Rubblization: What Past Efforts are Telling Us

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Acknowledgment and Disclaimer

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Disclaimer: This presentation is based upon the results of ICT-R27-193-2: Flexible Pavement Design (Full-depth Asphalt and Rubblization) in cooperation with IDOT and USDOT/FHWA. The contents of this report reflect the view of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Illinois Center for Transportation, the Illinois Department of Transportation, or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

https://apps.ict.illinois.edu/projects/getfile.asp?id=9729
Rubbblization Process
Projects Since 1990

• Majority on I-57 and I-70
• Tend to be 10” Jointed Reinforced PCC or badly “D”-Cracked Continuously Reinforced Concrete Pavement (CRCP).
• High patching cost is why rubblizing was selected
• Bulk of projects in last 15 years
• IL 9.5 and SMA surfaces
• Variety of neat and Polymer PG asphalts used
Study Approach

Limit study to Interstates due to better data quality

Summarize Pavement Management Data:
• Condition Rating Survey Rating (CRS)
  9.0 = New/1.0 = impassible
• Rutting
• International Roughness Index (IRI)
• Traffic converted to 18,000 lb Equivalent Single Axle Loads (ESAL’s)

Graph Trends
• CRS vs Age
• Rutting vs ESAL
• Design Thickness vs ESAL on Section

Review of Plans:
• Mixes and Performance Grade (PG) Asphalts
• Plan Details
Rutting

- $Y = 0.1006 \log X + 0.0146$
- $R^2 = 0.7262$
CRS vs. Section Age: IL 9.5

CRS Trends IL-9.5 Mixes

- IL 9.5
- Poly-22
- Poly-28
- Linear (IL 9.5)
- Linear (Poly-22)
- Linear (Poly-28)

Equations:
- $y = -0.2109x + 8.776$  \( R^2 = 0.5362 \)
- $y = -0.1876x + 8.7664$  \( R^2 = 0.8053 \)
- $y = -0.1065x + 8.5239$  \( R^2 = 0.7457 \)
CRS vs. Section Age: SMA

\[ y = -0.0179x + 8.375 \]
\[ R^2 = 0.5208 \]

\[ y = -0.1136x + 8.7388 \]
\[ R^2 = 0.5602 \]

CRS Trends SMA Sections

- SMA-28
- SMA-22
- Linear (SMA-28)
- Linear (SMA-22)

CRS = 5.5
CRS vs. Section Age: SMA (I-70)

y = -0.075x + 9.1417
R² = 0.9643

CRS Trends
30-Year Life Project (I-70 Contract 70059) Last 3 Points Trend

CRS = 5.5
Projected years to CRS of 5.5 for Various HMA Surfaces

<table>
<thead>
<tr>
<th>Surface Mix Group</th>
<th>Asphalt Binder Grade</th>
<th>Y-Intercept</th>
<th>Slope</th>
<th>R²</th>
<th>Years to CRS of 5.5</th>
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<tbody>
<tr>
<td>IL-9.5</td>
<td>AC-20-PG64-22</td>
<td>8.78</td>
<td>-0.211</td>
<td>0.54</td>
<td>16</td>
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<tr>
<td>IL-9.5</td>
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<td>-0.107</td>
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<tr>
<td>SMA</td>
<td>Poly PGXX-22</td>
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<td>-0.114</td>
<td>0.56</td>
<td>28</td>
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<tr>
<td>SMA</td>
<td>Poly PGXX-28</td>
<td>8.38</td>
<td>-0.018</td>
<td>0.52</td>
<td>160</td>
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<tr>
<td>SMA (Last 3 data points)</td>
<td>Poly PGXX-28</td>
<td>9.14</td>
<td>-0.075</td>
<td>0.96</td>
<td>49</td>
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</tbody>
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Design vs. Performance: Original Section

Rubbllizing Design/Performance (2019)
ESAL at time of Overlay or In-Service ESAL on Original Pavement

Limiting Strain
Max Pavement Thickness
10.5" to 11.75"
Design vs. Performance: Overlaid Sections

Rubblizing Design/Performance (2019)
ESAL on Overlay, Original Rubblizing and Total

- Limiting Strain
- Max Pavement Thickness
- 10.5" to 11.75"

Traffic, Millions ESAL

HMA Overlay Thickness, Inches

- 700 KSI
- 500 KSI
- ESAL @ OL
- Overlay ESAL
- Total ESAL
Plan Review

Underdrains

- Early projects may or may not have replaced underdrains (4” some 6”)
- Rubblizing increases “water retention or storage” ability of the pavement
- Water bleeding at sags (if underdrain not replaced)
- Water high in calcium carbonate – once exposed to air precipitates out dries white
- No structural problems seen – Potential for frost heave??
Plan Review

Gaps to Protect Culverts

• Several Plan Sets Include Excessively Long Gaps of Crack and Seat and Unbroken Pavement
• Amount Non-Rubblized Usage Exceeded 10% of Some Projects
• Simple Evaluation Indicates 8 feet of Alternative Pavement Breakage Needed
• May Need to Instrument and Study to Resolve
Study
Findings

• Good to Excellent Performance – Exceeding Design Expectations
• Design Process is Conservative
• Rutting not Excessive – I-57 Rutting Cause Known (Level Binder)
• Softer PG Asphalts in Surface = Increase Life
• Limiting Strain Criterion – Controlling Thickness on Many Projects
• Some Plans Included Exceptionally Long Non-Rubblized Segments for Protection of Underground Structures
Recommendations for Improved Performance

- Replace IL-9.5 Surface Using PGXX-22 with:
  - SMA w/PGXX-22 or
  - IL 9.5 w/PGXX-28
- SMA w/PGXX-28 Would Provide Best Performance (Limited Data)
- Adopt an 8 ft Buffer Rubblizing next to Underground Structures
- Study Mix Modulus and Fatigue Outcomes of Recycled HMA Mixes
- Revisit Limiting Strain Criterion of 70 Microstrain with Softer PG Asphalts and Recycled HMA Mixes
PIATT COUNTY
MONTICELLO
ROAD
WHITETOPPING
RUBBLIZATION
Initial Project Scope

• Original project was to add 4 foot safety shoulders
• New drainage structures and upgrade ditches
• Existing 5 miles of 5 inch PCC Pavement Whitetopping placed in 2000 showing signs of distress
Final Project Scope

• Original project was to add 4 foot safety shoulders
• New drainage structures and upgrade ditches
• Existing 5 miles of 5 inch PCC Pavement Whitetopping placed in 2000 showing signs of distress
• Decision was made to address failing PCC Pavement
EXISTING CROSS SECTION

- ± 8" AGGREGATE BASE
- 3" HMA SUB-BASE
- 5" PCC PAVEMENT
PROPOSED FINAL CROSS SECTION

1.5” HMA SURFACE

2.5” TO 3.5” HMA LEVEL BINDER

5” PCC RUBBLIZED PAVEMENT

3” HMA SUB-BASE

± 8” AGGREGATE BASE
HMA LEVEL BINDER

- 2.5” TO 3.5” thick depending on location
- To be placed full width in two separate but equal lifts
- IL 9.5 Fine Graded level binder
- PG 64-22
- N50
- Concerns over first lift thickness and eventual ride quality
FINAL CROSS SECTION

- ± 8” AGGREGATE BASE
- 3” HMA SUB-BASE
- 5” PCC RUBBLIZED PAVEMENT
- 2.75” HMA BINDER
- 0.75” HMA LEVEL BINDER
- 1.5” HMA SURFACE
• SS-1H at 0.30 GAL/SQYD
QUESTIONS