Transportation Engineers’ Association of Missouri 2019 Conference

Why rebuild, when you can recycle!

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What’s The Solution?
Asphalt Overlay
Overlay with Paving Fabric
What If There Was A Way…

• To reduce your risk
• To reduce the cost
• To increase the strength
• To save on repairs and maintenance
• To do something good for the environment
FDR

32\textsuperscript{ND} President

Lead us out of the Great Depression & WWII

New Deal

Elected 4 times

Died 1945
Full Depth Reclamation
What is it?

Full Depth Reclamation (FDR) is a pavement rehabilitation technique in which the full flexible pavement section and predetermined portion of the underlying material are uniformly pulverized or blended, resulting in a stabilized base course. (ARRA)
Mixing

Full Depth Reclamation
Cutting Head
When is FDR Applicable?

- Flexural distresses in wheel lanes
- Pavement condition index below 55
- Excessive rutting or alligator cracking
- Excessive patching (20% or more)
- Need to widen roadway
- Need to increase structural design
- Need to correct asphalt pavement cross slope
Types of FDR

• Mechanical Stabilization
  – Aggregates

• Chemical Stabilization
  – Lime, Cement, Fly-Ash

• Bituminous Stabilization
  – Engineered Emulsion
  – Foamed Asphalt (not common in the Midwest)

• Combination
FDR STEPS

• **Project evaluation & Mix design**
• Initial pulverization
  - Mechanical stabilization: add rock
• Compaction & grading
• Stabilization/additives: cement, asphalt emulsion, foamed asphalt, fly ash, or lime.
• Initial compaction, grading, & final compaction
• Cure
• Surface – asphalt, micro, chip-seal, concrete.
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Evaluation & Mix Design
FDR STEPS

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Initial Pulverization

- Mechanical Stabilization
  - Add Rock

- Initial Pulverization
  - Chemical
  - Bituminous
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Grading & Compaction
Proof-Roll

- Loaded tandem truck
- Identify unsuitable areas
- Fix identified areas prior to additive
FDR STEPS

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- **Initial pulverization**
  - Mechanical stabilization: add rock
- **Compaction & grading**
- **Stabilization/additives:**
  - Chemical & Bituminous
- **Initial compaction, grading, & final compaction**
- **Cure**
- **Surface** – asphalt, micro, chip-seal, concrete.
Chemical Additives

- Lime
  - Quicklime
  - Hydrated Lime
- Cement
  - Portland Type 1
- Fly Ash
  - Class C
Incorporate Water

- **Cementitious**
  - Cement
  - Fly Ash
  - -1 to +2 of OMC

- **Lime**
  - +4 of OMC

- **Bituminous**
  - -1 to +2 OMC
Wet Subgrade
Apply Rhino Slurry
Incorporate Slurry
Bituminous Additives

- Engineered Emulsions
  - CSS1H
    - Road Science
    - SEM
- Foamed Asphalt
FDR STEPS

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Compaction

- **Cementitious**
  - 10 ton Pad-foot, single/double drum vibratory roller
  - 96 to 98% Max. Dry

- **Bituminous**
  - 10 ton Pad-foot, pneumatic, single/double drum vibratory roller
  - 96 to 98% Max. Dry
Final Grading & Compaction
Final Compaction

- Single or Double Drum
  - Static Mode
- Pneumatic Tired
FDR STEPS!

• **Project evaluation & Mix design**
• **Initial pulverization**
  – Mechanical stabilization: add rock
• **Compaction & grading**
• **Stabilization/additives: cement, asphalt emulsion, foamed asphalt, fly ash, or lime.**
• **Initial compaction, grading, & final compaction**
• **Cure**
• **Surface – asphalt, micro, chip-seal, concrete.**
Curing for Chemical FDR

- Maintain Moisture
- Water Curing
  - As needed
- Bituminous
  - SS1h (dilute 60%)
  - Sand Blotter (opt.)
- Strength Gain
  - 300 to 500 psi
  - 3 to 7 days
Curing
Curing for Bituminous FDR

- Moisture Evaporation
  - 7 to 10 days

- Gain strength
  - Immediate Strength
FDR STEPS

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Typical Surfaces

- Hot Mix Asphalt
- Concrete
- Chip Seal
- Micro
- Cape Seal
- Aggregate Base
FDR STEPS to Success!

- **Project evaluation – mix design**
- Initial pulverization
  - Mechanical stabilization: add rock
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- Final compaction & grading
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Typical FDR Applications

- Aggregate roads
- Aggregate staging areas/lots
- Asphalt roads
- Asphalt parking lots
- Airport taxiways (asphalt)
- Tennis courts
- Asphalt running tracks
- ALL THINGS ASPHALT
Mechanical

Water tanker truck
WR 240/WR 24G
Single-drum compactor
Grader
Tandem roller
Chemical
Bituminous
FDR vs. R&R

Case Studies
Figure 1.4. FDR with cement reduces the permeability of the base layer compared to a base of RAP or other unstabilized granular material.
Figure 1.2. Unstabilized asphalt base results in more concentrated stress on the subgrade than FDR with cement base.

Figure 1.3. FDR with cement base reduces fatigue cracking compared to an unstabilized base.
Case Study

- Southern Illinois University Edwardsville
- Boone County – Gibbs Road
- City of Hartford – Maple Street
6” Cement FDR with chip seal surface
   Structural Coefficient = 2.175

2” Asphalt overlay
   Structural Coefficient = .80

FDR treated base, with chip seal surface is almost 3x stronger than a 2” overlay.
Structural Layer Coefficients

- Dry pulverization: 0.11 per inch
- Bituminous stabilized: 0.20 per inch
- Cement stabilized base: 0.25 per inch
- Asphalt binder: 0.40 per inch
- Cold-in-place: 0.35 per inch
Unconfined Compressive Strength After 21 Days Curing

- 6% cement
- 6% lime
- 3% cement and 3% lime

Stabilizer content

- Dry application to dry soil
- Dry application to moist soil
- Slurry application to moist soil

UCS (psi)
SIUE LOT F

• 10,500 SY Parking Lot
• Cost: $300k ($28.5 per square yard)
• This included under drains installed on 50’ centers
• Removal and replacement cost $500k ($45-$50 per SY.)
• Cost savings of $200,000.00
Boone County, Missouri
Gibbs Road

- 10,000 Square Yards
- 9-inches of treated base
- 6% Portland Cement
- 3-inch wearing surface
- 40% SAVINGS
City of Desloge, Missouri
School Street

- 3,900 Square Yards
- 6-inches of treated base
- 4% Portland Cement
- 2-inch wearing surface
- 35% SAVINGS
City of Hartford, Illinois
Maple Street

- 5,500 Square Yards
- 12-inches of treated base
- 5% Portland Cement
- 3-inch wearing surface
- 35% SAVINGS
FDR vs. New Base

Based on One Mile, 24ft Wide, 6in Base

Number of Trucks Needed: 12 vs. 180

• New Roadway Material (Tons): 300 vs. 4,500

• Material Landfill (cy): 0 vs. 2,700

• Diesel Fuel Consumed (Gal): 500 vs. 3,000
Average Unit Costs

- Processing (6”-12”): $3.00 to $6.00/sy
  - Initial Pulverization
  - Compaction
  - Grading
  - Water Curing
- Cement: $110/ton
- Emulsion: $3.00/gal
We Can Build It Better

- Faster
- Better
- Stronger
- More uniform
- Less susceptible to moisture infiltration
- Longer life = less maintenance
- Could save 25% to 50% over remove/replace
Thank You!

Byrne & Jones Construction
Stabilization Division

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