2018 NRRA Pavement Workshop May 23-24

Welcome to the 2018 NRRA Pavement Workshop

This year is a celebration. The NRRA implemented and constructed our first season of test cells in 2017. We haven't seen this volume of research construction for more than a decade at MnROAD, and there are too many congratulations to go around to encapsulate them here.

I knew when we started the NRRA that it was important to emphasize that this was an alliance, not just a loose association of like-minded organizations and individuals. As an alliance, our efforts had to be about accomplishing research together. It had to be about collaboration and, as we say time and time again, implementation.

2017 demonstrated our conviction. Thank you for joining us in celebrating what we've accomplished. Look around and learn and talk to the people responsible for all of the research, especially our teams: Preventive Maintenance, Geotechnical, Rigid Pavements, Flexible Pavements and Technology Transfer. And once we are done patting ourselves on the back, help us roll up our sleeves and chart a course for the future of our alliance.

Together we can make a difference.

Sincerely,

Glenn Engstrom, MnDOT
Chair of NRRA Executive Committee

2019 NRRA Pavement Workshop
Save the Date
May 22-23, 2019

http://www.dot.state.mn.us/mnroad/nrra/pavementworkshop/index.html

2018 NRRA PAVEMENT WORKSHOP
MnROAD TOUR (DAY 1 - MAY 23)

MnROAD Tour Details: MnROAD is a pavement test track made up of various research materials and pavements owned and operated by the Minnesota Department of Transportation, working with its NRRA partners and other researchers around the world. MnROAD finds ways to make roads last longer, perform better, cost less to build and maintain, be built faster and have minimal impact on the environment. MnROAD guided tour consist of reviewing the test cells on both the 3.5-mile mainline Interstate I-94 westbound roadway and the 2.5 mile Low Volume Roadway.

Tours: will be provided by MnDOT key personnel familiar with each test section and the research studies/findings that have been achieved. A number of Minivans will take ~6 members out at a time to provide a custom tour depending on the group's interests. People will be picked up in the driveway going out on the Low Volume Road near the "MnROAD Tour" sign. Suggested NRRA Stops are listed below – see cell maps for a complete list of all the designs/test cells:

- **Mainline Interstate I-94** (West to East)
  - Cells 101,201, 115,215 → NRRA Preventative Maintenance (Micro and Thin Overlay)
  - Cell 2-4 → Full Depth Reclamation built in 2008
  - Cells 705,805 (overlay), 506-806 (new) → NRRA Fiber Reinforced PCC
  - Cell 16-23 → NCAT Thermal Cracking Performance Test Validation
- **Low Volume Road**
  - Cells 55-58 → NCAT Open Graded Friction Coarse
  - Cell 124…624 → NRRA PCC Early Opening to Traffic
  - Cells 185…189 → NRRA Recycled Aggregate Base
  - Cells 127….728 → NRRA Large Stone Base and Geogrids
  - Cell 133…235 → NRRA Cold Central Plant Recycling (thin overlay and chip seals)
  - Cell 37 → Initial Diamond Grinding initial test deck
  - Cell 138,238 → NRRA Reduced Cement Content
  - Cell 139,239 → NRRA Thin Fiber Reinforced Street
- **Original I-94 (Cannot tour today)**
  - Cells 94001-94015 → NRRA PCC Spall Repairs
  - Cells 983-995 → NRRA HMA Overlays of PCC

Special thanks to:
- David White (Ingios Geotechnics, Inc.) – Automated Plate Load Testing Equipment Cells 128/228
- MnROAD Operations Staff (MnDOT) - demoing their equipment along with the MnROAD data collection equipment outside the MnROAD pole barn during the event.

Thank you for visiting MnROAD today – Let us know if you want more information on the current efforts or have ideas for the future - www.mndot.gov/mnroad

NRRA Workshop (Day 1)

May 23, 2018

Monticello Community Center – 505 Walnut Street, Monticello, MN 55362

9:00 - 9:30	National Road Research Alliance - General State of the Alliance *Glenn Engstrom, NRRA Executive Committee Chair (MnDOT)*
9:30 -10:30	Flexible Overview *Barry Paye, NRRA Team Chair (WiSDOT)* Rigid Overview *Brett Trautman, NRRA Team Chair (MoDOT)*
10:30 - 11:00	Break
11:00 - 12:00	Geotechnical Overview *Terry Beaudry, NRRA Team Chair (MnDOT), Dave Van Deusen (MnDOT), John Siekmeier (MnDOT)* Preventive Maintenance Overview *Jerry Geib, NRRA Team Chair (MnDOT)*
12:00 - 1:00	Lunch
1:00 - 2:00	Preventive Maintenance Workshop (Room #1) Spray Applied Rejuvenators *Rob Green (MDOT), Phil Ruffus (MoDOT), Jerry Geib (MnDOT)* DOT Pavement Management Decision Trees *Jerry Geib (MnDOT)*
	Geotechnical Workshop (Room #2) Pavement Design Criteria for Recycled Aggregate Base and Large Stone Subbase *Bora Cetin (Iowa State University)* Case Study TDA Recycled Tires *Joaquin Wright (GHD)*
2:00 - 2:15	Break
2:15 - 3:15	Flexible Workshop (Room #1) NRRA State Asphalt Pavement Performance Testing Hamburg Wheel – *Barry Paye (WisDOT)* IFIT– *Brian Pfeifer (IDOT)* MIST – *Dr. Z. You (Michigan Tech)* TSR– *John Donahue or Brett Trautman (MoDOT)* DCT– *Dave Van Deusen (MnDOT)*
	Rigid Workshop (Room #2) Summary of CP Tech Center Study on Mechanisms of Joint Distress *Gordon Smith (CP Tech Center Iowa State University)* Concrete Pavement Repair Product Evaluations at MnROAD *Tom Burnham (MnDOT)* Findings From Study on Dowel Bar Anchorage in Full-depth Concrete Repairs *Maria Masten (MnDOT)*
3:15	Workshop End

MnROAD Site - 9011 77th Street NE, Monticello, MN 55362

3:30	Tours/Demos
5:00	Dinner
6:00 -7:30	Executive Committee Meeting *MnROAD conference room [states only]*

NRRA Workshop (Day 2 morning)

May 24, 2018

University of Minnesota (St Paul Campus – 1890 Buford Ave., St Paul, MN 55362)

7:30	Registration and Continental Breakfast
8:00	Welcome *Glenn Engstrom, NRRA Executive Committee Chair (MnDOT)*
8:10	Gene Skok Scholarship Awards *Joe Labuz (University of Minnesota)*
8:15	National Perspective of Mike Anderson *Skok Distinguished Speaker* *R. Michael Anderson (Asphalt Institute)*
9:00	Reflections on 34 years of Pavement Engineering *Rohrbach Distinguished Speaker* *Dave Rettner (American Engineering Testing)*
9:30	Break / Exhibits *Visit the NRRA members during the break*
10:15	NRRA Workshop Summary Benefits of the NCAT / MnROAD Partnership *Ben Worel (MnDOT)* *Buzz Powell (National Center for Asphalt Technology)*
10:45	MnROAD Construction Associate Member Testimonials *John Roberts (International Grooving and Grinding Association)* *Soheil Nazarian (Univ. of El Paso, Center for Transportation Infrastructure)* *David White (Ingios)* *Luke Pinkerton (Helix)*
11:30	Lunch
12:30	Technical Talk – Future Technologies *Bryan Downing (CAT Paving Products)*
1:00	State Member Testimonial *John Donahue (MoDOT)* *John Senger (IDOT)* *Barry Paye (WisDOT)*
1:30	NRRA Future Goals and Direction *Glenn Engstrom, NRRA Executive Committee Chair (MnDOT)*
1:45	Break / Exhibits
2:15	Concurrent Research Tracks (Rooms 1,2,3,4 – See next page)

NRRA Workshop (Day 2 afternoon)

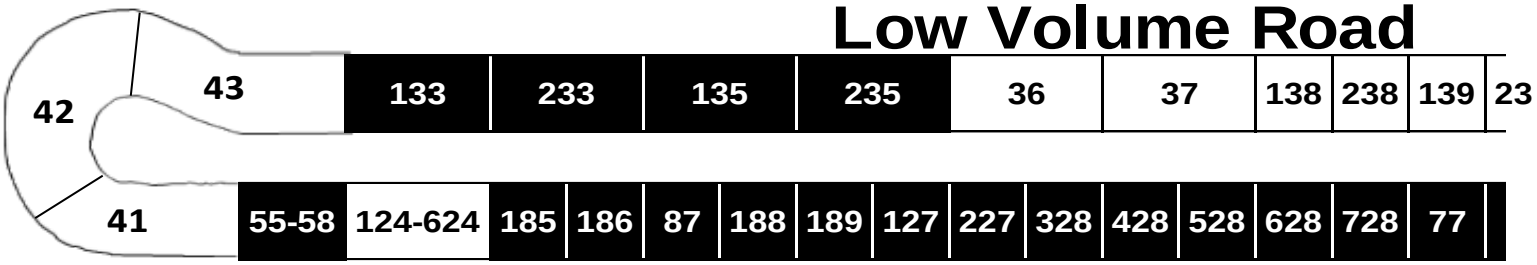
May 24, 2018

2:15	Concurrent Research Tracks (Rooms 1,2,3,4)
	Geotechnical Team (Room 1) *Moderator – John Siekmeier* Recent frost depth/protection research *Bora Cetin (Iowa State University)* Frost Depth Estimation and Mitigation *Steve Henrichs (MnDOT)* Pavement Foundation Construction Quality Assurance and Process Control *Dave White (Ingios)* Quantifying Moisture in Granular Materials for Mechanistic Pavement Design *Soheil Nazarian (University of El Paso, Center for Transportation Infrastructure)*
	Flexible Team (Room 2) *Moderator – Brandon Brever (Minnesota Asphalt Paving Association)* Overlay Study *Eshan Dave (University of New Hampshire)* Cold Central Plant Recycling *Dave Rettner (American Engineering and Testing)* IFIT and Illinois experience *Brian Pfeifer (IDOT)* Future of asphalt binder specifications *Andy Cascione (Flint Hills Resources)*
	Rigid Team (Room 3) *Moderator - Charles Wienrank (IDOT)* Evaluation of the Benefits From Structural Fibers in Thin Concrete Pavements *Manik Barman (University of Minnesota Duluth)* Concrete Overlay Performance on Iowa's Roadways *Gordon Smith (CP Tech Center at Iowa State University)* 10-year Anniversary of the Route D Unbonded Concrete Overlay, Oldest US Project With Geotextile Interlayer *John Donahue (MoDOT)* Reliability Analysis of MnDOT's Concrete Rehabilitation Sections *Bernard Izevbekhai (MnDOT)*
	Preventive Maintenance Team (Room 4) *Moderator – Jerry Geib (MnDOT)* Maintaining Poor Pavements *Joe Korzilius (SRF)* PCC Patching *Justin Lashley (Braun)* Diamond grinding and lightly surfaced roads *Joe Korzilius (SRF)* IDIQ of PCC pavement *Phil Ruffus (MoDOT)*
4:15	Adjourn
4:30 - 6:30	Closing Reception *Refreshments and appetizers*

This two-day conference provides practical information to practitioners and others interested in pavement design, construction, rehabilitation, and maintenance. The conference examines national and local trends and innovations to expand understanding of pavement challenges and solutions.

MnROAD

Low Volume Road



Miinnesota Local Road Research Board
Supported since 1994

Cell numbers in RED were built by NRRA in 2017

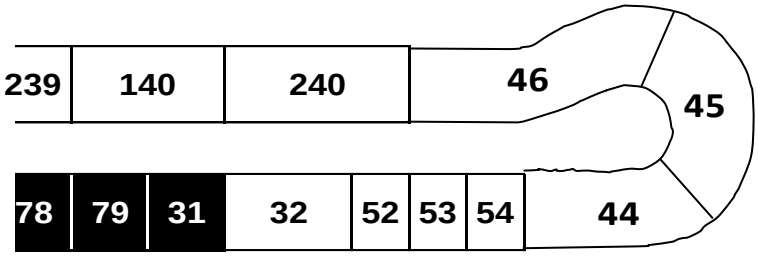
December 2017

North Side Cells (West to

	West Loop			Cold Central Plant Recycling (CCPR)				Original PCC		Redu Cementitio
	41	42	43	133	233	135	235	36	37	138
	12" PCC New Ulm Quartz 15'Lx12'W 1" dowel Trans Tined	12" PCC North Concrete Luverne 15'Lx12'W 1" dowel Trans Tined	12" PCC Shiely Lakeland 15'Lx12'W 1" dowel Trans Tined	2X Chip 4" CCPR Emulsion 12" Class 6	2X Chip 4" CCPR Foam 12" Class 6	1.5" HMA 4" CCPR Foam 12" Class 6	1.5" HMA 4" CCPR Emulsion 12" Class 6	6" PCC 15'Lx12'W 1" dowel Trans Tined 5" Class 5	6" PCC 12'Lx12'W Trans Tined 5" Class 5	8" PCC 1" Dowel 15'Lx12'W Astro Turf 500 lbs Cement 5" Class 5
	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Sand	Sand 2007 PCC Grind Strips	Clay
Opened	Jul 93	Jul 93	Jul 93	2017	2017	2017	2017	Jul 93	Jul-93	2017
Length (ft)	491	490	494	425	425	425	437	480	504	240.5
Inside Gap	97	147	175					127	42	19.5
Outside Gap	102	152	175							
Outside Cell (ft)	510	510	508							

South Side Cells

West Loop Tie to Cell 41	Open Graded Friction Coarse				Concrete - Early Opening to Traffic						Recycled Unbound Base				
	55	56	57	58	124	224	324	424	524	624	185	186	87	188	189
	1" OGFC Reg Tack 12" PCC 12x15 1" dowel Trans Tined	1" OGFC Trackless 12" PCC 12x15 1" dowel Trans Tined	1" OGFC Trackless 3" HMA 58-34 4" Class 6	1" OGFC Reg Tack 3" HMA 58-34 4" Class 6	6" PCC 15'Lx12'W 1" dowel Astro Turf 6" Class 6	6" PCC 15'Lx12'W 1" dowel Astro Turf 6" Class 6	6" PCC 15'Lx12'W 1" dowel Astro Turf 6" Class 6	6" PCC 15'Lx12'W 1" dowel Astro Turf 6" Class 6	6" PCC 15'Lx12'W 1" dowel Astro Turf 6" Class 6	6" PCC 15'Lx12'W 1" dowel Astro Turf 6" Class 6	3.5" HMA 12" Coarse RCA	3.5" HMA 12" Fine RCA	4" HMA 4" Mesabi Ballast 11"	3.5" HMA 12" Recycled Agg Base Class 6	3.5" HMA 12" Recycled Agg Base Class 6
	Clay	Clay	Sand	Sand	Sand 1st Loaded	Sand 2nd Loaded	Sand 3rd Loaded	Sand 4th Loaded	Sand No Initial Load	Sand Trans Load (Ruts)	3.5" Select Granular Borrow Sand	3.5" Select Granular Borrow Sand	Clay Sand	3.5" Select Granular Borrow Clay	3.5" Select Granular Borrow Clay
Opened	Sept 2016	Sept 2016	Sept 2016	Sept 2016	2017	2017	2017	2017	2017	2017	2017	2017	Oct 08	2017	2017
Length (ft)	50	50	50	49	130	120	120	120	60	18	201	201	226	201	200
Gap (ft)												50	1.5	1	



Low Volume Road ESALS per Year						
Year	Inside Lane (80,000 lbs)			Outside Lane (102,000 lbs)		
	Laps	Flexible	Rigid	Laps	Flexible	Rigid
1994	3,283	7,682	12,311	889	6,285	10,241
1995	7,748	18,130	29,055	2,927	20,694	33,719
1996	8,598	20,119	32,243	2,576	18,212	29,676
1997	6,874	16,085	25,778	2,172	15,356	25,021
1998	10,165	23,786	38,119	2,236	15,809	25,759
1999	4,658	10,900	17,468	1,694	11,977	19,515
2000	8,888	20,798	33,330	2,451	17,329	28,236
2001	8,155	19,083	30,581	2,203	15,575	25,379
2002	9,849	23,047	36,934	1,797	12,705	20,701
2003	6,923	16,200	25,961	2,820	19,937	32,486
2004	3,950	9,243	14,813	1,202	8,498	13,847
2005	5,986	14,007	22,448	2,082	14,720	23,985
2006	6,634	15,524	24,878	2,246	15,879	25,874
2007	5,295	12,390	19,856	935	6,610	10,771
2008	2,958	6,922	11,093	Since 2008 MnROAD has not loaded the outside lane to learn more about the environmental deterioration without traffic		
2009	6,229	14,576	23,359			
2010	6,623	15,498	24,836			
2011	5,336	12,486	20,010			
2012	8,447	19,766	31,676			
2013	6,335	14,824	23,756			
2014	8,739	20,449	32,771			
2015	8,160	19,094	30,600			
2016	7,962	18,631	29,858			
	75,141	175,830	281,780	21,765	153,879	250,733

Located at the MnROAD Site - not on LVR

PCC Pervious Pavements

64	2007	7" PCC/ 12" CA-15 Base/Geotextile /clay (Park Lot)
64-1	2011	6" Precast/1"base /12"CA-15 Base/Fab/clay (Park Lot)
74	2006	4" PCC/6"washed Stone/Geotextile/clay (SideWalk)

Implements of Husbandry

83	2007	3.5" HMA/8" C-5 Base/Clay (Stockpile Area)-450 ft
84	2007	5.5" HMA/9" C-5 Base/Clay (Stockpile Area)-450 ft

to East)

duced titious PCC	Fiber Reinforced PCC Street		Thin Unbonded Concrete Overlay		East Loop		
238	139	239	140	240	46	45	44
8" PCC 1" Dowel 15'Lx12'W Astro Turf 470 lbs Cement	3" Fiber Reinf PCC Turf	4" Fiber Reinf PCC Turf	3" Fiber Reinf PCC	3" Fiber Reinf PCC	12" PCC High Early Mix 15'Lx12'W 1" dowel Trans Tined	12" PCC Type III Mix 15'Lx12'W 1" dowel Trans Tined	12" PCC Control 15'Lx12'W 1" dowel Trans Tined
	6" Class 5	6" Class 5	Thin Fabric 5.5"-7.0" PCC 15'Lx12'W	Std Fabric 5.5"-7.0" PCC 15'Lx12'W			
5" Class 5	4" Common Borrow	4" Common Borrow	5" Class 5	5" Class 5			
Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay
	6'Lx6'W Sealed Joints 30% RSR	6'Lx6'W Sealed Joints 30% RSR	6'Lx6'W 20% RSR Long Tined	6'Lx6'W 20% RSR Long Tined			
2017	2017	2017	Jul 13	Jul 13	Jul 93	Jul 93	Jul 93
270	275.5	258.5	225	234	508	489	442
.5	8		26	108	98	146	0
					102	153	0
					493	511	463

lls (West to East)

Large Subbase		Large Subbase and Geogrid Cells					Stabilized Full Depth Reclamation			Mesabi Rock	Thin PCC	PCC Dowels	60-Year PCC	Mesabi PCC	East Loop Tie to Cell
127	227	328	428	528	628	728	77	78	79	31	32	52	53	54	
3.5" HMA	3.5" HMA	3.5" HMA	3.5" HMA	3.5" HMA	3.5" HMA	3.5" HMA	4" 58-34 Elvaloy + PPA	4" 58-34 Elvaloy + PPA	4" 58-34 Elvaloy + PPA	4" 64-34	5" PCC	7.5" PCC 15'Lx 13/14'W Astro Turf	12" PCC 15'Lx12'W 1.5" SS dowels Trans Broom	7.5" PCC 15'Lx12'W 1" dowel Astro Turf	
6" Class 6	6" Class 6	6" Class 5Q	6" Class 5Q	6" Class 5Q	6" Class 5Q	6" Class 5Q	8" FDR	8" Class 6	8" FDR + Fly Ash	4" Class 5	7" Class 5Q	5" Class 4	5" Class 5	12" Class 6	
18" Large Subbase 1 lift	18" Large Subbase 2 lifts	Grid 1 9" Large Subbase	Fabric Grid 1 9" Large Subbase	Fabric Grid 2 9" Large Subbase	Grid 2 9" Large Subbase	9" Large Subbase	Clay	Clay	Clay	12" Class 3	Clay 2012 Repairs Diamond Grind	Clay Number of different Dowels	36" Select Granular Clay PCC Shld	Clay	
Clay	Clay	Clay	Clay	Clay	Clay	Clay				Clay					
2017	2017	2017	2017	2017	2017	2017	Oct 07	Oct 07	Sep 07	Sep 04	June 00	Jun 00	Oct 08	Oct 04	
258	260	109	108	108	113	131	286	365	324	500	460	285	115	194	
							30	49	49	69	30				

MnRO

Original Interstate 94

Weigh In Motion

2013 Diamond Grinding 964-969	2013 Dowel Replacement 970-982	2017 Spall Repairs 94001-94010	[redacted]

23	22	21	20	19	18	17	16	215	115	114-914	613	12	72	73	71	[redacted]

Mainline Interstate 94

2016 HMA Performance Testing Test Sections (tied to NCAT)	Maintain Roadways	W Bonded Conc

	23	22	21	20	19	18	17	16	215	115	914	814	714	614
									1.5" HMA	MicroSurface	6" PCC	6" PCC	6" PCC	6" PCC
	5" HMA PG 64E-34	5" HMA PG58H-34	5" HMA PG 58H-34	5" HMA PG 52S-34	5" HMA PG 64S-22	5" HMA PG 64S-22	5" HMA PG 64S-22	5" HMA PG 64S-22	2.25" WM 58-34	2.6" WM 58-34	6' x 6' Astro Turf Driving LN 1" Dowels	6' x 6' Astro Turf Driving LN No Dowels	6' x 6' Astro Turf Driving LN 1" Dowels	12L' x 6W' Astro Turf Driving LN Plate Dowels
	Low LTC Potential 15% RAP HiMA 12" Class 6	High LTC Potential 20% RAP LMS PG Binder + anti-strip 12" Class 6	Med LTC Potential 20% RAP Typical Mix 12" Class 6	Med/High LTC Potential 30% RAP 12" Class 6	Med LTC Potential 20% RAP 3% Air Voids 12" Class 6	Med LTC Potential 20% RAP 12" Class 6	High LTC Potential 10% RAP 5% RAS 12" Class 6	High LTC Potential 20% RAP 5% RAS 12" Class 6	11" 64-22 1993 HMA	11" 64-22 1993 HMA	8" 58-28 93HMA	8" 58-28 93HMA	7.5" 58-28 93HMA	7" 58-28 93HMA
	12" Class 3	12" Class 3	12" Class 3	12" Class 3	12" Class 3	12" Class 3	12" Class 3	12" Class 3	Clay	Clay	Clay	Clay	Clay	Clay
	7" Select Gran	7" Select Gran	7" Select Gran	7" Select Gran	7" Select Gran	7" Select Gran	7" Select Gran	7" Select Gran	M-Mill .75" Overlay 1.5" (2 0.75" lifts, 4.75 mm PG 58V-34)	M-Mill .375" Micro surface CQS-1P 0.375"				
	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay						
Opened	Sept 16	Sept 16	Sept 16	Sept 16	Sept 16	Sept 16	Sept 16	Sept 16	2017	2017	Oct 08	Oct 08	Oct 08	Oct 08
Length (ft)	500	500	500	500	500	500	500	500	283	290	60	24	18	109
Gap (ft)		80	80	90	50	70	70	47			12			

Original 5-Year PCC	Fiber Reinforced PCC	Fiber Reinforced PCC Overlay	Unbonded PCC Overlay of PCC	Stabilized Full Depth Reclamation

	9	8	7	806	706	606	506	805	705	605	505	4	3	2
	7.5" PCC 2008 Ultimate Grind	7.5" PCC 2007 Traditional Grind	7.5" PCC 2007 Innovative Grind	5" Fiber Reinf. PCC (High) Astro Turf	5" Fiber Reinf. PCC (Enhanced) Astro Turf	6" Fiber Reinf. PCC (Standard) Astro Turf	5" PCC Control No Fibers Astro Turf	5" PCC Fibers Unsealed No Dowels Astro Turf	5" PCC Fibers Unsealed No Dowels Astro Turf	5" PCC No Dowels Trans Broom	5" PCC No Dowels Trans Broom	1" 64-34 2"64-34	1" TBWC 2"64-34	1" TBWC 2"64-34
	4"PSAB	4"PSAB	4"PSAB	11" Class 5Q	11" Class 5Q	11" Class 5Q	11" Class 5Q	Geotextile 7.5"PCC 1993 cracked D 12'Lx6'W, 12'Lx8'W P 12'Lx6'W, 12'Lx7'	Geotextile 7.5" PCC 1993 Driving 12'Lx14'W Passing 12'Lx12'W	Geotextile 7.5" PCC 1993 Driving 6'Lx7'W Passing 6'Lx6.5'W	Geotextile 7.5"PCC 1993 cracked Driving: 6'Lx7'W Passing: 6'Lx6.5'W	8" FDR + EE	6" FDR + EE	6" FDR + EE
	3"Cl 4	3"Cl 4	3"Cl 4	3" Class 5	3" Class 5	3" Class 5	3" Class 5	3" Class-4	3" Class-4	3" Class-4	3" Class-4	9" FDR + Fly Ash	2" FDR 2"Cl 5	6" FDR
	Clay	Clay	Clay	Clay	Clay	Clay	Clay	27" Class-3	27" Class-3	27" Class-3	27" Class-3		33" Class 3	4" Class 4
	15'Lx14'W 15'Lx13'W	15'Lx14'W 15'Lx13'W	20'Lx14'W 20'Lx13'W 1" dowel					Clay	Clay	Clay	Clay	Clay	Clay	Clay
	13' PCC Shoulder Passing Ln 1" dowel	13' PCC Shoulder Passing Ln 1" dowel		Fibers 0.75% by Volume	Fibers 30% RSR	Fibers 20% RSR		4" PCC Shoulder Inside lane	4" PCC Shoulder Inside lane	RCC Shoulders	RCC Shoulders			
Opened	Sep 92	Sep 92	Sep 92	2017	2017	2017	2017	2017	2017	Sep 11	Sep 11	Oct 08	Oct 08	Oct 08
Length (ft)	518	510	500	131	135	134	146	118	133	148	153	496	454	560
Gap (ft)	8	30	35	28								75	110	60

Original I-94 Westbound Test Sections

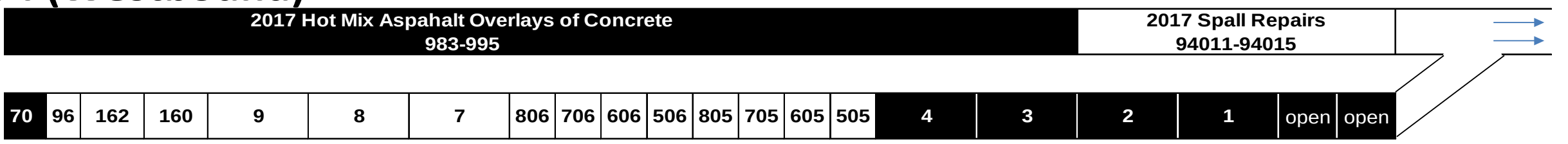
2013 Diamond Grinding			
Section	Layer Description	Length (ft)	Gap (ft)
964	2013 Traditional Grind (First 100' Transil Plus Sealant)	500	0
965	Longitudinal Groved - 125 blades	500	0
966	Longitudinal Groved - 125 blades	500	0
967	Longitudinal Groved - 90 blades	500	0
968	Longitudinal Groved - 90 blades	500	0
969	2013 Traditional Grind (First 100' Transil Plus Sealant)	500	0

2013 Joint Replacement Study (3 Joints per Section)			
Section	Layer Description	Length (ft)	Gap (ft)
970	Full Depth PCC Repair - 1 dowels - No Grout"	80	0
971	Full Depth PCC Repair - 1.25 dowels - No Grout"	80	0
972	Full Depth PCC Repair - 1 dowels - Bag Grout"	80	0
973	Full Depth PCC Repair - 1.25 dowels - Bag Grout"	80	0
974	Full Depth PCC Repair - 1 dowels - Dip Grout Method"	80	0
975	Full Depth PCC Repair - 1.25 dowels - Dip Grout Method"	80	0
976	Full Depth PCC Repair - 1 dowels - Capsule Grout Method"	80	0
977	Full Depth PCC Repair - 1.25 dowels - Capsule Grout Method"	80	0
978	Full Depth PCC Repair - 1 dowels - Powers Epoxy"	80	0
979	Full Depth PCC Repair - 1.25 dowels - Powers Epoxy"	80	0
980	Full Depth PCC Repair - 1 dowels - Rezi Weld Epoxy"	80	0
981	Full Depth PCC Repair - 1.25 dowels - Rezi Weld Epoxy"	80	0
982	No PCC Repair	80	0

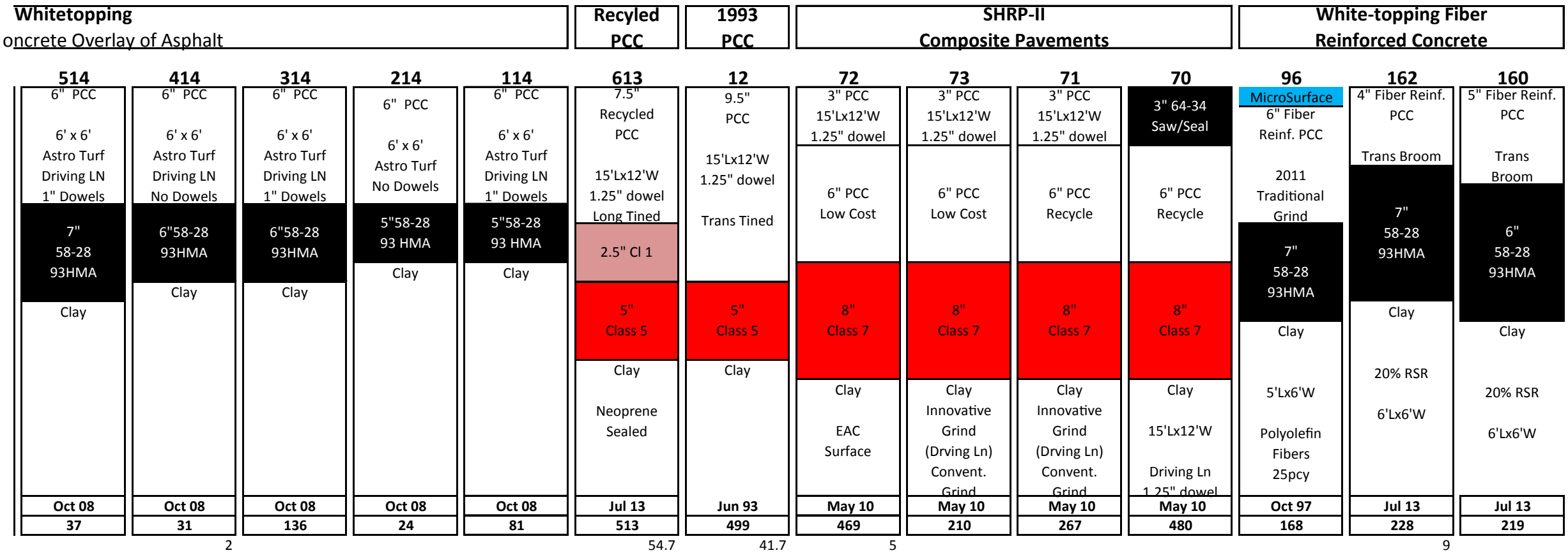
Section
94001
94002
94003
94004
94005
94006
94007
94008
94009
94010
94011
94012
94013
94014
94015

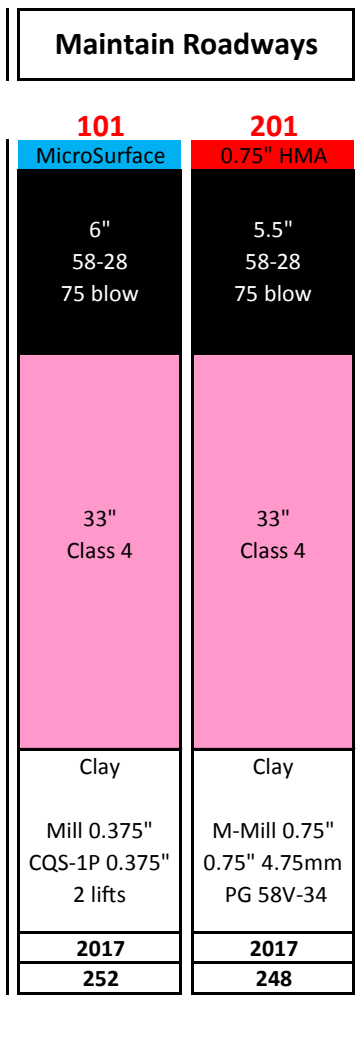
AD

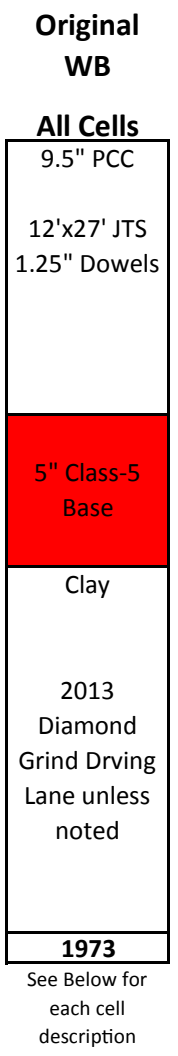
94 (Westbound)



94 (Westbound)







Mainline Westbound - ESALS per Year				Year	Original Westbound - ESALS per Year			
Driving Lane		Passing Lane			Driving Lane		Passing Lane	
Flexible	Rigid	Flexible	Rigid		Flexible	Rigid	Flexible	Rigid
263,499	395,956	67,082	104,717	1994 *	37,388	56,183	9,518	9,518
579,931	877,886	176,791	276,724	1995	61,508	93,109	18,751	18,751
532,911	808,851	159,421	248,394	1996	176,345	267,656	52,754	52,754
415,828	632,244	110,144	173,507	1997	306,921	466,656	81,296	81,296
542,037	821,696	163,020	254,847	1998	157,057	238,089	47,236	47,236
641,264	967,499	186,017	289,248	1999	165,844	250,215	48,108	48,108
672,845	1,015,504	178,090	272,328	2000	200,422	302,491	53,048	53,048
712,973	1,077,422	191,675	291,229	2001	169,180	255,660	45,482	45,482
712,316	1,077,750	185,766	282,422	2002	163,089	246,758	42,532	42,532
692,453	1,042,991	190,299	288,709	2003	182,098	274,281	50,044	50,044
434,937	656,611	111,581	169,923	2004	469,534	708,841	120,456	120,456
812,340	1,222,622	215,201	325,195	2005	182,640	274,885	48,384	48,384
713,038	1,075,755	184,544	280,287	2006	261,714	394,847	67,735	67,735
759,904	1,142,266	188,653	285,853	2007	152,481	229,204	37,855	37,855
209,337	318,084	46,074	70,208	2008	671,325	1,020,062	147,755	147,755
773,095	1,170,257	196,919	291,873	2009	234,689	355,257	59,779	59,779
583,177	877,282	141,483	215,470	2010	350,418	527,139	85,014	85,014
632,002	956,376	149,516	227,038	2011	388,709	588,213	91,960	91,960
719,264	1,098,214	178,118	270,145	2012	277,897	424,310	68,818	68,818
921,873	1,390,830	245,983	368,504	2013	103,992	157,118	27,748	27,748
827,056	1,250,927	219,653	328,592	2014	182,561	276,124	48,485	48,485
875,172	1,323,535	237,183	353,444	2015	165,342	250,049	44,810	44,810
564,989	857,596	131,070	189,949	2016	468,941	711,805	108,788	108,788
				2017				

2017 Spall Repair Study (~3 Panels per Section)		
Layer Description	Length (ft)	Gap (ft)
Rapid Set - DOT Repair Mix (CTS Cement)	80	0
RepCon 928 (SpecChem)	80	0
FasTrac 246 Concrete Mix (Western Materials & Design)	80	0
PaveSaver - Ploymeric Concrete Patch (DS Brown)	80	0
FastPatch (Willamette Valley Company)	80	0
Rapid Surface Repair Easy Mix (Five Star Products)	80	0
ProSpec Rapid Patch Commercial DOT Repair	80	0
AquaPatch	80	0
High Performance (HP) Concrete Repair (Craftco)	80	0
TechCrete TRB (Craftco)	80	0
Break		
3U18 Modified PCC	80	0
ECOFIX™ BRAND RAPID REPAIR PATCH (USG)	80	0
Helix steel fiber in Rapid set DOT mix	80	0
Flexcrete	80	0
HMA Repair (Plant Mix)	80	0

2017 HMA over PCC			
Section	Layer Description	Length (ft)	Gap (ft)
983	PCC Control	500	100
984	1.5 inch HMA overlay (9.5 mm)	500	100
985	1.5 inch HMA overlay (12.5 mm)	500	100
986	1.75 inch HMA overlay (12.5 mm)	500	100
987	2.5 inch (19 mm) HMA overlay; 1.5 inch (9.5 mm) HMA overlay	500	100
988	25 inch (19 mm) HMA PG 58H-28 overlay;1.75 inch (12.5 mm) 4.0 voids HMA overla	500	100
989	25 inch (19 mm) HMA PG 58H-28 overlay;1.75 inch (12.5 mm) 5.0 voids HMA overla	500	100
990	25 inch (19 mm) HMA PG 58H-28 overlay;1.75 inch (12.5 mm) 3.0 voids HMA overla	500	100
991	25 inch (19 mm) HMA PG 58H-28 overlay;1.75 inch (9.5 mm) fine mix HMA overlay	500	100
992	1 inch high-polymer interlayer;1.5 inch (9.5 mm) HMA overlay	500	100
993	1.5 inch (9.5 mm) HMA overlay	500	100
994	1.5 inch (9.5 mm) HMA overlay	500	100
995	0.75 inch UTBWC	500	100

ARRA™
Asphalt Recycling & Reclaiming Association

2018 SEMI-ANNUAL MEETING

SAVE THE DATE! • OCTOBER 15-18, 2018 • NORFOLK, VA

ARRA represents "Responsible Renewal. Reliable Results," by servicing our nation's increasing infrastructure deficits through offering cost effective, engineered solutions built to last while meeting the ever growing demands of being socially and environmentally accountable.

In Norfolk, industry leading professionals from around the world will speak on key industry topics to help industry companies and agencies improve their businesses while saving taxpayer dollars by being more efficient, safer, comfortable with technology, and embracing trends before others see it coming.

A special opportunity is being provided to tour the I-64 project, visit the CCPR plant doing the work and see a demonstration, and hear from Virginia DOT about the great work that has been done. An additional meeting highlight will be a tour of the USS Wisconsin BB-64 battleship with a reception afterwards in the ship's turret.

Please not only mark these dates down in your calendar, but get these dates into the calendars of your co-workers, colleagues, clients and reach out to new contacts and invite them to attend this very affordable, useful and significant event that will benefit your businesses.

INFRASENSE

WE SURVEY PAVEMENTS USING GPR AND VISUAL IMAGING TO MAP:

- LAYER THICKNESSES
- STRIPPING
- DETERIORATION
- CRACKING, SPALLING, & PATCHING
- VOIDING IN BASE/ SUBGRADE
- RELATIVE DENSITY

THE GPR DATA CAN BE COMBINED WITH FWD OR TSD DATA TO CALCULATE:

- REMAINING LIFE
- STRUCTURAL NUMBER
- PAVEMENT MODULUS
- SUBGRADE MODULUS

infrasense.com
781-281-1686

Certificate of Completion

Professional Development Hours

Participant

NRRA Pavement Workshop
Education Activity

National Road Research Alliance
Activity Sponsor

Various
Instructor/Leader

Activity Date

Professional Development Hours

Minnesota Department of Transportation has determined that this educational activity meets the State of Minnesota Board of Registration Continuing Education Requirements. The Minnesota Board of Architecture, Engineering, Land Surveying, Landscape Architecture, GeoScience, and Interior Design (Board of AELSLAGID) has final authority to review and approve Professional Development Hours.

Attach any or all of the items below for your records:

- ☐ Registration receipts
- ☐ Agenda/Syllabus
- ☐ Course plan
- ☐ Announcement/Brochure information
- ☐ Other information or details
- ☐ Expected outcome of the education activity

Speaker Bios

R. Michael (Mike) Anderson, P.E.

- Director of Research and Lab Services
- Worked for AI since 1991
- Started his career in the asphalt industry in 1987 with the Kentucky Department of Highways, Division of Materials
- Continued his career working for H.G. Mays Corporation before joining AI
- Has been actively involved with a number of national research projects including the Strategic Highway Research Program (SHRP) and several post-SHRP implementation projects as well as multiple NCHRP (National Cooperative Highway Research Program) projects involving asphalt material testing and analysis.
- Member of the Association of Asphalt Paving Technologists (AAPT), International Society for Asphalt Pavements (ISAP), Canadian Technical Asphalt Association (CTAA), ASTM International, and Association of Modified Asphalt Producers (AMAP)
    - Served AAPT as President in 2008-09; serving now as Executive Director (2013-)
    - ISAP Executive Administrator (2014-)
- Has been an author or co-author of numerous published peer-reviewed technical papers, manuals, and reports
- Is a registered professional engineer in Kentucky

Dr. Manik Barman is an Assistant Professor in the Department of Civil Engineering at the University of Minnesota Duluth (UMD). He received his Ph. D. (2014) from the University of Pittsburgh. Before Joining UMD (2015), he served as a Senior Research Fellow at the University of Oklahoma (OU) for two and a half years (2013-2015). Dr. Barman teaches infrastructure materials and pavement engineering related courses at UMD. His current research projects focus on (i) use of structural fibers in concrete pavements and overlays, (ii) best practices for patching pot-holes of asphalt pavement, (iii) cost-effectiveness of crack sealing methods, and (iv) high-density asphalt mix, etc. He is actively involved in several professional organizations (e.g., ASCE, TRB, ACI, NRRA, IRC, etc.) and currently serving as a member of the two TRB Standing Committees. He is a peer reviewer of several scholarly journals in the pavement engineering area and also a lead editor for a proceeding in the 5th Geochina International conference 2018."

Terry Beaudry is the Grading, Base, Aggregate, and Reclamation Engineer and is currently on mobility to the Bridge Standards Unit of the Bridge Office.

Terry attended the University of Minnesota (Minneapolis) and has Bachelor of Science degrees in Geology, Geophysics, & Civil Engineering.

He has been with the Minnesota Department of Transportation for over thirty years and has served in the Bridge and Materials Offices as well as District 9 and Metro District in various positions.

Brandon Brever is currently the associate director of the Minnesota Asphalt Pavement Association (MAPA). The organization represents about 96 percent of Minnesota's asphalt industry – approximately 23 asphalt producers along with 9 asphalt non-producers and 100+ associate members who supply materials to the asphalt pavement industry. The association represents members' interests regarding items involving transportation, the environment, and legislation.

Andy Cascione is an Asphalt Technical Representative at Flint Hills Resources in Rosemount, MN, which produces liquid asphalt, polymer modified asphalt, and asphalt emulsions. Andy graduated from Michigan Tech (BS '04) and Iowa State University (PhD '14) with degrees in Civil Engineering. In between degree programs, he worked as a HMA QC Engineer and Construction Materials Testing Engineer in Arizona.

Dr. Bora Cetin is an Assistant Professor in the Geotechnical and Geoenvironmental Engineering Area in the Department of Civil, Construction and Environmental Engineering at Iowa State University. He is the head of the Sustainable Geotechnical Infrastructure Group (SGIG). His research program encompasses multiple research fields including transportation infrastructure, nuclear waste disposal, municipal solid waste landfill design, remediation of mine waste/contaminated soils, and sustainable geotechnical practices.

Dr. Eshan Dave is assistant professor in the Department of Civil and Environmental Engineering at the University of New Hampshire. Prior to his current position he was Associate Professor at the University of Minnesota Duluth. He obtained his M.S. (in 2003) and Ph.D. (in 2009) from the University of Illinois at Urbana-Champaign. Eshan's research interests focus on the use of performance-based evaluation and design techniques to prolong the life of pavements in an economical manner. His current research is focusing on developing performance based asphalt specifications, mechanistic evaluation of thermal and reflective cracking in pavements, life cycle assessment of pavement infrastructure, 3D printed infrastructure systems and use of unmanned aerial systems (UAS) for infrastructure condition assessment.
Eshan is Chairman of the International Society of Asphalt Pavements Technical Committee on Pavement Evaluation, Secretary of the RILEM technical committee on Asphalt Pavement Recycling, Chairman of the Transportation Research

Board subcommittee AFK50(1) on Asphalt Modelling and member of the FHWA Expert Task Group on Long Term Pavement Performance program. He is also active member of the ASCE, ASTM, Association of Asphalt Paving Technologists and American Concrete Institute.

Name: **John P. Donahue**
Employer: Missouri Department of Transportation
Job Title: Construction and Materials Liaison Engineer
Time of Service with Current Employer: 19 years
Previous Employer: Federal Highway Administration
Time of Service with Previous Employer: 10 years
Committees: TRB
Rigid Pavement Design Committee (AFD50)
General and Emerging Pavement Design (AFD30)
AASHTO
Chair of AASHTO Pavement ME Design Task Force
Committee on Materials and Pavements (COMP) Steering Committee
Education: BS in Civil Engineering from U. of Illinois at Champaign-Urbana (1987)
MS in Civil Engineering from U. of Illinois at Champaign-Urbana (1989)
Certification: Registered Professional Engineer in Missouri
Married and has four daughters.

Bryan Downing has 24 years of product development experience for Caterpillar, the first 11 years spent designing machines and now offering customer's Paving Solutions as a Global Sales Consultant. His Paving industry experience includes emphasis on compaction products and technology integration across the asphalt paving process. Bryan's field application testing and consulting has led to significant compaction innovations, including the development of Caterpillar's Intelligent Compaction (IC) systems. Bryan is recognized as a compaction expert and is closely involved in with regional DOT/FHWA implementation and application use of IC. As a Global Sales Consultant at Caterpillar, Bryan works closely with contractors and Caterpillar's Engineers to innovate Paving solutions and integrate technology into paving machinery to bring value to customers in the asphalt paving industry.

Glenn Engstrom is currently the Director, MnDOT's Office of Materials and Road Research. This position provides overall leadership and administrative guidance to the 125 employees of the Office of Materials & Road Research. The Office provides technical expertise in the areas of materials testing, pavement management, geotechnical engineering and pavement research to MnDOT, counties and cities.
Past Positions included:

- Chief Geotechnical Engineer, MnDOT
- Assistant District Engineer (ADE), Maintenance, MnDOT District 7
- Manager, Minnesota Road Research Section, MnDOT
- Area Engineer, FHWA Minnesota Division
- Structural Engineer - Short, Elliot, and Hendrickson
- Project Manager and Structural Engineer, US Army Corps of Engineers, St Paul District

Jerry Geib works as a Research Operations Engineer for the Minnesota Department of Transportation. He has held positions as a Research Engineer, Pavement Preservation Engineer, and Pavement Design Engineer during his 19 year career at MnDOT. He also works on developing specifications and guidelines, and providing training and assistance. He served on the FHWA Expert Task Group for Pavement Preservation.
Jerry works on "Keeping the Good Roads – Good."

Steven Henrichs is the Assistant Pavement Design Engineer with MnDOT's Office of Materials and Road Research. Originally from Fargo, ND, Steve graduated with a BS in Civil Engineering from North Dakota State University. He worked 6 years with the NDDOT in Research and Pavement Design before moving to Minnesota and his current position for the past ten years.

Dr. Bernard Izevbekhai* obtained his Bachelor of Engineering (Civil) and Master of Structural Engineering from University of Benin, Nigeria. He also possesses a Master of Science in Infrastructure Systems Engineering and Doctor of Philosophy from The University of Minnesota. A Registered Professional Engineer in the State of Minnesota, and currently Research Operations Engineer, he acted as Section Manager for MnDOT's Road Research Section in 2015. He was previously MnDOT's Deputy Concrete Engineer after his experience as MnDOT's Metro Division Soils Engineer. Previous international experience include Negotiator and Project Manager in the Nigerian-German Bilateral Cooperation.

Dr. Izevbekhai is an active member of many Standing Committees of the Transportation Research Board of the National Academies (NASEM) and author of numerous Journal publications. He was recipient of the IGGA Government Official of the Year 2010 as part of the study team that developed and validated the quiet concrete grind (NGCS). He also invented the Aggregate Avoidance Index evaluation process for interfacial strength of pavement materials. Research interests include probabilistic and stochastic systems, reliability analysis and mathematical modelling.

*Phonetic Pronunciation: Ease-Eh-Wake-High

Joe Korzilius, PE, is in the Construction and Survey Services Group for SRF Consulting. Joe has more than 34 years of experience in the design and construction of transportation-related projects. His experience includes a 21-year career with the Minnesota Department of Transportation (MnDOT) as a Geotechnical, pavement, and research Engineer at MnDOT's Central laboratory in Maplewood, MN and supporting program delivery as Materials and Pavement Engineer in the Metro District. For MnDOT Joe has worked on pavement research that included concrete pavement rehabilitation repair alternatives, retrofit load transfer, and performance of thin and ultra-thin concrete pavement sections providing evaluations assessing cost effectiveness.
As a consulting engineer Joe has continued working as a geotechnical and pavements engineer performing engineering and analysis work using ground penetrating radar and falling weight deflectometer as well as providing designs for stabilized subgrades. Additionally, Joe has served as Project Quality Manager on multiple Design-Build projects where he was responsible for oversight of project quality for design as well as inspection and testing for construction. Joe also works with county and local agencies to use pavement management data to plan, budget, and design their annual pavement rehabilitation, roadway repair, and pavement replacement programs.

Justin Lashley is the Concrete Engineer for the Concrete Consulting group at Braun Intertec. Justin's focus is designing concrete mixtures and evaluating in-situ concrete during construction or structures that have been in service for years.

Maria Masten is the State Concrete Engineer in the MnDOT Office of Materials and Road Research. Maria has previously held positions as a student worker in the MnROAD Research Section and Pavement Management.

She graduated from the University of Minnesota in 1996 with a Bachelor of Science in Civil Engineering and is a registered professional engineer in the State of Minnesota.

Ms. Masten has worked at MnDOT for 23 years and she is currently the chair of the National Concrete Consortium.

Soheil Nazarian, Ph.D., P.E., DGE is the McIntosh Murchison Chair Professor of Civil Engineering and the Director of the Center for Transportation Infrastructure Systems at The University of Texas at El Paso (UTEP). He has more than 35 years of experience in the areas of evaluation and design of transportation infrastructure. He has been the PI and co-PI of more than 100 research projects funded by federal and state agencies such as Texas Department of Transportation, Federal Highway Administration and Strategic Highway Research Program.

Barry Paye has worked with Wisconsin DOT since 2006, and currently serves as the Department's Chief Materials and Pavement Engineer in the Bureau of Technical Services. He serves as the WisDOT liaison to the AASHTO Committee on Materials and Pavements (COMP) and as the vice chair of the asphalt technical section. He also serves as the Chair of the AASHTO Product Evaluation Listing (APEL) and the AASHTO National Transportation Product Evaluation Program (NTPEP) Warm Mix Asphalt technical committee. Previously, he served as the WisDOT Central Office Material's Lab Supervisor, and in several construction and materials roles in the Northeast Region. Prior to working for WisDOT, Barry worked for the Minnesota DOT for over 4 years, working on the ROC 52 Design Build Project. Barry has his BS and MS in Civil Engineering from UW-Madison, specializing in construction management and HMA research. He is a licensed Professional Engineer in Minnesota and Wisconsin.

Brian Pfeifer was appointed as bureau chief of the Central Bureau of Materials at the Illinois Department of Transportation in April of 2016. He is responsible for the establishment of policies and procedures to provide a statewide materials inspection and acceptance program, as well as for the operation of the central materials testing facilities. Brian received a BS in Civil Engineering from the University of Illinois at Urbana-Champaign in 1994 and started his career at Illinois DOT in 1995. Between 2006 and 2016, Brian served as the Asset Management/Pavement & Materials Engineer for the Federal Highway Administration, Illinois Division. He is a licensed Professional Engineer in Illinois, and currently serves as chair of the Technical Subcommittee on Emulsified Asphalts under the AASHTO Committee on Materials and Pavements.

Luke Pinkerton is chief technology officer with Helix Steel. He has an engineering and physics background, and a strong interdisciplinary technical aptitude. He has patents and building code approval for a product that replaces rebar in concrete

Buzz Powell earned a Ph.D. in Civil Engineering at Auburn University with an emphasis in pavements and geomaterials. He worked for 12 years with the Alabama DOT and 2 years in the private sector before becoming NCAT's Test Track Manager in 1999. He has been an Assistant Director at NCAT since 2007.

David Rettner has been with American Engineering Testing, Inc. (AET) since 2004 where he first began as a Principal Engineer, focusing on Design/Build highway construction as well as geotechnical and pavement engineering. Prior to joining AET David spent 19 years working for MnDOT primarily in pavement design, pavement research, construction materials and geotechnical engineering.

Today, David spends a lot of his time working on MnDOT design/build projects and is also considered an authority in the region on cement stabilization for heavily loaded low volume roads and on bituminous stabilized full depth reclamation and

cold in-place recycling. He is also a longstanding member of industry organizations such as the Transportation Research Board, ACI, and ACEC/MN.

John Roberts is the Executive Director of the International Grooving and Grinding Association (IGGA), and Vice President of the American Concrete Pavement Association's (ACPA), Pavement Restoration Division. Prior to joining the IGGA/ACPA, John was employed by Ebasco Services Inc., where he worked on projects ranging from radioactive cleanups to reconstruction of the Manhattan Bridge. John was also the owner of a concrete contracting company located in New York where he specialized in the construction of bridges, pavements and structures. John was an honor student graduating from Rensselaer Polytechnic Institute, Magna Cum Laude with a B.S. in Civil Engineering.

Dan Schellhammer is Vice President at Midstate Reclamation and Trucking, Inc.

-2002 graduate of the University of Minnesota with a degree in Civil Engineering

-Registered Professional Engineer in the state of Minnesota

-Member of the NRRA Tech Transfer team

-Member of the ARRA CIR task force

-Vice President of Midstate Reclamation

Gordon L. Smith, P.E. recently joined the National Concrete Pavement Technology Center as an Associate Director. Smith began his career in concrete pavements by working for an Iowa concrete paving contractor (Central Paving Corporation) for 14 years, followed by thirty one years of service to the Iowa Concrete Paving Association (ICPA) and the Iowa Ready Mixed Concrete Association (IRMCA).

Smith, a registered PE in Iowa and Nebraska, received a BS in Civil Engineering from Iowa State University in 1975. He has a wealth of first-hand knowledge in concrete pavement design, specification, construction and maintenance, complemented by a strong background in concrete materials. While certainly not solely responsible for Iowa's prominence in the concrete pavement world, his leadership has helped to guide both local and national advancements in the areas of concrete overlays, early opening of concrete pavements to traffic, performance engineered mixtures, and concrete pavement preservation to mention only a few.

As ICPA executive, Smith was involved with the National Concrete Pavement Technology Center at Iowa State University since its inception in 2001. He continuously served as a Board member and was the Chairman of the Advisory Board for the past 5 years. Smith demonstrates a firm understanding of the needs of the industry, including research, technology transfer for the engineering community, contractor and agency field training and equipment/product innovation. In his service to the CP Tech Center and the industry, he has served on numerous technical advisory groups for publications.

Smith is also an active member of key professional organizations and has authored several reports and articles relating to concrete pavement design/construction/performance and concrete overlays. In 2012, he was awarded the American Concrete Pavement Association's Hartman-Hirshman-Egan Award in recognition of his service to the concrete paving industry, in Iowa and throughout the nation. Smith recently received the AGC of Iowa's "Friend of the Industry" Award, acknowledging his contributions to the greater highway construction industry.

Brett Trautman graduated from the University of Missouri – Columbia in 1989 with a degree in Civil Engineering. He has worked for MoDOT for over 28 years. Brett spent the first 6 years of his career in the Central District working in the Materials Section. In 1996, he joined the Construction and Materials Division as a Field Materials Engineer. In 2013, Brett was promoted to Physical Laboratory Director where he oversees the testing of concrete, bituminous mixtures, aggregates, rebar, and other materials utilized on MoDOT projects. Brett and his wife, Kim, have been married for 27 years and have three sons. Brett is a registered Profession Engineer in the State of Missouri.

Dave Van Deusen has close to 30 years of materials and pavement engineering work experience in academia, government, and private sector. He received a B.S. in Geo-Engineering (1989) and M.S. in Civil Engineering (1991) from the University of Minnesota, Department of Civil Engineering.

Dave is a registered PE in Minnesota, and he was a registered PE in North Dakota for two years.

Dr. David J. White is president and chief engineer for Ingios Geotechnics, Inc. and serves as Collaborating Professor at Iowa State University, where he worked for 14 years in the Department of Civil, Construction, and Environmental Engineering and founded the Center for Earthworks Engineering Research.

Dr. White has authored numerous technical publications and completed research and consulting projects covering topics of earthwork construction, soil stabilization, in-ground instrumentation, evaluation and development of in situ technologies and machine-integrated monitoring systems including intelligent compaction, and writing construction specifications.

Dr. White conceived and designed the Automated Plate Load Test technology and Modulus-based Validated Integrated Compaction Monitoring technology. Dr. White has several patents on geo-construction technologies, and was the recipient of the 2007 Arthur Casagrande Professional Development Award – ASCE. He also received TRB's Geology and Earth Materials Section Best Paper Awards in 2013. Dr. White is a registered professional engineer.

Charles Wienrank is the Pavement Design Engineer in the Illinois Department of Transportation's Bureau of Research. He joined the Department in 2000 after six years of employment in the private sector, where he specialized in the areas of pavement research and pavement management.

In his current position with IDOT, Charles provides pavement design assistance on both new pavement designs and on innovative rehabilitation techniques. He also serves as the Technical Review Panel chair on pavement design research projects. Charles represents IDOT on the Executive Committee, Rigid Team, and Flexible Team for NRRA.

Charles earned his Bachelor's and Master's degrees in civil engineering from the University of Illinois at Urbana-Champaign, and is a licensed Professional Engineer in the State of Illinois.

Ben Worel received his Bachelor of Science degree in Civil Engineering at the University of Minnesota. He is a professional engineer with the State of Minnesota. His work experience is primarily in the area of pavement research and pavement management. He worked for seven years with Braun Intertec – a Minnesota-based consultant (1989-1996). He works mainly on the Strategic Highway Research Program (SHRP) and the Long Term Pavement Performance project (LTPP). He has worked for the Minnesota Department of Transportation for 20 year (1996-Present). His day-to-day activities as MnROAD Operations Engineer include research and partnerships including National Road Research Alliance (NRRA). He is Chair of TRB's AFD40 Committee (Full Scale Accelerated Pavement Testing) and member and friend to a number of other committees. He is currently working with the National Road Research Alliance to best utilize the MnROAD site for its NRRA customers. He loves his family, coworkers, and dog Jesse not necessarily always in that order.

Joaquin Wright is currently a Senior Project Manager and TDA specialist for GHD Inc. This is the current firm under the CalRecycle TDA civil engineering support contract. He has worked actively with Tire Derived Aggregate since 2000. He obtained his BS in Environmental Resource Engineering from Humboldt State University, and is currently an adjunct professor at the University. He is a Sustainability Professional credentialed as a "train the trainer" with the Institute for Sustainable Infrastructure (ISI), and has extensive experience in the area of Solid Waste Management and environmental remediation, from design to construction management as well as diversion and recycling. His experience with TDA use in California is extensive and ranges from slope and road repair to material property research. Joaquin has managed numerous TDA research projects, pilot studies, TDA projects and outreach efforts funded by California Department of Resources Recycling and Recovery (CalRecycle).

Dr. Zhanping You received his Ph.D. in civil engineering from the University of Illinois at Urbana-Champaign in 2003. He is a Professor in Civil and Environmental Engineering at Michigan Technological University since 2008. Professor You has over 20 years of practical and research experience with pavements engineering and materials. In his capacity as a Professor, he has completed research projects on a wide range of subjects including pavement mechanistic design, warm mix asphalt, rubber asphalt, nano modified asphalt materials, micromechanics based models for pavement materials, electronic waste plastics application, self-healing materials for pavements, and bio asphalt derived from biomass. Sponsors of his research program include: National Science Foundation (NSF), U.S. Environmental Protection Agency (U.S. EPA), Michigan Department of Environmental Quality (MDEQ), Federal Highway Administration, Michigan Department of Transportation (MDOT), Minnesota Department of Transportation (MnDOT), and Texas Department of Transportation (TxDOT). He also served as a principal investigator and director of the Center of Excellence for Transportation Materials, which is a partnership between MDOT and Michigan Technological University. He an editor for a dozen publications in pavement engineering proceedings, books, and journals. He was a recipient of the U.S. Department of Transportation's Dwight David Eisenhower Transportation Faculty Fellowship and Dwight David Eisenhower Graduate Fellow. Dr. You has been involved in professional services for many professional organizations. He is chair of Bituminous Materials Committee of Construction Institute of ASCE.

NRRA Executive Committee Members

Dave Ahlvers, Missouri Department of Transportation

Curtis Bleech, Michigan Department of Transportation

Steve Bower, Michigan Department of Transportation

John Donahue, Missouri Department of Transportation

Glenn Engstrom (Chair), Minnesota Department of Transportation

Joe Holland, Caltrans – California Department of Transportation

Kuo-Wei Lee, Caltrans – California Department of Transportation

Paul Oehme, Minnesota Local Road Research Board – Chanhassen

Bob Orthmeyer, Federal Highway Administration

Greg Ous, Minnesota Department of Transportation

Barry Paye, Wisconsin Department of Transportation

Brian Pfeifer, Illinois Department of Transportation

Lyndon Robjent, Minnesota Local Road Research Board – Carver County

Charles Wienrank, Illinois Department of Transportation

REDUCED MAINTENANCE WITH TDA (TIRE DERIVED AGGREGATE) FOR WET ROADWAY SUBGRADES

TDA MANUFACTURING — PRISTINE BY DESIGN
a division of First State Tire

FIRST STATE TIRE RECYCLING

1. **Capillary Break**: TDA does not hold or wick water.
2. **TDA Permeability**: 1-30 cm/sec.
3. **Lightweight**: TDA puts less strain on wet subgrades.
4. **Interlocking**: Type B TDA has self-reinforcing capabilities that can eliminate differential settlement.
5. **Thermal Insulation**: TDA insulates 8x better than soil.
6. **Shear Strength:** Internal friction angle of 35-40°.

National Concrete Pavement Technology Center

CP Tech Center

IOWA STATE UNIVERSITY
Institute for Transportation

The CP Tech Center is a training and research center working to unite agencies, industry and researchers to advance concrete pavement technology

Focus areas include:

- Pavement preservation and asset management
- Recycling concrete into the pavement system
- Concrete overlays
- Specifying and delivering optimized mixtures

We do this by

- Developing manuals and technical publications
- Delivering workshops, webinars and presentations
- Conducting research
- Assisting agencies and industry
- Engaging with professional organizations


WISCONSIN
DEPARTMENT OF TRANSPORTATION


CAT


National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY


Caltrans


Cargill
CENTER FOR TRANSPORTATION STUDIES
UNIVERSITY OF MINNESOTA


APA
ASPHALT PAVEMENT ALLIANCE


BASF
We create chemistry


Illinois Department of Transportation


THE TRANSTEC GROUP
The World's Pavement Engineering Specialists


LRRB
LOCAL ROAD RESEARCH BOARD


DEPARTMENT OF TRANSPORTATION


Minnesota Asphalt Pavement Association


MDOT
Michigan Department of Transportation


COLLABORATIVE AGGREGATES LLC


CONCRETE PAVING ASSOCIATION OF MINNESOTA
CPAM


GSE
ENVIRONMENTAL


DIAMOND SURFACE INC.


MoDOT


NRRA
National Road Research Alliance


FLINT HILLS resources


ROADSCANNERS


UMD
UNIVERSITY OF MINNESOTA DULUTH
Driven to Discover


BRAUN
INTERTEC
The Science You Build On.


CONSTRUCTION CO.
MATHY
ONALASKA, WIS.


Center for Transportation Infrastructure Systems
CTIS


PAYNE & DOLAN
INCORPORATED


3M


WSB


Michigan Technological University
Michigan Tech Transportation Institute


IGGA
International Grooving & Grinding Association


ingios
GEOTECHNICS


PITT SWANSON ENGINEERING


AMERICAN ENGINEERING TESTING, INC.


AMPP
ASPHALT MATERIALS & PAVEMENTS PROGRAM

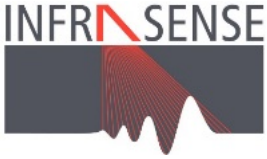

ARRA
Responsible Renewal. Reliable Results.


NDSU
UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
NORTH DAKOTA LOCAL TECHNICAL ASSISTANCE PROGRAM


paviasystems


MINNESOTA STATE UNIVERSITY
MANKATO


All States Materials Group®


INFRASENSE


FIRST STATE TIRE RECYCLING


UCPRC
UNIVERSITY of CALIFORNIA | PAVEMENT RESEARCH CENTER
Davis • Berkeley


DOW
®


HELIX™
A Pensmore™ Company


AGGREGATE & READY MIX
ASSOCIATION OF MINNESOTA


National Concrete Pavement Technology Center
CP
Tech Center


Husky Energy


University of New Hampshire