Effective Time for Application of Slurry Seal on Asphalt Pavements in the Truckee Meadows Region

University of Nevada Reno (UNR)
Western Regional Superpave Center

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Problem Statement and Objective

- The time of Slurry Seal (SS) application is left to the Project Engineer judgment and practice.
  - SS right after construction
  - SS after 1, 3, 5 etc. years of service
  - ...

- **Objective:** Evaluate the field performance & effectiveness of SS on asphalt pavements in Truckee Meadows Region
Research Phases

Phase I:
- Evaluate \textit{effectiveness} \& \textit{optimum time} for \textit{single} application of slurry seal

Phase II:
- Evaluate \textit{effectiveness} \& \textit{optimum time} for \textit{sequential} application of slurry seal
Phase I: Research Approach

- Collect & evaluate performance data of asphalt pavements
  - *without* slurry seal
  - *receiving* single slurry seal at various times: 0, 1, 3, 5, 7, and 9.

- Identify *effectiveness* & *optimum time* for SS application.
Asphalt pavement sections were identified within the jurisdictions of: WCED, COR and COS.

<table>
<thead>
<tr>
<th>Initial Construction Pavement Type</th>
<th>Road Classification</th>
<th>ADT</th>
<th>Total number of sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Construction</td>
<td>Arterial</td>
<td>≥ 10,000</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Collector</td>
<td>&lt; 10,000</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Residential</td>
<td>&lt; 6,000*</td>
<td>525</td>
</tr>
<tr>
<td>Overlay</td>
<td>Arterial</td>
<td>≥ 10,000</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Collector</td>
<td>&lt; 10,000</td>
<td>226</td>
</tr>
<tr>
<td></td>
<td>Residential</td>
<td>&lt; 6,000*</td>
<td>1,848</td>
</tr>
</tbody>
</table>

*With a high percentage of trucks (> 4%)
Within each group (i.e. Road class), pavement sections were broken into three categories:

- **Do –Nothing**: SS was not applied to the pavement
- SS applied immediately after construction (referred to as \(0\))
- SS applied at: 1, 3, 5, 7, and 9 years after construction

Performance was measured in terms of PCI.
Phase I: Prediction Performance Models

New Construction - Arterial

![Graphs showing PCI vs Age in Years for New Construction and Slurry Seal at different years (0, 1, 3, 5, 7, 9).]
Phase I: Prediction Performance Models

Overlay - Arterial

[Graphs showing PCI over age for different scenarios]
Phase I: Prediction Performance Models

New Construction - Collectors

Age in Years

PCI

0 100
20
40
60
80
100
0 2 4 6 8 10 12 14 16 18 20

New Construction
Slurry Seal at year 0

New Construction
Slurry Seal at year 1

New Construction
Slurry Seal at year 3

New Construction
Slurry Seal at year 5

New Construction
Slurry Seal at year 7

New Construction
Slurry Seal at year 9

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Phase I: Prediction Performance Models

*Overlay - Collector*

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Phase I: Prediction Performance Models

New Construction - Residential

Age in Years

PCI

- New Construction
- Slurry Seal at year 0

Age in Years

PCI

- New Construction
- Slurry Seal at year 1

Age in Years

PCI

- New Construction
- Slurry Seal at year 3

Age in Years

PCI

- New Construction
- Slurry Seal at year 5

Age in Years

PCI

- New Construction
- Slurry Seal at year 7

Age in Years

PCI

- New Construction
- Slurry Seal at year 9

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Phase I: Prediction Performance Models

Overlay - Residential

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Phase I: Slurry Seal *Performance Life* & *Extension in Pavement Service Life*

**Performance Life ~ 2 yrs**

**Performance Life ~ 3 yrs**

**Extension in Pavement Service Life ~ 2 yrs**
Phase I: SS Performance Life & Extension in Pavement Service Life

- In general, performance life ranged between 2 & 4 years.
  - Except when slurry seal was applied at year 0 and 1, performance life ranged from 0 to 1 year.

- Except few cases, the pavement service life was not extended by application of the single slurry seal.
Phase I: Slurry Seal Effectiveness

Relative Benefit = 100×B / B₀

Benefit Cost Ratio = B / C

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Phase I: Effectiveness Analysis – New Construction

![Graphs showing benefit, relative benefit, and benefit-cost ratio over the years for different types of roads (Arterial, Collector, Residential)].

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Phase I: Effectiveness Analysis – Overlay

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Phase I: Conclusion

- Application of SS *immediately* or *one year after* construction of asphalt layer is not effective in terms of:
  - the benefit to the users and
  - the benefit-cost ratio for the agency.

**Optimum time** for application of a Single Slurry Seal:
- Newly constructed pavements: 3 years after construction.
- Pavements subjected to overlays: 3-5 years after construction.
Phase II:  
**Sequential Slurry Seal Applications**

- Collect & evaluate performance data of asphalt pavements
  - With a *first* slurry seal application at: 0, 1, 3 and 5 years
  - receiving a *second* slurry seal at either: 7 or 9 years.

- Identify *effectiveness* & *optimum time* for sequential SS application.

- PMS data from WCED, COR and COS
Phase II: Sequential Slurry Seal Applications

<table>
<thead>
<tr>
<th>Initial Construction Pavement Type</th>
<th>Year of the 1\textsuperscript{st} Slurry Seal Application</th>
<th>Total Number of Sections</th>
<th>2\textsuperscript{nd} Slurry Seal Applied at year 7</th>
<th>2\textsuperscript{nd} Slurry Seal Applied at year 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Construction</td>
<td>0</td>
<td>10</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>15</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>15</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>N/A</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Overlay</td>
<td>0</td>
<td>15</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>13</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>17</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>N/A</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td><strong>Total Number of Sections</strong></td>
<td><strong>85</strong></td>
<td></td>
<td><strong>87</strong></td>
<td></td>
</tr>
</tbody>
</table>
**Newly Constructed Pavements:**

1st SS at year 3, 2nd SS at year 7

- **1st slurry seal**: 4.0 yrs
- **2nd slurry seal**: 3.5 yrs

**Predicted Do-Nothing performance curve** (Using performance models developed in Phase I)

**Predicted SS at year 3 performance curve** (Using performance models developed in Phase I)
Newly Constructed Pavements: 1st SS at year 3, 2nd SS at year 9

Predicted Do-Nothing performance curve (Using performance models developed in Phase I)

Predicted SS at year 3 performance curve (Using performance models developed in Phase I)

Age in Years

Present Condition Index (PCI)
Overlay Pavements:  
1st SS at year 3, 2nd SS at year 7 

Predicted Do-Nothing performance curve  
(Using performance models developed in Phase I) 

Predicted SS at year 3 performance curve  
(Using performance models developed in Phase I)
**Overlay Pavements:**
1\textsuperscript{st} SS at year 3, 2\textsuperscript{nd} SS at year 9
Phase II: Slurry Seal Effectiveness

Relative Benefit = \( \frac{100 \times B}{B_0} \)

Benefit-Cost Ratio = \( \frac{B}{C} \)
Phase II:

Effectiveness
PHASE II: Conclusions

- Application of first SS immediately or one year after construction is not effective in terms of both the benefit to users and benefit cost ratio for the agency.

- Regardless of construction activity, optimum time for a sequential slurry seal is when first SS is applied in year 3 & second SS is applied in year 7 (i.e. 4 years after the application of the first SS)
PHASE II: Conclusions

- Pavement service life was extended by 2.0 to \(~4.0\) years when first SS was applied in years, 3 or 5 and second SS in either year 7 or 9.
- For those application conditions, the sequential SS was effective in delaying the time for reconstruction.
OVERALL RECOMMENDATION

- For both new and overlay constructions, it is recommended that the agency applies
  - First slurry seal 3 years after the construction of the asphalt layer and the second slurry seal 7 years after the construction.
Acknowledgment

- Financial Support of Washoe RTC

- City of Reno, City of Sparks and Washoe County, Nevada for providing access to their pavement management data.
THANK YOU FOR YOUR ATTENDANCE

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