Project Progress Update

Continued Field Evaluation of Precutting for Maintaining Asphalt Concrete Pavements with Thermal Cracking

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Outline

• Problem Statement
• Recap of the previous project
• Project progress
• Summary of literature review
• Field survey results in summer 2016
• Data analysis
• Next step
Problem Statement

- Thermal cracks are perhaps the most noticeable form of crack-related damage in asphalt pavement in cold climates.
- Previous experience in Alaska and other northern states demonstrated that using precut technique to reduce thermal cracks is promising.
- A systematic approach has not been developed to implement application of precutting in AC pavements.
- Development of a precutting technology needs to consider:
  - new pavements placed on new embankments
  - new pavements placed on existing embankments—the latter having already developed thermal cracking in the sub-pavement aggregate.
Previous Work

• Test sections at Richardson Hwy, Moose Creek (20 miles SE of Fairbanks), built in 2012
  – Surveyed after 1 year (2013) and 2 years (2014)
  – 10 sections, all on Pavement Structure I
  – Precut depth: 0.5, 1.0 and 1.5 inches
  – Precut spacing: 25 and 40 feet
• Test sections at Parks Highway, Healy, 100 miles SW of Fairbanks, built in 2014
  – Surveyed after 1 year (2015)
  – 16 sections, on Pavement Structure II-V
  – Precut depth: 0.625, 1.25, and 2 inches
  – Precut spacing: 25 and 35 feet
Previous Work

- Precutting treatment appears promising to control thermal cracks
- Shorter precut spacing and deeper precut depth look promising in crack control according to preliminary results
- These findings were based on preliminary results from relatively short time periods
- Continuing evaluation and monitoring are needed
Project Progress

• Task 1 literature review – draft completed
• Task 2 field monitoring
  – Single evaluation of Phillips Field Road, completed
  – Periodical monitoring of Moose Creek project, 2016 surveyed
  – Periodical monitoring of Healy project, 2016 surveyed
• Task 3 comparison of thermal cracking and analysis
  – Data analysis was conducted based on field surveys in 2016
• Task 4 reporting and recommendations
Summary of Literature Review

• Thermal cracks in asphalt pavement
  – Generally occur transversely across the width of pavement
  – Form when the internal thermal-induced stress exceeds the tensile strength
  – Two major contributors to thermal cracking
    • Low temperatures
    • Large diurnal temperature differentials
  – May cause other types of pavement degradation
    • Pavement base and subbase weakened by water that enters
    • Water and fine materials are pumped out through cracks
    • Frost heave may generate in the presence of water
Summary of Literature Review

• Maintenance approaches for thermal cracking
  – Crack sealing
  – Replacement with overlay
  – Better mix designs
  – Using modified asphalt
  – Precutting

• Precuts in concrete pavement
  – Not used for continuously reinforced concrete paving
  – Replacing cold joints
  – Conventional or early entry sawing
    New methods including tape insertion
Summary of Literature Review

• Precuts in asphalt pavement
  – Many northern states have used the precut technique successfully
  – Airports have utilized precuts with sealants in many states including Alaska
  – Not enough reports, gap in precut knowledge
Summary of Literature Review

• Minnesota experience (Janisch and Turgeon 1996)
  – 50 test sections evaluated for joints in:
    • New asphalt (effective)
    • Asphalt overlay of existing asphalt (effective when cuts were placed over existing cracks)
    • Asphalt overlay of concrete (effective when cuts were placed over existing joints and cracks)
  – Cut Spacing: 30-50 feet
  – Cut depth: 2 inches or 1/3 pavement depth
Summary of Literature Review

• Minnesota experience (personal communication)
  – Generally was very effective
  – However, a cupped depression developed approximately 5-7 years after implementation
  – Under lower vehicular traffic these distresses developed much later
  – No longer employed as standard practice
  – Has been replaced by using PG 58-34 binder
Summary of Literature

- Iowa experience (Marks 1984)
  - 8 Test Sections
    - Precut Depth 1/4 inch x 3 inch
    - Precut Spacing of 40, 60, 80, and 100 feet
    - No cracks in 3.5 years, control had 1 natural crack per 170 feet

- Maine experience (Marquis 2004)
  - Two test sections
  - Natural cracks extended from joints into shoulder
  - No natural cracks in test sections, few in control
Summary of Literature Review

• North Dakota experience (Evert and Richter 2007)
  – Five test sections
  – Three reservoir dimensions tested
  – Cut spacing of 30, 40, and 80 feet
    • Least successful section had 80 feet cut spacing

• Alaska Phillips Field Road section (Griffith 2011)
  – One test section
    • Cut spacing at 50 feet
    • Cut depth to 1/4 inch from bottom of layer
  – Subjective Results
    • Section is performing extremely well
Field Survey in Summer 2016

• Moose creek project
  – Data was collected in June, 2016
  – Previous data was collected in 2013 and 2014

• Healy project
  – Data was collected in June, 2016
  – Previous data was collected in 2015

• Phillips Field Road
  – 32 years old
  – Single evaluation was conducted in June 2016
  – Scheduled to be milled in summer 2016
# Moose Creek Project Design

Note: Precut depth ratio is the ratio of precut depth over the thickness of AC layer.

<table>
<thead>
<tr>
<th>Section No.</th>
<th>Section Type</th>
<th>Precut Spacing (ft)</th>
<th>Precut Depth (in)</th>
<th>Precut Depth Ratio</th>
<th>Pavement Structure</th>
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<td>3/4</td>
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Pavements structure V is the strongest, most sound structure for the road followed by II, IV, III and I.

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<th>Pavement Structure</th>
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<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
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Field Evaluation

• Document the crack amount (the same with previous monitoring)
• Label the crack severity
• Measure the crack width
• Document if precuts are active
• Document each crack on the survey sheet and will keep it for the record
• Number the point of interest (cracks, special surrounding environment, precuts, other pavement deterioration, etc.) and take photos
Field Evaluation
What We Did?
Moose Creek Project Survey Results

<table>
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<td>25-ft Spacing/1-in depth</td>
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<td>40-ft Spacing/0.5-in depth</td>
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<td>40-ft Spacing/1-in depth</td>
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<td>40-ft Spacing/1.5-in depth</td>
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<tr>
<td>on-crack/1.5-in depth</td>
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Healy Project Survey Results

Sections

- Type II Control
- Type II S, 25-ft, 2-in
- Type III Control
- Type III S, 25-ft, 2-in
- Type III S, 35-ft, 2-in
- Type IV Control
- Type IV S, 25-ft, 0.625-in
- Type IV S, 25-ft, 1.25-in
- Type IV S, 35-ft, 0.625-in
- Type IV S, 35-ft, 1.25-in
- Type V Control
- Type V S, 25-ft, 2-in
- Type V S, 35-ft, 2-in

Survey in 2015
Survey in 2016

Natural Crack Spacing (ft)
Crack Filling Observed on One Section

- “Cut on existing cracks” section with 1.5 in cut depth from Moose Creek project was maintained with crack filling
More Observations

Active Precut

Non-active Precut
Precut Sections vs. Control Sections

**Moose Creek (2013), Pavement Structure I**

- Precut Depth (in):
  - 0.5
  - 1
  - 1.5

**Natural Crack Spacing (ft)**
- 25 ft Precut Spacing
- 40 ft Precut Spacing
- Control

**Moose Creek (2014), Pavement Structure I**

**Moose Creek (2016), Pavement Structure I**
Precut Sections vs. Control Sections

Healy (2015), Pavement Structure II

Healy (2015), Pavement Structure III

Healy (2015), Pavement Structure IV

Healy (2015), Pavement Structure V

Precut Depth (in)

Natural Crack Spacing (ft)

25 ft Precut Spacing

35 ft Precut Spacing

Control
Precut Sections vs. Control Sections

- Healy (2016), Pavement Structure II
- Healy (2016), Pavement Structure III
- Healy (2016), Pavement Structure IV
- Healy (2016), Pavement Structure V

Bar charts showing natural crack spacing vs. precut depth for different pavement structures, with data indicating 25 ft, 35 ft precut spacing, and Control.
Effect of Precut Spacing

- Using the 2016 survey results and holding the precut depth ratio at 3/4
Effect of Precut Depth

- Using the 2016 survey results from structure I and IV sections.
Effect of Pavement Structure

- Using the 2016 survey results and holding the precut depth ratio at 3/4
Phillips Field Road Survey Results

- Many longitudinal cracks were observed
- Many block cracks
- Only 7 transverse cracks were observed, including 2 low severity cracks
- 13 out of 23 precuts were active
- Many potholes were observed when longitudinal cracks meet precuts
- This section was 32 years old, but its general driving condition was found to be pretty good. All the cracks, including transverse cracks, active precuts, longitudinal cracks and block cracks seemed not to deteriorate the pavement condition in a significant level
Philip Field Road Observations

Block Cracks

Longitudinal Cracks
Philip Field Road Observations

Non-active precut

Active precut
Philip Field Road Observations

Potholes
Summary

• Field monitoring status
  – moose creek project, 3 times in 4 years (2013, 2014, 2016)
  – Healy project, 2 times in 2 years (2015, 2016)
  – Philip field road, single evaluation 32 years after its construction

• The survey recordings are well documented in text and pictures

• Data analysis was conducted and presented
Preliminary Conclusions (after 2016 Survey)

• Precutting treatment appears promising to control natural thermal cracks.

• Shorter precut spacing and strong pavement structure look promising in crack control according to preliminary results. There may have an optimum precut depth that produces the best crack reduction effect.

• These findings were based on preliminary results from relatively short time periods.

• Continuing evaluation and monitoring of test sections and cost effectiveness analysis are needed to recommend an effective design methodology and construction practice for Alaska and cold areas of other northern states.
Next Step

• Task 1 literature review – add more references when referred to
• Task 2 field monitoring – 2017 for Moose Creek and Healy projects
• Task 3 comparison of thermal cracking and analysis
  – Further data analysis
  – Data comparison with other northern states and countries
  – Cost analysis
• Task 4 reporting and recommendations