

Serving the Nation

Nationally, MnROAD has played a key role in: Supporting several NCHRP studies, including the development of the next generation pavement design guide, providing a location with a wide range of surface characteristics to study noise, smoothness, and safety and developing and field validating intelligent transportation systems (ITS).



MnROAD Site
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Monticello, Minnesota 55362
Site Phone # (651) 297-2996
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Become a Research Partner!

The Minnesota Department of Transportation is committed producing timely cost-effective research findings that have a local, regional and national impact on improving our transportation system. Please contact us to further to discuss MnROAD and the partnership opportunities available to you and your organization.

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MnROAD

*Safer, Smarter, Sustainable Pavements
Through Innovative Research*



Supported by NRRA Members and Associates
including Minnesota Local Road Research Board



October 2016

Welcome to MnROAD!

MnROAD, located near Albertville, Minnesota (40 miles northwest of the Twin Cities), is a cold region testing facility and laboratory operated by the Minnesota Department of Transportation (MnDOT) and is unique to the world. MnROAD consists of two road segments that are divided into over 50 test cells, each representing various combinations of road-building materials and designs:

- Mainline (ML) 3.5-mile Interstate-94 roadway
- Low Volume Road (LVR) 2.5-mile roadway that uses a controlled 5-axle semi tractor-trailer

MnROAD was originally constructed in 1994 at a cost of \$25 million provided by state and federal funding. The partnership between Minnesota Department of Transportation (MnDOT) and the Minnesota Local Road Research Board (LRRB) provided the majority of MnROAD operational funding during the first ten years. Over the years, researchers from around the nation, and the world, have utilized the MnROAD facility and data.



MnROAD enables researchers to:



- Evaluate pavement performance under real, physical conditions (traffic, environment, materials).
- Examine the way factors such as moisture, frost, traffic loading, construction, and materials interact through the use of an extensive instrumentation network.
- Design customized experiments supporting specific researcher needs that utilize the experienced MnROAD research staff and its equipment.
- Provide a safe work zone for testing because of its unique ability to remove traffic without disruption to the driving public.
- Develop tools and methods based on actual performance data to improve the design, construction, and maintenance of pavements.

Monitoring & Field Performance

MnROAD has been monitoring pavement performance since 1994 through laboratory testing, sensor response, and field monitoring over the life of each test cell. Each research project determines the specific testing and monitoring needed as part of the project's experimental design and work plan and once completed is entered to the database.

MnROAD Field Monitoring Data

MnROAD monitoring begins with the initial measurements after construction and follows the pavement performance throughout its life. Forensic studies are completed after the study's conclusion. MnROAD incorporates traditional field monitoring along with MnROAD developed field tools.



MnROAD Laboratory Testing Data

MnROAD and its partners, run both standard and experimental types of testing for subgrade, bound/unbound base materials, concrete, and asphalt surface materials.



MnROAD Database

This database allows MnROAD researchers to accurately record methodology and pertinent information for research use and requests.

All data and reports are available at no cost and are featured on the MnROAD website or by request. Certain information is stored offline requiring a request to MnROAD research staff.

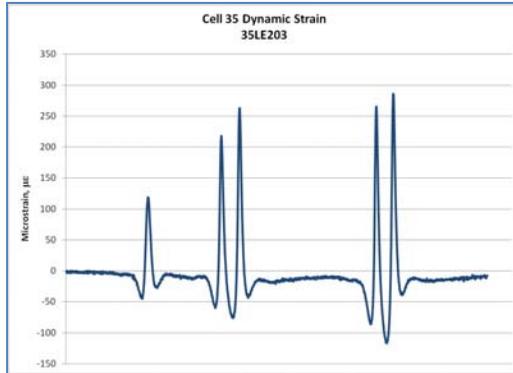
www.mndot.gov/mnroad/data

MnROAD Sensors

MnROAD has installed over 9500 sensors over the last 17 years. Each sensor type has unique testing frequencies and data handling procedures. These sensors are linked by fiber optics directly into the MnROAD's computerized data collection system and measure variables such as temperature, moisture, strain, deflection and frost depth, among others, in and under the pavement.

There are two different types of pavement sensors: static (environmental) and dynamic (forces applied by traffic). MnROAD also collects traffic data and has a weather station, on site.

The dynamic pavement response sensors, triggered by the passage of heavy vehicles, take readings up to 2000 times per second while the static sensors capture environmental data every 15 minutes.



Examples of sensor types:

Dynamic Sensors: LVDT, Concrete Embedment Strain Gauge, Steel Strain Gauge, Dynamic Soil Pressure Cell, and Bituminous Strain Gauge.

Static Sensors: Horizontal Clip Gauge, Moisture Gauge, Thermocouple, Resistivity Probe, Tipping Bucket, and Vibrating Wires.



Successes and Benefits

Results from Phase I (1994-2006) and Phase II (2007-2016) at MnROAD have made positive impacts within the state of Minnesota and the nation at large. Increases in performance and pavement life have resulted in a reduction in costs for maintenance, repairs, user delays and congestion. Related to Minnesota only (granted other states and organizations have also benefited) MnROAD studies are estimated to save \$33 million/year (Phase I) and 10.3 million/year (Phase II) which both outweigh our costs.

Phase I Research	Savings/yr
Spring Load Restriction Policy	\$14 Million
Winter Load Increase Policy	\$7 Million
Low Temperature Cracking Reduction	\$5.7 Million
ME Flexible Design Method	\$4 Million
ME Rigid Design Method	\$1.2 Million
Sealing Pavement/ Shoulder Joints	\$1.2 Million

Phase I Full Report - <http://dotapp7.dot.state.mn.us/ResearchTracking/pdf/2008MRRDOC033.pdf>

Phase II Research	Savings/yr
Investigation of Low Temperature Cracking in Asphalt Pavements (Phase-II) - TPF-5(132)	\$2,273,000
Development of an Open Graded Aggregate Base (Stable and Drainable)	\$4,770,000
Thin and Ultrathin Concrete Overlays of Existing Asphalt Pavements - TPF-5(165)	1,927,000
Development of Design Guide for Recycled Unbound Pavement Materials - TPF-5(129)	829,000
Full-Depth Reclamation Stabilized with Engineered Emulsion	505,700
Field Investigation of Highway Base Material Stabilized With High Carbon Fly Ash	92,400

Phase II Full Report - <http://dotapp7.dot.state.mn.us/ResearchTracking/pdf/201519.pdf>

Local Initiatives

The mission of the LRRB is to serve local, city and county engineers through the development of new initiatives, the acquisition and application of new knowledge, and the exploration and implementation of new technologies. LRRB funding of MnROAD supports research to improve local road design, construction, maintenance and better environmental practices.

We perform several services for the LRRB which are best categorized into these areas:

- 1) Providing technical support for LVR operations,
- 2) Providing field support for pavement preservation, maintenance & rehabilitation,
- 3) Assisting with waste product utilization including shingles, glass, fly ash, recycled PCC, and HMA, and
- 4) Following-up and implementing completed research.



Join MnROAD in Current and Future Studies

National Road Research Alliance

National Pooled Fund – Posting expected Aug. 1

Minnesota Lead State – \$150,000/yr agencies & \$2,000/yr for industry/associations/academia

Minnesota is pleased to announce a new pooled fund that will help use the MnROAD Test Track for local, regional and national research, tech transfer, and implementation needs. Currently six states have joined (CA, IL, MO, MN, WS) and over 20 associate members from Industry, associations, and academia. The pooled fund will focus on solving problems that impact road owners with an emphasis on customer needs. Member road owner agencies will have the ability to provide input and make decisions on future MnROAD construction and research scheduled in 2017. MnDOT will match up to \$2.5 million in construction funding to aid in the development of the next round of test sections at MnROAD to support common goals. Industry, associations, and academia is playing an important role to provide critical input on long-term future trends in research and barriers to implementation, including working with their customers and members who play a direct role in implementation.

More details on NRRRA - <http://www.dot.state.mn.us/mnroad/nrra/index.html>

MnDOT's MnROAD Research Facility Partnership with National Center for Asphalt Technology (NCAT)

Pooled Fund TPF-5(267) – <http://www.pooledfund.org/Details/Study/496/>
Alabama Lead State – MnDOT is a subcontractor to Auburn (NCAT)

MnROAD and NCAT have partnered on two studies beginning in 2015. The first is to advance national pavement preservation technology through quantification of life-extending benefits. The second project addresses development and implementation of asphalt performance tests to predict cracking for common distress. This will enable engineers to select mixtures and assess mixture performance expectations before any mix is placed in the field during construction. Sharing resources and expertise will improve coordination of experiments, expand evaluation of pavement performance in both northern and southern climates, and provide cost-effective solutions that can be implemented nationwide. In 2016 both eight test sections were built at MnROAD and pavement preservation treatments have been placed on US-169 and CSAH-8 in Mille Lacs County.

More details on this partnership - <http://www.dot.state.mn.us/mnroad/NCATpartnership/index.html>.



Phase II Asphalt Studies



HMA Surface Characteristics related to Ride, Texture, Friction, Noise & Durability (LRRB, MnDOT, FHWA)

MnDOT is measuring various surface characteristics over time to develop improved mix designs.

http://www.dot.state.mn.us/mnroad/projects/HMA_Surf_Chara/index.html

Recycled Asphalt Pavements (LRRB, MnDOT, FHWA)

MnDOT is incorporating Recycled Asphalt Pavement and Shingles into asphalt mixtures and studying their effect on pavement durability.

<http://www.dot.state.mn.us/mnroad/projects/RAP/index.html>

Field Investigation of Polyphosphoric Acid Modified Asphalt

(Innophos, Marathon, Paragon, ICL, MTE, WR1, FHWA, MnDOT)

MnDOT is studying the effects of PPA binder modification in laboratory and field performance of modified asphalt mixtures.

http://www.dot.state.mn.us/mnroad/projects/Polyphosphoric_Acid_Mod_Aspphalt/index.html

TPF-5 (153) Optimal Timing of Preventative Maintenance for Addressing Environmental Aging in HMA Pavements (MD, MN, OH, TX, LLRB)

The Asphalt Institute is taking a fresh approach to characterizing binder aging and its impact on the timing of surface treatments.

http://www.dot.state.mn.us/mnroad/projects/Optimal_Timing/index.html

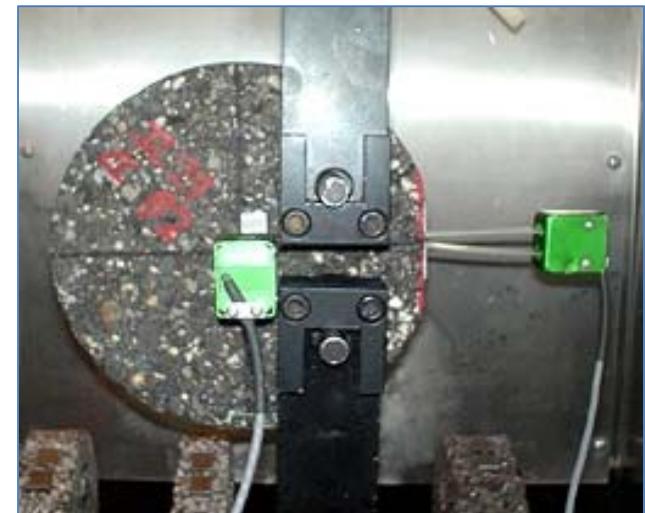
TPF-5 (132) Investigation of Low Temperature Cracking in Asphalt Pavements – Phase II (CT, IA, MN, ND, NY, WI)

The University of Minnesota is developing Low Temperature Cracking mixture specifications based on laboratory fracture testing and modeling.

http://www.dot.state.mn.us/mnroad/projects/Low_Temp_Cracking/index.html

Permeable (HMA) Pavement Performance in Cold Regions (LRRB, MnDOT)

MnDOT's study focusing on snow melt, permeability, layer stiffness, and other differences between porous and conventional HMA.



Phase II Concrete Studies

TPF-5 (134) PCC Surface Characteristics – Diamond Grinding (MN, TX, IGGA, ACPA, FHWA)

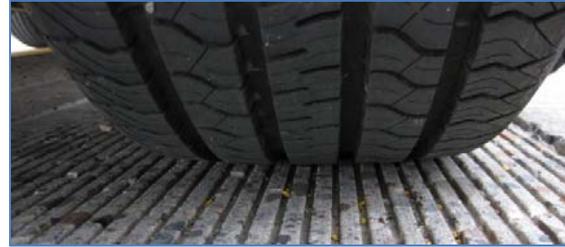
MnDOT and Minnesota State University's study of the effect of the full-scale deployment of innovative diamond grind concrete surface for optimized noise, friction, and ride quality.

http://www.dot.state.mn.us/mnroad/projects/PCC_Rehab/index.html

Investigation of High Performance Concrete Pavement

MnDOT's development of an improved service life prediction model for current 60-year concrete designs while understanding the behavior in regards to maturity, slab warp and curl, and thermal expansion.

http://www.dot.state.mn.us/mnroad/projects/High_Performance_PCC_Design/index.html



Pervious Concrete Pavement Study (LRRB, MnDOT)

MnDOT's study of permeability, freeze thaw durability, and maintenance activities at MnROAD and on city streets.

http://www.dot.state.mn.us/mnroad/projects/Pervious_Conc_Pavement/index.html

PCC Surface Characteristics – Construction (MnDOT, FHWA)

MnDOT'S study to determine how surface characteristics of various textures on new concrete affect noise, friction, ride and other properties

http://www.dot.state.mn.us/mnroad/projects/PCC_Construction/index.html

Pervious Concrete Overlay Mix Design for Wearing Course Applications (CTRE, MnDOT)

MnDOT's study of cracking, permeability, and ride performance of pervious concrete overlays.

http://www.dot.state.mn.us/mnroad/projects/Pervious_Concrete_Mix_Design/index.html



Phase II Core Research

MnROAD test cells are designed around studies developed by our partners which represent local, state, national and international interests. The cells include both new construction and rehabilitation along with various asphalt and concrete pavement surfaces.

Construction of Phase II test cells began in 2007 and continued with projects in 2008, 2010 and 2011. Almost 40 test cells were reconstructed on the Low Volume Road and Mainline representing over 20 different research projects. Listed below are the five research aims during Phase II:

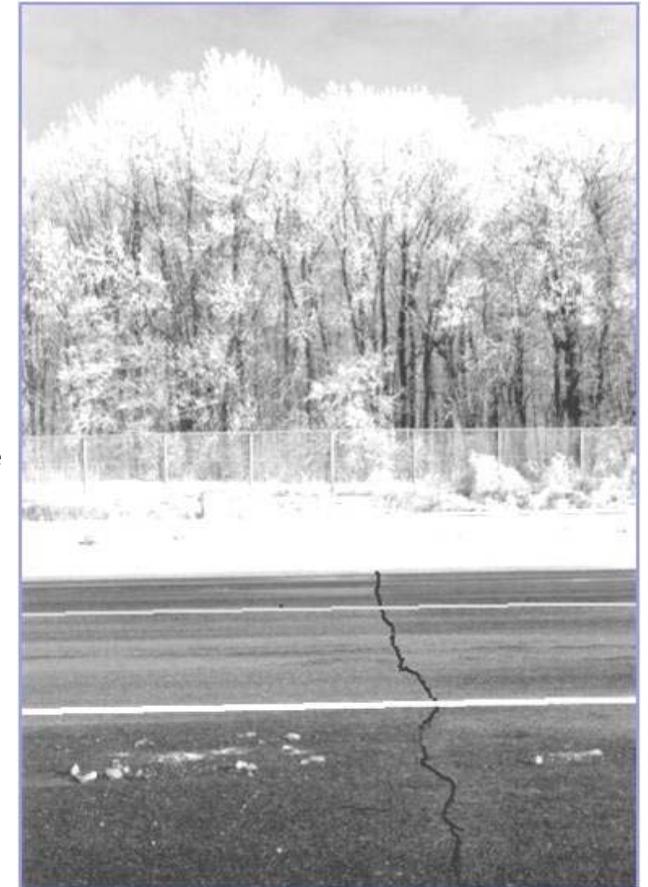
Innovative Construction – Team with industry and academia to implement new technology, materials, and construction methods that maximize productivity and reduce user delays.

Green Roads – Reduce dependence on virgin materials throughout the pavement structure by reusing pavement materials and various waste products including taconite aggregates, fly ash, shingles, Recycled Asphalt Pavement, and other materials. Also, to more efficiently design pavement based on today's technology.

Preservation and Rapid Renewal – Develop and improve techniques to maintain and rehabilitate our current pavement investments, reduce life cycle costs, and maximize investments for long term performance.

Surface Characteristics – Establish new techniques with our research partners for smooth, quiet, durable, and safe skid-resistant pavements.

Non-Pavement Research – Continue supporting traffic, environmental, industrial, and intelligent transportation systems through the use of MnROAD's unique facility.



Phase II Composite Studies



SHRP II R21 Composite Pavement Study

Applied Research Associates is incorporating sustainable technologies in long-lasting, low maintenance pavements.

http://www.dot.state.mn.us/mnroad/projects/Composite_Pavement_Systems/index.html

TPF-5 (165) Development of Design Guide for Thin and Ultrathin Concrete Overlays of Existing Asphalt Pavements (MS, MN, MO, NY, PA, TX)

University of Pittsburgh is developing a rational design method for whitetopping.

<http://www.dot.state.mn.us/mnroad/projects/Whitotopping/index.html>

TPF-5 (149) Design and Construction Guidelines for Thermally Insulated Concrete Pavements (CA, MN, WA, FHWA, LRRB)

University of Minnesota is developing design and construction guidelines for thermally insulated concrete pavements.

http://www.dot.state.mn.us/mnroad/projects/Composite_Pavement_Systems/index.html

Unbonded Concrete Overlay Using PASSRC and Unwoven Geotextiles (CPAM, ACPA, MnDOT)

MnDOT is supporting industry initiatives to find the best-performing interlayer material for stress relief and drainage in UBOL design.



Phase II Farm Equipment Study

TPF-5 (148) The Effects of Implements of Husbandry "Farm Equipment" on Pavement Performance (MN, LRRB, IA, IL, WI, PNAAW)

University of Minnesota is investigating the effects of heavy farm equipment on the stress and strain behavior of county roads.

http://www.dot.state.mn.us/mnroad/projects/Implements_of_Husbandry/index.html

Phase II Base & Aggregate Studies

TPF-5 (129) Recycled Unbound Pavement Materials (CA, MI, MN, OH, TX, WI)

University of Wisconsin's study of the strength, deformation, and material performance of recycled aggregate base s.

http://www.dot.state.mn.us/mnroad/projects/Recycled_Unbound_Pavement_Materials/index.html

The Use of Taconite Aggregates in Pavement Applications (NRRRI, MnDOT)

MnDOT's study to learn the suitability of waste rock from Minnesota's Iron Range for use in pavement applications.

http://www.dot.state.mn.us/mnroad/projects/Taconite_Aggregates/index.html

Full Depth Reclamation Stabilized with Engineered Emulsion (Road Science, LLC, MnDOT)

MnDOT's study of the structural design and field performance of stabilized full-depth reclamation layers.

<http://www.lrrb.org/media/reports/201236.pdf>



Field Investigation of Highway Base Material Stabilized with High Carbon Fly Ash (Bloom Consultants, U of WI, MPCA)

MnDOT's evaluation of the physical and environmental properties of base materials stabilized with high carbon fly ash in comparison to recycled pavement materials and crushed stone.

http://www.dot.state.mn.us/mnroad/projects/High_Carbon_Fly_Ash/index.html

Development of New Open Graded Base Specification (MnDOT, FHWA)

MnDOT development a new OGAB specification that is both permeable and stable under construction traffic.

Pooled Fund Research

Visit www.pooledfund.org or the MnROAD web site, www.mndot.gov/mnroad/projects, for more information.