Pavement Preservation in Cold Regions

By

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Outline

- Introduction
- Pavement preservation treatments in Alaska
- Field evaluation of crack sealing of AC pavement in Alaska
- Evaluation of precut thermal cracks for an AC Pavement in interior Alaska
- Summary
Background

☐ The Problem
  ■ Too many road miles
  ■ Not enough funds

☐ The Opportunity
  ■ A sound pavement preservation program to optimize paving funds
  ■ Will need dedicated funding
Example
Problem Types
Ravelling and Miscellaneous Cracking Can Fix
Miscellaneous Thermal Cracks and Construction Joint Can Fix
Transverse Thermal Crack

Can Fix
Thermal Cracks Can Fix
Ruts (Studded Tire Wear) Can Fix
Rut with Alligator Cracking

Can’t Fix

Alligator Cracking with Pothole
Rut
And
Alligator
Cracking
Can’t Fix
The Solution

- Using Pavement Preservation concepts
  - Surface Seals
  - Thin HMA overlays

- Using new or improved technologies
  - Thin bonded wearing courses
  - Warm mix technologies
  - In-place surface recycling
Pavement Preservation Concept

- Overview
  - When, where, what
  - Choosing the right treatment
- Better use of existing and improved technologies
Effective Pavement Preservation

$1 for preventive maintenance here

Costs 6-10 times or more when it’s done as rehab
Show Time
Common Types of Pavement Preservation Treatments

- Fog and rejuvenating seals
- Chip seals
- Slurry surfacings
- Cape seals
- Bonded wearing courses
- Thin HMA overlays
Pavement Preservation

“Strategy including all activities to provide & maintain serviceable roadways”

- Lower life cycle costs
- Higher quality pavements
- Keeping good pavements good
- Greener solutions

The right treatment on the right pavement at the right time
Preservation Treatments Used in Alaska
Evaluation of Pavement Preservation Treatments

- A total of 44 road sections were evaluated

- Five cities/towns: Anchorage, Fairbanks, Northpole, Juneau, and Gakona

- Pavement Surface Evaluation and Rating (PASER) manual for asphalt roads was used to evaluate the distresses for the road sections (Pavement Service Evaluation & Rating)

- Five preservation treatments have been used to date in Alaska including: thin HMA overlays (8), chip seals (25), slurry surfacing (2), crack sealing (8), and pre-saw cut joints (1)
## PASER

<table>
<thead>
<tr>
<th>Quality</th>
<th>Rating</th>
<th>Treatment (Asphalt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>9-10</td>
<td>No maintenance required</td>
</tr>
<tr>
<td>Good</td>
<td>7-8</td>
<td>Crack sealing and minor patching</td>
</tr>
<tr>
<td>Fair</td>
<td>5-6</td>
<td>Preservation treatments (non-structural)</td>
</tr>
<tr>
<td>Poor</td>
<td>3-4</td>
<td>Structural renewal (overlay)</td>
</tr>
<tr>
<td>Failed</td>
<td>1-2</td>
<td>Reconstruction</td>
</tr>
<tr>
<td>Surface Rating</td>
<td>Visible Distress</td>
<td>General Condition/ Treatment Measure</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>10</td>
<td>None</td>
<td>New condition.</td>
</tr>
<tr>
<td>9</td>
<td>None</td>
<td>Recent overlay, like new.</td>
</tr>
<tr>
<td>8</td>
<td>No longitudinal cracks except reflection of paving joints. Occasional widely spaced transverse cracks, 40 ft. All cracks sealed or tight, opening 1/4” or less.</td>
<td>Recent sealcoat or new cold mix. Little or no maintenance required.</td>
</tr>
<tr>
<td>7</td>
<td>Very slight or no raveling showing some traffic wear. Tight longitudinal cracks due to reflection of paving joints. Tight transverse cracks spaced 10 ft with slight crack spalling. None to a few patches in excellent condition.</td>
<td>First signs of aging. Maintain with routine crack filling.</td>
</tr>
<tr>
<td>Rating</td>
<td>Description</td>
<td>Action</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>--------</td>
</tr>
<tr>
<td>3</td>
<td>Closely spaced longitudinal and transverse cracking with spalling and crack erosion. Severe block cracking. Some alligator cracking, 25% of surface or less. Patches in fair to poor condition. Moderate rutting or distortion at 1” to 2” deep. Occasional potholes.</td>
<td>Needs patching and repair prior to major overlay. Milling and removal of deterioration extends the life of the overlay.</td>
</tr>
<tr>
<td>1</td>
<td>Severe distress with extensive loss of surface integrity.</td>
<td>Failed and needs total reconstruction.</td>
</tr>
</tbody>
</table>
Thin HMA Overlays

- One of the most popular preservation treatment used in Alaska (used in each of the three regions)
- Typical HMA overlay thickness is 2 inches
- Central Region (Anchorage) uses this treatment to mitigate existing rutting
- Northern Region (North Pole) attempts to address thermal cracking, permafrost degradation, and other distresses
Thin HMA Overlays

Before application
(PASER rating – 5)

After application
(PASER rating - 9)

(Cross Way, North Pole, 2011)
H&H Rd, North Pole, Thin Overlay

Before

During
Thin HMA Overlays

Debarr Rd, Anchorage – Tight transverse crack spaced 40 ft. Thin overlay placed one year ago. ADT approximately 21,000.
Slurry Surfacing

- Microsurfacing applied at Eielson in 2003: approximately eight years old with a smooth surface, no rutting and no cracking

- Slurry seal applied in 2003: minor thermal cracking

- Both performed well in Northern Region
Slurry Surfacing (Eielson AFB)

Before application (PASER rating – 7)

After application (PASER rating – 9)
Slurry Seal

(Applied in summer 2005; Photo taken August 2011)
Chip Seals

- A total of 25 road sections with chip seal surveyed
- Different areas exhibited different problems: transverse cracking and permafrost degradation in Fairbanks area, and bleeding and cracking in Anchorage area.
- When placed correctly for areas with good drainage and low traffic, the chip seals performed well (Duben St., Anchorage)
Chip Seal

19th St by Arctic intersection, Anchorage – Chip Seal placed 2001. Transverse cracking from thermal stresses and longitudinal from frost.
Single C Chip AST

Before

Broadmoor Ave, Fairbanks

After
Double Chip Seal

Farmers Loop, Fairweather to Summit, Fairbanks, chip seal 2008, photo taken in 2011, PASER rating - 7
Crack Sealing

- A very common practice in Alaska.

- No matter if crack sealing projects surveyed are newly or previously applied, cracks of different types with different severity levels can be seen.

- Hard to tell old cracks occurring previously or new cracks after cracking sealing is applied.
Crack Sealing

Old Seward Highway, Anchorage, crack sealing in 2011, Photo taken in 2011, PASER rating – 4
Crack Sealing (South Cushman, Fairbanks)

Before

After
Crack Sealing (2\textsuperscript{nd} Ave, Fairbanks)

Before

After
Pre-saw Cut Joints

- Made on a new section of HMA with approximately 50 ft spacing without sealing pre-cut joints.

- In over a decade there is no substantial deterioration to warrant any rehabilitation work. There are not any substantial cracks in between most pre-cut joints.

- Pre-cuts initiate stress concentrations at the cut locations while relieving stresses at other locations in the pavement.
Pre-saw Cut Joints

Philips Rd, Fairbanks, pre-saw cut joints in 2000, photo taken 2011, PASER rating – 6
## Summary of Service Lives

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Service life, years</th>
<th>Treatment</th>
<th>Service life, years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Literature</td>
<td>Survey</td>
<td></td>
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<tr>
<td>Crack Sealing</td>
<td>3-8</td>
<td>3.4</td>
<td>Microsurfacing</td>
</tr>
<tr>
<td>Patching</td>
<td>4</td>
<td>3.6</td>
<td>Thin Overlays</td>
</tr>
<tr>
<td>Fog Sealing</td>
<td>-</td>
<td>3.4</td>
<td>Bonded Wear Courses</td>
</tr>
<tr>
<td>Chip Sealing</td>
<td>3-10</td>
<td>5.6</td>
<td>Interlayers</td>
</tr>
<tr>
<td>Slurry Seals</td>
<td>3–5</td>
<td>4.6</td>
<td>In-place Recycling</td>
</tr>
<tr>
<td>AST/BST</td>
<td>-</td>
<td>6.0</td>
<td></td>
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</tbody>
</table>
Field Evaluation of Crack Sealing Treatment in Alaska
Is this Particular Practice Economically Worthwhile?

Sealant Use Noticed in Several Salt Lake City, Utah Parking Lots & Side Roads
Background

- Crack Sealing is the most common preservation technique.

- Much M&O funding is spent on sealing cracks.

- Effective sealing of cracks is difficult in Alaska’s environment.

- Years of observations suggested that sealing effort may be reduced.

- We needed to evaluate thermal crack sealing in a meaningful way.
Was the study economically important to Alaska?

Based on Parks Highway data:

~ $2,600 per centerline mile per year for sealing

(Alaska has ~ 5,000 centerline miles of paved road)
Objectives

- Define areas where sealing is best done or avoided.
- Collect data with photo’s, qualitative data, and quantitative data.
- Provide recommendations on which thermal cracks to seal or not seal and for what situations.
Field Site Selection

- AC pavement with a minimum pavement surfacing age of 20 years
- 91 sites located in non-urban areas on the interconnected network of roads comprising Alaska’s main highway system
- Alaska, Elliot, Glenn, Parks, Richardson, Steese, Sterling, Tok Cutoff
Site Selection – Actual Locations
Data Collection Methods

- **PASER** – qualitative, rating from 1 (failed road, total reconstruction) to 10 (newly constructed road)

- **LTPP** – quantitative
  - Count the number of thermal cracks at low, medium, and high severity.
  - Measure the lengths of thermal cracks at low, medium, and high severity.
  - Measure the length of effectively sealed thermal cracks at low, medium, and high.

- **Special Thermal Crack Evaluation (STCE)** – photos and expert opinion
Two Types of Thermal Cracks in STCE

Major

Lessor
Does the condition of the thermal cracks themselves tend to deteriorate with time?

- Theory says they should be affected by repeated vehicle loadings.
- This question is addressed by comparing the condition of thermal cracks in wheel path versus non-wheel path areas on old pavements.
Do thermal cracks negatively influence other aspects of pavement performance?

- This is assumed to be the case in all pavement preservation literature.

- The question is addressed by examining the pavement for signs of fatigue cracking, potholing, excess rutting, or other signs of structural softening in the vicinity of thermal cracking on old pavements.
Is sealing of thermal cracks necessary?

- Standard practice says yes.

- This question is addressed by comparing the condition of sealed cracks versus non-sealed cracks on old pavements.
Major thermal cracks and lessor thermal cracks are examined as two separate thermal crack types.

Does traffic affect thermal cracking – wheel path vs. non-wheel path?

Does thermal cracking cause other pavement distresses such as fatigue cracking and potholes?

Is the overall condition of the pavement maintained or improved by sealing thermal cracks?
Data Analysis

Condition of major transverse cracks (wp Vs non-wp*)
(* wheel path versus non-wheel path)
Data Analysis

Condition of lessor thermal cracks (wp Vs non-wp)
Examples of major thermal cracks causing no other pavement distresses.
Photo Interpretation

Examples of lessor thermal cracks with no difference between wheel path vs non-wheel path
Recommendations

- Educate (need to be able to recognize thermal crack types)
- Do not seal lessor thermal cracks
Recommendations (Cont’d)

- Major thermal cracks on old pavements – do not seal if degradation is not apparent.
Recommendations (Cont’d)

- Major thermal cracks on newer pavements – seal every other crack.

Anchorage; 1yr, thin HMA overlay thermal cracks spaced 40ft
Recommendations (Cont’d)

- Major thermal cracks with severe bumps – apply band patch/seals, aids with leveling.
Areas showing signs of delamination – apply sealant if the section will not be reconstructed within the current construction season.
Evaluation of precut thermal cracks for an AC Pavement in interior Alaska

25+ year old major transverse thermal cracks, precut (lt.)
natural (rt.)
Field Construction

- Test sections at Richardson Hwy, 20 miles SE of Fairbanks, 2012
  - Section 1: control section without saw cuts;
  - Section 2: 17 cuts at three depths (0.5”, 1.0”, and 1.5”) with each 25’ apart;
  - Section 3: 11 cuts at three depths (0.5”, 1.0”, and 1.5”) with each 40’ apart;
  - Section 4: 28 cuts (7 at a depth of 0.5”, 10 at 1.0” and 11 at 1.5”) and the cuts located over the preconstruction natural thermal cracks).
Natural Transverse Thermal Cracks
Precut Transverse Cracks — Non-active
Precut Transverse Cracks — Active
Precut Transverse Cracks with Partial Capture of Natural Transverse Cracks

Figure 1. Precut cracks with partial capture of natural cracks at ~ Stations 1013+62 (lt.) & 1021+76 (rt.)

Natural Transverse Thermal Crack
Precut Crack
Natural Transverse Thermal Crack

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# Crack Surveys and Results

<table>
<thead>
<tr>
<th></th>
<th>Preconstruction Natural Cracking</th>
<th>Post-Construction Natural Cracking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2013</td>
<td>2014</td>
</tr>
<tr>
<td>Average Natural Crack Spacing (All subsections)</td>
<td>72.9</td>
<td>67.1</td>
</tr>
<tr>
<td>Standard Deviation of Spacing (All subsections)</td>
<td>32.9</td>
<td>46.4</td>
</tr>
<tr>
<td>Total No. of Natural Transverse Cracks (All subsections)</td>
<td>74</td>
<td>81</td>
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<tr>
<td>Average Natural Crack Spacing (Subsection 1)</td>
<td>60.8</td>
<td>42.1</td>
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<tr>
<td>Standard Deviation of Spacing (Subsection 1)</td>
<td>21.4</td>
<td>9.6</td>
</tr>
<tr>
<td>Total No. of Natural Transverse Cracks (Subsection 1)</td>
<td>22</td>
<td>32</td>
</tr>
<tr>
<td>Average Natural Crack Spacing (Subsection 2)</td>
<td>80.8</td>
<td>77.4</td>
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<tr>
<td>Standard Deviation of Spacing (Subsection 2)</td>
<td>30.3</td>
<td>42.9</td>
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<tr>
<td>Total No. of Natural Transverse Cracks (Subsection 2)</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Average Natural Crack Spacing (Subsection 3)</td>
<td>74.5</td>
<td>71.7</td>
</tr>
<tr>
<td>Standard Deviation of Spacing (Subsection 3)</td>
<td>33.2</td>
<td>36.6</td>
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<tr>
<td>Total No. of Natural Transverse Cracks (Subsection 3)</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Average Natural Crack Spacing (Subsection 4)</td>
<td>75.6</td>
<td>101.2</td>
</tr>
<tr>
<td>Standard Deviation of Spacing (Subsection 4)</td>
<td>39.0</td>
<td>78.4</td>
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<tr>
<td>Total No. of Natural Transverse Cracks (Subsection 4)</td>
<td>18</td>
<td>14</td>
</tr>
</tbody>
</table>
# Crack Surveys and Results

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Natural Crack Count during Indicated Survey Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2013</td>
</tr>
<tr>
<td>Subsection 2</td>
<td></td>
</tr>
<tr>
<td>0.5” Cut Depth</td>
<td>7</td>
</tr>
<tr>
<td>1.0” Cut Depth</td>
<td>3</td>
</tr>
<tr>
<td>1.5” Cut Depth</td>
<td>6</td>
</tr>
<tr>
<td>Subsection 3</td>
<td></td>
</tr>
<tr>
<td>0.5” Cut Depth</td>
<td>5</td>
</tr>
<tr>
<td>1.0” Cut Depth</td>
<td>5</td>
</tr>
<tr>
<td>1.5” Cut Depth</td>
<td>4</td>
</tr>
<tr>
<td>Subsection 4</td>
<td></td>
</tr>
<tr>
<td>0.5” Cut Depth</td>
<td>6</td>
</tr>
<tr>
<td>1.0” Cut Depth</td>
<td>4</td>
</tr>
<tr>
<td>1.5” Cut Depth</td>
<td>4</td>
</tr>
</tbody>
</table>
Summary

- Pavement preservation treatments are widely used in cold regions. Five preservation treatments have been used to date in Alaska.

- Different treatments provided varied improvement of pavement life. Same treatments may be applied to different regions but to prevent or mitigate different failure modes. Use of some treatments should be considered job specifically.

- Crack Sealing is the most common preservation technique. However, significant maintenance funds can be saved or redirected by not sealing or by reduced sealing of thermal cracks in AC pavements depending on the forms of thermal cracks.

- Precutting treatment appears promising to control thermal cracks. Continuing evaluation and monitoring of test sections are needed to recommend an effective design methodology and construction practice for Alaska and cold areas of other northern states.
Thank you!

Questions?
Contact

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