Cold In-place Recycling (CIR) and Full Depth Reclamation (FDR)

What it is and What it Does

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CIR on the Pavement Life Curve. Use Asphalt Recycling for Preservation

- Preservation
- Rehabilitation
CIR Preservation or Minor Rehabilitation

Recycle AC to:
- Stable Base
- Within 1” of less Supportive Material

Recycled AC

6” Stable Base

Native Soil

>1”
Cold In-place Recycling (CIR)

Distressed Pavement = New Pavement Using A Train of Equipment that:

- Mills deteriorated pavement
  - Reclaimed asphalt pavement (RAP)
- Crushes RAP to gradation
- Mixes with recycling agent
- Re-Paves recycled mix
- Compacts to specified density
- Readies for surface treatment
Cold In-place Recycling (CIR) Repairs Deteriorated Pavement 2” to 4”
CIR Crushing and Sizing Train (Some Variations But Same Concept)
Recycling Plant Meets Caltrans Calibration Requirements

- Crusher
- Screen Deck
- New Mix
- Mass Flow Meter
- Pug Mill
Pavement Milled

- **Main Mill**
  - Self-propelled
  - Minimum 12.5 ft cutter
  - Automatic depth controls to maintain the depth
  - Control cross slope

- **Supplemental Mill**
  - Put millings in front of main mill to pickup and process
  - Shoulders and misc. areas
Cracking Pattern Disrupted

70% Rule for Mitigation of Reflective Cracking
Crushing and Sizing Equipment, 100% Closed Circuit System.

Crushing and sizing equipment capable of reducing RAP to the 100% passing 1-inch sieve prior to mixing.
New Recycled Mix Windrowed
Pick Up and Paved

Paver with minimum power of 170 Hp
Laydown and Rolling

- Compacting Equipment
  - Minimum 1 pneumatic-tired roller at least 25 tons
  - At least 2 double drum vibratory steel-wheeled rollers at least 10 tons
  - Minimum width at least 66-inches.
  - All rollers must have working water spray systems.
Quick Opening to Traffic

- Rolling is completed
- Some cure time
- Fog-seal and sand blotter are applied
Cured 2 to 3 Days Down to 2.0% Residual Moisture and then Rerolled Prior to Surfacing
Because of Higher Void Ratio’s Surfaces Must Be Sealed

Fog Sealed or Slurry Sealed
Low volume – Shoulders and Lots

Chip Sealed – Low Volume Highways
HMA Overlaid – Higher Volume Highways and Most Residential
100% Recycled Asphalt
Eucalyptus Avenue  Moreno Valley, July 2009
Project Profile; Moreno Valley, July 2009
“Energy and Cost Savings”

- 8,744 tons of asphalt removed and repaved.
- 840 fewer trucks used utilizing CIR, compared to a mill and fill operation.
- 1,649 fewer barrels of oil used.
- 79.6% fewer carbon emissions utilizing CIR compared to mill and fill operation.
- Cost savings to the City $262,320.00.
- Cut 30% off the project schedule.
Clean Rap = New Pavement:

- Stockpiled and kept clean
- Crushed RAP to gradation
- Mixed with recycling emulsion
  - In central plant
- Transported to lay down area
- Paved as a recycled mix
- Compacted to specified density
- Readied for surface treatment
City of Santa Ana Project “Restore”
2009/2010
Milling Existing Asphalt/Sweeping
RAP Loaded, Crushed, Processed
New Recycled Asphalt
Swept and Tacked Prior to Install
What to Asphalt Recycle

Thermal Cracking

Fatigue Cracking

Dry, Raveled

Poor Rideability

Patched
Where to Use In-Place Recycling

- Anywhere mill and fill is considered
- Adequate existing pavement thickness
  - CIR typically 2 to 4 inches in thickness.
  - Thick enough to take to stable base or leave 1” of existing pavement over native soils.
- Will handle all cracking distress provided not base related
- Surface maintenance is no longer effective
- To repair raveling & potholes
- Where safety is a concern
- When life cycle costs dictate
- No limitation to traffic/ADT
- Able to accommodate train
Pavements Not To Be Recycled

Poor Drainage

Paving fabric makes it messy!

Poor Base

Avoid unstable subgrade or base problems!
Removing Paving Fabric
Full Depth Reclamation (FDR)

- Mechanical Stabilization (Pulverization)
- Bituminous Stabilization
- Chemical Stabilization
FDR on the Pavement Life Curve. Use Full Depth Reclamation for Rehabilitation.

- Preservation
- Rehabilitation
Full Depth Reclamation

Improves existing materials in-place to provide greater structural support and reduction of imported material.
Full Depth Reclamation Construction Sequence

Asphalt Base
Sub-base

Existing road

Pulverized
Sub-base

Pulverization to design depth

Pulverized
Sub-base

Removal of excess material (if necessary) and shaping

Stabilized
Sub-base

Addition of reagents, mixing & compacting

Stabilized
Sub-base

Surfacing

Final surface treatment
Mechanical Stabilization (Pulverization)

AC and underlying materials are pulverized and mixed to provide a homogenous base material.
Add Additives = Stabilized Base

Chemical Stabilization
• Portland Cement
• Lime

Bituminous Stabilization
• Asphalt Emulsion
• Foamed Asphalt
Bituminous Stabilization

Asphalt Emulsion or Foamed Asphalt

Generally for stabilization of blended material with 8 to 20 percent fines.

Increases long term strength and pavement support characteristics, while remaining flexible and wear resistant. (Caltrans Gravel Factor = 1.5 to 1.7)

Does not crack within itself (shrinkage cracking). Immediate traffic.

Can add RAP, Aggregate Base, Cement or Lime to enhance gradations or change underlying soil plasticity characteristics.
Bitumen or Emulsion Introduced at Mixer
Project Profile; Cecil Avenue Delano, CA
FDR with Asphalt Emulsion Traffic Index - 9
Pulverization
Reclaimer adding 4% Engineered Emulsion
Compaction and Final Grading

No Disruption in Business
Delano Project

Before

After
City of Delano Benefits with FDR

- Construction time reduced from 33 shifts to 11 shifts.
- Cost savings of 35% to City of Delano.
- Higher structural value for base section that will accommodate an increase in T.I. in future.
- 1,675 truck loads of export/import eliminated along with the associated emissions, wear and tear on city streets and traffic congestion.
- Reduced Disruption to local business and schools.
Chemical Stabilization
Portland Cement or Quicklime (CaO)

Cement is the most economical way to gain substantial increases in strength and wear resistance, but more rigid behavior. (Caltrans Gravel Factor = 1.4 to 1.8)

Lime is used to increase the performance when soils have plastic and expansive properties. (Caltrans Gravel Factor = 1.2 to 1.3)

Curing period typically 3 to 4 days, traffic is allowed if surface is compacted and un-yielding.

May require a stress relief course to prevent new reflective cracking or utilize micro-cracking.
Project Profile; City of Oxnard
FDR Strategy
Using Type II Portland Cement
Pavement Pulverized
Spreading Portland Type II Cement
Initial Mixing
Secondary Mixing
(adding water)
Open to Local Traffic During Construction
Questions?

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