Pavement Rehabilitation Selection
Making a Decision:
Applying What You’ve Learned
Rehabilitation Selection

- Tools for Decision Making
  - Bituminous Pavement
    - LRRB - Flexible Pavement Distress Manual
    - LRRB - Investigation 808
    - Basic Asphalt Recycling Manual (BARM)
    - Industry Input
Rehabilitation Selection
Flexible Distress Manual

IDENTIFY DISTRESS

CAUSES

INSUFFICIENT STRENGTH

CONSTRUCTION / MATERIALS PROBLEMS

ENVIRONMENTAL EFFECTS

IS DISTRESS LOW SEVERITY OR LOCALIZED?

DOES PAVEMENT HAVE SUFFICIENT STRENGTH?

YES

NO

SPOT REPAIR AND / OR STRUCTURAL OVERLAY

MAJOR REPAIR AND STRUCTURAL OVERLAY OR RECONSTRUCTION

IS DISTRESS LOW SEVERITY OR LOCALIZED?

YES

NO

IS THE PAVEMENT A SAFETY HAZARD?

YES

NO

SPOT REPAIR AND / OR SEAL COAT ON THIS OVERLAY

LRRB Pavement Rehabilitation Selection
Rehabilitation Selection
Flexible Distress Manual

Description
Severity Level
How to Measure
Rehabilitation Selection Flexible Distress Manual

Rehabilitation Alternatives for each Severity Level
Investigation 808 Summary

- Types of Reclamation
- Decision Factors
- Database Development
- Decision Checklists
- Criteria
- Recommendations
Selection Criteria

1. Is existing HMA thickness adequate to support CIR equipment (3.5 in.)?

2. Is existing subgrade stiffness adequate to support CIR equipment (5000 psi)?

3. Consider Surface Rating (SR) degradation rate.

4. If not structurally adequate then CIR should **NOT** be used without additional overlay.
Rehabilitation Selection
Investigation 808

Selection Criteria (Continued)

5. If SR < 2.5 and multiple cracking or transverse cracking Individual Weighted Distress (IWD) > 5.0:
   – Mill and Overlay should not be used
     • If existing HMA > 3.5 in. use CIR or FDR
     • If existing HMA < 3.5 in. use FDR only
NOTE:

- An IWD = 5.0 for a pavement with all medium severity transverse cracks represents a crack count of 25 cracks per 500 ft.

- An IWD = 5.0 for a pavement with all high severity transverse cracks represents a crack count of 12 cracks per 500 ft.
Selection Criteria (Continued)

6. If the SR < 2.5 and multiple or transverse cracking IWD is < than 5.0, use mill & overlay.

7. Finally, cost/benefits should be considered along with decay rates in the final decision.
### Rehabilitation Selection

#### Basic Asphalt Recycling Manual

#### Candidate Rehabilitation Techniques

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<th>Pavement Distress Mode</th>
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<th>HIR</th>
<th>CIR</th>
<th>Thin HMA</th>
<th>Thick HMA</th>
<th>FDR</th>
<th>Combination Treatments</th>
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#### Distress Severity

- **Most Appropriate**
- **Least Appropriate**
Rehabilitation Selection

• Tools for Decision Making
  – Concrete Pavement
    • American Concrete Pavement Association -ACPA
      – Guide to Concrete Overlay Solutions
    • Mn/DOT Materials Office
    • Industry Input
Rehabilitation Selection
Guide to Concrete Overlay Solutions

Summary of Pavement Evaluation Process

The purpose of evaluating existing pavement conditions is to collect data about any distresses and performance problems that occur and their causes. This information helps the agency determine if a pavement is in good condition for a specific overlay and, if not, the types of repairs required before an overlay is constructed. The overall pavement condition and its expected service life can be determined using Pavement Condition surveys and Functional Capacity Evaluations (FCE). These tools provide a comprehensive assessment of the pavement's condition.

1. Condition Evaluation:
   - Evaluate the pavement condition using the pavement condition index (PCI)
   - Consider the extent and severity of distresses

2. Surface Evaluation:
   - Baseline condition assessment
   - pavement condition evaluation

3. Subsurface Evaluation:
   - Investigate the subgrade condition
   - Consider the subgrade support capacity

4. Performance Evaluation:
   - Evaluate the pavement's performance
   - Consider the pavement's response to traffic loads

5. Cost/Benefit Analysis:
   - Evaluate the cost of repair options
   - Consider the economic feasibility

6. Decision Making:
   - Choose the most appropriate repair option
   - Consider the long-term maintenance requirements

Figure 8: Examples of existing pavement conditions

Initial Evaluation (steps 1-3)

1. Pavement History:
   - Previous treatments
   - Aggregate gradation
   - Aggregate content
   - Design life
   - Expected traffic and performance level

2. Visual Examination:
   - Physical condition
   - Surface distresses
   - Subsurface distresses

3. Core Analysis:
   - Material properties
   - Mix design
   - Aggregate gradation
   - Surface distresses

4. Condition Assessment
   - Condition index
   - Service life
   - Repair requirements

5. Decision Evaluation
   - Cost-benefit analysis
   - Decision-making process

Condition Assessment Profile

Figure 9: Example of a concrete overlay solution

Condition Evaluation Report and Pavement Condition Rankings

What is the extent of pavement distresses? Based on the visual examination and performance evaluation results.

LRRB Pavement Rehabilitation Selection

Pages 8 - 9
Rehabilitation Selection Guide to Concrete Overlay Solutions

Selecting Appropriate Concrete Overlay Solution

Pavement Condition Rankings

Concrete Pavement Condition

- Good (Concrete)
  - Structurally and functionally sound but in need of increased structural capacity, improved rideability or oxid resistance, or removal of surfacerepair.

- Fair (Concrete)
  - Structurally and functionally sound but in need of surface or functional repair.

- Poor (Concrete)
  - Fairly low surfacedefects, potential for functional repair or moderate cost-effective repairs.

- Deteriorated (Concrete)
  - Significant surface deterioration, including structural, structural/functional, or other related damages.

Asphalt/Composite Pavement Condition

- Good (Asphalt/Composite)
  - Structurally and functionally sound but in need of increased structural capacity, improved rideability or oxid resistance, or removal of surfacerepair.

- Fair (Asphalt/Composite)
  - Structurally and functionally sound but in need of functional repair.

- Poor (Asphalt/Composite)
  - Fairly low surfacedefects, potential for functional repair or moderate cost-effective repairs.

- Deteriorated (Asphalt/Composite)
  - Significant surfacedeformation, including structural, structural/functional, or other related damages.

Cost of surfacerepair, cost of surfacerepair, cost of surfacerepair, and cost of surfacerepair are compared.

Can the surface repair cost effectively solve any deficiencies? Bring the pavement to “Good Condition” before moving construction?

Can the surface condition meet the required “Good Condition” level before moving construction?

Can the materials be used for surfacerepair and design? Do the costs and design requirements?

Can or Bonded Overlay (2-5 in.) or Design Unbonded Overlay (4-5 in.)

Design Bonded Overlay (2-5 in.)

- Can a full or (2-5 in.) or a greater bonded overlay using cost-effective design procedures be cost-effective and design recommendations?

- Can the materials be used for surfacerepair and design? Do the costs and design requirements?

Design Unbonded Overlay (4-5 in.)

- Can or surfacerepair and design? Do the costs and design requirements?

Concrete overlays can provide economical solutions to pavement rehabilitation. However, the recommendations provided in this document are general in nature and are intended to be used as guidelines. Local conditions and specific project requirements may require additional analysis and evaluation.
Case Study #1 Overview
Pavement History

- Two local roadways
- Built in 1993 using Mn/DOT Spec 2340 mix
  - 6” bit on one roadway
  - 8” bit on the other roadway
- Both roads received a chip seal between 1998 and 2001
Case Study #1 Overview
Pavement Condition

• The wearing course began debonding from the lower layers in the spring of 2008
  – A number of shallow potholes formed
• Potholes were milled and patched
Case Study #1 Overview
Pavement Strength Evaluation

- In-place and Rice Specific Gravity tests were performed on the bituminous wearing course
- Core densities ranged from 86% to 92%
- Extracted bituminous content was 6.0% in the good areas and 5.7% in the bad areas
Case Study #1 Overview
Surface, Base and Subgrade Analysis

• The chip seal has debonded from the underlying wearing course in areas showing surface distress
• There is stripping in the wearing course, causing the shallow potholes
Case Study #1 Overview
Surface and Subsurface Drainage Review

- Curb and gutter is currently in place on both roadways and in good working condition
- There is evidence of moisture intrusion into the wearing course underlying the chip seal
  - Seen in the upper ½” of cores 3, 4 and 5
Case Study #1 Discussion
Case Study #1 Recommendations

• Major Considerations:
  – Age of pavement
  – Bituminous pavement deterioration
    • Limited to the wearing course

2” Mill and Inlay
Case Study #2
Case Study #2 Overview
Pavement History

- County State Aid Highway
- Constructed in 1989
  - 5” bituminous pavement
  - 12” aggregate base
  - Clay subgrade
- Constructed with a portion of roadway in the adjacent county
- Abuts a two mile portion of road built in 1941
  - 4” – 5” bituminous pavement (after several overlays)
  - 9” aggregate base
Case Study #2 Overview Pavement Condition

- Surface condition rating is 3.40
  - Low to moderate transverse, longitudinal and fatigue cracks
- Surface condition rating of the abutting older roadway is 2.80
Case Study #2 Overview
Pavement Strength Evaluation
Surface, Base and Subgrade Analysis

- From the coring report:
  - Surface thickness varies 4.0” to 6.0”
Case Study #2 Overview
Pavement Strength Evaluation
Surface, Base and Subgrade Analysis

- From the coring report:
  - Surface thickness varies 4.0” to 6.0”
  - Average surface thickness is 5”
Case Study #2 Overview
Pavement Strength Evaluation
Surface, Base and Subgrade Analysis

• Spring Season Axle-Load
  – Posting = 9 tons/axle
  – Capacity = 8.3 tons/axle

• Deflection Analysis Results:
  – Effective Subgrade R-value = 7.4

• Structural Analysis Results:
  – Reported GE = 23.2 inches
  – Effective GE = 21.0 inches
  – Mn/DOT Design GE = 30.4 inches
Case Study #2 Overview
Surface and Subsurface Drainage Review

- Ditches are in-place
- Roadway appears to be draining adequately
Case Study #2 Discussion
Case Study #2 Recommendations

• Major Consideration:
  – The performance of overlays throughout the history of the abutting older pavement
  • Cracks have propagated through the overlays at a rapid rate
  • Using CIR in similar situations has produced better results on other County projects
Case Study #2 Recommendations

- Engineered Cold In-place Recycling
  - Recycle 4” of the original bituminous pavement
  - Surface with 3” of bituminous pavement
  - Drain tile
Case Study #2 Comparisons

- Different approaches taken by the two counties with this roadway:
  - County #1 chose CIR option in 2004
  - 8 low severity transverse cracks within first 8/10th of a mile (2008)
Case Study #2 Comparisons

- County #2 chose 2” Mill and Overlay option in 2005 with Seal Coat in 2006
  - Over 300 low to moderate transverse cracks and numerous longitudinal and fatigue cracks within first 8/10th of a mile (2008)
Case Study #3 Overview
Pavement History

- Low volume, rural trunk highway
- Built as a gravel road in 1934
- Reconstructed in 1955
  - 1.5” bituminous wearing course over 6” of soil-cement treated base
- 2.75” bituminous overlay placed in 1973
Case Study #3 Overview
Pavement Condition

- Severe pavement deterioration
  - Rutting >1.5” deep
Preliminary deflection testing indicated the in-place subgrade to be very wet and unstable.
Case Study #3 Overview
Surface and Subsurface Drainage Review

• Subgrade consists of 2’ of ditch soil placed under roadway
  – Organic silt loam soils
  – Poor drainage and wet, weak subgrade year round
Case Study #3 Discussion
Case Study #3 Comparisons

- Test sections were constructed in 1993
  - 2 bituminous overlay sections
    - Test Section 1 – 3” thickness
    - Test Section 2 – 5” thickness
  - 4 whitetopping sections
    - Test Section 3 – 6” thickness, bonded, undoweled
    - Test Section 4 – 6” thickness, bonded, doweled
    - Test Section 5 – 6” thickness, bonded, undoweled
      - HMA milled for even surface
    - Test Section 6 – 6” thickness, unbonded, undoweled
- Edge drains were installed along all the test sections
Case Study #3 Comparisons

- Bituminous Overlay Maintenance:
  - Transverse and longitudinal cracks were routed and sealed in 1997
  - Chip seal applied in 2000

- Whitetopping Maintenance:
  - No maintenance has been performed on the whitetopping sections through 2007
Case Study #3 Comparisons

- 3” Bituminous Overlay
  - Crack spacing is 15 – 20’
Case Study #3 Comparisons

- 5” Bituminous Overlay
  - Crack spacing is 50’
Case Study #3 Comparisons

- 6” Whitetopping
  - Bituminous surface was milled before placement
  - Bonded
  - Undoweled
- Only required maintenance has been patching over settled culverts
- Some longitudinal cracking
Case Study #3 Recommendations

• Proposed Design:
  – 6” Whitetopping
    • Milled bituminous surface for uniform thickness
    • Bonded
    • Undoweled
  – Edge drains along the roadway
    • Will reduce subgrade instability and extend the life of the pavement
## Case Study #3 Recommendations

### TH 30 Total Construction Costs for Pavement and Shoulders (1993 dollars)

<table>
<thead>
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<th>Test Section</th>
<th>Special Items Included</th>
<th>Bid Price/mile</th>
<th>As-built Price/mile</th>
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1 mile = 1.6 km
### Equivalent Uniform Annual Costs

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1 inch = 25.4 mm  
a) Annual inflation rate = 3.0%
Case Study #3 Recommendations

• Although all sections are in good condition (2002), this proposed design:
  – Is the most economical design to date
  – Has required no maintenance to date
  – Has a better ride quality than the other sections