources





Research & Innovation

We put your ideas in motion

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What we do

The MnDOT Office of Research & Innovation administers research projects for MnDOT and the <u>Local Road Research Board</u>.

Our staff helps to identify the innovation needs of transportation practitioners and shepherds their research projects from the idea stage all the way to implementation.

Check out the <u>Research Strategic Planning and Priorities</u> that guide our work. According to a survey, 78 percent of recently completed research has impacted how MnDOT serves Minnesotans (2015-2018 Research Program Outcomes Survey).

Learn more about our products and services on our <u>About</u> page and also in our annual At-A-Glance.

Looking for something specific?

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Pervious Concrete P

Runoff into Shorevie



Connect



Minnesota Department of Transportation www.dot.state.mn.us/research/



Design & Analysis

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U.S. Department of Transportation Federal Highway Administration

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Pavement Management & Performance

Materials & Construction Technology

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Pavements

Design & Analysis

- Life Cycle Cost Analysis
- · Mechanistic Empirical Design Guide
- Surface Characteristics, Smoothness
- · Pavement Preservation

Materials Quality Assurance

- Quality Assurance
- Risk Assessment
- Warranties

Sustainability

- Recycling
- Sustainable Pavement Program
- Warm Mix Asphalt

Pavement Management & Performance

- Roadmap
- · Pavement Health Track

Materials & Construction Technology

- Aspha
- Concr
- Mater

U.S. Department of Transportation Federal Highway Administration

Federal Highway Administration

FHWA - www.fhwa.dot.gov/pavement

Email Notification

• Join the FHWA Pavement & Materials Email List to receive updates about the Program

AID-PT

- Accelerated Implementation and Deployment of Pavement Technologies FY 19 Annual Report
- Prior Annual Reports

Updated: 10/30/2020



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Minnesota Local Technical Assistance Program MN LTAP – www.mnltap.umn.edu



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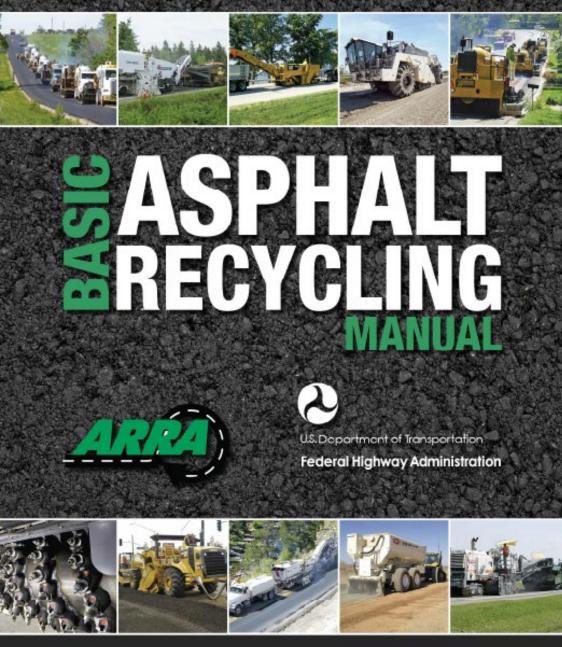


FIND AN ARRA MEMBER Find a contractor or supplier to meet your needs

SEARCH HERE



Asphalt Recycling and Reclaiming Association ARRA - www.arra.org





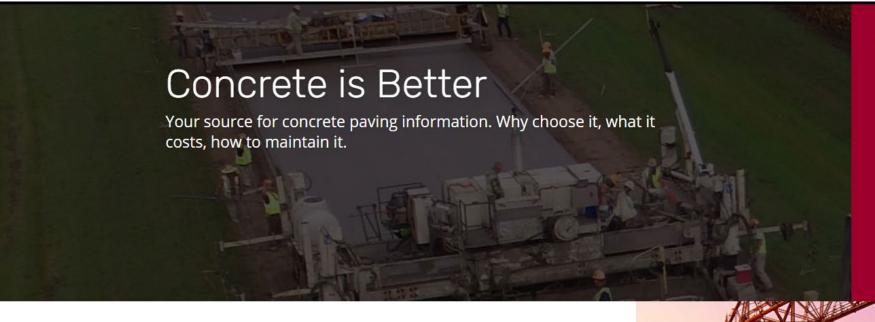
BARM: Basic Asphalt Recycling Manual

ASPHALT RECYCLING & RECLAIMING ASSOCIATION

U.S. Department of Transportation Federal Highway Administration



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Concrete Pavement

CPAM Seeking Full-Time Promoter

The Concrete Paving Association of Minnesota (CP) promotion and technical support of the concrete p



Concrete Paving Association of Minnesota CPAM – www.concreteisbetter.com



MN Asphalt Virtual Conference

FEBRUARY 3-4, 2021



MAPA members are committed to the state and its overall quality of life. The comprised of companies ranging from small driveway – paving operations to construction companies that produce and/or place asphalt pavement on roparking lots, recreational facilities, etc.

It is MAPA's mission to serve our members by advancing the technology of a pavement to their customers. We strive to accomplish this mission with our Professional Engineers by providing technical assistance, training, and cons



Minnesota Asphalt Pavement Association MAPA – www.asphaltisbest.com





THE ROAD AHEAD

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NEWSROOM

Using Plastics in Asphalt Mixes

In October 2019, NAPA and the Asphalt Institute created a joint task force to evaluate the potential of using recycled plastics in asphalt. The task force hired the National Center for Asphalt Technology to conduct a literature review, which yielded two new documents.



PAVEMENT ASSOCIATION

National Asphalt Pavement Association NAPA – www.hotmix.org



NATIONAL CENTER FOR CDD PAVEMENT PRESERVATION

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The National Center for Pavement Preservation (NCPP) was established by Michigan State University and FP2, Inc. to lead collaborative efforts among government, industry, and academia in the advancement of pavement preservation by advancing and improving pavement preservation practices through education, research and outreach.





TSP2 Pavement & Bridge **Partnerships**



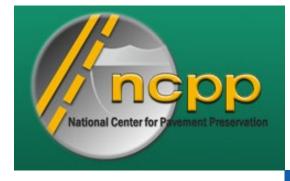
Equipment Management Partnership



NCPP Hosted Conferences and Meetings



Technical Video Library





Pavement Preservation Councils



Pavement Preservation Classes



Research Roadmap Database

National Center for Pavement Preservation NCPP - www.pavementpreservation.org



National Ready Mixed Concrete Association

Founded in 1930, the National Ready Mixed Concrete Association (NRMCA) is the leading advocate for the ready mixed concrete industry. Its mission is to responsibly represent and serve the entire ready mixed concrete industry through leadership, promotion, education, and partnering.

NRMCA's sister organization, the RMC Research & Education Foundation (RMCREF), has been long-represented within TERRA. RMCREF funds and distributes cutting-

edge research, includir Sustainability Hub, as also funds developmen professionalism, and si

More about NRMCA

TERM Transportation Engineering and Road Research Alliance
Partnering for Roadway Innovation

Transportation Engineering and Road Research Alliance TERRA – www.terraroadalliance.org

RESEARCH SPOT





Road Research

National Road Research Alliance

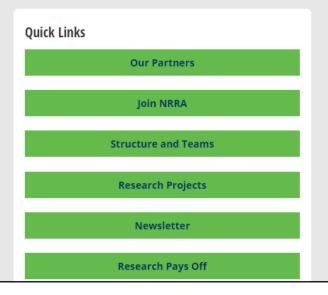
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National Road Research Alliance

The National Road Research Alliance (NRRA) is a Pooled Fund with the goal to improve the future sustainability of our roads through research and a commitment to cooperative implementation. The alliance sponsors research at the MnROAD test track, one of the most sophisticated cold-weather pavement facilities in existence, as well as other locations.

The first phase of the NRRA is concluding in January 2021, but we are moving forward with a Phase II to seamlessly begin in February 2021. In Phase II, our focus is narrowing to the two priorities of sustainability and application of intelligent construction technologies for all pavement projects.





Download the Phase 2 Marketing Kit (zip)

Join the alliance

To date, 11 state agencies and mo become NRRA members. We are s improve and expand transportation more participants. Join us and sha

Research teams & project

Our research teams are di Construction, Preventive N

National Road Research Alliance

NRRA - http://dot.state.mn.us/mnroad/nrra

members and guides the decision-making for the research to be funded.

Questions?

Joe Stadheim, City of New Ulm Tom Wesolowski, City of Shoreview Dan Wegman, Braun Intertec Sue Miller, SRF Consulting Group

