

HMA Thin Lifts for Pavement Preservation in Tennessee

MARK WOODS, P.E.
TDOT DIV. OF MATERIALS AND TESTS



The Tennessee Program

- 5,109 Interstate Lane Miles
- 26,244 State Route LM
- 31,353 Total*

* As of 2008



The Tennessee Program

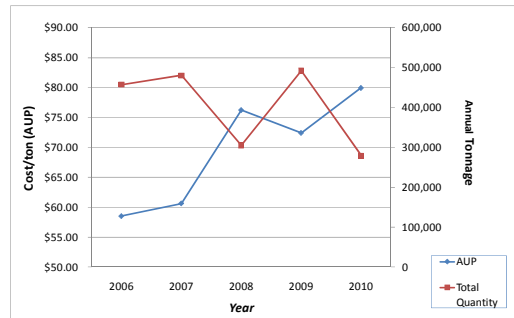
- Historically, resurfacing practices involved milling the surface and replacing with 3-4" binder and 1-1/4" surface.

→ *The "Worst First" approach.*

"If it ain't broke, don't fix it."



Average Unit Price "411-D" 12.5-mm NMAS PG64-22



2008 Bituminous Adjustments

• Bituminous Adjustments*

- Interstates - \$4,984,504.33
- State Routes - \$8,268,530.42

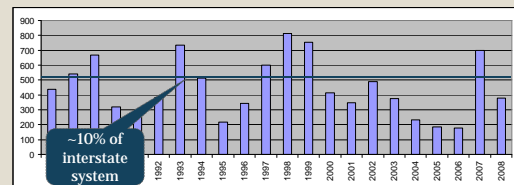
• Total - \$13,253,034.75

→ Approximately 10% of TDOT's resurfacing program.



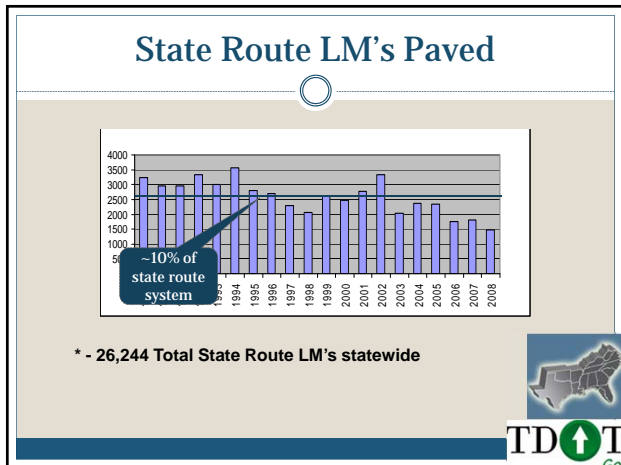
* - As of 10/30/2008

Interstate LM's Paved



* - 5,109 Total Interstate LM's statewide





Tennessee Pavement Preservation Initiative

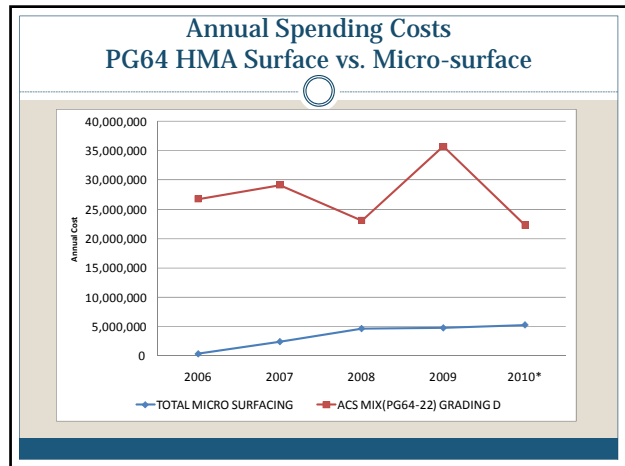
- “The department has made the decision to increase our use of preventive maintenance treatments on state routes to approximately \$10 million (10%) of the budget for pavement management/resurfacing in 2008.”

March 27, 2008

Tennessee Pavement Preservation Initiative

- A July 25th Letter to TN FHWA Office – A “List of Preventive Maintenance Activities...”
 - “Ultra-Thin (<1”) and Thin (1”& 1-1/2”) Asphalt Overlays”
 - Micro-surfacing
 - Etc.....

July 25, 2008



4.75-mm Pooled Fund Project

- TDOT's first official “thin lift”
- SR-50, Robertson Co.
- 2.5 miles
- 1 lane 15% Rap, 1 lane virgin
- Average core thickness 0.91”
- Range 0.73 – 1.25”

4.75-mm Pooled Fund Project

		Virgin	Recycle
Design	Opt. AC	6.8	6.8
	Design Air Voids	6	6
	VMA	21	20.8
	VFA	70	72
	Vbe	15.0	14.8
	Stability (lb)	3677	3677
	Flow (0.01 in)	16.0	15.2
	DAR	1.78	1.78

N_{des} = 50 gyrations

4.75-mm Pooled Fund Project

		Virgin	Recycle
Produced	Placement Date	6/17/2008	6/18/2008
	%AC	6.41	6.62
	Prod. Air Voids	3.5	2.5
	VMA	17.9	17.4
	VFA	80.4	85.4
	Vbe	14.4	14.9
	Stability (lb)	4283	3950
	Flow (0.01 in)	19.1	16.7
DAR		1.91	1.90
APA Rut Depths (mm)		6.3	5.3



4.75-mm Pooled Fund Project



4.75-mm Pooled Fund Project



Tennessee's New "Thin Lift" Mixes

- Prior to 2008, TN's smallest surface mix was 1/2" (12.5-mm) NMA, typically placed at 1-1/4"
- Two new gradations were developed for:
 - 3/8" (9.5mm)
 - 1/4" (4.75 mm)
 → Both Marshall Mix Design

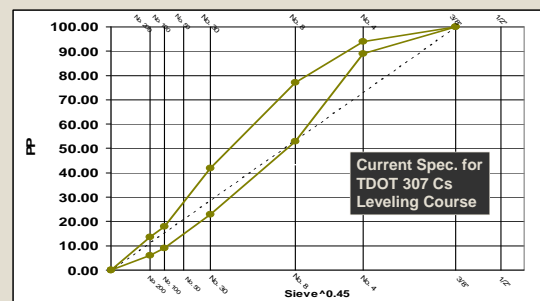


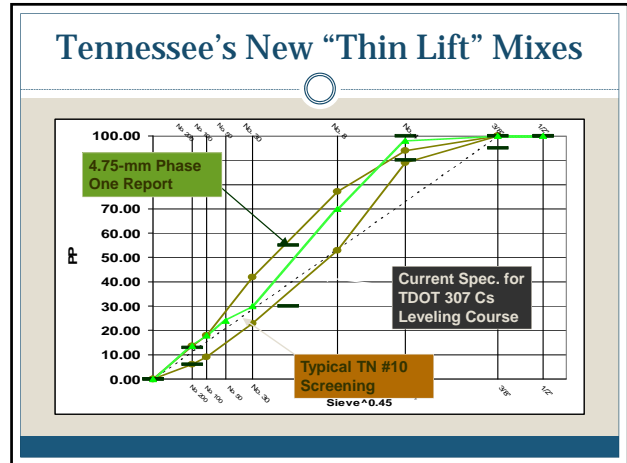
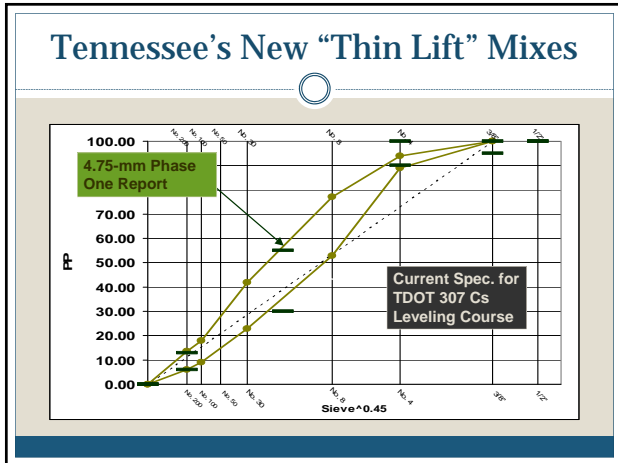
Tennessee's New "Thin Lift" Mixes

- The FIRST new mix specification:
 - Titled 411 "TL"
 - 1/4" (4.75-mm) NMA
 - 75-blow Marshall spec
- Developed based on:
 - 4.75-mm SP specification from the Pooled Fund Phase One draft report
 - Local materials
 - TDOT's current specification for 307-Cs leveling course.
 - A "screenings mix" for surface



Tennessee's New "Thin Lift" Mixes





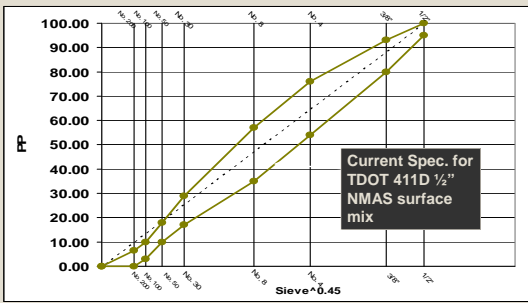
- ### 411 TL Specification
- Gradation limits for 411-TL were set essentially the same as TDOT 307-Cs leveling course
 - This specification allowed for less #4 and no 3/8, to permit lighter application rates.
-

- ### 411 TL Specification
- 1/4" (4.75-mm) NMAS
 - 6.0-8.0 allowable optimum AC%
 - VTM: 4.0±0.2%*
 - Minimum 16% VMA
 - Minimum Stability: 2000 lb
 - DAR: 1.0 - 2.0
 - Maximum 15% natural sand
 - Maximum 15% RAP (Processed -5/16")
 - Minimum 50% approved non-polishing surface aggregates
-

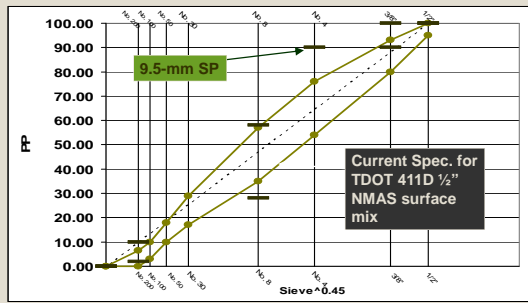
- ### 411 TL Specification
- 4 Projects were let in June 2008 under this specification at prescribed spread rates of 85, 65, and 45 lbs/yd² (Approx. thickness of 7/8", 5/8", and 1/2", respectively)
 - 2 project were awarded:
 - Greene Co. – 45 lbs/yd²
 - Hickman Co. – 65 lbs yd²
-

- ### Tennessee's New "Thin Lift" Mixes
- The SECOND new mix specification:
 - Titled 411 "TLD"
 - 3/8" (9.5-mm) NMAS
 - 75-blow Marshall spec
 - Developed based on current TDOT specification for 411-D, typical 1/2" (12.5-mm) NMAS surface mix
-

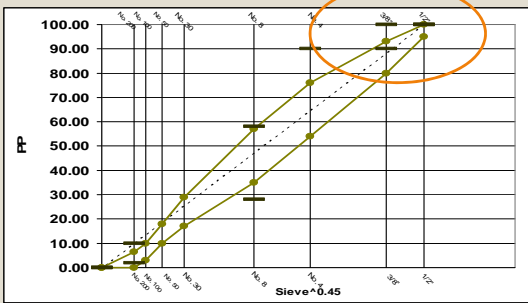
Tennessee's New "Thin Lift" Mixes



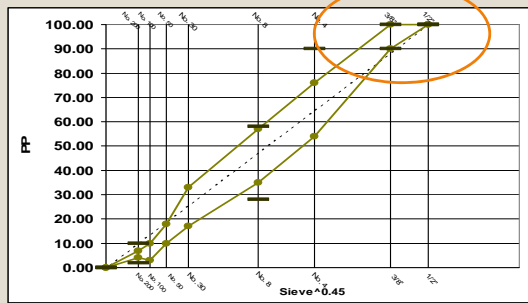
Tennessee's New "Thin Lift" Mixes



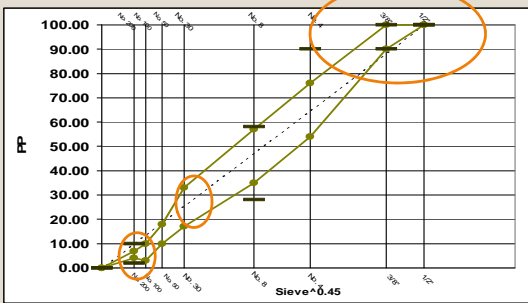
Tennessee's New "Thin Lift" Mixes



Tennessee's New "Thin Lift" Mixes



Tennessee's New "Thin Lift" Mixes





411 TLD Specification

- 3/8" (4.75-mm) NMAS
- 5.3-7.0 allowable optimum AC%
- VTM: 3.8±0.3%*
- Minimum 14% VMA
- Minimum Stability: 2000 lb
- DAR: 0.6-1.2
- Maximum 15% RAP (Processed -5/16")





411 TLD Specification

- 3 Projects were let in June under this specification at a prescribed spread rates of 85 lbs/yd² (Approx. thickness of 7/8")
- 1 project was awarded in Campbell Co.

"Thin-lift" Letting



- 7 total thin lift projects were let in June 2008.
- 3 projects were awarded based on cost per square yard.

"Thin-lift" Letting - 2008

PROJECT	TYPE MIX	NMAS	APPLICATION RATE (lbs/yd ²)	COST (\$/ton)	COST (\$/yd ²)
MICRO*	Micro	1/4" (4.75-mm)	22 (Agg)	173.28	2.13
CNG203	411TL	1/4" (4.75-mm)	45	112.00	2.52
CNG098	411TL	1/4" (4.75-mm)	65	84.50	2.75
CNG088	411TL	1/4" (4.75-mm)	65	98.25	3.19
CNG195	Micro	1/4" (4.75-mm)	32 (Agg)	173.28	3.20
CNG202	411TLD	3/8" (9.5-mm)	85	76.25	3.24
CNG174	411TLD	3/8" (9.5-mm)	85	82.00	3.49
CNG081	411TLD	3/8" (9.5-mm)	85	92.50	3.93
CNG204	411TL	1/4" (4.75-mm)	85	99.00	4.21
411D*	411D	1/2" (12.5-mm)	132.5	75.53	5.00

*Hypothetical data collected from previous lettings

Hickman Co. Existing Surface








Hickman Co. Existing Surface





Hickman Co. 65 lb/yd² 1/4" Mix








Hickman Co. 65 lb/yd² ¼" Mix







Hickman Co. 65 lb/yd² ¼" Mix

APA Rut Depths

- Campbell Co (3/8" NMAS) – 3.97 mm
- Greene Co. (¼" NMAS) – 5.67 mm

Alternate Bid Contracts

In the March 2009 contract letting, TDOT announced 9 contracts to be alternate bid between 411TL thin lift asphalt and micro-surface.

- 8 contracts: 45 lb/yd² HMA thin lift vs. 22 lb/yd² micro
- 1 contract: 65 lb/yd² HMA thin lift vs. 36 lb/yd² micro

Alternate items were quantified by the square yard.

Alternate Bid Contracts

March 2009

County	Square Yards	Lowest Unit Price		Application Rate (lbs/yd ²)		L (mi)	Award	Approx cost/ton	
		PG64 411TL	Micro	PG64 411TL	Micro			PG64 411TL	Micro
Clairborne	64,533	2.26	2.26	45	22	4.4	HMA	100.44	205.45
Grundy	78,318	2.06	2.27	45	22	4.8	Micro	91.56	206.36
Hardin	82,368	2.45	2.27	65	36	6.54	HMA	75.38	126.11
Lincoln	201,800	1.91	2.01	45	22	13.76	HMA	84.89	182.73
Macon	78,892	2.20	2.00	45	22	6.19	HMA	97.78	181.82
Overton	64,218	2.5	2.38	45	22	4.12	HMA	111.11	216.36
Sevier	46,206	1.9	2.24	45	22	3.52	HMA	84.44	203.64
Stewart	84,480	1.53	2.27	45	22	6	HMA	68.00	206.36
Warren	98,462	2.05	2.02	45	22	6.62	Micro	91.11	183.64

- 55.95 center line miles total
- 2009 AUP for 411TL by ton: \$79.60
- Approx. 2009 AUP for micro-surface by ton: \$187

Alternate Bid Contracts

March 2010

County	Square Yards	Lowest Unit Price		Application Rate (lbs/yd ²)		L (mi)	Award	Approx cost/ton	
		PG64 411TL	Micro	PG64 411TL	Micro			PG64 411TL	Micro
Bedford	200,831	-	2.42	85	32	12.8	Micro	-	151.25
Hawkins	349,395	3.09	1.81	65	22	24.54	Micro	95.08	164.55

- 37.34 miles total
- 2010 AUP for 411TL by ton: \$74.28
- Approx. 2010 AUP for micro-surface by ton: \$180

Thin Lift and Micro Quantities

Description	Unit	Total Quantity				
		2006	2007	2008	2009	2010
ACS MIX(PG64-22) GRADING D	TON	457368	480619	305301.6	492664.6	279376
ACS MIX(PG64-22) THIN LIFT CS ASPHALT	S.Y.				698574	-
ACS MIX(PG64-22) THIN LIFT CS ASPHALT	TON			5249	13359	9515
ACS MIX(PG76-22) THIN LIFT CS ASPHALT	TON					132
ACS MIX(PG64-22) THIN LIFT D ASPHALT	TON				40556	26341
ACS MIX(PG70-22) THIN LIFT D ASPHALT	TON			11355	16660	14789
EMULSIFIED ASPHALT FOR MICRO SURFACING	TON	297	2029	3388	2942	2394
AGGREGATE FOR MICRO SURFACING	TON	2462	16763	28189	23701	19899
MICRO SURFACING	S.Y.				176780	837631

As of November 2010, over 300 centerline miles placed of 411TL and 411TLD placed.

Federal Projects

The Tennessee FHWA and Federal Lands office adopted the two provisions for use on multiple projects including:

- Between Gatlinburg and Pigeon Forge 85 lb/yd²
- ~30 centerline miles on Natchez Trace Parkway

Conclusions / Recommendations

- All thin mixes are best accompanied by a proper application of tack coat, preferably polymer modified.
- The >2"NMAS lift thickness rule of thumb should still apply.
- TDOT currently plans on limiting these mixes to lower volume routes.
- Micro vs thin lift HMA alternates were successful. Need to evaluate lifespan of each product at various application rates to evaluate comparability.

