Georgia's Extensive Experience with Modified Binders

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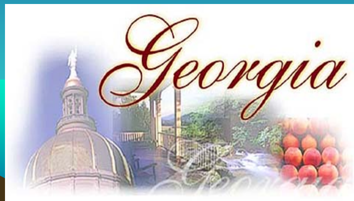
Georgia's History of Open-Graded Frictional Course (OGFC)

- Georgia's OGFC was conceived in the 1950's and 1960's
- These mixes were thin porous wearing layers primarily on interstate highways
- Early OGFC was very susceptible to ***premature failure*** due to weathering
- GDOT put moratorium on OGFC use in 1982



Georgia's Improvement on OGFC

- 1992 GDOT re-evaluated the performance of OGFC and improved the mixes with following features:
- (1) ***Polymer modified AC*** was added to improve the durability; (2) fibers were added to eliminate AC drain-down; (3) hydrated lime was added as an anti-stripping agent; (4) production temperature was increased; (5) coarser gradations and thicker layers were used to improve permeability

History of GDOT's Polymer Modified Asphalt Cement (PMAC)

- In the first few projects requiring PMAC, AC was routed from the storage tanks into a trailer-mounted blending unit where the polymer chips were added for mixing
- The base AC (AC-20) were modified with about 4.0-4.5% polymer by weight of AC
- Primarily two polymers, SB & SBS for PMAC

Polymers GDOT has dealt with included but not limited to:

Karaton D 1101, Karaton D 1184, Stylink, Vector 2411, Finaprene 411, Enichem 6302, Solprene 411, and Novophalt


OGFC
Conventional

GDOT Research Report No. 9601

"Evaluation of Georgia DOT Specifications and Test Procedures for Polymer Modified Asphalt Cements"

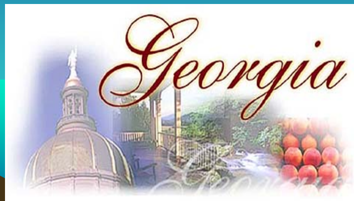
conducted by PRI and funded by GDOT

Research Leads to the Following Major Findings

- No analytical tests suitable for widespread use by suppliers and GDOT were found that would separate the wide range of commercially available polymer classes into the performance categories desired by GDOT

- GDOT requirements for certain polymers to meet Superpave binder specifications will insure the purchase of high-quality, high-performance binders that meet the specific performance needs for Georgia

- The existing GDOT PMAC specification, incorporating the Superpave binder specification as modified by GDOT, will provide GDOT with high quality binders for highway construction

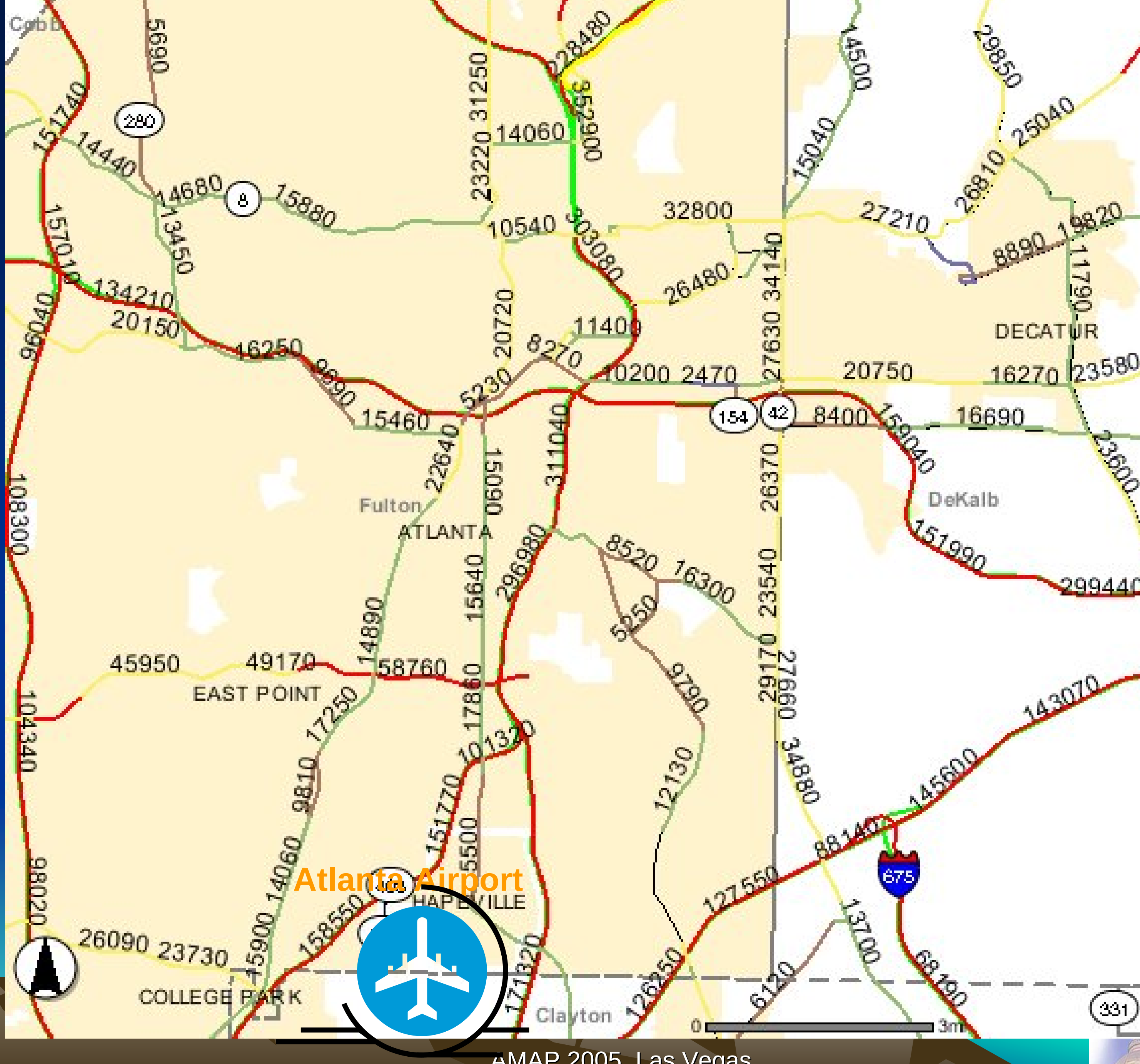


Current GDOT OGFC/PEM Policy

- Use modified OGFC as the final ride surface on all intestates and on state routes which have daily traffic volumes exceeding 25,000

Traffic Growth Trends Since 1970’s in U.S.

Number of Drivers	2X
Number of Vehicles	3X
Miles Traveled	4X



AMAP 2005 Las Vegas

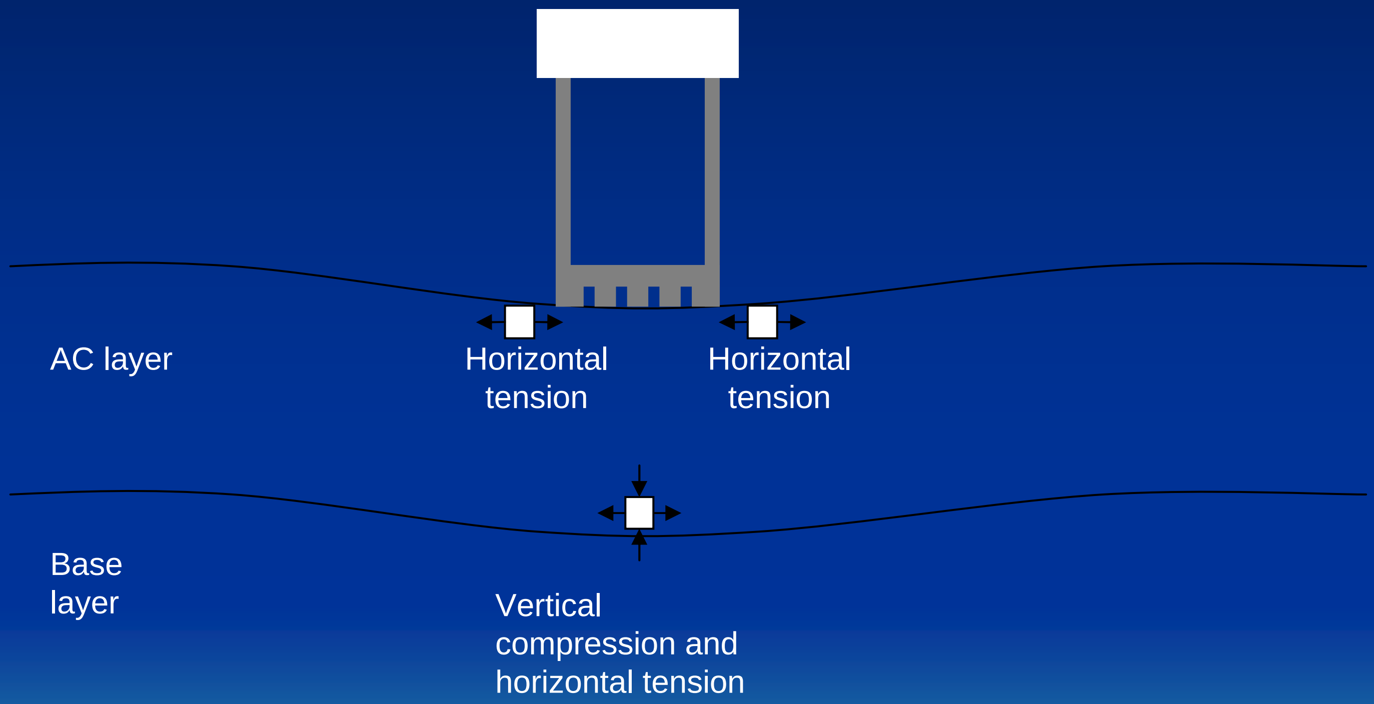

TIP
TRANSPORT INTERNATIONAL POOL


Georgia

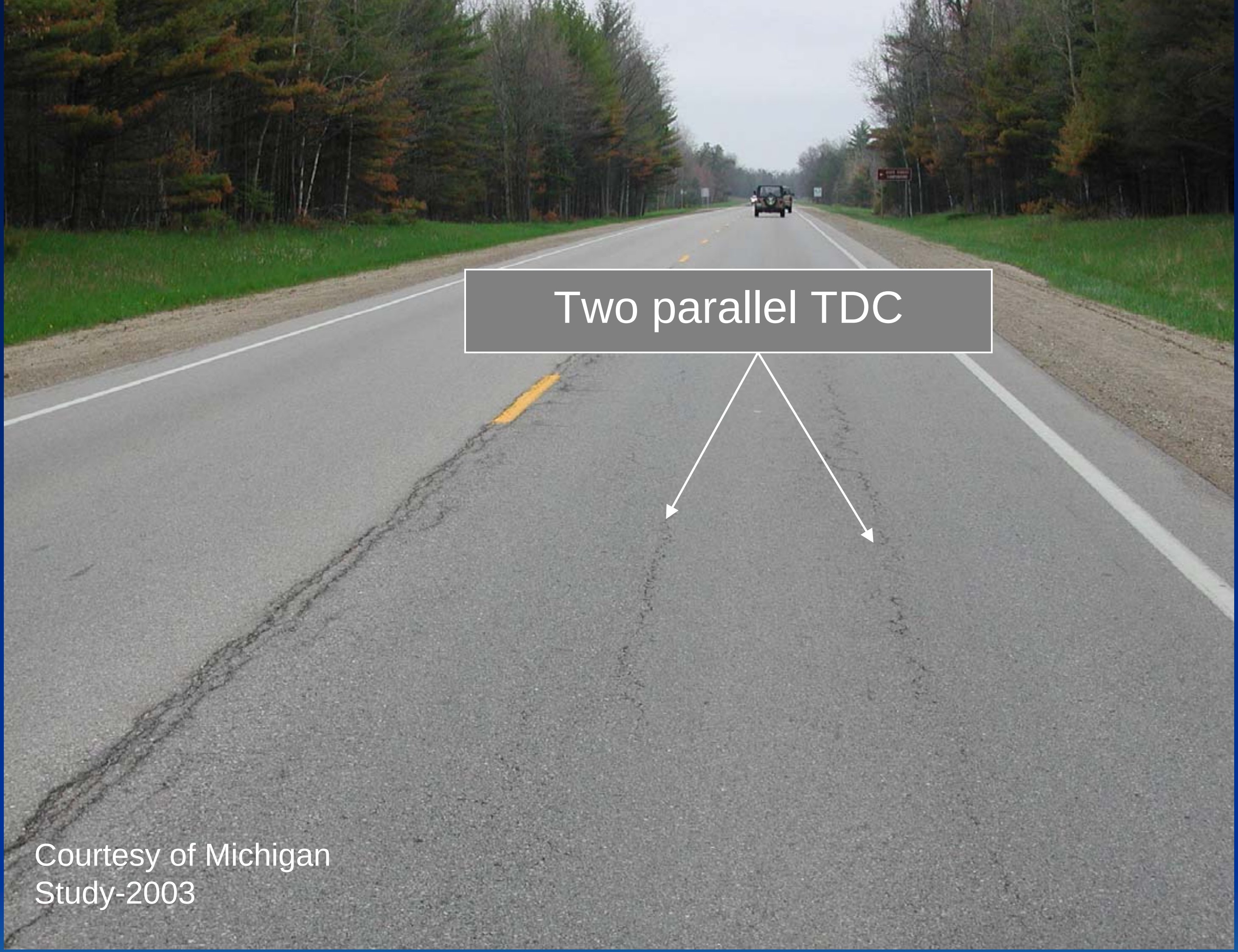
Load Related Cracking

Courtesy of Michigan
Study-2003

Top-down cracking (TDC) caused by high tensile stress near pavement surface

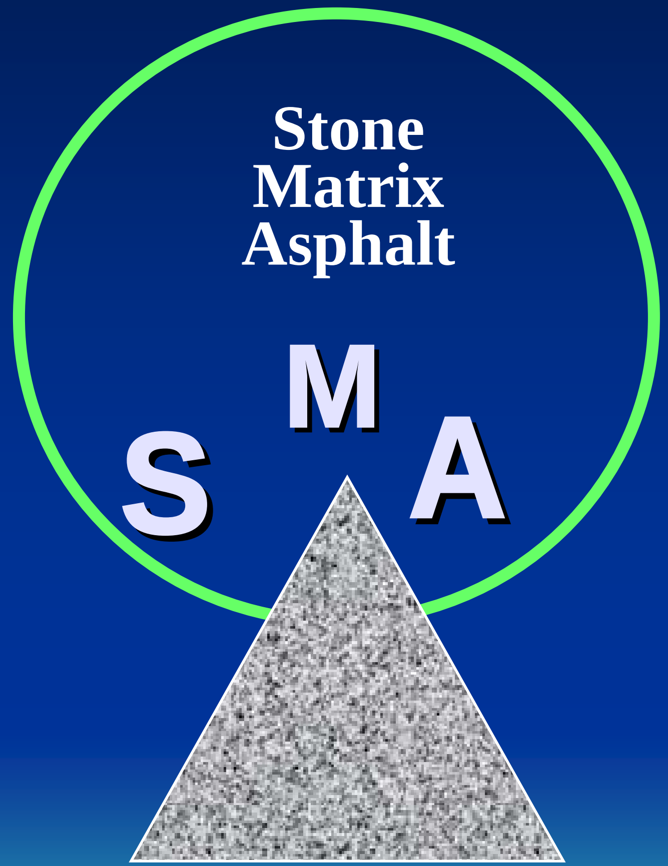


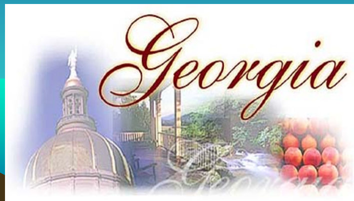
Courtesy of Michigan Study-2003


Two parallel TDC
Courtesy of Michigan
Study-2003

The tensile stress near surface caused by higher tire pressure is equivalent to a “Indirect Tensile Test”

Stone Matrix Asphalt





Better Roads®, October 2002

"Georgia has had considerable experience with SMA. Since 1991, the state has paved some 3 million tons of the materials. On all asphalt-surfaced interstates, Georgia resurfaces with SMA, topped by an open-graded friction course. The state used SMA for all state routes that carry more than 50,000 vehicles per day."

Components of Georgia SMA

Aggregate
Asphalt Cement
Polymer Modifier
Mineral Filler
Fiber Stabilizer
Hydrated Lime

The Dawn of SMA in Georgia

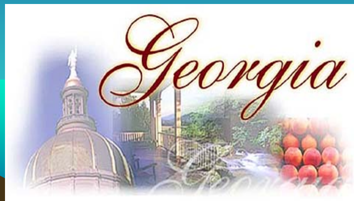
- SMA research project No. 9102, 1991 –2.5 miles of SMA (over conventional asphalt) on I-85 in northeast of Georgia with ADT of 35,000 including 40% trucks
- SMA research project No. 9202, 1992 – ½ mile SMA (over PCC) placed on I-75 south of Atlanta with ADT of 47,000 including 21% truck.

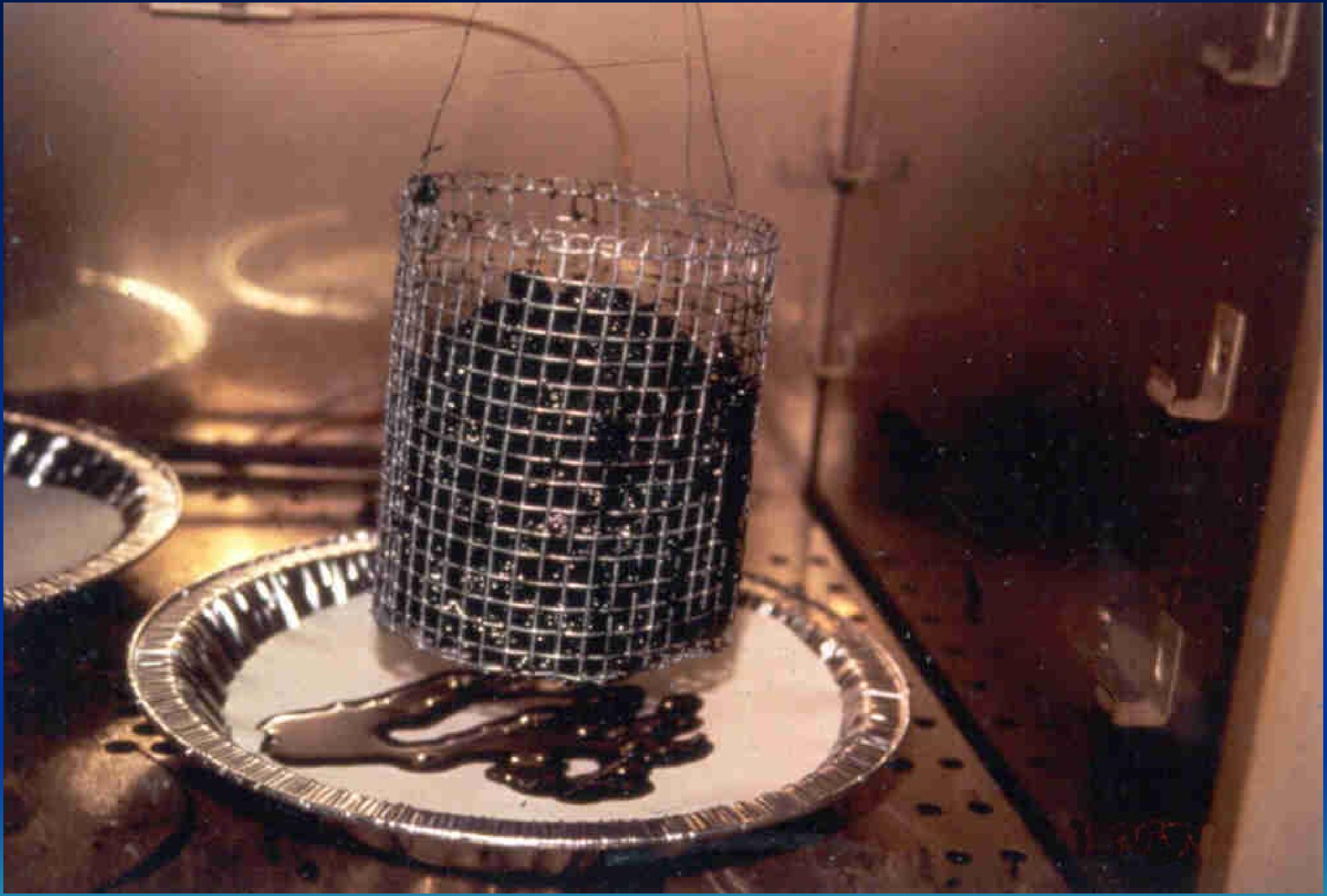
Shear Strength Comparison Dynamic Shear Rheometer @ 100°F

	Shear Strength (Pa)
PG 67-22 Neat	68,174
PG 64-22 + 4% SBS	141,350
PG 64-22 + 4% SBS & 0.5% Mineral Fiber	262,810

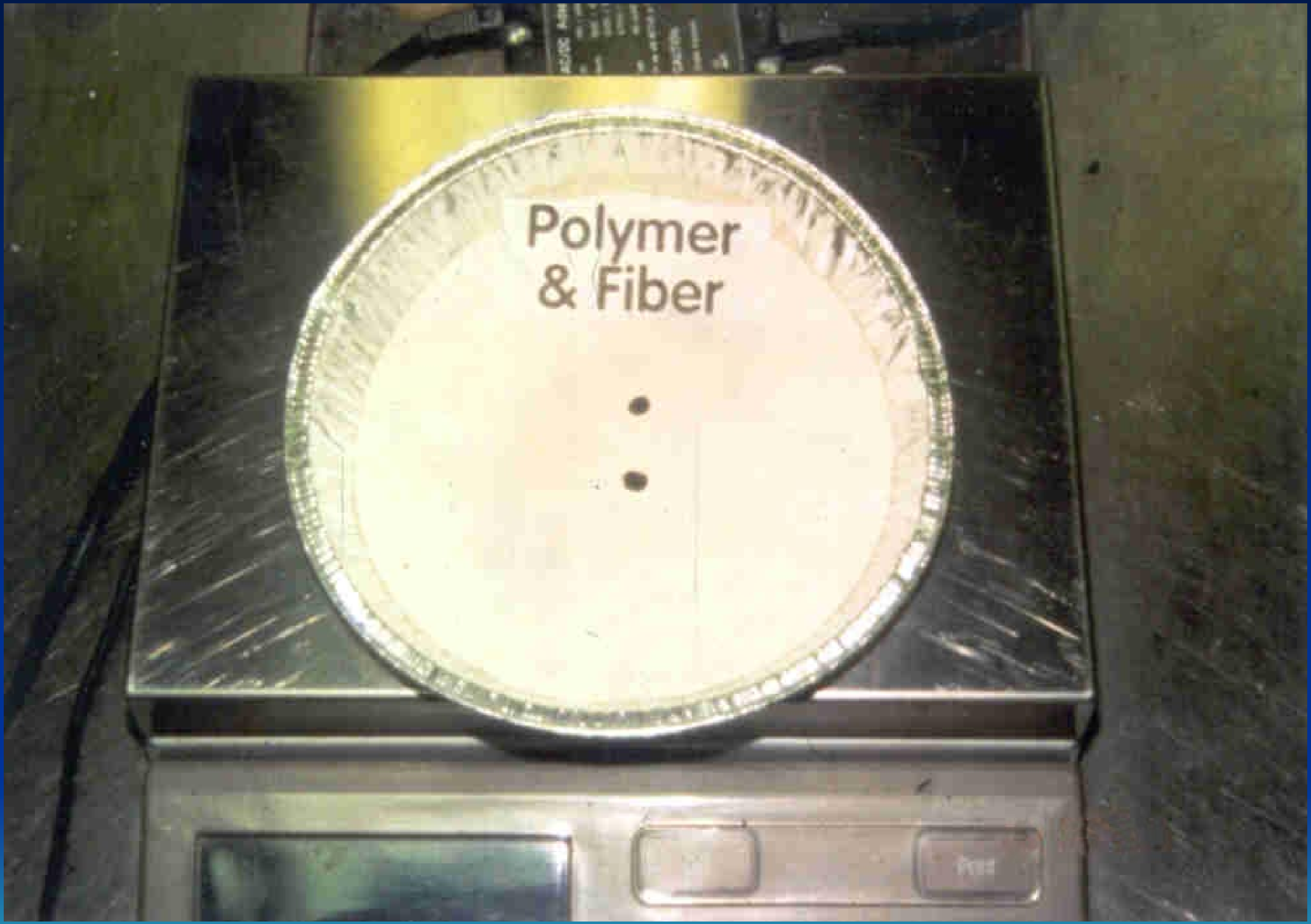
The Reason That Georgia Continues To Use SMA

"I would say SMA costs 30 to 40% more, because of the better aggregates, polymer modifies …But you expected service life is 40% longer – and you gain from the lowered highway user costs, because you're not disrupting traffic as often", says Peter Wu, State Bituminous Construction Engineer - Better Roads®, October 2002






Georgia


Polymer
& Fiber

PG 64-22

PG 76-22

Remember it is polymer modified asphalt – a good release agent sprayed on truck beds


Georgia

Break-down rolling must begin at the highest temperature (260 – 280 F) without excessive shoving

The Single Largest SMA Project in the World – I-75 Resurfacing in Georgia

- 330 lane-mile of milling and inlay resurfacing that included the placement of 200,000 tons of SMA
- The project work was performed under adverse traffic conditions with construction zone traffic volumes averaging 300,000 vehicles per day
- The project was let July 1995 and completed in May 1996, right before the 96’ Olympic Games in Atlanta

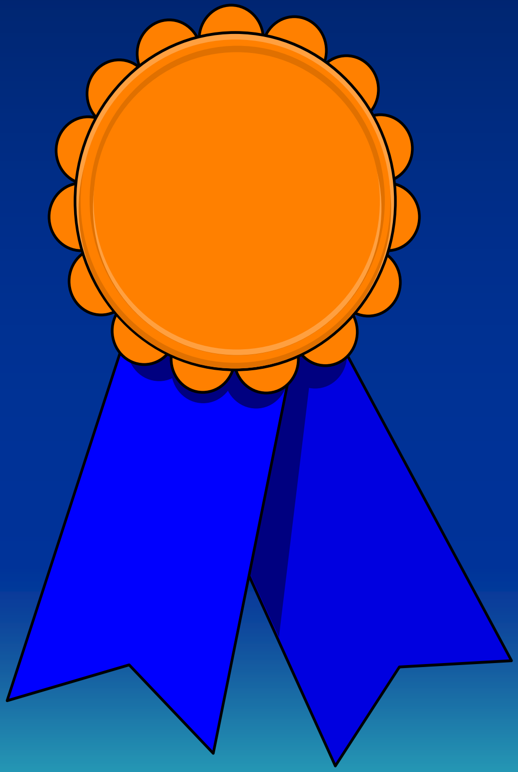

Georgia

After 9 summers SMA mixes have shown virtually no rutting.

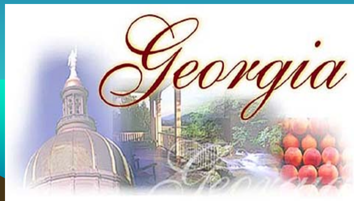
SMA Use in Georgia Since 1991

- More than 3.5 million tons so far
- All Interstate Routes
- State Routes with >50,000 ADT

Georgia's SMA Award - Winning Projects



- NAPA Sheldon G. Hayes
- National Quality Initiative
- NAPA Quality in Construction



Polymer Modified ***Superpave*** Mixes in Georgia

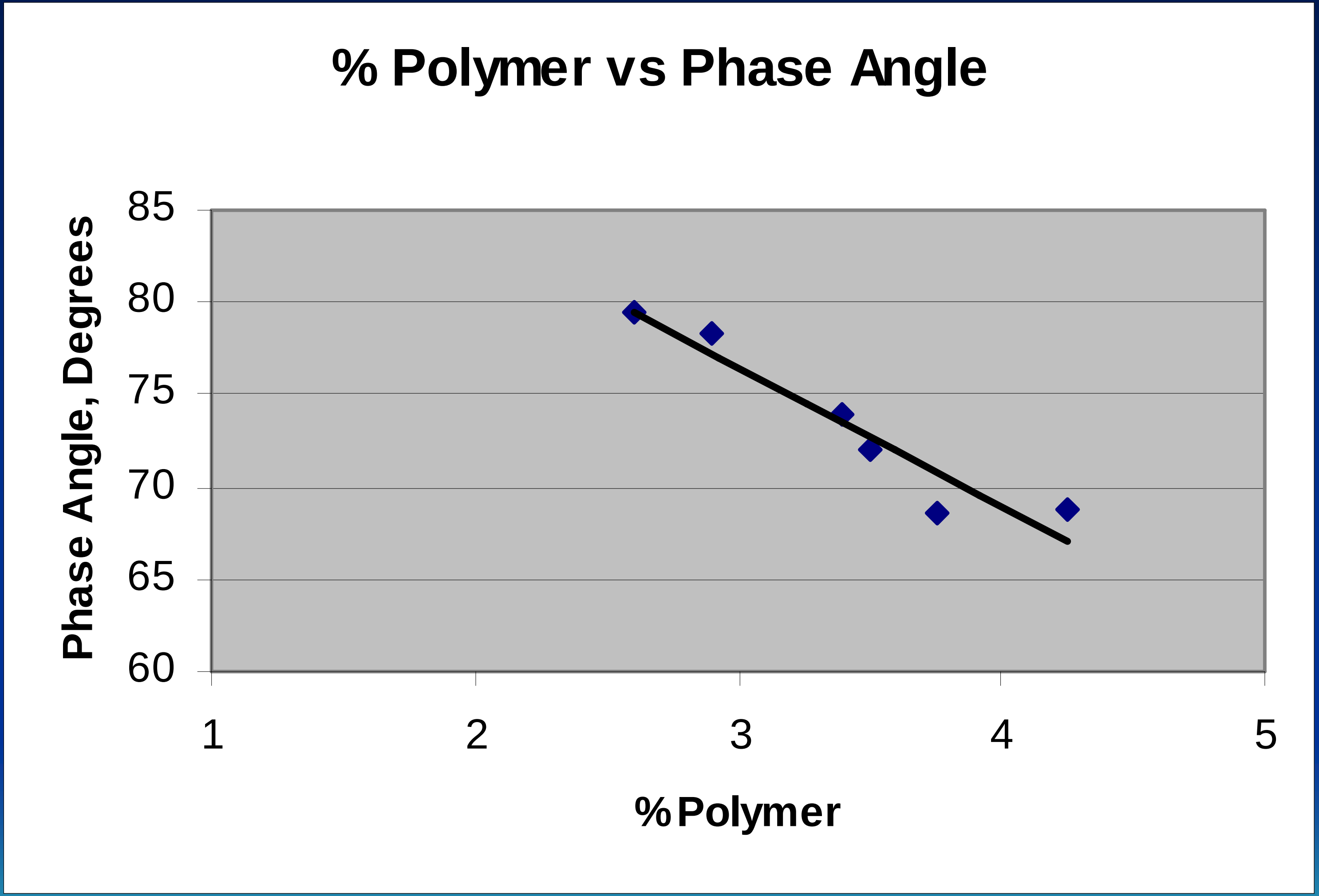
- GDOT implemented Superpave asphalt binder in January 1997 and mix specification in January 1998

- Standard paving grade established is PG 67-22 which was comparable to the AC-30 GDOT has used for more than 15 years

- PG 67-22 is a intermediate grade between PG 64-22 and PG 70-22. Only one supplier in the state can make PG 70-22 without polymer modification

- GDOT selected PG 76-22 as the only polymer modified grade for Georgia

- Since the Superpave implementation, PMAC specification was dropped, and PG 76-22 binder has been used since 1996 in Georgia
- Add SB & SBS only, no “air-blown”, uniform and homogeneous without separation
- A ***phase angle less than 75 º*** from original DSR has been added to help ensure that polymer modification is used – which was obtained through Superpave binder tests on generic PMACs previously used by GDOT


% Polymer vs Phase Angle
Phase Angle, Degrees
85
80
75
70
65
60
1
2
3
4
5
%Polymer


Georgia

Mix Design Levels and Application of Polymer Modified Asphalt for Superpave

Level A <2,000 ADT
Level B>2,000 to 25,000 ADT
Level C>25,000 to 50,000 ADT
Level D >50,000 ADT

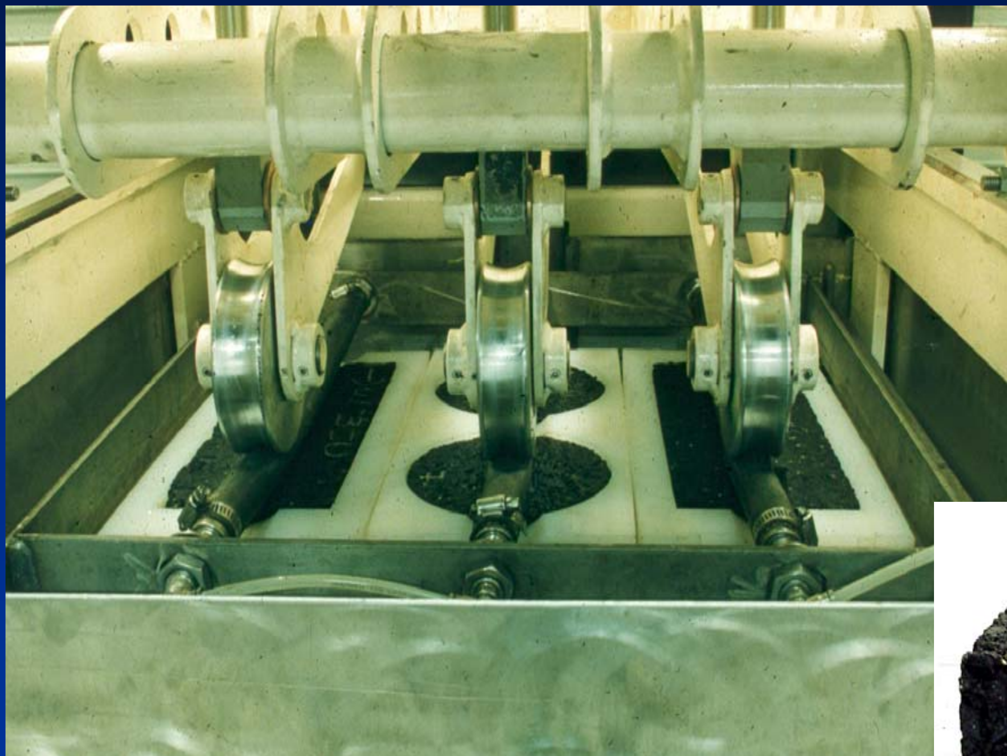
Level C & D require polymer modified asphalt - PG 76-22 in the surface course mixes

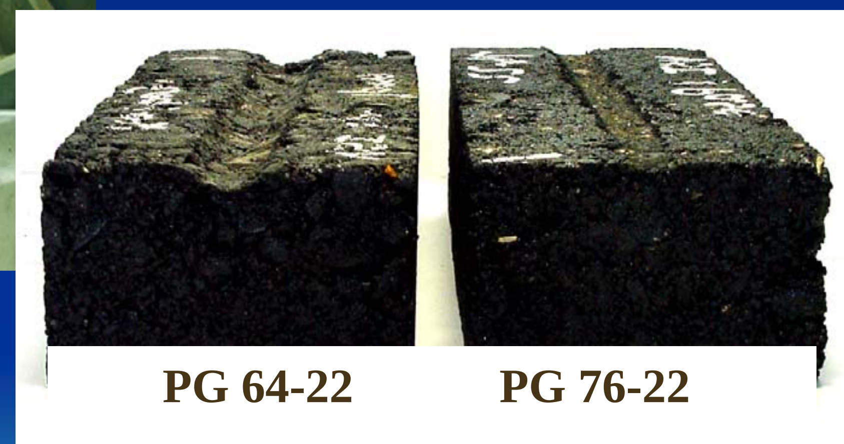
A complete copy of the GDOT's specification can be obtained through the following website:

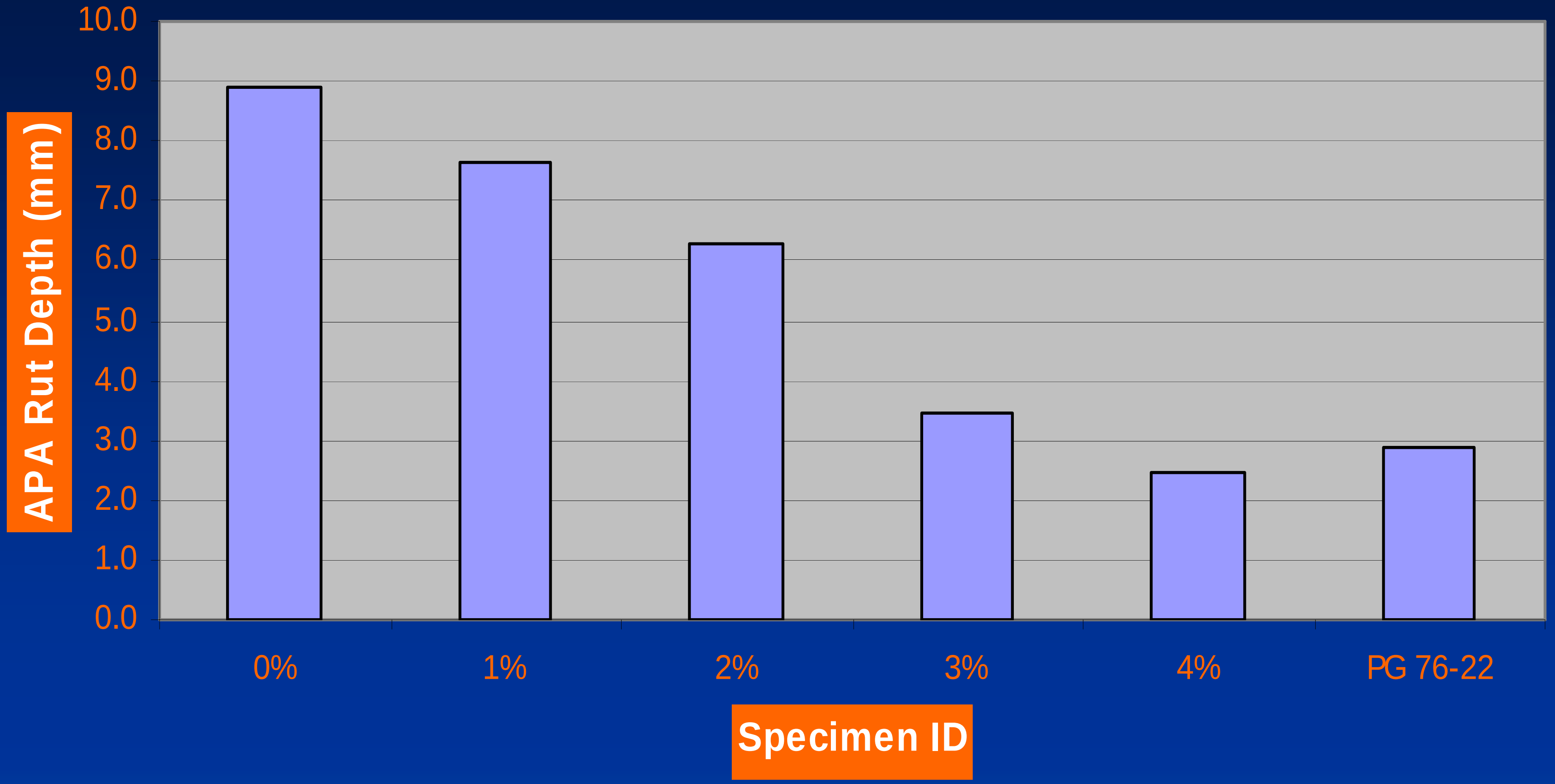
http://tomcat2.dot.state.ga.us/thesource/specs/index.html

- *Asphalt Binder* – Section 820
- *Asphalt Mixtures* – Section 828

Rut Tester – Asphalt Pavement Analyzer (APA)







Data: courtesy of
Ronald Collins

The Benefits of Polymer Modified Asphalt are not just limited to rut resistance, but also is more ***moisture resistant*** to HMA

Moisture Damage Assessment of Asphalt Pavement


Georgia


5


6

Future Polymer Modified Asphalt for
Surface Treatment Program

The Office of Maintenance is responsible for the 18,055 miles State Highway System in Georgia. The Office of State Aid, in cooperation with individual local governments, provides matching funding for the maintenance of the 65,666 miles county and city paved road systems.

Why do we need to get polymer into surface treatment program?

- The Office of Maintenance has not used BST as a surface wearing course in over 6 years. This decision has resulted from excessive automobile ***windshield damage claims*** in years past. Prior to this, BST was considered for State Roads with an ADT of 800 or less. BST is used on State routes as a crack-relief interlayer in conjunction with HMA resurfacing projects.
- The Office of State Aid considers BST an option for rural county roads with an ADT of 200 or less.

Benefit and Cost Analysis

The performance of a chip seal shall be improved by the use of a ***polymer-modified emulsion*** with regard to stone retention, raveling, cracking, rutting, and bleeding

Table 2 – Requirements for Latex-Modified Cationic Asphalt Emulsion

Type	Rapid Setting	
Tests	CRS-2L	
Tests on Emulsion	**Min**	**Max**
Viscosity, Saybolt Furol @ 122°F, sec.	100	400
Storage stability, 24 hours, percent		1
Settlement, 5 days, percent		5
Demulsibility, 35 ml, 0.8% dioctyl sodium sulfosuccinate, percent	40	
Particle charge test	Positive	
Sieve test, percent		0.10
Residue by evaporation, percent	68	
Tests on Emulsion Residue	**Min**	**Max**
Penetration @ 77°F, 100g, 5 sec., 0.1 mm	70	150
Ductility, @ 77°F, 5 cm/min., cm	125	
Elastic recovery @ 50°F, percent	58	
Ring & ball softening point, °F	130	
Solubility in trichloroethylene*, percent	97.5	

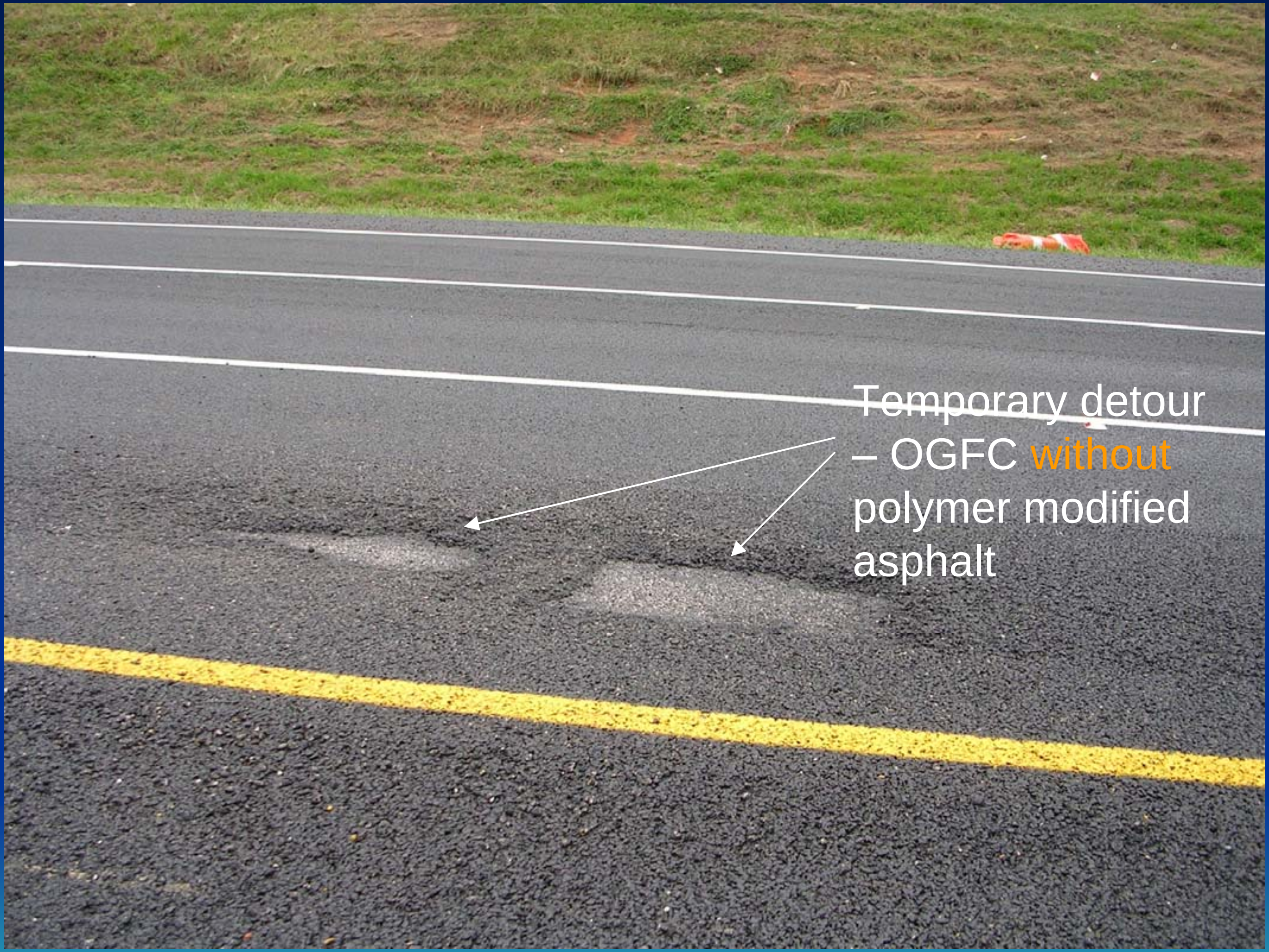
* If the solubility of the residue is less than 97.5 percent, the base asphalt cement for the emulsion shall be tested. The solubility of the base asphalt shall be greater than 99 percent.

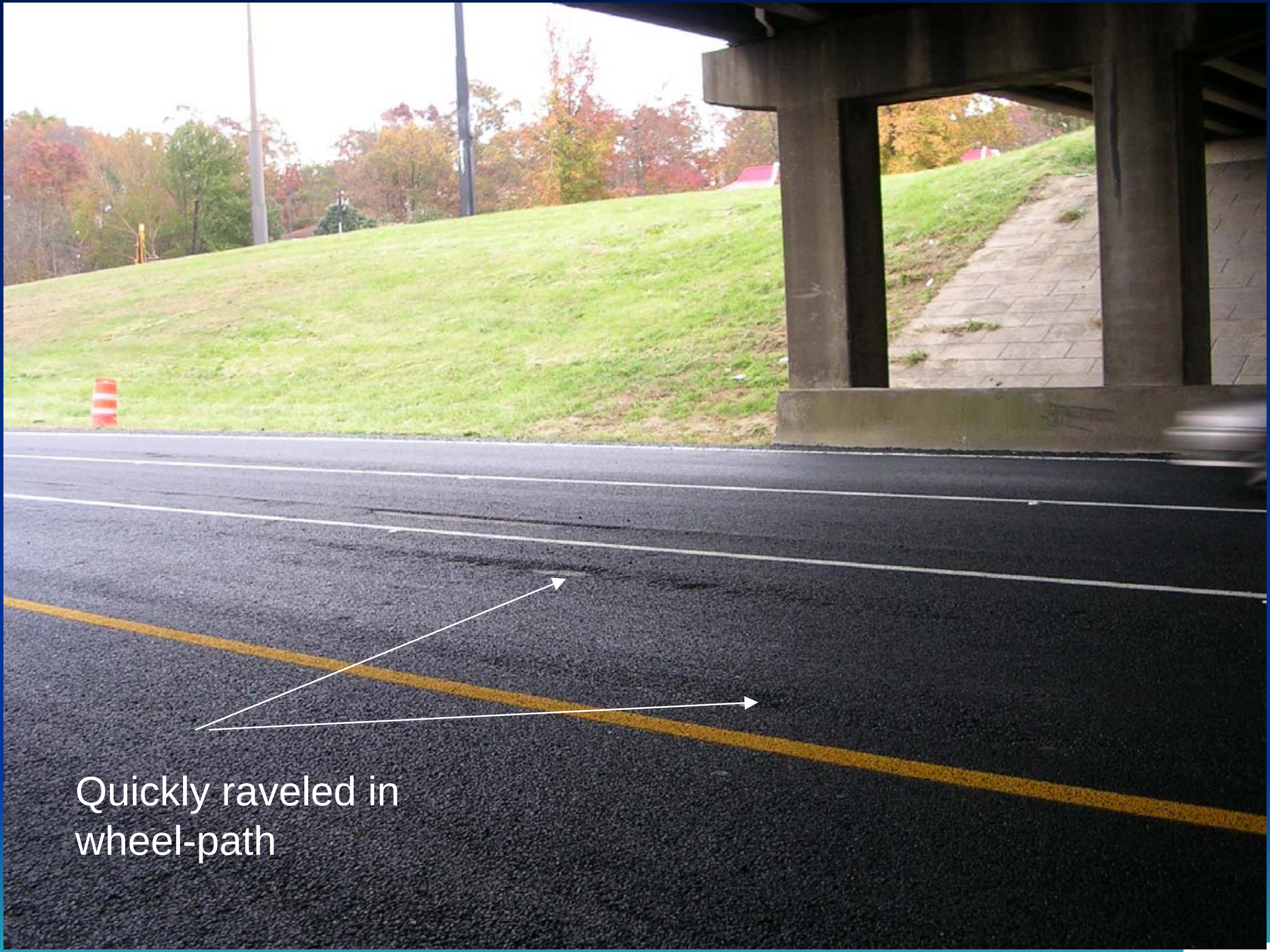
Proposed

- GDOT does not restrict innovation or the use of new high-performance modifiers;
- But needs to assure ourselves that the use of unusual modifiers which *meet* the Superpave specifications will NOT produce problems in the lay-down and durability of pavements.

- Example – Evaluation of Elvaloy RET.
- A test section was placed in May 2003 on a section of the Veterans Parkway (US route 27) in Columbus, Georgia with ADT of 32,000 for a 12.5 mm Superpave mixture required a PG 76-22.
- GDOT is monitoring its performance and continues its evaluation.

Final tips: If you think that it is too expensive to use polymer modified asphalt in paving, try ignorance.


Temporary detour – OGFC without polymer modified asphalt


Quickly raveled in wheel-path

GDOT’s Asphalt Program
(Past 3 Years)

Year	Total HMA (tons)	HMA (PMAC, tons)	PMAC Binder (gal)
2004	7,508,384	695,660	9,061,000
2003	7,906,504	663,160	8,514,000
2002	8,075,261	944,289	12,409,000

Georgia's Cost Comparisons (Superpave Surface Mixes)

Year 2002 (1/1/2002-12/31/2002)

Non-Polymer Modified Mixes:	**$34.32/ton**
Polymer Modified Mixes:	**$38.97/ton**
Cost Increase on the Mix:	**13.5% more**

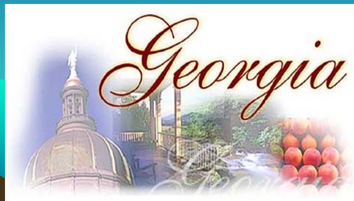
Year 2004 (1/1/2004-12/31/2004)

Non-Polymer Modified Mixes:	**$38.20/ton**
Polymer Modified Mixes:	**$44.20/ton**
Cost Increase on the Mix:	**15.7% more**

NCHRP 9-10:	**10-20% more**

Governor's "Fast Forward" Program

- On April 14, 2004, Georgia's Governor Sonny Perdue introduced the Fast Forward Congestion Relief Program to address Georgia's growing congestion problems. Fast Forward is a comprehensive 6-year, $15.5 billion transportation program that will relieve congestion and spur economic growth through the acceleration of existing highway projects. The Fast Forward Program will allow Georgia to do in 6 years what would otherwise take 18 years to complete.



Questions???