Using Cement to Reclaim Asphalt Pavements

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What is Cement Stabilization?

- Mixture of portland cement, soil/aggregate and water
- Pulverized, mixed, compacted to high density
Cement-Based Pavement Materials

- Roller-Compacted Concrete
- Conventional Concrete
- Soil-Cement
- Flowable Fill
- Cement-Modified Soil
- Full-Depth Reclamation
- Cement-Treated Base
- No Wearing Course
- Wearing Course
- Cast
- Rolled
Full-Depth Reclamation (FDR)

- Pulverization and recycling of asphalt and base
- Utilizes existing materials
- Fast and convenient
- Eliminates new base
- Environmentally friendly
Pavement Distress

Alligator Cracking

Base Failure
Pavement Distress

Excessive Patching
Advantages of FDR

- Use of in-situ materials
- Little or no material hauled off and dumped
- Conserves virgin material
- Saves cost by using in-place “investment”
- Saves energy by reducing mining, hauls
<table>
<thead>
<tr>
<th>Benefits</th>
<th>Full Depth Reclamation</th>
<th>Mill &amp; Fill</th>
<th>Overlay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Course</td>
<td>6–10” FDR</td>
<td>1.5” Mill &amp; Fill</td>
<td>1.5” Overlay</td>
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<tr>
<td></td>
<td></td>
<td>HMA</td>
<td>HMA</td>
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<tr>
<td></td>
<td>Base/Sub-base</td>
<td>Base/Sub-base</td>
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<tr>
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<td>Subgrade</td>
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<td>Subgrade</td>
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</tbody>
</table>
Conventional Build Up Granular Structure

- 24 ft
- 3:1 or 4:1 Side Slope
- Subgrade
- 3 to 4xh
- Asphalt Surfacing
- Granular (h)

Existing Thin Paved Structure

- 24 ft
- Subgrade
- Asphalt Surfacing

Full-Depth Recycled Structure

- 24 ft
- Subgrade
- Asphalt Surfacing
- Stabilized Base
Cement Stabilization History

- 70 years of successful pavements
- Diverse geographic areas (Texas, Florida, California, Montana, Michigan, Canada)
- Wide variety of soil types
  - Gravels
  - Sands
  - Silts
  - Clays
“Portland Cement is probably the closest thing we have to a universal stabilizer.”

Increased Rigidity Spreads Loads

Unstabilized Granular Base

Cement-Stabilized Base

100 psi

15 psi

4 psi
Rutting can occur in surface, base and subgrade of unstabilized bases due to repeated wheel loading.

Cement-stabilized bases resist consolidation and movement, thus virtually eliminating rutting in all layers but the asphalt surface.
Reduced Moisture Susceptibility

Moisture infiltrates base
- Through high water table
- Capillary action
- Causing softening, lower strength, and reduced modulus

Cement stabilization:
- Reduces permeability
- Helps keep moisture out
- Maintains high level of strength and stiffness even when saturated
Reduced Fatigue Cracking

High deflection due to low base stiffness
Results in high surface strains and eventual fatigue cracking

Unstabilized Base

Cement-Stabilized Base

Higher stiffness of cement-stabilized base produces lower deflections
Resulting in lower surface strains and longer pavement life
FDR Engineering

- Evaluation of existing materials
- Design of stabilized mix
- Thickness design
- Construction procedures
- Quality control
Moisture/Density Relationship

Moisture Content vs. Dry Density (lb/cf)

- Maximum Dry Density
- Optimum Moisture Content

ASTM D558
Unconfined Compressive Strength
## Typical Recycled Base and Surface Thickness

<table>
<thead>
<tr>
<th>Road Function</th>
<th>Typical Thickness</th>
<th>Recommended Surface</th>
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<tbody>
<tr>
<td>Residential</td>
<td>5 in</td>
<td>0.75 – 1.5 in</td>
</tr>
<tr>
<td>Secondary</td>
<td>8 in</td>
<td>1.5 – 2.5 in</td>
</tr>
<tr>
<td>Highway</td>
<td>10 in</td>
<td>2 – 3+ in</td>
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</table>
Recycling Process

- Simple process
  - Cement Spreader
  - Motor Grader
  - Pulverizer/reclaimer
  - Water truck
  - Roller/compactor
- Fast
Pulverization

- Pulverize mat to appropriate gradation
- Typically 1-2 passes
Inside a Reclaimer

- Deep recycled layer
- Injection of water and/or fluid stabilizing agents
- Operating direction
- Milling drum
- Distressed pavement
- Granular material
Aggregate Adjustment
Cement Spreading

- Cement is spread on top in measured amount
Blending and Moisture Addition

- Cement is blended into pulverized, recycled material
- Water is added to optimum moisture
Grading

- Material is graded
- Excess removed
Excellent Time for Widening!!

Example:
Montgomery County, NY
Compaction

- Material is compacted
- 95% Proctor density minimum
Curing

Prime Coat

Water
Surfacing

- Surface course applied
  - Chip seal
  - Asphalt
  - Concrete