NRRA
National Road Research Alliance
Strategic Implementation Through Cooperative Pavement Research

MnROAD
SAFER, SMARTER, SUSTAINABLE PAVEMENTS
THROUGH INNOVATIVE RESEARCH

MnROAD with a Focus on Building Innovative APT Research Studies

July 2024

Benjamin Worel
Michael Vrtis
Tom Burnham

DEPARTMENT OF TRANSPORTATION

Todays Agenda / Goals

Goal – Share with other APT facilities build innovative research studies / test sections

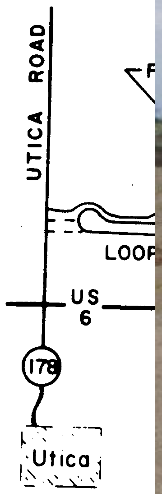
- Webinar Welcome / MnROAD Overview – Ben (10 min)
- Building Test Sections with Deliberate Distress – Michael (20 min)
- Building Test Sections with Innovative Concrete Materials – Tom (20 min)
- Questions (10 min)

MnROAD – why was it really built?

MnROAD Early History

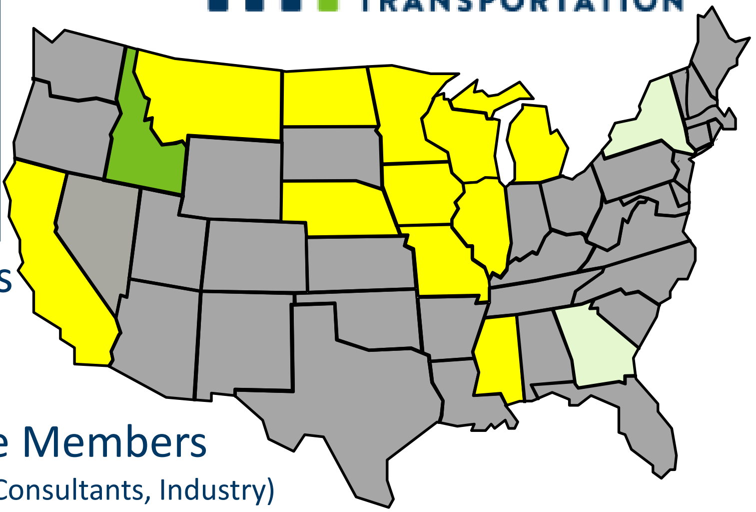
- **AASHO Road Test** (1956-1960)
- **Need for Local Calibrations**
  - MnDOT started Investigation 183 / Flexible Designs (1960's)
  - SHRP/LTPP started for national efforts (1988)
  - Idea of a cold regions testing facility (1980's)
- **MnROAD Development**
  - Late 80's Development of Support
  - 1990 Getting $25 million in 1990
  - 1993 Construction/Instrumentation
  - August 2, 1994 Traffic

    (MnROAD is turning 30 years old!)



MnROAD Background

- **MnROAD Owned and Operated by Minnesota DOT**
  - Including other national pooled fund efforts
- **HMA and PCC Research**
- **Long-Term Customer Service / Valued Partners**
  - Minnesota Department of Transportation
  - Minnesota Local Road Research Board
  - SHRP II / NCHRP / FHWA / Partnerships
  - Pooled Funds Efforts (States) / Industry
- **Major Experiments**
  - Phase I (1994-2006)
  - Phase II (2007-2016)
  - Phase III (2017-2022) – NRRA/NCAT
  - Phase IV (2022) – NRRA/NCAT
  - 2024 Current Construction



NRRA Agency Members

NRRA Associate Members

(Associations, Universities, Consultants, Industry)

MnROAD- Minnesota Road Research Facility

Also "other" Road
- **Farm Loop**
- **MN-6**
- **US-169 / CSAH-8**
- **15th Street**
- **70th Street**
- **+ Others**

mndot.gov

Mack Tractor (93406) with Fruehauf Trailer (93410)

2025 MnROAD Mainline Changes to Interstate-94

The current facts

- I-94 Traffic has increased dramatically over 30 years
- 3 Lanes have been constructed to the east and west of MnROAD in 2019
- Now "the GAP" is being designed for 2025-2026 construction

What does this mean for MnROAD?

- 2025-2026 Limited Access – Automated data collection
  - MnROAD Automated Distress Rodeo (August 2023)
- Fall of 2026
  - Trucks only will be diverted onto MnROAD
  - Automated gates and message boards
  - MnROAD mainline will have a loaded (driving lane) and environmental lane (passing lane)
    - All sensors are located in the driving lane
    - Trucks primary ESAL contributor

MnROAD Data

- **Performance Monitoring**
- **List is missing**
  - Albedo Measurements
  - Drone Videos
  - Road Doctor with GPR
  - Detailed Forensics
  - Rolling Weight Deflectometer
  - Rolling Density Meter
  - Many others

  - Working towards greater automation

Each Data type has detailed information on the equipment and data collection used

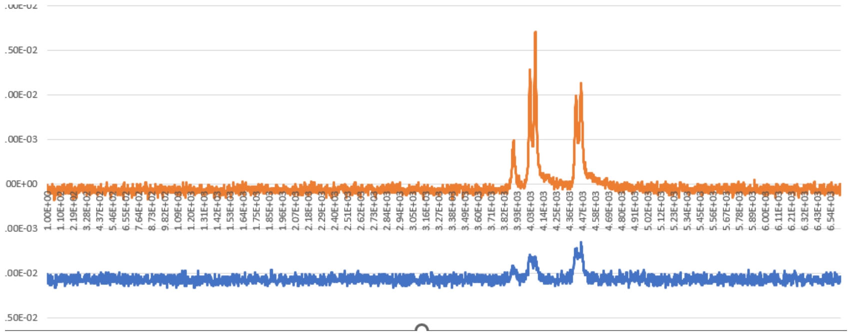
Measurement	Frequency	Comment
Aging Samples	1 / year	Cores taken to monitor aging of HMA mix and PCC joint condition
Distress Survey	2 / year	Modified LTPP Survey on all cells
Dynamic Load Testing	4 / year	Dynamic load testing of sensors. Loading from MnROAD truck and FWD.
Joint Faulting/ Shoulder Dropoff	2 / year	Use an automated Georgia Faultmeter per modified LTPP protocol
Friction	1-2 / year	KJ Law profiler, grip tester and dynamic friction tester used
Falling Weight Deflectometer	8 / year	Testing schedule varies throughout the year. Routine and special testing on HMA and PCC.
HMA Rutting/ Crack Cupping	3 / year	Advanced Laser Profile System (ALPS) used to characterize rutting and crack cupping
Noise	3 / year	On Board Sound Intensity (OBSI) measurements and sound absorption
Piezometer	4 / year	Monitoring well measurements
Permeability	2-4 / year	Test permeability of pervious/porous test cells
Ride Quality	2-4 / year	Pathways and lightweight profiler
Sound Absorption	3 / year	Sound absorbtion measurements.
Surface Texture	1 / year	Sand Patch and Circular Texture Meter

MnROAD Data

- **Sensors**
  - MnROAD Data Collection Network
  - ~15,000+ Sensors Installed
  - Static (every 15 min)
    - Temperature
    - Moisture
    - Joint Opening
    - Concrete Maturity
    - Environmental Stain
    - Pressure
    - Ground Water
    - Frost Depth

- Dynamic Data
  - Live Traffic Loading - Controlled Loading
  - Earth Pressure Cells
  - Pore-Water Pressure
  - Asphalt and Concrete Stains
  - Displacement

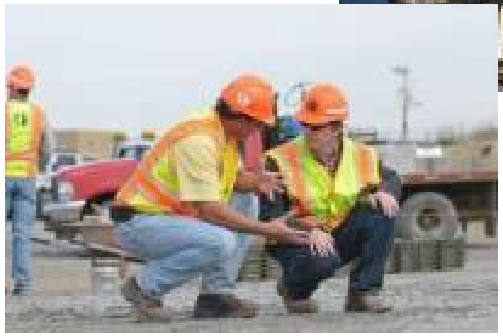
- 2 Weather Stations
- Traffic Data
  - 2022 Installing a new systems



Each Data type has detailed information on the equipment and data collection used

MnROAD Role in Innovative Research

- **Do something in a small scale before large scale**
- **Push the envelope / Dealing with "Risk"**
  - Service Road / Stockpile areas – high risk
  - Low Volume Road – risky
  - Mainline (I-94) – some risk
  - State/county/city roads – lower risk
- **MnROAD "Open Cells"** (Pavement Life Left vs Research Life Remaining)
- **Detailed Monitoring** (sensors & performance)
- **Ability to attract high quality staff, research partners, and funding**
- **Sharing of ALL data and findings** - LTPP InfoPave - Overview (dot.gov)

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Building Test Sections with Deliberate Distress

- Michael Vrtis, P.E., Ph.D.

2022 NRRA Reflective Cracking Challenge
2023 LRRB Low Volume Road Reflective Cracking Challenge
2024 “Stripping Test Sections”

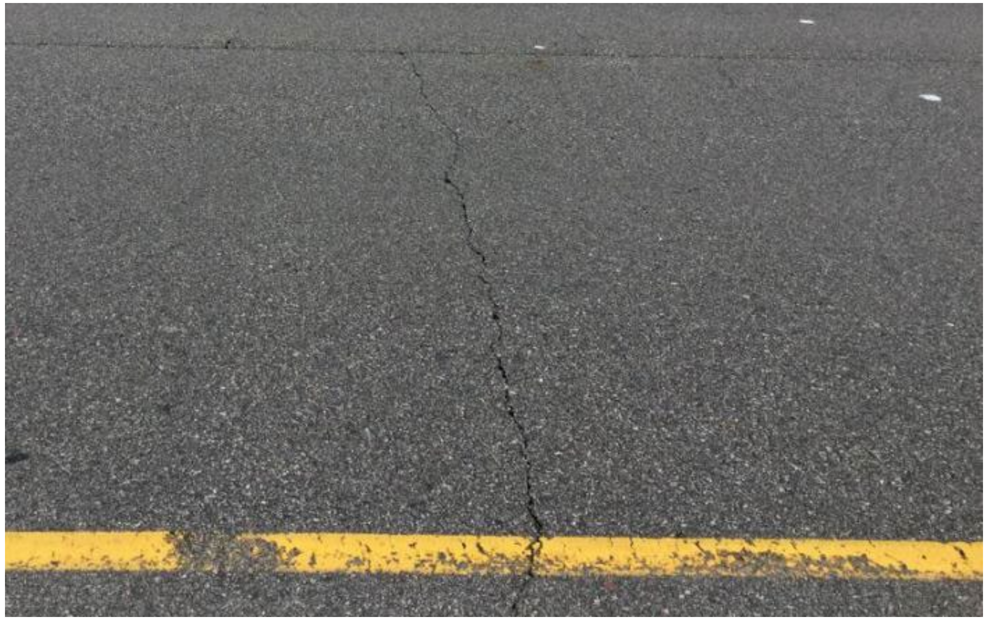
2022 MnROAD Reflective Cracking Challenge

- **Experiment designed to better match APT research to MnDOT network applications**
  - BOB = bituminous over bituminous ~50% network

Statewide (All Districts)

Pavement	Percent	Miles
BIT	12%	1,682
BOB	50%	7,104
BOC	22%	3,136
CON	17%	2,377
CRCP	0%	2
All	**100%**	**14,301**

Pavement	PQI	RQI	SR
BIT	3.6	3.5	3.8
BOB	3.3	3.2	3.4
BOC	3.4	3.3	3.6
CON	3.6	3.4	3.9
CRCP	3.8	3.6	4.0
All	**3.4**	**3.3**	**3.6**



MnROAD Reflective Cracking Challenge

National Center for Asphalt Technology NCAT AT AUBURN UNIVERSITY

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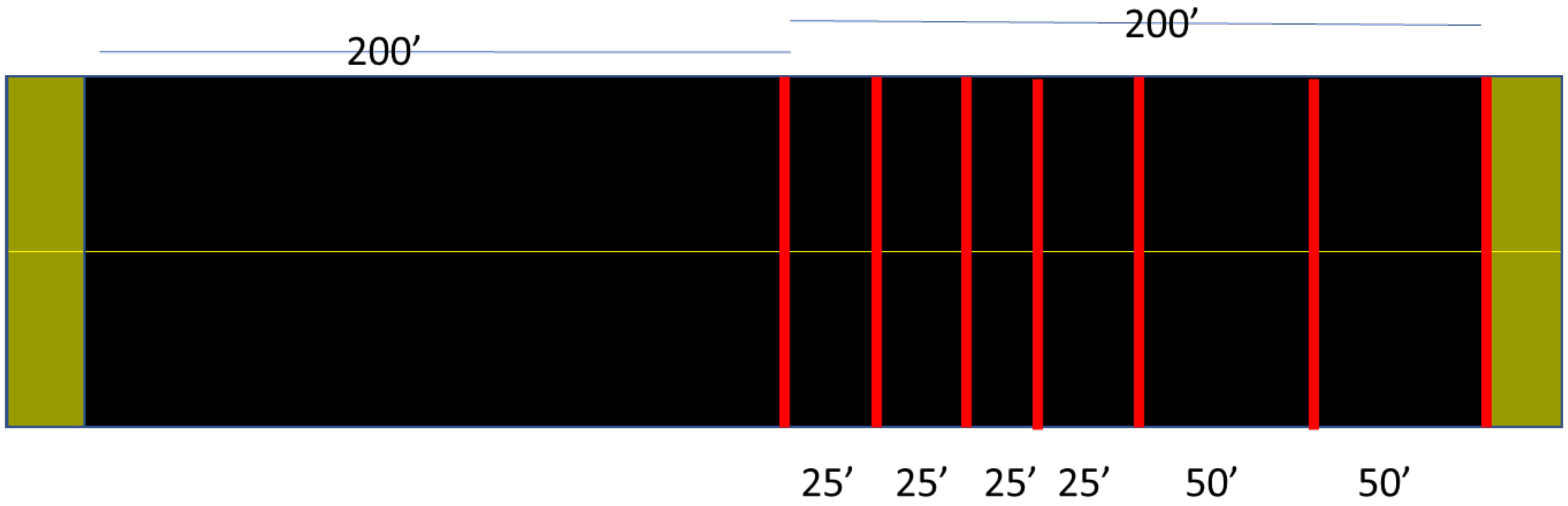
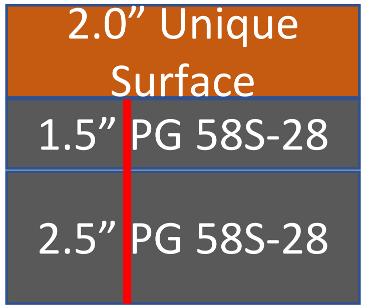
MnROAD Reflective Cracking Challenge





- Paved 450’ per section
- 200’ reflective cracking
- 200’ conventional

Saw-cutting

- Full depth (5”) saw cuts were made 24’ through travel lanes
- Cuts were minimally cleaned with leaf blower and wire
- No cleaning after milling

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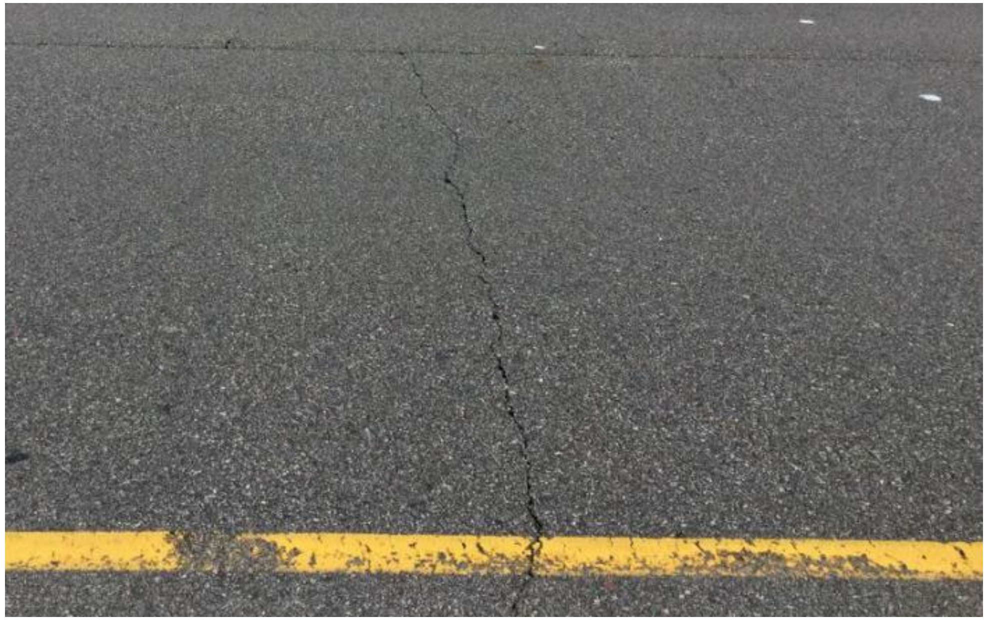
MnROAD Additive Group Surface Mix Details

- **10 Sections with differing surface HMA**
  - Controls
    1. PG 58H -34 (modified) **2239**
    2. PG 58S -28 (unmodified) **2230**
    3. PG ~49 -34 (unmodified) **2238**
  - Additive Sections
    4. Aramid Fiber 1 w/ PG 58H -34 (modified) **2233**
    5. Aramid Fiber 2 w/ PG 58H -34 (modified) **2234**
    6. Dry Plastic Additive w/ PG ~49 -34 **2236**
    7. Dry Rubber Additive w/ PG ~49 -34 **2237**
    8. Wet Plastic Additive **2232**
    9. Wet Rubber Additive **2235**

    (8–9) **w/ PG 52-34 from Mathy**
  - Super Pave 5.0
    10. PG 58V -34 (modified) (NRRA) **2231**



- **All mixes contain**
  - MnDOT Traffic Level 5 (10<30 mESALS)
  - Superpave Gyratory BMD
  - ¾" Max Agg (SP 12.5mm)
  - 20% RAP

MnROAD Additive Group Surface Mix Details

Cell ID	Additive Type/ Mix ID	Additive Manufacturer	Dosage Rates
2239	Control (PG 58H-34)	- -	
2238	Control (PG 49-34)	-	
2237	Dry Rubber	Liberty Inc.	12% SmartMix by weight of the binder
2236	Dry Plastic	Avangard	0.5% LLDPE pellets by weight of aggregate
2235	Wet Rubber	Entech	10% by weight of the binder
2234	Forta Fiber	Forta Corp.	1 lb. fiber per 1 ton of asphalt mix
2233	ACE Fiber	Surface Tech	3.4 ounces per ton of mix
2232	Wet Plastic	Dow chemicals	1.0% LLDPE plastic & 1.5% Elvaloy by
2231	Superpave 5		binder weight
2230	Control (PG 58S-28)		

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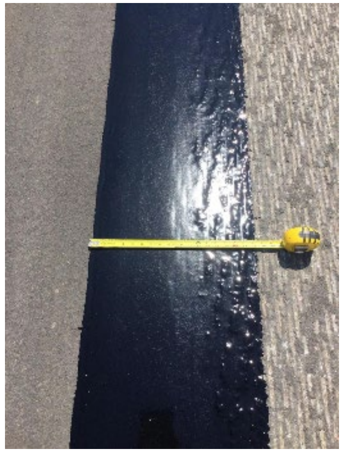
MnROAD SAFER, SMARTER, SUSTAINABLE PAVEMENTS THROUGH INNOVATIVE RESEARCH

Longitudinal Joint Treatment

- J-Band applied on centerline and longitudinal shoulder joint
- Driving lane paved 13’ wide with 12’ lane to push longitudinal joint away from traffic
- J-Band donated application for this effort



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MnROAD SAFER, SMARTER, SUSTAINABLE PAVEMENTS THROUGH INNOVATIVE RESEARCH

2023- Low Volume Reflective Cracking Challenge

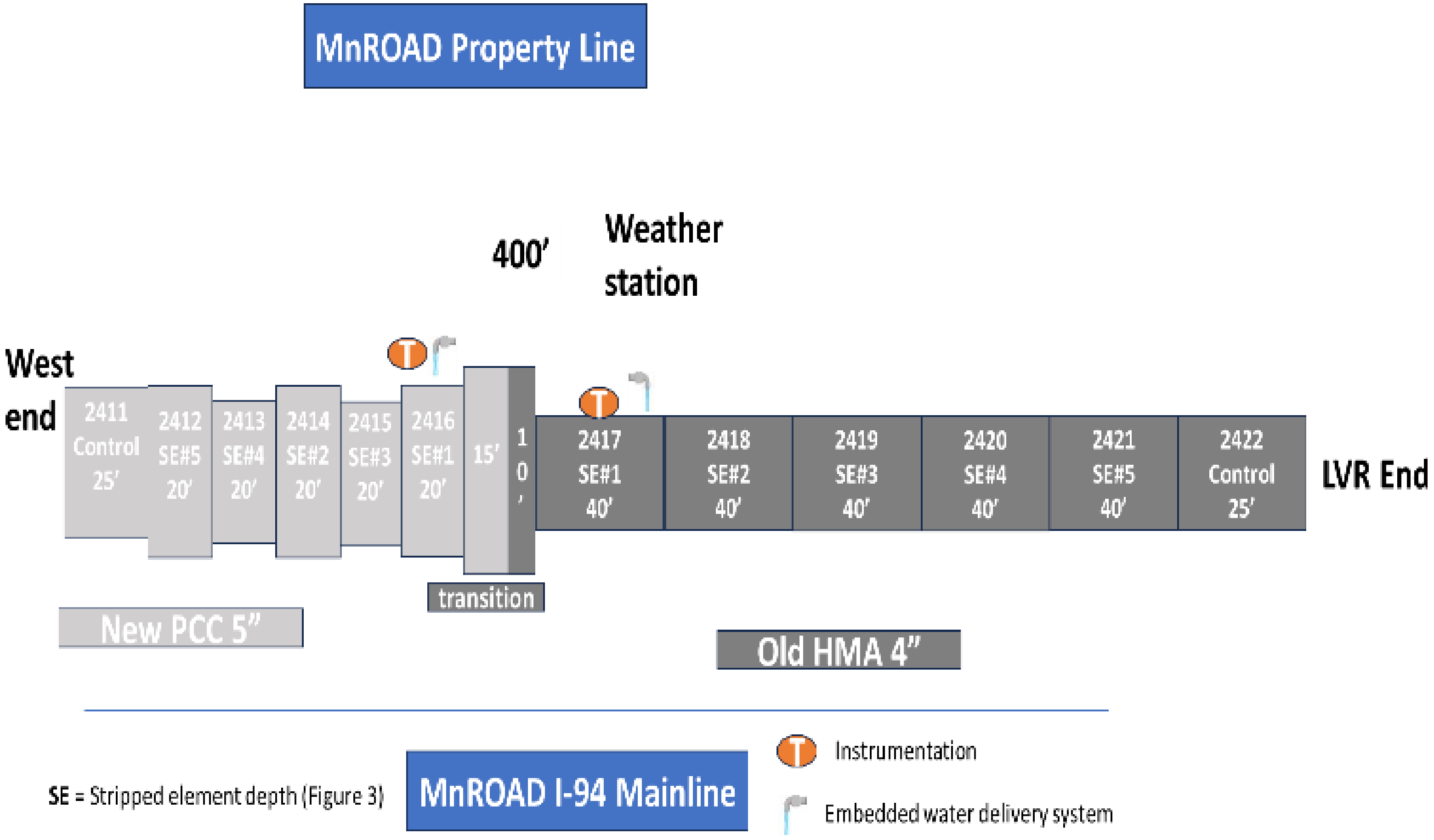
- Fall 2023 MnROAD needed repairs on several LVR sections
- Replicated 2022 I-94 mainline sections with LVR conditions
- 4 sections created to evaluate reflective cracking potential with respect to binder modification and content

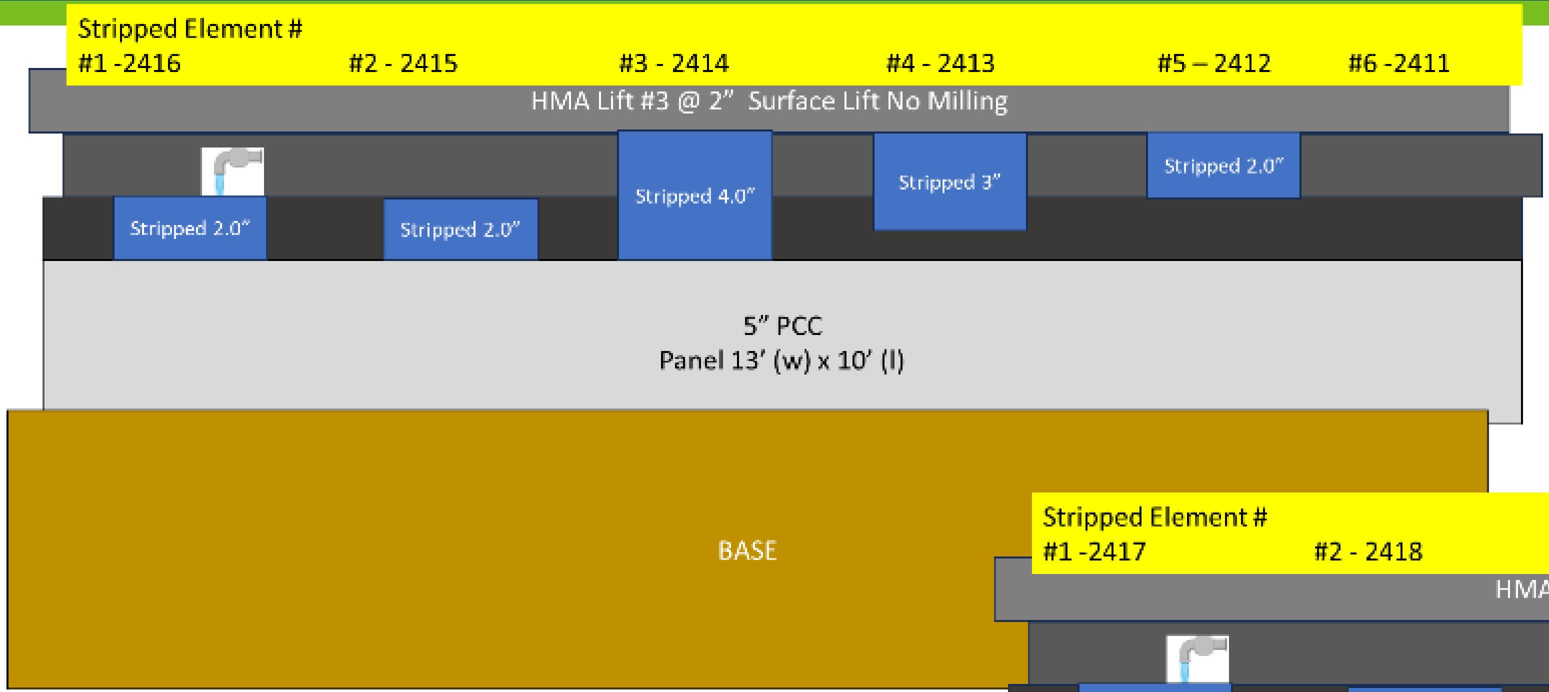
2023- Low Volume Reflective Cracking Challenge

2024 “Stripping Test Sections”

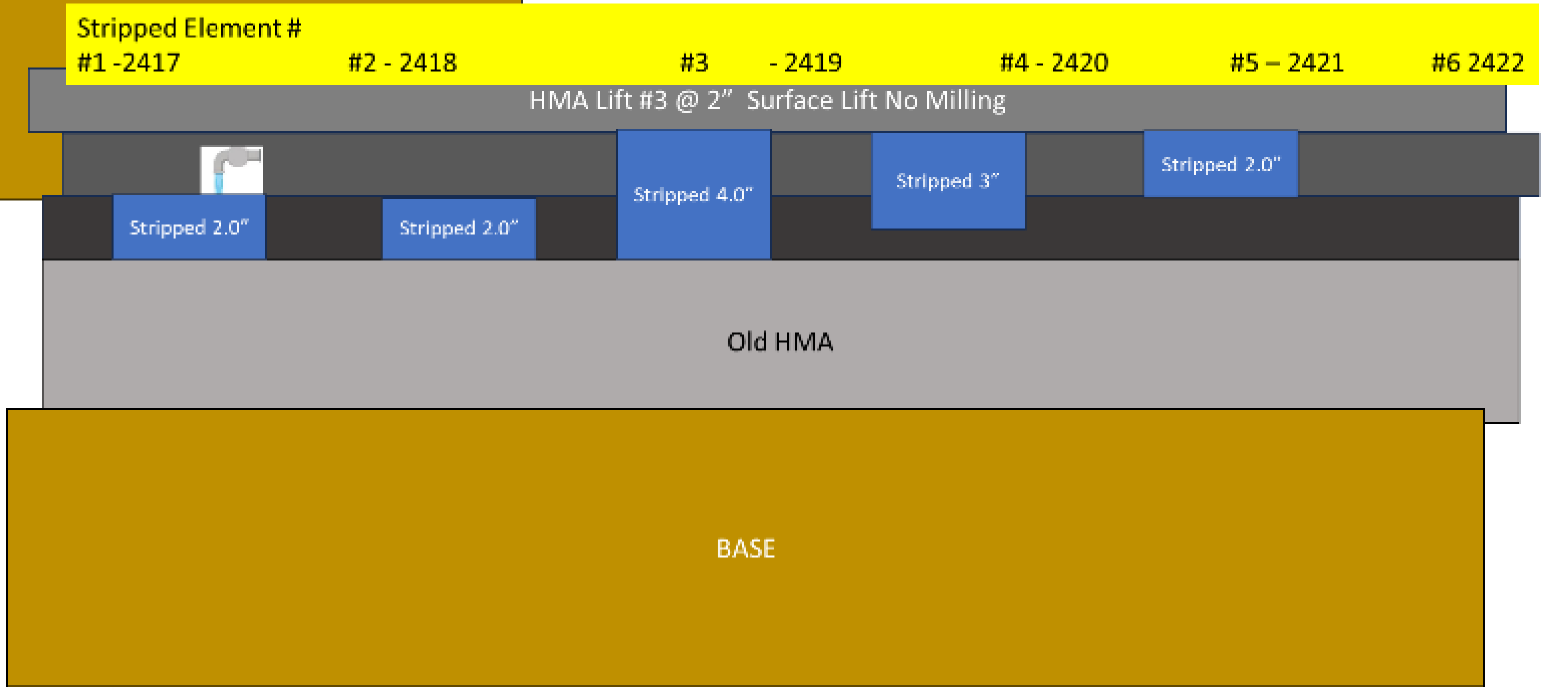
- TPF-5 (504) NDE Stripping Pool Fund
  https://www.pooledfund.org/Details/Study/733
- “The primary objective of the proposed pooled-fund project is to develop a methodology for rapid and automatic detection of stripping in bituminous pavements using 3D-GPR and other NDE technologies.”
- MnROAD section objective = build HMA with known areas of asphalt stripping to train GPR algorithms to identify stripping

MnROAD Service Road

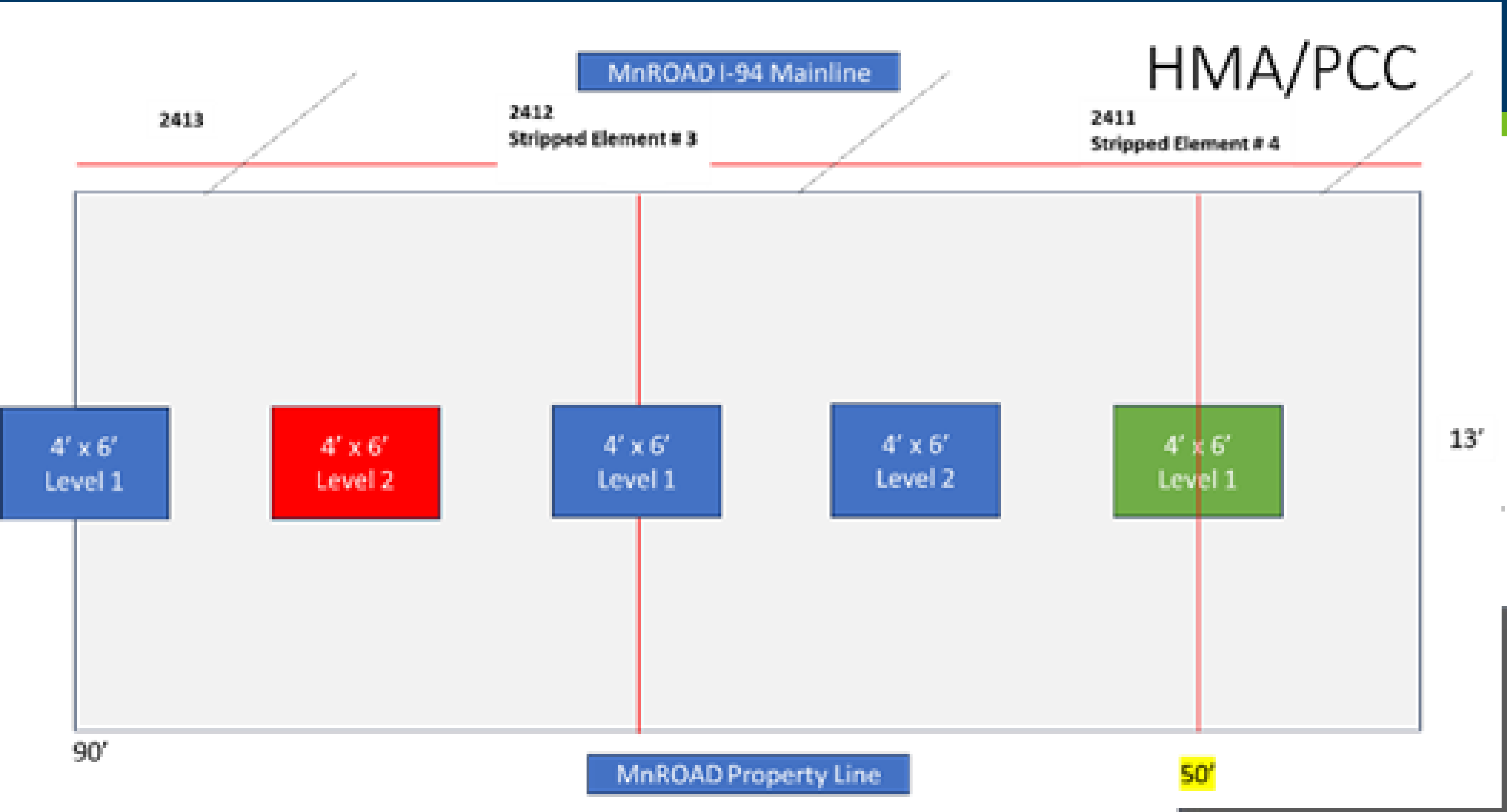

MnROAD Property Line
400'
Weather station
West end
2411 Control 25'
2412 SE#5 20'
2413 SE#4 20'
2414 SE#2 20'
2415 SE#3 20'
2416 SE#1 20'
15'
10'
2417 SE#1 40'
2418 SE#2 40'
2419 SE#3 40'
2420 SE#4 40'
2421 SE#5 40'
2422 Control 25'
LVR End
transition
New PCC 5"
Old HMA 4"
SE = Stripped element depth (Figure 3)
MnROAD I-94 Mainline
Instrumentation
Embedded water delivery system

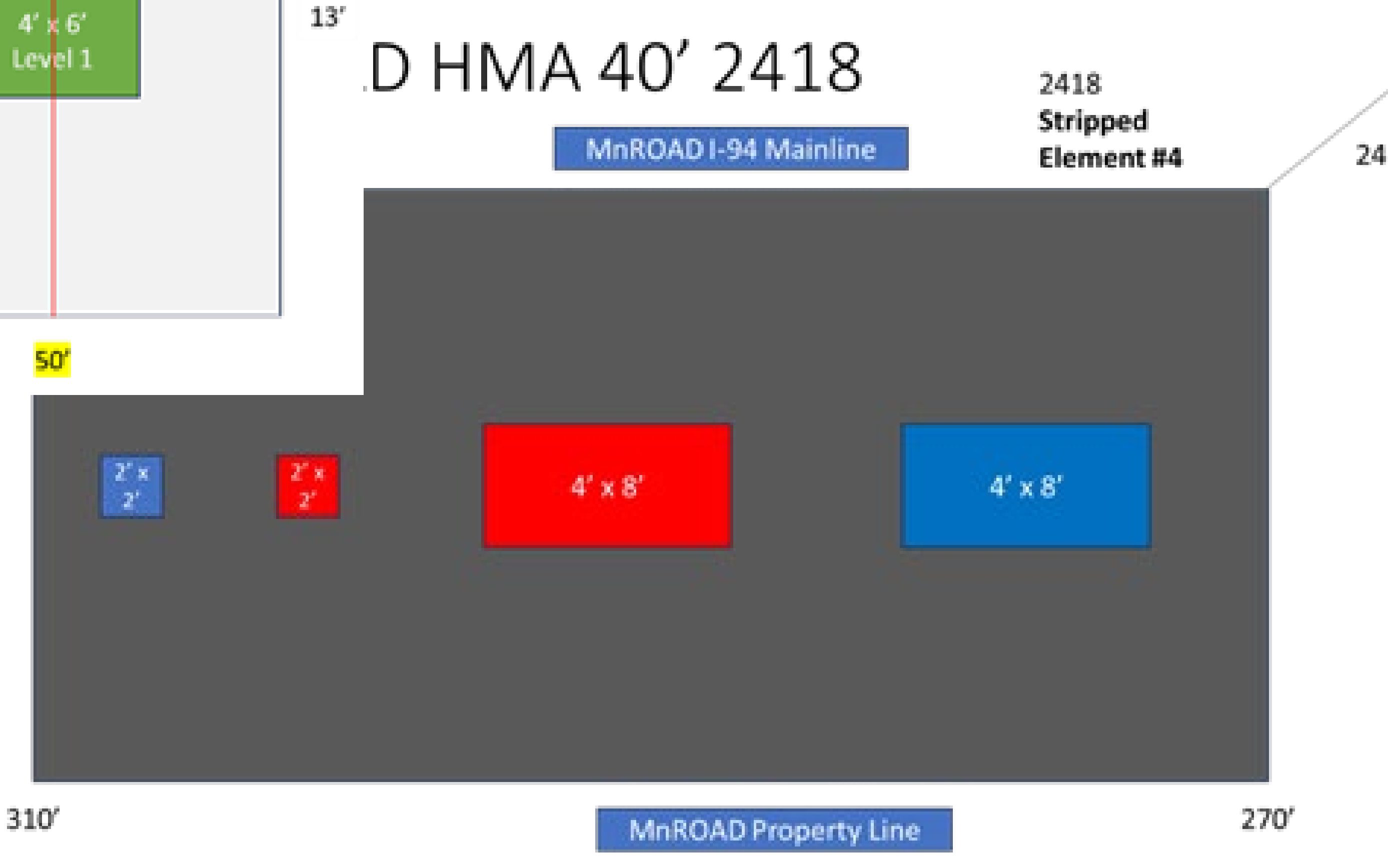


Stripped Element #
#1 -2416
#2 - 2415
#3 - 2414
#4 - 2413
#5 – 2412
#6 -2411
HMA Lift #3 @ 2” Surface Lift No Milling
Stripped 2.0”
Stripped 2.0”
Stripped 4.0”
Stripped 3”
Stripped 2.0”
5” PCC
Panel 13’ (w) x 10’ (l)
BASE



Stripped Element #
#1 -2417
#2 - 2418
#3 - 2419
#4 - 2420
#5 – 2421
#6 2422
HMA Lift #3 @ 2” Surface Lift No Milling
Stripped 2.0”
Stripped 2.0”
Stripped 4.0”
Stripped 3”
Stripped 2.0”
Old HMA
BASE


HMA/PCC
MnROAD I-94 Mainline
2413
2412
Stripped Element # 3
2411
Stripped Element # 4
4' x 6'
Level 1
4' x 6'
Level 2
4' x 6'
Level 1
4' x 6'
Level 2
4' x 6'
Level 1
90'
MnROAD Property Line
50'


13'
D HMA 40' 2418
2418
Stripped
Element #4
MnROAD I-94 Mainline
24
2' x
2'
2' x
2'
4' x 8'
4' x 8'
310'
MnROAD Property Line
270'

7/18/2024

Unique Challenges

- How to create “Stripped” asphalt
  - Level 1 = coarse aggregate only
  - Level 2 = needed partially stripped asphalt

June 12 – lift 1

June 13 – Milling “Stripped” Areas

June 13 – Milling “Stripped” Areas


THE HOME DEPOT


THE HOME DEPOT


CASE

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DEPARTMENT OF TRANSPORTATION

Constructing MnROAD Low Carbon Concrete Test Sections

Tom Burnham | Research Operations Engineer, Minnesota Department of Transportation

TRB APT Monthly Webinar

7/11/2024

DEPARTMENT OF TRANSPORTATION

NRRA National Road Research Alliance

Current Pavement Research Focus

- **Sustainability**
  - **Reduce volume of materials used**
  - **Recycle existing materials**
  - **Reduce use of high carbon content materials**
    - **Must maintain or enhance durability of pavements**
- **Resilience**
  - **Design pavement structure to survive increasing number of extreme climate events**

Concrete Pavements in Minnesota

MnDOT's modern concrete pavements are already considered lower carbon content mixes:

- **Up to 30% fly-ash replacement for Portland cement**
- **Well graded aggregates = less paste = less cement**
- **Durability: 0.40 water-to-cementitious ratio**
- **Thinner slabs**

Goal: Even lower carbon content mixes!

Lower Carbon Content Concrete Pavements

In 2021, the NRRA Rigid Team decided to fund three lower carbon content concrete pavement studies:

- **Use of Carbon Dioxide for Sustainable and Resilient Concrete Pavements**
- **Use of Alternative Pozzolanic Materials Towards Reducing Cement Content in Concrete**
- **Use of Alternative Cementitious Materials in Concrete Pavements**

Result: Construction of 16 lower carbon concrete test sections in 2022

MnROAD Concrete Test Sections 2209 - 2224

- **Lower carbon content concrete sections**
  - **Mainline = interstate I-94 traffic (>1 million CESALS/yr)**
  - **Opened to traffic on October 12, 2022**
- **Design details:**
  - **7.5-inch-thick jointed concrete pavement**
  - **Alternative cementitious, lower cement content, or carbon sequestration concrete mixes**
  - **Panel length/width = 15 ft L / 13 ft W**
  - **Unsealed joints**
  - **1.25” dia. x 15” long epoxy coated dowel bars**
  - **Moderately draining base**

Lower Carbon Materials Selection

How to choose materials for test sections?

- Little knowledge or expertise within MnDOT/NRRA on pave-ability of many new products
- Many products developed in laboratories or used only in non-pavement applications
- Many materials are proprietary
- Insufficient staff to guide suppliers through ready-mix production and paving process

Materials Selection and Constructability Project

Development of Mix Designs and Matrix of Materials for MnROAD Low Carbon Concrete Test Site

- **Seek out materials for approval by NRRA Rigid Team**
- **Provide guidelines on fresh and hardened concrete testing**
- **Oversee production of concrete for test sections**
- **Observe issues during production and paving**
- **Produce final report (currently in publication process)**

Project Team:

- Larry Sutter, Ph.D., P.E., Sutter Engineering, LLC
- Nick Weitzel, P.E., Sarah Lopez, P.E., NCE
- Tom Van Dam, Ph.D., P.E., WJE

Low Carbon Concrete Material Selection Criteria

- **Material producer must be able to deliver sufficient material to construct a 270-ft long, 29-ft wide, 7.5-inch-thick test section**
- **All mixtures required to be:**
  - **Batched and mixed in a conventional ready-mix concrete plant**
  - **Transported using conventional concrete trucks with time to initial set > 45 minutes**
  - **Capable of placement using a conventional slipform paver**
- **Final concrete mixture designs required to meet specified fresh and hardened concrete properties**

Low Carbon Concrete Material Selection Criteria

- **Material required to have the potential to be market-ready, including scalable material availability and the ability to be integrated into conventional concrete production and placement**
- **Material supplier required to conduct trial batching and demonstrate that required concrete properties could be met**
- **Minimum of 30% replacement of cementitious content by weight**
- **Additive materials supplied at no cost to MnROAD**

MnROAD Concrete Test Sections 2209 - 2216

Cell	Supplier/Material Name	Cementitious Content and Materials
2209	Ultra High Materials - 0% Portland clinker hydraulic cement	650 pcy cementitious (propriety ingredients)
2210	CarbonCure™ design mixture with CO_2 injection	558 pcy cementitious, 30% Coal Creek Class F fly-ash, 6 oz. CO_2 per yard
2211	MnDOT control mixture* with CarbonCure™ CO_2 injection	570 pcy cementitious, 30% Coal Creek Class F fly-ash, 6 oz. CO_2 per yard
2212	CarbonCure™ design mixture without CO_2 injection	558 pcy cementitious, 30% Coal Creek Class F fly-ash
2213	Carbon Upcycling processed fly-ash-based alternative supplementary cementitious material	500 pcy cementitious, 30% treated fly-ash ASCM
2214	Ash Grove blended cement Duracem® N Type IP(30)	570 pcy cementitious, 30% calcined clay
2215	Urban Mining Pozzotive® ground-glass pozzolan	570 pcy cementitious, 30% ground-glass ASCM
2216	TerraCO_2 OPUS manufactured ASCM	570 pcy cementitious, 35% ASCM

*Control Mix = 570 pcy cementitious: 70% ASTM C595 Type IL(10), 30% Coal Creek Class F fly-ash

MnROAD Concrete Test Sections 2217 - 2224

Cell	Supplier/Material Name	Cementitious Content and Materials
2217	MnDOT control mixture* without CarbonCure™ CO_2 injection	570 pcy cementitious, 30% Coal Creek Class F fly-ash
2218	Standard MnDOT Paving mixture (control)	570 pcy cementitious, 30% Coal Creek Class F fly-ash
2219	Optimized Concrete Mixture (Iowa State University)	501 pcy cementitious, 30% Coal Creek Class F fly-ash
2220	Burgess Pigment Metakaolin Class N natural pozzolan	570 pcy cementitious, 12% metakaolin natural pozzolan and 18% Coal Creek Class F fly-ash
2221	3M™ Class N natural pozzolan from shingle baghouse fines	570 pcy cementitious, 15% 3M natural pozzolan, 15% Prairie State Plant Class F fly-ash
2222	Hess Pumice Class N natural pozzolan	570 pcy cementitious, 30% pumice natural pozzolan
2223	Continental Blended Cement Type IL(20)	570 pcy cementitious, 30% Coal Creek Class F fly-ash
2224	Carbon Limit ground limestone blended with proprietary pozzolan additive	570 pcy cementitious, 30% Carbon Limit ASCM

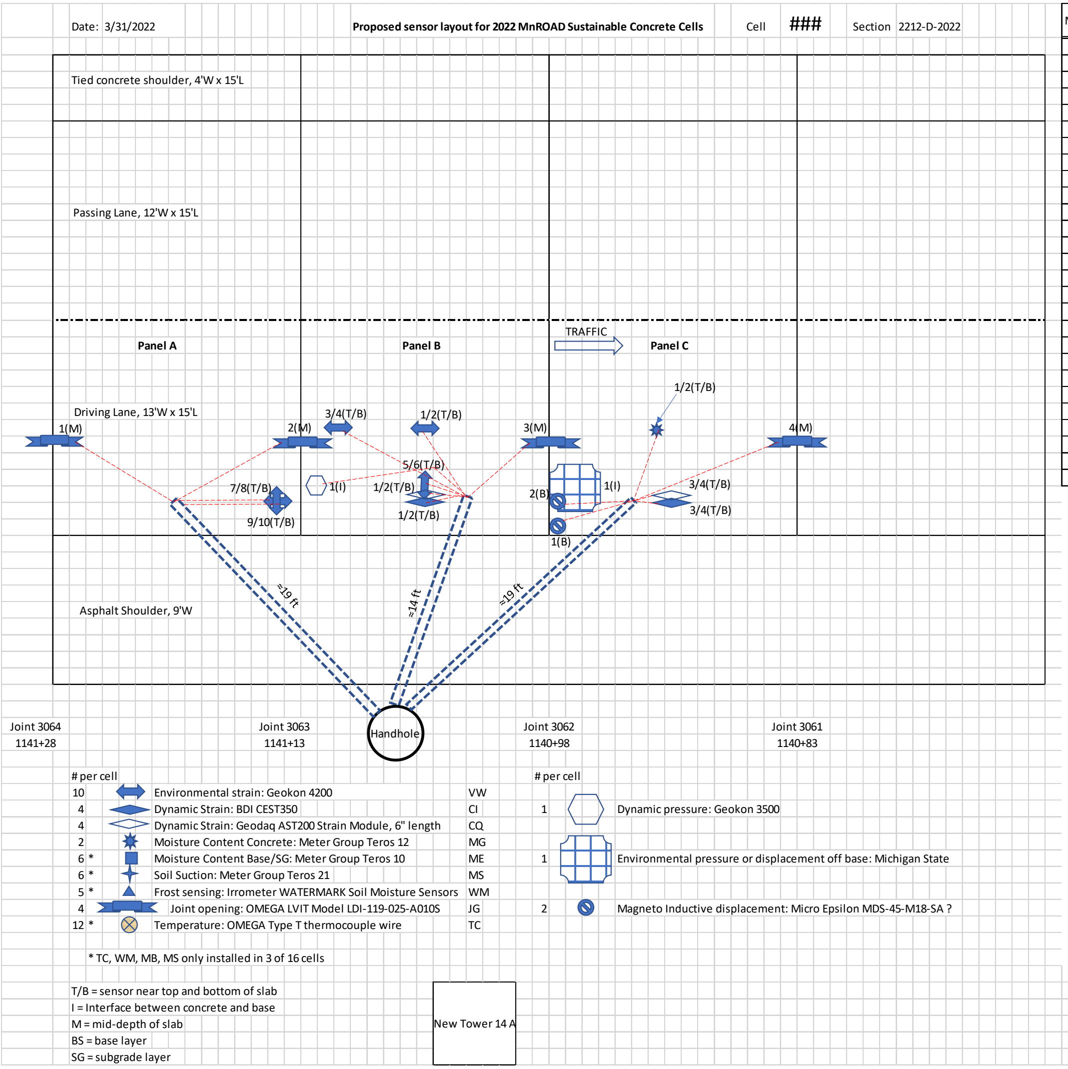
*Control Mix = 570 pcy cementitious: 70% ASTM C595 Type IL(10), 30% Coal Creek Class F fly-ash

Fresh and Hardened Concrete Testing

MnDOT Aggregate Quality,
Paste Content and Gradation,
Air Content C231/T152,
Super Air Meter, Hardened Air
Content, Unit Weight, Slump,
Temperature, Box Test, V-Kelly,
Phoenix Test, Microwave Oven
Moisture Content, Compressive
Strength, Flexural Strength,
Maturity, Resistivity,
Rapid Chloride Permeability,
Bulk Resistivity,
Freeze-Thaw Resistance,
Thermal Gravimetric Analysis,

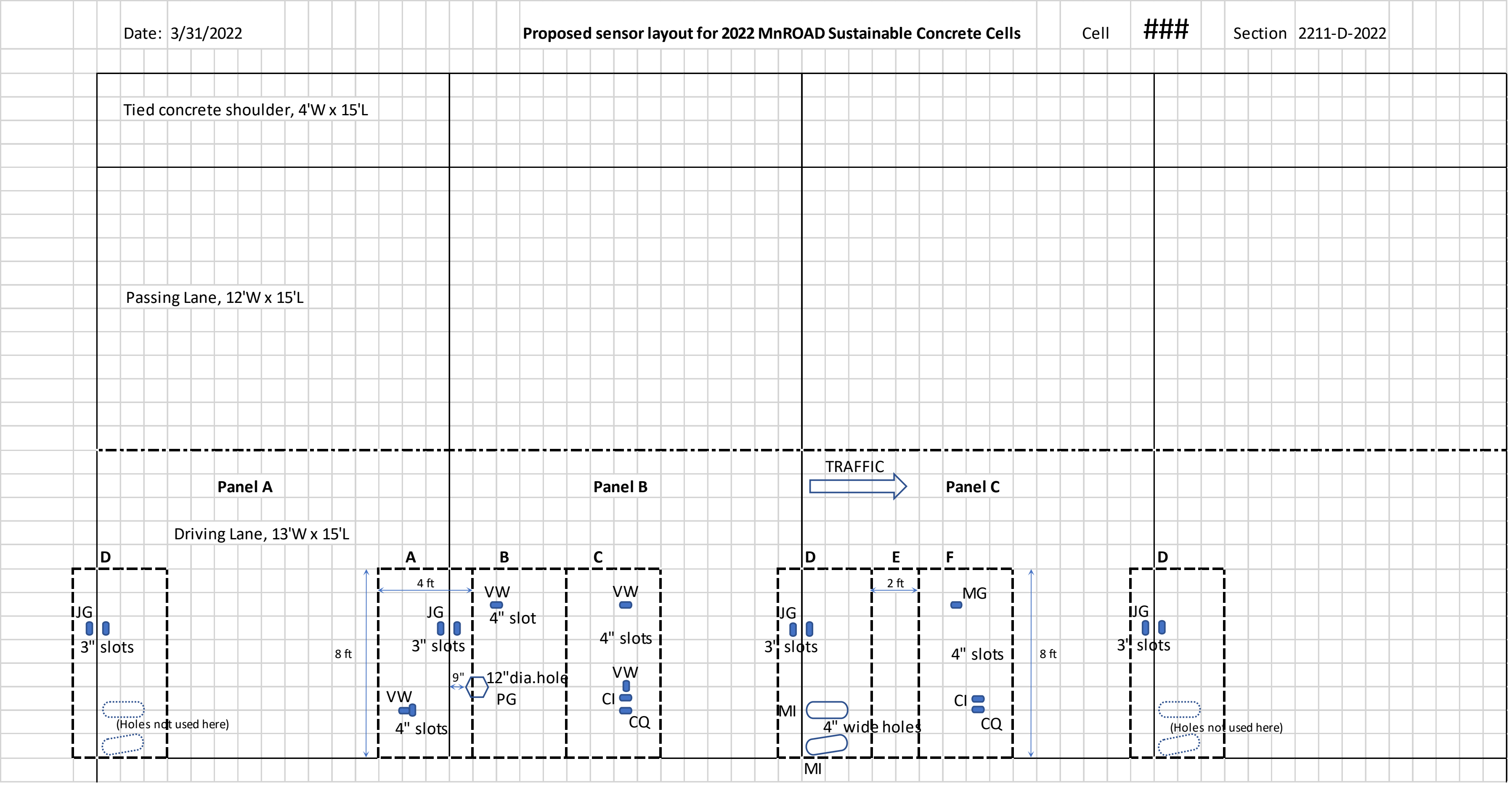
Time to Critical Saturation,
Deicing Salt Damage,
ASR-Concrete Prism,
ASR-Miniature Concrete Prism,
Mortar Bar Expansion,
Poisson's Ratio and Elastic Modulus,
Coefficient of Thermal Expansion,
Drying Shrinkage, Expansion of
Mortar Bars Stored In Water,
Expansion of Mortar Bars in Sulfate
Solution,
Fly-Ash or Natural Pozzolan
Classification,
Semi-Adiabic Calorimetry

Typical MnROAD Instrumentation Plan



Model	Seq	Orientation	Sensor Name	STA	Lead Length	Offset (ft)	Depth (in)	Material	Sensor type
VW	1	L	2212VW01	1141+05.5		-6.5	1	Concrete	Geokon 4200
VW	2	L	2212VW02	1141+05.5		-6.5	6.5	Concrete	Geokon 4200
VW	3	L	2212VW03	1141+12		-6.5	1	Concrete	Geokon 4200
VW	4	L	2212VW04	1141+12		-6.5	6.5	Concrete	Geokon 4200
VW	5	T	2212VW05	1141+05.5		-10	1	Concrete	Geokon 4200
VW	6	T	2212VW06	1141+05.5		-10	6.5	Concrete	Geokon 4200
VW	7	L	2212VW07	1141+14		-11	1	Concrete	Geokon 4200
VW	8	L	2212VW08	1141+14		-11	6.5	Concrete	Geokon 4200
VW	9	T	2212VW09	1141+14		-11	1	Concrete	Geokon 4200
VW	10	T	2212VW010	1141+14		-11	6.5	Concrete	Geokon 4200
CI	1	L	2212CI01	1141+05.5		-10.5	1	Concrete	BDI CEST350
CI	2	L	2212CI02	1141+05.5		-10.5	6.5	Concrete	BDI CEST350
CI	3	L	2212CI03	1140+90.5		-10.5	1	Concrete	BDI CEST350
CI	4	L	2212CI04	1140+90.5		-10.5	6.5	Concrete	BDI CEST350
CQ	1	L	2212CQ01	1141+05.5		-11	1	Concrete	Geodaq AST200, 6"
CQ	2	L	2212CQ02	1141+05.5		-11	6.5	Concrete	Geodaq AST200, 6"
CQ	3	L	2212CQ03	1140+90.5		-11	1	Concrete	Geodaq AST200, 6"
CQ	4	L	2212CQ04	1140+90.5		-11	6.5	Concrete	Geodaq AST200, 6"
MG	1	n/a	2212MG01	1140+90.5		-6.5	1	Concrete	Meter Group Teros 12
MG	2	n/a	2212MG02	1140+90.5		-6.5	6.5	Concrete	Meter Group Teros 12
JG	1	L	2212JG01	1141+28		-7.5	3	Concrete	OMEGA LDI-119-025-A010S
JG	2	L	2212JG02	1141+13		-7.5	3	Concrete	OMEGA LDI-119-025-A010S
JG	3	L	2212JG03	1140+98		-7.5	3	Concrete	OMEGA LDI-119-025-A010S
JG	4	L	2212JG04	1140+83		-7.5	3	Concrete	OMEGA LDI-119-025-A010S
PG	1	n/a	2212PG01	1141+12		-10	7.5	Concrete	Geokon 3500
MI	1	n/a	2212MI01	1140+97		-11.5	7.5	Class5Q	Micro Epsilon MDS-45-M18-SA ?
MI	2	n/a	2212MI02	1140+97		-10	7.5	Class5Q	Micro Epsilon MDS-45-M18-SA ?

MnROAD Instrumentation Installation Plan



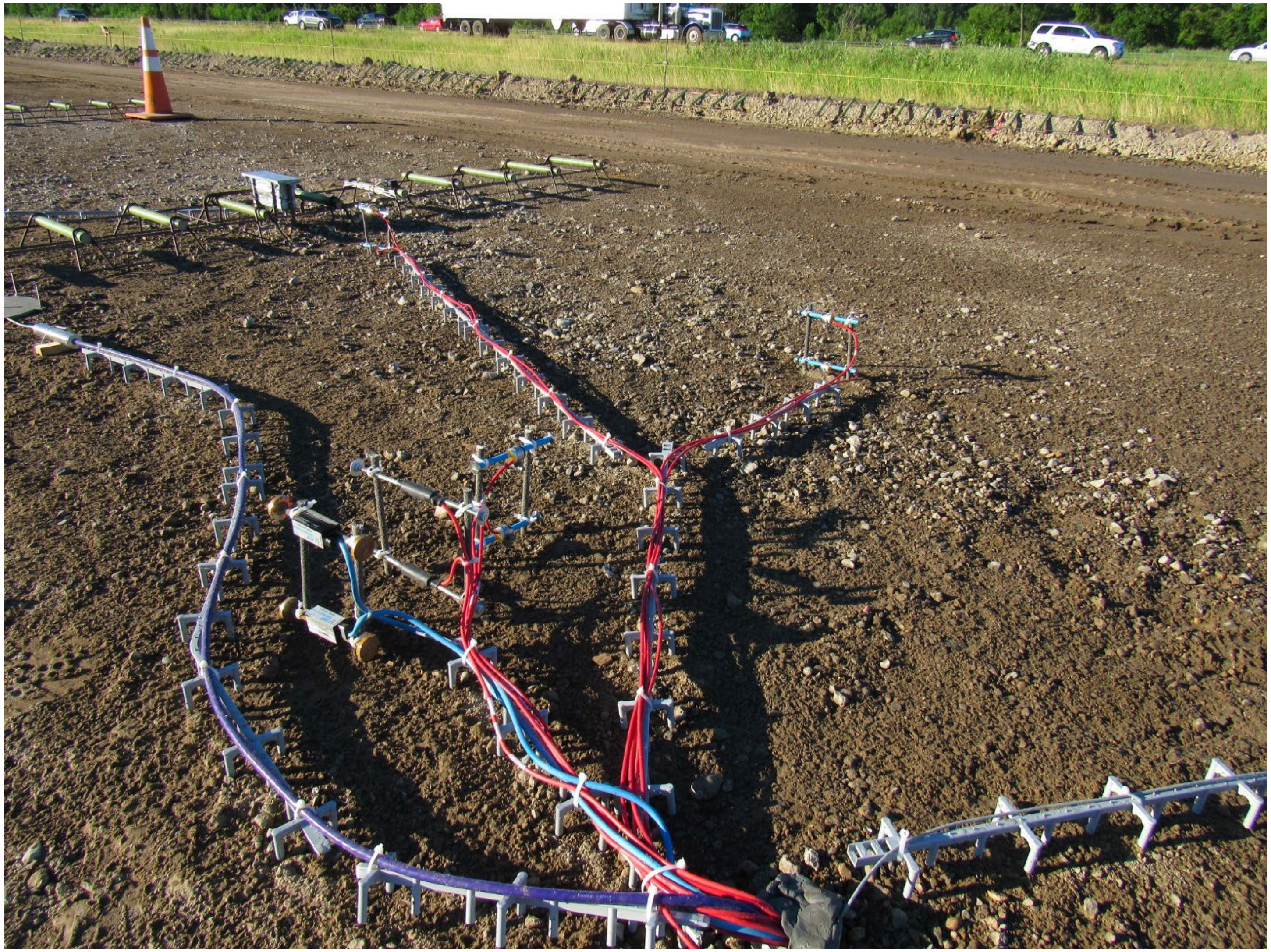
Plywood templates to locate support dowels

MnROAD Instrumentation

Plywood templates to locate support dowels

MnROAD Instrumentation

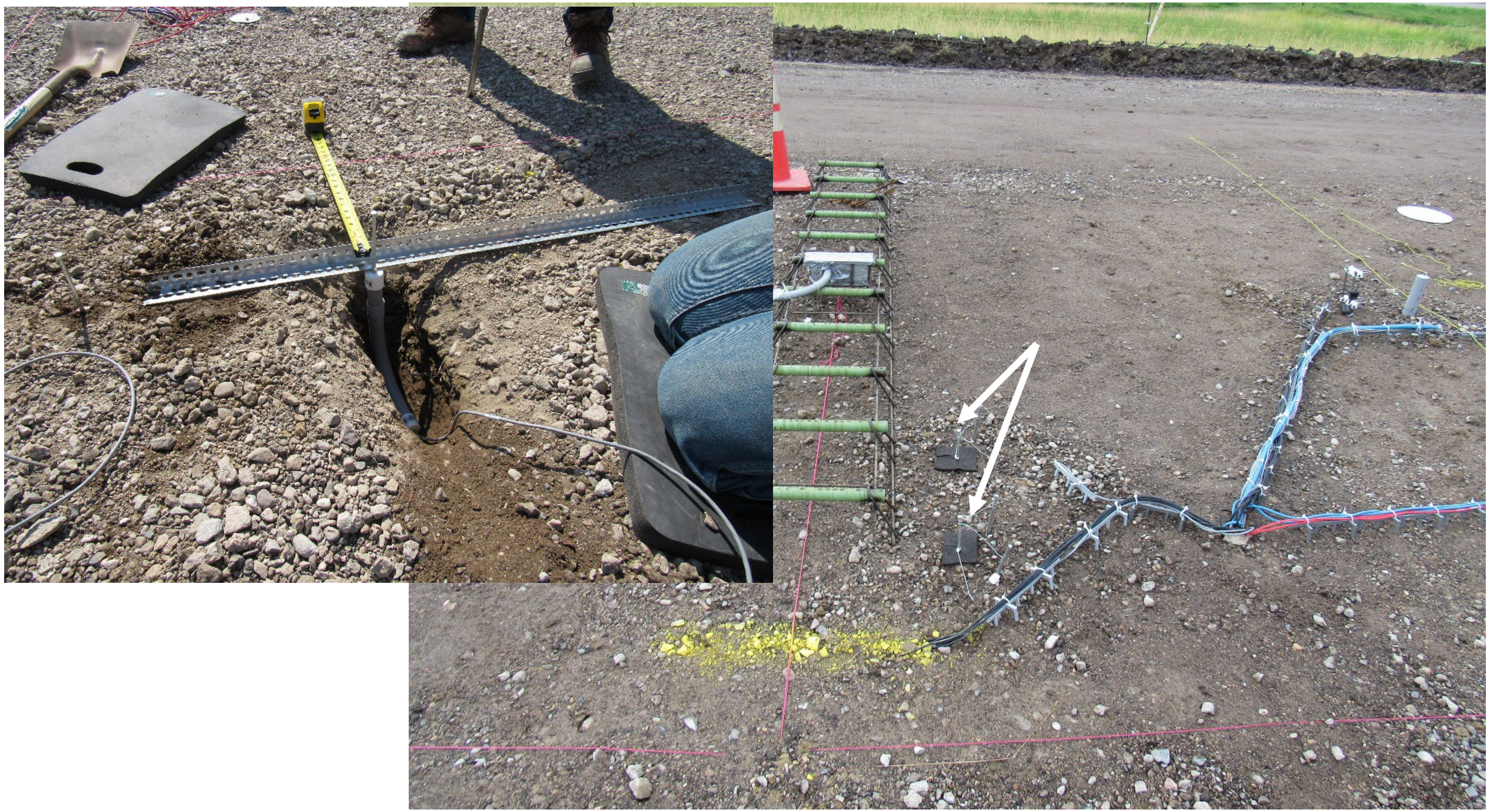
MnROAD Instrumentation



MnROAD Instrumentation

Pressure plate attaches to bottom of slab

MnROAD Instrumentation



Magnetic induction slab lift sensors

MnROAD Instrumentation

Joint opening sensor blockout and maturity sensor

MnROAD Instrumentation Lessons Learned

- **Plywood templates can help locate sensor support dowels consistently**

- **Do not use GPS distances for calculating sensor lead lengths**
  - **Leads running inside conduit laid under deep ditches require much additional length**
  - **Had to splice addition lead wire onto many sensors**
  - **High failure rate with spliced lead wires**

- **In many cases, the weight of concrete moved magnetic induction sensors out of range**

MnROAD Concrete Test Section Construction

Construction issues:

- **Materials delivered in super sacks had to be transferred into pneumatic tanker (very tedious)**
- **Despite trial mixing in lab, some mixes not fully “dialed-in” by time of placement**
- **Several mixes required the addition of water or additional water reducer in the field to achieve desired workability**

MnROAD Concrete Test Section Construction

Construction issues:

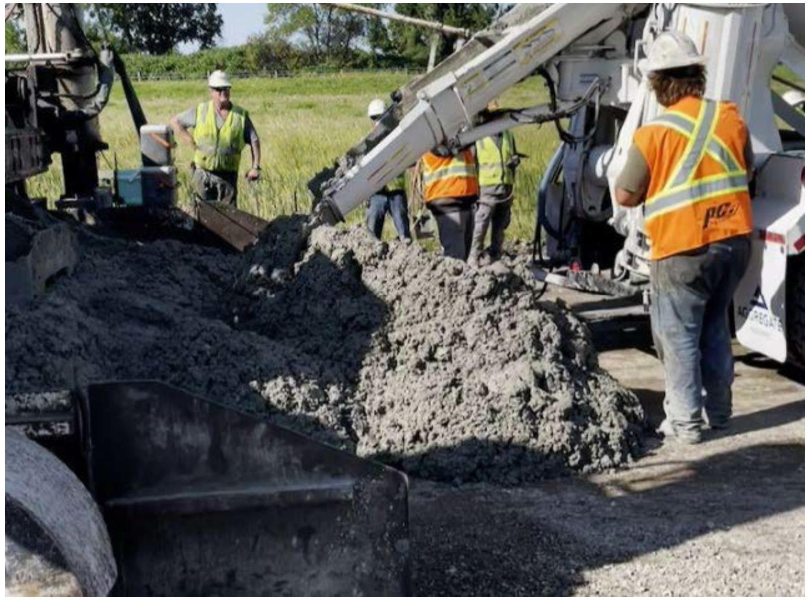
- ➢ Frequent delays in delivery by ready-mix trucks
- ➢ Concerns in some cells with early setting, requiring them to be placed and finished quickly before becoming too stiff to consolidate
- ➢ Some surfaces were difficult to finish (tearing)
- ➢ Even after two attempts to adjust the mix, one section ended up with only a very short segment of material remaining in place
- ➢ A majority of the sections needed to be diamond ground due to inadequate texture depth
    - Sensor areas (45 ft long) were left with as-built texture for comparison

MnROAD Concrete Test Section Construction

MnROAD Concrete Test Section Construction

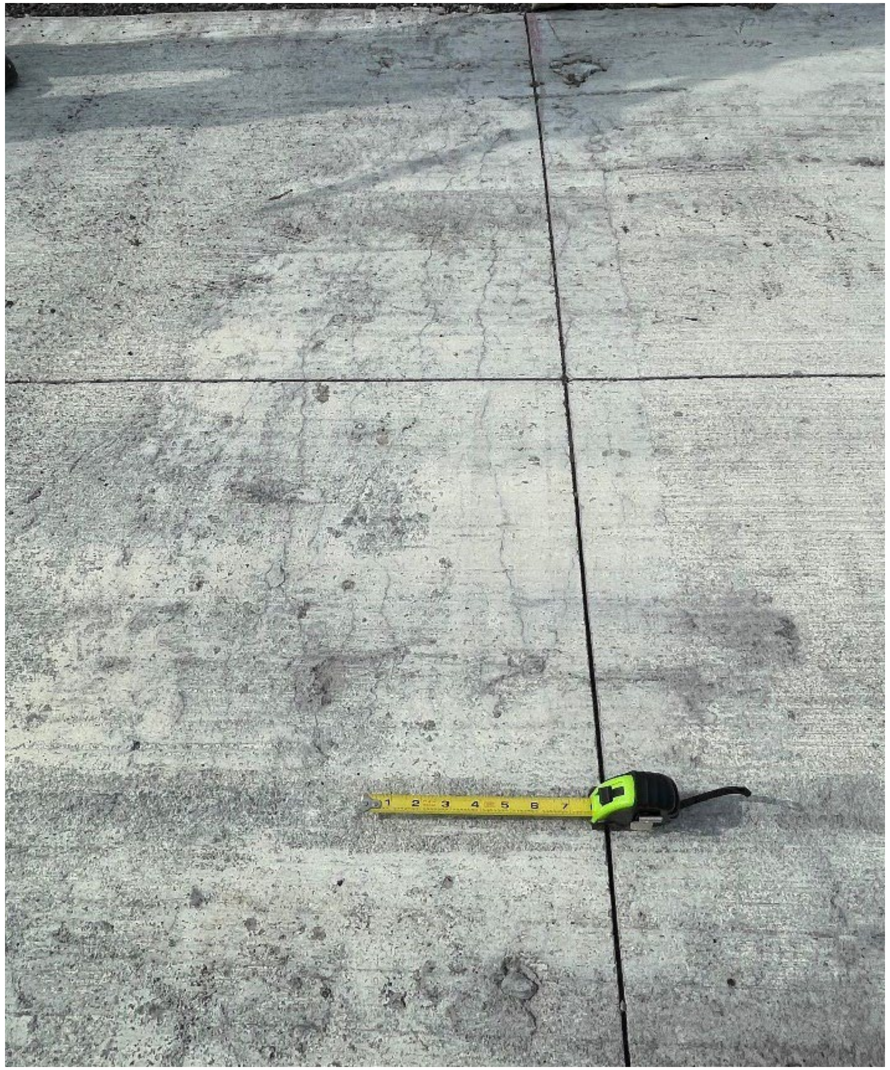
MnROAD Concrete Test Section Construction

MnROAD Concrete Test Section Construction



MnROAD Concrete Test Section Construction

MnROAD Concrete Test Section Construction



MnROAD Concrete Test Section Construction

MnROAD Concrete Test Section Construction

MnROAD Concrete Test Section Texturing

Early Life Repairs Needed

Performance After One Year

Performance After One Year

Performance After One Year

Performance After One Year

Performance After One Year

Construction and Material Selection Resources

- **For more info on the material selection:**

  Development of Mix Designs and Matrix of Materials for MnROAD Low Carbon Concrete Test Site **- Final Report - September 2023**

  - **Nick Weitzel, P.E., Sarah Lopez, P.E. NCE**
  - **Tom Van Dam, Ph.D., P.E. WJE**
  - **Larry Sutter, Ph.D., P.E. Sutter Engineering, LLC**

  (Currently in process of publication)

- **2022 MnROAD Construction Activities report:**
  - **https://mdl.mndot.gov/items/202337**

What's Next?

- **Continue to monitor performance of lower carbon concrete test sections constructed at MnROAD in 2022**
- **Construct 8+ additional lower carbon concrete test sections in 2024**

Announcement/Reminder

13th International Conference on Concrete Pavements

Minneapolis, Minnesota, USA | August 25-29, 2024

https://13thiccp.concretepavements.org/

Theme: ***Innovative Paths Toward Lower Carbon in Concrete Pavements***

DEPARTMENT OF TRANSPORTATION

Questions?

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