Forensic Evaluation of Cracking in Panels Adjacent to Panel Replacements on Interstate 5 in WA State

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Outline

• Project background
• Panel replacement construction
• Pavement performance
• Distress investigation
• Summary and recommendations
Project Background

- Originally constructed in 1961
- 9” PCCP over 7” aggregate base
- Current Traffic Info
  - 64,000 ADT
  - 9% trucks
  - Annual design ESALs ~ 17 million
Project Background

• No major rehabilitation until 2003
• Pre rehabilitation conditions
  – Panel cracking
  – Faulting ½ to ¾ inch
• Major rehabilitation work
  – Dowel bar retrofit (~12,000 dowel bars)
  – Panel replacement (~ 20 panels per ln-mi)
  – Diamond grinding
Project Background

• Project duration
  – Began April 2003
  – Completed October 2003

• Panel replacements conducted during three or five day continuous (daytime) lane closures
Panel Replacement Construction
Panel Replacement Construction
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Panel Replacement Construction
Panel Replacement Construction
Construction Challenges

• Spalling and cracking of existing concrete during dowel bar drilling
• Contractor needed repeat reminders to properly set the grade
• New concrete mix placed too high
• Inconsistent concrete mix
Pavement Performance

• Mid November 2003
  – Presence of severe panel cracking in original concrete panels adjacent to panel replacements
  – Within 5 months, maintenance made emergency repairs to 6 panels
Distress Identification

• Inadequate application of bond breaker
Distress Identification

• Drilling operations
Distress Identification

• Relief cuts were not used
Distress Identification

- Relief cuts were not used
Distress Identification

- Construction equipment
Distress Identification

• MIT Scan results

<table>
<thead>
<tr>
<th>Specification</th>
<th>Percent Exceeding Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal (&gt; ½ inch)</td>
<td>39.0</td>
</tr>
<tr>
<td>Vertical (&gt; ½ inch)</td>
<td>16.0</td>
</tr>
<tr>
<td>Side Shift (&gt; 1 inch)</td>
<td>19.0</td>
</tr>
<tr>
<td>Depth (&gt; 1 inch)</td>
<td>3.7</td>
</tr>
</tbody>
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– At this time, no apparent correlation between misaligned dowel bars and panel distress
Summary/Recommendations

• Possible contributors:
  – Panel demolition/excavation
  – Drilling operations
  – Construction equipment operating on panels supported with weak base or subgrade materials
  – Dowel bar misalignment
Summary/Recommendations

• Panel cracking is most likely due:
  – Use of guillotine pavement breaker
  – Lack of relief cuts

• Excessive forces were transmitted to adjacent panels during the breaking process
Summary/Recommendations

• Drilling Operations
  – Drill into sound concrete

• Panel Excavation Techniques
  – Confirm depth of saw cuts
  – Use full depth relief cuts

• Operation of construction equipment
  – Weak base and/or subgrade, restrict the use of construction equipment on grade
THANK YOU