MnROAD Benefits

Safer, Smarter, Sustainable Pavements through Innovative Research

Ben Worel
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Presentation Outline

MnROAD Background  --  Benefits/Results
National Partnership / Future Plans
Investment into Pavement Research

• Current State of our Roadways (roads in poor condition)

• Research is needed to come up with the answers
  – No new source of funding expected
  – Cannot continue to do the same things that got us here

• Minnesota Trunk Highway System
  11,963 miles (19,248 km) - Hot Mix Asphalt
  + 2,259 miles (3683 km) - Portland Cement Concrete
  + 9 miles (14 km) – Untreated Gravel
  = Total: 14,321 miles (23,042 km)

• Total Roads in MN: 142,913 miles (229,996 km)
Investment into Pavement Research

Minnesota Highway System

2000
Average RSL = 13.7 years
Investment into Pavement Research

Minnesota Highway System

2013
Average RSL = 9.4 years

2000
Average RSL = 13.7 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.
Existing I-94
EB HMA ~ 1,000K ESALS
WB PCC ~ 200K ESALS
MnROAD
Office of Materials and Road Research

“Mainline”, Westbound Interstate-94 Live Public Traffic

W.B. I-94 Traffic Diverted (3 days / month) ~800,000 ESALS/Yr
MnROAD “Low Volume Road”
Controlled Access
MnROAD Fully Loaded Semi
~16,000 ESALS/Yr
(loaded / unloaded Lane)
MnROAD

• 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
MnROAD Operations

• Staffing ~20 Road Research (7 FTE MnROAD)
• Research Development
• Construction
• Performance Monitoring
  – Cracking / Rutting / Ride
  – Deflection (FWD), …..
• Sensors
  – Static (Environmental)
  – Dynamic (Traffic Loading)
• MnROAD Database
• Technology Transfer
• Traffic Loadings
MnROAD Air Temperatures

MnROAD Weather Station
(AIR Temperature Statics)

Month

Air Temperature (C)

Record High
Average High
Average Temp
Average Low
Record Low

-40.0
-30.0
-20.0
-10.0
0.0
10.0
20.0
30.0
40.0

JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

35 C
July 24, 1999

-39.5 C
February 2, 1996

-40.0
-30.0
-20.0
-10.0
0.0
10.0
20.0
30.0
40.0

Record High
Average High
Average Temp
Average Low
Record Low

Legend:
MnROAD 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)  
Concrete Benefits

• 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)
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

• **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 - Stabilization using High Carbon Fly Ash**
  - $0.1 Million
  (Insurance for construction delays)

- **Savings – Full Depth Reclamation**
  - $0.5 million
  (Proven design and life extending benefits)
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
  - Better understanding of the asphalt aging
  - Flexible Microsurfacing
MnROAD Phase-II (2007-2016)
Pavement Preservation Benefits

• Savings – Diamond Grinding
  – $3.5 million
  (Bernard’s economic analysis 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)
National Research Initiatives

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

• Currently 6+ Northern States
  – Similar treatments (North) / (South)
    • MnDOT Specs / Emulsions + Similar Sections
    • Thin Overlays and Surface Treatment
  – Low Volume Roadway (157th Street)
  – High Volume Roadway (US-10)

  – NCAT Contracted “Surface Treatments”
  – MnDOT Contracted “Thin Overlays”
  – Construction 2015 or 2016
National HMA Cracking Performance Test
Northern Efforts

• 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.
National HMA Cracking Performance Test
Northern Efforts

• Southern States → Top Down Focus
• Northern States → Low Temp / Reflective Cracking
  – Select ~8 mix designs
    • L-M-H Fracture Energy, Range of Binder Replacement
    • Innovative Mixes, ........
  – MnROAD Cell Availability
    • New Construction (8 new cells)
    • Rehab of HMA (2 cells + 3 miles old EB I-94)
    • Rebab of PCC (3 Cells ML + 1 Cell LVR + 2 miles old WB I-94)
  – May tie to TERRA to join in a complete effort
MnROAD Past Investment

• 9 Year Average Funding = $2.75 million
• Funded by

  • National Facility
    – Increase outside funds
    – Increase outside use

  • National Facility
    Industry - $36,500
    Other State SPR - $282,000
    FHWA - $307,000
    MnDOT SPR
      $551,000
    Local Road Research Board
      $558,000
    MnDOT Operating Funds
      $1,010,000
National MnROAD and NCAT Efforts (looking for your participation)

• NCAT Pooled Fund
  – Alabama DOT Lead
  – MnROAD Partnership Focus on
    • Pavement Preservation @ 120K/yr
    • National HMA Cracking Performance Test @ 210K/yr
  – http://www.pooledfund.org/Details/Study/496
• **TERRA Pooled Fund**
  - Minnesota DOT Lead with MnROAD Test Facility
  - TERRA and past MnROAD pooled fund states
  - Expected to be 150K/yr
  - Focus on
    - 2014 Peer Exchange Research Needs
    - Research Other important needs
    - Pavement Preservation Efforts (Starting Year-4)

• **Legislative Funding also being pursued**
Discussion

We all have a stake in A to B