Project Selection Criteria for Cold In-place Recycling

By
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Objectives of Presentation

- Identify factors to consider in project selection for cold in-place recycling (CIR) projects
- Review the type of field investigations to be conducted
Project Selection Criteria

- Design life
- Funding availability
- Geometric design considerations
- Construction factors
- Traffic control considerations
- Pavement assessment
Other Factors to Consider

- Conservation of natural resources and energy
- Environmental concerns
- Life cycle cost analysis
Design Life

- What is expected from CIR pavement in terms of life?
- CIR can provide 10 to 20 years of service
- Preventive maintenance should be planned for all CIR projects
Funding Availability

- Funds are limited these days
- Agencies are looking for more cost effective treatments
- CIR cost less than the traditional mill and fill operation
Geometric Design Considerations

- What can CIR do?
  - Minor improvements in the cross slope or super elevation
  - Take out some roughness or high spots if there is sufficient thickness

- What CIR cannot do?
  - Improve longitudinal profile deficiencies
  - Improve the strength of the pavement without an overlay
Geometric Features Can Limit CIR

- Tight turns
- Steep grades (>6 %)
- Castings in the pavement
- Cul de sacs – the ends
Construction Factors

- Proper construction procedures and knowledgeable contractors are needed for a successful project.
- Climate or weather can affect the cure time.
- Effective communications between the contractor and agency are essential.
- Need for proper inspection—you get what you inspect!
Traffic Control Considerations

- Traffic control for CIR is similar to a mill and fill operation, with much fewer trucks.
- Mat can be opened to traffic within a few hours or at the end of the day.
- Engineered emulsions allow the mat to be compacted immediately after the paving operation.
Pavement Assessment

- What pavement distress is best suited for CIR?
- What types of pavement structures are best suited for CIR?
- What distresses are not suited for CIR?
### Pavement Factors to Consider

<table>
<thead>
<tr>
<th>Factor</th>
<th>Level</th>
<th>CIR applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride</td>
<td>Poor</td>
<td>Yes</td>
</tr>
<tr>
<td>Rutting</td>
<td>&gt; 3/8 inch</td>
<td>Needs further investigation*</td>
</tr>
<tr>
<td>Cracking</td>
<td>Longitudinal or transverse</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Determine the cause of rutting
<table>
<thead>
<tr>
<th>Factor</th>
<th>Level</th>
<th>CIR applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface condition</td>
<td>Dry or raveled</td>
<td>Yes</td>
</tr>
<tr>
<td>Surface condition</td>
<td>Flushing or Bleeding</td>
<td>Needs further consideration*</td>
</tr>
<tr>
<td>Potholes</td>
<td>Surface only</td>
<td>Yes, unless they are related to subgrade</td>
</tr>
</tbody>
</table>

*If due to excessive oil, may need to add new aggregate*
# Pavement Factors to Consider

<table>
<thead>
<tr>
<th>Factor</th>
<th>Level</th>
<th>CIR applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stripping in mix</td>
<td>Cohesion or adhesion failures</td>
<td>Needs further consideration*</td>
</tr>
<tr>
<td>Skid resistance</td>
<td>Poor</td>
<td>Yes</td>
</tr>
<tr>
<td>Drainage</td>
<td>Poor</td>
<td>Needs further consideration**</td>
</tr>
</tbody>
</table>

* Determine extent and depth of problem, possibly use lime, check mix design  
** Poor drainage has to be improved
Other Factors to Consider

<table>
<thead>
<tr>
<th>Factor</th>
<th>Level</th>
<th>CIR applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of facility</td>
<td>Rural</td>
<td>Yes</td>
</tr>
<tr>
<td>Type of facility</td>
<td>Urban</td>
<td>Yes*</td>
</tr>
<tr>
<td>Snow plow usage</td>
<td>Rural or urban</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*To be discussed more later*
Steps for a CIR Project Evaluation

- Conduct a pavement condition survey
- Determine whether the distress is functional or structural
- Conduct field testing to quantify pavement condition and structure
- Perform laboratory testing
- Establish structural or overlay design
- Perform a LCCA
Conduct a Pavement Condition Survey

- Determine the type and extent of distresses
- Use a standard pavement distress manual (e.g. LTPP StreetSaver, or Caltrans)
- Look for potential drainage related distresses
Determine Whether the Distress is Functional or Structural

- Types of distress
  - Functional - ride, surface cracking, raveling, flushing
  - Structural - fatigue cracking or severe rutting

- Identify if possible the possible causes of the distresses

- CIR is the best solution for functional distresses
Defects and Features to Look For

- **Edge Support**
  - Are shoulders present? If not shoulders, are side slopes to ditches shallow
  - If not to both, problems could occur

- **Pavement Width**
  - If pavement is to be widened, is there sufficient depth or will new materials be added

- **Patches**
  - Patches are an indication of subgrade problems
Field Testing

- For functional distresses
  - Take cores to determine the thickness of the hot mix
  - Pavement thickness should be at least the depth of recycling
  - Intact structural section must support the train. This can be measured using a FWD or DCP
- Looking to identify construction and material variations and deficiencies
<table>
<thead>
<tr>
<th>Testing</th>
<th>Frequency</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement thickness</td>
<td>Every ¼ mile</td>
<td>Feasibility and recycling depth</td>
</tr>
<tr>
<td>Subgrade soil</td>
<td>1 per mile</td>
<td>Structural design</td>
</tr>
<tr>
<td>FWD survey (not always)</td>
<td>Every 300 ft</td>
<td>Determine subgrade strength</td>
</tr>
<tr>
<td>Bulk pavement sampling</td>
<td>Represent project conditions</td>
<td>Determine mix designs</td>
</tr>
</tbody>
</table>
Perform Laboratory Tests

- Base and Subgrade (Sometimes)
  - Gradation
  - Strength or modulus

- Asphalt Pavement (Always)
  - Binder properties
  - Mix gradation
  - Mix design to determine type and amount of added emulsion
Establish Structural or Overlay Design

- Use a standard thickness design procedure
  - AASHTO
  - Caltrans
  - Mechanistic

- Recommended equivalency factors
  - $G_f = 1.7$ vs. $2.0$ to $2.5$ for HMA
  - $a$ value $= 0.3$ vs. $0.42$ for HMA
  - Stiffness-normally less than HMA
Types of Surfaces Used on CIR

- Low volume Roads
  - Chip seals
  - Slurry surfacings
  - Thin HMA overlay

- Medium to high volume roads
  - HMA overlay
  - Open graded or dense graded
<table>
<thead>
<tr>
<th>Traffic index</th>
<th>CIR depth inches</th>
<th>HMA depth, in</th>
<th>Wearing surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 6.5</td>
<td>3</td>
<td>none</td>
<td>Chip seal</td>
</tr>
<tr>
<td>&lt; 7.5</td>
<td>3</td>
<td>2</td>
<td>Chip seal</td>
</tr>
<tr>
<td>&lt; 8.5</td>
<td>3</td>
<td>2.5</td>
<td>Chip seal</td>
</tr>
<tr>
<td>&lt; 9.5</td>
<td>3</td>
<td>2.5</td>
<td>Open graded</td>
</tr>
<tr>
<td>&lt; 10.5</td>
<td>3</td>
<td>3</td>
<td>Open graded</td>
</tr>
</tbody>
</table>
Perform a LCCA

- Recommended to determine most cost effective treatment
- CIR generally offers the lowest LCC
- Other benefits include energy and emissions savings
Things to Consider in Urban Areas

- Mobilizations - keep them to a minimum
- Mix designs - the more variation in the projects, the more the number of mix designs
- Effective widths - the most effective widths of treatment are 12-17 ft
- Effective lengths - In urban areas, about 1.2 to 1.7 miles can be completed in one shift (3 inch depth)
Things to Consider in Urban Areas (Con’t)

- Utilities - need to lower if possible to prevent stops
- Trees - can cause cleanup issues, slow curing, and require trimming
- Petromat or crack seals - slows production rates
- Soft subgrade - not good candidates as the train can punch through
Are These Candidates for CIR?
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Are These Candidates for CIR?
Summary

- Presented factors to consider in selecting projects for CIR
- Identified the steps used for preliminary engineering
- Discussed the need for mix and thickness design
- Identified the importance of having a knowledgeable contractor and inspection
- Benefits of CIR can be very great
Other Sources of Information

- NCHRP Synthesis 421, Transportation Research Board, 2011
- Selection of the Right Project for the Cold In-place Recycling Process, Draft report, ARRA, 2012
Questions

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