Outline

■ What is CIR?
  - Equipment
  - CIR Candidates
  - Project Selection Considerations

■ INDOT CIR Experience – US 40
  - Project Development
  - Pretreatment Conditions
  - Project Summary
  - Lessons Learned
  - Moving Forward
What is CIR?

- Rehabilitation Method
- 3” – 5” of existing HMA is recycled
- Material is...
  - Milled and crushed
  - Blended with recycling agents
  - Paver Laid
  - Compacted
CIR Train
CIR Equipment – Single Unit
CIR Equipment – Single Unit w/ Screed
CIR Equipment - Multi Unit

Source: Roadtec
Paver Laid Material
Rollers
Why Cold In-Place Recycling?

- Reuse non-renewable natural resources
- Energy Conservation
- Reduction in User Delays
- Mitigation or Elimination of Cracking
- Improved Roadway Performance
- Cost Savings
  - Compared to Multiple Lift Mill and Fill Projects
CIR Candidates

- Ideal to Address
  - Raveling
  - Reflective Cracking
  - Edge and Block Cracking
  - Potholes
  - Top Down Cracking
  - Stripping in Localized Layers
CIR Candidates
CIR Candidates
CIR Candidates
CIR Candidates
How Does CIR Work?

- Project Selection Guidelines
- Performance Based Mix Designs
- Quality Control Guidelines
CIR Project Selection Guidelines

- CIR Requires Surface Course
- Optimal Construction Season
- Adequate Structural Capacity
  - ~75% Design Strength of HMA
- Project Logistics
  - Utilities
  - Manholes
  - Curb and Gutter
CIR Project Selection Guidelines

- Issues to Avoid or of Concern
  - *Widespread Subgrade Failures*
    - CIR will not bridge poor subgrades
    - Localized areas can be repaired then processed
    - Need strong base for compaction
  - *Poor Drainage*
    - CIR needs adequate drainage to perform as designed
  - *Rutting*
    - Shear rutting in existing HMA
    - Need additional aggregate to develop internal strength
  - *Insufficient Structure*
    - Need adequate materials for process
    - Can add aggregate into CIR to increase structure
CIR Mix Design

- Obtain Cores from Project
- Crush Material
- Recombine to Expected Gradations
- Test at Multiple Emulsion Contents
Recycling Mix Design Parameters

- Which parameters do we investigate for good performance?
  - Stability
    - Resistance to rutting
  - Adhesion
    - Resistance to water damage
  - Strength Development
    - Rate of Development
What is Asphalt Emulsion?

- Combination of:
  - Asphalt
  - Water
  - Surfactants
- Delivered and mixed at low temperatures
  - “Cold” Process
  - Workability
- Chemical Break
  - Formulated to release water
  - Gains strength upon break
  - Curing
CIR Quality Control

- Quality Control is Crucial to Successful Projects!
  - Density, Density and Density
  - Material Yields
    - Is the correct amount of asphalt going in mixture
  - In-place Gradations
    - Adjust emulsion rate based on gradation
  - Curing Conditions
    - Need to not trap moisture during surfacing
Where are we today?

- US 40 CIR Project
  - Project Recap
  - What have we learned
  - Moving forward
INDOT CIR EXPERIENCE – US 40

- US 40
- West National Rd
  - 9th St West Terre Haute
  - I-70 Ramps
- 4 Lane Divided Hwy
- New Bridges
- Transfer to Vigo County
INDOT CIR Experience – US 40

- **US 40 CIR**
  - Composite Pavement
  - ~4 inches HMA
  - Alternate Bid Project
  - Mill and Fill vs CIR and HMA overlay
INDOT CIR Experience – US 40

- **Estimated 350K less than mill and fill option**
- **CIR bid cost:** $8.25/ sq. yd.
  - 4 inch CIR
  - 1.2 gal/sq. yd.
- **CIR area:** 97,404 sq. yd.
- 165 lbs./ sq.yd.
- 9.5 mm HMA Surface
US 40 – Preconstruction Conditions
US 40 – Preconstruction Conditions

- Aged surface
- Minor rutting
- Heavy patching due to stripped HMA layer
- Chip Seal in Rural Section
INDOT CIR Experience - US 40

- Stripping in lowest lift of HMA
INDOT CIR Experience – US 40

CIR Core with Overlay vs. Existing Pavement
INDOT CIR Experience – US 40

■ Timeline
  - **Original CIR started on September 19, 2014**
  - **West Bound Lanes and In-town Section Completed October 2014**
    ■ Portion of section had to be reprocessed
  - **Eastbound Lanes completed August 2015**
  - **Reprocessed Lane completed August 2015**
INDOT CIR Experience – US 40

Compacting WB CIR 2014
INDOT CIR Experience – US 40

Completed CIR Mat WB Driving Lane 2014
INDOT CIR Experience – US 40

- 2014 Challenges on US 40
  - Equipment Issues
    - CIR machine was down for several working days
    - Meter on CIR machine failed
      - Resulted in under asphalted section to be reprocessed
      - Stabilizer needs to be a separate pay item
  - Late Season Weather
    - Equipment delays pushed project into less than ideal recycling climate
    - Excessive Rain
      - Resulted in wet subgrade and failures in shoulders
      - Repair areas that could not set up before heavy rainfall
INDOT CIR Experience – US 40

- Shoulders consisted of 4 in. HMA on subgrade
- Fall 2014 processing multiple shoulder failures
- Summer 2015 one shoulder failure
  - _Low, shaded area along outside shoulder_
INDOT CIR Experience – US 40

Reprocessing 2014 Low Emulsion Area
Processed Lane versus Existing US 40
INDOT CIR Experience – US 40

March 2015 WB Ramp to I70
INDOT CIR Experience – US 40

December 2015 WB Lanes
INDOT CIR Experience – US 40

- Lessons Learned
  - Timing of the CIR process
  - Importance of Quality Control
  - Need to refine Specifications
    - Smoothness for CIR different than HMA
    - Should we include profile milling with single lift overlays?
    - Desired cross slope
  - How to address shoulders
    - Subgrade failures in the shoulders
CIR Moving Forward

- Specification Development
  - Collaborative Effort between INDOT & Industry
  - Similar to FDR Specification Development
Thank you!

- Questions and Comments