Full Depth Reclamation with Cement

Presented for:

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Full Depth Reclamation (FDR)

A process that rebuilds *worn out* asphalt pavements by recycling the existing roadway and preserving the original roadway investment.

The old road is 100% Recyclable depending upon grade and new pavement section.

No need to haul off 100% of the old failed roadway to the landfill - creates less waste.

This process saves $$$ and builds long lasting roads.
Full Depth Reclamation (FDR) After
Full Depth Reclamation (FDR) After
FDR is most appropriate under the following conditions:

■ The pavement is seriously damaged and cannot be rehabilitated with simple resurfacing.

■ The existing pavement distress indicates that the problem likely exists in the base or subgrade.

■ The pavement structure is inadequate for the current or future traffic.

■ The existing pavement distress requires full-depth patching or undercutting on more than 20% of the surface area.
INDOT has Specs for Full Depth Reclamation
Actual Core Samples of FDR with Cement Slurry

Cement is The Key Ingredient
FDR – Keys to Success

- Design
- Scarification and Pulverization
- Water Addition if necessary
- Spreading Chemical
- Mixing
- Grading
- Compaction
- Curing
- Install New Pavement Surface
Site Investigation

- The site should be investigated to determine the cause of the original failure.

- Cores or test pits should be conducted to determine the existing layer thicknesses and to gather samples of all the materials to be recycled.
Lab Evaluation

- The Cores can be pulverized to simulate on-site construction pulverization

- The millings, aggregate, and soil mix is combined with the varying percentages of cement and tested to determine the maximum dry density and optimum moisture
Lab Evaluation

Moisture Density Relationship with 5% “Soil-Crete” Added

- Dry Density (pcf)
  - 110
  - 109
  - 108
  - 107

- Moisture (%)
  - 14
  - 15
  - 16
  - 17
  - 18
  - 19
  - 20
  - 21
  - 22
The mixture compacted to 95% and molded into test samples which are cured and tested for strength.

A minimum unconfined compressive strength is required by INDOT.
Thickness and Application Rate

Data from lab testing and traffic loading is used in design.

MEPDG design software can be used to determine thickness and strength needed.
Pavement Thickness

- **Asphalt Surface**: 1.5"
- **Asphalt Binder**: 2.5"
- **Asphalt Base**: 3.0"
- **Compacted Soil**: 3.0"

Total Thickness: 7.0"

**Company Logo**: Sagamore Ready Mix
Pavement Thickness Comparison

Reconstruct

<table>
<thead>
<tr>
<th>Layer</th>
<th>Thickness</th>
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<tbody>
<tr>
<td>Asphalt Surface</td>
<td>1.5”</td>
</tr>
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FDR increased the Structural Design by over 40% at a cost reduction of $4.45 / SYD

FDR

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<td>Asphalt Base</td>
<td>3.0”</td>
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<tr>
<td>FDR with Cement Slurry</td>
<td>10”</td>
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14.5”
Milling

May be needed if grade cannot be raised
Pulverization
Scarification and Pulverization

- Can be done with Milling
- Usually 6 to 10” depth
- Multiple passes may be needed
- 100% passing the 2 inch sieve
- 55% passing the #4
Corrective Aggregate

SAGAMORE READY MIX
Moisture Control

- Water addition may or may not be necessary depending on the nature of the existing soils.
- Best if applied after scarification and before Slurry.
Application of the Cement
Dry Method
Dry Cement Spreading
Cement Slurry Placement

Slurry is spread in a measured amount on the surface
Dust can be DANGEROUS!
Slurry is CLEANER and SAFER

100% DUST FREE!

INDOT approved for soil stabilization, modification and FDR

SAGAMORE READY MIX
I-65 / I-70 South Split Hyperfix
August 13, 2012

To: Mr. Gary Pence, P.E.,
INDOT Office of Project Management

Subject: US 31 Geotechnical Report - Subgrade Treatment Recommendation Addendum
Contract # IR-34750
Des 1296427/0710215; US 31 Parts 1Thru Part 8
Hamilton County

Gentlemen,

The subgrade treatment recommendation for the subject contract parts is Type IA. All chemical soil modification shall be conducted with Portland cement slurry.

This geotechnical report final addendum supersedes all other geotechnical technical memoranda, geotechnical reports, and geotechnical report addendums except where the subgrade treatment acts as a drainage layer as recommended in the geotechnical report and except for the ramps where Type 1 subgrade treatment is recommended. The areas of exception are as follows:

- Part 3: Line "PR-K2", Station 429+00 +/- to Station 451+00 +/
- Part 8: Line "PRS-9-NN", Station 31+75 +/- "PRS-8-NN" to Station 37+25+/
- US 31 and I 465 Interchange Ramps
- US 31 and 151st Interchange Ramps

If you have any questions, please contact this office.

Sincerely,

Mir Zaheer, P.E.
Geotechnical Design Engineer

MZ/YB

c: Mr. Nayyar Siddiki
Mr. Chad Nerman
Parsons Brinkerhoff – Attn: Ms. Liza Dwyre
RW Armstrong – Attn: Mr. Jason Rowley
Mr. Mike Prather
Ms. Lisa Egler
File

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Q: Fri 2/20/2015 8:41 AM
There are no provisions in the plans or specifications for the restoration of Garfield Street (Line C storm sewer outfall). Will this work be paid for? If not, can a detail be furnished showing a pavement replacement section?

A: Fri 2/20/2015 12:00 PM
This will be paid for. The pavement will only be replaced in the open cut area required to install the storm sewer.
The pavement section will be: 165 lb/yd2 HMA Surface Type B on
385 lb/yd2 HMA Intermediate Type B on
5” of Compacted Aggregate Base, No. 52 on
Subgrade Treatment Type IB with a cement slurry only

A revision to the pay items is forthcoming.
SUBGRADE TREATMENT, TYPE IB, CEMENT MODIFICATION

The Standard Specifications are revised as follows:

SECTION 207, DELETE LINE 87, INSERT AS FOLLOWS:
  Type IB. 14 in. (350 mm) Portland Cement, Type I soil modification.

SECTION 207, AFTER LINE 164, INSERT AS FOLLOWS:
  Subgrade Treatment, Type IB, Cement Modification..................SYS

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CHEMICAL MODIFICATION OF SOILS

The Standard Specifications are revised as follows:

SECTION 215, BEGIN LINE 18, DELETE AND INSERT AS FOLLOWS:

Quicklime or Portland cement may **shall** be used dry or as a slurry.

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SLURRY is DUST FREE!

- Business Friendly
Benefits of Cement Slurry

- Dust Free
- No Swell – Only Grade Change is Material Addition
- INDOT Approved
- 100% Hydration of all Cement Particles
- Cost Competitive to Dry Placement
- Less Mobilization Costs
- Ability to add Retarder
Mixing Cement with Reclaimed Road
Initial Compaction

- Compaction should begin within 30 minutes of mixing the Cement.
- A vibratory pad-foot roller is used initially.
Density Tests

- Moisture and density can be monitored to achieve 95 to 98% of Standard Proctor
Grading

- This step could involve additional earthwork in order to widen the roadway.

- Critical for smoothness especially when only a chip seal is to be applied.
Final Compaction

A smooth drum roller is used for final compaction.
Compacted Base can be opened immediately to Light Duty Traffic.
Proofroll
Strength Gain with Age

strength

time
Rigid Subgrade!
SoilCrete Treated after 48 hour Cure
Milled Surface of FDR
Pavement Surface

A new pavement surface can then be applied:

- Chip Seal
- Conventional Concrete
- Roller-Compacted Concrete
- Hot-Mix Asphalt
- Microsurfacing
Energy Use and Materials

**Full-Depth Reclamation vs. New Base**

- **Number of Trucks Needed**
  - New Base: 12
  - Full-Depth Reclamation: 180

- **New Roadway Material**
  - Tons (metric tons)
    - New Base: 300 (270)
    - Full-Depth Reclamation: 4,500 (4,100)

- **Material Landfill Volume**
  - Cubic yard (yd³)
    - New Base: 2,700 (2,100)
    - Full-Depth Reclamation: 3,000 (11,400)

- **Diesel Fuel Consumed**
  - Gallon (liter)
    - New Base: 500 (1,900)
    - Full-Depth Reclamation: 4,500 (4,100)

Based on 1 mile (1.6 km) of 24-foot (7.3-m)-wide 2-lane road, 6-inch (150-mm) base
Rutting can occur in surface, base and subgrade of un-stabilized bases due to repeated wheel loading. Cement stabilized bases resist consolidation and movement, thus virtually eliminating rutting in all layers but the asphalt surface.
URBAN APPLICATIONS
Town of Zionsville
Outstanding Achievements in Concrete – Sustainable Concrete Construction

2013 Award Recipients

Citizens Energy Group
DLZ Engineering
ms consultants, inc.
Alt & Witzig Engineering, Inc.
Eagle Valley, Inc.
Builder’s Concrete & Supply Co., Inc.

62nd/Michigan (STEP) Septic Tank Elimination and Drainage Improvements
Purdue University
Ross Ade – R Lot

- 25,000 Square Yards
- 5% Cement Application Rate
- 2” Asphalt over FDR Base
I-74 Shoulder FDR

- 26 miles
- 153,000 Square Yards
- 4 - 5% Cement
- 3” HMA over FDR Base
I-74 FDR – INDOT used FDR shoulder to carry mainline traffic
FDR Shoulders performed well
FDR was a huge savings for INDOT as compared to reconstruct
RURAL APPLICATIONS
Daviess County

- 60 Miles of FDR Roads
- 1st Road Done in 1980
- Excellent Performance
- Only Spot Repairs of Isolated Water Related Failures
- Experimented with 8” Treatment Depth
- New FDR is 16” with 6% Cement
- Good Crack Seal Program
- Good ditches help longevity
- Phil Cornelius – Daviess County Highway Supervisor
Others that have Done FDR Projects

- Cass
- Daviess
- Johnson
- Hendricks
- Hancock
- Putnam
- Steuben
- White
- More…

- Indianapolis
- Fishers
- Brownsburg
- Westfield
- Whitestown
- Franklin
- More…
Windmill Access Roads - Before
Windmill Access Roads - After
Turn Your…

into

a

ROUGH ROAD

TOUGH ROAD

SHall@SagamoreReadyMix.com

Full Depth Reclamation with Cement