Development of Preservation Project Selection Criteria for Pavement Management

An Implementation Case Study for New Mexico Department of Transportation

Presented by:
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Committee Made it Clear that Pavement Preservation was Top Priority for Agency.

Important that PMS Incorporates Treatment Selections with Proper Timing for Preservation.

Preservation, Preventive, and Routine Treatments needed to Add Life to Pavements in Configuration.

Fog Seals, Patching, and Crack Sealing Had to be Included in Analysis Treatment Selections.
Pavement Distresses

Collecting Appropriate Condition Data to Trigger Pavement Repairs
## Distresses Collected by Pavement Type

<table>
<thead>
<tr>
<th>Flexible Pavements*</th>
<th>Rigid Pavements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alligator Cracking</td>
<td>Corner Breaks</td>
</tr>
<tr>
<td>Transverse Cracking</td>
<td>Faulting</td>
</tr>
<tr>
<td>Edge Cracking</td>
<td>Joint Seal Damage</td>
</tr>
<tr>
<td>Longitudinal Cracking</td>
<td>Lane/Shoulder Drop-off</td>
</tr>
<tr>
<td>Block Cracking</td>
<td>Longitudinal Cracks</td>
</tr>
<tr>
<td>Patching</td>
<td>Patch Deterioration</td>
</tr>
<tr>
<td>Bleeding</td>
<td>Spalling of Joints &amp; Cracks</td>
</tr>
<tr>
<td>Weathering &amp; Raveling</td>
<td>Transverse &amp; Diagonal Cracks</td>
</tr>
</tbody>
</table>

*Reviewing Flexible setup due to time constraints
Condition Indexes

Converting Condition Data into Decision Variables for Triggering Treatments
Problem:
- Single Index Only Provides a General Indicator of Overall Health

Questions:
- What Distresses are Present?
  - Severities and Extents?
- What Repair(s) Is Required?
- Reasonable Cost of Repair?
Treatment Selection Indexes

**Individual Index**
- Alligator Cracking
- Edge Cracking
- Potholes/Patching

**Combined Index**
- Structural Index

**Environmental Index**
- Transverse Cracking
- Block Cracking
- Oxidation/Raveling

**Functional Index**
- Skid
- Rutting
- Ride Quality

**Condition**
- Decision Tree Variable

Preservation Targeting
Treatments and Repair Strategies
Treatments

- Unit Costs
- Performance Rules
- Improvement Rules
- Exclusion Rules
- Structure Rules
- Treatment Priority
<table>
<thead>
<tr>
<th>Flexible Repair Category</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - Monitor</td>
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</tr>
</tbody>
</table>
| F1 - Preventative       | F1A - Crack Seal  
                          | F1B - Fog Seal  |
| F2 - Patch               | F2 - Patch |
| F3 - Preservation (Minor) | F3A - Scrub Seal  
                          | F3B - Chip Seal  
                          | F3C - Slurry Seal  
                          | F3D - Cape Seal  
                          | F3E - OGFC  
                          | F3F - Micro Surfacing  
                          | F3G - Plant Mix Wearing Course overlay – Nova Chip |
| F4 - Preservation (Major) | F4A - Pavement Resurfacing and Curb line milling Cutler (1.5” to 2.5”))  
                          | F4B - Hot In-Place Recycling (Remixing) (1.5” to 2.5”))  
                          | F4C - Hot In-Place Recycling (Heater Scarification) (1.5” to 2.5”))  
                          | F4D - Cold Mill Asphalt Recycling (Warm or Cold)  
                          | F4E - HMA/WMA Mill and Inlay (1.5” to 2.5”))  
                          | F4F - SMA Mill and Inlay (1.5” to 2.5”)) |
| F5 - Rehabilitation (Minor) | F5A - HMA/WMA Mill and Inlay 2.5” to 4”  
                          | F5B - Hot In-Place Recycling (Remixing) (2.5” to 4”))  
                          | F5C - Hot In-Place Recycling (Heater Scarification) (2.5” to 4”))  
                          | F5D - Pavement Resurfacing and Curb line milling Cutler (2.5” to 4”))  
                          | F5E - HMA/WMA Overlay 2.5” to 4”  
                          | F5F - SMA Mill and Inlay (2.5” to 4.0”)) |
| F6 - Rehabilitation (Major) | F6A - HMA/WMA Mill and Inlay greater than 4”  
                          | F6B - Hot In-Place Recycling (Remixing) greater than 4”  
                          | F6C - Hot In-Place Recycling (Heater Scarification) greater than 4”  
                          | F6D - Pavement Resurfacing and Curb line milling Cutler greater than F4”  
                          | F6E - HMA Overlay greater than 4”  
                          | F6F - Process Place and Compact W/Overlay  
                          | F6G - Full Depth Reclamation (FDR) |
| F7 - Reconstruction      | F7 - Reconstruction |
# Preservation Treatments

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                        | F1B - Fog Seal    |
| **F2 - Patch**           | F2 - Patch     |
| **F3 - Preservation (Minor)** | F3A - Scrub Seal  
                        | F3B - Chip Seal   
                        | F3C - Slurry Seal  
                        | F3D - Cape Seal     
                        | F3E - OGFC         
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| **F4 - Preservation (Major)** | F4A - Pavement Resurfacing and Curb line milling Cutler (1.5” to 2.5”)  
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                        | F4F - SMA Mill and Inlay (1.5” to 2.5”) |
## Condition Index Improvements by Repair Category

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Structural</td>
<td>Add 0</td>
<td>Add 10</td>
<td>Add 5</td>
<td>Add 15</td>
<td>Add 40</td>
<td>Add 60</td>
<td>Reset to 100</td>
</tr>
<tr>
<td>Environmental</td>
<td>Add 10</td>
<td>Add 0</td>
<td>Add 10</td>
<td>Add 30</td>
<td>Add 50</td>
<td>Reset to 100</td>
<td>Reset to 100</td>
</tr>
<tr>
<td>Safety</td>
<td>Add 0</td>
<td>Add 0</td>
<td>Reset to 100</td>
<td>Reset to 100</td>
<td>Reset to 100</td>
<td>Reset to 100</td>
<td>Reset to 100</td>
</tr>
<tr>
<td>Roughness</td>
<td>Add 0</td>
<td>Add 0</td>
<td>Add 5</td>
<td>Reset to 100</td>
<td>Reset to 100</td>
<td>Reset to 100</td>
<td>Reset to 100</td>
</tr>
</tbody>
</table>
Decision Trees

Purpose:
Right Treatment, Right Place, Right Time
Environmental Decision Tree

Flexible Pavement

- Matrix Priority #1 (Interstates) and
- Matrix Priority #2 (Arterials of National-Regional Significance)

- Matrix Priority #3 (Arterials of Statewide Significance) and
- Matrix Priority #4 (Arterials of State Regional Significance)

- Matrix Priority #5 (Routes of Local Significance)

EI < 30 ➔ Treatment = Rehabilitation (Major)
30 < EI < 45 ➔ Treatment = Rehabilitation (Minor)
45 < EI < 65 ➔ Treatment = Preservation (Major)
65 < EI < 80 ➔ Treatment = Preservation (Minor)
EI > 80 ➔ See Maintenance Tree Detail

EI < 25 ➔ Treatment = Rehabilitation (Major)
25 < EI < 40 ➔ Treatment = Rehabilitation (Minor)
40 < EI < 60 ➔ Treatment = Preservation (Major)
60 < EI < 75 ➔ Treatment = Preservation (Minor)
EI > 75 ➔ See Maintenance Tree Detail

EI < 20 ➔ Treatment = Rehabilitation (Major)
20 < EI < 35 ➔ Treatment = Rehabilitation (Minor)
35 < EI < 55 ➔ Treatment = Preservation (Major)
55 < EI < 70 ➔ Treatment = Preservation (Minor)
EI > 70 ➔ See Maintenance Tree Detail

Transverse Cracking Index < 80 ➔ Treatment = Preservation (Minor)

80 < Transverse Cracking Index < 90 ➔ Weathering/Raveling Index > 80 ➔ Treatment = Preventative
Weathering/Raveling Index < 80 ➔ Treatment = Preservation (Minor)

Transverse Cracking Index > 90 ➔ Weathering/Raveling Index > 80 ➔ Monitor
Weathering/Raveling Index < 80 ➔ Treatment = Preservation (Minor)
Functional Decision Tree

Matrix Priority #1 (Interstates) and Matrix Priority #2 (Arterials of National-Regional Significance)

- Roughness Index < 65
  - Safety Index < 50: Treatment = Rehabilitation (Minor)
  - 50 > Safety Index > 75: Treatment = Preservation (Major)

- Roughness Index > 65
  - Rut Depth > 2.5 Inch: Treatment = Rehabilitation (Minor)
  - 0.25 Inch < Rut Depth < 0.75 Inch: Treatment = Preservation (Minor)

Matrix Priority #3 (Arterials of Statewide Significance) and Matrix Priority #4 (Arterials of State Regional Significance)

- Roughness Index < 60
  - 50 > Safety Index > 75: Treatment = Preservation (Major)

- Roughness Index > 60
  - Rut Depth > 2.5 Inch: Treatment = Rehabilitation (Minor)
  - 0.75 < Rut Depth < 2.5 Inch: Treatment = Preservation (Major)

- Roughness Index > 65
  - Safety Index > 75: Monitor

Matrix Priority #5 (Routes of Local Significance)

- Roughness Index < 55
  - Safety Index < 50: Treatment = Rehabilitation (Minor)
  - 50 > Safety Index > 75: Treatment = Preservation (Major)

- Roughness Index > 55
  - Rut Depth > 2.5 Inch: Treatment = Rehabilitation (Minor)
  - 0.75 < Rut Depth < 2.5 Inch: Treatment = Preservation (Major)

- Roughness Index > 75
  - Rut Depth < 0.25 Inch: Monitor
Pavement Age Decision Tree

Flexible Pavement

Matrix Priority #1
(Interstates)
and
Matrix Priority #2
(Arterials of National–Regional Significance)

Matrix Priority #3
(Arterials of Statewide Significance)
and
Matrix Priority #4
(Arterials of State Regional Significance)

Matrix Priority #5
(Rooms of Local Significance)

Last Treatment Applied was Preventive Maintenance?

Yes

Years Since Last Preventive Maintenance Treatment < 5
Monitor

No

Pavement Age < 4
Monitor

Pavement Age > 4
Treatment = Preservation (Minor)

Yes

Years Since Last Preventive Maintenance Treatment < 6
Monitor

No

Pavement Age < 5
Monitor

Pavement Age > 5
Treatment = Preservation (Minor)

Yes

Years Since Last Preventive Maintenance Treatment < 7
Monitor

No

Pavement Age < 6
Monitor

Pavement Age > 6
Treatment = Preservation (Minor)
Performance Models

Purpose:
Define Treatment Life and Benefit
(Reviewing Preservation Only)
Preservation (Major) Models

LEGEND
- Structural Index (within zone of influence)
- Structural Index (outside of zone of influence)
- Environmental Index (within zone of influence)
- Environmental Index (outside of zone of influence)
- Safety Index (within zone of influence)
- Safety Index (outside of zone of influence)
- Overall Condition Index

Condition Index vs. Time (Years)
Preservation (Minor) Model

- Original Deterioration Curve
- Preservation (Minor) Deterioration Curve

Additional Years of Pavement Life Due to Preservation Treatment: 2 Years

Assumed End of Life Threshold
Patching Model

- Deterioration Curve
- Meet Existing Curve

Structural Index vs. Time (Years)

- Add 10
- 2 Years
Life Cycle Treatment Rules

If Funded when Conditions Reach Threshold Values

Diagram showing Life Cycle Treatment Rules with PM, 1R, and 3R labels.
Multi-Constraint Optimization Analysis
Multi-Constraint Optimization Analysis

**Objective:**
Maximize Benefit

**Constraint:**
Budget

- **Overall Budget**
- **Primary Routes Budget**
- **Secondary Budget**
- **Interstate Budget**
- **Reconstruction**
- **Rehabilitation**
- **Preservation**

Maximize Condition:

- Overall Budget
- Primary Routes Budget
- Secondary Budget
- Interstate Budget
- Reconstructed
- Rehabilitation
- Preservation
Optimized vs. Worst-First Analysis
Why Choosing Preservation is Critical

![Graph showing the comparison between Optimized and Worst-First analysis over 10 years. The graph indicates that the Optimized approach maintains a higher overall condition index (OCI) compared to the Worst-First approach.](graph.png)
Thoughts on Software Calibration

- Reconstruction and Major Rehabilitation Treatments are Easy
  - Typically Indexes Reset to 100
  - Thickness of Treatments removes most if not all Distresses
  - Agency has Good Historical Data available to Support Performance Predictions

- Preservation Treatments are more Complex
  - Indexes Increase but may not Reset to Perfect
  - Typically, performance of the Treatment is dependent on the previous Treatment
  - Performance is Absolutely Dependent on Existing Condition
NMDOT Moving Forward

- Transitioning from Manual Distress Surveys to Automated Surveys
- Linking Historical Construction Records with Pavement Performance
- Also Linking Pavement Design with Pavement Performance with MEPDG Dashboard
- More Analysis Testing to Ensure Configuration is Finely Tuned to Agency Expectations
Questions???

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