MnDOT Pavement Research

Safer, Smarter, Sustainable Pavements through Innovative Research

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Presentation Outline

MnROAD Operations - Results / Benefits
Future Plans
Pavement Condition

• Current State of our Roadways?
  – MnDOT Pavement Management Van
    • Surveys Done
      – Every Year State Roads
      – 25% of the CSAH Roadways
Investment into Pavement Research

Minnesota Highway System

2000
Average RSL = 13.7 years

Percent Roadway/Miles

Remaining Service Life (years)
Investment into Pavement Research

Minnesota Highway System

2013
Average RSL = 9.4 years

2000
Average RSL = 13.7 years

Roadway Miles

Remaining Service Life (years)
A long-term accelerated pavement testing facility that gives researchers a unique, real-life laboratory to study and evaluate the performance of materials used in roadway construction.
MnROAD
Office of Materials and Road Research

MnROAD
"Mainline",
Westbound
Interstate-94

W.B. I-94 Traffic Diverted
(3 days / month)
MnROAD “Low Volume Road”
Controlled Access
MnROAD Traffic Loadings

Low Volume Road

5-axle Tractor-Trailer Truck
80,000 Inside Lane = 5 days/week
Outside Lane Environmental

Rigid ~ 25,500 ESALs/yr
Flexible ~ 16,000 ESALs/yr

Interstate Mainline

I-94 WB Public Traffic
29,700 AADT -- 13% HCAADT (2013)

Rigid ~ 1.2 Million ESALs/yr
Flexible ~ 0.8 Million ESALs/yr
MnROAD Test Facility

• **Initial Development**
  
  • **Major Experiments**
    – Phase I (1994-2006)
    – Phase II (2007-2016)
    – Future Phase III (2016 - 2026)

• **Layout and Designs**
  – Mainline / Low Volume
  – Asphalt / Concrete / Aggregate
  – 3,5,10 Year Designs
  – Accelerated Findings
  – Low Impact / Risk to the public
MnDOT - Road Research Staffing

• 19 Road Research Staff
  – Maplewood Staff
    Asphalt Concrete Design = 12 FTE
  – MnROAD Operations
    @ MnROAD = 3 FTE
    @ Maplewood = 4 FTE

– Student Workers
MnROAD Operations

• Research Development
• Construction
• Performance Monitoring
  – Cracking / Rutting / Ride
  – Deflection (FWD), ..... 
• Sensors
  – Static (Environmental)
  – Dynamic (Traffic Loading)
• MnROAD Database
• Technology Transfer
• Traffic Loadings
Types of Benefits

• **Direct**
  – Savings of materials
  – Sustainable

• **Indirect**
  – Time savings and quality

• **Avoidance**
  – Don’t do that on the system

• **Demonstration**
  – Confidence to try something new
MnROAD Phase-I (1994-2006) Benefits

Saves $33 million Annually (Savings from 2006-2018)

- Seasonal Load Limits
  - Spring Restrictions / Winter Overloads
- Improved Design Methods
  - Flexible & Rigid Updated Designs
    - Environment Drives Pavement Performance
    - Current Designs are too Conservative
- Sealing Pavement / Shoulder Joints
MnROAD Phase-II (2007-2016) Summary

- **MnROAD Costs (9 yr avg)**
  - Benefits Report
  - $2.75 million / year

- **Savings ~ $10.3 million/yr**
  - Whitetopping $1.9 million
  - LTC $2.3 million
  - Stabile and Drainable $4.7 million
  - Recycled Unbound Materials $0.8 million
  - Full Depth Reclamation $0.5 million
  - Stabilization using High Carbon Fly Ash $0.1 Million

- **Estimated Savings greater than overall Costs (Beneficial)**
MnROAD Phase-II (2007-2016)

Asphalt Benefits

• Asphalt Materials
  – Use of Warm Mix
  – Better understanding on modification
  – Developing a performance test for LTC
  – Use of Recycled materials

• Savings – Low Temperature Cracking
  – 2.3 million / year
    (Reduced cracking / less maintenance / better performance)
Low Temperature Cracking

- **TPF-5(132) Pooled Fund**
  - National mix test and specification
  - HMA cells and other state roadways
  - University of Minnesota Lead

- **Observations**
  - Fracture Energy we are able to measure
  - Changes noticed for
    - Aggregate Type
    - Aggregate Gradation Size
    - Binder Grade
    - Binder Modification
    - Air Voids
    - Use of Recycle

- **Benefits**
  - Fracture energy key to thermal cracking but other cracking?
  - Give engineers more insight in the materials they select
MnROAD Phase-II (2007-2016)

Unbound Benefits

• **Unbound Materials**
  – Importance of drainage / Performance

• **Savings – Stabile and Drainable**
  – $4.7 million
    (Reduced deterioration of HMA cracks and PCC joints – maintenance)

• **Savings – Recycled Unbound Materials**
  – $0.8 million
    (More sustainable material selection vs virgin materials)

• **Savings – Full Depth Reclamation**
  – $0.5 million
    (Proven design and life extending benefits)

• **Savings - Stabilization using High Carbon Fly Ash**
  – $0.1 Million
    (Insurance for construction delays)
Full Depth Reclamation

- Road Science Partnership
  - 3 Cells (mainline)
  - 1 Cell (LVR)

- Observations
  - 2.75” Interstate surface on engineered FDR
  - Engineered emulsion provides a balance stiffness and flexibility.

- Benefits
  - Design method for HMA Full depth repairs
  - Design method for distressed pavements
  - Sustainable practice
MnROAD Phase-II (2007-2016)

Pavement Preservation Benefits

• Pavement Preservation
  – High Volume Chip seals
  – [https://www.youtube.com/watch?v=Ol5R7n8zGoc](https://www.youtube.com/watch?v=Ol5R7n8zGoc)
  – Flexible Microsurfacing
  – Better understanding of the asphalt aging

• Savings – Diamond Grinding
  – $3.5 million
    (Economic analysis shows a savings of ~100,000 mile for amount of future noise walls and height based on OBSI)
    (assumes 7 jobs @ 5 miles job from past years MnDOT data)
Optimal Timing of Preventive Maintenance for Addressing Environmental Aging in HMA Pavements

- **TPF-5(153) Pooled Fund**
  - Asphalt Institute
  - MnROAD test cells and other sections
  - Lab aging study with coring of roadways treated yearly

- **Observations**
  - The optimal timing to prevent aging of the asphalt is 1 year after HMA placement
Implements of Husbandry

- **TPF-5(148) Pooled Fund**
  - Effects of farm equipment on roadways
  - 3 Cells – (HMA 7 and 9 ton and thin PCC)

- **Observations**
  - More damage in the afternoon
  - More damage with roads without shoulders
  - Larger equipment tends to show greater damage than a 5-axle tractor-trailer
  - Equipment manufacturers are moving towards smaller tanks

- **Benefits**
  - Wisconsin is implementing local meetings to stress communication of the issues, use of one-way roads, morning travel, road improvements
  - Potential for high savings of the local roadway system
MnROAD Phase-II (2007-2016)
Concrete Benefits (sorry)

• Concrete Materials
  – Improved Concrete Overlay Design
  – Use of Recycled Materials in PCC
  – Use of Fibers
  – Concrete Repairs

• Savings – Whitetopping
  – $1.9 Million / year
    (thinner designs utilized)
National Research Initiatives

National Pavement Preservation Study
Development of a National Cracking Test
National Pavement Preservation Study

• Partnership
  – MnROAD (North) / NCAT (South) Test Tracks
    • Offsite Low and High Volume Road Installations
    • Concrete and Asphalt Focus
    • Past/Current MnROAD Cells
  – FP² / National Center for Pavement Preservation
  – Government / Academia / Industry involvement

• Goals
  – National Study (Climatic zones)
  – Provide consistently collected data / analysis
  – Quantify the life extending benefits
National HMA Cracking Performance Test

• Partnerships
  – Utilize both MnROAD / NCAT Test Tracks
    • Top Down / Reflection / LTC cracking Efforts
    • Range of cracking potential mixes over Asphalt and Concrete
    • Battery of testing of many different existing tests Nationally

• Goals
  – We need tests and criteria that relate to performance.
  – We need tests that are practical for both mix design verification and quality control testing purposes.
  – We need tests that accommodate recycled materials, new and future additives, and combinations.
Goals:

- Strategic Implementation Through Cooperative Pavement Research
- Focus on regional and national needs
- Foster innovation through membership from states, academia and industry
- Ensure the development of implementable products for road owners
- Create an effective technology transfer program
- Direct 2017 MnROAD construction (MnDOT $2.5 million contribution)
- Developed around a 2014 National PEER Exchange

Currently Soliciting this Pooled Fund ➔ Looking for your involvement!

**Pooled Fund Solicitation**


Currently Minnesota / Wisconsin / Michigan has joined
Structure

Sets research objectives, goals and project selection

Executive Committee
(Pooled Fund Members @ $150K per year)

Tech Transfer Team
Research Team
Communications Team

Project Teams - Develops Recommendations and carries out critical efforts for NRRA

Associates/Academia - Provide innovative solutions to the State and Local identified research problem by participating in the project teams. (at $2K per year)
Each Team
Chaired by Executive Member with Executive, Associate, and Academic membership
Thank You