In-Place Recycling on Illinois DOT Roadways

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Bureau of Materials & Physical Research

2013
Midwestern States
Regional In-Place Recycling
Conference

Are In-Place Recycling Treatments Allowed in Illinois?

- **Cold In-Place & Hot In-Place Recycling**
  - **Limited use on state roadway system**
  - **Guidelines published September 2010 in Bureau of Design & Environment (BDE) Manual, Chapter 52 [Figure 52-4.A]**
  - **Allowed with BDE approval and experimental feature work plan (EFWP)**
- **Full-Depth Reclamation**
  - **Even less experience on IDOT roadways**
  - **Only allowed with EXWP**

BDE Manual, Ch. 52, Fig. 52-4.A

Pavement Conditions	Distress Levels [1]	Crack Filling	Crack Sealing	Fog Seal [2]	Sand Seal [2]	Slurry Seal	Micro-surfacing	Chip Seal	Cape Seal	CIR [2]	HIR [2]	SMART	Ultra- Thin Bonded Wearing Course	Cold Mill
Alligator/ Fatigue Cracking [3]	L1	F	F	NR	NR	F	F	F	F	F	F	F	F	NR
	L2, L3, L4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Block Cracking	M1	R	R	F	R	R	R	R	R	R	R	F	F	F
	M2	R	R	NR	NR	F	NR	F	F	F	F	NR	NR	NR
	M3, M4	F	F	NR	NR	NR	NR	NR	NR	F	F	NR	NR	NR
"Stable" Rutting [4]	N1, N2	NR	NR	NR	NR	F	R	F	F	R	R	R*	F	F
	N3	NR	NR	NR	NR	NR	F	NR	NR	R	R	R*	NR	F
Joint Reflection and Transverse Cracking [5]	O1	NR	NR	F	R	F	R	R	R	F	F	R**	F	F
	O2, O3	R	R	NR	NR	NR	F	F	F	F	F	F	NR	NR
	O4, O5	F	F	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Overlayed Patch Reflective Cracking	P1, P2, P3, P4, P5	F*	F*	F*	F*	F*	F*	F*	F*	F*	F*	F*	F*	F*
Longitudinal / Center of Lane Cracking	Q1	R	R	F	F	F	F	F	F	F	F	F	F	F
	Q2, Q3	R	F	NR	NR	NR	F	F	F	F	F	F	F	F
	Q4, Q5	NR	NR	NR	NR	NR	NR	NR	NR	F	F	NR	NR	NR
Reflective Widening Crack	R1	R	R	F	F	F	F	F	F	F	F	F	F	F
	R2, R3	F	F	NR	NR	F	F	F	F	F	F	F	NR	NR
	R4, R5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Centerline Deterioration	S1, S2, S3, S4	F*	F*	F*	F*	F*	F*	F*	F*	F*	F*	F*	F*	F*
Edge Cracking	T1	F	F	F	R	F	F	R	F	R	R	R**	F	F
	T2	F	F	NR	NR	NR	F	F	F	F	F	F	NR	NR
	T3, T4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Permanent Patch Deterioration	U1, U2, U3, U4	F*	F*	F*	F*	F*	F*	F*	F*	F*	F*	F*	F*	F*
Shoving, Bumps, Sags, and Corrugation	V1	NR	NR	NR	NR	NR	F	F	F	R	R	R	F	R
	V2, V3	NR	NR	NR	NR	NR	NR	NR	NR	R	R	R	NR	R
Weathering/ Raveling	W1, W2	NR	NR	F	F	R	R	R	R	F	F	F	F	F
	W3, W4	NR	NR	NR	NR	F	F	F	F	R	R	R*	NR	NR
Reflective D-Cracking	X1, X2, X3	NR	NR	NR	NR	NR	NR	NR	NR	F	F	NR	F	F
Friction	Poor	NR	NR	NR	R	R	R	R	R	F	F	R	R	F
ADT	< 5,000	R	R	R	R	R	R	R	R	R	R	R	R	R
	5,000 – 10,000	R	R	F	F	F	R	R	R	F	R	R	R	R
	> 10,000	R	R	NR	NR	NR	F	F	F	NR	R	R	R	R
Relative Cost	($ to $$$$)	$	$	$	$$	$$	$$	$$	$$	$$$	$$$	$$$	$$$	$

Note 1. Information about pavement distress codes is located in Appendix C of the Illinois Highway Information System Roadway Information & Procedure Manual.

Note 2. This treatment may only be used with approval from BDE and will require an Experimental Feature according to Construction Memorandum 02-2.

Note 3. Preservation treatments do not correct alligator cracking. Of the treatments, chip seals are most appropriate at addressing the alligator cracking.

Note 4. If stable rutting is present without other distresses, microsurfacing or mill and overlay are the recommended treatments.

Note 5. If cracking is joint reflection related, the preservation treatments will not correct the distress.

R - Recommended treatment for the specified pavement condition. Care must be examined in making sure that all critical distress types are addressed by the selected treatment.

R* - Recommended treatment when used with milling prior to treatment.

R** - Used in combination with crack sealing.

F - Feasible treatment but depends upon other project constraints including other existing distresses.

F* - This is a localized distress and should be treated locally while other distress types present should dictate choice of global treatment.

NR - Treatment is not recommended to correct the specified pavement condition.

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Cold In-Place Projects

- US 24 between Astoria, IL and Summum, IL
  - Contract 88703
  - No experimental feature
  - 2.4 miles of CIR
  - Started in Fall 2010, Finished in Spring 2011
  - Cross-section:
    - 1.50 inches HMA Surface Course (Spring 2011)
    - 2.25 inches HMA Binder Course (Fall 2010)
    - 4.00 inches CIR (Fall 2010)

Cold In-Place Projects

- **Mt. Auburn Road south of Mt. Auburn, IL**
  - **Contract 72F65**
  - **Low volume, unmarked route, no experimental feature**
  - **2.0 miles of CIR**
  - **Summer 2013**
  - **Cross-section:**
    - **Cape Seal**
    - **3.00 inches CIR**

Mt. Auburn Road – September 2013

Potential Future CIR Project

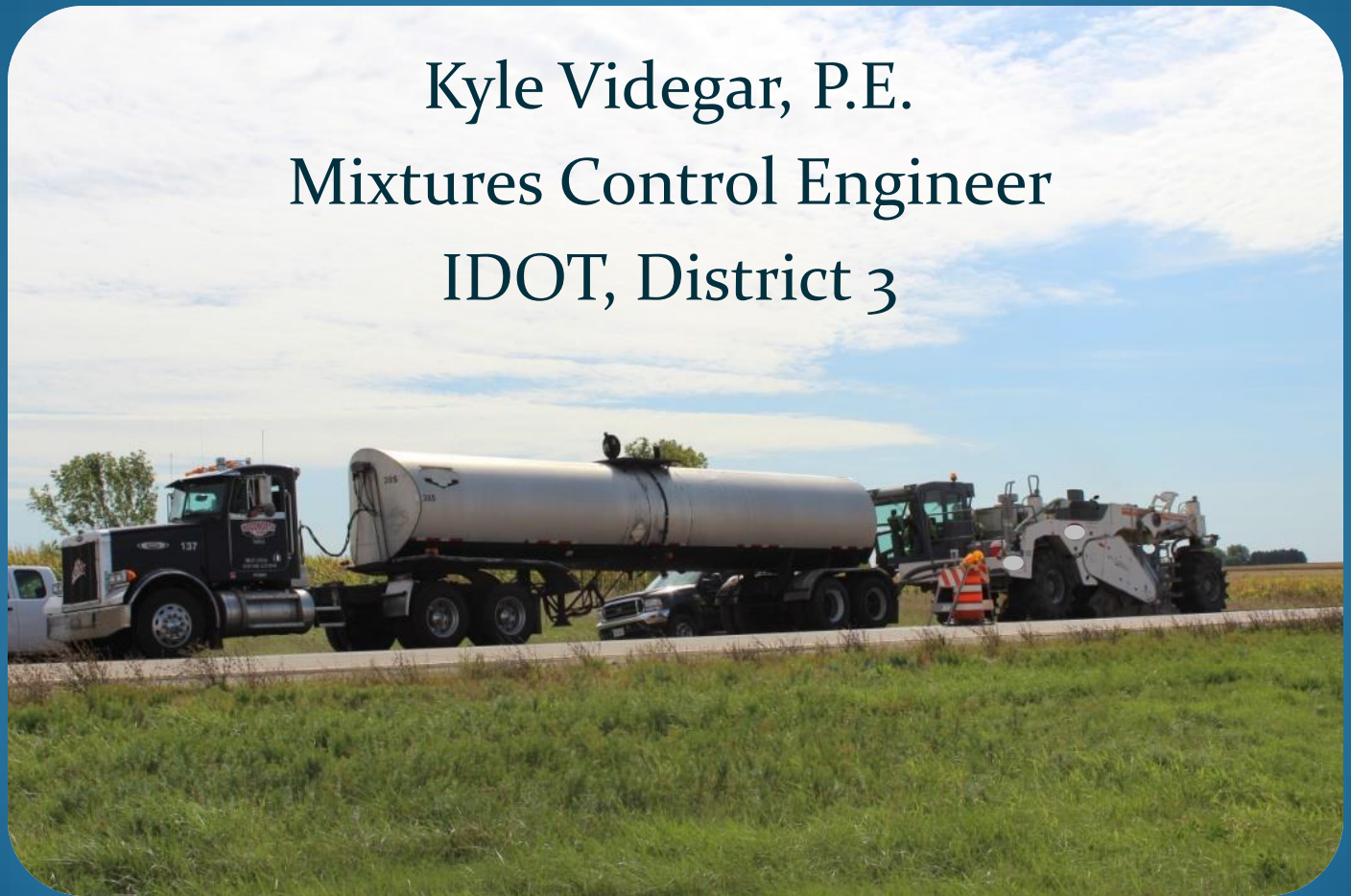
- **US 54 East of Springfield, IL**
  - **Target date of FY 2019**
  - **Planning on using experimental feature**
  - **8.3 miles of CIR**
  - **Cross-section:**
    - **1.50 inches HMA Surface Course**
    - **0.75 inch HMA Leveling Binder**
    - **4.00 inches CIR**

Hot In-Place Recycling

- **Built a few projects in mid 1990s**
- **Mixed performance**
- **No recent projects**

Full Depth Reclamation Using Emulsified Asphalt

Kyle Videgar, P.E.
Mixtures Control Engineer
IDOT, District 3



Our Project

NB I-39 in
La Salle County

- 2 Miles
- Shoulders 10 ft wide, 6 in deep
- 11,496 SQ YD

Our Project


I-39 N.B.
Core #1
Mile Post 60.5
Outside Shld. 2' O/S
3/20/12


I-39 N.B.
Core #2
Mile Post 60.5
Outside Shld. 8' O/S
3/20/12

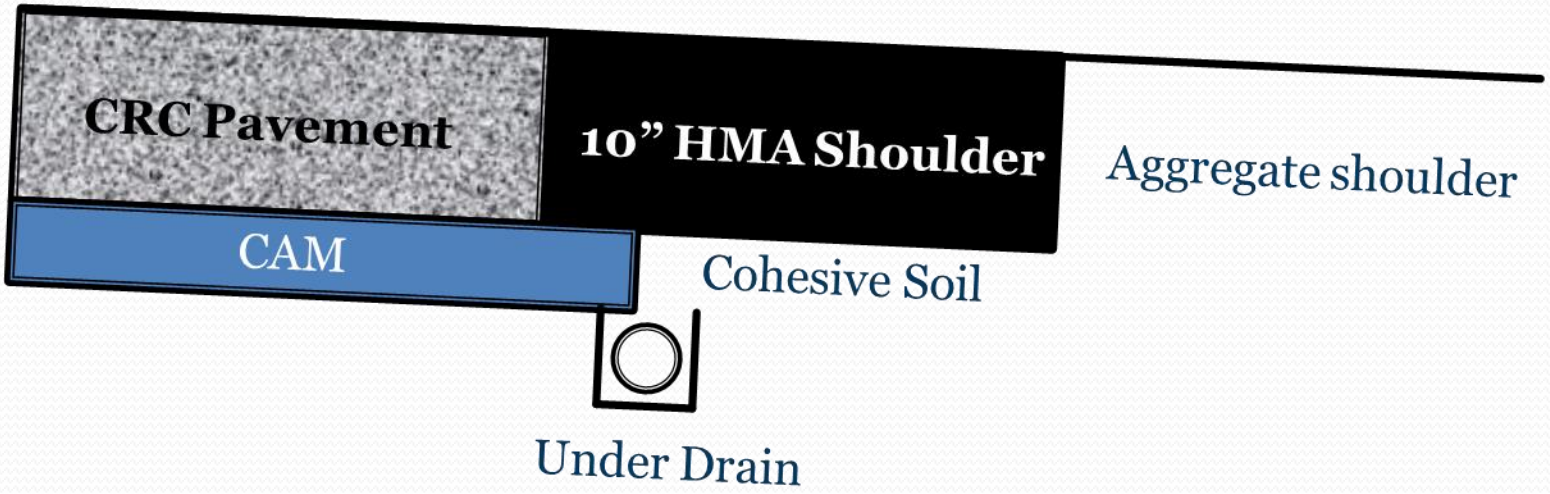
Our Project Costs

Description	Quantity	Units	Unit Cost	Total Cost
BIT MATLS PR CT	1,152.00	Gallon	$2.00	$2,304.00
HMA SC "C" N50	1,324.30	Ton	$100.00	$132,430.00
HMA SURF REM 2	11,496.00	Sq Yd	$1.65	$18,968.40
SHOULDER RUM STRIP 16	10,346.00	Foot	$1.00	$10,346.00
MOBILIZATION	1.00	L Sum	$10,750.00	$10,750.00
SHOULDER REPAIRS	14,941.07	L Sum	$1.00	$14,941.07
SHOULDER REC FD	11,496.00	Sq Yd	$13.05	$150,022.80
TC-PROT 701406 SPL	1.00	L Sum	$14,000.00	$14,000.00
			TOTAL	**$353,762.27**
			TOTAL Sq Yd	**11496**
			Cost/Sq Yd	**$30.77**

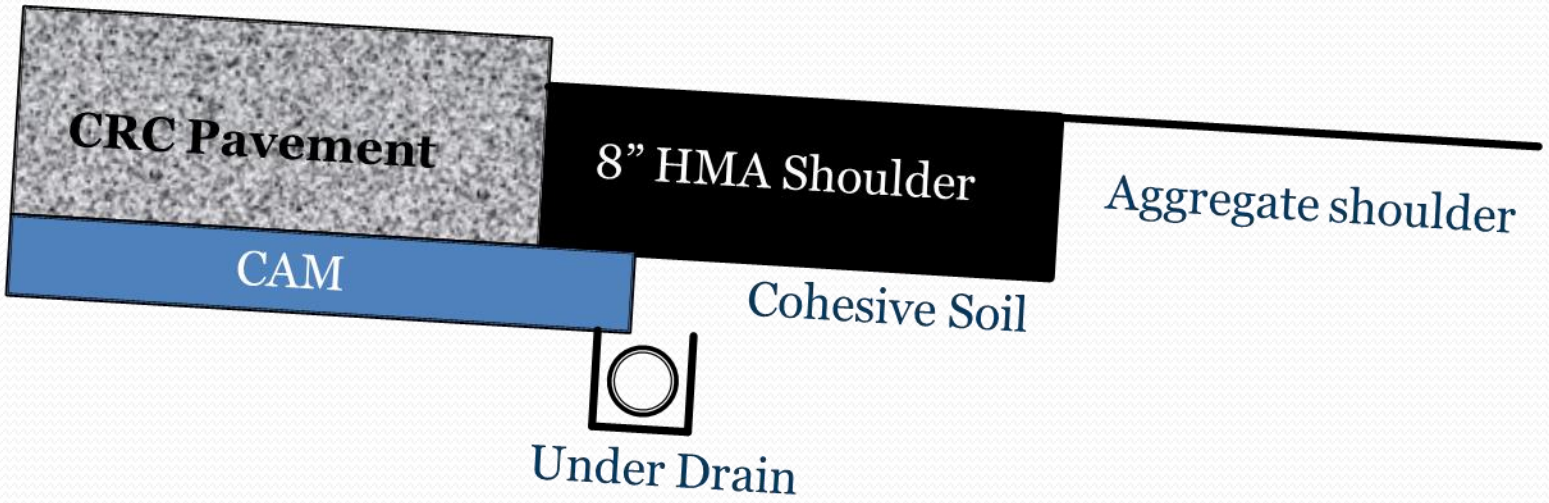
Alternative Project Costs

- For 15,000 sq yd of 8” HMA
  - 6700 ton
  - $500,000 (HMA only)

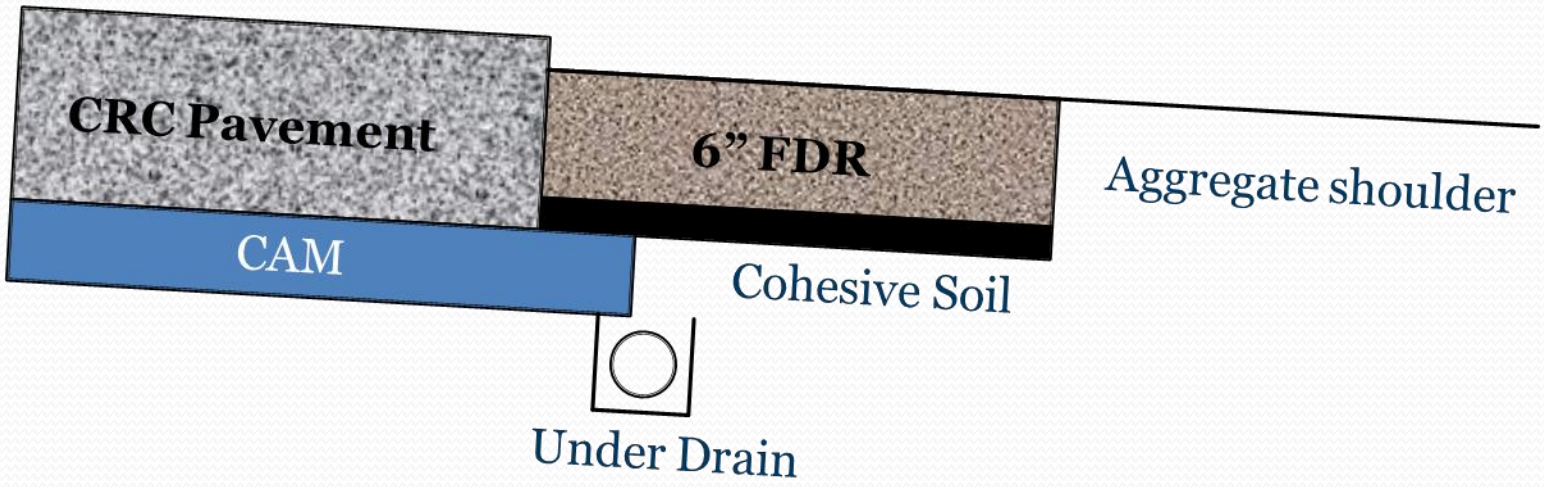
Existing Typical Section



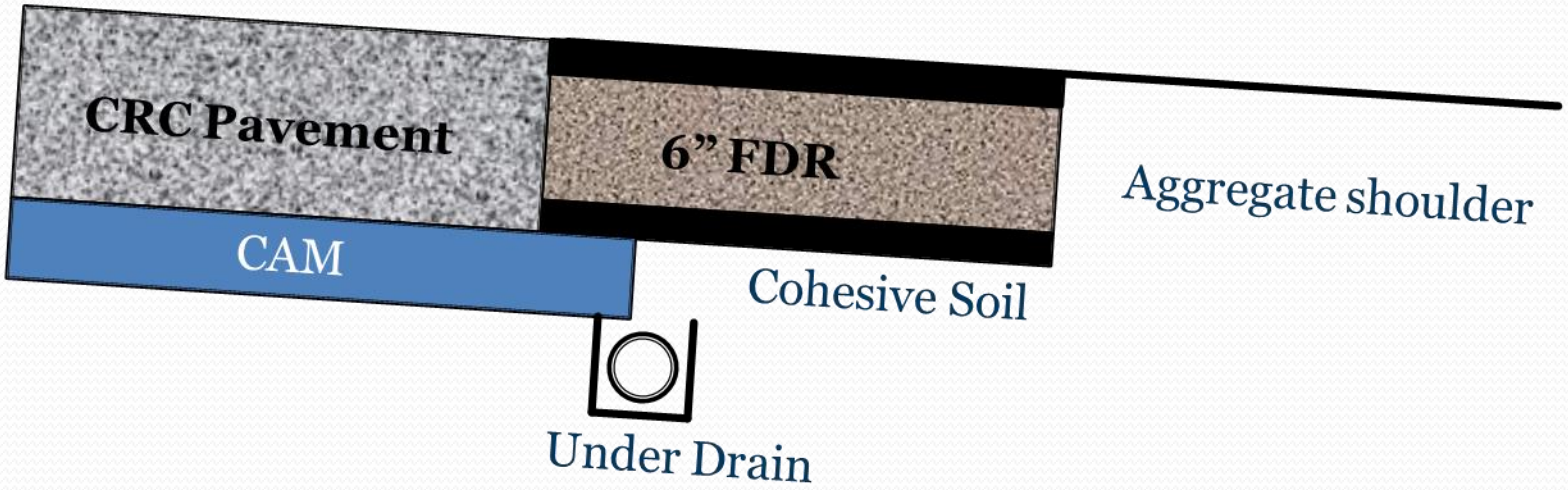
After 2” HMA Removal



6” Full-Depth Reclamation



2” HMA Overlay



Mix Design

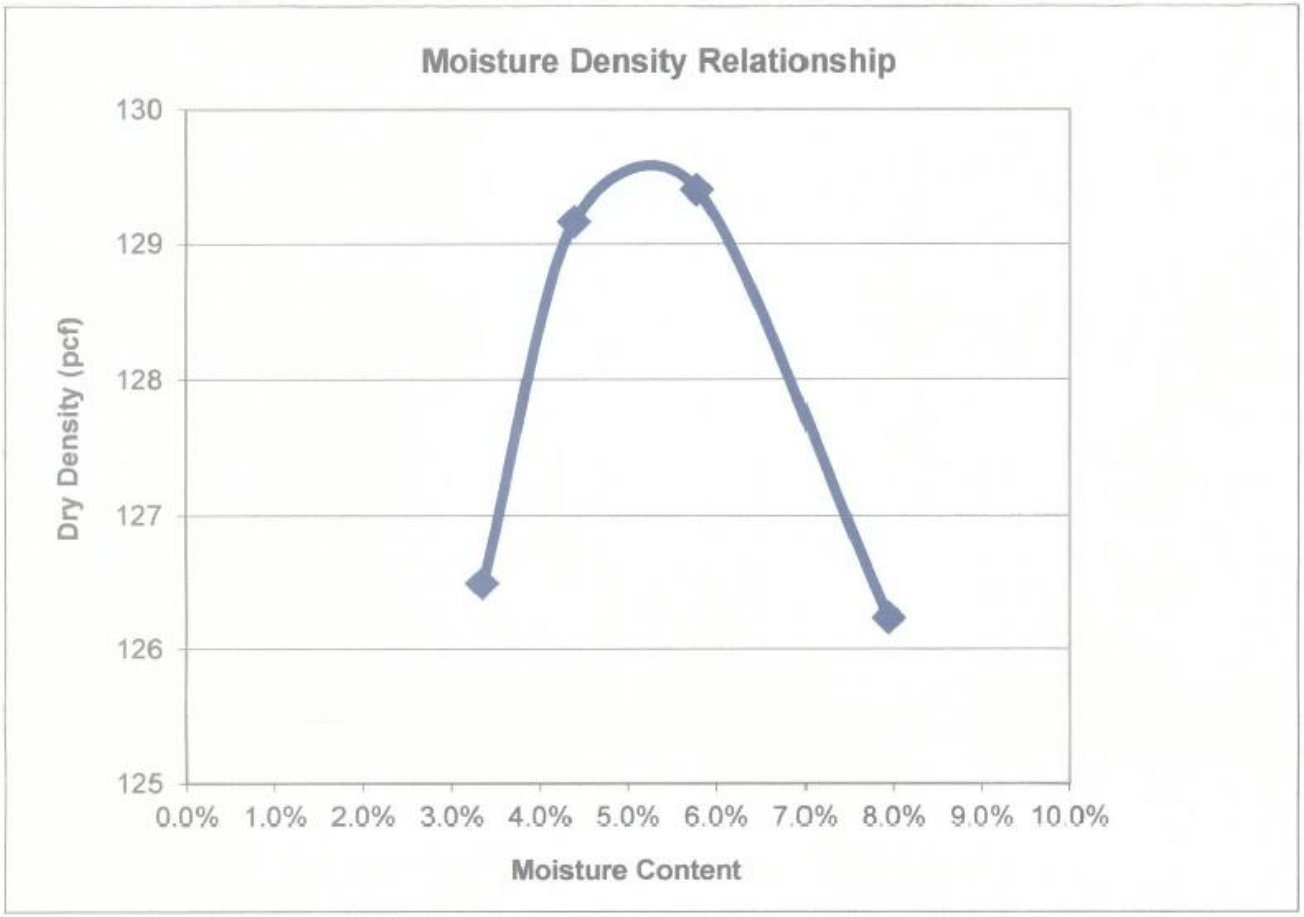
Mix Design Sheet

GRADATION AND SAND EQUIVALENCY

	Sieve Size	Sample
Percent Passing	2"	100.0%
	1 1/2"	100.0%
	1"	96.5%
	3/4"	82.8%
	1/2"	75.7%
	3/8"	63.2%
	#4	45.4%
	#8	33.4%
	#16	21.0%
	#30	11.2%
	#50	5.4%
	#100	2.6%
	#200	1.8%
Sand Equivalent		94%

Mix Design Sheet

MODIFIED PROCTOR



Mix Design Sheet

Target Emulsion
2.5%

RECOMMENDATIONS			
Emulsion Target (Based on Dry Weight)	2.5		gal /SY
Penetration after Distillation	115	FDR Depth: 6 in	1.8
Optimum Water for Mixing (%)	2.50		
Modified Proctor Density, pcf	129.7		
Modified Proctor OMC, %	5.20		
CONSTRUCTION PARAMETERS			
Add Rock Type	None	Pre-pulverization Thickness	6"
Add Rock Depth	None	Avg. Bituminous Thickness	8.8"
Add Rock Width	None	Overlay or Chip Seal	Overlay

Emulsion	Emulsion Content			Specification Requirement
Percent Emulsion	2.0	2.5	3.0	
%H20 before emulsion addition	2.50	2.50	2.50	
Bulk Specific Gravity, ASTM D 6752 or ASTM D2726	2.171	2.188	2.179	Report
Rice Specific Gravity, ASTM D2041	2.467	2.453	2.450	Report
Air Voids	12.0	10.8	11.0	Report
Short Term Strength, ASTM D 1560	291	297	240	175 min.
ITS of control samples, ASTM D 4867, psi	68.5	68.5	70.0	40 psi min.
ITS of conditioned samples, ASTM D 4867, psi	38.7	45.9	43.9	25 psi min.

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Modified Proctor Density
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Optimum Moisture Content
5.2%

Mix Design Sheet

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Penetration after Distillation	115	FDR Depth: 6 in	1.8
Optimum Water for Mixing (%)	2.50		
Modified Proctor Density, pcf	129.7		
Modified Proctor OMC, %	5.20		

CONSTRUCTION PARAMETERS			
Add Rock Type	None	Pre-pulverization Thickness	6"
Add Rock Depth	None	Avg. Bituminous Thickness	8.8"
Add Rock Width	None	Overlay or Chip Seal	Overlay

Emulsion	Emulsion Content			Specification Requirement
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Short Term Strength
297 g/25mm width

Pre-Pulverization

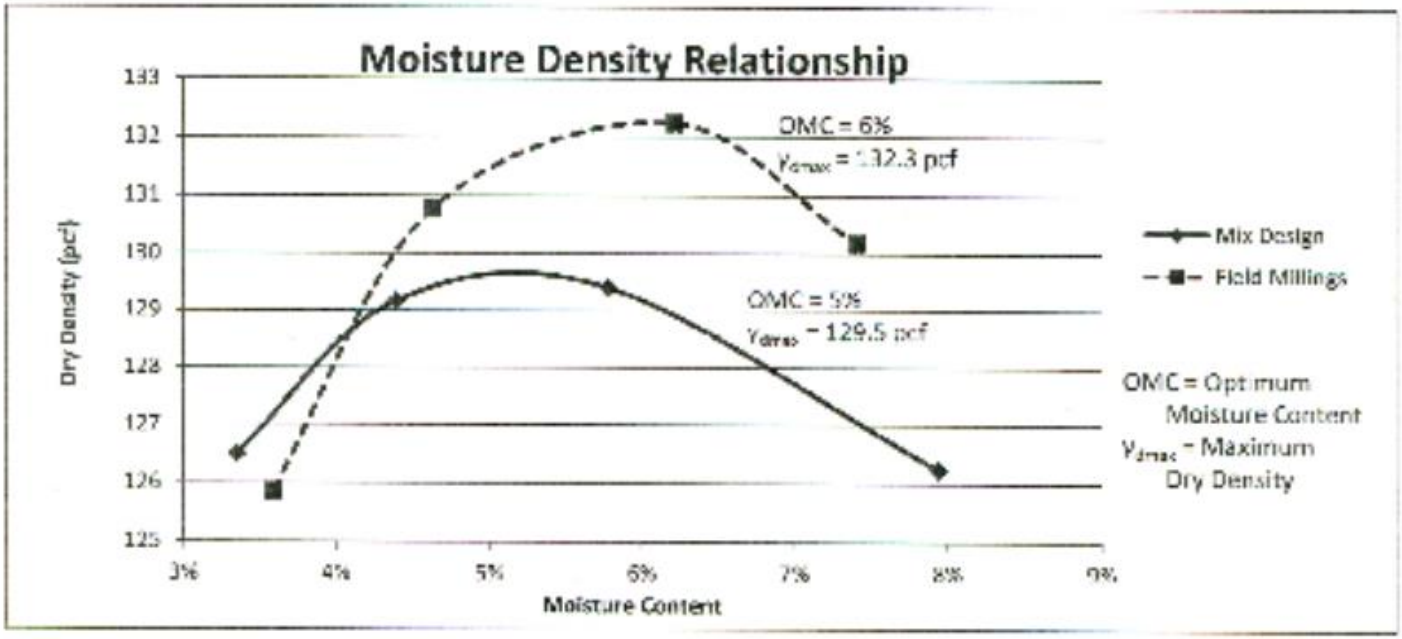
Sampling to Verify Gradation

Sampling to Verify Gradation

Mix Design & Field Millings Test Results

Parameter	Mix Design	Field Millings	Specifications Mix Design	Gradaton (WASHED) (LAB)		
					Mix Design	Field Millings
Percent Emulsion	2.5	2.5		Sieve Size	% Passing	% Passing
%H20 before emulsion addition	2.50	3.00		2.5"	100.0%	100.0%
				1.0"	96.5%	98.3%
Bulk Specific Gravity, ASTM D 6752 or ASTM D2726	2.188	2.088	Report	3/4"	82.8%	97.1%
				1/2"	75.7%	88.8%
Rice Specific Gravity, ASTM D2041	2.453	2.500	Report	3/8"	63.2%	79.2%
				No. 4	45.4%	54.7%
Air Voids, %	10.8	16.5	Report	No. 8	33.4%	38.7%
				No. 16	21.0%	19.7%
ITS of control samples, ASTM D 4867, psi	68.5	62.0	40 psi min.	No. 30	11.2%	12.8%
				No. 50	5.4%	9.0%
ITS of conditioned samples, ASTM D 4867, psi	45.9	36.0	25 psi min.	No. 100	2.6%	7.7%
				No. 200	1.8%	7.3%

Sampling to Verify Gradation

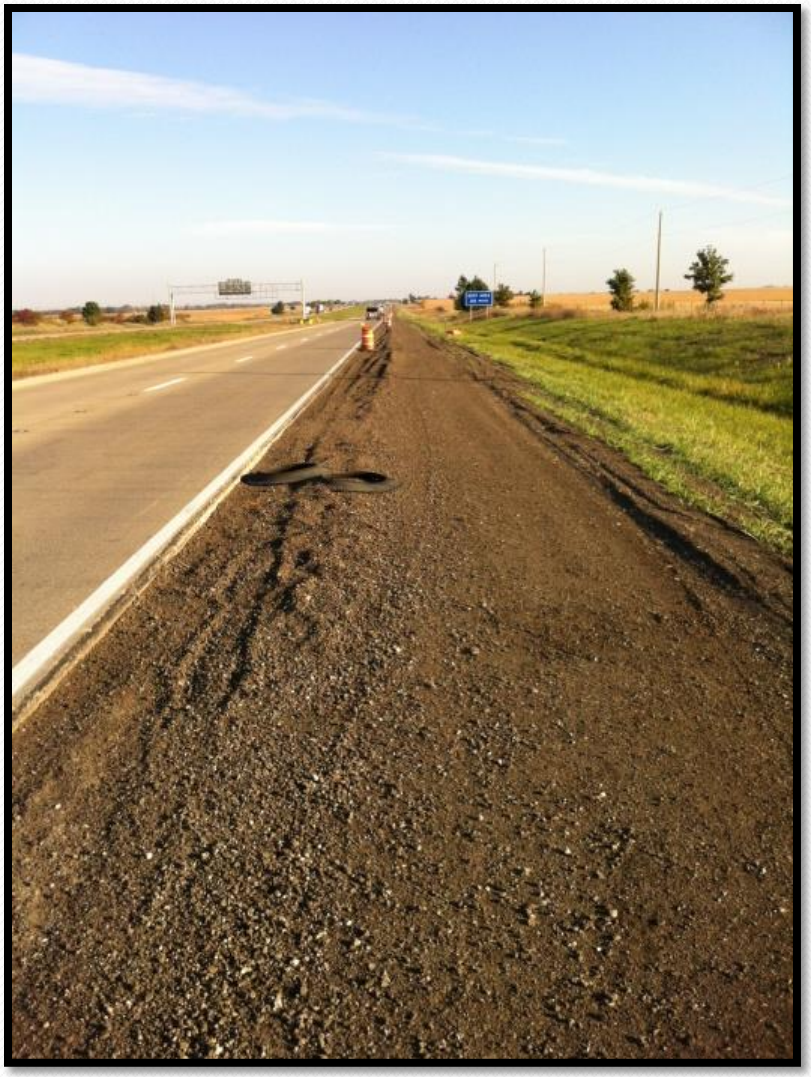


Density Determination

- Wet Proctor ranged from 133.8 to 138.1 pcf
- Spec called for growth curve (did not do)
- Inconsistent densities

Emulsion

Problem



Core at 2 Months

Core at 1 year

Presently

Falling Weight Deflectometer

- Performed approx. 1 year after construction
- Deflections > 50 mils
- Past projects ranged from 10 to 20 mils
- Old shoulders (control) were tested around 24 mils

Conclusions

- Spec needs work
  - Growth curve is not practical
    - Remove requirement from spec
  - Must include emulsion as pay item
    - When having density issues allows contractor to increase emulsion, not just add water
  - Should determine dry density not wet
    - Could falsify density by increasing moisture
  - Need to come up with accurate gradation in mix design
    - Make multiple gradations (coarse/medium/fine)
  - Require 2 QC personnel on project
    - Allows QC to perform on-site gradation and monitor operations at same time

Future

- Bad experience, not bad concept
- Working on cement/fly ash alternative spec
- Alternative to reconstruction