Deficiencies and Remedies of Pavement Stripping

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Agenda

I. Background – Tony Kutzke
II. Research Summary – Dave Rettner
III. Brooklyn Park Maintenance Strategy – Jesse Struve
IV. Questions
Background

Asphalt pavement stripping was identified as a major concern for approximately 60 percent of all Cities who attended the 2014 City Engineer’s Association of Minnesota conference in January, 2014 and approximately one-third of the Counties that attended the County Engineers Association conference.
Background

Many cities and counties are experiencing premature aging of the pavement on streets constructed in the mid-1990’s (and in many cases later) which resulted in questions by residents and City officials relating to reoccurrence of stripping in newer pavements.
Background

This phenomenon does not appear to be localized to any region, contractor, bituminous supplier, agency, or pavement typical section.
Constructed in 1997
Constructed in 1998
Constructed in 2001
Constructed in 2003
Background

MnDOT conducted a study which was published in April, 2013 that identified high air voids as the main cause of the stripping.

That study resulted in additional questions which are the focus of the objectives of this project.
Project Objectives

Verify that high air voids are the source of the stripping problem.
Determine why high air voids occurred on the pavements that have stripping failure.
Determine ways to evaluate pavements to predict stripping potential.
Identify Asphalt Film Thickness (AFT) on pavement samples.
Project Tasks for Phase I

Task 1: Literature Review

Task 2: Field Sampling Program
- Identify potential project locations
- Select 16 locations and obtain approximately 12 cores per location

Task 3: Laboratory Testing Program
- Mix Properties from Cores
- Lab testing of cores and current mixes recommended by MnDOT Bituminous Office for Cities
Task 1 – Literature Review

- Little literature available regarding stripping under chipseals
- Some case studies on stripping of second lift of bituminous
  - Mainly focused on low density of upper layer allowing water to be trapped in lower layer
- Stripping susceptibility tests:
  - TSR (modified Lottman)
  - Lottman – with Freeze/Thaw Cycle
Task 2 – Field Testing

• Used 18 of 31 sites identified
  • Metro area cities and one county
• Most common mix was 41wear
• Most had 6”+ aggregate base
• 50% had sand subbase
• Many had no subbase or subgrade records
Task 2 – Field Testing

- Coring was performed on frozen pavement during Fall/early Winter 2014
- 12 -16 cores per location
  - Changed some sites due to inability to obtain cores
  - Coring may be a good screening test
- NCAT Permeameter didn’t work (unable to obtain adequate seal)
Cul-de-Sac
Task III – Lab Testing

- Hamburg Wheel Rut Testing
  - Looking for stripping
  - Tested with and without chipseal attached to the cores
  - No trends appeared
  - In most cases no stripping was evident
  - Older pavements performed better than new mixes did due to higher stiffness of aged binder
Task III – Lab Testing

- Hamburg Wheel Rut Testing
Task III – Lab Testing

• Hamburg Wheel Rut Testing
Task III – Lab Testing

- Hamburg Wheel Rut Testing
Task III – Lab Testing

Cores

Voids ranged from 1.4% to 8.4%
Extracted AC ranged from 4.2% to 5.6%
  • Likely some stripping starting to occur
VMA ranged from 13.2% to 19.3%
Calculated AFT (based on extracted AC content and gradation
  • 11 roadways ≥ 8.5 microns
Task III – Lab Testing

Recompacted Mix

TSR at 7.0% voids
  • 65% to 97%

TSR at 11.0% voids
  • 51% to 87%

Two mixes with the lowest TSR’s at 7.0% voids were also lowest at 11.0% voids
  • 4.4% and 4.8% extracted AC content
Additional Tasks

Nuclear Density Testing

• Tested 11 roadways included in the study (40 locations per roadway in a one block area)

• Nuclear density results on chipsealed roadways generally didn’t match core results
  • Results were highly variable – likely impacted by a combination of stripping and debonding of the chipseals
  • Results were typically in the 85% - 88% range
Additional Tasks

Nuclear Density Testing

• Tested 29 additional roadways constructed between 2007 and 2015 with mix data available
• All but one roadway tested was constructed with ordinary compaction
  • Average densities ranged from 88.4% to 97.1%
  • 21 segments had average density ≥ 92.0%
  • 27 segments had average density ≥ 91.5%
Additional Tasks

Ground Penetrating Radar

• Measured dielectric constant – perhaps use as a screening tool.
  • Large variability
  • Likely due to presence of stripping
  • May be useful as a screening tool – high variability may indicate the presence of stripping
  • Would need further development
Additional Tasks

Ground Penetrating Radar
Survey of Cities - 129 responses

64% regularly use chipseals
- 17% sometimes, 19% never

35% no issues with stripping under chipseals
39% some but not a major issue
26% major issue

4% have significant stripping of non-chipsealed roads
21% - minor issue
75% - not a significant issue
Conclusions

• No smoking gun
  • Not all mixes strip
  • No apparent relationship between granular subbase and stripping

• No clear relationship between density and stripping was found

• There was insufficient data to conclude any relationship between the use of polymer modified emulsions in the seal coat and stripping
Conclusions

• Can only core pavement that isn’t stripping
  • Screening tool?
• Based on density testing of more recently constructed roadways density obtained by “Ordinary Compaction” is not significantly lower than “Maximum Density”
Conclusions

• This phenomenon is not typically seen on roadways that were not chipsealed.
  • Many roadways that were chipsealed have cul-de-sacs that were not chipsealed
    • The roadway has stripping but the cul-de-sac surface has only some surface raveling
    • Cracks are deteriorated under the chipseal but not when there isn’t one
Conclusions

• This research has shown that in some cases the use of chipseals has not resulted in extending the life of the pavement.

• Recommend retaining construction mixture and density test data in case this happens in the future.
2016 CEAM Conference

January 27, 2015
Previous Street Maintenance Strategy

• 7 maintenance districts
  – 208 miles of residential streets
  – 54 miles of Municipal State Aid (MSA) streets

• Goals
  – 90% adequate (sealcoat every 7-8 yrs.)
  – 8% marginal (overlay every 25 yrs.)
  – 2% problem (reconstruction every 40-50 yrs.)
Degrading Streets/Impacts

- **Approx. 165 miles of streets (15-25) yrs. old**
  - These streets are wearing out twice as fast compared to streets constructed/reconstructed before 1990
  - Overlay cost of approx. $170,000/mile
  - Approx. $28,000,000 exposure over 14 years

- **Approx. 40 miles of old streets (35+ yrs. Old)**
  - These streets have aged as expected
  - Overlay cost of approx. $170,000/mile
  - Approx. $6,800,000 exposure over 14 years

- **Approx. 7 miles streets need reconstruction**
Street Rehabilitation Plan/Impact

• Overlay 10-15 miles per year for 14 years
  – Two times through our 7 street maintenance districts

• Re-assess streets condition annually

• Adjust rehab techniques based on street condition

• Total of 205 miles is 78% of our city streets
  • Overlay cost of approx. $170,000/mile (in 2016 dollars)
  • Approx. $34,850,000 exposure over 14 years
Potential Funding Sources

• Increasing Operating Budget (13% adjustment required).

• Special Assessments for Mill and Overlay
  – Would still have to raise operating budget to pay for city portion.

• Franchise Fees
Process

• Numerous meetings with Council (began Aug 2014).
  – Initial meetings focused on the issue at hand and potential liability.
  – Council Directed staff to focus on franchise fees
Process

• **Public Meetings**
  – Held 4 public meetings in different areas of town.

• **Commission Meetings**
  – Budget Advisory Commission (BAC)
  – Citizens Long Range Improvement (CLIC)

• **Council Meetings**
  – Numerous meetings at work sessions

• **Public Hearings / Approval**
  – Fall of 2015
Franchise Fees Outcome

• Dedicated funding to transportation infrastructure.
  – Approx. $7 per household per month for street overlays
  – Approx. $7 per household per month for street reconstruction (eliminated special assessments)

• Rebate Franchise Fees to anyone paying assessments.

• Did not discount fees to private street residents.
Questions?

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