FULL DEPTH RECLAMATION FOR CITIES AND COUNTIES

OTEC - October 27, 2015
• Time + Traffic + Environment = Deterioration
• Temporary repairs include overlays or mill and fills to extend service life
• Eventually costly major repairs or total reconstruction needed
• Full Depth Reclamation (FDR) offers:
  – Substantial Savings
  – Reduced Construction Time
Full Depth Reclamation (FDR) is a pavement rehabilitation technique in which the full flexible pavement section and a engineered portion of the underlying base (possibly the subgrade) are uniformly pulverized and blended together to produce a stabilized base course (SBC); additional FDR (structural strength) may be obtained through the use of additives.
BENEFITS – CRACKS ARE ELIMINATED

Full Depth Reclamation
- Surface Course
  - 6–10” FDR
- Subgrade

Mill & Fill
- 1.5” Mill & Fill
  - HMA
  - Base/Sub-base
- Subgrade

Overlay
- 1.5” Overlay
  - HMA
  - Base/Sub-base
- Subgrade
FDR CANDIDATES

• Parking Lots
• Low Volume, Secondary Roads
• City / County Streets and Medium Volume Roadways
• Interstate Highways
• Private and Regional Airports
Liquid additive system:
Water – for Portland Cement Based FDR
Engineered Emulsion – for Portland Cement and Engineered Emulsion Based FDR
PORTLAND CEMENT BASED FDR

BENEFITS

• Allows otherwise unsuitable on-site materials to be turned into strong, structural base or sub-base material to support proposed pavement surface.

• Pavements rehabilitated with chemical FDR (Pozzolanic) are ones that would typically require substantial full depth repairs and/or undercuts, or total reconstruction.

• Cohesive subgrade soils can be stabilized.
BENEFITS

• Cost effective method of improving the strength of a reclaimed material while reducing the effects of moisture

• Remains a flexible structure and offers significant fatigue resistance and increased load bearing capacity

• Works well in combination with other additives such as virgin aggregate and/or cement and lime (dry or slurry)
DESIGN
STRENGTH BASED DESIGN

FDR Mix Designs and Structural Layer Coefficients

- Pavement sampling
- Measurement of material thicknesses
- Evaluation of in place materials
- Analysis of mix design alternatives based on:
  - Pre-pulverization depth
  - Admixture selection
  - Treatment depth
- Sample preparation
- Test specimen preparation
CITY of TOLEDO RD. DETERIORATION
CO. RD. 800 DETERIORATION
• Sampling Locations based on Evaluation of Non-Destructive Testing utilizing Falling Weight Deflectometer data
PORTLAND BASED FDR DESIGN
PORTLAND BASED FDR DESIGN

- Soil cement cylinder preparation using standard Proctor energy
- Unconfined Compressive Strength (UCS)
- % Volume Change During Capillary Soaking
PORTLAND CEMENT AND ENGINEERED EMULSION BASED FDR DESIGN

- Briquette preparation using Marshall methods
- Stability with flow testing
- Indirect tensile strength testing
- Structural layer coefficient determination
THE FDR PROCESS

CONSTRUCTION SEQUENCE

1. Pulverize and blend the existing pavement with the underlying base materials and subgrade
2. Profile and compact the pulverized material
3. Apply and mix stabilizing additives
4. Fine grade and compact the stabilized material
5. Fog seal or tack coat the stabilized base course, as required
CONSTRUCTION
Prior to Start of Reclamation:

- Pre-pulverization depth verification
- Verification of linear grading depth, if applicable
- Verification of material gradation and quality
- In-situ moisture content determination
PORTLAND CEMENT SPREADING
WATER INJECTION DURING PORTLAND CEMENT BASED FDR
ENGINEERED EMULSION INJECTION DURING FDR
ENGINEERED EMULSION INJECTION DURING FDR
ENGINEERED EMULSION INJECTION DURING FDR
INITIAL COMPACTION
FINAL COMPACTION
PORTLAND CEMENT AND ENGINEERED EMULSION BASED FDR FIELDWORK

- During Reclamation:
- Verification of application rates
- Sample treated materials
- Cast briquettes / strength samples based type of stabilization agent.
FINISHED CITY of TOLEDO STREET
FINISHED CO. RD. 800
FINISHED OAKLAND CO. RD.
MAT STRUCTURAL PROPERTIES (The Before and After)
PORTLAND CEMENT AND ENGINEERED EMULSION BASED FDR FOLLOW-UP TESTING

- Develop correlations between strength and field wet density
- Estimate in-place strength of SBC at each compaction test location
  - Dry ITS
  - Soaked ITS
  - Stability
• AASHTO layer coefficient (for SN calculation) for Portland Cement FDR Mat is typically 0.2
• Layer coefficient for Engineered Emulsion FDR Mat 0.25 to 0.30
• Layer coefficient for standard gravel base 0.12 to 0.14
• For a 12 inch FDR Portland cement stabilized mat structural number would be 2.4 compared to 1.68 for aggregate (30% higher)
• Structural number for 16 inch FDR Portland cement Stabilized mat would be 3.2. Cost difference between 12 inch and 16 inch mat would be cost of additional cement to treat four additional vertical inches (dosage rate is typically between 3-7%)
CO. RD. 800 – PRE/POST FDR - STRUCTRUAL NUMBER

ESN PRE

ESN POST
CO. RD. 800 – PRE/POST FDR - STRUCTRUAL NUMBER DATA

- Pre-Construction SN: Min. 1.11, Max. 6.98 and Average 2.07 (HMA 7.5” and Agg. base 6.5” – Averages) Predicted SN = 4.06.

- Post Construction SN: Min. 2.23, Max. 30.0, and Average 19.3

- Average increase in SN: +800%

- Calculated SN based on Engineer’s Pavement Section: 5” Asphalt (@ 0.42) and 16” FDR (@ 0.20) = 5.30
OAKLAND CO. RD. – PRE/POST FDR - STRUCTURAL NUMBER DATA

- Pre-Construction SN: Min. 1.06, Max. 8.23 and Average 3.35 (Avg. 7” to 9” HMA on Clay Subgrade)
- Post Construction SN: Min. 2.34, Max. 5.85, and Average 3.99
- Increase in SN: +119% (on Min), 19% (on Avg.)
- Calculated SN based on Engineer’s Pavement Section: 4” Asphalt (@ 0.42) and 12” FDR (@ 0.20) = 4.08
- FDR MAT (NDT Avg. back calculation): (3.96 – 1.68) = 2.28
  At 12” thick, FDR Mat layer coefficient = 0.19
AUERBURN RD., OHIO – POST FDR - STRUCTRUAL NUMBER DATA
Pre-Construction SN: Unknown, Not Tested

Post Construction SN: Min. 3.96, Max. 10.24, and Average 7.39

Average increase in SN: Unknown

Calculated SN based on Engineer’s Pavement Section:
- 4” HMA (@ 0.42), 4” Aggregate (@ 0.14) and 16” FDR (@ 0.20) = 5.44

FDR MAT (industry): 0.2 x 16” = 3.2

FDR MAT (NDT Avg. back calculation): (7.39 – 2.24) = 5.15
At 16” thick, layer coefficient = 0.32
QUESTIONS & ANSWERS