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Construction of Full Depth Reclamation of MnROAD Test Cells

Need

Improve pavement structure on bituminous roads

- Improve functionality
  - Improve road condition
  - Support higher traffic
    - Growing populations
    - “80,000-lb roads”
- Identify and correct base problems
- Widen roads
- Build structure down into pavement
  - Helps maintain road geometrics

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Key Components

1. Project selection, pavement and material assessment
2. Engineered mix design
3. Performance-related specifications
4. Innovative emulsion technology
5. Construction & QC

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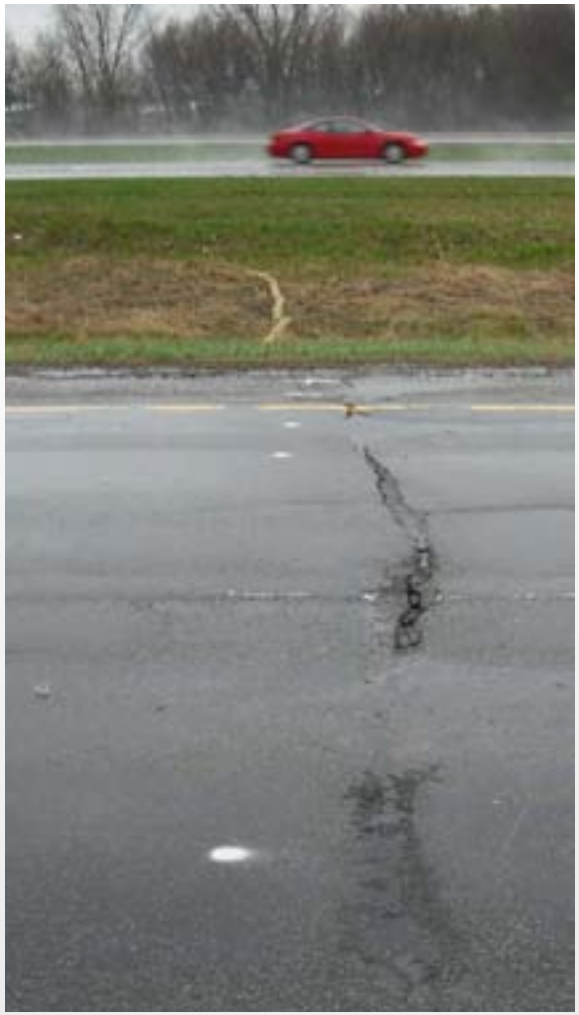
Project Selection

- Bituminous pavement
  - Needing rehabilitation
  - Bituminous surface on aggregate base
  - Bituminous surface on clay subgrade
  - Sufficient asphalt and base depth to accommodate reclamation process
    - **At least 2” greater than reclamation depth**

Project Selection

- High severity distresses
  - Ruts
  - Cracks
  - Potholes
  - Base problems
  - Edge failures
- **Good drainage**, or drainage to be corrected



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Pavement Assessment

Structural evaluation by agency or consulting engineer and SemMaterials

- Structure; layer evaluations
- Drainage / water table
- Distresses
- Road needs

Dynamic Cone Penetrometer (DCP)

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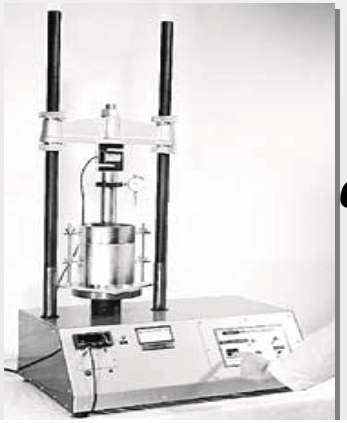
Pavement Assessment

- Coring
- Soil borings
  - Sample top 6-10”
  - Auger to 5’ for layer thickness & identification & water table location
- Strength testing options to identify weak areas & determine subgrade strength/modulus
  - Falling Weight Deflectometer (FWD)
  - California Bearing Ratio (CBR) or R-Value
  - Dynamic Cone Penetrometer (DCP)
  - Proof rolling (granular surfaces only)
- Other: Ground Penetrating Radar (GPR) – Thickness variability

Falling Weight Deflectometer - FWD

R-Value Determination (Hveem)



CBR device

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Sampling

- Coring or sawing / backhoe sampling
- Accurate knowledge of the road structure from construction and maintenance records or from borings will reduce the number of sampling locations

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Pavement Design

- Roadway Data
  - Annual traffic levels of 330,000 to 640,000 Equivalent Single Axle Loads (ESAL) in recent years
  - Targeted 3,500,000 ESAL for the design life
  - Terminal present serviceability index (PSI_t) of 2.5
  - Built in 1993
- Climatic Conditions
  - Avg Annual Precipitation is 27.4”
  - Drainage is critical with medium to high frost susceptibility of the soil materials
- Soil Properties
  - Sandy lean clay
  - R-value approximately 12

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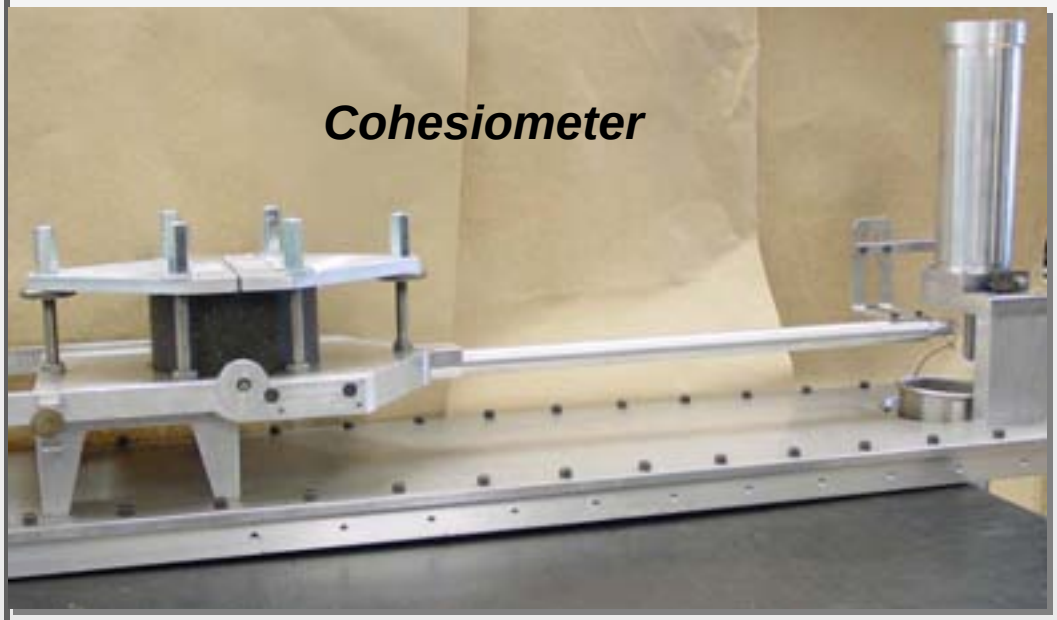
2. Engineered Mix Design

Superpave Gyratory Compactor

Lab Mixer

Cohesiometer



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2. Engineered Mix Design

- 5 key tests and detailed procedures
- Virgin aggregate, RAP, or cement may be needed
  - To increase depth of finished structural layer
  - To improve gradation
    - Cleanliness (P200)
    - Material quality
    - Grading

3. Performance-Related Specification Guidelines

Criteria		Performance Parameter
Short Term Strength by **Cohesiometer ASTM D1560**		*Determine if appropriate early curing is occurring*
Strength and retained strength **ASTM D4867**		*Strength and resistance to moisture damage*
Resilient Modulus **ASTM D4123**		*Relative indicator of quality* **Strain or deflection w/ applied load for structural design**
Indirect Tensile Test (IDT) **AASHTO T 322**		*Thermal cracking resistance*
Construction & QA/QC Requirements		*Reliability*

Tests run on 150-mm SGC prepared specimens

*Detailed guideline specifications available

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MnRoad's Four Mix Designs Cell 2

- Existing Section
  - ⅜“ Microsurface (placed in 2003)
  - 6” of AC
  - 4” Class 6 Agg Base
  - 28” Class 4 Agg Base
  - Subgrade (R=12)
- Planned Section (50% RAP/50% Agg)
  - ¾“ Ultra Thin Bonded Wearing Course
  - 2” PMAC (PG 64-34)
  - 6” FDR-EE
  - 6” Agg/RAP Reclaimed Base
  - Granular Subbase

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MnRoad's Four Mix Designs Cell 3

- Existing Section
  - 6” of AC
  - 4” Class 5 Agg Base
  - 33” Class 3 Agg Base
  - Subgrade (R=12)
- Planned Section (75% RAP/25% Agg)
  - ¾“ Ultra Thin Bonded Wearing Course
  - 2” PMAC (PG 64-34)
  - 6” FDR-EE
  - 2” Agg/RAP Reclaimed Base
  - Granular Subbase

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MnRoad's Four Mix Designs Cell 4

- Existing Section
  - ⅜“ Microsurface (placed in 2003)
  - 9” of AC
  - 0” Class 6 Agg Base
  - Subgrade (R=12)

- Planned Section (100% RAP)
  - ¾“ Ultra Thin Bonded Wearing Course
  - 2” PMAC (PG 64-34)
  - 8” FDR-EE
  - 9” Fly ash Stabilized Subgrade
  - Subgrade (R=12)

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MnRoad's Four Mix Designs Shoulders

- Existing Section
  - 2” of AC
  - Variable Depth Agg Base
  - Subgrade (R=12)

- Planned Section (50% RAP/50% Agg)
  - ¾“ Ultra Thin Bonded Wearing Course
  - 4” FDR-EE
  - Variable Depth Agg Base
  - Subgrade (R=12)

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4. Engineered Emulsion Technology

Formulated for:

- **Chemical break / Solventless**
  - Earlier strength than conventional emulsions
  - Adhesion characteristics
  - Resistant to moisture damage

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4. Engineered Emulsion Technology, cont.

Formulated for:

- **High asphalt content**
  - Good dispersion with higher film thickness
  - Durable
  - Flexible
- **Climate-specific binder**
- **Formulated for MnROAD FDR project**

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5. Construction

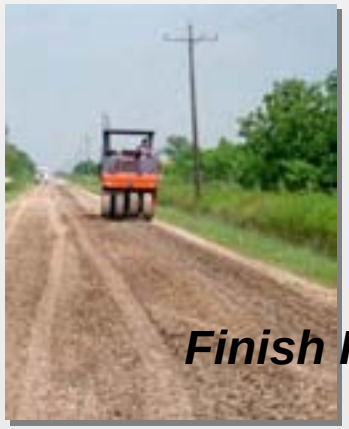
Equipment

- Reclaimer or recycling train
- Padfoot roller
- Blade to level surface
- Rollers


Wirtgen 2500


Padfoot roller


Motor Grader


Finish Rolling

Pre-pulverization or re-grinding

- Thick asphalt pavement is often pre-grinded for better mixing of emulsion
- Add rock during pre-pulverization
- For mixing efficiency – Slow down, keep rear gate low
- To reduce top size, slow down
- Re-grinding – If mixing is difficult, re-mix on pass back. High speed is okay,
- Re-grinding – If stabilized material is very wet, re-mill, aerate, and re-compact.

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Quality Control Reclaiming

- Before emulsion
  - Pulverization depth
  - Top size
  - Water content (before - day of emulsion addition) +/- 1%
- During emulsion
  - Depth
  - Emulsion content
    - Emulsion QC at plant
  - Distribution across width
  - Overlap

Quality Control
Compaction and Overlay

- Compaction (nuclear* or sand cone)
  - Modified Proctor for target density
  - *By the agency or contractor
- 50% OMC before overlay

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Benefits of FDR-EE

1. Flexible & strong bituminous stabilized base
   - Resists rutting
     - Strong enough for traffic before surfacing
   - Improved resistance to thermal cracking
   - Improved resistance to fatigue cracking
   - Improved resistance to moisture damage

Pre-pulverization

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Benefits, cont.

2. Early & increased strength
   - Immediate compaction
   - Traffic return usually same day
     - Longer, depending on truck traffic & subgrade strength
   - Overlay within 1-2 weeks (or sooner)
     - Depends on weather & moisture
   - More uniform strength
   - Increases structural capacity
     - May reduce overlay thickness need

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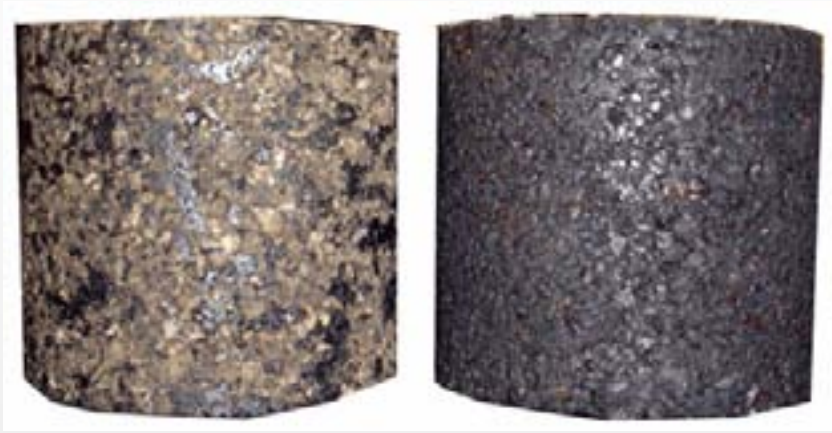
Benefits, cont.

3. Excellent coating
   - Better bituminous coating than alternatives
   - Durable bound base

Same aggregate;
same residual asphalt content



Foam Treated ***Engineered Emulsion Treated***

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Projects

- Colorado
- Nevada
- California
- Georgia
- Illinois
- Michigan
- Missouri
- Minnesota
- Nebraska
- Texas
- Oklahoma

System Expectations

- Typical production = 0.5 - 0.75 centerline mile / day (reclaimer)
- Traffic control
  - Road may need to be closed during working day; requires working full width of road
- Coating
  - Don’t expect 100% coating, unless 100% RAP
  - More fines = lower coating
- Weak spots in subgrade
  - Boring & sampling won’t catch all thin areas / weak spots
  - Address during construction with good construction techniques

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System Expectations, cont.

- Account for variability in road
  - Sufficient sampling & testing
  - Adjust as necessary during construction
- May require multiple reclaimer passes
  - For adequate sizing
  - For emulsion dispersion (high fines)
  - For moisture management
- Manage time to compaction
  - Little to no delay in compaction
  - Environmental conditions play a role (temp, humidity, wind, etc…)

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Bid / Pay Items

- FDR (equipment, construction, etc.) usually one pay item
- Emulsion usually another pay item

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FDR-EE price

- Varies depending on local market and labor conditions, cost of asphalt
- Approximately $7 to $8 / SY in place for a 6” FDR-EE section

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Summary

- FDR-EE
  - Cost effectively builds structure down into pavement
  - Site assessment, sampling, mix design, and field support are keys to success
  - Performance-related design tests & specs improve reliability & performance
    - Early Strength
    - Cured Strength
    - Cracking Resistance
    - Moisture Resistance
    - Construction Quality
    - QA / QC

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Partners for MnRoad Construction

- TERRA/MnDOT
  - Oppourtunity and monitoring
- WSB
  - Design Plans
- AET
  - Fly ash design and Quality Control
- LaFarge
  - Fly ash material
- MidState
  - Reclaimation and Stabilization
- Hardrives
  - Milling, compaction and paving

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Questions
Thank
You