PRR 165 – Performance of Mechanistically-Designed Pavements
2012 – 2015 Data

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Illinois Department of Transportation - Bureau of Research
Agenda

- History
- Data Collection Process
- Life-Cycle Models
- Current Analysis
- Future Efforts
- Questions
Background and History

• First mechanistically-designed sections were constructed in 1986 on Routes FA 401 and 409 (US 20 and US 50).

• Physical Research Report (PRR) 112 was the first report to evaluate and analyze the performance of these four different design sections.

• An internal report written in 1994 documented the performance of the original four sections plus an additional four new sections constructed between 1986 and 1992.

• Additional internal reports were written in 1997 and 2000 reporting on 88 different structural sections.
FA 401 and 409 Locations

Figure 1 from PRR 112
FA 401 (US 20)

Figure 2 from PRR 112
FA 409 (US XX)

Figure 3 from PRR 112

CODE:
UD = Underdrains
NUD = No Underdrains
L = Lime Modification
NL = No Lime Modification
Recent History

• PRR 159 was published in March of 2011.
  • Analysis period from 1986 to 2010.
  • 105 contracts (55 HMA, 24 JPCP, and 26 CRCP contracts)

• PRR 165 was published in October of 2016.
  • Analysis period from 1986-2015.
  • Contained the same 105 contracts as PRR 159.

• In April of 2016 the Bureau of Research added 80 new mechanistic sections that will be monitored and added to the next report.
Data Collection

- Performance data on these sections comes from manual pavement distress surveys (PDS).
- Traffic and condition (IRI, Rut, etc.) information are downloaded from the Illinois Roadway Information System (IRIS).
- A database was created specifically for this effort to capture all of the data and project details due to the limitations of IRIS.
- Each section will receive a PDS the year opposite of the scheduled video van collection, so that some level of survey is performed every year.
Data Collection Cont.

• Before 2014, the entire length of each section was surveyed.
## HMA Matrix of Contracts

Table 1 from PRR 165

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**NOTE:**
- * denotes contract partially removed
- * denotes contract completely removed for historical design features
- * denotes contract completely removed for supplemental design

Table 1: Selected Performance Monitoring Sections – Full-Depth HMA Matrix
Splitting Contracts into sub-sections

• The original project is not always completely rehabilitated at the same time.

• There have been a number of sections that have received partial overlays.

• < 25% of contract was overlaid, overlaid portion was truncated.

• 25%-75% was overlaid, the contract was split into sub-sections

• > 75% of contract was overlaid, the remaining portion was truncated.
Survey Results

Survey Section Information

District: 4  
County: Tazewell  
Key Route: PAI 155  
Marked Route: 155  
Contract Number: 88031A  
Year of Construction: 1991  
Pavement Type: HMA  
Pavement Thickness: 16.75

Survey Section Limits

Beginning: 15.62  
Ending: 17.21  
Surveyed Lanes: 2 of 4  
Direction Surveyed: SB  
Overlay: 2000  

Traffic Year: 2013  
AADT: 17768  
PV: 15221  
SU: 854  
MU: 1693

2015 Summary Of Distresses

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Survey Results (cont.)

**Survey Section Information**

- District: 4
- Key Route: FAP 317
- Contract Number: 88067A_2
- County: Woodford
- Marked Route: US 24
- Year of Construction: 1995
- Pavement Type: HMA
- Pavement Thickness: 13
- Beginning: 0.00
- Ending: 1.5
- Surveyed Lanes: 2 of 2
- Direction Surveyed: EB/WB
- Overlay: 2010

**Traffic Year:** 2015  
**AADT:** 6537  
**PV:** 6128  
**SU:** 149  
**MU:** 260

**2015 Summary Of Distresses**

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Distresses Collected

1. ALLIGATOR OR FATIGUE CRACKING
2. ASPHALT BLEEDING
3. BELT CRACKING
4. BLOCK CRACKING
5. CENTER OF LANE CRACKING
6. CENTERLINE CRACKING
9. REFLECTIVE D-CRACKING
13. LONGITUDINAL CRACKING
14. OVERLAID PATCH DETERIORATION
16. PERMANENT PATCH DETERIORATION
Distresses Collected (cont.)

18. POTHOLE & LOCALIZED DISTRESS
21. RAVELING & WEATHERING
22. REFLECTED PATCH JOINT CRACKING
23. REFLECTION CRACKING OF TRANS. JOINTS
24. REFLECTIVE WIDENING CRACKING
25. RUTTING
27. SHOVING/CORRUGATION
30. TRANSVERSE CRACKING
31. PUMPING & WATER BLEEDING
Alligator or Fatigue Cracking
Block Cracking
Centerline Cracking
Raveling and Weathering

Image from NAPA website
Rutting
Historical and Current Design Sections

• The Bureau of Research decided to focus the analysis on pavement designs that are relevant today.

• Research removed various contracts that had design features that are no longer part of IDOT standards.
### Table 4 - Historical Sections Removed

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<th>Year of Construction</th>
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<td>US 50</td>
<td>Pavement 1.5&quot; thinner than design</td>
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### Table 5 - Supplemental Designs Removed

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Full-Depth Hot-Mix Asphalt (HMA) Maintenance and Rehabilitation Model

- Found on page 54-7.5 of Bureau of Design and Environment Manual
- This model represents the anticipated maintenance that this pavement will receive over a set length of time and is basis for the life-cycle cost analysis used for pavement type selection.
Full-Depth Hot Mix Asphalt (HMA) Maintenance and Rehabilitation Model

Pages 54-7.5 – 54-7.6 of Bureau of Design and Environment Manual
Figure 2: Percent Patching as a Function of Age: Full-Depth HMA - All Sections

- 2010 and Earlier Surveys (Bare)
- 2010 and Earlier Surveys (1st Overlay)
- 2010 and Earlier Surveys (2nd Overlay)
- 2012 - 2015 Surveys (Bare)
- 2012 - 2015 Surveys (1st Overlay)
- 2012 - 2015 Surveys (2nd Overlays)

HMA Model
Figure 3a: Percent Patching as a Function of Age: Full-Depth HMA - Current Design Criteria

- 2010 and Earlier Surveys (Bare)
- 2010 and Earlier Surveys (2nd Overlay)
- 2012 - 2015 Surveys (1st Overlay)
- 2012 - 2015 Surveys (2nd Overlays)
- HMA Model
Figure 3b: Percent Patching as a Function of Age:
Full-Depth HMA - Current Design Criteria (Expanded View)

- 2010 and Earlier Surveys (Bare)
- 2012 - 2015 Surveys (Bare)
- 2010 and Earlier Surveys (1st Overlay)
- 2012 - 2015 Surveys (1st Overlay)
- 2010 and Earlier Surveys (2nd Overlay)
- 2012 - 2015 Surveys (2nd Overlays)

HMA Model
Figure 11: Overlays as a Function of Age: Full-Depth HMA - All Sections
Figure 12: Overlays as a Function of Age:
Full-Depth HMA - Current Design Criteria

Figure 12 – PRR 165
Service Life of Initial HMA Wearing Surface

Figure 13: Age of Sections: Full-Depth HMA Sections - Current Design Criteria

- Age at 1st Overlay
- Age of Bare Sections in 2015
Figure 24: ESALs as a Function of Age:
Full-Depth HMA - Current Design Criteria

- Bare Pavement
- 1st Overlay
- 2nd Overlay
Figure 27: Percent Patching as a Function of ESALs:
Full-Depth HMA - Current Design Criteria

- Bare Pavement
- 1st Overlay
- 2nd Overlay
What is Next? Future Monitoring Efforts

- Bureau of Research added 80 new sections to the monitoring effort this year.
- Supplemental designs (unbonded concrete overlays and HMA over rubblized concrete) added to monitoring list.
- Continued monitoring of sections with pavement preservation treatments to determine their roll in the life cycle models.
- Continue to collect data to fill in the gaps: Communication with the districts about overlays, patching quantities before an overlay, and preservation treatments will be critical.
Questions

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