101st Annual Road School

Full Depth Reclamation
REUSE YOUR ROADWAY

Road Rehabilitation Technology

James W. Render Jr.
Business Development
Essroc Cement

Jerry Larson
Executive Director
IRMCA
Windmill Projects - Benton Co. Indiana

- County Road System
  - Built for Farm use
  - Light loads
- 200 fully loaded trucks per Windmill
- Road system failure
  - Job delays
  - RM truck breakdowns
  - Dozers on site to pull trucks in & out
  - Disaster & dissatisfaction for residents
Before FDR Process
After FDR Process
Lessons Learned

- FDR / SCS Process was competitive with conventional road building process with stone.
- FDR / SCS Process held up under tremendous loading
- Gave the taxpaying farmers & residents access to their land during the construction sequence
- Why couldn’t you use this process on conventional county road systems
Current Situation

- County / municipality road systems already in place
- Emphasis on maintenance / rehabilitation
- These roads are local, low-volume, either flexible pavements or unpaved (gravel)
- As asphalt prices continue to escalate the old tired solutions are becoming cost prohibitive
Tight times put gravel on the road

Gravel roads, once a symbol of quaint times, are emerging as a sign of financial struggle in a growing number of rural towns.

High costs and tight budgets have prompted communities in Maine, Michigan, Indiana, Pennsylvania and Vermont to convert or consider converting their cracked asphalt roads back to gravel to cut maintenance costs, officials in those states say.
ALTERNATIVES???

- Fix the potholes & resurface with asphalt, again & again & again
- Reclamation with aggregate, again & again & again
- Dig it up & start again
ALTERNATIVES???

- Fix the potholes & resurface with asphalt, again & again & again
- Reclamation with aggregate, again & again & again
- Dig it up & start again
  - Excavation
  - Fill with #2’s
  - Add DGA
  - Chip Seal
NEW ALTERNATIVE!

FIX IT RIGHT THE FIRST TIME !!!

- Full Depth Reclamation with cement
- Green solution - In place recycling
- Long term solution for short term money
- Surface of Asphalt or chip seal
Full Depth Reclamation

A New Solution for Changing Times
Full Depth Reclamation Using Cement is a method of pavement reconstruction that utilizes the existing asphalt, base, and subgrade material to produce a new stabilized base course.
Reuse Your Roadway!

Create a Cement Stabilized Base to carry the loads
Three Worlds Coming Together

- Soils
- Asphalt
- Concrete
- Roller Compacted Materials
Why Portland Cement???

“Portland Cement is probably the closest thing we have to a universal stabilizer.”

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 gives significantly better strength than LKD
Conventional FDR Construction Sequence
FDR Construction Sequence

- Spreading
- Pulverization
- Mixing
- Initial Compaction
- Grading
- Final Compaction
- Curing
- Surfacing
Bulk Transfer
Spreading Dry Cement
Dry Mixing
Inside a Reclaimer

Deep recycled layer

Injection of water and/or fluid stabilizing agents

Operating direction

Milling drum

Distressed pavement

Granular material
Gradation
Moisture/Density Relationship

Moisture Content vs. Dry Density (lb/cf)

- Maximum Dry Density
- Optimum Moisture Content

ASTM D558
Optimum Moisture Content
Initial Compaction
Final Compaction
Curing
Basic Premise

- We are making a lean concrete out of the existing road base.
- By utilizing the existing material, we don’t significantly change the road elevation, allowing ditch line integrity to be maintained.
- Although this material can NOT be used as a road surface, it allows a chip seal, slurry seal or other thin flexible pavement to last far beyond normal expectations.
FDR

Design Advantages & Engineering Properties
Increased Rigidity Spreads Loads

Unstabilized Granular Base

100 psi

15 psi

Cement-Stabilized Base
- Soil-Cement
- Cement-Treated Base
- FDR

100 psi

4 psi
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.
Thinner Pavement Section

Un-stabilized Granular Base

Cement-Stabilized Base
  - Soil-Cement Base
  - Cement-Treated Base
  - Full-Depth Reclamation

Accepted Rule-of-Thumb:
8 inches of a crushed stone base is equal to 6 inches of a FDR base stabilized with cement
High water table

- 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
**Existing Thin Paved Structure**

- Subgrade
- Asphalt Surfacing
- 24 ft

**Conventional Build Up Granular Structure**

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

**Full-Depth Recycled Structure**

- Subgrade
- Asphalt Surfacing
- Stabilized Base
- 24 ft
Widening

- Best Practice
- Mixing chamber assures blending of aggregate from the road base to the sub base material in the lane widened area.
- This thorough mixing is the most efficient way of creating a contiguous base that will perform.
- No more failure on the widened lane joint.
Widening Example
Mix Design

- Just as in Ready Mix Concrete or Roller Compacted Concrete, a material evaluation is necessary to determine properties of FDR
  - Cement Content – Spread Rate
  - Optimum Moisture Content
  - Compaction
  - Target Strength
Trial Batches

- Typically any new project has trial batches made from the material.
- Modified Procter is run to determine optimum moisture content & spread rate.
- The finer the material, the higher the “Spread Rate”
Determining Spread Rate

- In the dry process your mix design sets a spread rate typically between 4 – 8% cement by weight.
- This would be determined in the field by laying a square foot canvas cloth on the surface & driving the spreader over the cloth, picking it up & weighing the dry cement.
Moisture/Density Relationship

![Graph showing Moisture/Density Relationship with Moisture Content on the x-axis and Dry Density (lb/ft³) on the y-axis. The graph includes a peak at 11% Moisture Content, labeled as Optimum Moisture Content, and a dashed line indicating Maximum Dry Density at approximately 120 lb/ft³. The text 'ASTM D558' is also present on the graph.](image-url)
Field Testing - Moisture
Nuclear Density Testing
FDR

Green Advantages
Environmental Advantages

- Use of in-place materials
- Little or no material hauled off and dumped
- Maintains or improves existing grade
- Conserves virgin material
- Saves cost by using in-place “investment”
- Saves energy by reducing mining and hauls
Reclamation-versus-New Base

- Trucks (Number): 12, 180
- Material (tons): 300, 4500
- Landfill (cy): 0, 2700
- Diesel (gal): 500, 3000

1 Mile of 24'-wide 2-lane road, 6" base + 2" asphalt surface
How can I use my own forces to rebuild roads with FDR with Cement???

RM FDR
Ready Mixed Full Depth Reclamation
The County Model
Grout Calculator
Indiana County Market

- Several Counties have now used FDR
  - Cass County
  - Union County
  - Henry County
  - Putnam County
  - Daviess County
    - Did 30 miles of traditional FDR in the 90's with great success
    - Roadways still in use with very little maintenance
The History FDR in Indiana

- Dry spread
- Wet Mix
- RM Heavy Grout
- RM Slurry
- RM Drag Box Grout
Henry County
Benton County
Putnam County
Drag Box Grout
Union County
Cass County Indiana RM FDR

- Initial plan was to overlay an existing road with 7” of asphalt.
- Working with IRMCA they came up with a value engineering proposal to FDR the existing chip sealed road with 10” deep FDR and double chip seal the roadway.
- Cass County had their own Mixer.
- The savings allowed them to add another project to their slate this season.
Roadway was mixed
Windrowed with a grader
Slurry addition
Questions???

Thank You!!!