U.S. Department of Transportation
Federal Highway Administration

National Center for Asphalt Technology
NCAT
at Auburn University

Office of Pavement Technology

High RAP Field Projects

Audrey Copeland and Andrea Kvasnak

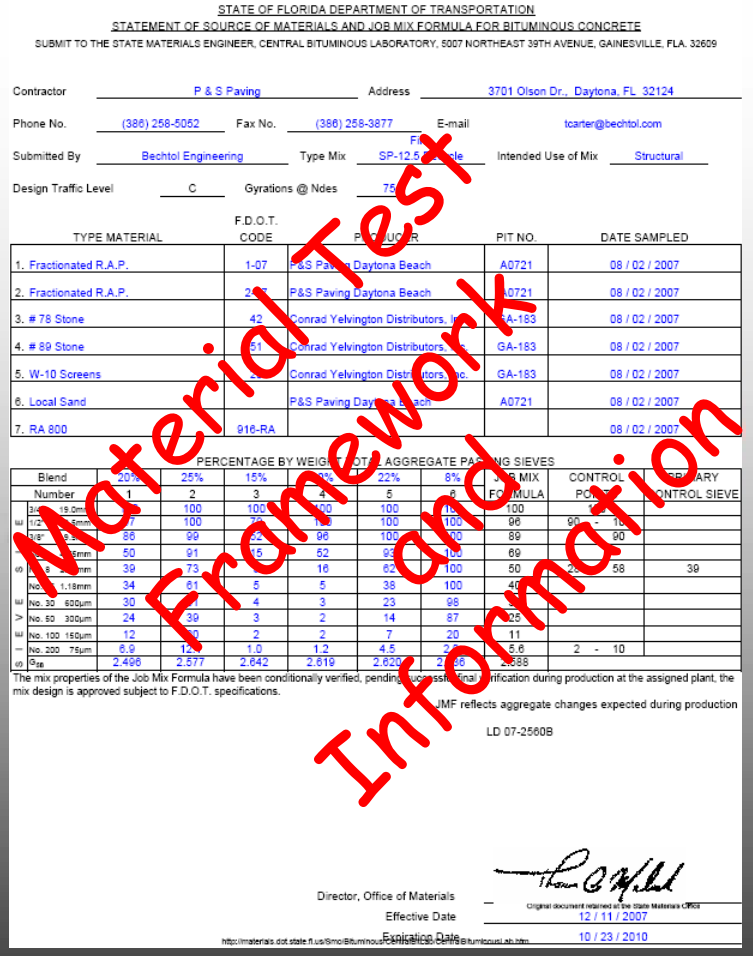
RAP Expert Task Group Meeting
March 5-6, 2008
San Diego, CA

Field Project Goals

- Documentation
- Mix design process, production, and construction
- Performance testing
- Develop information for future mix design and quality control procedures

Data Collection

1) Project Summary
2) Material Properties
3) Production Information
4) Laydown Information
5) Testing



STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION
STATEMENT OF SOURCE OF MATERIALS AND JOB MIX FORMULA FOR BITUMINOUS CONCRETE
SUBMIT TO THE STATE MATERIALS ENGINEER, CENTRAL BITUMINOUS LABORATORY, 5007 NORTHEAST 39TH AVENUE, GAINESVILLE, FLA. 32609

Contractor: P & S Paving — Address: 3701 Olson Dr., Daytona, FL 32124
Phone No.: (386) 258-5052 — Fax No.: (386) 258-3877 — E-mail: tcarter@bechtol.com
Submitted By: Bechtol Engineering — Type Mix: SP-12.5 Friction Course — Intended Use of Mix: Structural
Design Traffic Level: C — Gyrations @ Ndes: 75

TYPE MATERIAL	F.D.O.T. CODE	PRODUCER	PIT NO.	DATE SAMPLED
1. Fractionated R.A.P.	1-07	P&S Paving Daytona Beach	A0721	08 / 02 / 2007
2. Fractionated R.A.P.	2-07	P&S Paving Daytona Beach	A0721	08 / 02 / 2007
3. # 78 Stone	42	Conrad Yelvington Distributors, Inc.	GA-183	08 / 02 / 2007
4. # 89 Stone	51	Conrad Yelvington Distributors, Inc.	GA-183	08 / 02 / 2007
5. W-10 Screens	23	Conrad Yelvington Distributors, Inc.	GA-183	08 / 02 / 2007
6. Local Sand		P&S Paving Daytona Beach	A0721	08 / 02 / 2007
7. RA 800	916-RA			08 / 02 / 2007

PERCENTAGE BY WEIGHT OF TOTAL AGGREGATE PASSING SIEVES

Blend Number	20% 1	25% 2	15% 3	8% 4	22% 5	8%	JOB MIX FORMULA	CONTROL POINTS	PRIMARY CONTROL SIEVE
19.0mm	100	100	100	100	100	100	100		
1/2" 12.5mm	97	100	100	100	100	100	96	90 - 100	
3/8" 9.5mm	86	99	92	96	100	100	89	90	
No. 4 4.75mm	50	91	15	52	93	100	69		
No. 8 2.36mm	39	73	7	16	62	100	50	28 - 58	39
No. 16 1.18mm	34	61	5	5	38	100	40		
No. 30 600µm	30	47	4	3	23	98	31		
No. 50 300µm	24	39	3	2	14	87	25		
No. 100 150µm	12	20	2	2	7	20	11		
No. 200 75µm	6.9	12.4	1.0	1.2	4.5	2.1	5.6	2 - 10	
G_{sb}	2.496	2.577	2.642	2.619	2.620	2.636	2.588		

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.

JMF reflects aggregate changes expected during production

LD 07-2560B

Director, Office of Materials
Original document retained at the State Materials Office
Effective Date: 12 / 11 / 2007
Expiration Date: 10 / 23 / 2010
http://materials.dot.state.fl.us/Smo/Bituminous/Certification/Certs/Bituminous/Lab.htm

Material Test Framework and Information

FHWA Mobile Asphalt Laboratory

- **Material Characterization**
- **Mix Design Replication**
- **Mix Production Sampling**
- **Volumetric Property Measurements**
- **Performance Testing**
- **Pavement Structure Evaluation**

Laboratory Activities At NCAT

- Extraction and Recovery
- PG Classification
- Moisture Susceptibility
- Dynamic Modulus
- IDT Creep Compliance and Strength
- Beam Fatigue

National Center for Asphalt Technology NCAT AUBURN UNIVERSITY

Field Projects

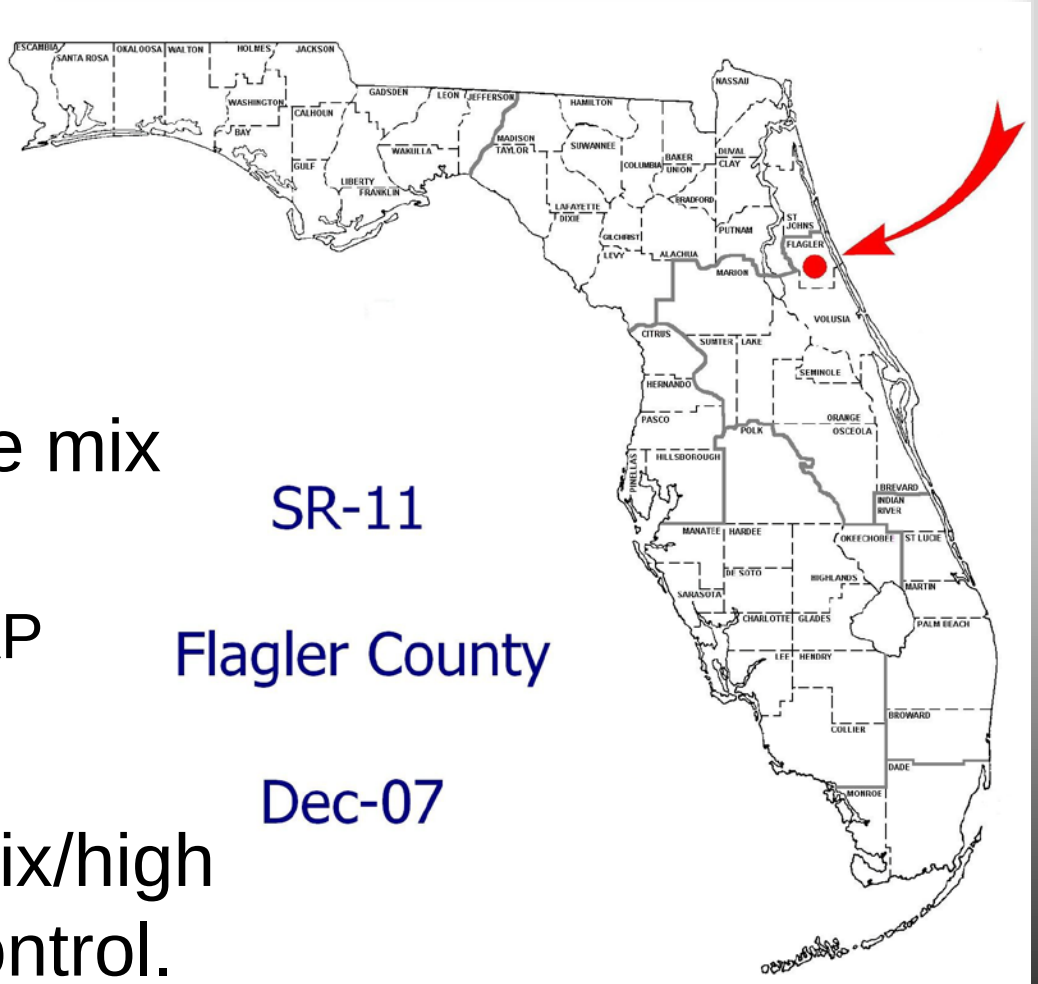
State	RAP Percentage	Date
North Carolina	40%	September 2007
South Carolina	30% and 50%	October 2007
Wisconsin	25%	November 2007
Florida	45%	December 2007

North Carolina Summary

- Plant lot and driveway
- 40% RAP
- Astec Double Barrel Green
- Material sent to NCAT for extractions
- Gerry Huber and Audrey Copeland on site

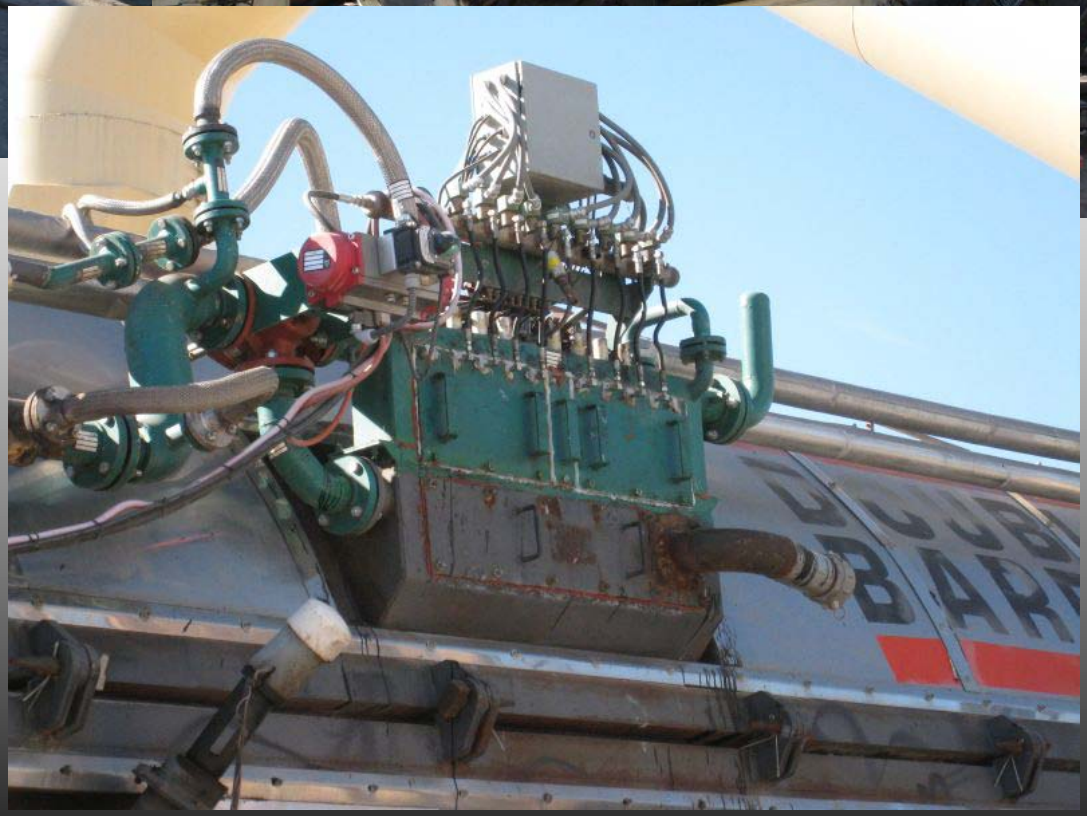
Florida Summary

- Two lane road
- RAP milled from top 2” of existing road.
- Superpave -12.5 fine mix
  - RA-800
  - 45% fractionated RAP
  - 1.5” structural layer
- 9.6 miles of warm mix/high RAP; 4.9 miles of control.



Fractionated RAP

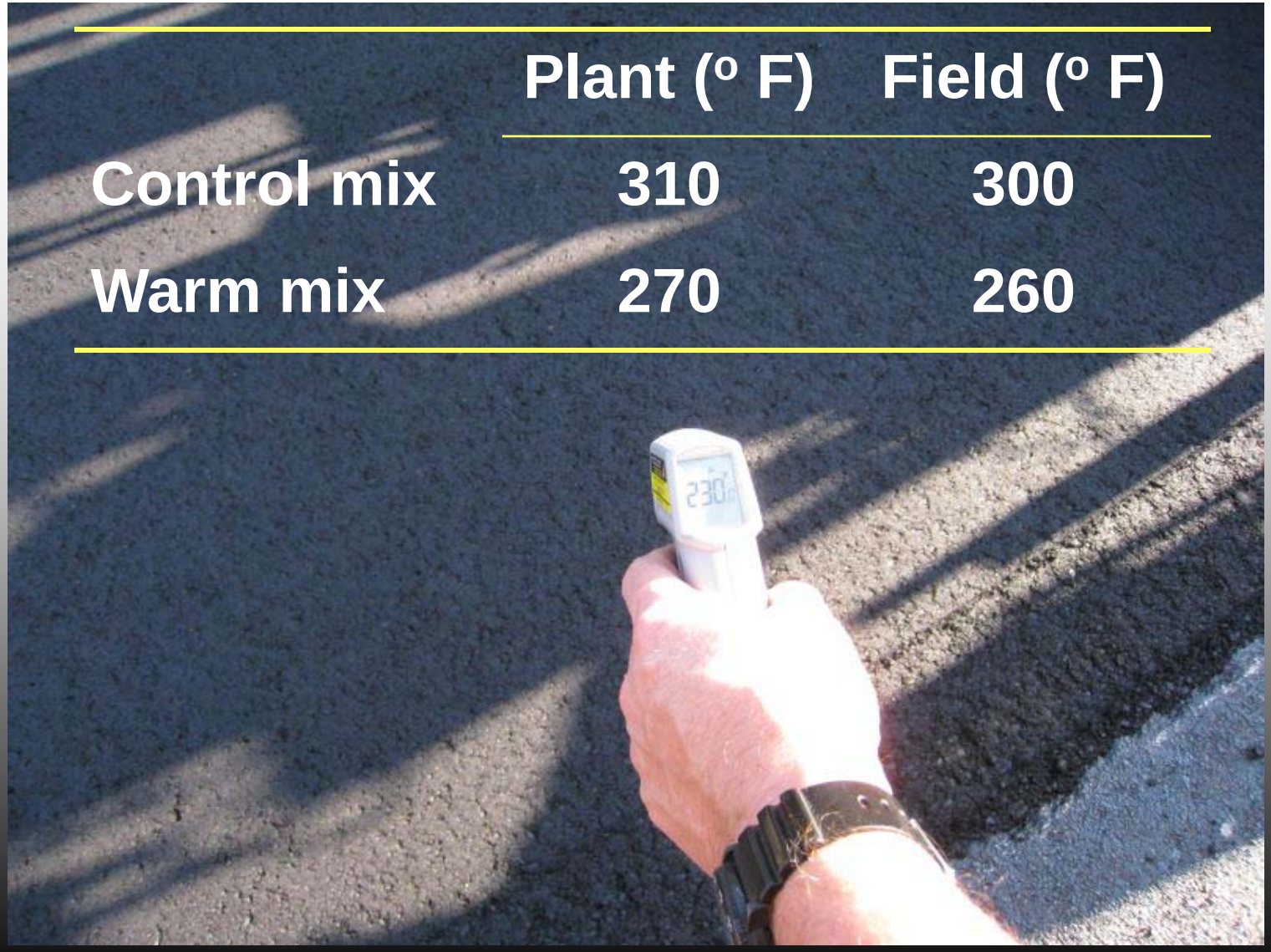
Double Barrel Green Process
- Water injection



- Water added at 2% by weight of binder.

Temperature Targets

	Plant (º F)	Field (º F)
Control mix	310	300
Warm mix	270	260




SAKAI

Florida Project Performance

- State Materials Office Results:
  - All volumetric properties very good for control mix.
  - Low AV (1.8%) for warm mix due to high AC content (0.5% high, target was 5.6%).
  - Lab rut depths for both mixes were good, but warm mix was better (2.7 vs. 4.1 mm).
  - Moisture resistance TSR 3% less for warm mix (58 vs. 61%).

Florida Project Performance (continued)

- State Materials Office Results:
  - Recovered viscosity (Poises):
    - Specification range: 4,000 to 12,000
    - PG 64-22 (warm mix) – **15,300**
    - RA-800 (warm mix) – 9,900
    - RA-800 (control mix) – 10,700

Florida QC Test Results

- Average for project
- Gradation good for both mixtures.
- AC slightly high (0.2%) for warm mix and slightly low (0.3%) for control mix.
- Air voids: 3.0 for warm mix
  3.9 for control mi
- Density: 93.7% for warm and control mixes.

South Carolina Summary

- Two lane road
- Four mixes
  - Two intermediate layers
    - 30% and 50% RAP
  - Two surface layers
    - 30% and 50% RAP
- Astec Double Barrel Green
- NCAT mobile laboratory on site

Wisconsin Summary

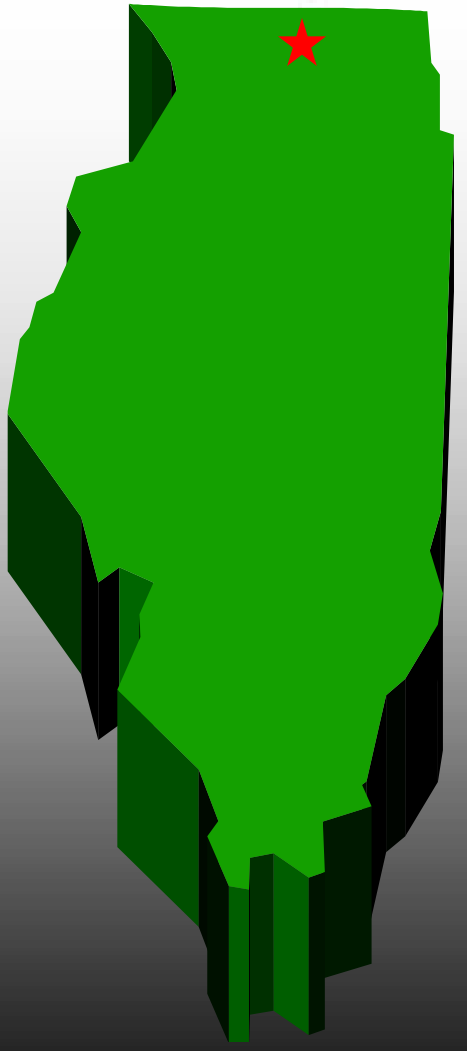
- Business park streets
- 25% RAP
- Advera® WMA
- Material sent to NCAT for testing
- Jack Weigel and Andrea Kvasnak on site

Future Projects

- Illinois
- Minnesota
- Delaware

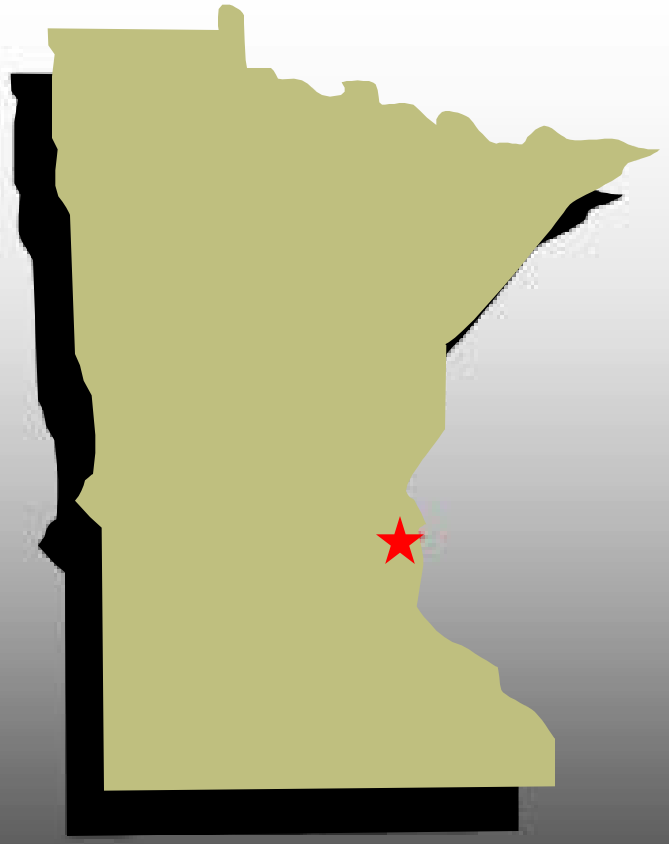
Illinois

- Maximum allowable RAP 10-50%
- Overlay, shoulders, and temporary pavement
- 14 miles on Northwest Tollway I-90
  - Near Rockford



Minnesota

- MnROAD
- 30% RAP
- Vary binder
- Vary processing (fractionated and non-fractionated)



DelDOT High RAP Project

- I-95 lane widening project - $58 million
- DelDOT specs limit RAP to 20%
- Contractor requested and approved up to 35% RAP
- 80,000 tons to be placed in 2008
  - Base, binder, surface
- Future interchange project
  - Shoulder (with high RAP surface) will become right lane in about three years.

Contractor Experience

- Using RAP for 7 years
- Successful project at Port of Wilmington with 35% RAP
- Mill off roadway and re-use on roadway
- Acquired screens and crushing process
- Fractionate into 3 sizes
  + ½, ½ - ¼, and –¼
- 3 cold feed bins
- Tilman single drum

Delaware I-95

Mainline

SMA (No RAP)

PG76-22

Shoulder Mix

30% RAP

PG64-28

Superpave 9.5 mm

Bituminous Concrete Base Course

Depth from surface: 50 mm

30% RAP

Superpave 19 mm

- 200,000 vehicles/day across 4 lanes
- ESALS: 3 million
- Mainline right lane in @ 3 years
- Superpave Mixture Design
- PG 58-28 from Citgo Paulsboro, NJ

Initial Performance Test

State Materials Office Results

- Asphalt Pavement Analyzer (APA)
  - Temperature 65º C (149º F) dry
- 19 mm base mix
  - Average Air Voids – 7.3 %
  - Average Rut Depth – 4.9 mm
- 9.5 mm shoulder mix
  - Average Air Voids – 7.3 %
  - Average Rut Depth – 7.1 mm

Best Practices Learned

- Stockpile management
- Fractionation?
- Sample RAP sources regularly
- Plant processing
- Warm-mix technologies may facilitate high RAP
- Avoid production of mixtures at various temperatures - warm mix versus hot mix

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Thank you! Questions?