MINNESOTA’S EXPERIENCE WITH LOW W/C RATIO PAVEMENTS

SEALANTS AND FILLERS FOR JOINTS AND CRACKS COMMITTEE, AHD25
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A Very Long-Life Pavement – TH61 - Built 1954
LONG LIFE PAVEMENTS IN MINNESOTA

- In 1995, MnDOT decided to move away from strength to a low w/c ratio specification for acceptance to achieve more durable and lasting pavements.
- Pilot projects with different variables tried:
  - Bought Water Reducer for Contractor
  - Statistically based aggregate quality spec
  - Well-Graded Aggregate Variations
  - Use of incentives
  - Use of 1 1/2” coarse aggregate
MnDOT Joint Sealing History

- Pre-2008
  - Hot Pour – 1/2” wide sawcut with either backer rod or paper
    - 3723 Hot-Poured Elastic Type
    - 3725 Hot-Poured, Extra Low Modulus, Elastic Type
  - Silicone – 3/8” wide sawcut with backer rod
  - Preformed Compression Seal – 3/8” wide sawcut

- Many unsealed and single sawcut test sections

- Awaiting the report “Cost-Effectiveness of Sealing Transverse Contraction Joints in Concrete Pavements”

- Neighboring state of Wisconsin - unsealed
**All Roadways: Speed Limit 45 MPH or Less**

<table>
<thead>
<tr>
<th>Base Materials</th>
<th>Contraction Joint Sealant Type</th>
<th>Longitudinal Joint Sealant Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>3725 Hot Pour</td>
<td>3725 Hot Pour or None</td>
</tr>
</tbody>
</table>
### New Construction: Speed Limit Greater Than 45 MPH

<table>
<thead>
<tr>
<th>Type of Construction</th>
<th>Base Materials</th>
<th>Contraction Joint Sealant Type</th>
<th>Longitudinal Joint Sealant Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Construction: Speed limit greater than 45 mph</td>
<td>Open Graded Aggregate Base (OGAB)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>New Construction: Speed limit greater than 45 mph</td>
<td>Drainable Stable Base (DSB)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>New Construction: Speed limit greater than 45 mph</td>
<td>Class 5</td>
<td>3725 Hot Pour</td>
<td>3725 Hot Pour or None</td>
</tr>
</tbody>
</table>
# High Performance Concrete

<table>
<thead>
<tr>
<th>Type of Construction</th>
<th>Base Materials</th>
<th>Contraction Joint Sealant Type</th>
<th>Longitudinal Joint Sealant Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Performance Concrete</td>
<td>N/A</td>
<td>3721 Preformed Elastomeric</td>
<td>3725 Hot Pour or None</td>
</tr>
</tbody>
</table>
# Concrete Overlays

<table>
<thead>
<tr>
<th>Type of Construction</th>
<th>Base Materials</th>
<th>Contraction Joint Sealant Type</th>
<th>Longitudinal Joint Sealant Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overlay: Concrete over Concrete</td>
<td>PASSRC Geotextile</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Overlay: Concrete over Bituminous</td>
<td>Full Depth Bituminous</td>
<td>3725 Hot Pour</td>
<td>3725 Hot Pour or None</td>
</tr>
<tr>
<td>Overlay: Concrete over Concrete</td>
<td>Bituminous Bond Breaker</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Concrete Pavement Rehab

<table>
<thead>
<tr>
<th>Type of Construction</th>
<th>Base Materials</th>
<th>Contraction Joint Sealant Type</th>
<th>Longitudinal Joint Sealant Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPR</td>
<td>N/A</td>
<td>3725 Hot Pour or None</td>
<td>3725 Hot Pour or None</td>
</tr>
</tbody>
</table>

![Concrete pavement with joint sealant](image)
Silicone sealant completely debonded. Severe joint distress.
Silicone sealant mostly de-bonded from both sides. Dev. distress and mass loss along depth of joint crack.
Neoprene sealant missing. Developed tunneling and vertical spalling full depth.
Sealant bonded both sides, pristine joint crack
D1 3805-67 (TH61)

Purposefully Unsealed Joint, Developing tunneling
Degenerated Hot Pour Sealant developing tunneling and vertical spalling full depth.
Silicone sealant mostly de-bonded from one side of joint. Developing tunneling
Silicone sealant well bonded both sides. LATE, pristine crack.
Silicone sealant well bonded both sides. LATE, pristine crack.

D2-6019-22 (US2)
Silicone sealant fully de-bonded one side. Vertical scaling in paste along joint crack (8mm)
PRELIMINARY CONCLUSIONS

- Intact Joint Sealant = No distress ~ joint sealant preparation is critical
- Post w/cm cores exhibit less distress and thinner zones of ettringite-filled entrained-sized air voids ~ benefit of reduced permeability
FUTURE WORK

- Core the remaining projects in the Metro and SW Minnesota and test.
- Research and conclude on the effects of deicer types.
- Further research and conclude on joint sealant use/condition vs. concrete joint condition.
FUTURE WORK – JOINT SEALANT TEST SECTIONS

- Install DS Brown Delastic Preformed Pavement Compression Sealant
  - TH 23 in Rock County
    - E-347 3/8” wide sealant – ¼” wide joint
    - Manufacturer recommends doing an initial sawcut and then widening
  - MnROAD
    - E-347 ~ 3/8” wide sealants – 1/4” joint opening
    - E-313 ~ 1/4” wide sealant – 3/16” joint opening
    - Possibly seal unsealed joint with a silane type material as Wisconsin DOT is currently doing