



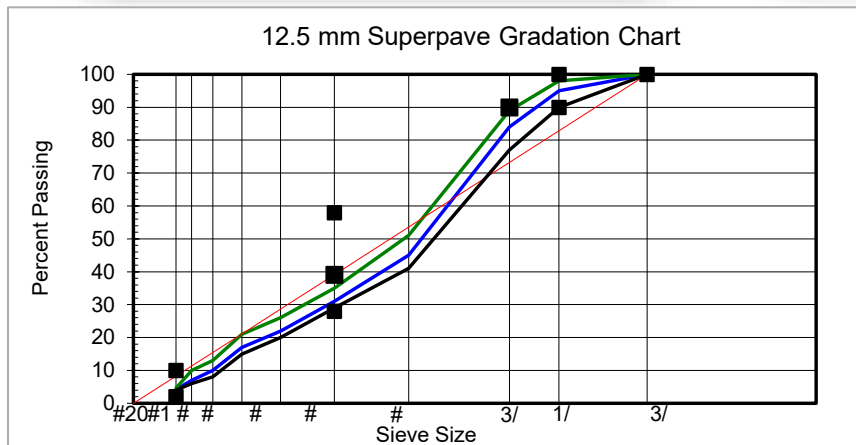
Florida Department of  
**TRANSPORTATION**

# **Construction Academy**

## **Asphalt 101**

**Jim Musselman**  
**State Asphalt Materials Engineer**  
**September 2025**

## A cylindrical sample of dark, porous material, likely a carbon aerogel, showing a highly textured, granular surface. The material is dark brown to black with a complex, interconnected network of fibers or pores visible on its surface. It is placed on a light-colored, flat surface against a dark background.



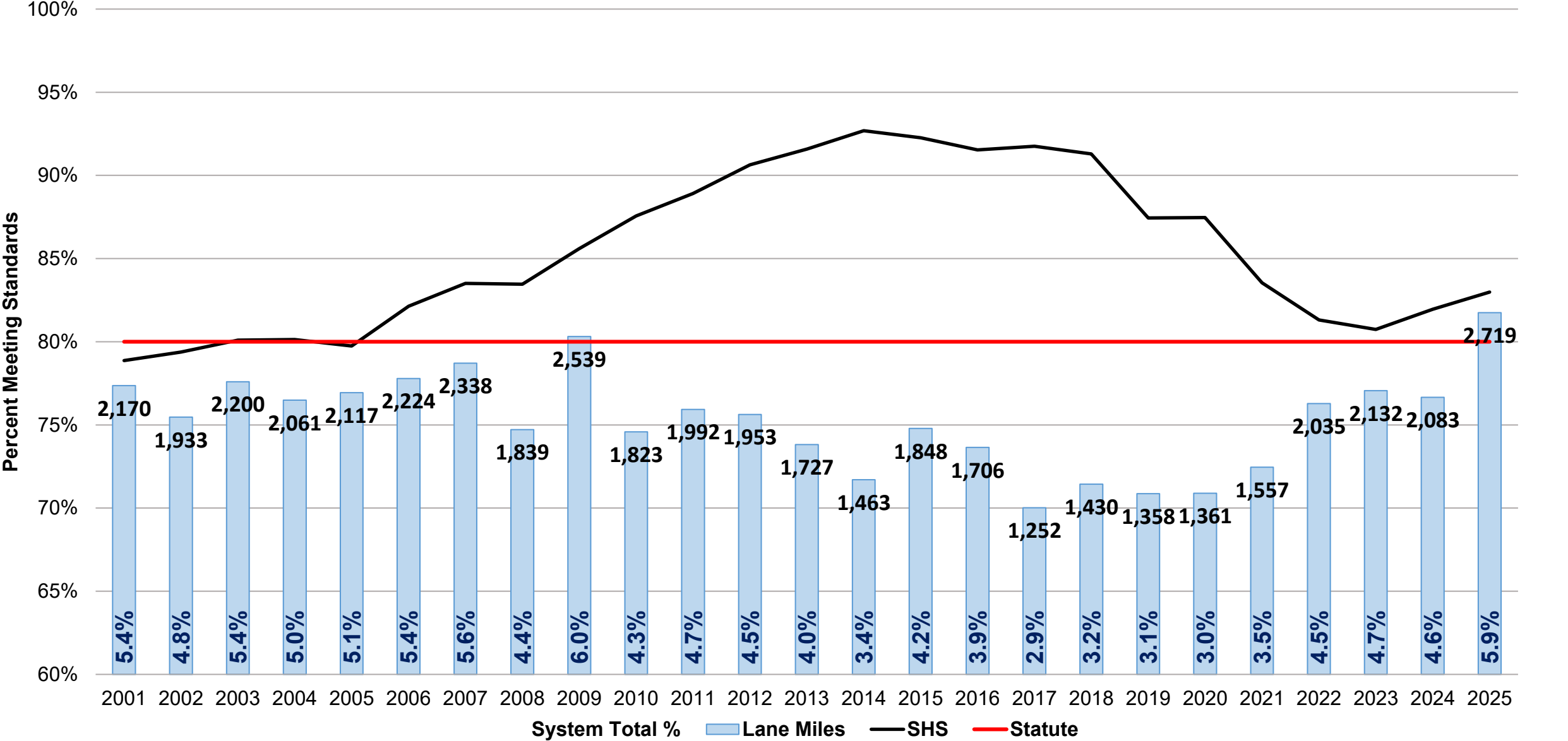
# State Highway System

- 45,742 lane miles
  - 8,844 Interstate lane miles (19.3%)
  - 34,356 Arterial lane miles (75.2%)
  - 2,542 Turnpike lane miles (5.5%)
- 97.3% of pavement is asphalt
- 2.7% of pavement is concrete



# State Highway System

## Lane Miles Resurfaced and Percent Meeting Standards



# What is in an Asphalt Mixture?

## Asphalt Binder

- Binds the aggregate together
- Provides...
  - the “glue”
  - lubrication for compaction
  - durability (resistance to cracking)
- The most expensive part of an asphalt mix
  - ~\$600 – \$800/ton

## Aggregate

- Provides the majority of the load carrying ability of the pavement.
- Needs to be strong, durable, consistent, clean, and available
- Cost ~\$25 – \$50/ton

## Other things:

- Reclaimed Asphalt Pavement (RAP), Stabilizing fibers, Hydrated lime, liquid anti-strip additives, warm mix additives,



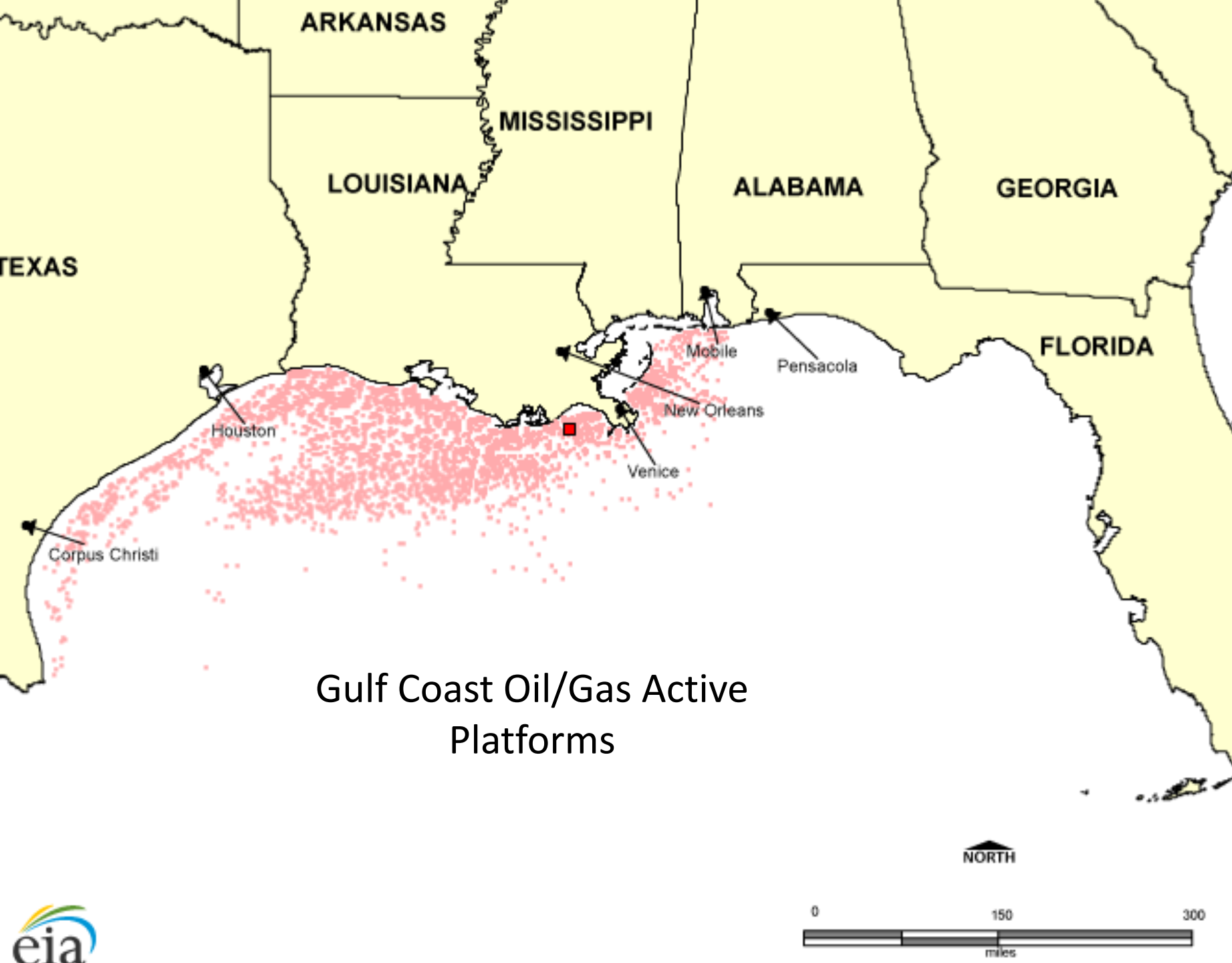
A close-up photograph showing a thick, dark, viscous liquid being poured from a glass container into a shallow, circular dish. The liquid is dark and glossy, and the pouring action is captured in a way that shows its thick consistency. The background is a soft, out-of-focus gradient of light blue and white.

Asphalt Binder

# Where does asphalt come from?

Crude Oil





## Gulf Coast Oil/Gas Active Platforms

Uncheck or check an item to hide or show it in the map.

- ☐ Electric Power Plants ( $\geq 100$  MW)
  - Coal ▲
  - Hydroelectric ◆
  - Natural Gas ▼
  - Nuclear ⬮
  - Petroleum ●
  - Wood 🌲
  - Wind ⚡
  - Other ●
- ☐ Electricity Transmission Lines ( $\geq 345$ kV) ———
- ☐ Electricity Transmission Lines ( $< 345$ kV) ———
- ☐ LNG terminals ⚓
- ☐ Natural Gas Market Centers (Hubs) ⚡
- ☐ Natural Gas Processing Plants ◆
- ☐ Natural Gas Interstate, Intrastate, and Gathering Pipelines ———
- ☐ Oil Import Site & Oil Seaports ⚓
- ☐ Petroleum Refineries ■
- ☐ Propane Hub ✖
- ☒ Louisiana Offshore Oil Port ■
- ☐ Strategic Petroleum Reserves ●
- ☒ Oil/Gas Active Platforms ■

Show All

Hide All



Pipeline



## Crude Oil Transportation

Tanker







Oil Refinery



## Gulf Coast Oil Refineries

Uncheck or check an item to hide or show it in the map.

☐ Electric Power Plants ( $\geq 100$  MW)

Coal ▲

Petroleum ●

Hydroelectric ◆

Wood ⬆

Natural Gas ▼

Wind ✕

Nuclear ⚙

Other ●

☐ Electricity Transmission Lines ( $\geq 345$ kV) ———

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☐ LNG terminals ✕

☐ Natural Gas Market Centers (Hubs) ⬆

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☐ Natural Gas Interstate, Intrastate, and Gathering Pipelines ———

☐ Oil Import Site & Oil Seaports ⬆ ⚙

☒ Petroleum Refineries ■

☐ Propane Hub ✕

☐ Louisiana Offshore Oil Port ■

☐ Strategic Petroleum Reserves ●

☐ Oil/Gas Active Platforms ■

Show All

Hide All



# Material Barged from Refinery to Terminal





# Rail Transportation



# Asphalt Binder Terminal





# Asphalt Binder Terminal



Jan 23, 2023 11:10:43 AM  
36° NE



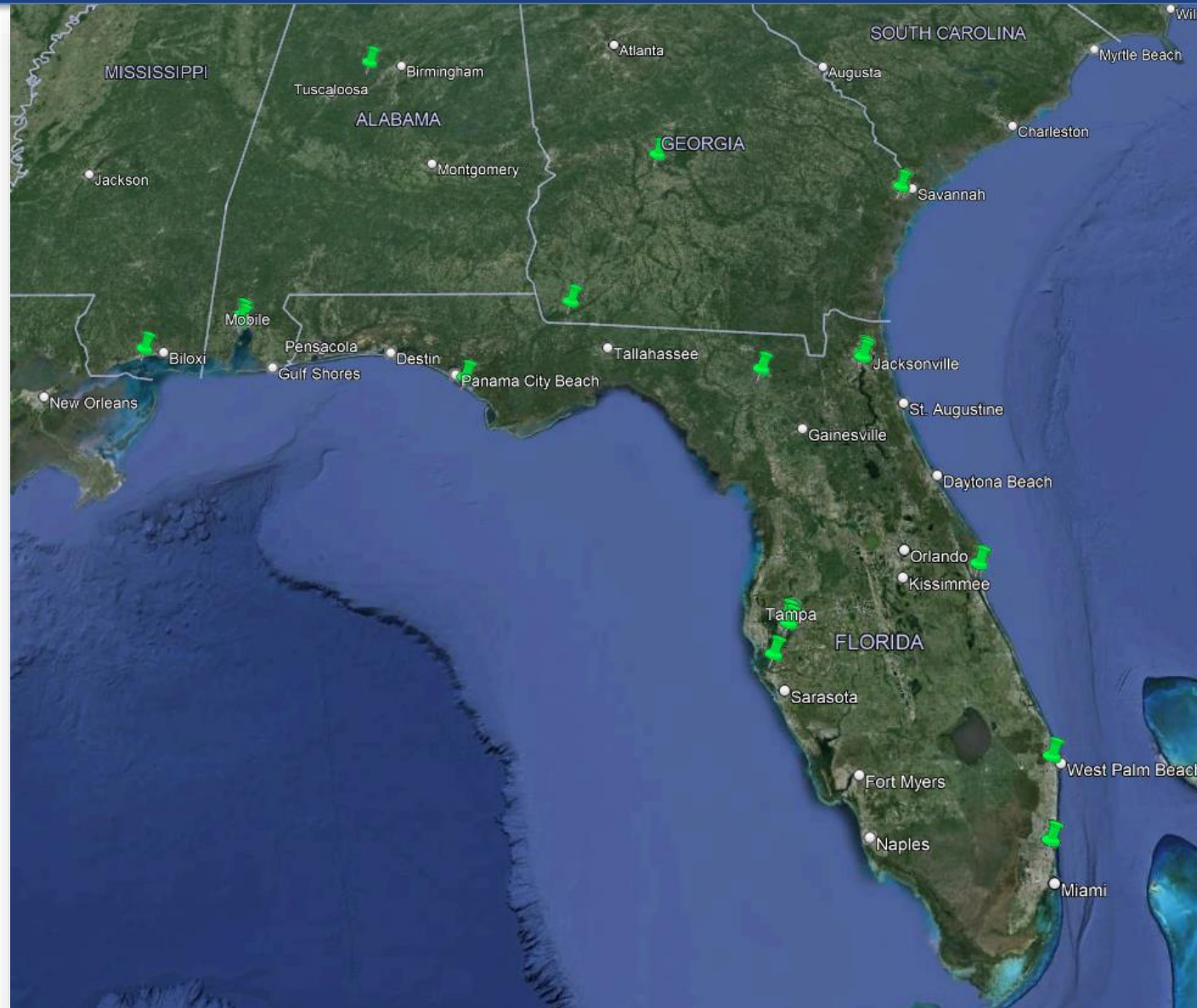


Florida Department of Transportation

Binder Delivered to  
Asphalt Plant



# Asphalt Binder Terminals in Florida

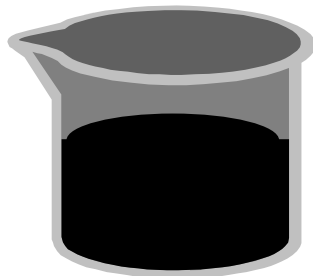


# Superpave Asphalt Binders

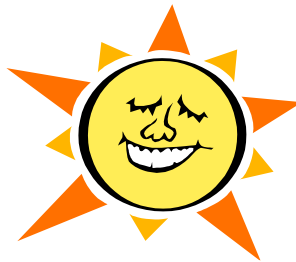
Grading system based on climate

**PG 67-22**

Performance  
Grade



Average 7-day  
max pavement  
design temp (°C)



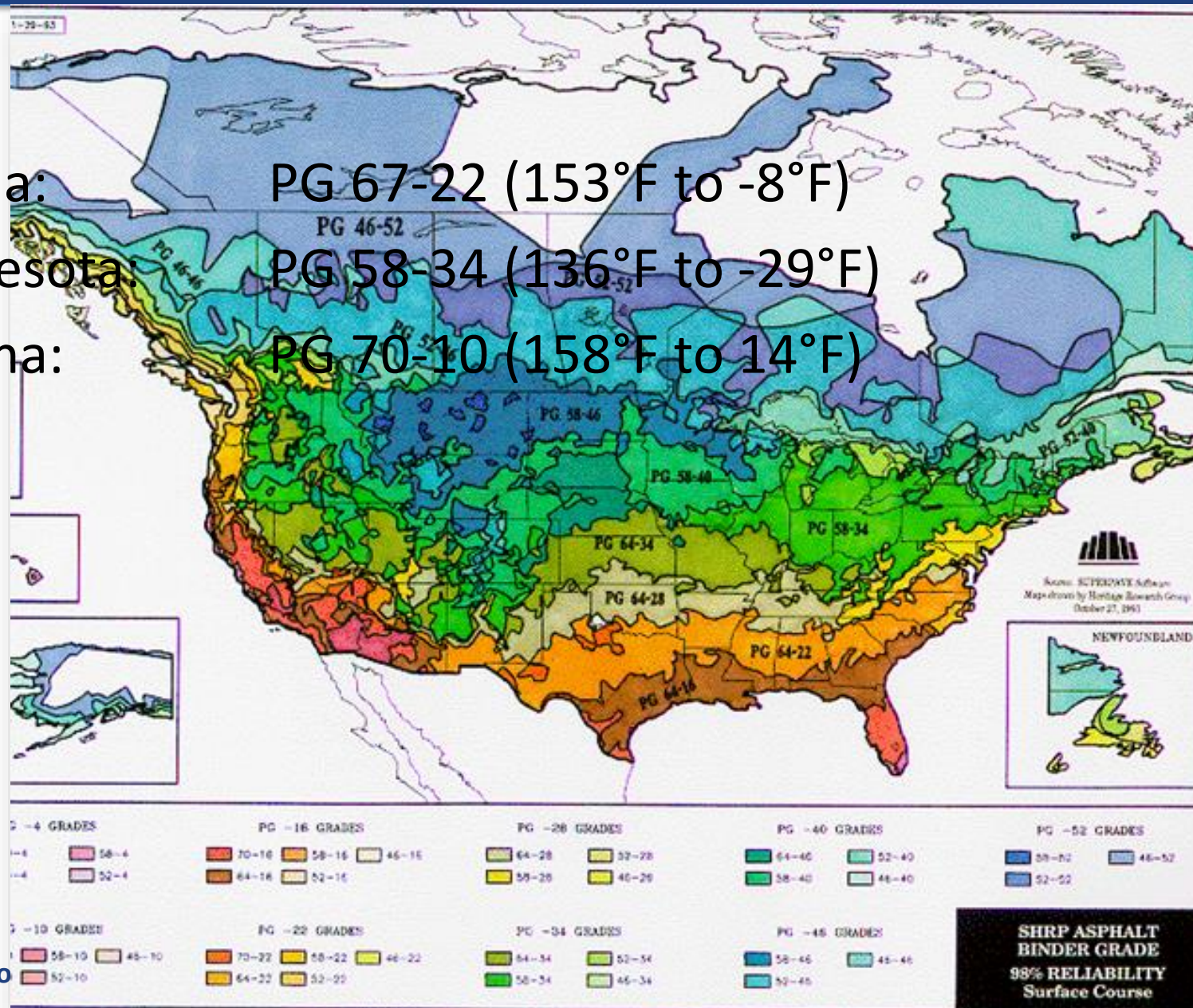
Min pavement  
design temp (°C)





# EXAMPLES OF PG GRADING SYSTEM

- Florida: PG 67-22 (153°F to -8°F)
- Minnesota: PG 58-34 (136°F to -29°F)
- Arizona: PG 70-10 (158°F to 14°F)



# FDOT Unmodified Asphalt Binders (Section 916)

- PG 67-22:
  - Used with 0 – 15% Reclaimed Asphalt Pavement (RAP)
- PG 58-22:
  - Used with 16 – 30% RAP
- PG 52-28
  - Used with > 30% RAP

Softer binders are used to offset the stiffness from the oxidized RAP binder

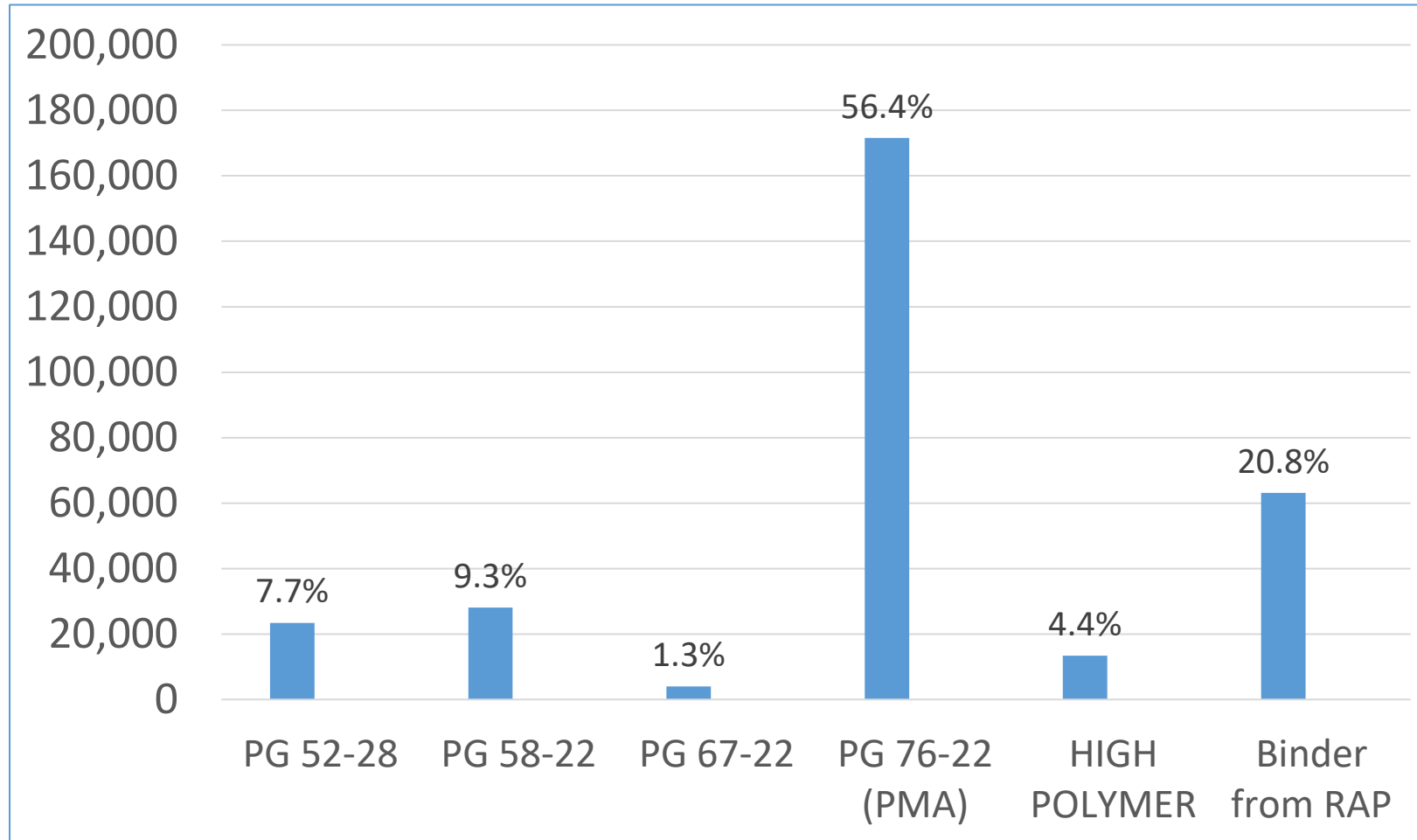


# Modified Asphalt Binders (Section 916)

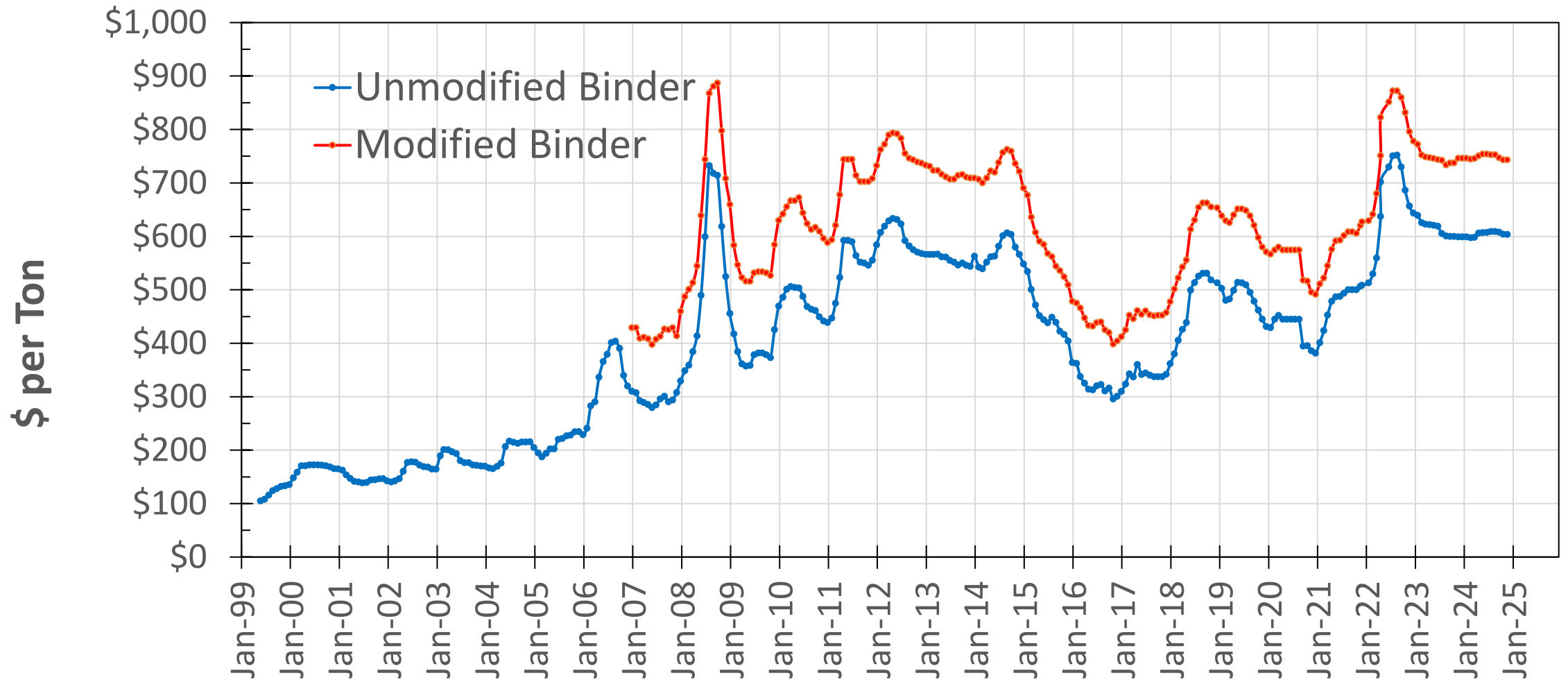
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- PG 76-22 (PMA)
  - PG 67-22 base asphalt
  - Polymer Modified Asphalt
    - Styrene-Butadiene-Styrene (SBS) Polymer
- PG 76-22 (ARB) – Not used
  - PG 67-22 base asphalt
  - Minimum 7% ground tire rubber (GTR)
  - Polymer modification optional
- High Polymer (PMA)
  - PG 58-22 base asphalt
  - Polymer Modified Asphalt (SBS Polymer)

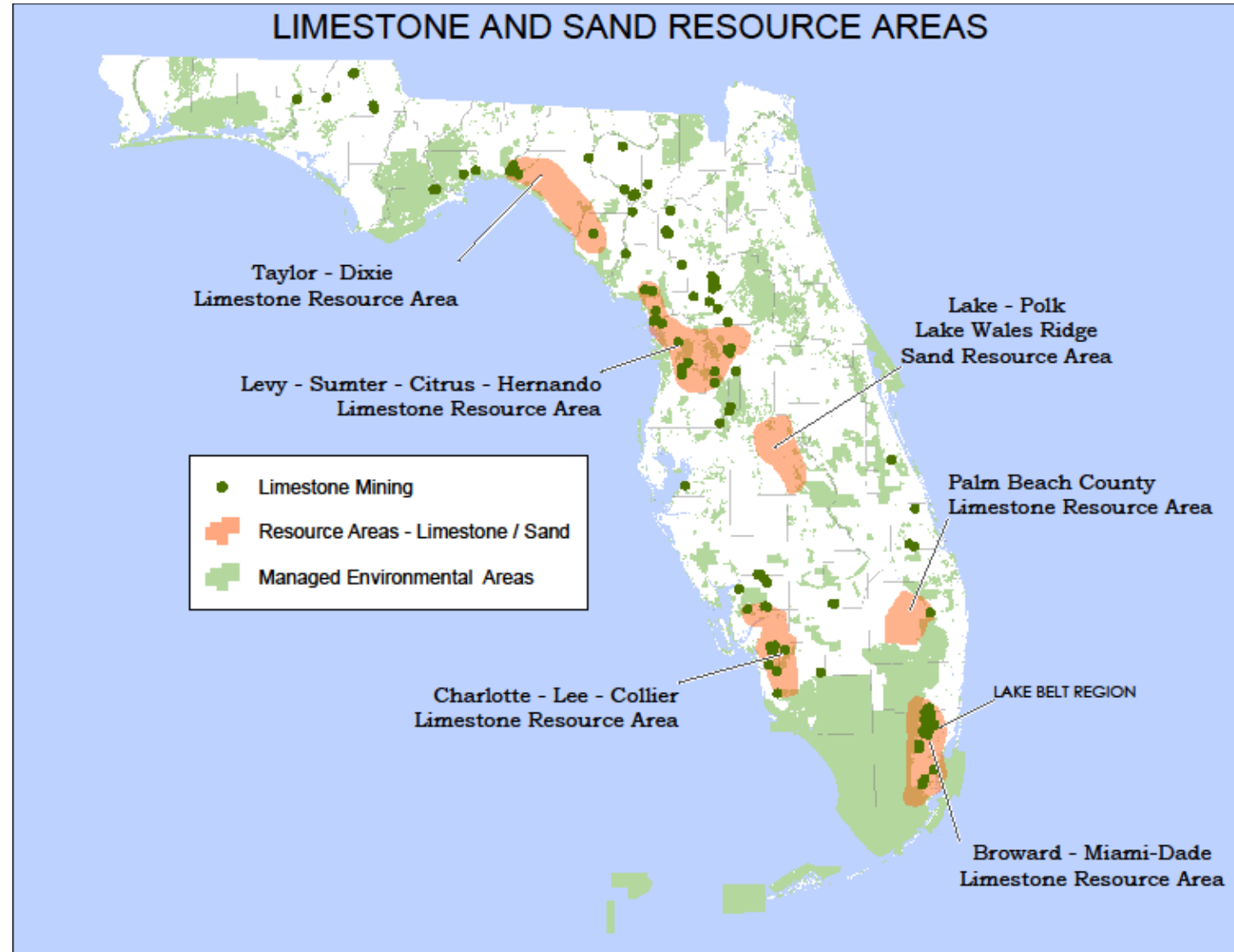
# Binder Tonnage (FY 23/24)



# Asphalt Binder Price Index (\$/Ton)



# Aggregate





# Limestone (Miami)





# Granite (Georgia)





# Aggregate Mines and Terminals



# Approved Asphalt Plants





# Asphalt Mixtures

- Superpave Asphalt Concrete (Section 334)
  - Structural asphalt mixtures
  - SP-9.5, SP-12.5, SP-19.0
- Asphalt Concrete Friction Courses (337)
  - FC-9.5, FC-12.5
  - FC-5 (Open Graded Friction Course)
- Superpave Asphalt Base (234)
  - B-12.5

SP = Structural Course

FC = Friction Course

B = Base Course

9.5, 12.5, 19.0 = Largest Aggregate size

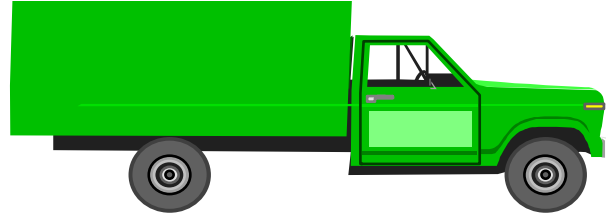


# Type SP Mixtures - Structural (Section 334)

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- Purpose: Load carrying portion of pavement
  - Superpave Mix Design
- Three mixes based on maximum aggregate sizes
  - 9.5 mm (SP-9.5)
  - 12.5 mm (SP-12.5)
  - 19.0 mm (SP-19.0)
- Three Traffic Levels (B, C, E)
  - Based on 18,000 lb. Equivalent Single Axle Loads (ESAL's)
  - Low traffic = B, High traffic = E

# ESAL Examples



**15,000 lb**

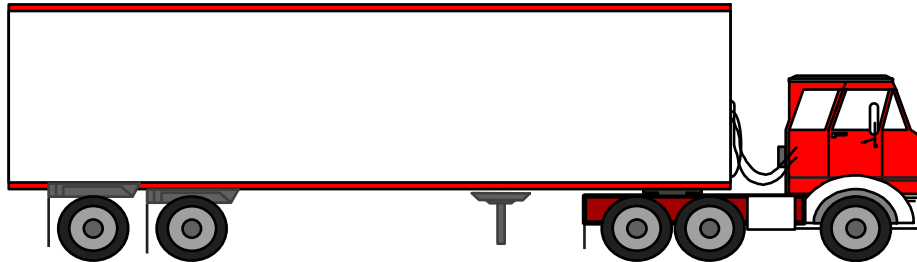
**0.48 ESAL**

**6,000 lb**

**+ 0.01 ESAL**

**=**

**0.49 ESALs**



**34,000 lb**

**1.10**

**+**

**34,000 lb**

**1.10**

**+**

**12,000 lb**

**0.20**

**=**

**2.40 ESALs**



# Mix Design Traffic Levels

Traffic Level	ESAL's
B	0 to < 3 million ESAL's
C	3 million < 10 million ESAL's
E	≥ 10 million ESAL's

Traffic Levels  
are found in the  
Contract

ESALs come  
from  
Planning

ESAL predictions are based on the design life of the pavement – typically 20 years.

**TL-B**  
0 to < 3 million ESAL's



# Traffic Levels

**TL-C**  
3 to 10 million ESALs





**TL-E**  
≥10 million ESAL's



# Traffic Levels

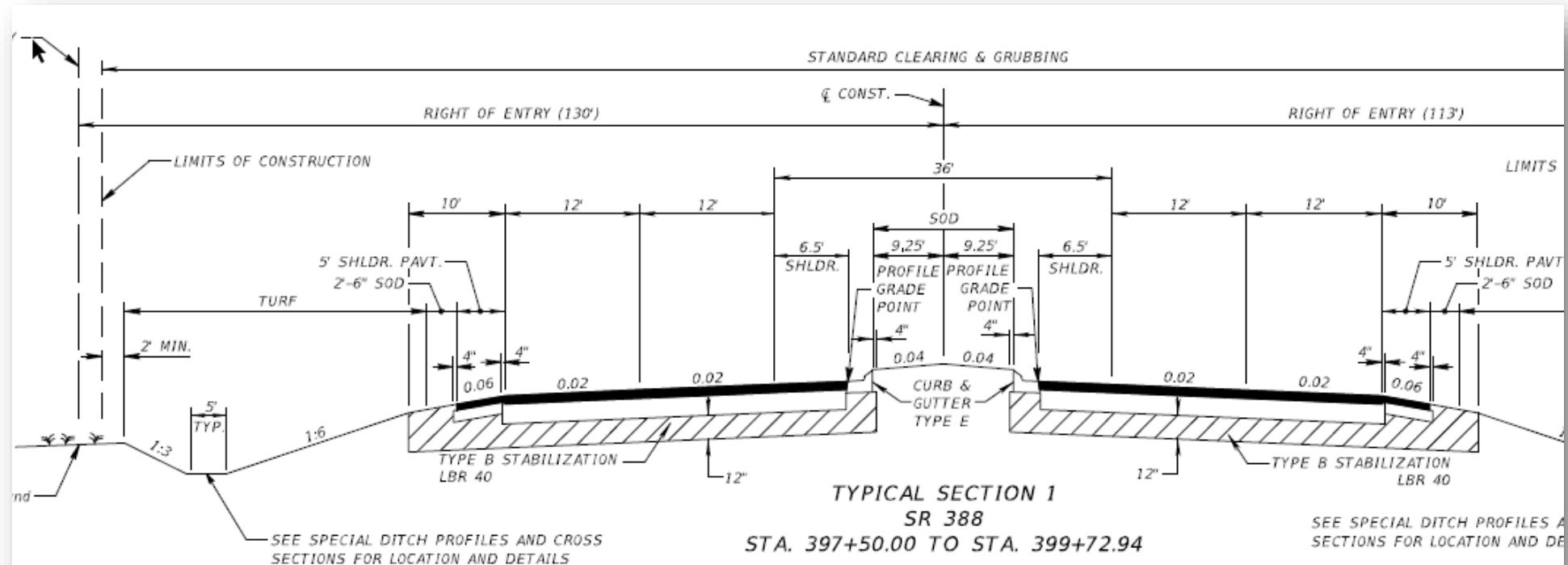
**TL-E**  
≥ 10 million ESAL's



SR. 826 N.B. 6/6/2006 4:56 PM  
FROM N.W. 36 STREET



# Typical Section



## NEW CONSTRUCTION

OPTIONAL BASE GROUP 9 WITH  
TYPE SP STRUCTURAL COURSE (TRAFFIC C) ( $3\frac{1}{2}$ ") (PG 76-22)  
AND FRICTION COURSE FC-5 ( $\frac{3}{4}$ ") (PG 76-22)

## SHOULDER PAVEMENT

OPTIONAL BASE GROUP 1 WITH  
TYPE SP, STRUCTURAL COURSE (TRAFFIC C) ( $1\frac{1}{2}$ ") (PG 76-22)  
AND FRICTION COURSE FC-5 ( $\frac{3}{4}$ ") (PG 76-22)

## TRAFFIC DATA

CURRENT YEAR = 2014 AADT = 4,500  
ESTIMATED OPENING YEAR = 2020 AADT = 10,500  
ESTIMATED DESIGN YEAR = 2040 AADT = 20,600  
K = 9.0% D = 55.8% T = 11.7% (24 HOUR)  
DESIGN HOUR T = 5.85%

CLEAR ZONE = 24' (50 MPH)

NOTE: DESIGN CLEAR ZONE DOES NOT APPLY  
TO CLEAR ZONE WIDTHS FOR WORK ZONES.

# Traffic Level and Binder Type Shown on Plans

## *NEW CONSTRUCTION*

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OPTIONAL BASE GROUP 9 WITH  
TYPE SP STRUCTURAL COURSE (TRAFFIC C) ( $3\frac{1}{2}$ " ) (PG 76-22)  
AND FRICTION COURSE FC-5 ( $\frac{3}{4}$ " ) (PG 76-22)

## *SHOULDER PAVEMENT*

---

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AND FRICTION COURSE FC-5 ( $\frac{3}{4}$ " ) (PG 76-22)

# Asphalt Mix Design

Mix design is the “recipe” that the contractor will use to produce their mixture

Contains some of the targets that are used for payment

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

ASPHALT MIX DESIGN - SPM 16-14835A (TL-C)

Owning Company Coastal Bridge LLC

Type Mix SP-9.5 Intended Use Of Mix Structural

Design Traffic Level C Gyration @ Ndes 75

Product	Description	Name	Production Facility	Plant/Mine	Terminal
334-CRUSHED	Crushed RAP Stockpile	1-16	Coastal Bridge LLC	A0139	
C54	S1B Stone		Martin Marietta Aggregates	NS315	
F22	Screenings	Screenings	Martin Marietta Aggregates	NS315	
Sand	Sand				

PERCENTAGE BY WEIGHT TOTAL AGGREGATE PASSING SIEVES

Blend	20%	20%	45%	15%				JOB MIX FORMULA	CONTROL POINTS	PRIMARY CONTROL SIEVE
Product	334-CRUSHED RAP	C54	F22	Sand						
3/4" 19.0mm	100	100	100	100				100		
1/2" 12.5mm	99	100	100	100				100	100 -	
3/8" 9.5mm	97	92	100	100				98	90 - 100	
No. 4 4.75mm	81	39	100	100				84	- 89	
No. 8 2.36mm	64	8	74	100				63	32 - 67	47
No. 16 1.18mm	53	4	47	100				48		
No. 30 600µm	46	2	30	95				37		
No. 50 300µm	34	2	17	80				27		
No. 100 150µm	18	1	10	35				14		
No. 200 75µm	8.3	1.0	5.0	2.0				5.9	2 - 10	
G <sub>sb</sub>	2.614	2.625	2.580	2.644				2.605		

The mix properties of the Job Mix Formula have been conditionally verified, pending successful final verification during production at the assigned plant, the mix design is approved subject to F.D.O.T. specifications. UMF reflects aggregate changes expected during production.

Total Binder Content	5.7	%	Gmb @ Ndes	2.345
Compaction Oven Corr. Factor	0.00		Gmm	2.442
(* To Be Added) (- To Be Subtracted)				
Gmm Corr. Factor	-0.002		Va	4.0
Mixing Temp.	320	*F	VMA	15.1
(Plant)				
Compaction Temp.	320	*F	VFA	74
(Roadway)				
Spread Rate @ 1"	106	lb/yd <sup>2</sup>	P-200/Pbe	1.2

Effective Date 8/16/2016

Expiration Date 8/16/2019





# Dense-Graded Friction Courses (Sections 337 / 334)

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- Good microtexture
  - Function of the aggregate
- Superpave mixes:
  - FC-9.5
  - FC-12.5
- Aggregate Types: Miami limestone, granite, basalt, gabbro, granitic gneiss, quartzite, shell rock
  - Polish resistant
- PG 76-22 (PMA) binder
- High Polymer binder when specified in the plans

# Open-Graded Friction Courses, FC-5 (Section 337)

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- Required on high-speed multi-lane facilities
  - Design Speed  $\geq$  55 mph
- Good macrotexture
  - Minimize hydroplaning
- 100% friction approved aggregate (No RAP)
- PG 76-22 (PMA)
- High Polymer binder when specified in the plans
- Stabilizing fibers (more asphalt, less draindown)
- Granite aggregate requires hydrated lime



## FC-5 Nassau County







**FC-12.5 Microtexture**



**FC-5 Macrotexture**



# Asphalt Surfaces

- 50.3% of asphalt surfaces are dense graded (by lane mile)
- 49.7% of asphalt surfaces are open graded



# Other Asphalt Mixtures

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- Superpave Asphalt Base (234)
  - B-12.5
  - Traffic Level B
  - May substitute an SP-12.5 or SP-19.0
  - Paid by the square yard (285 – Optional Base)



# Questions/Comments?

