Cold In-Place and Cold Central Plant Recycling Project Selection and Best Practices

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Outline

- Selecting the right project for CIR
  - Things to consider when picking the right project for CIR
- General Information and Best Practices
  - New York
  - Kansas
  - Nevada
- Case Study - Utah’s Double Double - US-191
Selecting a project for CIR or CCPR

- CIR Process should be applied at the right time to the right project. Good specifications and an engineered approach are equally important.

Design Criteria to consider

1. Design Life
2. Funding Availability
3. Conservation of Natural resources and Energy
4. Environmental Factors
5. Geometric Design and Construction
6. Traffic Control
7. Project Selection/Investigation
8. Life-cycle Cost Analysis
9. Construction Practices

- 1. Design Life
  - When properly maintained CIR provides between 10 to 20 years of service life.
2. Funding Availability
- CIR usually cost about 30% less than alternative methods providing the same structural section.

3. Conservation of Natural Resources
- Agencies may be required to consider strategies with lower environmental impact.
- CIR offers the ideal sustainable strategy since it utilizes 100% of the existing materials and requires 80% less energy per ton compared to hot mix overlays.
4. Environmental Concerns

- Materials for CR (like any other rehabilitation technique) should be considered for the given environmental conditions such as rain, snow, or freeze-thaw climate.
- Example: The emulsion added to CR should be PG graded to withstand temperature fluctuations and extremes.
- CIR has to be sealed with some type of surface treatment.

5. Geometric Design and Construction Considerations

- The CIR process may provide opportunities for minor improvements in cross slope, and can be used to widen a roadway.
6. Traffic Control
- Similar to what you would have on a mill and fill operation minus the construction truck traffic which is significantly reduced.
- Traffic can usually be turned back on the roadway within a few hours after the process is complete or at the end of the day.

7. Project Selection/Investigation:
- Cold in-place recycling can treat most common pavement distresses depending upon the depth of treatment as shown in the Pavement Conditions Table on the next slide.
### Pavement Conditions

<table>
<thead>
<tr>
<th>Distress</th>
<th>Criteria</th>
<th>CIR Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic</td>
<td>All Levels</td>
<td>Yes</td>
</tr>
<tr>
<td>Ruts</td>
<td>&lt; 3/8&quot;</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>&gt; 3/8&quot;</td>
<td>Needs Further Consideration(a)</td>
</tr>
<tr>
<td>Cracks</td>
<td>Fatigue Longitudinal Transverse</td>
<td>Needs Further Consideration(b)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Surface</td>
<td>Dry Flushing Bleeding Variable</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Raveling</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Potholes</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Stripping</td>
<td></td>
<td>Needs Further Consideration(c)</td>
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<tr>
<td>Texture</td>
<td>Rough</td>
<td>Yes</td>
</tr>
<tr>
<td>Ride</td>
<td>Poor</td>
<td>Yes</td>
</tr>
<tr>
<td>Drainage</td>
<td>Poor</td>
<td>No(d)</td>
</tr>
<tr>
<td>Snow Plow Use</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Low Skid Resistance</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Rural</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Urban</td>
<td></td>
<td>Needs Further Consideration(e)</td>
</tr>
<tr>
<td>Low life Cycle Cost</td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

- a) If rutting is greater than 3/8 inch determine the cause of the rutting
- b) Ensure that structural requirements can be met. CIR in conjunction with HMA overlay may be needed
- c) Determine severity and depth of existing layers that are affected. Consider additive such as lime in the CIR to mitigate the issues. CIR mixture design verification and overall structural enhancement will be critical
- d) Poor drainage has to be improved for CIR to perform adequately (possible FDR with CCPR Candidate)
- e) Geometrical constraints to be considered based on the type of recycling units used

#### 7. Project Selection/Investigation Continued:
- The following steps are recommended for CIR project evaluation.
  - **Step 1.** Conduct an In-Depth Pavement Distress Identification or Condition Survey
  - **Step 2.** Determine Whether the Cause of Pavement Distress is Functional or Structural
  - **Step 3.** Conduct Field-Testing to Validate and Quantify Field Condition Observations
  - **Step 4.** Laboratory Testing
Aging Asphalt Surface

DISTRESS DIAGNOSIS AND CAUSE:
Surface may appear dry, generally in good condition, and is several years old. It shows minimal distress but has been subject to wear and tear. The underlying structure is in good condition.

Fatigue Cracking (Alligator)

DISTRESS DIAGNOSIS AND CAUSE:
Surface has interconnected cracks that resemble Alligator skin. Fatigue cracking can be greatly influenced by environmental and other effects while traffic loading remains the direct cause where underlying structure is insufficient. Poor drainage in the road base is a frequent cause of this degradation of the base or subgrade.
**Longitudinal & Thermal Cracking**

DISTRESS DIAGNOSIS AND CAUSE:
Cracks run along and across traffic in the roadway. Common causes would be poor joints during paving or expansion and contraction of the asphalt mat due to temperature changes. In some cases, unstable base could be a factor.

**Potholes and Patches**

DISTRESS DIAGNOSIS AND CAUSE:
Potholes are large holes in the roadway that has deteriorated into the base. They are common on roadways that have poor drainage where water has settled into a crack and froze causing the asphalt to dislodge and create a pothole.
**Bleeding and Flushing**

DISTRESS DIAGNOSIS AND CAUSE:

A shiny black surface with a lack of aggregate would be a good indicator of bleeding. It is caused by the liquid asphalt migrating to the surface of the pavement. The result could lead to a loss of surface texture and slippery roadways.

**Raveling & Stripping**

DISTRESS DIAGNOSIS AND CAUSE:

Loose aggregate on the surface of the pavement is a good sign of raveling. It is common for this to happen in areas that the binder is unable to hold aggregate together, or where the roadway was not compacted properly. Poor drainage could also be a cause.
Rutting
DISTRESS DIAGNOSIS AND CAUSE:
Rutting is a permanent deformation in the pavement typically the surface is indented in the wheel path. Common causes are unsuitable base structure, heavy trucks, and moisture damage.

8. Life-Cycle Cost Analysis (LCCA)
• Typically CIR offers the lowest life-cycle cost as compared to other alternatives for projects that exhibit medium to high severity non load related cracking.
9. Construction Practices

- Proper construction, and knowledgable contractors are vital.
- Agencies should reach out to industry and obtain their input and recommendation before the project is advertised to gain knowledge on applicable new technologies and constructability of the desired project. Effective communications, coordination, follow up on project performance and documenting lessons learned after completion of each project are key factors for agencies building a successful CIR program.

General Information and Best Practices for CIR

- New York
  - General Information
  - Best Practices
- Kansas
  - General Information
  - Best Practices
- Nevada
  - General Information
  - Best Practices
General Information on CIR in New York

- CIR (4") with a 1 ½" overlay is expected to last 10-15 yrs with little maintenance as compare to a 5-8 year life with a 1 ½" traditional overlay.
- The CIR effort would have not been successful without the strong support from the NYSDOT central office for specification development, information dissemination, and training.
- Contractors that specialize in CIR have a large capital equipment investment and recognize the importance of high quality workmanship.
- CIR methods attract only high quality contractors because of the cost of equipment and unacceptable cost of failure with strong commitment to quality and performance.

Best Practices of CIR in New York

- NYSDOT has developed construction/inspection standards that clearly identify the responsibilities of the owner and the contractor.
- NYSDOT requires pre-construction meeting at least one week prior to paving including the CIR crew supervisor. This is followed up with a pre-pavement meeting on the first day of the CIR operation with the entire crew and the inspection team.
- NYSDOT develops a mix design using the average gradation and asphalt content, by ignition, from 6" diameter roadway cores cut to the depth of the proposed recycling (3 or 4 inches). The agency determines the percent “add stone” (maximum 20%) and either the agency or contractor establishes the project emulsion content (minimum 3%) depending on the type of contract. The contractor is permitted up to 110% of the emulsion bid quantity.
General Information on CIR in Kansas

- Use of CIR in Kansas has improved the pavement smoothness condition significantly to rank them in the top five in the nation for overall ride smoothness.
- Kansas has a well-documented Bid Tab system Pavement Management System (PMS) to track project details since October of 1992 to date. It indicates that over 6000 lane miles have been cold in-place recycled thus exhibiting a high degree of confidence in performance of the process.
- CIR is about 45% less cost than a 4" HMA overlay.
- KDOT takes numerous 20-40 core samples per project, DCP subgrade test of the cores, holes are also done at this time, and gives them to SemMaterials, which in turn provides the project mix design, construction field field adjustments, and provides technical guidance.

Best Practices of CIR in Kansas

- Proper project selection with the use of dynamic cone penetrometer (DCP) has resulted in a better assurance that cold in-place equipment/process can be used.
- Using engineered emulsion with lime slurry is an improvement for overall performance; the lime slurry is providing early strength and anti-stripping, while the emulsion is providing a good bond for the material.
- KDOT relationship between emulsion supplier, and CIR construction industry has fostered a very cooperative partnership to advance the CIR initiative. Annual meetings with all involved to review specifications and prior construction year issues has aided in improvements in the overall program. 20+ years of partnership.
General Information on CIR in Nevada

- NDOT has used CIR successfully for over 20 years. The use of CIR and Full Depth Reclamation (FDR) instead of conventional reconstruction strategies has allowed NDOT to save over $600 million dollars while providing longer lasting pavements. NDOT has improved their systems’ pavement condition significantly without spending more money, minimizing traffic interruptions during construction, and preserving natural resources.

- NDOT has effectively Cold In-place Recycled 770 centerline miles or 11% of its system since 1997.

- Utilizing this process has allowed NDOT to implement strategies that are more cost effective than overlay, mill and overlay, or reconstruction. NDOT has documented $600 million in savings, over the last 20 years, utilizing CIR and FDR as rehabilitation strategies as selected by this process.

Best Practices of CIR in Nevada

- NDOT considers CIR material as an “asphalt treated base” rather than hot mix, and treats it as such.

- NDOT has end-product specifications that allow the contractor to do field quality control and adjust the mix emulsion content. CIR contractors are specialist and know what is needed to provide a quality product. NDOT requires the contractor to overlay the cold in-place layer after a minimum of 10 and maximum of 45 days curing. If problems exist, they usually appear within 24-48 hours after the CIR mat is opened to traffic.

- Equipment calibration prior to production on each project ensures proper application rates of materials, i.e. emulsion, lime, and aggregate weight pulled off the belt scale.
The Double/Double on US 191

Project: US-191; MP 12.5 to MP 21 aka The Cracks
Problem: US-191; MP 12.5 to MP 21 aka The Cracks

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**Problem:** US-191; MP 12.5 to MP 21 aka The Cracks

![Image of road cracks and measurements]

**Problem:** US-191; MP 12.5 to MP 21 aka The Cracks

![Image of dollar signs]
What to do with this section?
- The state started discussions with various manufacturers on solutions.
- Needed to be able to bridge these cracks with as much material as possible
- UDOT started thinking about success with CIR Projects
- UDOT talked with industry professionals about the ability to go 6" deep with CIR.
- Discussion of Central Plant Recycle (CPR)
- Received "Buy In" from Region Senior Leadership
- Started the process of designing UDOT's first Double/Double
- CIR/CPR Specification

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Initial Pavement Strategy
Advertisement, Bid, & Construction

- Advertised: September 16, 2010
- Bid Open Date: October 19, 2010
- Awarded to Aggregate Industries (Frehner Construction)
  - Chose Coughlin Company to do the CIR Operation
- Bid 69 Calendar Days
- Construction began April 12, 2011

Construction:
Construction:

Construction:
Construction:

Finished Product
Construction:

1.5 Years Later

2.5 Years Later
### Results

- **Project Completed in 54 Calendar Days**
- **Total Project Funds Expended:** $3.6 M
  - ($5.2 M in HMA alone if bid as a Mill/Fill)
- **Distress Improvements**
  
<table>
<thead>
<tr>
<th>Year</th>
<th>RIDE</th>
<th>Env Crack</th>
<th>RUT</th>
<th>OCI</th>
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<tbody>
<tr>
<td>2013</td>
<td>80.92</td>
<td>95.1</td>
<td>74.68</td>
<td>88.0</td>
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<tr>
<td>2011</td>
<td>83.19</td>
<td>95.41</td>
<td>74.97</td>
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<tr>
<td>2010</td>
<td>46</td>
<td>56.2</td>
<td>70.3</td>
<td>65.3</td>
</tr>
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- **Heavy Truck Traffic Is Increasing**
Questions?

Thanks for your Participation

Please complete the evaluation to provide your feedback on this session and suggest topics for future events.

Remember to mark these upcoming events on your calendar!

March 7-11, 2017
www.conexpoconagg.com
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