Engineering Analysis Reports (EAR) Workshop

EAR Workshop

1. Background (Musselman)
    a. Purpose of the workshop
    b. Introductions
2. Basics (Musselman)
    a. Pavements
    b. Mix Types
    c. Asphalt Mix Basics
        i. Volumetrics
        ii. 0.45 Gradation chart
3. Specification overview (Upshaw)
    a. HMA testing requirements
    b. Failure criteria – QC/IV – Master Production Range
    c. Defective Material – 334-5.9.5
4. FDOT Pavement Performance (Schaub)
    a. Pavement Condition Survey
    b. Performance Trends
5. Cause and effects (Moseley)
    a. Binder content (high/low)
    b. Gradation (coarse/fine, impact on VMA, volumetrics, effective binder content, etc.)
    c. Dust (high/low,)
6. General relationships between test data and performance (Sholar)
    a. Air voids (high & low)
    b. Density (low)
    c. Binder content (FC-5)
    d. Gradation (FC-5)
7. Analysis Tools (Sholar)
    a. Production data
    b. Cores (gradation, binder content, G_{mb}, G_{mm}, permeability, in-place V_a)
    c. Asphalt Pavement Analyzer
    d. Recompacted cores
8. Overview of EAR Process (Blazo)
    a. Disposition of Defective Material Form
    b. Flow Chart
9. Engineering Analysis Reports (Musselman)
    a. EAR Guidelines
    b. Model EAR
    c. Summary

EAR
Workshop

Basics

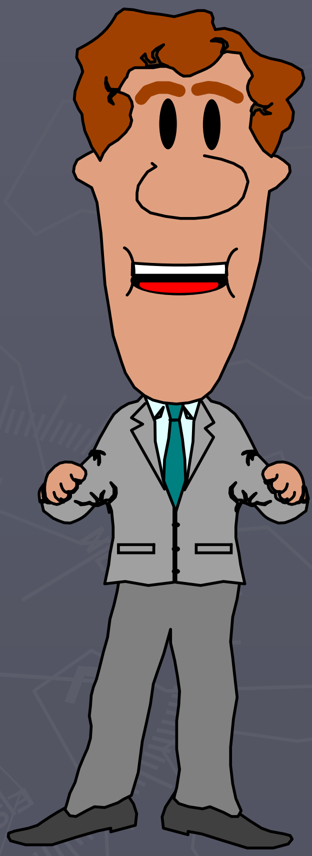
EAR Workshop

Purpose

Familiarize participants with:

1. HMA pavement basics
2. HMA failures; causes and effects
3. Relationship between test results and performance
4. Available analysis tools & methodologies
5. FDOT EAR process
6. FDOT expectations

BACKGROUND



- Name
- Company
- Position within Company

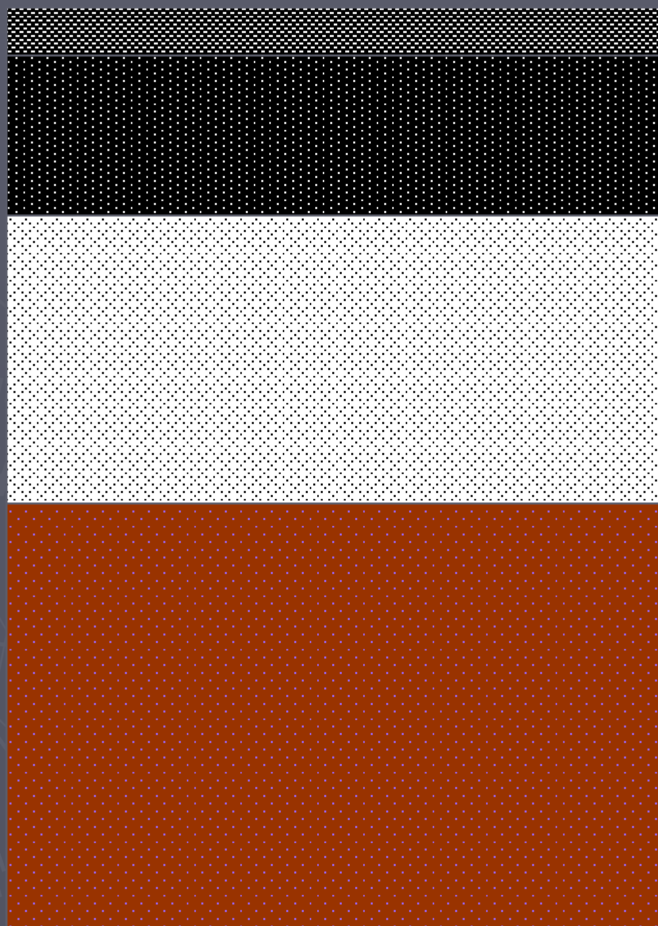
Today’s Topics

- HMA Basics
- Specification Overview
- Relationships between test data & performance
- What causes a failure?
- FDOT Pavement Performance
- EAR Process

HMA Basics

- Pavements
- Mix & Binder Types
- Asphalt Mix Basics (Volumetrics 101)

Typical Asphalt Pavement Structure



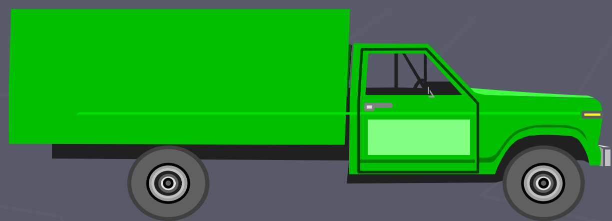
Mix Types

- Friction Courses
  - FC-9.5, FC-12.5, FC-5
- Structural Courses
  - SP-9.5, SP-12.5, SP-19.0
- Base Courses
  - B-12.5
- Other
  - Asphalt Treated Permeable Base (ATPB)
    - Used under PCC pavements

Structural Mixes

- Designated as Type SP
  - Superpave
- Purpose: load carrying portion of pavement
  - Layer coefficient 0.44
- Three nominal maximum aggregate sizes
  - 9.5 mm (SP-9.5)
  - 12.5 mm (SP-12.5)
  - 19.0 mm (SP-19.0)
- Five Traffic Levels (A-E)
  - Based on 18-kip Equivalent Single Axle Loads (ESAL's)
  - Low traffic = A, High traffic = E

ESAL Configuration Examples



67 kN + **27 kN** = **0.49 ESALs**
15,000 lb + **6,000 lb**
0.48 ESAL + **0.01 ESAL**

151 kN + **151 kN** + **54 kN** = **2.40 ESALs**
34,000 lb + **34,000 lb** + **12,000lb**
1.10 + **1.10** + **0.20**

Mix Types (Cont'd)

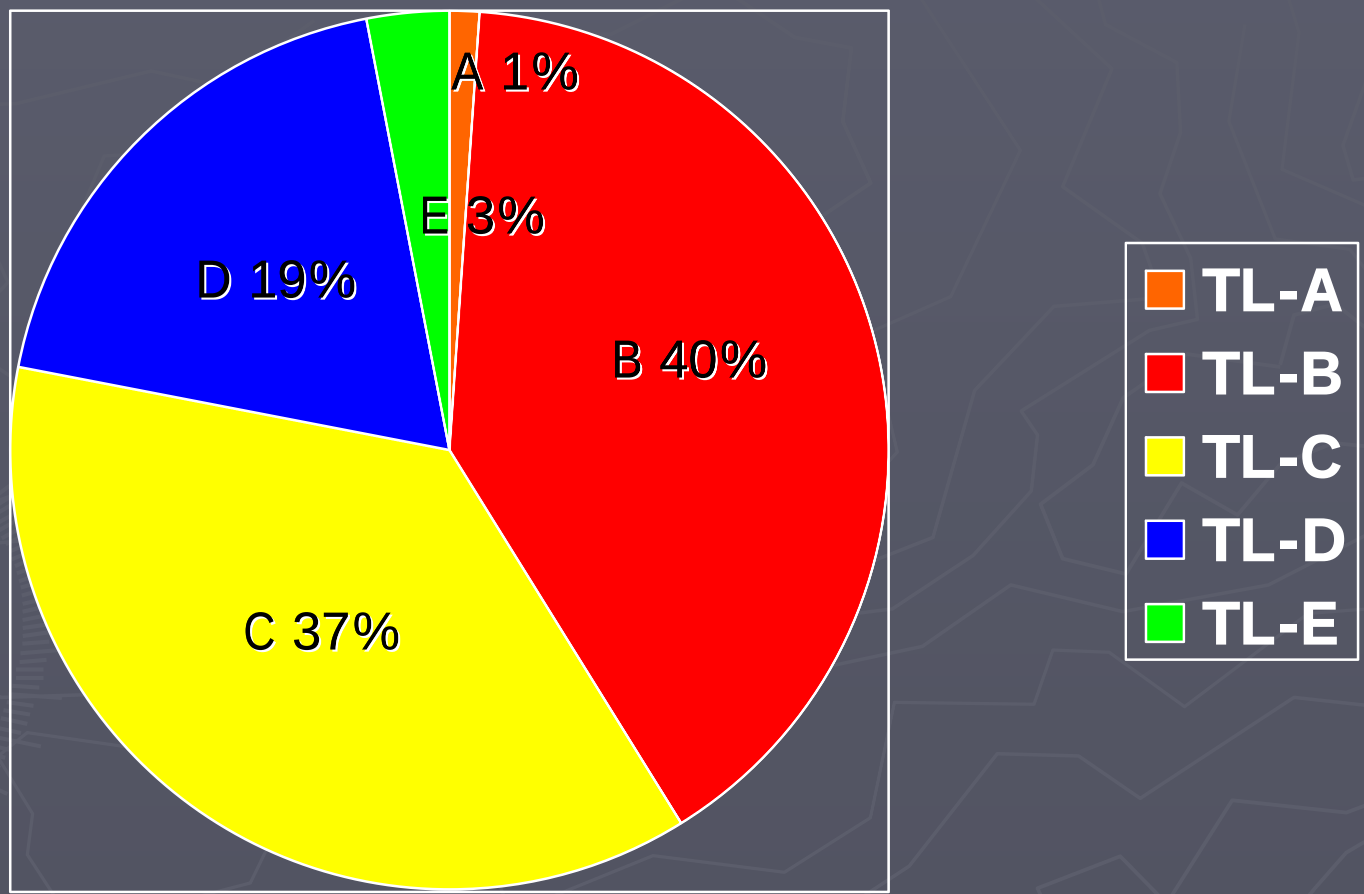
- Traffic Levels – Based on design life of the pavement:

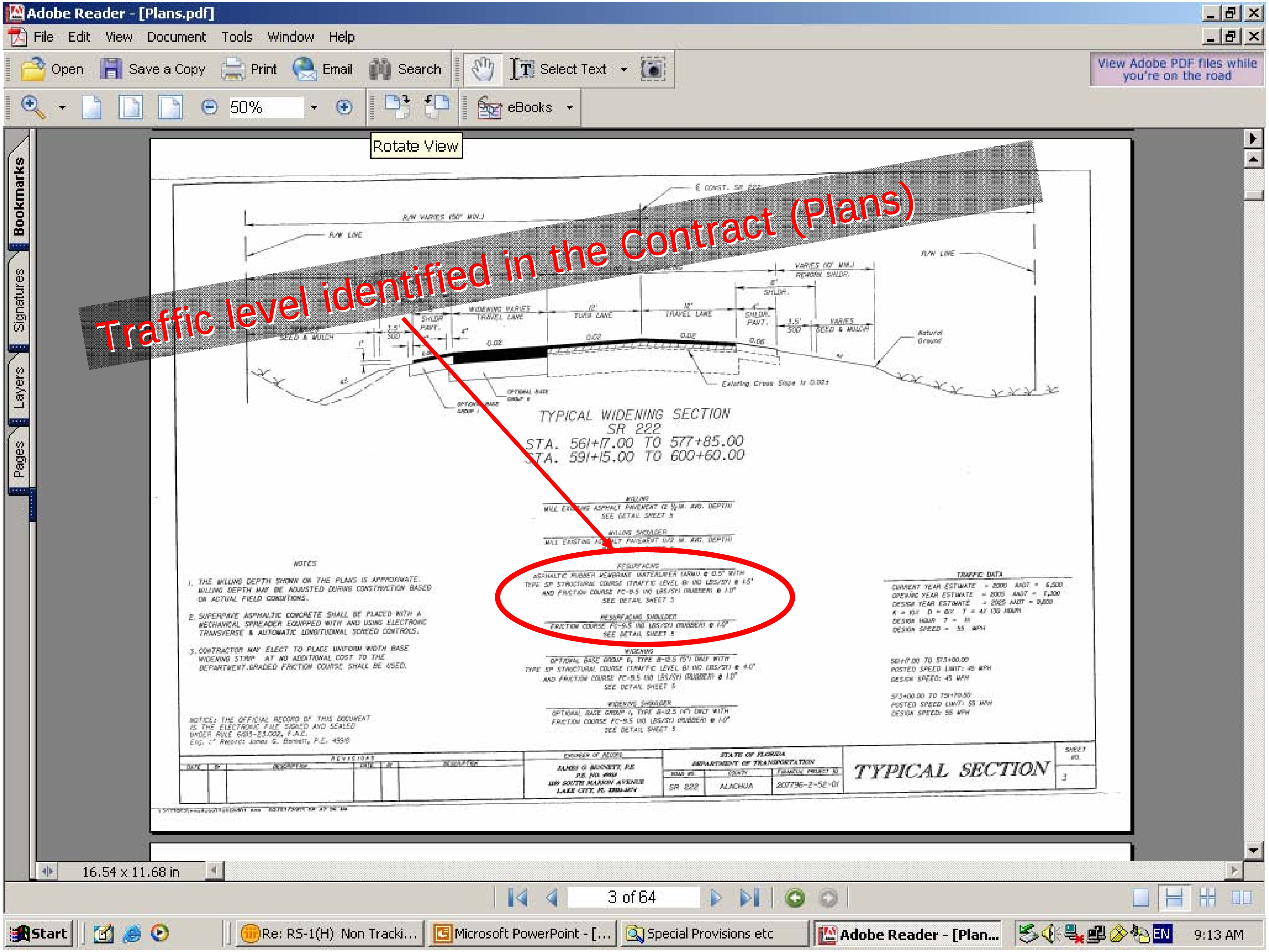
A	<300,000 ESAL's
B	300,000 – 3 million ESAL's
C	3 million – 10 million ESAL's
D	10 million – 30 million ESAL's
E	>30 million ESAL's

Traffic Levels A, B, C: Fine Graded

Traffic Levels D & E: Coarse Graded*

Traffic Distribution in Florida




Traffic level identified in the Contract (Plans)
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TYPICAL WIDENING SECTION
SR 222
STA. 561+17.00 TO 577+85.00
STA. 591+15.00 TO 600+60.00
TYPICAL SECTION
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3 of 64
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GROUP I

TYPICAL WIDENING SECTION
SR 222
STA. 561+17.00 TO 577+85.00
STA. 591+15.00 TO 600+60.00

MILLING

MILL EXISTING ASPHALT PAVEMENT (2 ½ IN. AVG. DEPTH)
SEE DETAIL SHEET 5

MILLING SHOULDER

MILL EXISTING ASPHALT PAVEMENT (1/2 IN. AVG. DEPTH)
SEE DETAIL SHEET 5

RESURFACING

ASPHALTIC RUBBER MEMBRANE INNTERLAYER (ARMI) @ 0.5" WITH
TYPE SP STRUCTURAL COURSE (TRAFFIC LEVEL B) (110 LBS/SY) @ 1.5"
AND FRICTION COURSE FC-9.5 (110 LBS/SY) (RUBBER) @ 1.0"
SEE DETAIL SHEET 5

RESURFACING SHOULDER

FRICTION COURSE FC-9.5 (110 LBS/SY) (RUBBER) @ 1.0"
SEE DETAIL SHEET 5

WIDENING

OPTIONAL BASE GROUP 6, TYPE B-12.5 (5") ONLY WITH
TYPE SP STRUCTURAL COURSE (TRAFFIC LEVEL B) (110 LBS/SY) @ 4.0"
AND FRICTION COURSE FC-9.5 (110 LBS/SY) (RUBBER) @ 1.0"
SEE DETAIL SHEET 5

16.54 x 11.68 in

3 of 64

Gradation Types

- Coarse mixes – Predominantly coarse aggregate
  - Gradation below restricted zone
  - Higher density requirement
  - Greater likelihood of being permeable
  - Placed thicker
- Fine mixes – Predominantly fine aggregate
  - Gradation above restricted zone
  - Similar to old FDOT Type S mixes
- Shown on the mix design

http://secure.sm.dot.state.fl.us/bituminous/superpave/3001-4000/3009A.pdf - Microsoft Internet Explorer

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, 2006 NORTHEAST WALDO ROAD., GAINESVILLE, FLA. 32609

Contractor: Orlando Paving Company   Address: 8150 Apopka Blvd., Apopka, FL 32703

Phone No.: (407) 290-9327   Fax No.: (407) 290-5068   E-mail: cmoorefield@hubbard.com

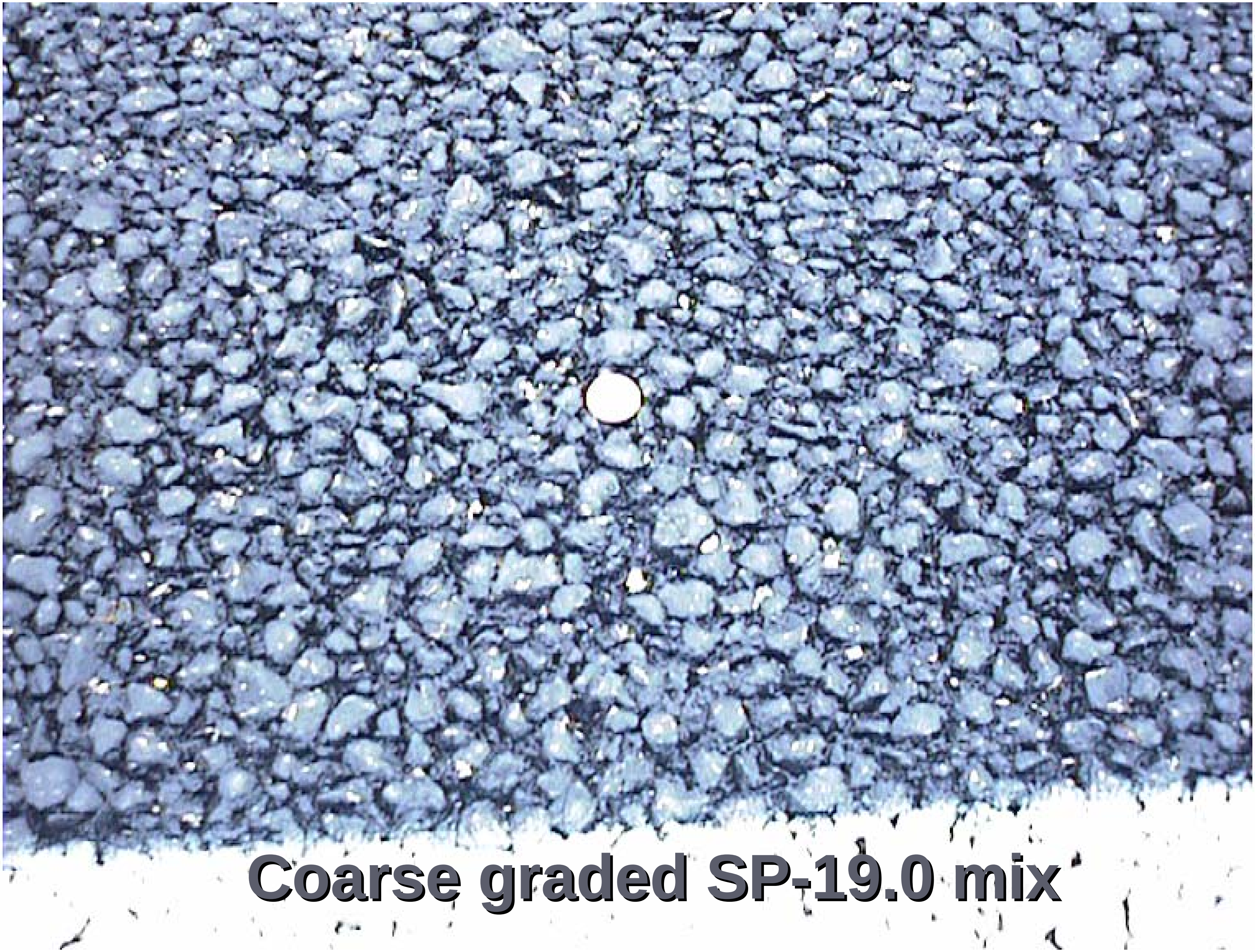
Submitted By: Orlando Paving Company   Type Mix: Fine SP-12.5 Recycle   Intended Use of Mix: Structural

Design Traffic Level: C   Gyrations @ N des: 75

TYPE MATERIAL	F.D.O.T. CODE	PRODUCER	PIT NO.	DATE SAMPLED
1. Crushed R. A. P.	2-00	Orlando Paving Company	A0531	06 / 01 / 2001
2. S-1-A Stone	42	Florida Rock Industries	TM-469 87-049	06 / 01 / 2001
3. FC-3 Stone	55	Rinker Materials Corp.	TM-447 87-090	06 / 01 / 2001
4. W-12 Screenings	21	Rinker Materials Corp.	TM-447 GA-178	06 / 01 / 2001
5.				
6.				

8.5 x 11 in   1 of 2


Fine graded SP-12.5 mix



Coarse graded SP-19.0 mix

Friction Courses

- Designated as FC
- Purpose: Provide a pavement surface with good frictional characteristics
- Required on all jobs with:
  - AADT >3,000
  - Design Speed >35 mph
- Use polish resistant aggregate
  - Oolitic limestone (Miami-Dade County)
  - Granite (Georgia & Nova Scotia)
- Also use asphalt rubber binder (ARB)

Friction Courses

- Fine Graded Friction Courses:
  - Good microtexture
    - Function of the aggregate
  - Two Nominal Maximum Aggregate Sizes:
    - FC-9.5 (Placed 1” thick)
    - FC-12.5 (Placed 1 ½” thick)
      - Formerly called FC-6
  - Standardized at Traffic Level C
  - Layer coefficient: 0.44
  - 100% oolite or 60% granite
  - ARB-5 (PG 67-22 w/5% GTR)

Friction Courses

- Open-Graded Friction Courses:
  - Required on high speed multi-lane facilities
    - Design Speed >50 mph
  - Good macrotexture
    - Function of surface texture
    - “Minimize” hydroplaning
  - FC-5
  - Layer coefficient: 0.00
  - 100% granite or 100% oolite
  - ARB-12 (PG 67-22 w/12% GTR)
  - Stabilizing fibers
  - Granite: hydrated lime


FC-5 Nassau County

Close-up FC-5 Macrotexture

Base Courses

- Designated as Type B
- One NMAS:
  - B-12.5
- Superpave
  - Standardized as Traffic Level B
  - Layer coefficient: 0.20
- May substitute an SP-12.5
  - It's basically the same mix

Asphalt Treated Permeable Base (APTB)

- No. 57 or 67 Stone
  - ¾” aggregate
- Approximately 2 – 3% PG 67-22
- Very porous/very open
- Used under PCC pavements

Binder Types

Superpave Asphalt Binders

► Grading system based on climate

PG 67-22

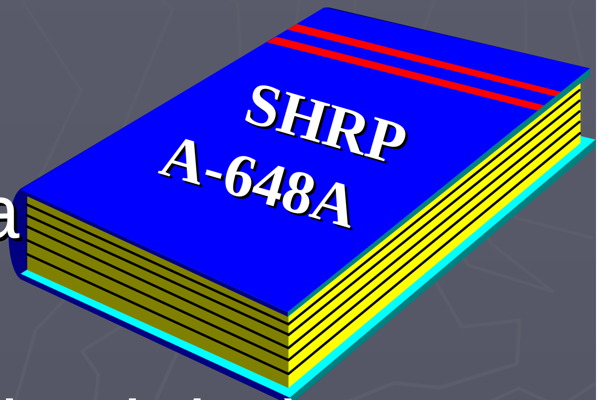
Performance Grade

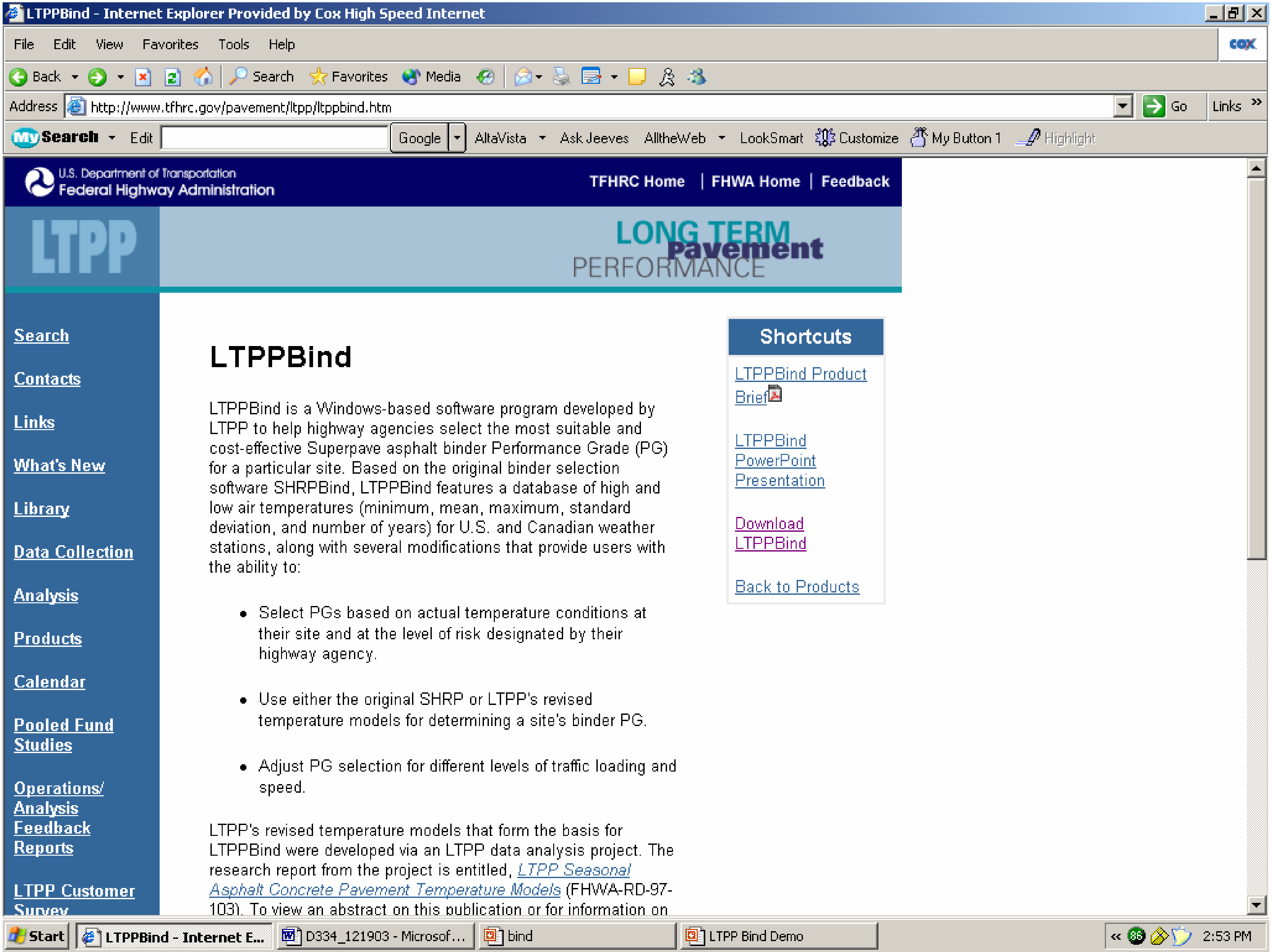
Average 7-day max pavement design temp

Min pavement design temp

Developed from Air Temperatures (over 20 year period)

- Superpave Weather Database
  - 6500 stations in U.S. and Canada
- Annual air temperatures
  - hottest seven-day temp (avg and std dev)
  - coldest temp (avg and std dev)
- Found on LTPP Website

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Federal Highway Administration
TFHRC Home | FHWA Home | Feedback
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LONG TERM Pavement PERFORMANCE
Search
Contacts
Links
What's New
Library
Data Collection
Analysis
Products
Calendar
Pooled Fund Studies
Operations/ Analysis Feedback Reports
LTPP Customer Survey
LTPPBind
LTPPBind is a Windows-based software program developed by LTPP to help highway agencies select the most suitable and cost-effective Superpave asphalt binder Performance Grade (PG) for a particular site. Based on the original binder selection software SHRPBind, LTPPBind features a database of high and low air temperatures (minimum, mean, maximum, standard deviation, and number of years) for U.S. and Canadian weather stations, along with several modifications that provide users with the ability to:
• Select PGs based on actual temperature conditions at their site and at the level of risk designated by their highway agency.
• Use either the original SHRP or LTPP's revised temperature models for determining a site's binder PG.
• Adjust PG selection for different levels of traffic loading and speed.
LTPP's revised temperature models that form the basis for LTPPBind were developed via an LTPP data analysis project. The research report from the project is entitled, LTPP Seasonal Asphalt Concrete Pavement Temperature Models (FHWA-RD-97-103). To view an abstract on this publication or for information on
Shortcuts
LTPPBind Product Brief
LTPPBind PowerPoint Presentation
Download LTPPBind
Back to Products
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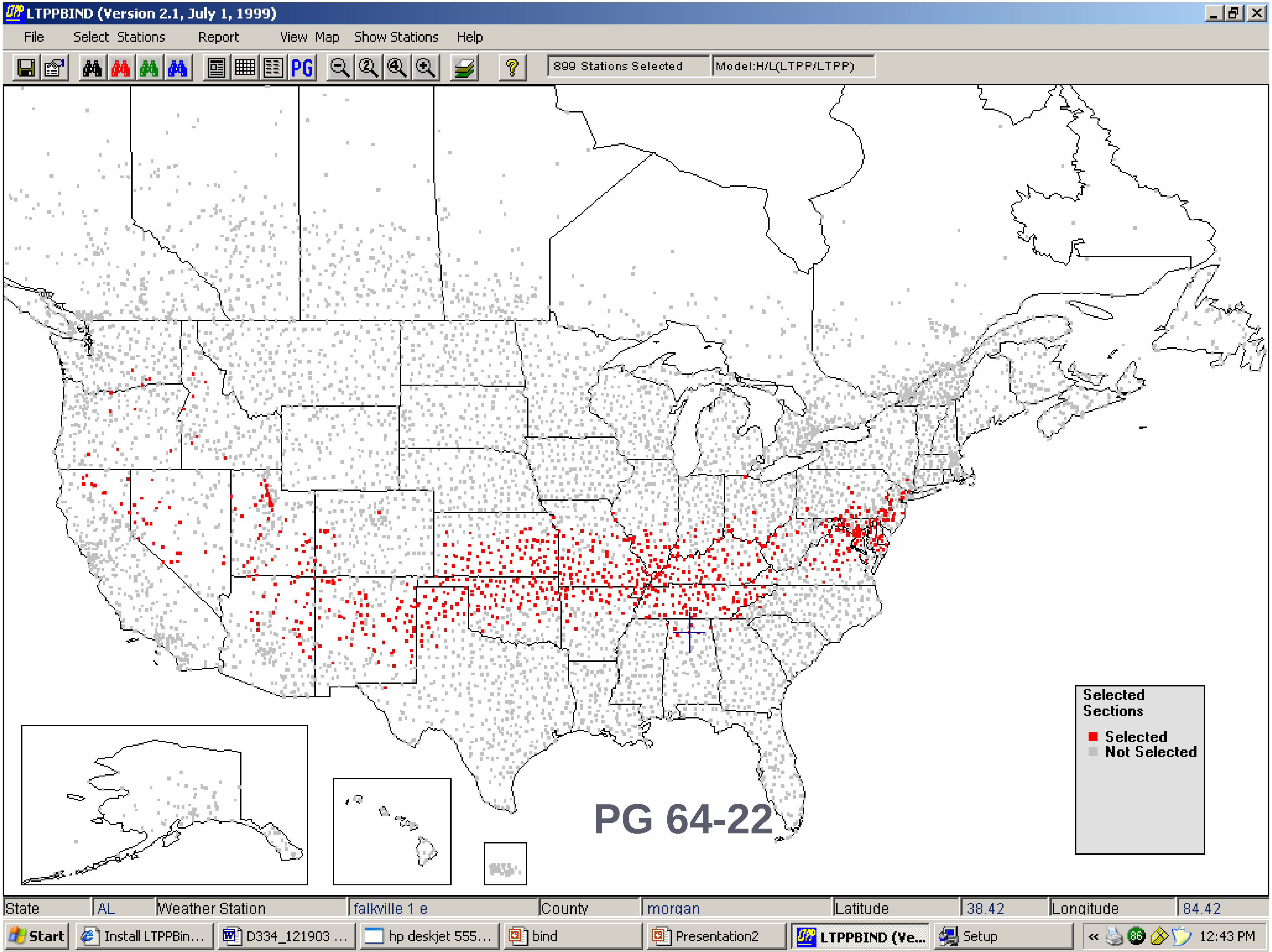

LTPPBIND (Version 2.1, July 1, 1999)
File
Select Stations
Report
View Map
Show Stations
Help
899 Stations Selected
Model:H/L(LTPP/LTPP)
PG 64-22
Selected Sections
Selected
Not Selected
State
AL
Weather Station
falkville 1 e
County
morgan
Latitude
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Longitude
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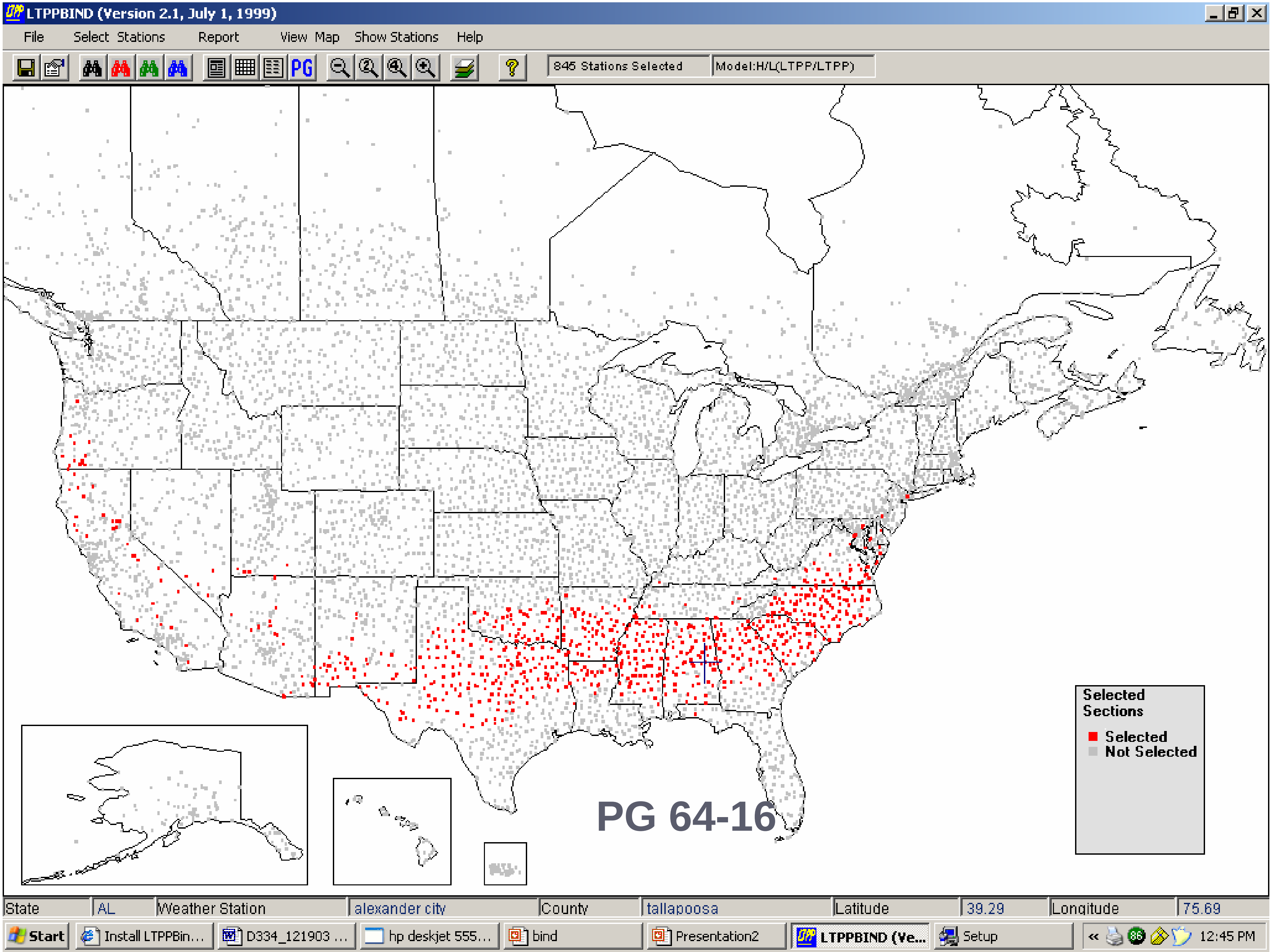

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Model:H/L(LTPP/LTPP)
PG
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Selected
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PG 64-16
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Weather Station
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County
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Latitude
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Longitude
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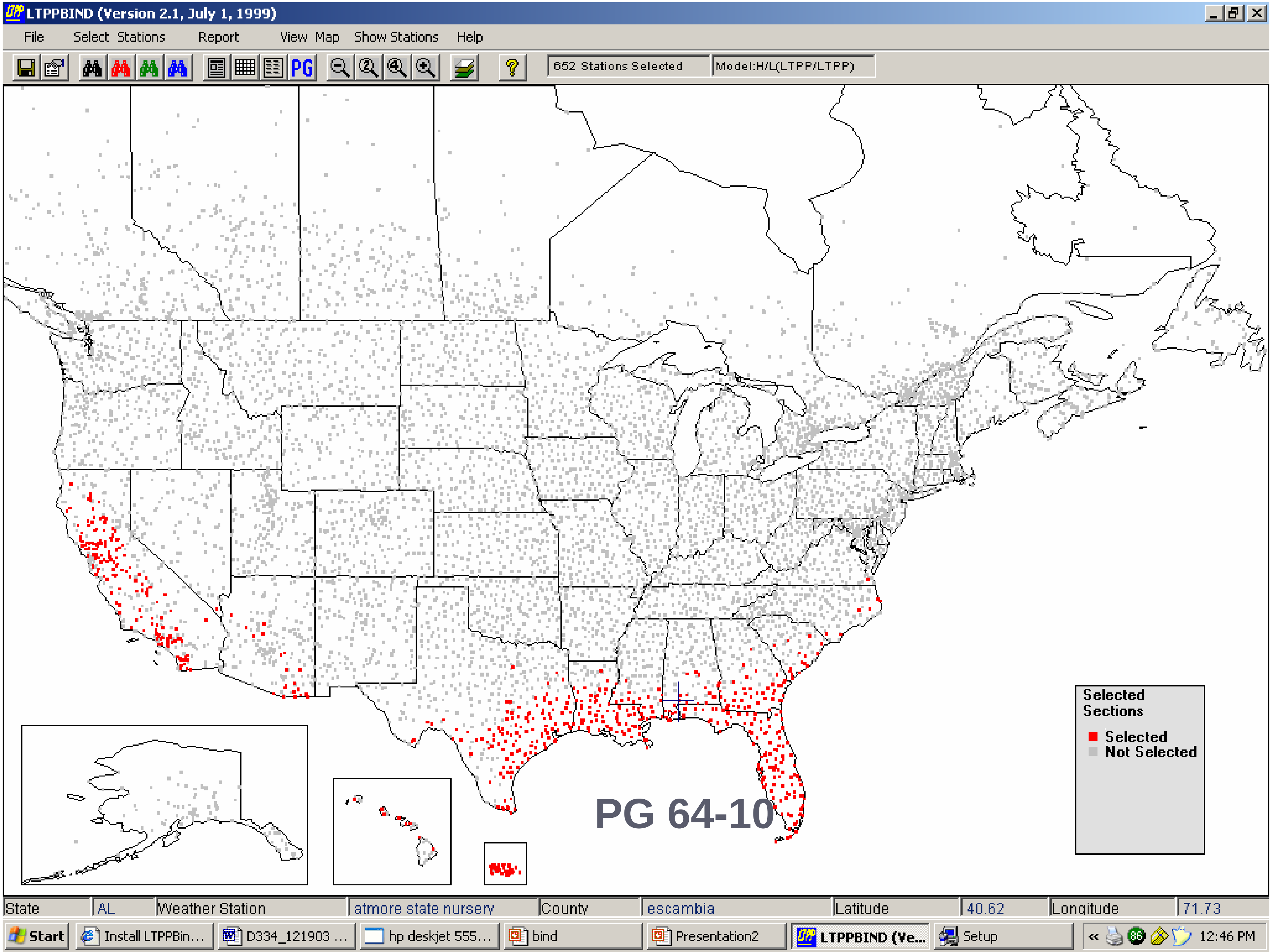
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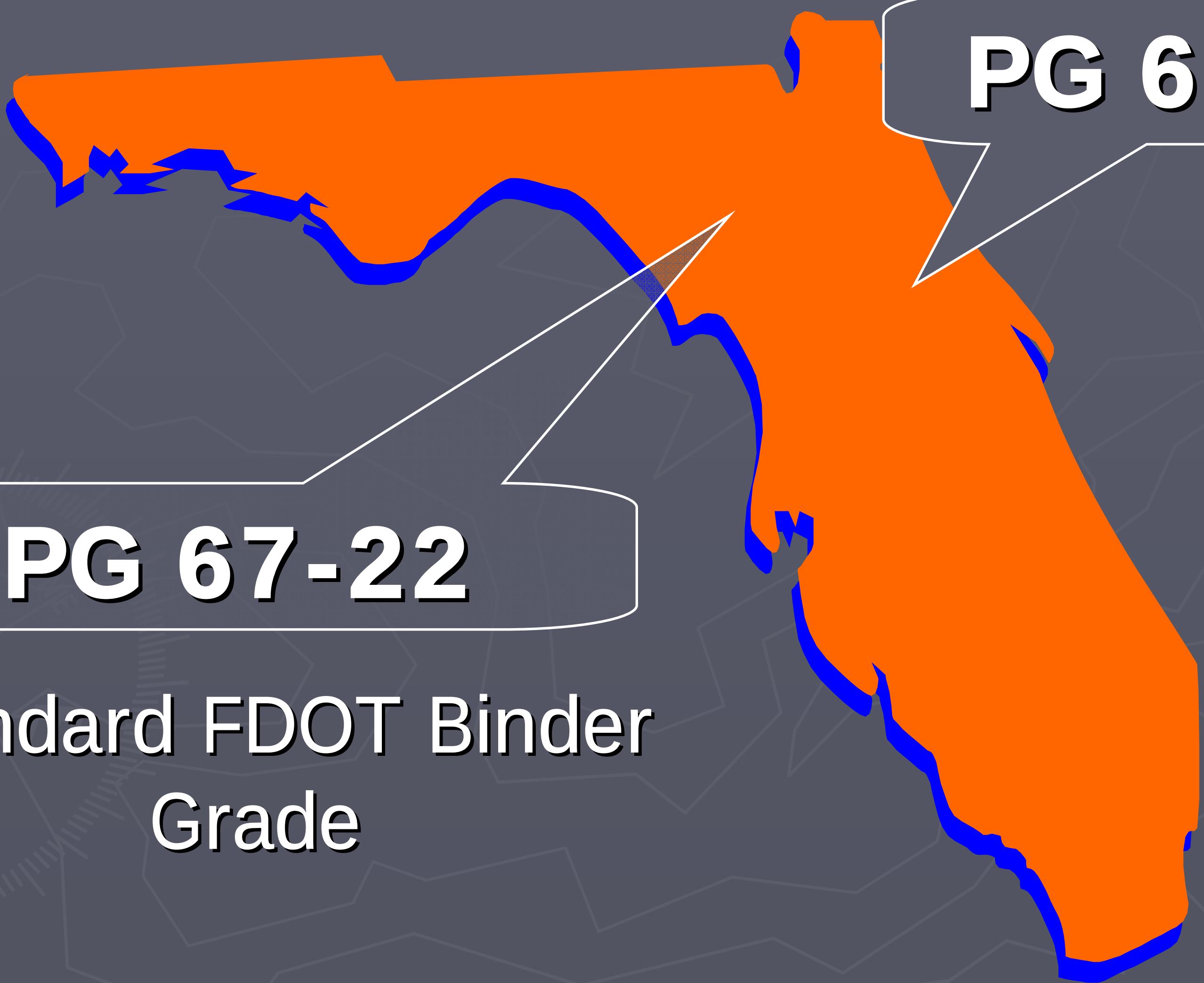
LTPP Binder Grade in Florida



PG 64-10

PG 67-22

Standard FDOT Binder Grade

Standard Binder Grades in Florida

- PG 67-22 (AC-30)
  - Special grade used in southeastern US
- PG 64-22 (AC-20)
- RA (Recycling Agent)
  - If >30% RAP in mix
- PG 76-22 (AC-30 w/polymer)
  - Rutting concerns

Volumetrics

Basic Terminology

- Specific Gravity (G): G_{xy}
  - x: b = binder
    s = stone
    m = mixture
  - y: b = bulk
    e = effective
    a = apparent
    m = maximum
  - Example:
    G_{mm} = gravity, mixture, maximum
    (i.e., maximum gravity of the mixture)

HMA Basics

- Bulk specific gravity of compacted mix (G_{mb})
  - FM 1-T 166
  - Core, SGC specimen
- Maximum specific gravity (G_{mm})
  - FM 1-T 209
  - Loose (uncompacted) mixture

- Air voids (V_a)
- Voids in the mineral aggregate (VMA)

HMA Basics

- Air Voids
  - Calculated using G_{mm} & G_{mb}

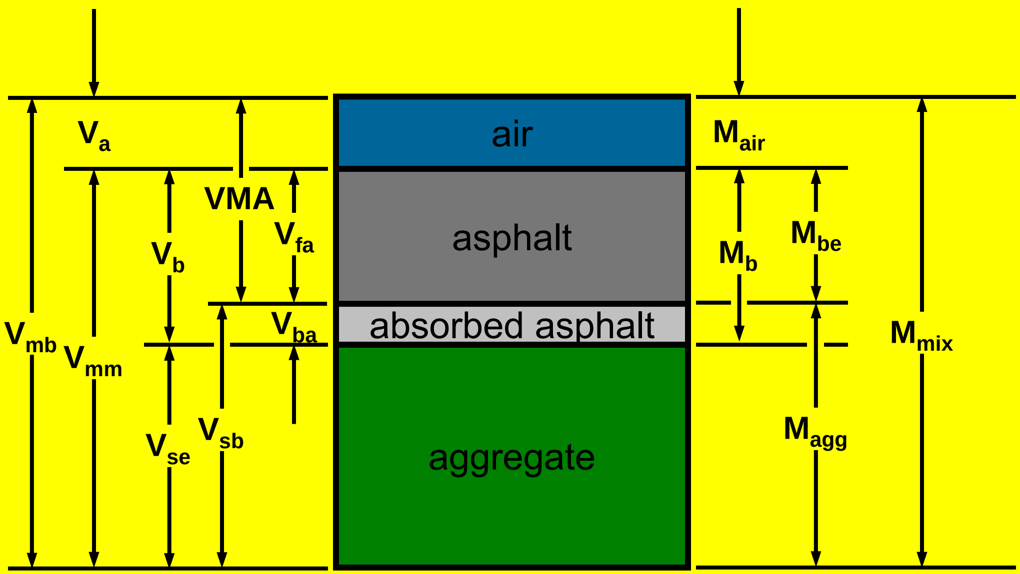
$$V_a = 100 * \left\{ \frac{G_{mm} - G_{mb}}{G_{mm}} \right\}$$

- VMA
  - Void space in mix containing air or binder
    - $VMA = V_a + V_{be}$
  - Calculated using G_{mb}, P_s, & G_{sb}

$$VMA = 100 - \frac{G_{mb} * P_s}{G_{sb}}$$

ASPHALT MIXTURE VOLUMETRICS

COMPONENT DIAGRAM



EQUATIONS USED IN HMA VOLUMETRIC ANALYSIS

Bulk Specific Gravity of Aggregate

$$G_{sb} = \frac{P_1 + P_2 + \ldots + P_N}{\frac{P_1}{G_1} + \frac{P_2}{G_2} + \ldots + \frac{P_N}{G_N}}$$

where G_{sb} = bulk specific gravity for the total aggregate
P_1, P_2, P_N = individual percentages by mass of aggregate
G_1, G_2, G_N = individual bulk specific gravities of aggregate

Effective Specific Gravity of Aggregate

$$G_{se} = \frac{P_{mm} - P_b}{\frac{P_{mm}}{G_{mm}} - \frac{P_b}{G_b}}$$

where G_{se} = effective specific gravity of the aggregate
G_{mm} = maximum specific gravity
P_{mm} = percent by mass of total loose mixture = 100
P_b = asphalt content
G_b = specific gravity of asphalt

Maximum Specific Gravity of Mixtures with Different Asphalt Contents

$$G_{sb} = \frac{P_{mm}}{\frac{P_s}{G_{se}} + \frac{P_b}{G_b}}$$

where G_{mm} = maximum specific gravity
P_{mm} = percent by mass of total loose mixture = 100
P_s = aggregate content, percent by total mass of mixture
P_b = asphalt content, percent by total mass of mixture
G_{se} = effective specific gravity of the aggregate
G_b = specific gravity of asphalt

Asphalt Absorption

$$P_{ba} = 100 \times \frac{G_{se} - G_{sb}}{G_{sb} G_{se}} \times G_b$$

where P_{ba} = absorbed asphalt, percent by mass of aggregate
G_{se} = effective specific gravity of aggregate
G_{sb} = bulk specific gravity of aggregate
G_b = specific gravity of asphalt

Effective Asphalt Content of a Paving Mixture

$$P_{be} = P_b - \frac{P_{ba}}{100} \times P_s$$

where P_{be} = effective asphalt content, percent by total mass of mixture
P_b = asphalt content, percent by total mass of mixture
P_{ba} = absorbed asphalt, percent by mass of aggregate
P_s = aggregate content, percent by total mass of mixture

Percent VMA in Compacted Paving Mixture

$$VMA = 100 - \frac{G_{mb} \times P_s}{G_{sb}}$$

where VMA = voids in mineral aggregate (percent of bulk volume)
G_{sb} = bulk specific gravity of total aggregate
G_{mb} = bulk specific gravity of compacted mixture
P_s = aggregate content, percent by total mass of mixture

Percent Air Voids in Compacted Mixture

$$V_a = 100 \times \frac{G_{mm} - G_{mb}}{G_{mm}}$$

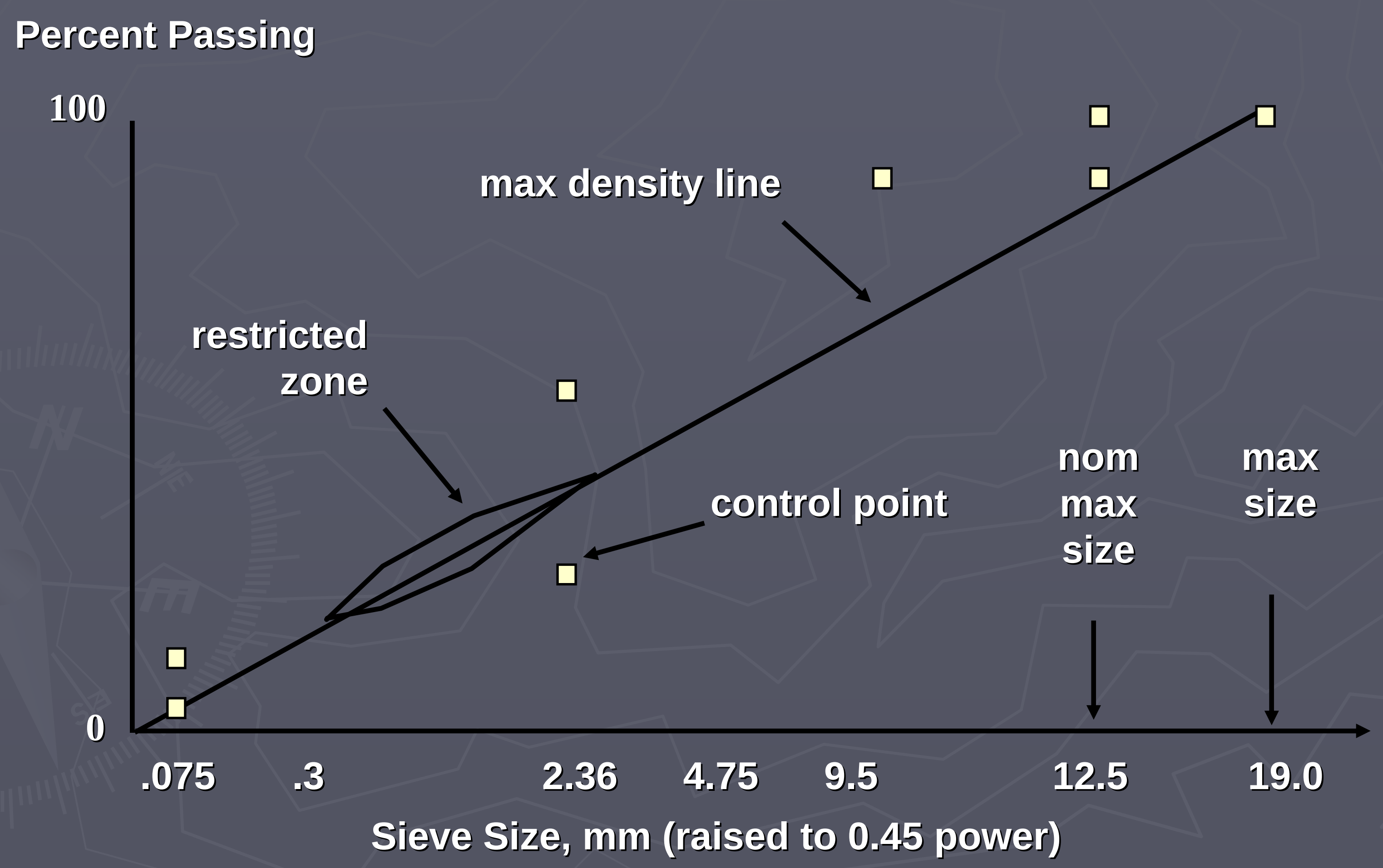
where V_a = air voids in compacted mixture, percent of total volume
G_{mm} = maximum specific gravity
G_{mb} = bulk specific gravity of compacted mixture

Percent VFA in Compacted Mixture

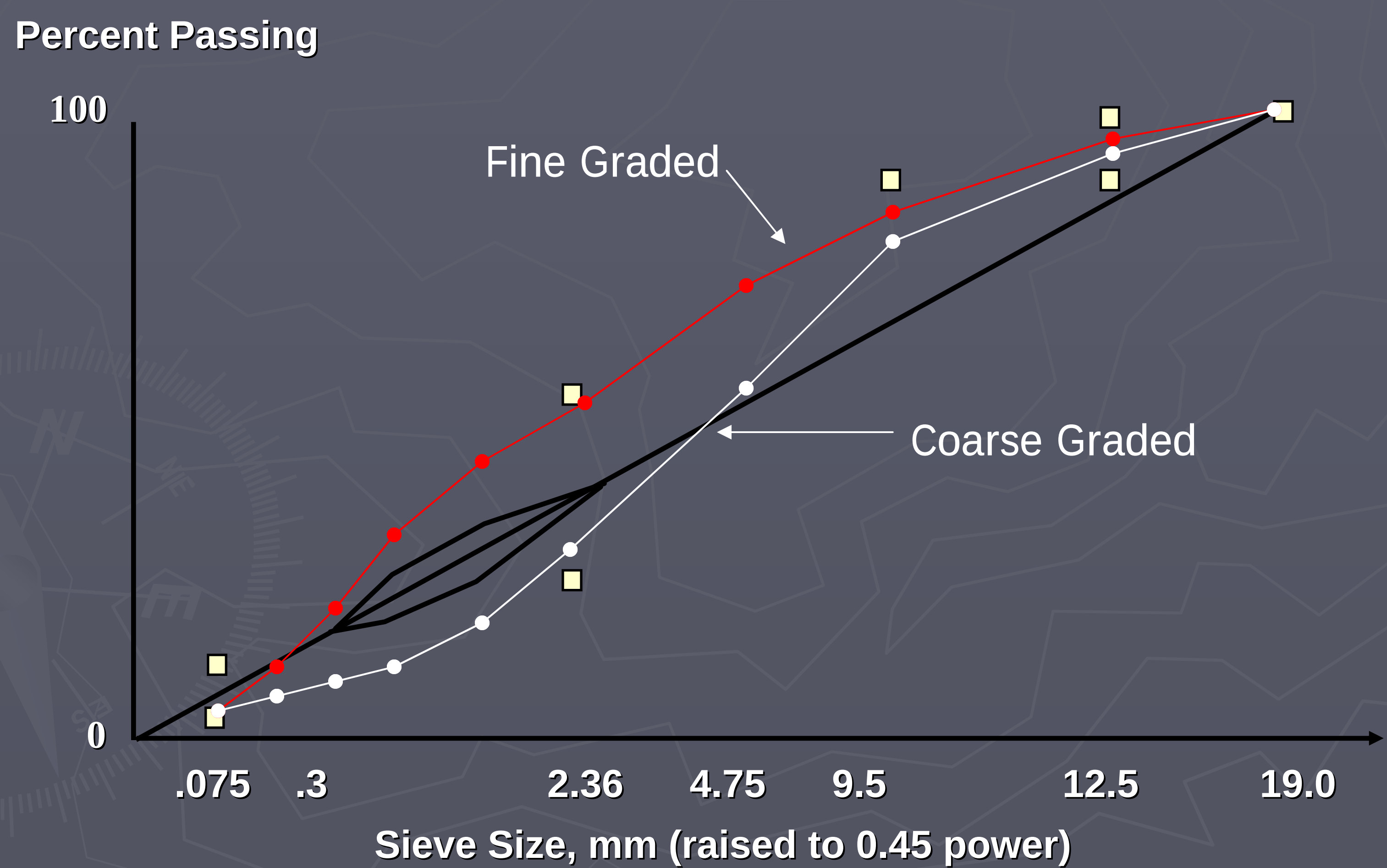
$$VFA = 100 \times \frac{VMA - V_a}{VMA}$$

where VFA = voids filled with asphalt, percent of VMA
VMA = voids in mineral aggregate, percent of bulk volume
V_a = air voids in compacted mixture, percent of total volume

0.45 Power Curve



0.45 Power Curve



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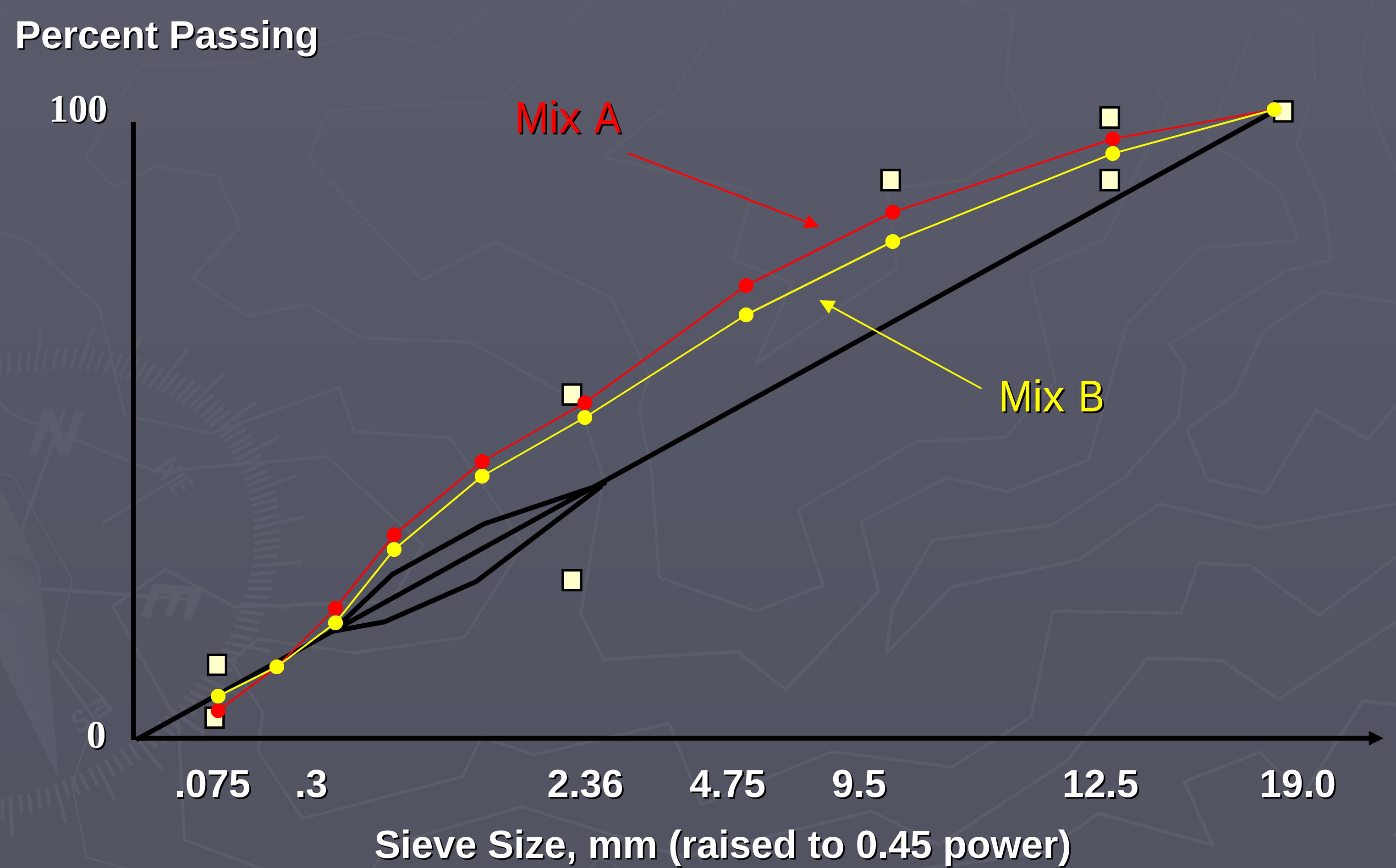


Summary

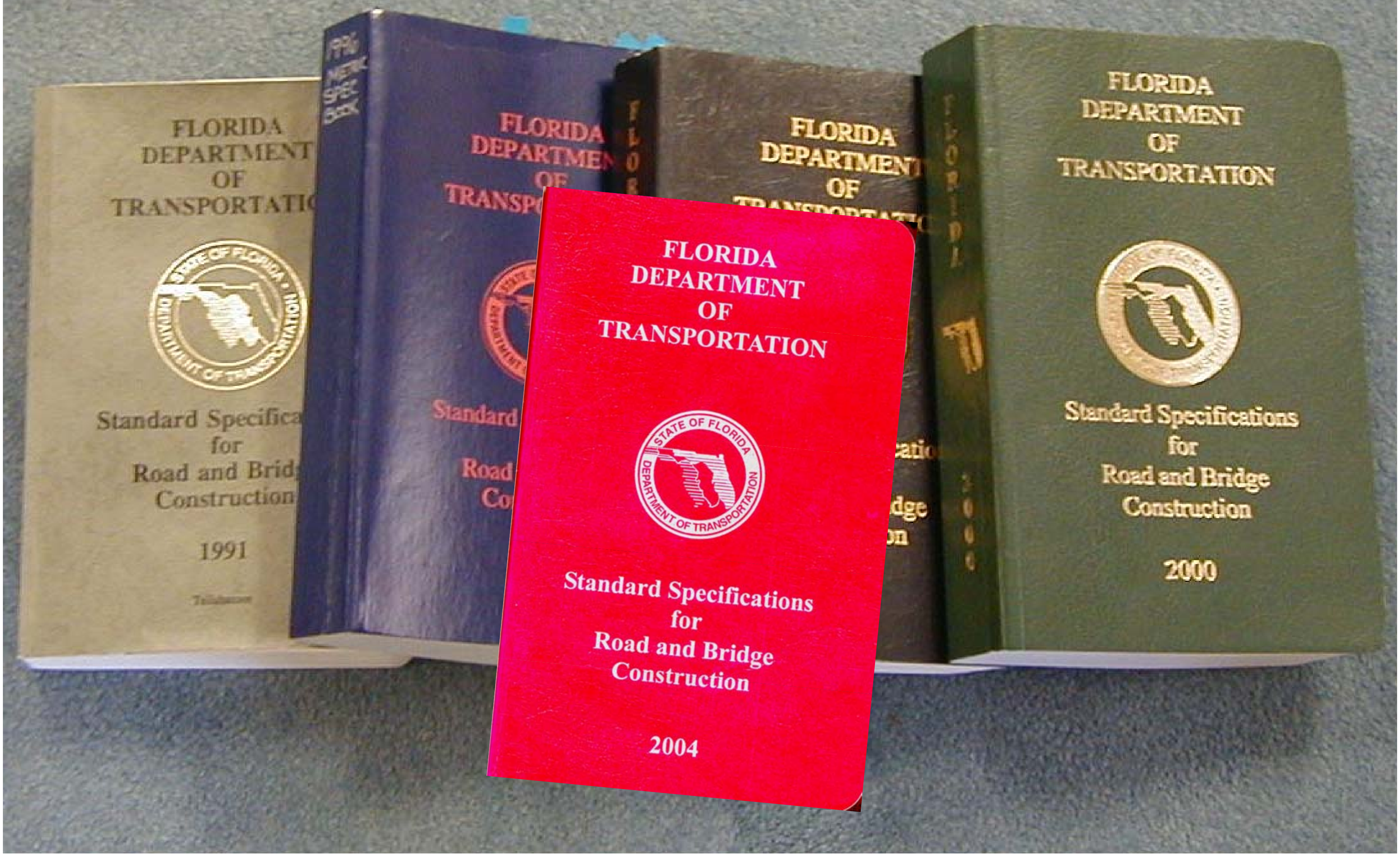
- Typical asphalt pavement structures
- Different asphalt mix types
- Asphalt binders
- Basic volumetrics

Questions?

EAR
Workshop

Specification Review

Specification Overview



Topics

- Brief overview of the CQC system for asphalt
- Basic testing requirements
- Failure criteria
- Defective material

Contractor Quality Control for Asphalt

- Production Lot sizes 2000 or 4000 tons
  - Four sublots 500 or 1000 tons
  - Plant Lot and Roadway Lot the same
- Quality Control (QC) tests randomly 1 set/sublot
  - FDOT determines when to sample
    - Split samples obtained for Verification & Resolution
  - G_{mm}, SGC (G_{mb}), P_b, gradation (P_{-8}, P_{-200})
  - Five cores (G_{mb}) per sublot for density
- Must meet requirements of Table 334-4
  - Master Production Range
  - Pass/Fail criteria

Table 334-4
Master Production Range

Characteristic	Tolerance (1)
Asphalt Binder Content (percent)	Target ± 0.55
Passing No. 8 Sieve (percent)	Target ± 5.50
Passing No. 200 Sieve (percent)	Target ± 1.50
Air Voids (percent) Coarse Graded	2.00 – 6.00
Air Voids (percent) Fine Graded	2.30 – 6.00
Density, percent G_{mm} (2)	
Coarse Graded (minimum)	93.00
Fine Graded (minimum)	90.00
(1) Tolerances for sample size of n = 1 from the verified mix design (2) Based on an average of 5 randomly located cores	

Contractor Quality Control for Asphalt

- Verification (VT) 1 set/Lot
  - Only determines if QC data is acceptable for pay
  - Randomly select one of four sublots
    - Split sample (plant)
    - Same cores (roadway)
  - G_{mm}, SGC (G_{mb}), P_b, gradation (P_{-8}, P_{-200})
  - Use Between-laboratory precision values
    - Table 334-5
  - If everything compares favorably → accept material and pay based on QC results
  - If an unfavorable comparison → Resolution

Table 334-5
Between-Laboratory Precision Values

Property	Maximum Difference
G_{mm}	0.016
G_{mb}	0.022
P_b	0.44 Percent
P_{-200}	FM 1-T 030 (Figure 2)
P_{-8}	FM 1-T 030 (Figure 2)

Contractor Quality Control for Asphalt

- Pay Factors determined per Lot:
  - V_a, Density, P_b, P_{-200}, P_{-8}
  - 1 – 2 tests: Small Quantity Pay Table
  - 3 – 4 tests: Percent Within Limits (PWL)
- Composite Pay Factor for each Lot determined based on the following weighting:
  - 35% Density
  - 25% V_a
  - 25% P_b
  - 10% P_{-200}
  - 5% P_{-8}
- System slightly different for FC-5
  - Lot size, Pay factors

Contractor Quality Control for Asphalt

- Independent Verification (IV) 1 set/Lot
  - District Bituminous staff
    - Plant – P_b, gradation (P_{-8}, P_{-200}), Air Voids
    - Roadway – Five cores (G_{mb}) for density
  - Use same Table 334-4
  - If any tests results do not meet the requirements of Table 334-4, cease production
  - Address failing test results in accordance with 334-5.9.5

Tests

- ► Asphalt Content (P_b)
  - FM 5-563
  - Loose (uncompacted) mixture
- ► Gradation (P_{-8} and P_{-200})
  - FM 1-T 030
  - Recovered Aggregate
- ► Volumetric Testing – prior to testing samples condition the test sized sample for 1 hour at the target roadway temperature

Tests

- Maximum specific gravity (G_{mm})
  - FM 1-T 209
  - Loose (uncompacted) mixture
- Gyratory Compaction – N_{des}
  - Plant Air Voids at N_{des}
  - AASHTO T 312-04
- Bulk specific gravity of compacted mix (G_{mb})
  - FM 1-T 166
  - Core, SGC specimen

334-5.9 Minimum Acceptable Quality Levels:

- Individual <u>Lot</u> Pay Factors 0.80 to 0.89
  - First time correct, 2 consecutive - cease
- Composite Pay Factor 0.75 to 0.79
  - Handle per 334-5.9.5
- Composite Pay Factor Less than 0.75
  - Remove and Replace

334-5.9.5 Defective Material:

- Includes IV and QC failures
- Remove and Replace....or
- Engineering Analysis Report
  - Paid by contractor
  - Remain in place at composite pay factor, or
  - Remove and Replace
- The Engineer may determine that an engineering analysis is not necessary or may perform an engineering analysis to determine the disposition of the material

334-5.9.5 Defective Material: Assume responsibility for removing and replacing all defective material placed on the project, at no cost to the Department.

As an exception to the above and upon approval of the Engineer, obtain an engineering analysis by an independent laboratory (as approved by the Engineer) to determine the disposition of the material. The engineering analysis must be signed and sealed by a Professional Engineer licensed in the State of Florida.

The Engineer may determine that an engineering analysis is not necessary or may perform an engineering analysis to determine the disposition of the material.

Any material that remains in place will be accepted with a composite pay factor as determined by 334-8, or as determined by the Engineer.

If the defective material is due to a gradation, asphalt binder content or density failure, upon approval of the Engineer the Contractor may perform delineation tests on roadway cores in lieu of an engineering analysis to determine the limits of the defective material that requires removal and replacement. Prior to any delineation testing, all sampling locations shall be approved by the Engineer. All delineation sampling and testing shall be monitored and verified by the Engineer. The minimum limit of removal of defective material is fifty-feet either side of the failed sample. For materials that are defective due to air voids, an engineering analysis is required.

QUESTIONS ?

EAR
Workshop

FDOT Pavement Performance

PAVEMENT CONDITION SURVEY UNIT

PAVEMENT MATERIALS SECTION

PAVEMENT CONDITION SURVEY

- ANNUAL SURVEY OF THE STATE HIGHWAY SYSTEM TO EVALUATE THE CONDITION OF THE WEARING SURFACE
- ANNUAL RIDE SURVEY OF HIGHWAY PERFORMANCE MONITORING SYSTEM (HPMS)

2004 – 2005
PAVEMENT CONDITION SURVEY
STATE MAINTAINED SYSTEM

	RATED MILES	LANE MILES
FLEXIBLE	18,159	40,381
RIGID	363	976
TOTAL	18,522	41,357

PCS DATA COLLECTION

- DETERMINE PRESENT CONDITION
- COMPARE PRESENT WITH PAST CONDITION
- PREDICT DETERIORATION RATES

PCS DATA COLLECTION

- PREDICT FUNDING NEEDS
- JUSTIFY STATEWIDE ANNUAL BUDGET REQUEST FOR REHABILITATION
- BASIS FOR DISTRICTS' PROJECT REHABILITATION FUNDING

FLEXIBLE PAVEMENT SURVEY

- RIDE
  - AUTOMATED
- RUTTING
  - AUTOMATED
  - MANUAL
- CRACKING (PLUS PATCHING AND RAVELING)
  - WINDSHIELD SURVEY

RIDE & RUT DATA

- HIGH SPEED PROFILER
  Class 1 by ASTM E-950

RIDE QUALITY INDEX

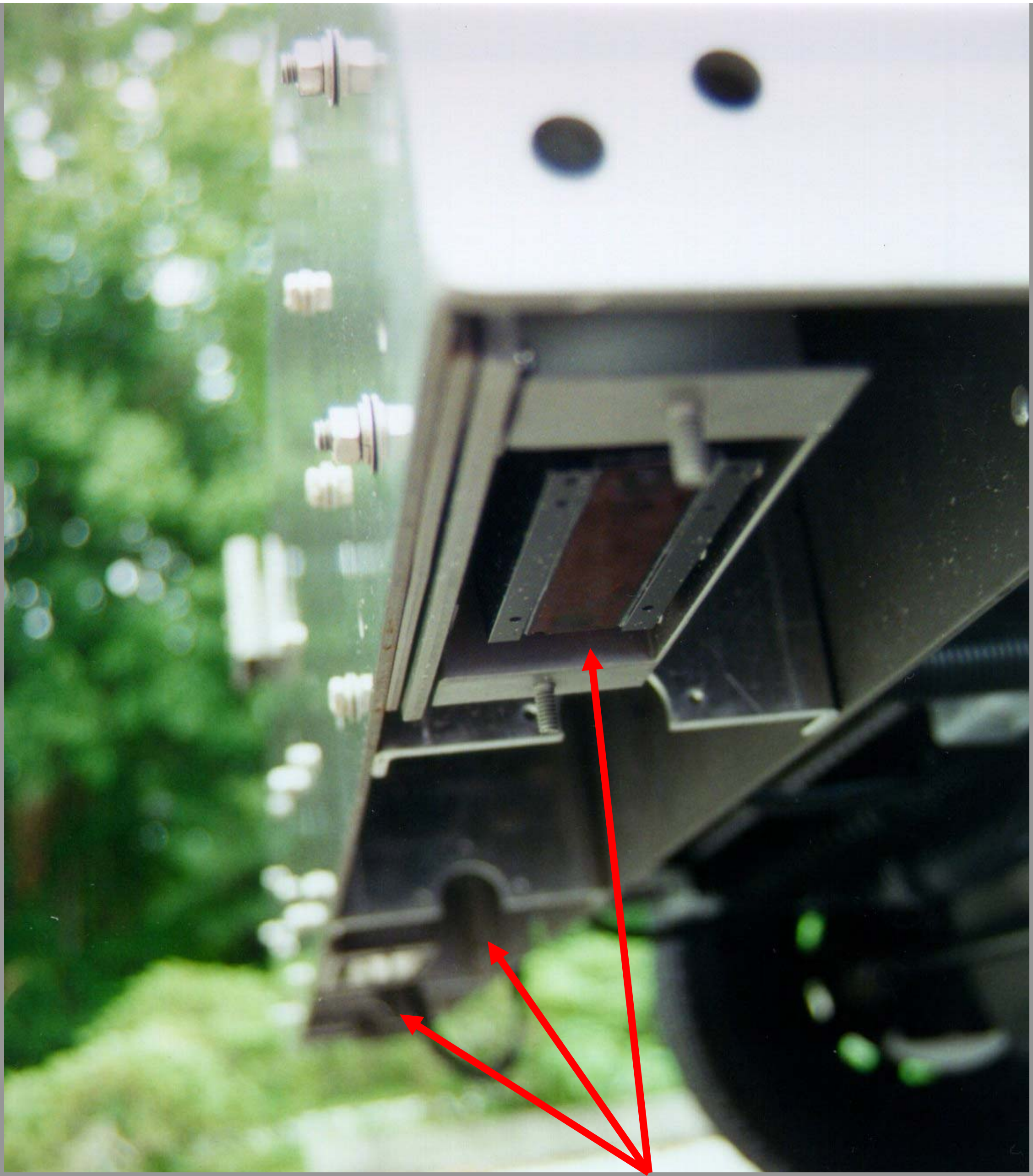
- RN - ASTM E-1489

  Used For Pavement Management System and For Ride Acceptance Testing On New Projects

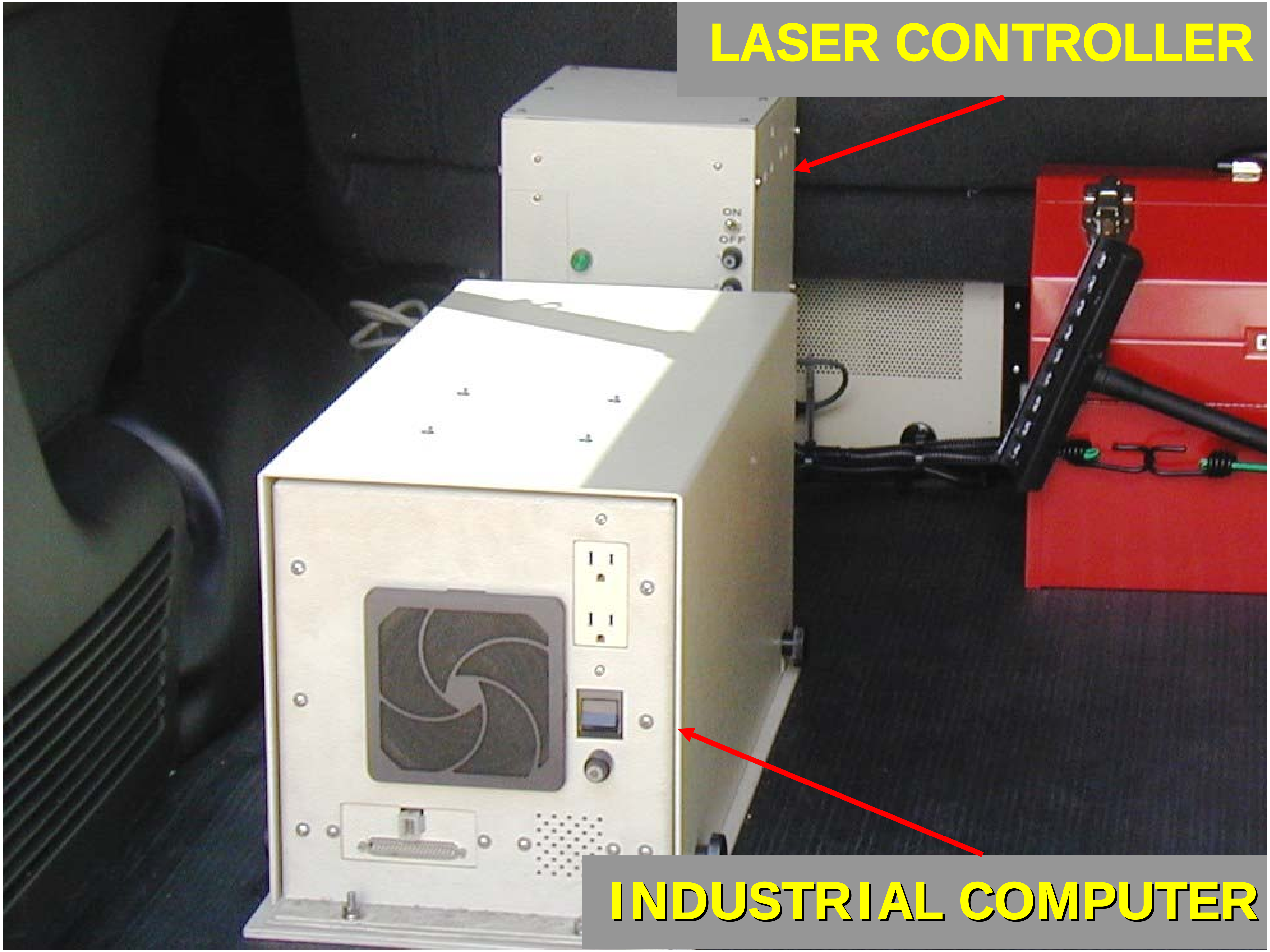
- IRI - ASTM E-1926

  Used For HPMS Monitoring

LASER PROFILER



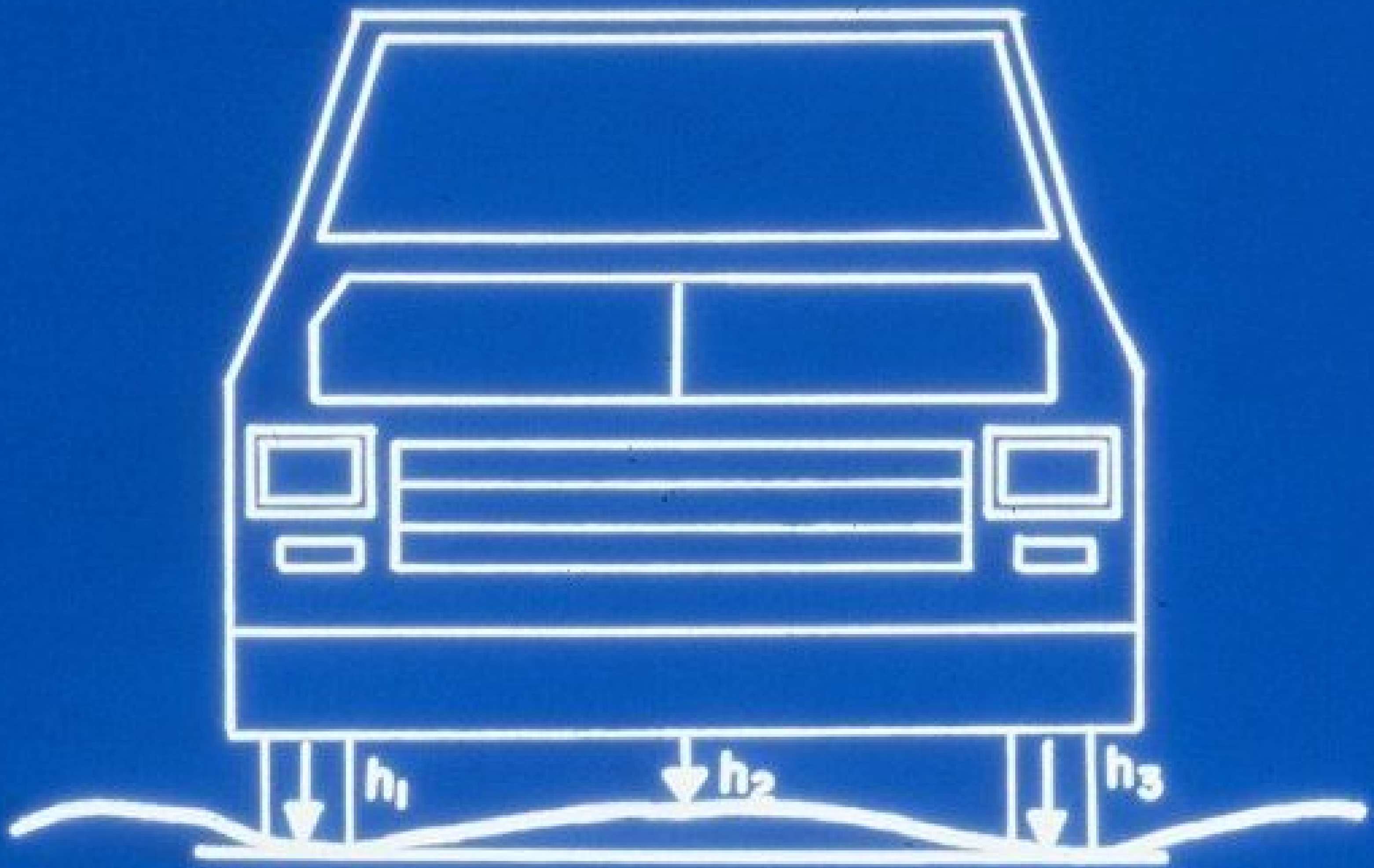
LASER SENSORS


LASER CONTROLLER
ON
OFF
INDUSTRIAL COMPUTER

OPERATOR CONSOLE

We Measure Ruts With Precision

Using a Road Profiler



PROFILER RUTTING DEDUCT POINTS

Rut Depth (inches)	Range (inches)	Deduct Points
0	0.00 - 0.06	0
1/8	0.07 - 0.19	1
1/4	0.20 - 0.31	2
3/8	0.32 - 0.44	3
1/2	0.45 - 0.56	4
5/8	0.57 - 0.69	5
3/4	0.70 - 0.81	6
7/8	0.82 - 0.94	7
1	0.95 - 1.06	8
1 1/8	1.07 - 1.19	9
1 1/4 +	1.20 +	10

MANUAL RUT DEPTH

MANUAL RUTTING DEDUCT POINTS

Rut Depth (inches)	Deduct Points
0	0
1/8	1
1/4	2
3/8	3
1/2	4
5/8	5
3/4	6
7/8	7
1	8
1 1/8	9
1 1/4 +	10


SLOWER
TRAFFIC
KEEP
RIGHT

CLASS 1B CRACKING

HAIRLINE CRACKS ≤ 1/8 INCH (3.18 mm).

CLASS 1B CRACKING

MAY HAVE SLIGHT SPALLING AND SLIGHT TO MODERATE BRANCHING.

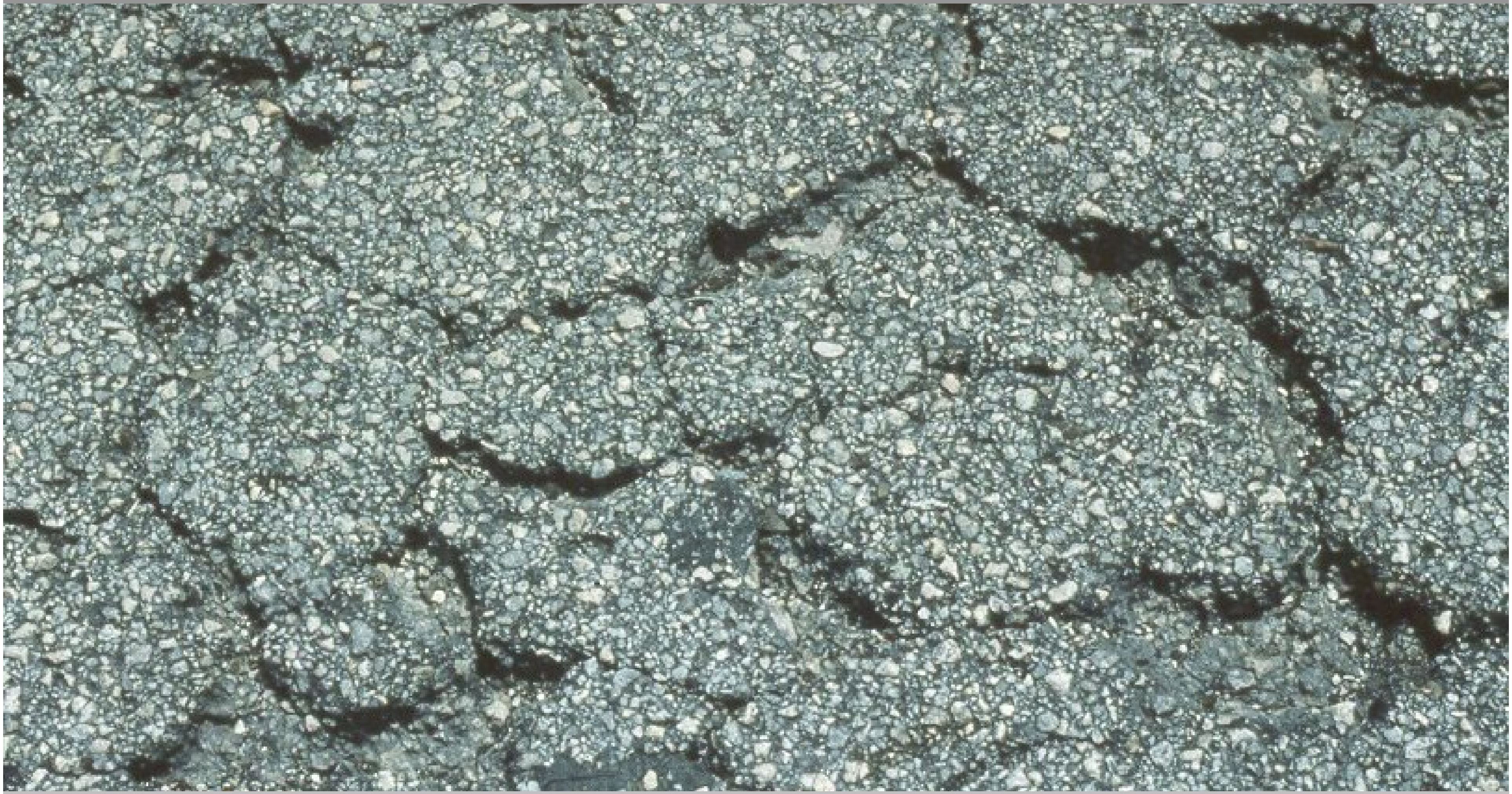
CLASS II CRACKING

CRACKS >1/8 INCH (3.18 mm) TO ≤1/4 INCH (6.35 mm) WHICH MAY HAVE SPALLING OR BRANCHING

CLASS II CRACKING

CRACKS LESS THAN 1/4 INCH (6.35 mm) WIDE WHICH HAVE FORMED CELLS LESS THAN 2 FEET (0.61 m) ON THE LONGEST SIDE (ALLIGATOR CRACKING).

CLASS III CRACKING



CRACKS >1/4 INCH (6.35 mm) REACHING DOWN TO THE BASE OR UNDERLYING MATERIAL

CLASS III CRACKING

PROGRESSIVE CLASS II CRACKING RESULTING IN SEVERE SPALLING WITH CHUNKS OF PAVEMENT BREAKING OUT, AND SEVERE RAVELING (LOSS OF SURFACE ND

SEVERE RAVELING (LOSS OF SURFACE AGGREGATE).

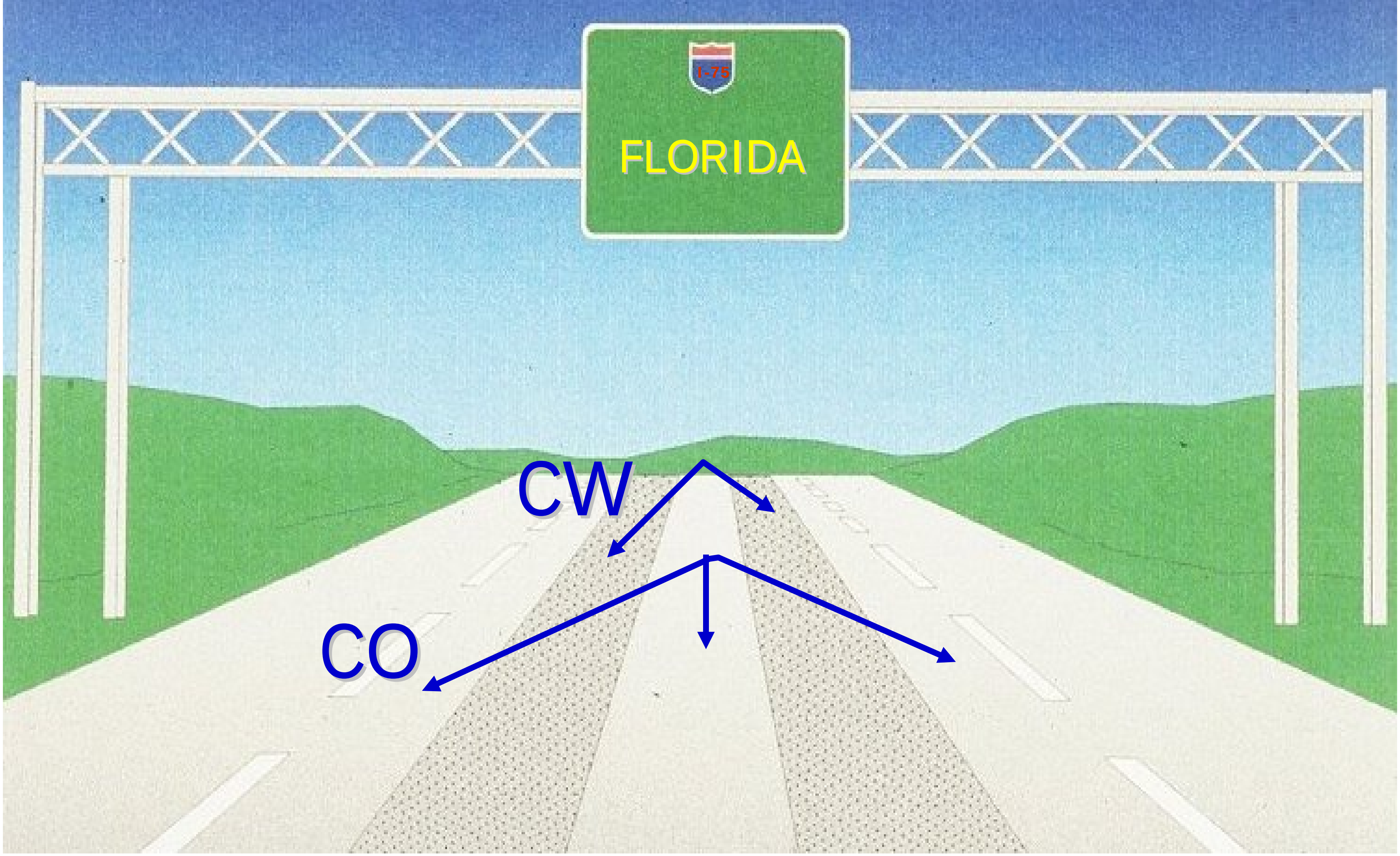
RAVELING

THE DISLODGING OF AGGREGATE PARTICLES AND LOSS OF ASPHALT BINDER.

PATCHING

PORTION OF PAVEMENT SURFACE > 0.1 SQ. FT THAT HAS BEEN REMOVED AND REPLACED.

WHEEL PATH AREAS



CONFINED TO THE WHEEL PATHS (CW)

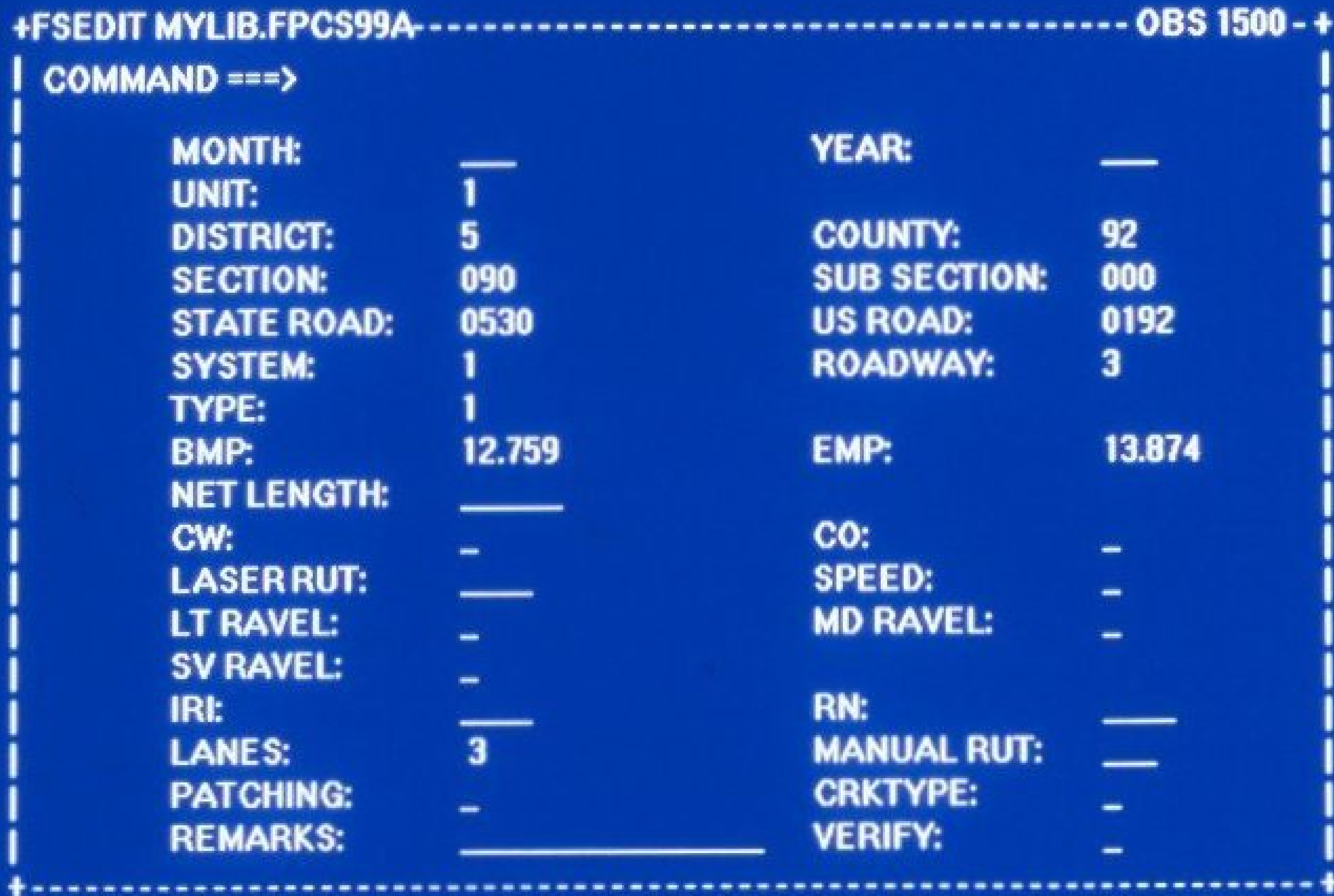
% of PVT Area affected by Cracking	PREDOMINATE CRACKING CLASS					
	IB CRACKING		II CRACKING		III CRACKING	
	CODE	DEDUCT	CODE	DEDUCT	CODE	DEDUCT
00-05	A	0.0	E	0.5	I	1.0
06-25	B	1.0	F	2.0	J	2.5
26-50	C	2.0	G	3.0	K	4.5
51 +	D	3.5	H	5.0	L	7.0

OUTSIDE THE WHEEL PATHS (CO)

% of PVT Area affected by Cracking	PREDOMINATE CRACKING CLASS					
	IB CRACKING		II CRACKING		III CRACKING	
	CODE	DEDUCT	CODE	DEDUCT	CODE	DEDUCT
00-05	A	0.0	E	0.0	I	0.0
06-25	B	0.5	F	1.0	J	1.0
26-50	C	1.0	G	1.5	K	2.0
51 +	D	1.5	H	2.0	L	3.0

NOTES FOR CW & CO WHEEL PATHS

- PERCENTAGES FOR CW AND CO ARE ESTIMATED SEPARATELY. EACH REPRESENTING 100% OF ITS RESPECTIVE AREA.
- CRACKING PERCENTAGES ARE COMBINED BUT ONLY THE PREDOMINATE TYPE OF CRACKING PRESENT WILL BE CODED
- CRACKING DEFECT RATING = 10 - (CW + CO).



Flexible Pavement Condition Survey Data Entry Screen

RIGID PAVEMENT SURVEY

- RIDE RATING
- DEFECT RATING

DISTRESS FACTORS IN DEFECT RATING

1) Surface Deterioration
2) Spalling
3) Patching
4) Transverse Cracking
5) Longitudinal Cracking
6) Corner Cracking
7) Shattered Slab
8) Faulting
9) Pumping
10) Joint Condition

SURFACE DETERIORATION

SPALLING

PATCHING

TRANSVERSE CRACKING

LONGITUDINAL CRACKING

CORNER CRACKING

SHATTERED SLAB

FAULTING

FAULTING

PUMPING

JOINT CONDITION

DEDUCT VALUES FOR RIGID PAVEMENT

TYPE OF DISTRESS	SEVERITY	NUMERIC VALUE
Surface Deterioration	Moderate Severe	0.003 per square foot 0.006 per square foot
Spalling	Moderate Severe	0.01 per linear foot 0.02 per linear foot
Patching	Fair Poor	0.018 per square yard 0.045 per square yard
Transverse Cracking	Light Moderate Severe	0.30 per crack 0.38 per crack 0.50 per crack
Longitudinal Cracking	Light Moderate Severe	0.15 per crack 0.19 per crack 0.25 per crack
Corner Cracking	Light Moderate Severe	0.25 per crack 0.31 per crack 0.40 per crack
Shattered Slab	Moderate Severe	1.15 per Shattered Slab 1.50 per Shattered Slab

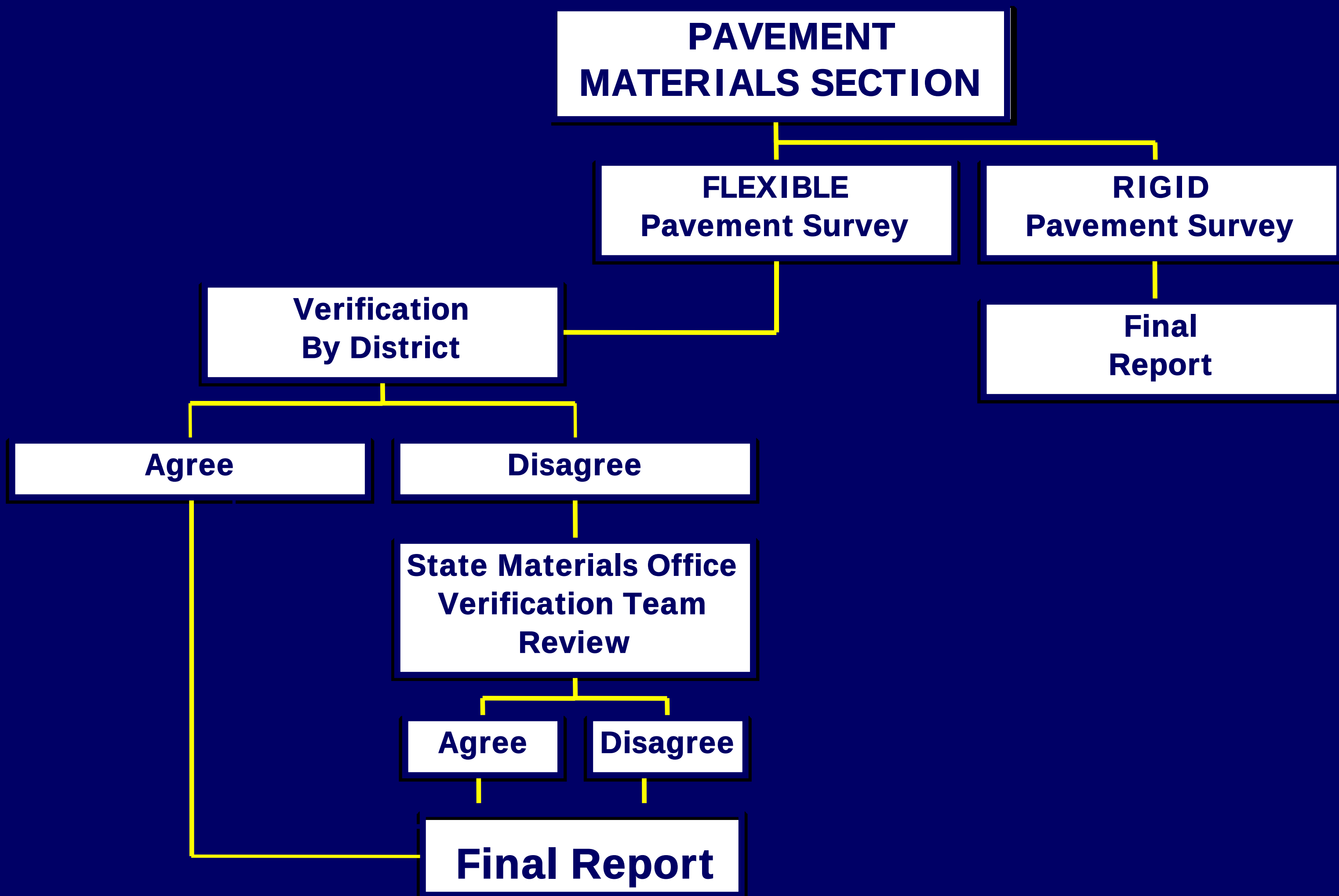
DEDUCT VALUES FOR RIGID PAVEMENT

TYPE OF DISTRESS	SEVERITY	NUMERIC VALUE	
Faulting	1.0 per 1/32” Faulting		
Pumping	Light	1%-25%	2
	Light	26%-50%	3
	Light	51%-75%	4
	Light	76%-100%	5
	Moderate	1%-25%	4
	Moderate	26%-50%	6
	Moderate	51%-75%	8
	Moderate	76%-100%	10
	Severe	1%-25%	6
	Severe	26%-50%	9
	Severe	51%-75%	12
	Severe	76%-100%	15
Joint Condition	Partially Sealed		5
	Not Sealed		10

DATA QUALITY CHECKS

- 150 + EDITS ON CODING ENTRIES
- YEAR TO YEAR COMPARE
- RCI EDIT CHECK

PCS VERIFICATION PROCESS



CALIBRATION

- PROFILERS RECEIVE ELABORATE CALIBRATION
- STRAIGHTEDGE CALIBRATION
- PLATE CALIBRATION
- SECTION CALIBRATION WITH DIPSTICK

STRAIGHTEDGE CALIBRATION

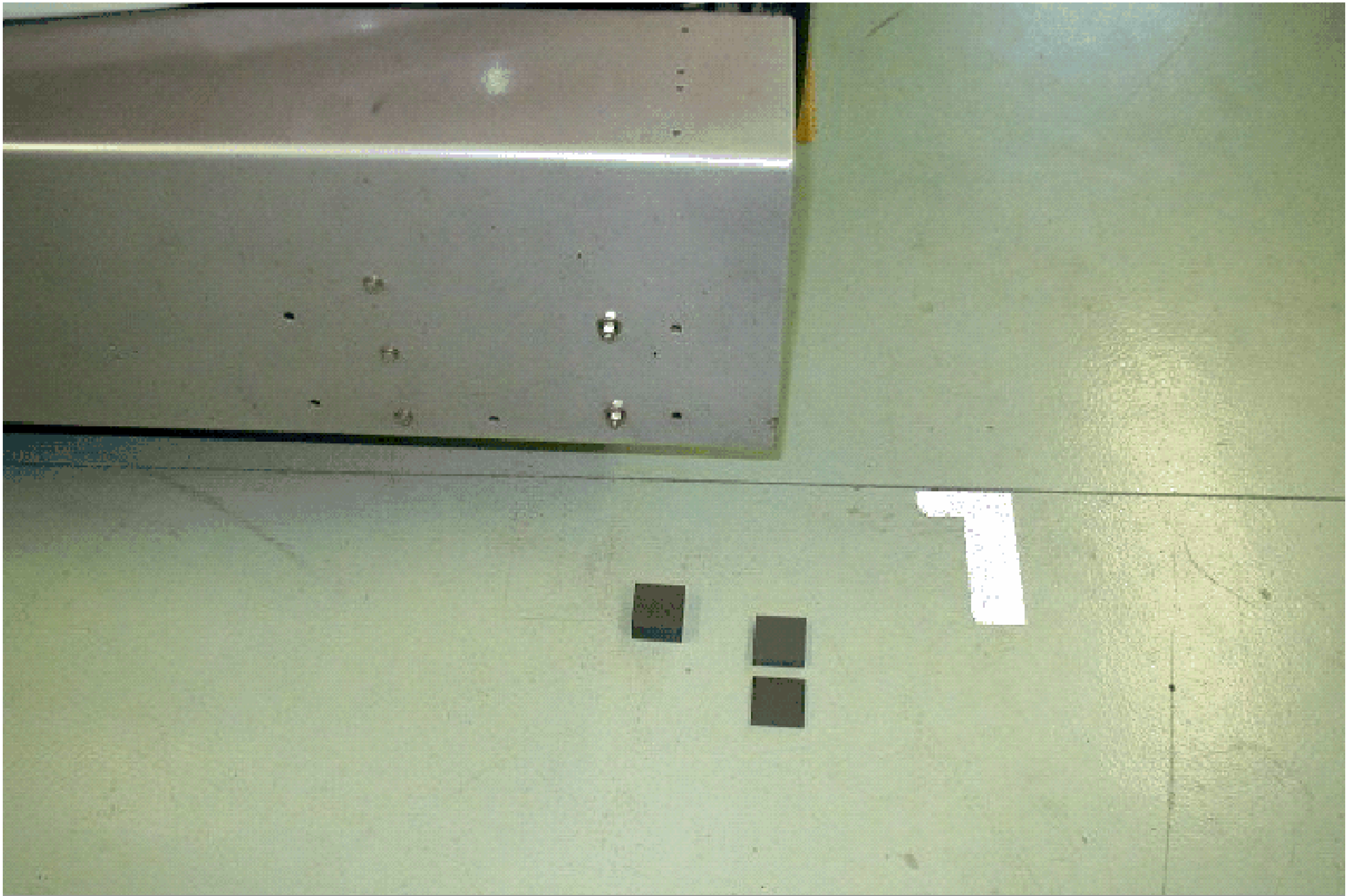


PLATE CALIBRATION

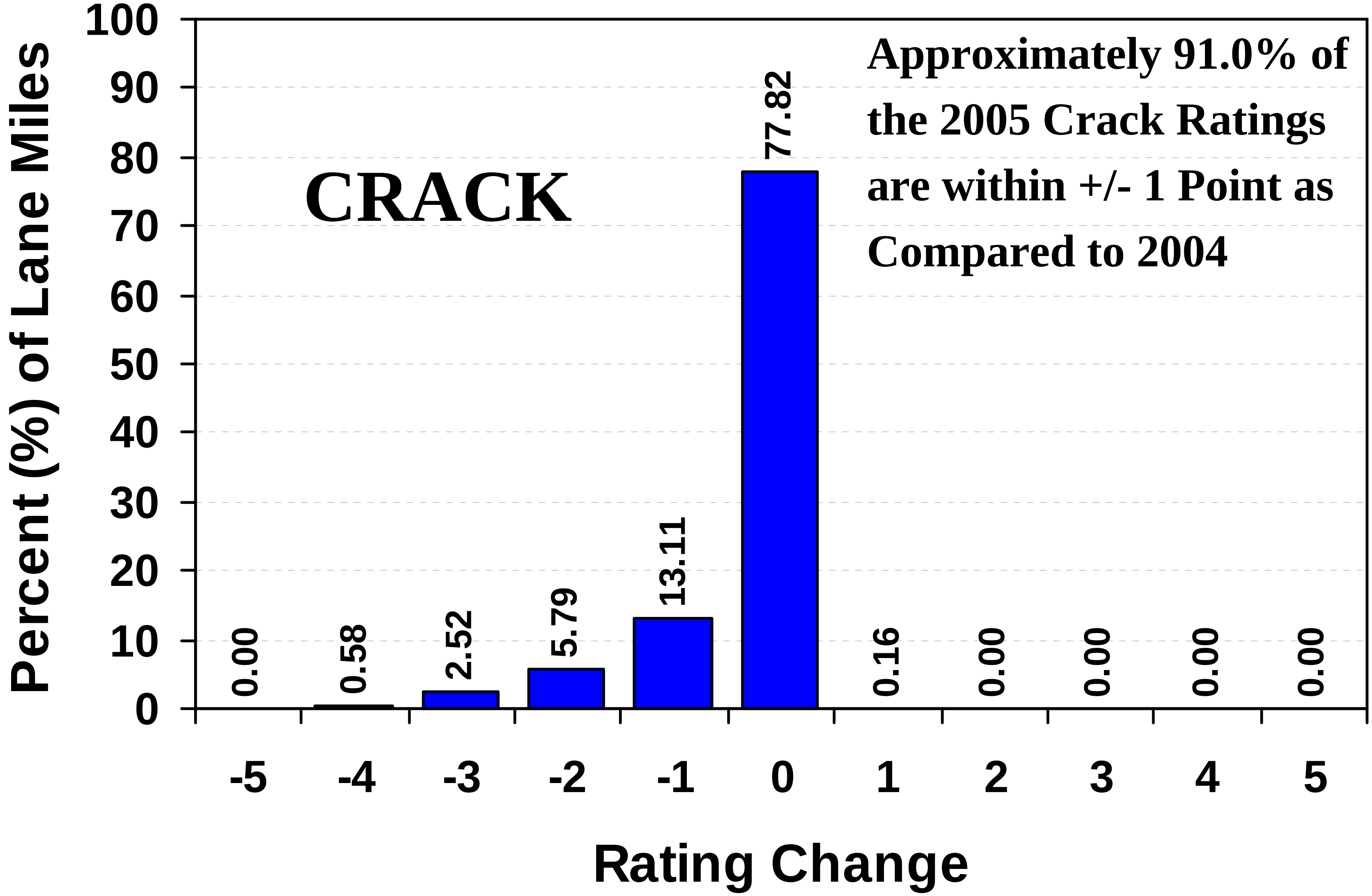

SHARP
DIPSTICK

TRAINING

- RATERS ARE COMPARED ANNUALLY ON PAVEMENTS THAT EXHIBIT A RANGE OF CONDITIONS

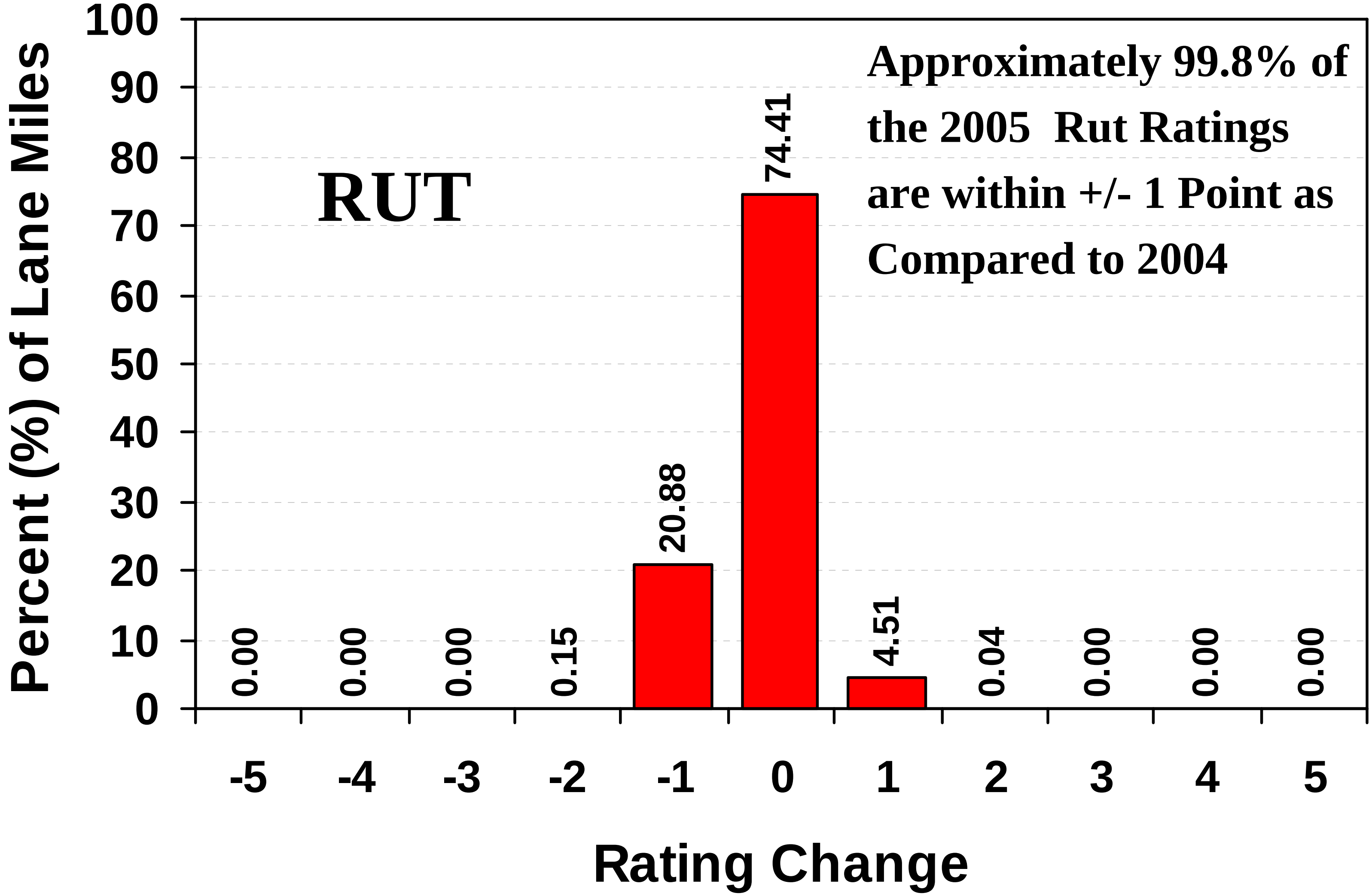
Crack Changes

2005 as Compared to 2004



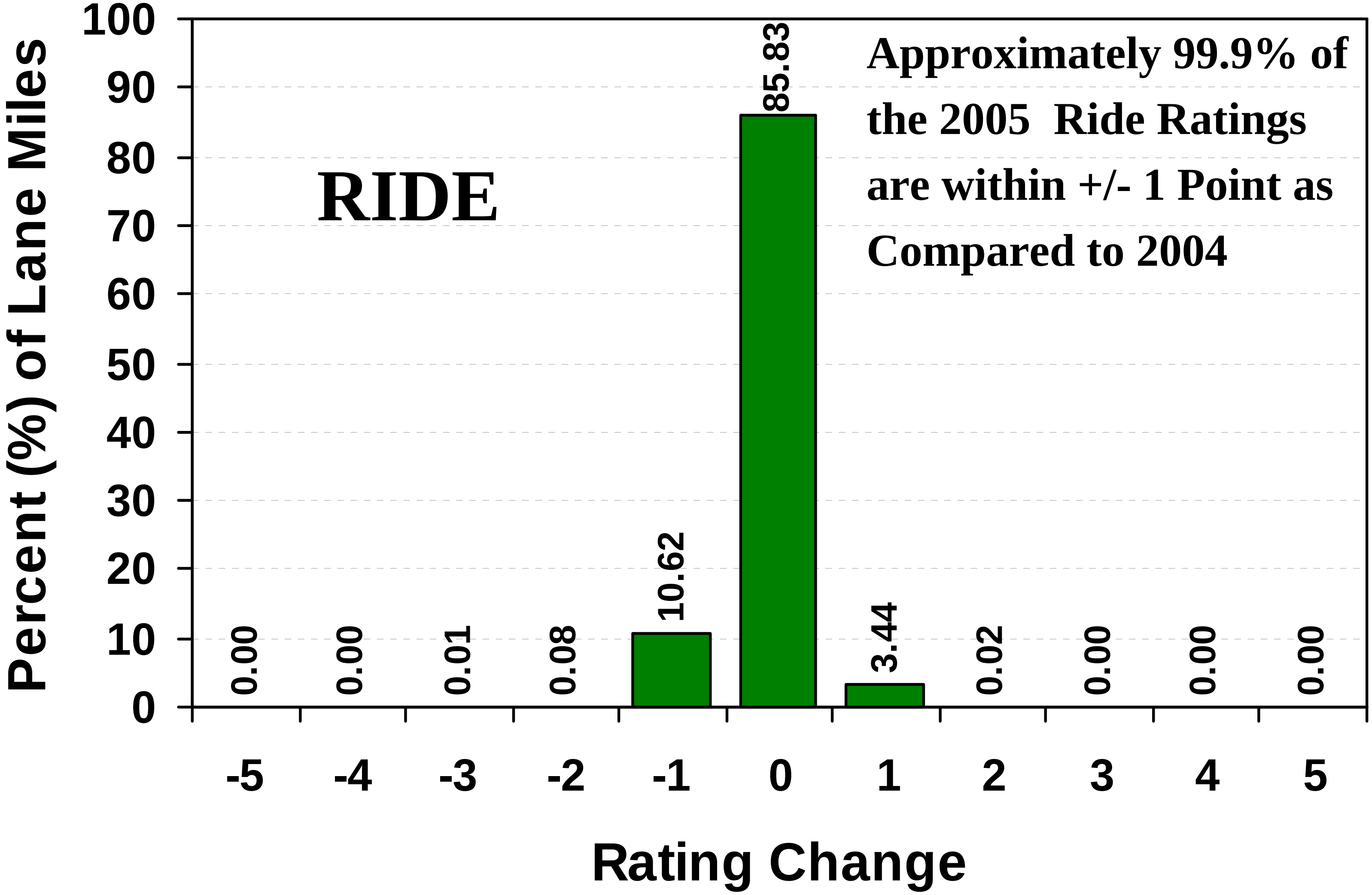
Rut Changes

2005 as Compared to 2004



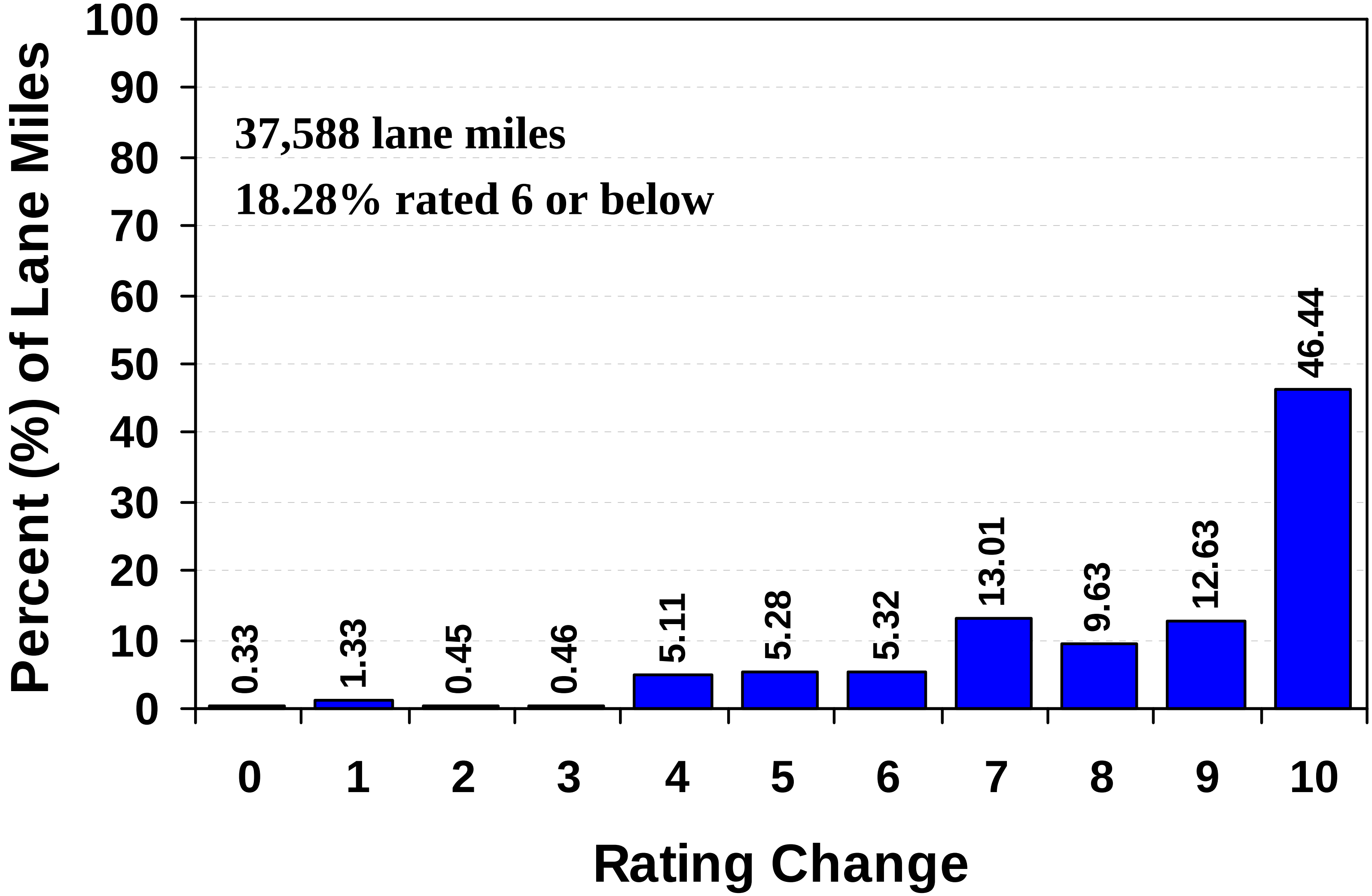
Ride Changes

2005 as Compared to 2004



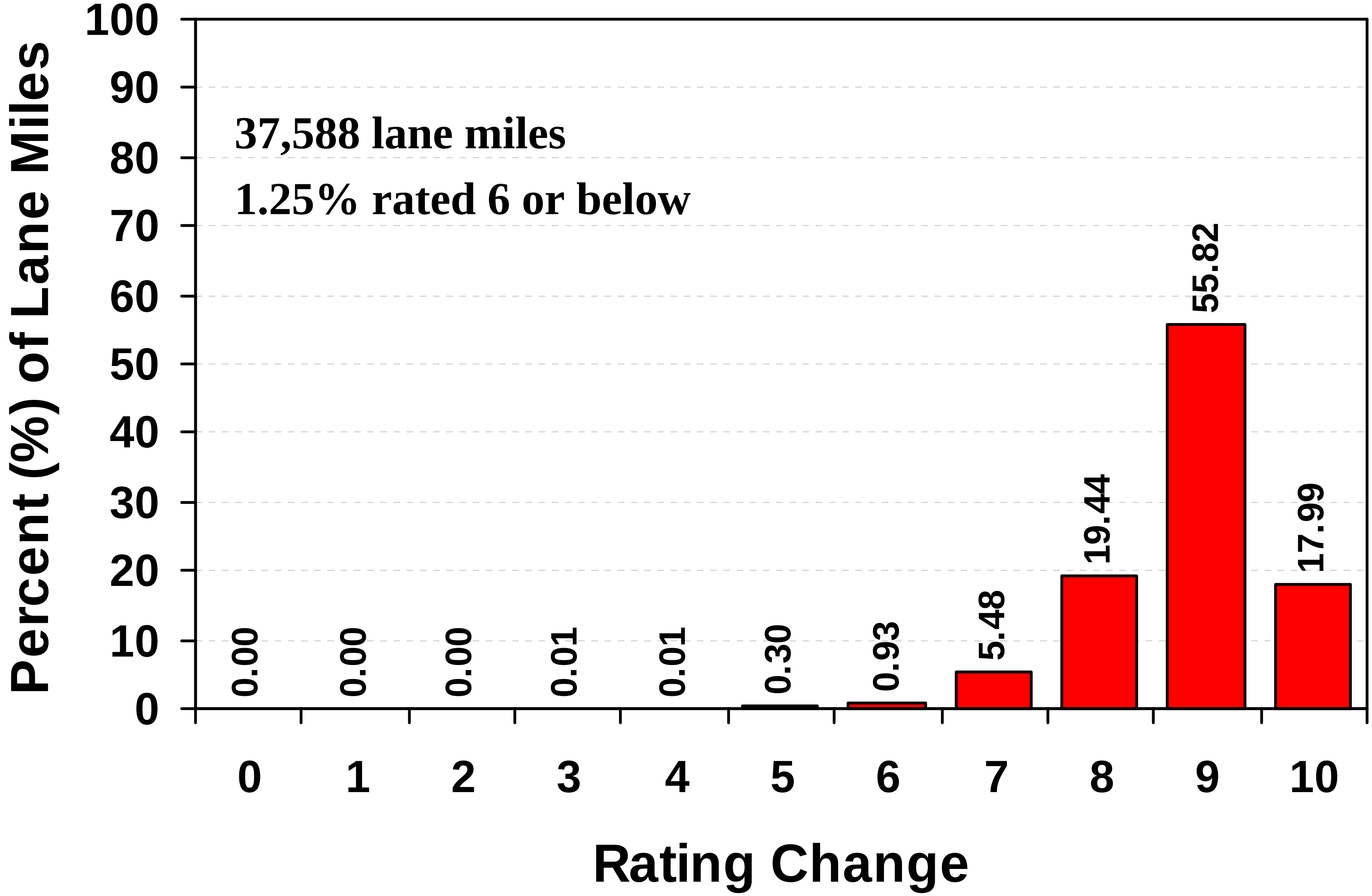
2005 Crack Distribution

Statewide (All Systems)



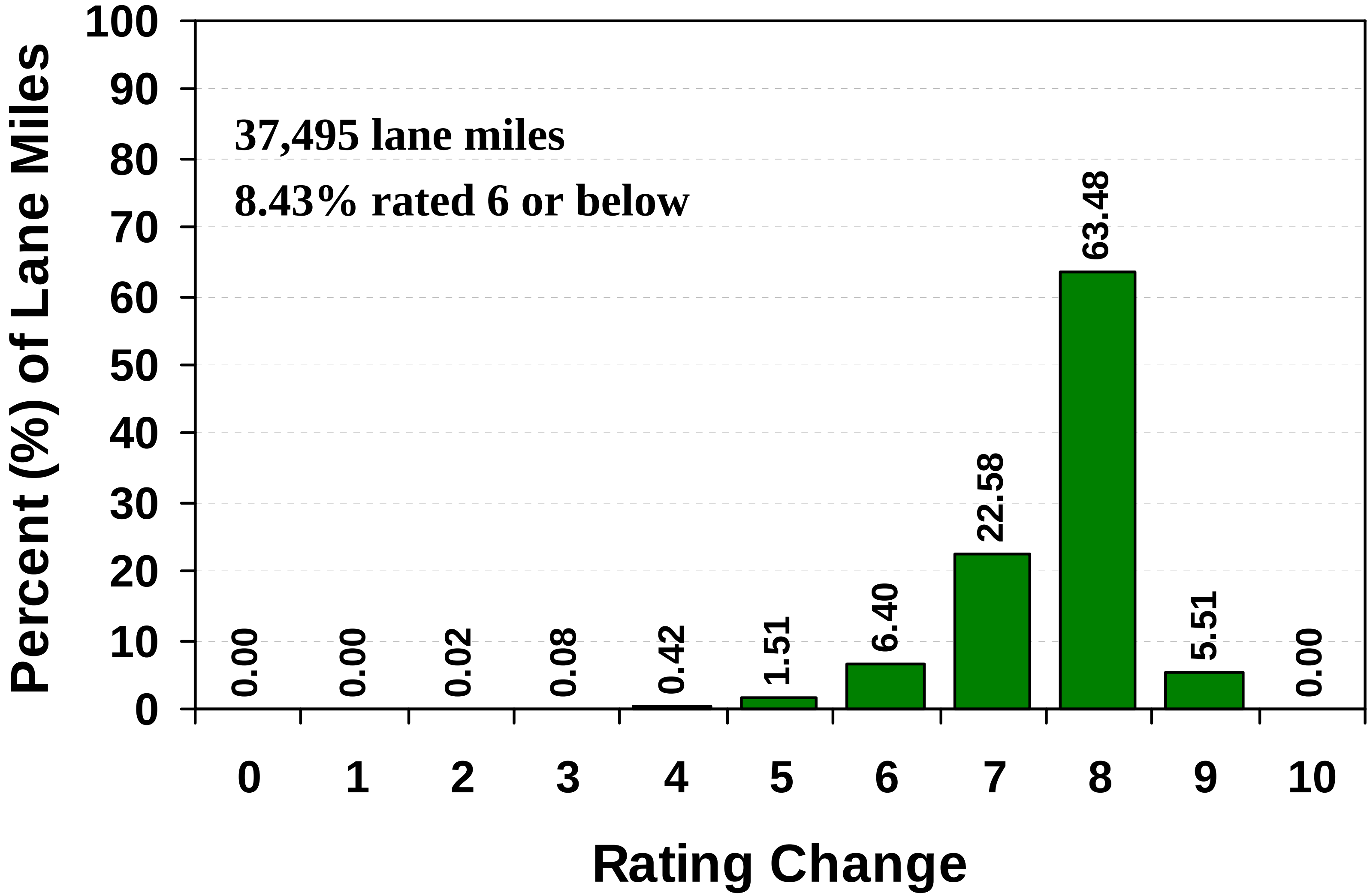
2005 Rut Distribution

Statewide (All Systems)



2005 Ride Distribution

Statewide (All Systems)

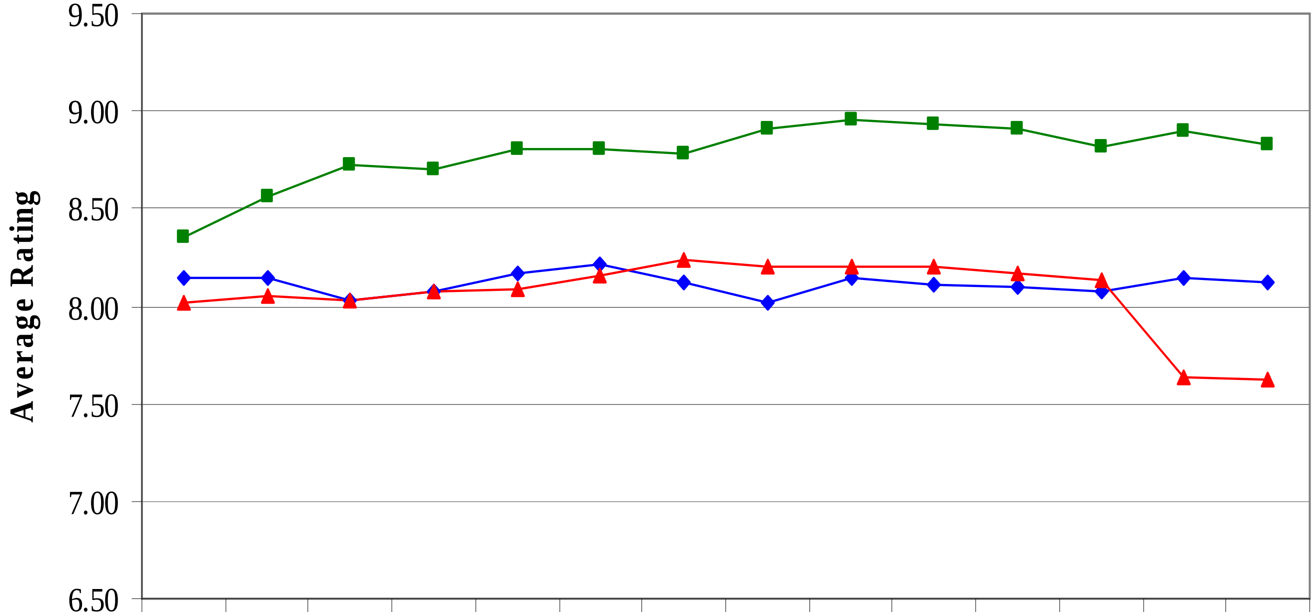


Deficient Lane Miles

Year	2003	2004	2005
Ride	2.6% 1063 Miles	6.3% 2556 Miles	5.6% 2311 Miles
Crack	15.8% 6410 Miles	16.5% 6718 Miles	17.0% 7006 Miles
Rut	1.5% 596 Miles	1.2% 498 Miles	1.2% 474 Miles

Historical Distress Ratings

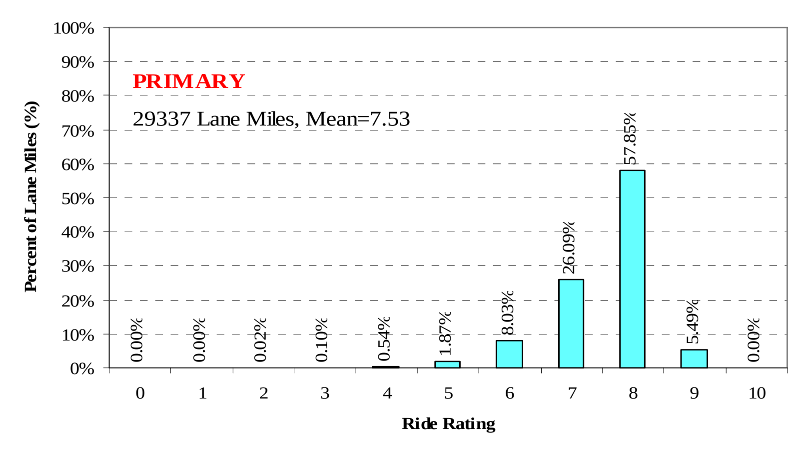
All Systems (All Districts)

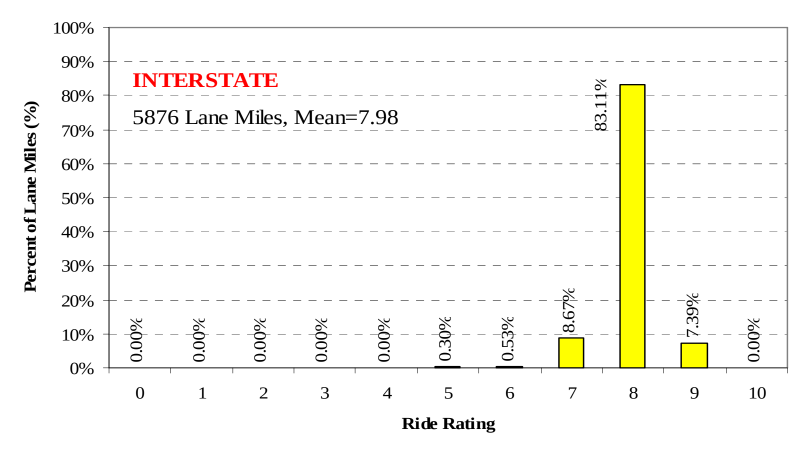


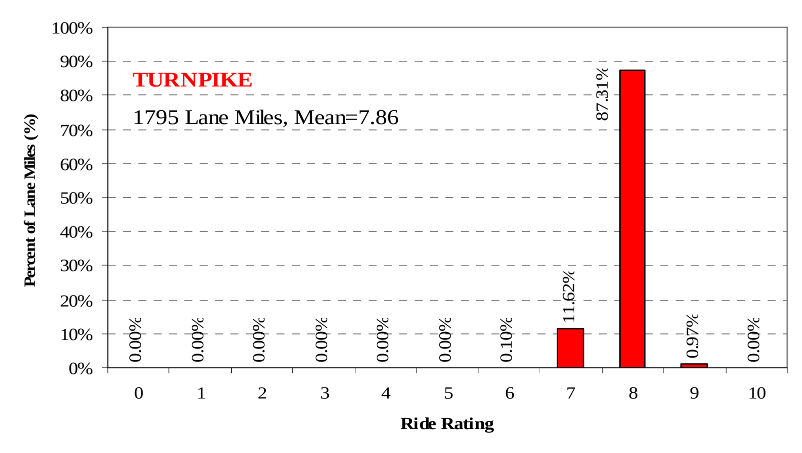
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Crack Rating	8.15	8.15	8.03	8.07	8.17	8.21	8.12	8.02	8.14	8.11	8.10	8.07	8.14	8.12
Rut Rating	8.35	8.56	8.72	8.70	8.81	8.81	8.78	8.91	8.96	8.93	8.91	8.82	8.90	8.83
Ride Rating	8.02	8.05	8.03	8.08	8.09	8.16	8.24	8.20	8.20	8.20	8.17	8.13	7.63	7.62

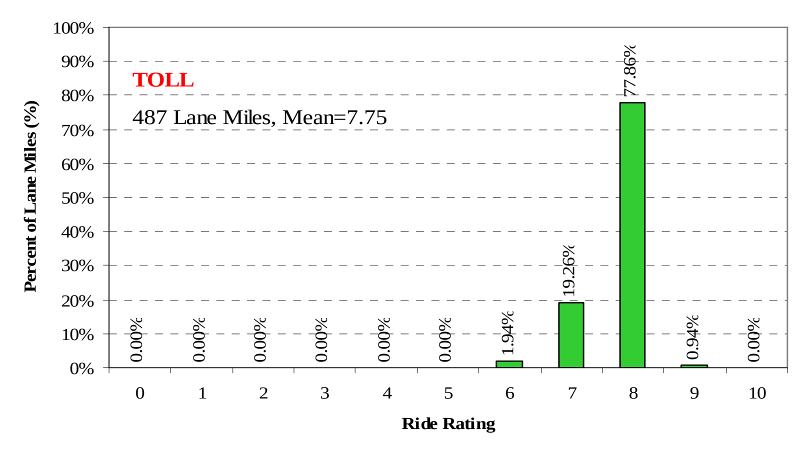
2005 Ride Distribution by System

Statewide









Smooth Pavement Means Happy Drivers

AUTOMATED DISTRESS EQUIPMENT

ROADWARE

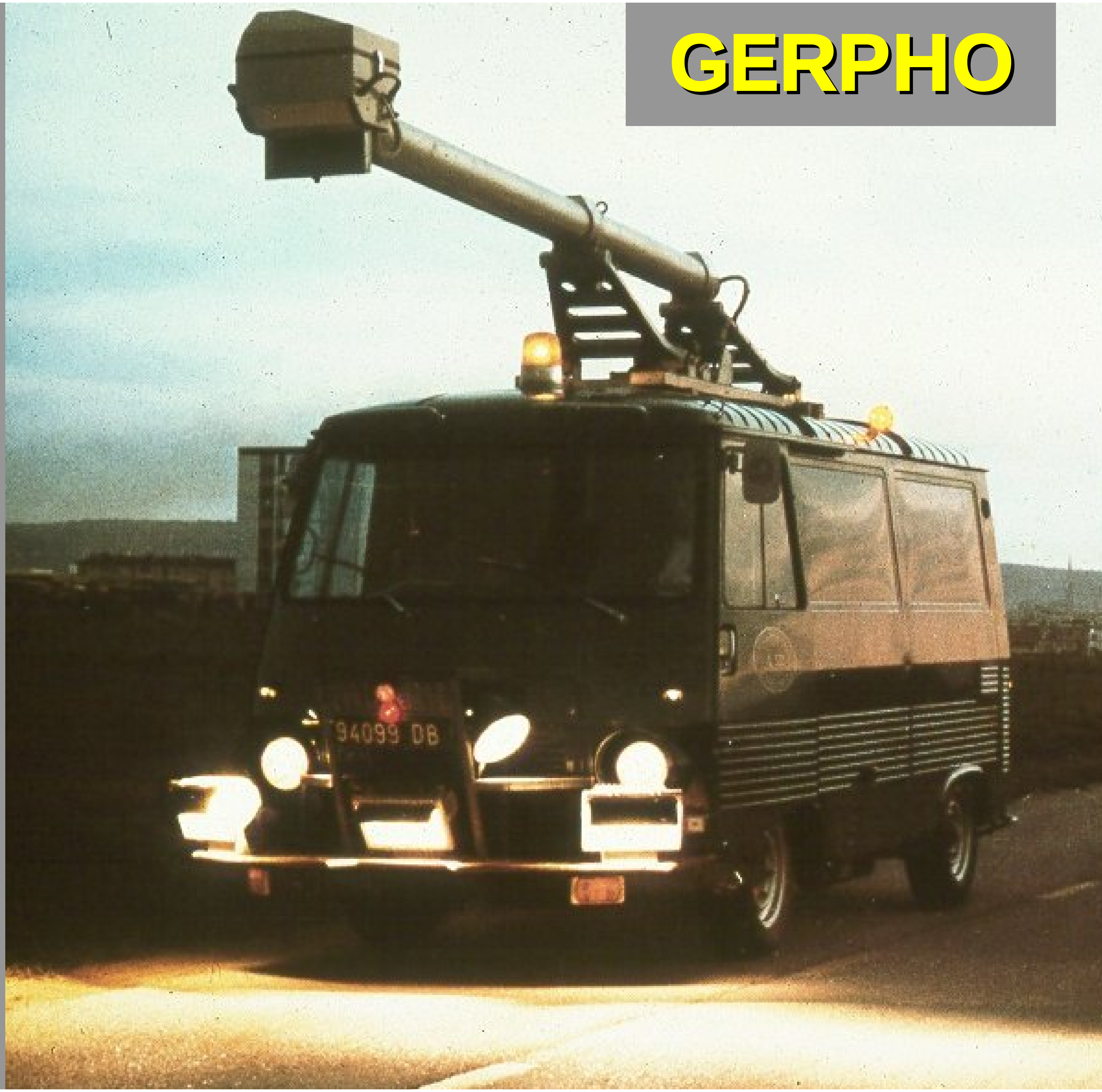
PATHWAY

PATHWAY

IMS

IMS

GERPHO



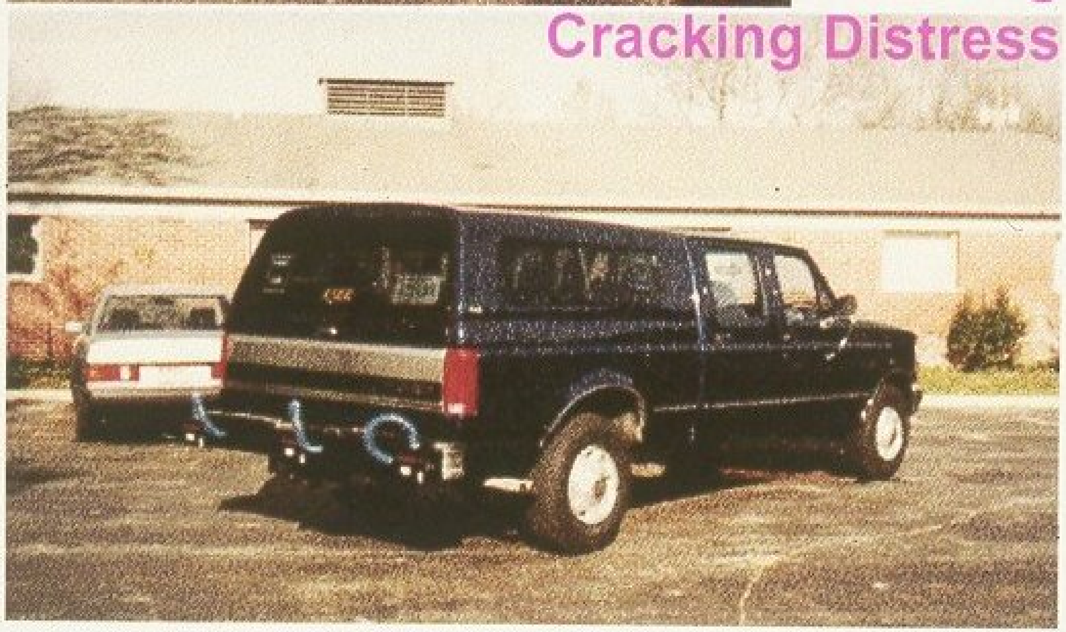
PASCO USA

Fault Detection System

MHM Associates, Inc.

ARIA
AUTOMATED ROAD IMAGE ANALYZER

Roughness IRI
Rutting
Ride Quality
Faulting
Cracking Distress



Phone: 219-291-4793 Fax: 219-291-4800 E-mail: JHMOH@AOL.COM
1920 Ridgedale Road ,South Bend ,IN 46614, USA

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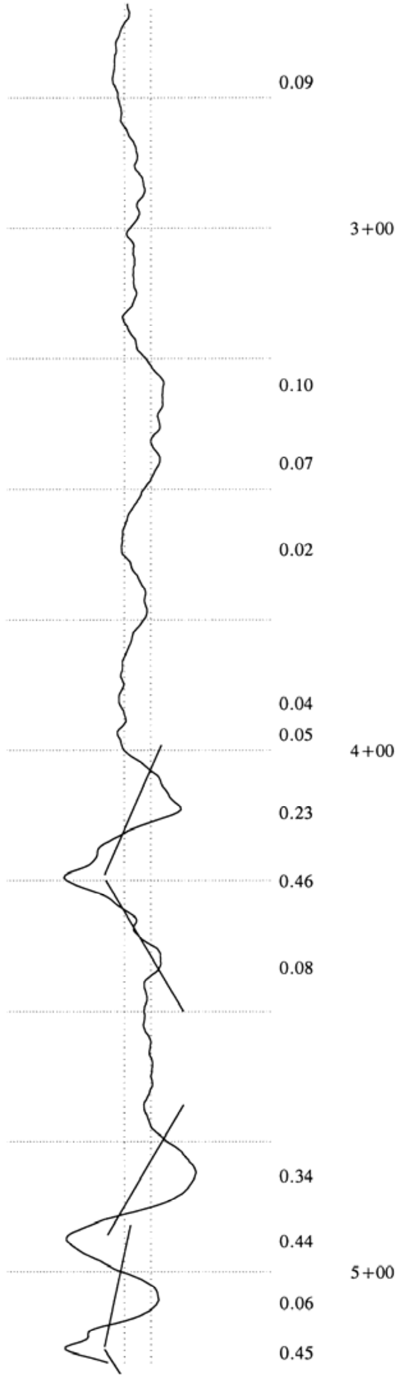
OTHER PAVEMENT SYSTEMS EVALUATION SERVICES

CALIFORNIA PROFILOGRAPH

LIGHTWEIGHT PROFILER



PROSCAN - PROFILOGRAM SCANNING SYSTEM
VERSION V4.56 - DEVORE SYSTEMS, INC.

File R16MPH1
Track 1 Segment 1   Page 2 of 3

Station 0+00.0 to 5+28.0
Segment length 21.12in (528ft, .100mi)

Up is to the right

Scallop (Filter 15)

minimum height	0.020	in
minimum width (300:1)	0.08	in
resolution	0.01	in
Blanking band	0.20	in
Defect template height	0.30	in

Profile Roughness Index 29.8 in/mi

Defect at 4+11.5 Bump
4+39.0 Bump
4+82.0 Bump
5+05.5 Bump
5+25.0 Bump

LIGHTWEIGHT PROFILER TRACE

FRICTION UNIT

RUNWAY FRICTION TESTER

FALLING WEIGHT DEFLECTOMETER

DYNAFLECT

GROUND PENETRATING RADAR UNIT

GROUND PENETRATING RADAR UNIT

HEAVY VEHICLE SIMULATOR

THE PCS TEAM

THE PCS TEAM

THE PCS TEAM

ANY

QUESTIONS ?

[redacted]

EAR
Workshop

Cause and Effects

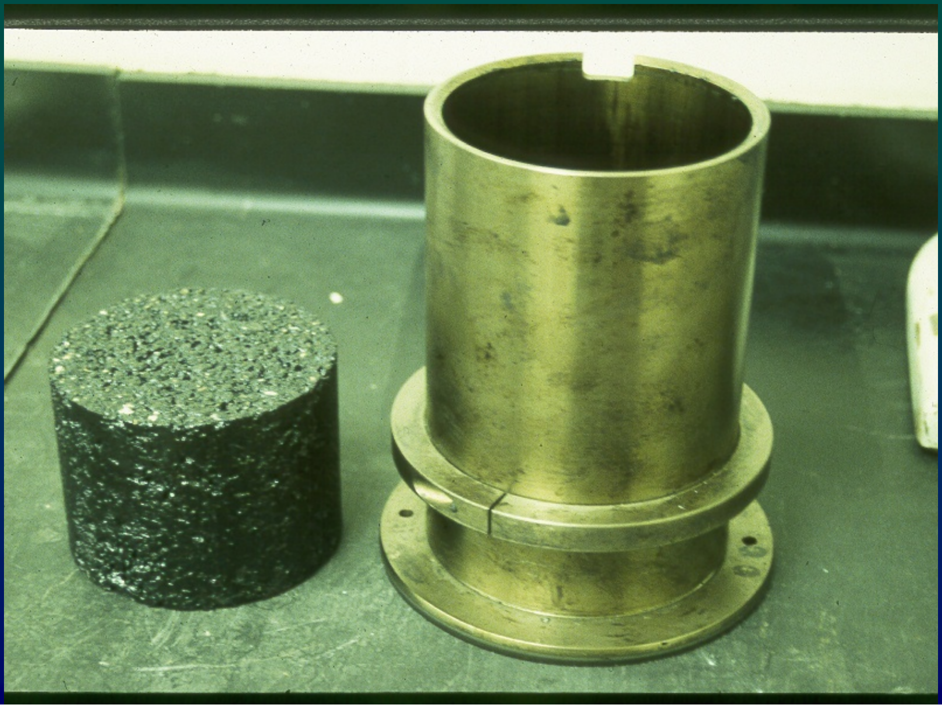
EAR Workshop
"Cause and Effect"

by: Howie Moseley

June 2005

Definitions

- <u>Air Voids</u> – Air void content of a lab compacted specimen in the SGC.
  - Also called plant or lab air voids.
- $V_a = (G_{mm} - G_{mb})/G_{mm} \times 100$

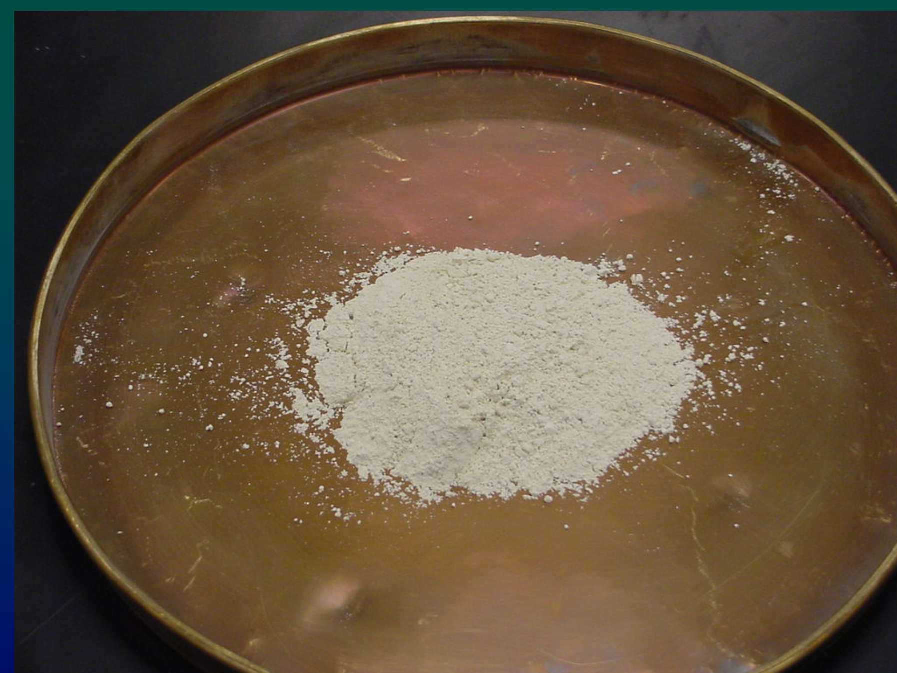


Definitions

- <u>Density</u> – In-place air void content at the roadway expressed as $\%G_{mm}$.
  - Also called in-place air voids.
- Density = $(G_{mb} / G_{mm}) \times 100$

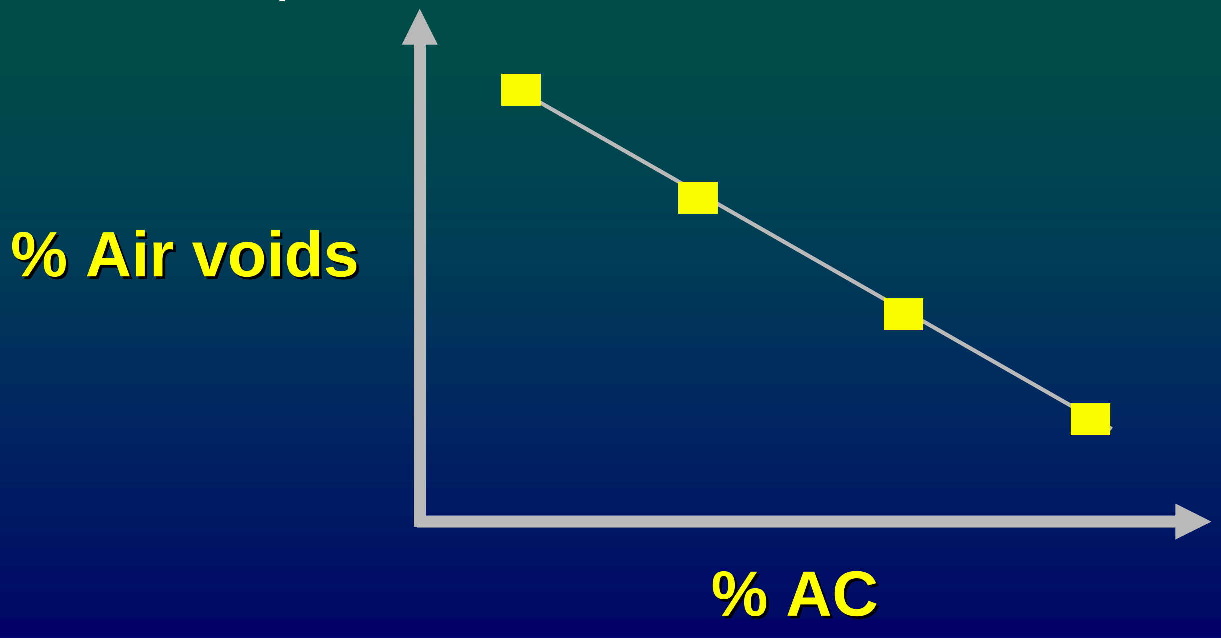
Definitions

- Percent passing the #200 sieve – Also called dust, mineral filler, -200 material, or P_{-200} material.



Air Voids and AC Content

- Air void content decreases as AC content increases.
  - No gradation change.
- Ratio is approximately 0.2 – 0.35% decrease in air void content for every 0.1% increase in AC content.
  - Mix dependant

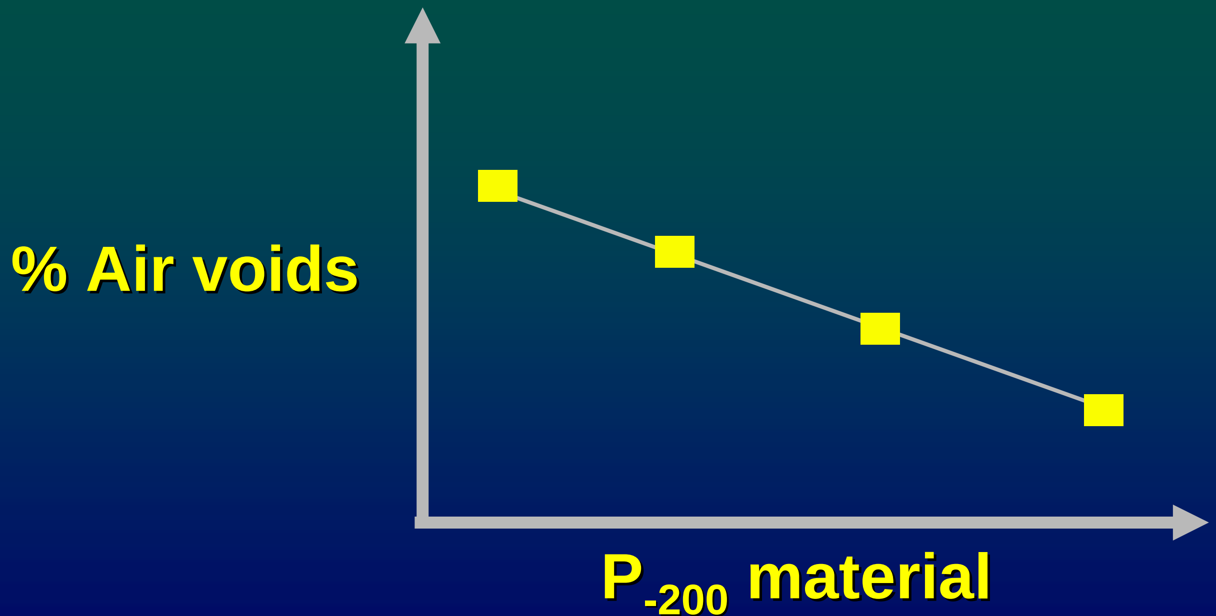


Air Voids and AC Content

- Increased AC content causes the G_{mm} to decrease.
- Increased AC content also causes the G_{mb} to increase.
- $V_a = (G_{mm} - G_{mb})/G_{mm} \times 100$
- At 4.6% AC: $V_a = (2.576-2.470) / 2.576 \times 100 = 4.1\%$
- At 5.1% AC: $V_a = (2.565-2.504) / 2.565 \times 100 = 2.4\%$
- (Real lab data)

Air Voids and P_{-200} Material

- Air void content decreases as P_{-200} material increases.
- Ratio is approximately 0.4 – 1.0% decrease in air voids for every 1.0% increase in P_{-200} material.
  - Mix dependant



Air Voids and P_{-200} Material

- Increased P_{-200} material causes the G_{mm} to decrease.
- Increased P_{-200} material also causes the G_{mb} to increase.
- $Va = (G_{mm} - G_{mb})/G_{mm} \times 100$
- At 4.7% P_{-200} material: V_a = (2.575-2.481) / 2.575 x 100 = 3.6%
- At 5.7% P_{-200} material: V_a = (2.560-2.488) / 2.560 x 100 = 2.8%
- (Real lab data)

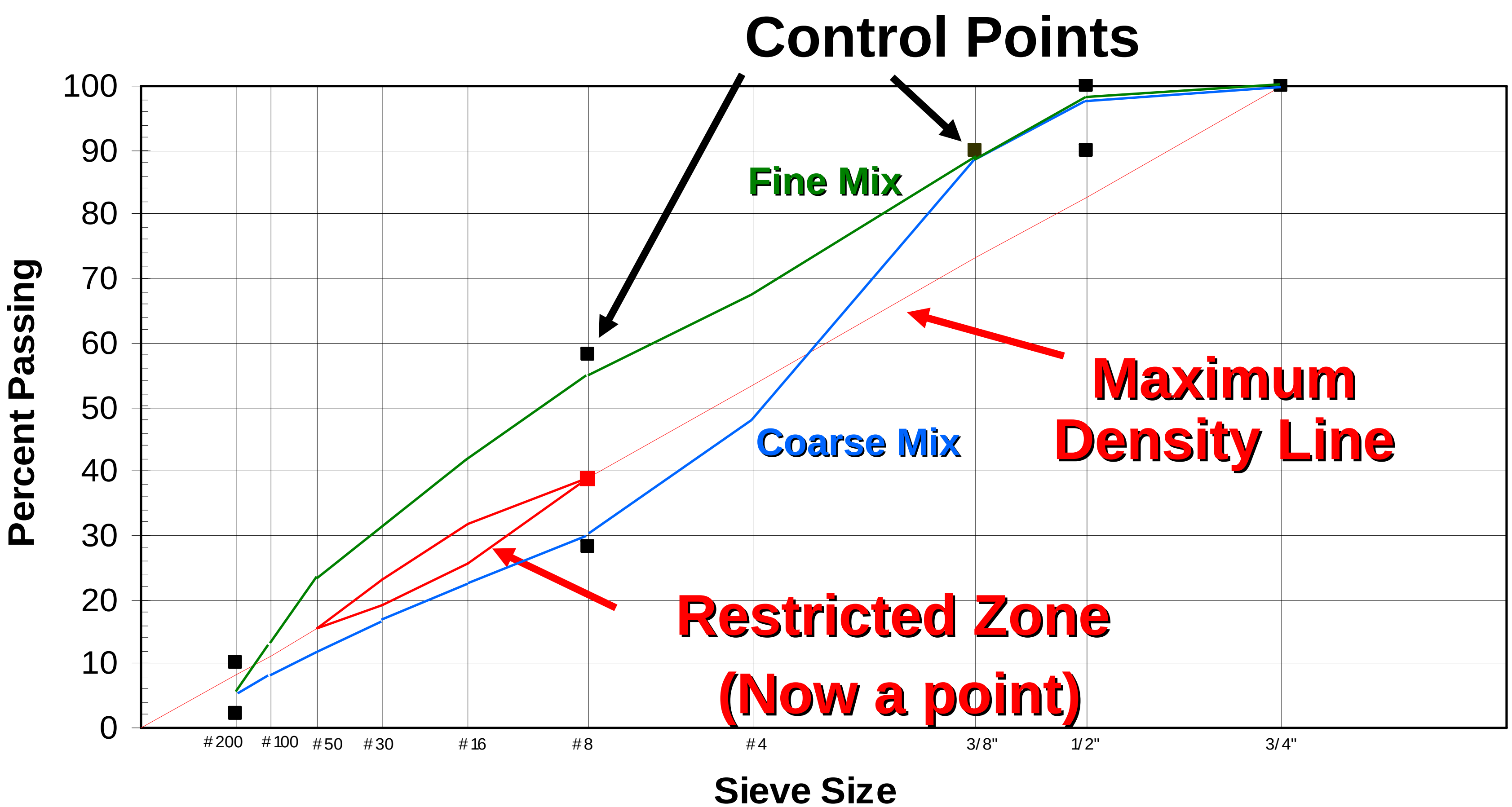
Density, AC, and P_{-200} Material

- Increased AC content and/or P_{-200} material in the mix will make it easier to achieve density in the field.
- Doesn’t necessarily mean density will be high in the field, just that the mixture is easier to compact.
- The mixture will also be more susceptible to compaction/rutting by traffic after construction.

Coarse and Fine Gradations

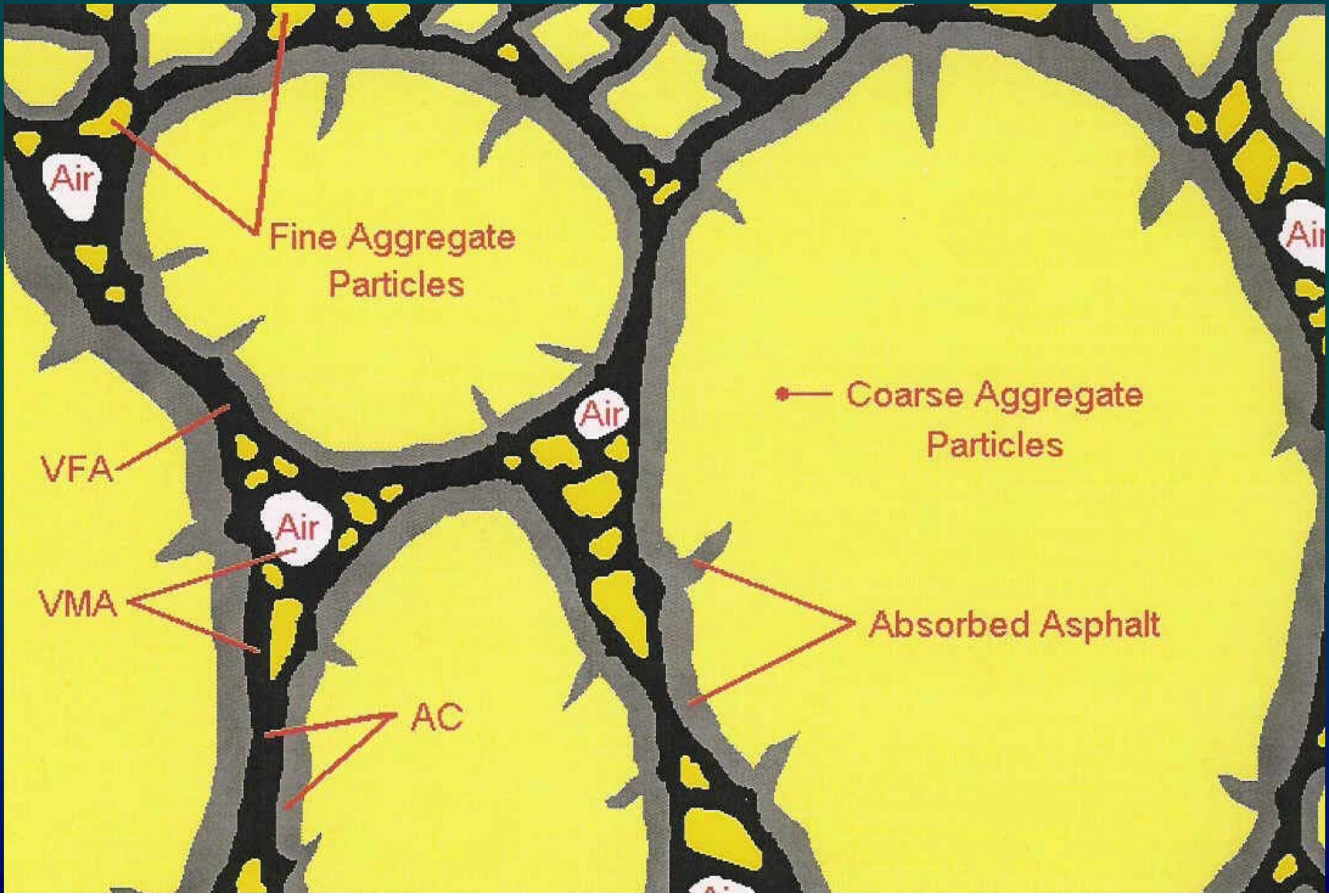
- Coarse gradations require a higher density level during construction.
  - Coarse mix target density is 94.5% G_{mm}.
  - Fine mix target density is 93.0% G_{mm}.
- Coarse mixes can have permeability issues if density is not achieved.
  - Problems can occur below 93.0% G_{mm}.
- Coarse mixtures are more difficult to compact during construction.
  - Tender zone

Coarse and Fine Gradations

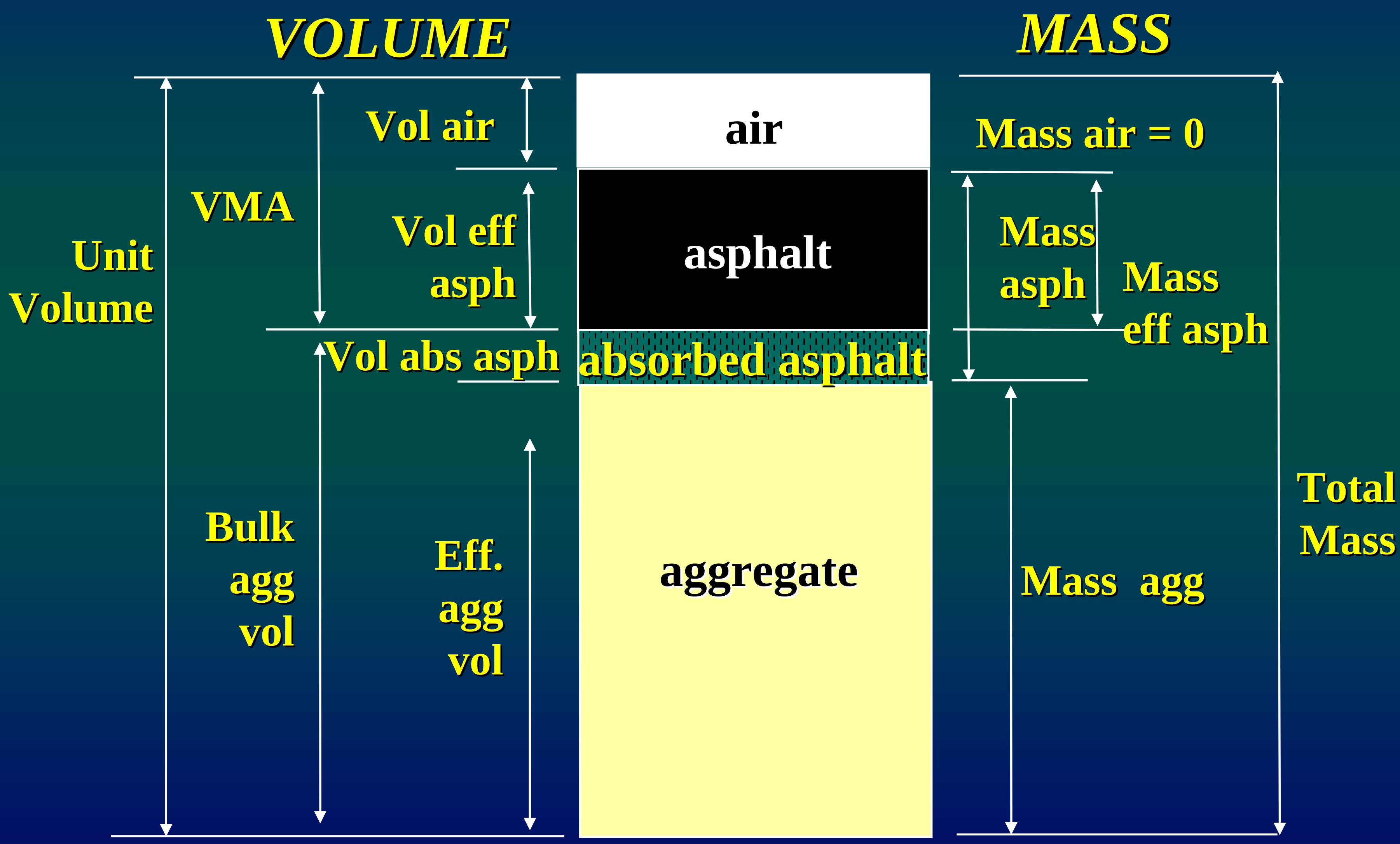


Gradation and VMA

- VMA = Voids in the mineral aggregate
- $VMA = 100 - \{[G_{mb} \times (100-P_b)]/G_{sb}\}$



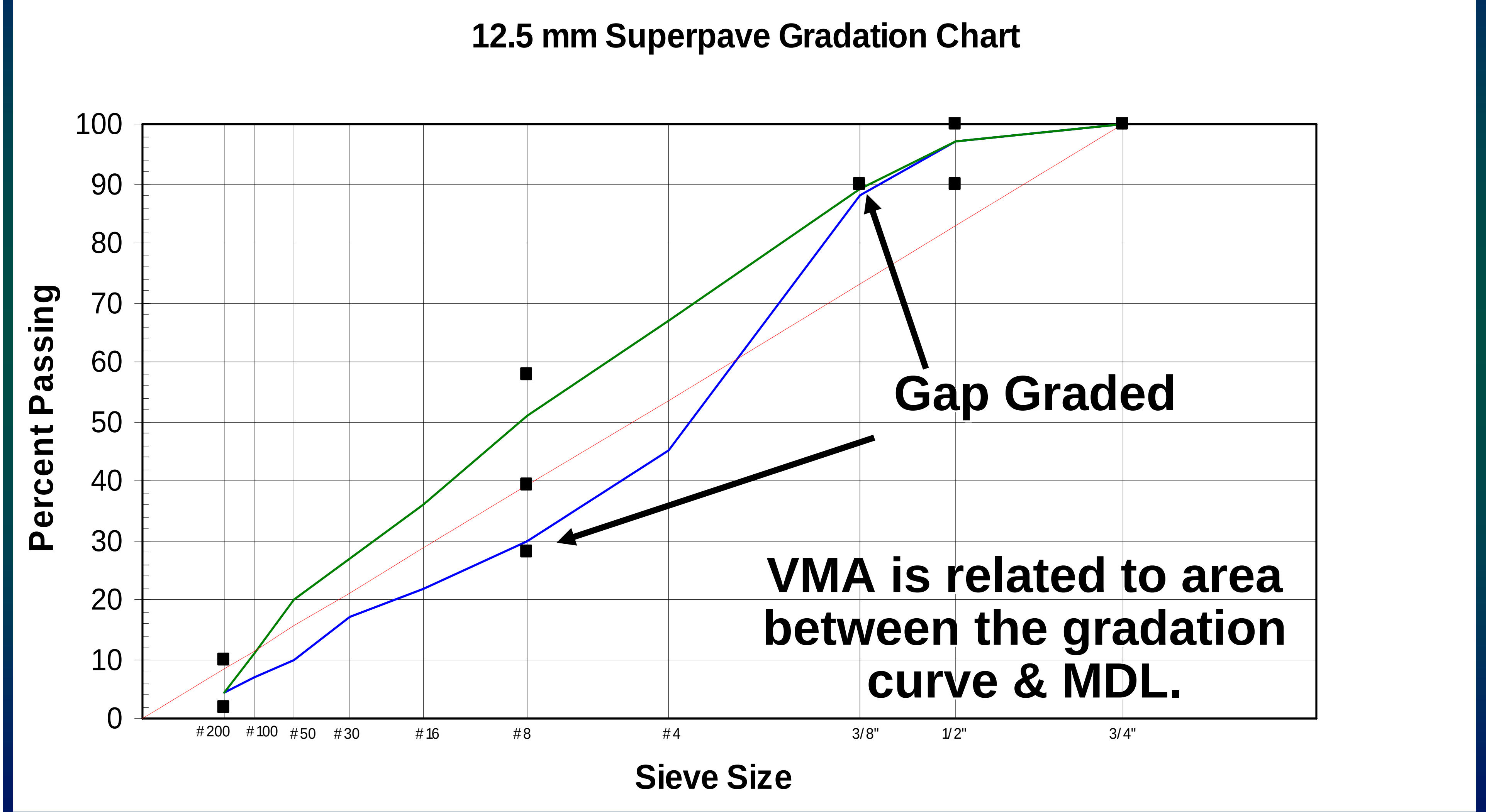
Asphalt Mixture Volumetrics



What affects VMA?

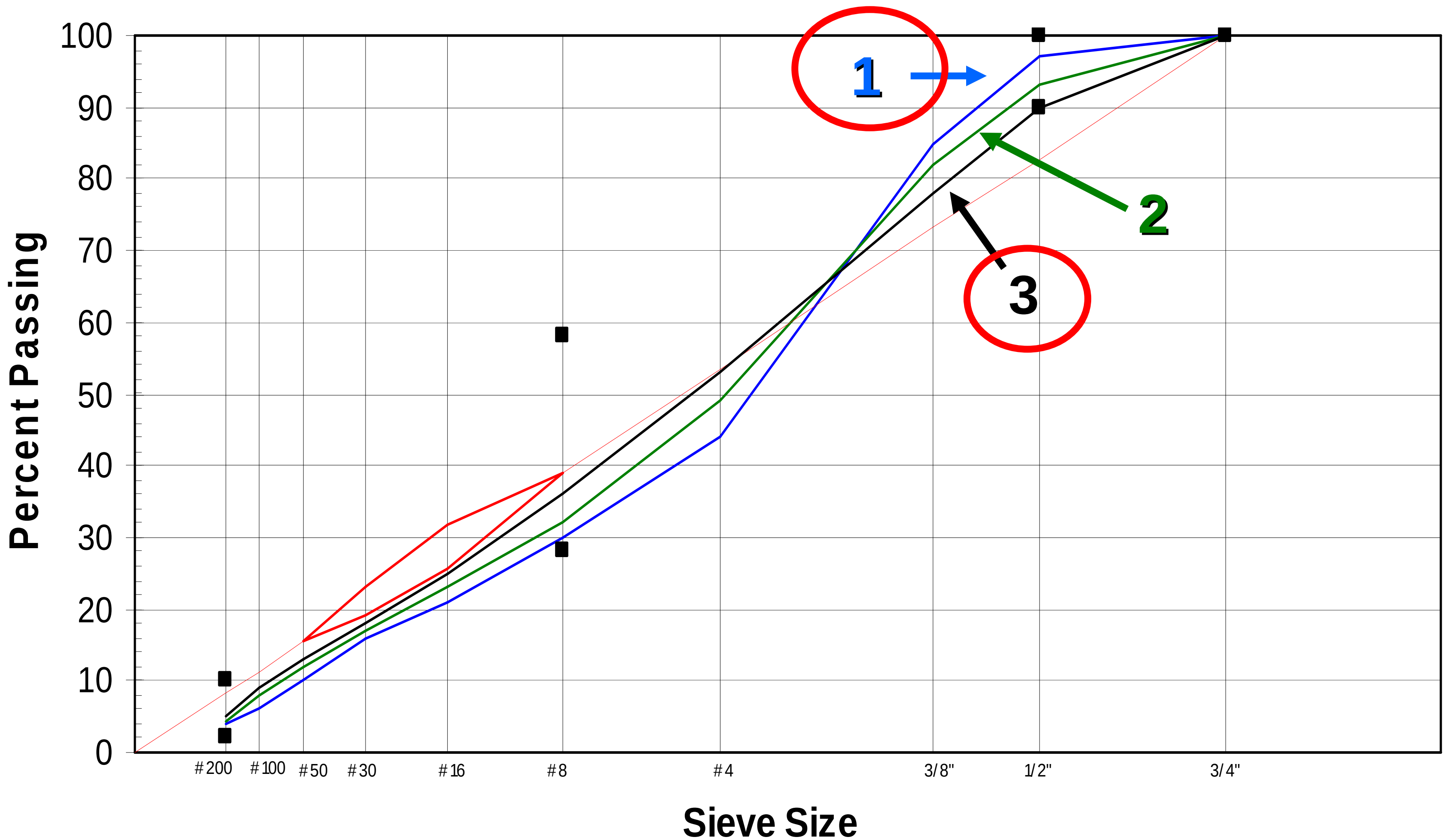
- Gradation
  - P_{-200} material
    - Lowers VMA
  - Maximum density line
    - Gradations closer to the maximum density line have lower VMA
    - Gap-graded mixes

What affects VMA?



Which Gradation will have the highest VMA?

Which Gradation will have the lowest VMA?



What else affects VMA?

- Aggregate type
  - Aggregate angularity or texture
  - Aggregate Shape
- Aggregate toughness
  - Aggregate breakdown at the plant
  - More P_{-200} material
  - Aggregate is less angular

Questions or Comments?

EAR
Workshop

General Relationships between Test Data and Performance

EAR Workshop

Relationships Between Test Results and Performance

June 2005

Test Results

- Air voids (laboratory compaction).
- Roadway density.
- Asphalt binder content.
- Gradation.
- Permeability.
- Shear testing.

Air Voids (lab compaction)

- Represents ultimate compaction in roadway.
  - Majority of densification occurs within 4 years (summers).
- Past research: less than 2.5 to 3.0% lab air voids is detrimental to rutting.
- Air voids too high:
  - Faster oxidation.
  - More difficult to achieve field compaction.
  - Potential permeability problem.
  - Often the result of low AC content.
  - Faster to crack.

Roadway Density

- **Too low:**
  - **Consolidation rutting.**
  - **Permeability for coarse mixes.**
  - **Stripping potential increases.**
  - **More oxidation/cracking.**
- **Too high:**
  - **Aggregate breakdown…uncoated particles.**

Asphalt Binder Content

- Too low:
  - Cracking and raveling (FC-5 and dense).
  - Permeability issue if result is high air voids for dense mixtures.
- Too high:
  - Binder draindown for FC-5……flushing, fat spots, bleeding.
  - Low air voids and rutting for dense mixtures.
  - Bleeding.

Gradation

- **Dense mixtures:**
  - Effect on VMA could reduce fatigue cracking resistance of mixtures….less film thickness.
  - Effect on air voids could affect rutting potential.
- **FC-5:**
  - Coarser gradation may lower surface area and cause excessive binder film thickness…..i.e., draindown.
  - Finer gradation may result in less porosity and reduced film thickness…..more serious.

Permeability

- Dense mixtures:
  - High permeability….increased stripping potential.
- FC-5:
  - Low permeability….reduced effectiveness at water drainage and spray reduction.

Shear Testing

- **Dense mixtures:**
  - **Low shear strength….strong potential for slippage.**

Comments / Questions?

EAR
Workshop

Analysis Tools

EAR Workshop

Analysis Tools

June 2005

EAR vs. Delineation Testing

- EAR for air void failures.
  - By EAR firm.
- Delineation testing for gradation, AC content and density failures.
  - Done by Contractor upon approval by the Engineer.
- EAR and delineation used to determine limits of defective material.

Analyzing Data

- **What data is available?**
  - **Production data: QC, VT, IV.**
  - **Plant reports.**
  - **Roadway reports.**
  - **Typical section – traffic data.**
  - **CPF sheets.**
  - **Forensic data – from roadway cores and field tests.**

Summary Sheet

Project Summary									
Project No.:	321456-1-52-01	SR No. :	121			Date:	9/13/2004	9/13/2004	9/13/2004
Contractor:	First American Asphalt			Gyrations		Tested by:	QC	QC	IV
Mix Design No.:	SP04-9999A	(mm):	12.5	@ N_i:	7	Lot / Sublot	8,1PC	8,1	8,1
Traffic Level:	C	Gmm:		@ N_d:	75	Load #:	4	21	35
VMA:	14.0% MIN	VFA:	65-75%	@ N_m:	115	Tons/day:			
Design Temp:	Production:		Compaction:			Cumulative tons:			

Property	JMF	AVG	STD	MIN	MAX	RNG	CNT			
25.0mm (1")		100.00	0.00	100.00	100.00	0.00	17.00	100.00	100.00	100.00
19.0mm (3/4")		100.00	0.00	100.00	100.00	0.00	17.00	100.00	100.00	100.00
12.5mm (1/2")	95	93.82	1.65	90.14	96.26	6.12	17.00	96.08	93.13	94.36
9.5mm (3/8")	89	87.42	1.83	84.34	91.26	6.92	17.00	89.45	86.73	87.26
4.75mm (#4)	66	65.56	2.01	62.65	68.99	6.34	17.00	64.83	63.81	63.10
2.36mm (#8)	45	45.11	1.81	42.64	48.38	5.74	17.00	**42.81**	**43.37**	**43.00**
1.18mm (#16)	32	31.86	1.85	28.68	34.44	5.76	17.00	29.69	30.11	29.37
600um (#30)	24	24.20	1.55	21.13	26.33	5.20	17.00	22.47	22.73	22.35
300um (#50)	18	18.22	1.38	15.36	20.30	4.94	17.00	16.66	16.98	16.75
150um (#100)	7	6.94	0.84	5.38	8.28	2.90	17.00	5.38	5.95	5.83
75um (#200)	2.9	2.42	0.24	2.15	3.10	0.95	17.00	**2.15**	**2.24**	**3.10**
Ext. AC %:	6.1	6.04	0.18	5.81	6.55	0.74	17.00	**6.10**	**6.00**	**6.55**
Rice MSG (Gmm):	2.399	2.399	0.01	2.385	2.412	0.03	17.00	**2.396**	**2.397**	**2.385**
Avg. Bulk (Gmb):	2.303	2.311	0.01	2.300	2.333	0.03	17.00	**2.315**	**2.305**	**2.333**
Agg. Sp. Gr. (Gsb):	2.557	2.557	0.00	2.557	2.557	0.00	17.00	**2.557**	**2.557**	**2.557**
Hgt.@N int.:		123.9	1.21	122.5	126.3	3.80	17.00	**126.3**	**124.4**	**126.0**
Hgt.@N des.:		115.9	0.57	115.2	117.3	2.10	17.00	**117.3**	**116.0**	**117.0**
%Gmm @ Ni	≤ 89.0	90.2	0.55	88.9	91.0	2.09	17.00	**89.73**	**89.67**	**90.83**
% Gmm @ Nd	96.0	96.4	0.45	95.9	97.8	1.95	17.00	**96.62**	**96.16**	**97.82**
% Air Voids @ Nd	4	3.65	0.45	2.18	4.13	1.95	17.00	**3.38**	**3.84**	**2.18**
% VMA @ Nd		15.07	0.23	14.74	15.74	1.00	17.00	**14.99**	**15.27**	**14.74**
% VFA @ Nd		75.83	2.82	72.28	85.21	12.93	17.00	**77.45**	**74.85**	**85.21**
Dust/Asphalt		0.48	0.04	0.41	0.56	0.15	17.00	**0.41**	**0.44**	**0.56**
Gmb @ Nd		2.311	0.01	2.30	2.333	0.03	17.00	**2.315**	**2.305**	**2.333**
Density lbs/cf		144.2	0.46	143.52	145.6	2.060	17.00	**144.46**	**143.83**	**145.58**
Gse		2.6	0.01	2.62	2.6	0.02	17.00	**2.62**	**2.62**	**2.63**
Pba		1.02	0.09	0.97	1.27	0.30	17.00	**0.97**	**0.97**	**1.12**
Pbe		5.08	0.15	4.76	5.50	0.74	17.00	**5.19**	**5.09**	**5.50**
Roadway Core 1 Gmb									2.234	
Roadway Core 2 Gmb									2.223	
Roadway Core 3 Gmb									2.228	
Roadway Core 4 Gmb									2.212	
Roadway Core 5 Gmb									2.226	
Average Core Gmb		2.21	0.01	2.20	2.23	0.03	11.00		2.225	
Sublot Gmm		2.40	0.01	2.39	2.41	0.03	17.00	2.391	2.397	2.385
% of Sublot Gmm		92.15	0.42	91.63	92.83	1.20	11.00		92.81	

Production Data

- Look for trends and changes in data.
  - AC increases, air voids decrease.
  - Gmm decreases, air voids decrease.
- If available, see if IV data follows same trends.

Forensic Data

- **Types of data:**
  - **Properties of field cores.**
  - **Laboratory tests from extra mix (if available).**
  - **Laboratory performance tests on field cores.**
  - **Performance tests at the roadway.**
  - **Core reconstitution.**

Properties of Field Cores

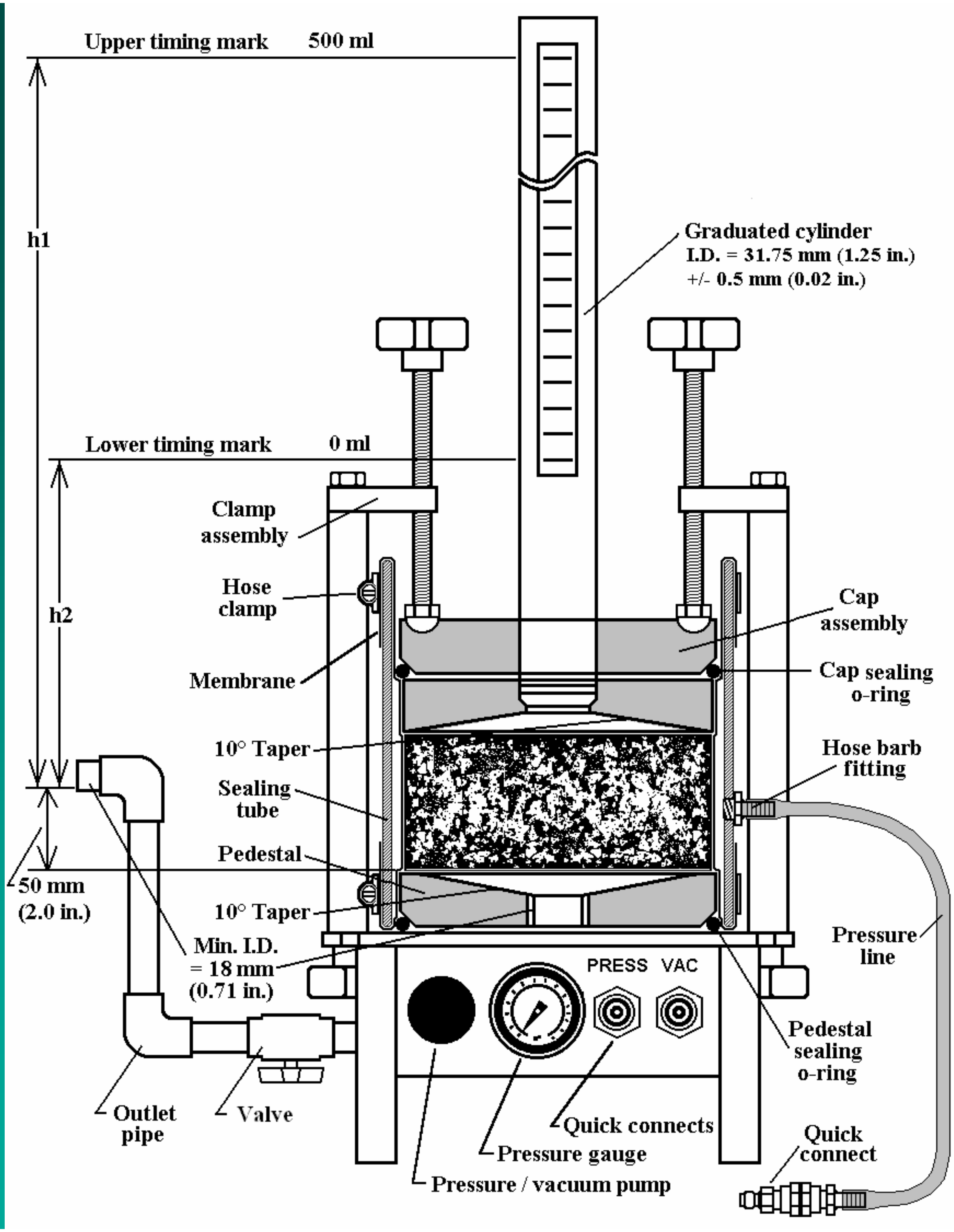
- Density (Gmb).
  - Sample in the WP and BWP.
- Maximum specific gravity (Gmm).
- Asphalt content and gradation.
- Frequency: 4 cores per 500 ft. 2 WP, 2 BWP. More cores if performance tests are needed.
- Gmb on all cores (wash cores well).
- Gmm on two cores.
- AC and gradation on two cores.
- Cut cores in good section ?

Lab Tests of Extra Mix

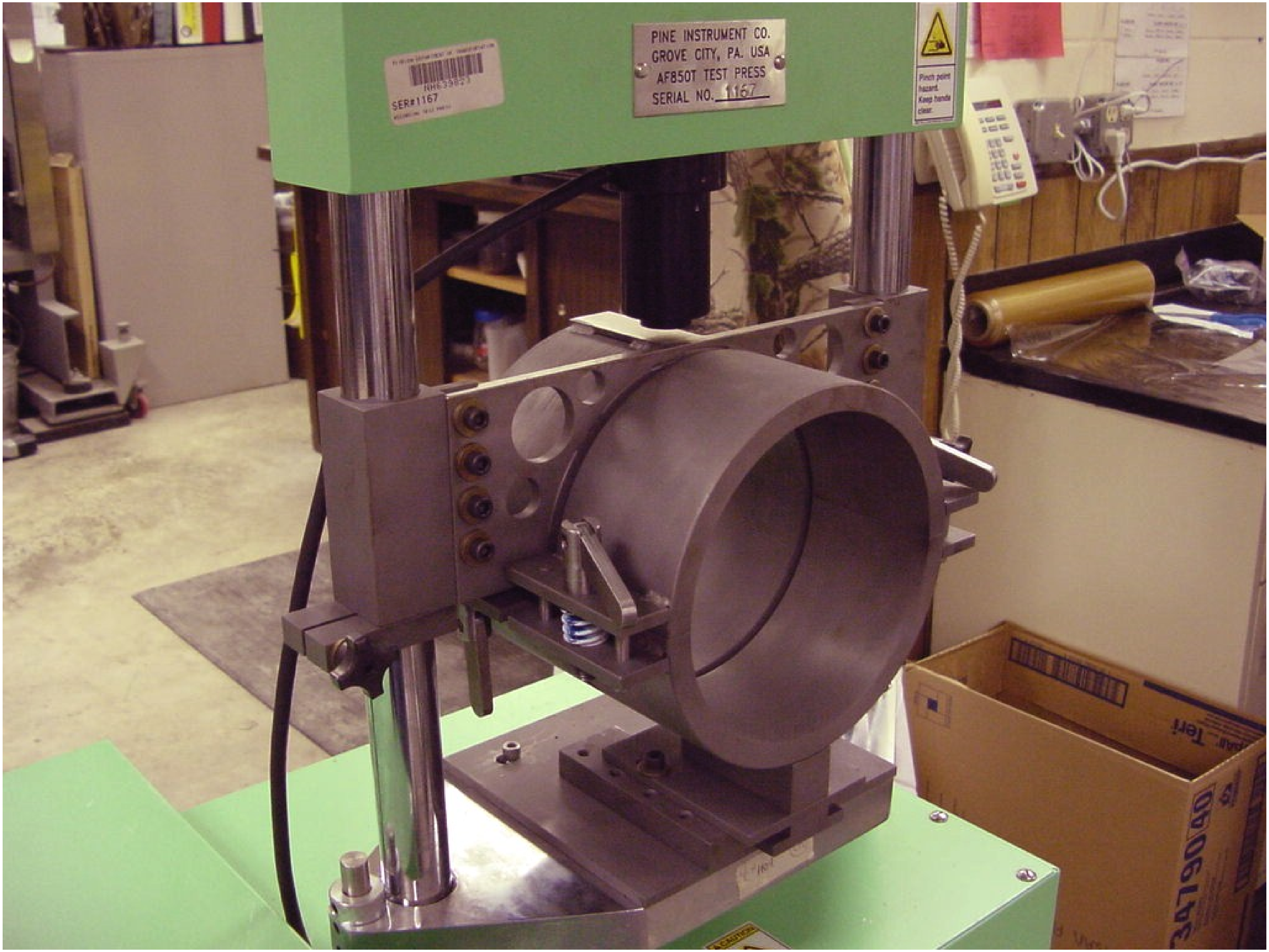
- Mix not always available.
- Used to check other results….
  - Gmb
  - Gmm
  - Air voids
  - AC and gradation

Laboratory Performance Tests on Field Cores

- **Dense graded mixtures only.**
  - **Permeability.**
  - **Shear test – bond strength between two asphalt layers.**

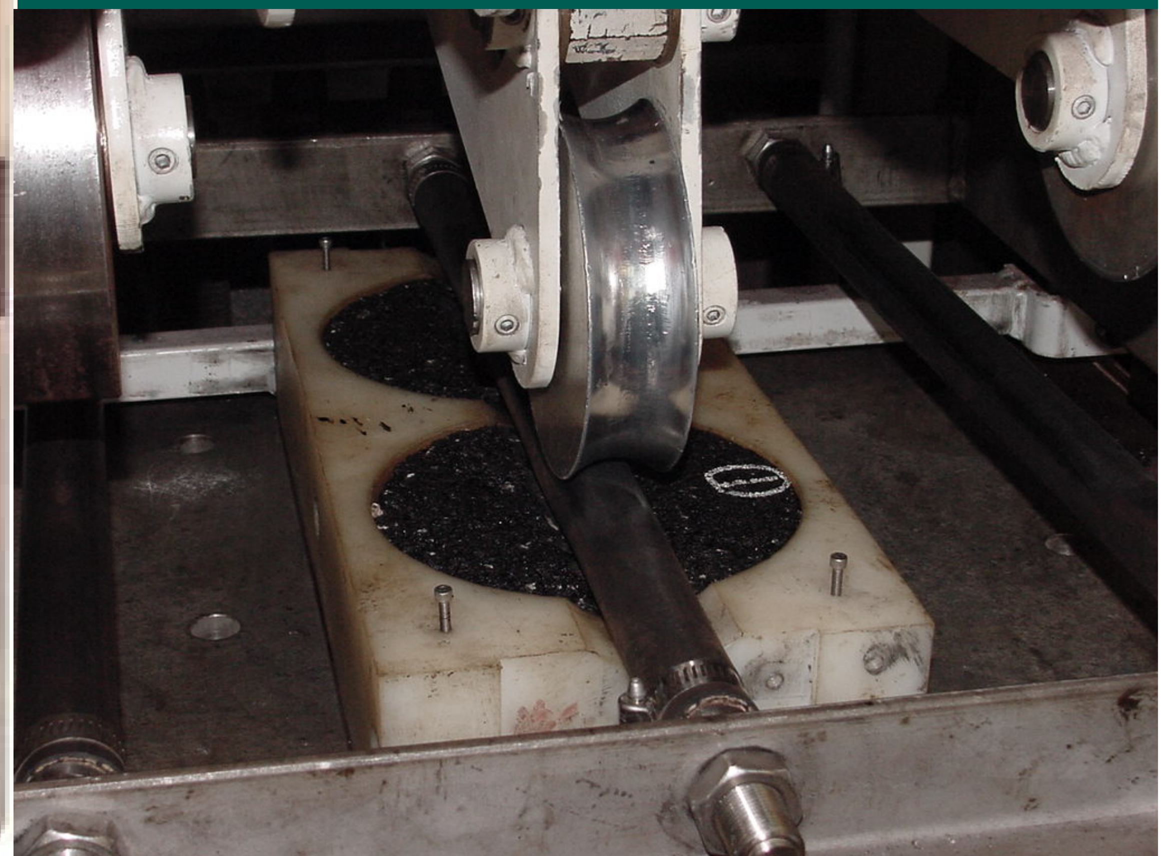


Upper timing mark
500 ml
h1
Graduated cylinder
I.D. = 31.75 mm (1.25 in.)
+/- 0.5 mm (0.02 in.)
Lower timing mark
0 ml
Clamp assembly
h2
Hose clamp
Cap assembly
Cap sealing o-ring
Membrane
10° Taper
Hose barb fitting
Sealing tube
Pedestal
50 mm (2.0 in.)
10° Taper
Min. I.D. = 18 mm (0.71 in.)
Pressure line
PRESS
VAC
Pedestal sealing o-ring
Outlet pipe
Valve
Quick connects
Quick connect
Pressure gauge
Pressure / vacuum pump


PINE INSTRUMENT CO.
GROVE CITY, PA. USA
AF850T TEST PRESS
SERIAL NO. 1167
SER#1167
Pinch point hazard. Keep hands clear.

Future

- Laboratory rutting test.
  - Asphalt Pavement Analyzer.
  - Hamburg rut device.
  - Good for lab or field specimens.

Performance Tests at Roadway

- Field permeability – OGFC only.
- Longitudinal and transverse density profiles with density gauge (like PQI).
  - Use in conjunction with lesser frequency core data.

Core Reconstitution

- Make gyratory pills from roadway cores.
- Measure Gmb. Calculate air voids.
- Used as a tool to evaluate mix with out-of-tolerance air voids.
- Evaluated method in research lab.

Comments / Questions?

EAR
Workshop

Overview of the EAR Process

- Disposition of Defective Material Form
- Flow Chart

EARs & Disposition of Defective Materials Form

Why an EAR?


Defective Material on project
Contractor proposes to leave material in place
•Fill out DDM form, Section A
•Develop a proposed scope
•Send form and scope to PA

Section A – Contractor

- Project Information
- Material Information
  - Location
  - Description
  - Quantity
- Prime's proposed EAR scope

Section A: Sample Information and Request for EAR – Contractor

Financial Project No.:	Contract No.:	Federal Job No.:
Material ID.:	Sample No.:	LIMS Sample ID.:
Pay Item No.:	Quantity:	Location:
Description of Defective Material: ☐ EAR Scope attached		

Section B - Project Administrator/Resident Engineer

- Fill out Section B
  - Determines if material should be removed and replaced

    OR

  - Allow use of EAR

Section B - Project Administrator/Resident Engineer

Section B: Proposal - Project Administrator/Resident Engineer

☐ Remove and Replace Material		
☐ Send to DME for Concurrence with Proposal, EAR Scope attached		
☐ Concurs	☐ Rejects (See Comments Below)	☐ Leave in Place, EAR not required
Signature:	**Date:**	
Comments:		

Section C - DME

- Remove and Replace

OR

- No EAR needed

OR

- Review Prime's proposed EAR scope &
  - Add to scope, revise scope or
  - If no scope is included, develop scope & parameters for EAR

Section C - DME

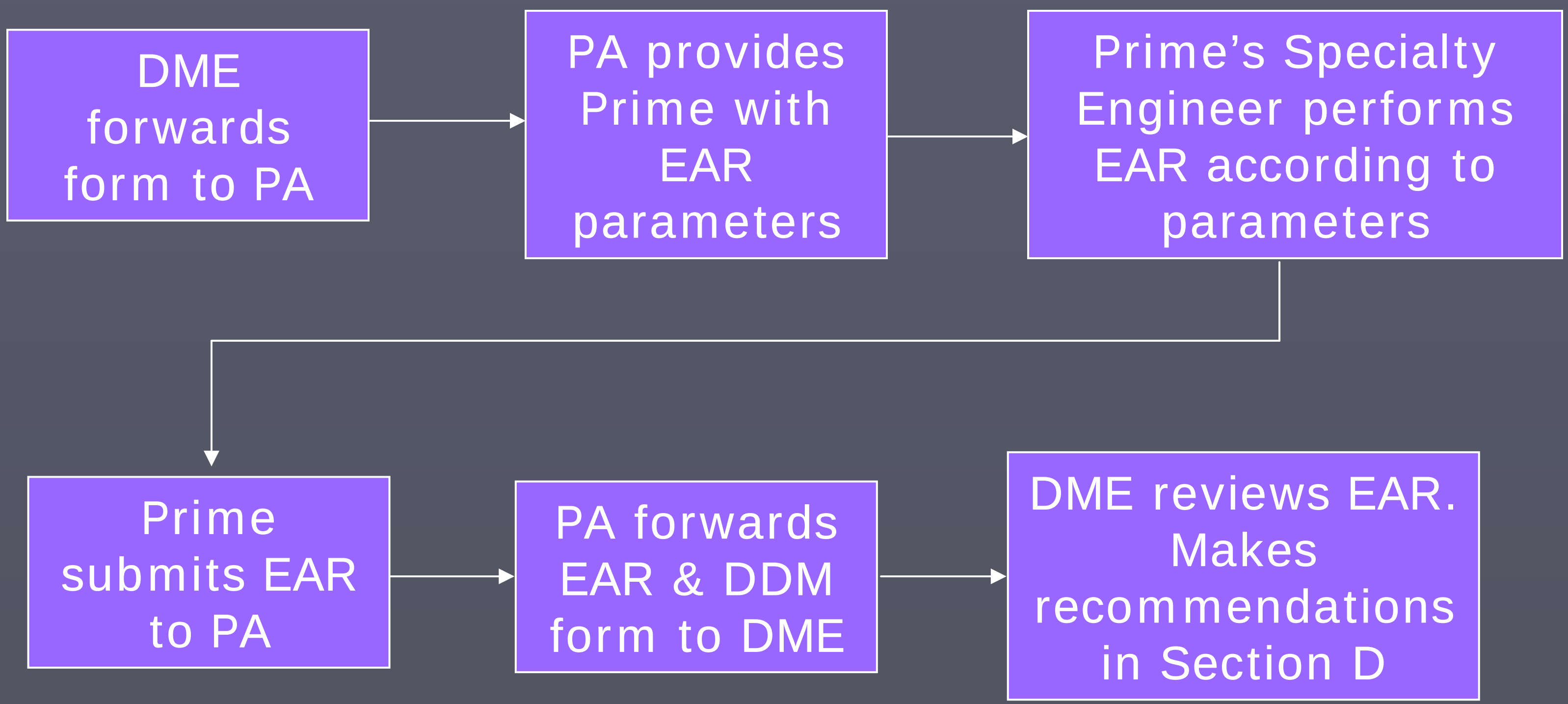
Section C: EAR Information – District Materials Engineer - Choose one and send form to DCE

- ☐ Remove and Replace Material
- ☐ Leave in Place – EAR not required, Send to DCE for Concurrence
- ☐ Concur with EAR Scope (attached) – Submit EAR

Signature:	**Date:**

Comments:

EAR


DME forwards form to PA
PA provides Prime with EAR parameters
Prime's Specialty Engineer performs EAR according to parameters
Prime submits EAR to PA
PA forwards EAR & DDM form to DME
DME reviews EAR. Makes recommendations in Section D

Section D - DME

- DME records EAR review results
- Concurs/Does not concur with EAR recommendations
- Recommends material disposition
  - Remove and Replace
  - Leave in place
  - Partial Removal
    - Where, how much

Section D - DME

Section D: Material Disposition Recommendation – District Materials Engineer

☐ EAR performed, DME recommendation: Choose one and send form to District Construction Engineer

☐ All material to be left in place. ☐ All material to be removed. ☐ Partial removal of material/Other

Quantity of material to be removed:
Location of material to be removed:
DME Concurs with EAR Recommendations ☐ Yes ☐ No

Signature:	**Date:**

Section E - DCE

- DCE records concurrence, non-concurrence with DME and why or why not
- If the DME and DCE concur follow DME's recommendations

Section E - DCE

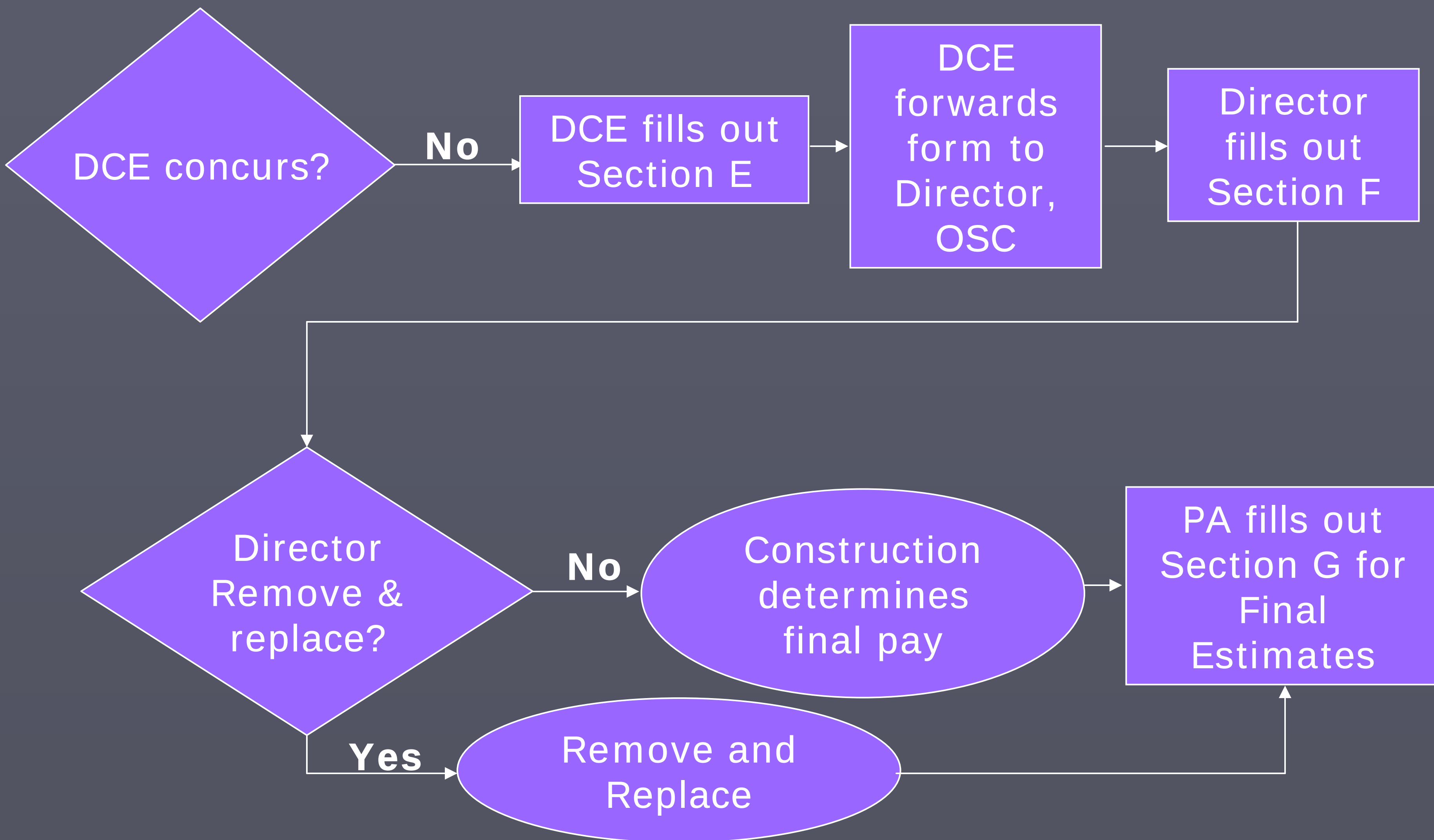
Section E: Concurrence - District Construction Engineer

☐ Concur with DME Recommendation – Send to Project Administrator	
☐ Do Not Concur with DME recommendation – Send to Director, Office of Construction ☐ DCE recommendation attached Comments:	
Signature:	**Date:**

Non-concurrence by DME/DCE

- If the DME and DCE don’t concur, the EAR and form go to the Office of Construction

DME & DCE don't concur



Section F - Director

- Director makes final decision
- Attaches decision to form
- Returns form & all backup to PA

Section F - Director

Section F: Decision - Director, Office of Construction

☐ Director, Office of Construction Decision attached. Send to Project Administrator	
Signature:	**Date:**

Section G - PA

- Record of final payment on material

Section G: Record of Final Payment Determination: - Project Administrator

Material left in place at % pay. Comments:

Questions?

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

DISPOSITION OF DEFECTIVE MATERIAL

Form 700-011-01
CONSTRUCTION
06/05

Section A: Sample Information and Request for EAR – Contractor

Financial Project No.:	Contract No.:	Federal Job No.:
Material ID.:	Sample No.:	LIMS Sample ID.:
Pay Item No.:	Quantity:	Location:
Description of Defective Material: ☐ EAR Scope attached		

Section B: Proposal - Project Administrator/Resident Engineer

☐ Remove and Replace Material	
☐ Send to DME for Concurrence with Proposal, EAR Scope attached	
☐ Concurs ☐ Rejects (See Comments Below) ☐ Leave in Place, EAR not required	
Signature:	**Date:**
Comments:	

Section C: EAR Information – District Materials Engineer - Choose one and send form to DCE

☐ Remove and Replace Material	
☐ Leave in Place – EAR not required, Send to DCE for Concurrence	
☐ Concur with EAR Scope (attached) – Submit EAR	
Signature:	**Date:**
Comments:	

Section D: Material Disposition Recommendation – District Materials Engineer

☐ EAR performed, DME recommendation: Choose one and send form to District Construction Engineer ☐ All material to be left in place. ☐ All material to be removed. ☐ Partial removal of material/Other Quantity of material to be removed: Location of material to be removed: DME Concurs with EAR Recommendations ☐ Yes ☐ No	
Signature:	**Date:**

Section E: Concurrence - District Construction Engineer

☐ Concur with DME Recommendation – Send to Project Administrator	
☐ Do Not Concur with DME recommendation – Send to Director, Office of Construction ☐ DCE recommendation attached Comments:	
Signature:	**Date:**

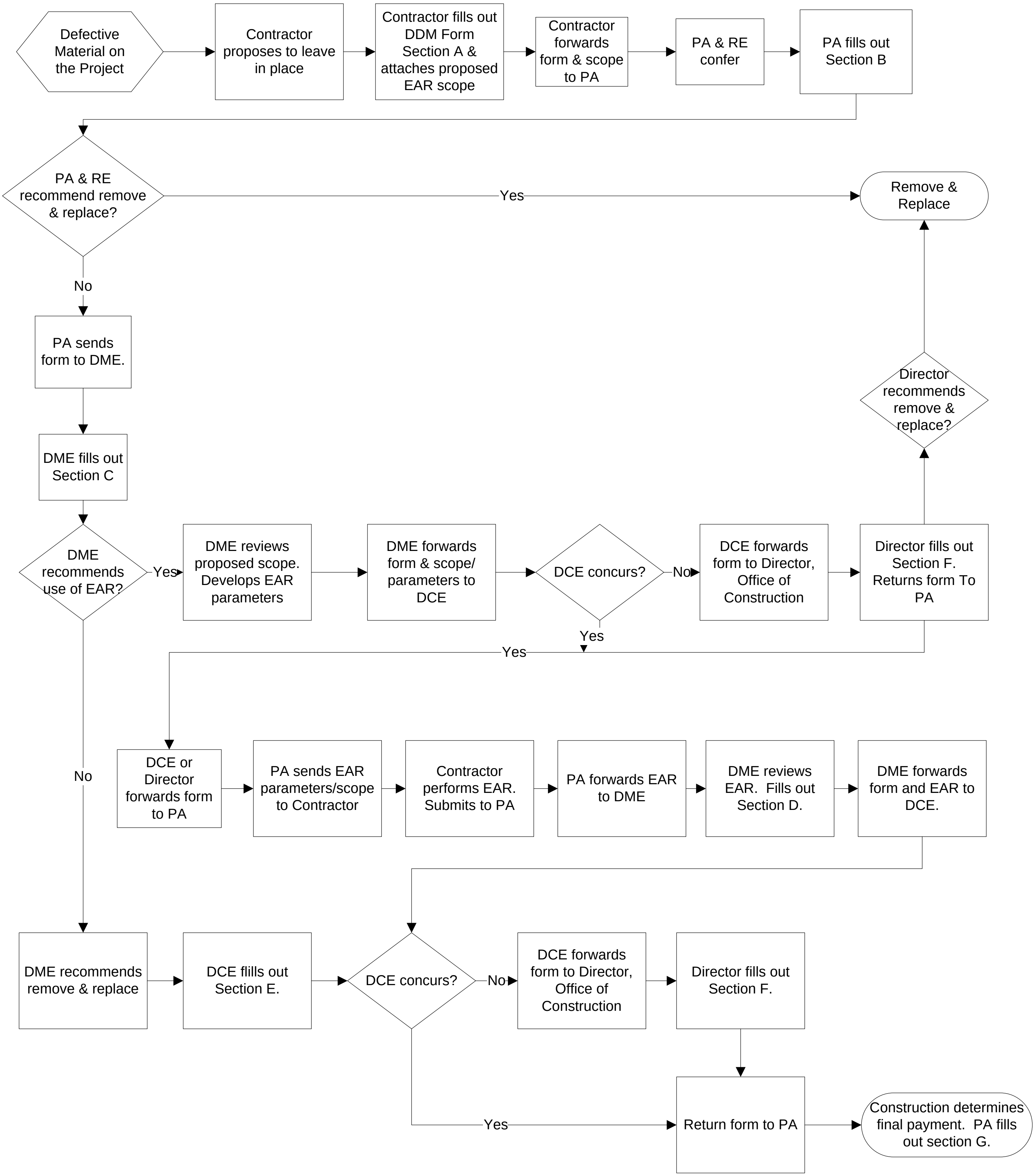
Section F: Decision - Director, Office of Construction

☐ Director, Office of Construction Decision attached. Send to Project Administrator	
Signature:	**Date:**

Section G: Record of Final Payment Determination: - Project Administrator

Material left in place at % pay. Comments:

cc: District Materials Office
District Construction Office
State Construction Office



Defective Material on the Project
Contractor proposes to leave in place
Contractor fills out DDM Form Section A & attaches proposed EAR scope
Contractor forwards form & scope to PA
PA & RE confer
PA fills out Section B
PA & RE recommend remove & replace?
Yes
Remove & Replace
No
PA sends form to DME.
DME fills out Section C
DME recommends use of EAR?
Yes
DME reviews proposed scope. Develops EAR parameters
DME forwards form & scope/ parameters to DCE
DCE concurs?
No
DCE forwards form to Director, Office of Construction
Director fills out Section F. Returns form To PA
Director recommends remove & replace?
Yes
Yes
No
DCE or Director forwards form to PA
PA sends EAR parameters/scope to Contractor
Contractor performs EAR. Submits to PA
PA forwards EAR to DME
DME reviews EAR. Fills out Section D.
DME forwards form and EAR to DCE.
DME recommends remove & replace
DCE flills out Section E.
DCE concurs?
No
DCE forwards form to Director, Office of Construction
Director fills out Section F.
Return form to PA
Yes
Construction determines final payment. PA fills out section G.

EAR
Workshop

- EAR Guidelines
- Model EAR

Department Guidelines for Preparing an Engineering Analysis Report

Following is a list of the basic requirements that should be included in an Engineering Analysis Report (EAR)

1. Identification information: This should be included at the beginning of the EAR identifying the project information, the name and address of the company submitting the EAR and the name and address of the company the EAR is being prepared for.

2. Problem statement: Describe in detail the problem which required the EAR. Provide a summary of the test results (QC, IV, as applicable) and specification requirements that triggered the EAR. Provide the location within the project of the questionable material. If possible, use Global Positioning System (GPS) coordinates to identify the location of the material.

3. Testing laboratory: Identify the laboratory that will be used and discuss the laboratory's qualifications and personnel that will perform the required tests. Provide technician identification numbers (TIN).

4. Engineering: Identify the Engineer responsible for analyzing the data and making final recommendations. Include a brief résumé listing similar past work efforts.

5. Testing plan: Discuss the testing approach that will be used, including the test methods and number of test replicates. Include information on who will provide the samples for the analysis, where they will be located (within the area of the questionable material) and when they will be obtained.

6. Analysis approach: Describe the approach and reasoning that will be used to evaluate the test data and determine the quality of the questionable material.

Approval of the testing plan and analysis approach must be obtained from the Department prior to obtaining any samples and/or testing.

7. Data presentation: Present the data in a tabular and/or graphical format.

8. Statistical analysis: Conduct statistical tests, as applicable, to determine the viability of the data. The statistical analysis should also determine if the samples used in the analysis are representative of the questionable material in-place.

9. Recommendations: Based on the test data obtained and current engineering practice, provide and justify the recommendations for the disposition of the questionable material. Discuss the quantities and locations of the material determined to be questionable.

10. P.E. Seal: The Professional Engineer responsible for the EAR and its recommendations must sign and seal the EAR

11. Attachments: Present any accreditation, certification, or other supporting documents, including pictures, plant and field records, control charts, etc. that are needed for the EAR Include a copy of the Department’s correspondence to the Contractor that indicates approval to perform an EAR for this particular problem.

FICTITIOUS ASPHALT ENGINEERING, INC.

November 18, 2004

Mr. George W. Kerry
QC Manager
First American Asphalt Contractors, Inc.
3171 N.W. 43rd Avenue
Gainesville, Florida 32606

Subject: Engineering Analysis Report – SP-12.5 LOT 8, sublot 1
Financial Project Number: 321456-1-52-01
Road No.: SR-121
County: Alachua

Dear Mr. Kerry:

At your request, an engineering analysis was performed on the failing material from LOT 8, sublot 1 of the subject project. The Engineering Analysis Report for this investigation is attached. Should you have any questions or require additional information, please let me know.

Sincerely,

John Q. Fictitious, P.E.
Bituminous Engineer

JQF/

Attachment

5007 NE 39TH AVENUE • GAINESVILLE, FLORIDA • 32609
PHONE: 352.867.5309 • FAX: 352.867.5308

Engineering Analysis Report

Financial Project Number: 321456-1-52-01
Road No.: SR-121
County: Alachua

Superpave Asphalt Concrete
Type SP-12.5, Fine Graded
Mix Design Number: SP 04-9999A
LOT 8, sublot 1

Prepared for:

Mr. George W. Kerry
QC Manager
First American Asphalt Contractors, Inc.
3171 N.W. 43rd Avenue
Gainesville, Florida 32606

Prepared by:

John Q. Fictitious, P.E.
Fictitious Asphalt Engineering, Inc.
5007 NE 39th Avenue
Gainesville, FL 32609

November 18, 2004

Problem Statement:

During the production of the SP-12.5 Superpave fine graded asphalt mix on the night of September 13, 2004, the air voids, as measured by the Independent Verification sample for LOT 8, sublot 1, were 2.18%. Article 334-7 of the Florida Department of Transportation (FDOT) Specifications for this project requires that the air voids be maintained within the range of 2.30 to 6.00%; consequently the sample failed to meet the Specification requirements. Since low air voids have been associated with plastic deformation (rutting) of asphalt pavements, an analysis of this failing material is warranted to determine the appropriate disposition.

The Quality Control (QC), Independent Verification (IV) and Verification (VT) data for the SP-12.5 mix in question has been summarized and can be found in Table 1. The failing IV test result is identified by the blue circle in Table 1. Preliminary review of the data indicates that the probable cause of the low air voids was primarily a high asphalt binder content in the mix. The gradation appears to be a contributing problem with a coarser gradation compared to the job mix formula (JMF) on all of the sieves except for the No. 200 sieve. Since the mix in question is a fine graded mix, a coarser gradation than the JMF would tend to cause lower air voids.

The IV sample was pulled from load number 35, at approximately 700 tons. The QC test for LOT 8, sublot 1 was pulled from load number 21, at approximately 420 tons. The QC test results were acceptable. The IV testing and results were not finished and available until after the completion of sublot 1 on September 13. Therefore, it is proposed that the asphalt mixture placed between the QC test result and the end of sublot 1 be evaluated. This represents 580 tons (1000 tons – 420 tons) of asphalt mixture. This questionable mix was placed on the project from Sta 223+05 to Sta 281+05 (5,800 ft.), in Lane L-1. The average spread rate for the material was 150.0 lbs/sy, equating to a compacted thickness of approximately 1.5 inches.

Testing Laboratory:

All testing associated with this Engineering Analysis Report was conducted by Fictitious Asphalt Engineering, Inc., Asphalt Laboratory. The FAE Asphalt Laboratory is an accredited laboratory meeting all of the requirements set forth under AASHTO R18. All personnel involved in testing activities in the FAE Asphalt Laboratory are qualified through the FDOT Construction Training Qualification Program (CTQP), and are actively evaluated through the FDOT Independent Assurance (IA) Program as well as the AASHTO Materials Reference Laboratory (AMRL) proficiency sampling program. Technician Identification Numbers are available upon request.

Engineering:

The following FAE staff were involved in various stages of the analysis:

Suburban Meyer, Senior Engineer – Supervised all field sampling
Robert Bowden, Junior Technician – Conducted all laboratory testing

The final recommendation will come from John Q. Fictitious, PE. A brief resume outlining Mr. Fictitious's related work experiences is given in Attachment 1.

Table 1 – Summary of Quality Control, Verification and Independent Verification Data

Project Summary																								
Project No.:	321456-1-52-01		SR No. :	121			Date:	9/13/2004	9/13/2004	9/13/2004	9/15/2004	9/15/2004	9/20/2004	9/20/2004	9/23/2004	9/23/2004	9/27/2004	9/27/2004	9/27/2004	9/27/2004	9/27/2004	9/27/2004	9/29/04	9/29/04
Contractor:	First American Asphalt			Gyrations			Tested by:	QC	QC	IV	QC	VT	QC	QC	QC	QC	QC	QC	IV	QC	VT	QC	QC	QC
Mix Design No.:	SP04-9999A	(mm):	12.5	@ N_i:	7		Lot / Sublot	8,1PC	8,1	8,1	8,2	8,2	8,3PC	8,3	8,4	9,1	PC	9,2	9,2	9,3	9,3	9,3	PC - 9/4	9/4
Traffic Level:	C	Gmm:		@ N_d:	75		Load #:	4	21	35	1		4	25	3	23	4	13	6	29	29	29	1	13
VMA:	14.0% MIN	VFA:	65-75%	@ N_m:	115		Tons/day:																310.18	310.18
Design Temp:	Production:			Compaction:			Cumulative tons:																310.18	310.18
Property	JMF	AVG	STD	MIN	MAX	RNG	CNT																	
25.0mm (1")		100.00	0.00	100.00	100.00	0.00	17.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
19.0mm (3/4")		100.00	0.00	100.00	100.00	0.00	17.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
12.5mm (1/2")	95	93.82	1.65	90.14	96.26	6.12	17.00	96.08	93.13	94.36	91.82	96.26	91.96	93.48	94.68	94.21	95.77	91.42	94.96	94.19	93.40	94.19	94.83	90.14
9.5mm (3/8")	89	87.42	1.83	84.34	91.26	6.92	17.00	89.45	86.73	87.26	84.93	91.26	84.89	86.28	88.63	87.98	88.37	84.34	88.32	88.51	86.67	88.51	88.92	85.10
4.75mm (#4)	66	65.56	2.01	62.65	68.99	6.34	17.00	64.83	63.81	63.10	64.29	68.99	63.12	63.04	67.64	66.59	68.55	62.65	67.73	66.83	64.43	66.83	65.29	66.79
2.36mm (#8)	45	45.11	1.81	42.64	48.38	5.74	17.00	**42.81**	**43.37**	**43.00**	**42.97**	**45.78**	**42.64**	**43.39**	**45.69**	**46.31**	**48.38**	**44.69**	**47.83**	**46.81**	**44.16**	**46.81**	**46.06**	**46.19**
1.18mm (#16)	32	31.86	1.85	28.68	34.44	5.76	17.00	29.69	30.11	29.37	28.68	30.68	30.68	30.45	33.96	33.62	34.44	31.43	34.33	33.91	32.01	33.91	32.49	31.90
600um (#30)	24	24.20	1.55	21.13	26.33	5.20	17.00	22.47	22.73	22.35	21.13	22.63	24.04	23.66	25.75	25.54	26.33	24.00	26.31	25.87	25.08	25.87	24.15	23.57
300um (#50)	18	18.22	1.38	15.36	20.30	4.94	17.00	16.66	16.98	16.75	15.36	16.59	18.64	18.20	18.10	19.51	20.17	18.35	20.30	19.63	19.26	19.63	17.93	17.62
150um (#100)	7	6.94	0.84	5.38	8.28	2.90	17.00	5.38	5.95	5.83	5.56	6.57	6.90	6.71	7.08	7.44	8.08	7.16	8.28	7.58	7.87	7.58	6.77	7.32
75um (#200)	2.9	2.42	0.24	2.15	3.10	0.95	17.00	**2.15**	**2.24**	**3.10**	**2.32**	**2.76**	**2.21**	**2.45**	**2.31**	**2.30**	**2.51**	**2.28**	**2.73**	**2.36**	**2.45**	**2.36**	**2.20**	**2.35**
Ext. AC %:	6.1	6.04	0.18	5.81	6.55	0.74	17.00	**6.10**	**6.00**	**6.55**	**6.09**	**6.32**	**5.82**	**5.87**	**6.11**	**5.92**	**6.14**	**5.84**	**6.10**	**6.04**	**5.81**	**6.04**	**5.90**	**5.96**
Rice MSG (Gmm):	2.399	2.399	0.01	2.385	2.412	0.03	17.00	**2.396**	**2.397**	**2.385**	**2.398**	**2.399**	**2.401**	**2.400**	**2.399**	**2.400**	**2.401**	**2.401**	**2.395**	**2.397**	**2.412**	**2.397**	**2.398**	**2.402**
Avg. Bulk (Gmb):	2.303	2.311	0.01	2.300	2.333	0.03	17.00	**2.315**	**2.305**	**2.333**	**2.307**	**2.300**	**2.306**	**2.311**	**2.310**	**2.308**	**2.317**	**2.311**	**2.320**	**2.313**	**2.313**	**2.313**	**2.303**	**2.306**
Agg. Sp. Gr. (Gsb):	2.557	2.557	0.00	2.557	2.557	0.00	17.00	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**	**2.557**
Hgt.@N int.:		123.9	1.21	122.5	126.3	3.80	17.00	**126.3**	**124.4**	**126.0**	**125.4**	**125.7**	**123.7**	**123.4**	**122.9**	**123.3**	**122.7**	**123.4**	**122.6**	**122.9**	**122.5**	**122.9**	**123.7**	**123.8**
Hgt.@N des.:		115.9	0.57	115.2	117.3	2.10	17.00	**117.3**	**116.0**	**117.0**	**116.4**	**116.6**	**116.1**	**115.7**	**115.5**	**115.8**	**115.3**	**115.8**	**115.2**	**115.6**	**115.3**	**115.6**	**115.8**	**115.9**
%Gmm @ Ni	≤ 89.0	90.2	0.55	88.9	91.0	2.09	17.00	**89.73**	**89.67**	**90.83**	**89.30**	**88.93**	**90.14**	**90.28**	**90.49**	**90.32**	**90.68**	**90.28**	**91.02**	**90.76**	**90.26**	**90.76**	**89.90**	**89.88**
% Gmm @ Nd	96.0	96.4	0.45	95.9	97.8	1.95	17.00	**96.62**	**96.16**	**97.82**	**96.21**	**95.87**	**96.04**	**96.29**	**96.29**	**96.17**	**96.50**	**96.25**	**96.87**	**96.50**	**95.90**	**96.50**	**96.04**	**96.00**
% Air Voids @ Nd	4	3.65	0.45	2.18	4.13	1.95	17.00	**3.38**	**3.84**	**2.18**	**3.79**	**4.13**	**3.96**	**3.71**	**3.71**	**3.83**	**3.50**	**3.75**	**3.13**	**3.50**	**4.10**	**3.50**	**3.96**	**4.00**
% VMA @ Nd		15.07	0.23	14.74	15.74	1.00	17.00	**14.99**	**15.27**	**14.74**	**15.27**	**15.74**	**15.07**	**14.93**	**15.18**	**15.08**	**14.95**	**14.90**	**14.80**	**15.00**	**14.79**	**15.00**	**15.25**	**15.19**
% VFA @ Nd		75.83	2.82	72.28	85.21	12.93	17.00	**77.45**	**74.85**	**85.21**	**75.18**	**73.76**	**73.72**	**75.15**	**75.56**	**74.60**	**76.59**	**74.83**	**78.85**	**76.67**	**72.28**	**76.67**	**74.03**	**73.67**
Dust/Asphalt		0.48	0.04	0.41	0.56	0.15	17.00	**0.41**	**0.44**	**0.56**	**0.45**	**0.54**	**0.45**	**0.49**	**0.46**	**0.46**	**0.49**	**0.46**	**0.53**	**0.46**	**0.51**	**0.46**	**0.44**	**0.47**
Gmb @ Nd		2.311	0.01	2.30	2.333	0.03	17.00	**2.315**	**2.305**	**2.333**	**2.307**	**2.300**	**2.306**	**2.311**	**2.310**	**2.308**	**2.317**	**2.311**	**2.320**	**2.313**	**2.313**	**2.313**	**2.303**	**2.306**
Density lbs/cf		144.2	0.46	143.52	145.6	2.060	17.00	**144.46**	**143.83**	**145.58**	**143.96**	**143.52**	**143.89**	**144.21**	**144.14**	**144.02**	**144.58**	**144.21**	**144.77**	**144.33**	**144.33**	**144.33**	**143.71**	**143.89**
Gse		2.6	0.01	2.62	2.6	0.02	17.00	**2.62**	**2.62**	**2.63**	**2.62**	**2.64**	**2.62**	**2.62**	**2.63**	**2.62**	**2.63**	**2.62**	**2.62**	**2.62**	**2.63**	**2.62**	**2.62**	**2.62**
Pba		1.02	0.09	0.97	1.27	0.30	17.00	**0.97**	**0.97**	**1.12**	**0.97**	**1.27**	**0.97**	**0.97**	**1.12**	**0.97**	**1.12**	**0.97**	**0.97**	**0.97**	**1.12**	**0.97**	**0.97**	**0.97**
Pbe		5.08	0.15	4.76	5.50	0.74	17.00	**5.19**	**5.09**	**5.50**	**5.18**	**5.13**	**4.91**	**4.96**	**5.06**	**5.01**	**5.09**	**4.93**	**5.19**	**5.13**	**4.76**	**5.13**	**4.99**	**5.05**
Roadway Core 1 Gmb									2.234		2.153	2.143		2.230	2.250	2.237		2.195		2.217	2.216	2.217		2.163
Roadway Core 2 Gmb									2.223		2.235	2.236		2.182	2.210	2.214		2.211		2.220	2.220	2.220		2.243
Roadway Core 3 Gmb									2.228		2.239	2.239		2.204	2.225	2.225		2.190		2.181	2.177	2.181		2.243
Roadway Core 4 Gmb									2.212		2.21	2.21		2.251	2.209	2.222		2.213		2.2	2.196	2.200		
Roadway Core 5 Gmb									2.226		2.179	2.174		2.187	2.241	2.223		2.200		2.212	2.241	2.212		
Average Core Gmb		2.21	0.01	2.20	2.23	0.03	11.00		2.225		2.203	2.200		2.211	2.227	2.224		2.202		2.206	2.210	2.206		2.216
Sublot Gmm		2.40	0.01	2.39	2.41	0.03	17.00	2.391	2.397	2.385	2.398	2.399	2.401	2.400	2.399	2.400	2.401	2.401	2.395	2.397	2.412	2.397	2.398	2.402
% of Sublot Gmm		92.15	0.42	91.63	92.83	1.20	11.00		92.81		91.88	91.72		92.12	92.83	92.68		91.70		92.03	91.63	92.03		92.27

Testing Plan:

In order to evaluate the questionable material placed on the project, a set of four six-inch diameter roadway cores were taken at a frequency of one set of cores per 500 feet of roadway. The first set of cores is located 500 feet from Sta 223+05 and a set of cores was then obtained every 500 ft. after that. Cores 1 and 2 were taken between-the-wheelpath and cores 3 and 4 were taken within the wheelpath. Prior to cutting cores, the pavement was inspected by Department & Contractor personnel for any signs of premature rutting. The samples were obtained by staff of First American Asphalt Contractors, Inc., under the direction and supervision of Fictitious Asphalt Engineering, Inc. personnel on October 14, 2004. Of each set of cores, the following tests were performed:

Bulk specific gravity - G_{mb} (FM 1-T 166) – Cores 1-4.
Maximum specific gravity – G_{mm} (FM 1-T 030) – Combined Cores 1 & 2.
Determination of asphalt binder content - P_b (FM 5-563) – Combined Cores 3 & 4.
Gradation analysis – (FM 1-T 030) – Combined Cores 3 & 4.

Analysis Approach:

Based on a review of the production data, the low air voids in the asphalt mixture that occurred on the night of September 13, 2004 were primarily due to high asphalt binder content (6.55% with a target of 6.10%). In addition, the gradation of the material on all of the sieves, except for the No. 200 sieve, is slightly on the coarse side.

Since the pavement was only opened to traffic for thirty one days prior to cutting the cores used in this analysis and the roadway in question does not have heavy truck traffic (8.7% with an AADT of 19,500), the pavement has not had adequate time to further densify and in-place air voids is not likely to be a good indicator of performance. Consequently, this analysis focused primarily on the characteristics that caused the low air voids (high binder content and a coarse gradation) rather than in-place air voids alone.

This analysis focused on 1) identifying the limits of the questionable material, and 2) determining whether the questionable material is suitable to remain in place or should be removed.

The following test data was summarized for each coring location:

- Asphalt binder content
- Gradation
- Maximum specific gravity (Gmm)
- Bulk specific gravity (Gmb)
- In-Place Density, expressed as % Gmm

Approval of Testing Plan and Analysis Approach:

The testing plan and analysis approach of this EAR were submitted to the Department for review on October 1, 2004. Approval was received on October 4, 2004.

Data presentation:

A summary of the data is presented in Table 2.

Analysis:

The IV sample was obtained from load number 35. This mix was placed approximately at Sta 251+05. Examination of the data shows that the asphalt binder content is close to the design target until Sta 248+05, where the asphalt binder content was 6.30 %. Core test results obtained at stations 253+05 and 258+05 show asphalt binder contents of 6.51 % and 6.39 %, respectively. The asphalt binder contents at the remaining stations were close to the design target. There appears to be an isolated section between stations 248+05 and 258+05 where the binder content was excessive.

The gradation at Sta 253+05 appears to be slightly coarser than the gradations at the other stations and this effect could cause a fine graded mix to have low air voids for specimens compacted in the gyratory compactor.

There appears to be no difference in the densities for the wheelpath and between-the-wheelpath cores. Also, no observed rutting was noticed by Department and Contractor personnel in the area near Sta 251+05.

The data obtained from the field cores corroborates the IV sample test data. The asphalt binder content at Sta 248+05 is 6.30, which is 0.20 % higher than the mix design, but is not unreasonable. However, the asphalt binder content at Sta 253+05 is 6.51 %, which is excessive. The asphalt binder content at Sta 258+05 is 6.39%, which is borderline excessive, but should not require removal.

Recommendations:

It is recommended that First American Asphalt Contractors, Inc. mill and replace the asphalt from Sta 248+05 to Sta 258+05. The milling should encompass the entire twelve foot width of lane L-1 and be the full depth of the paved layer, which is 1.5 in. This is approximately 100 tons of asphalt mix. This remedial action should alleviate any concerns of premature rutting in the area of concern.

Sincerely,

John Q. Fictitious

Table 2 – Summary of Test Data from Roadway Cores

Property	Design	Sta 228+05		Sta 233+05		Sta 238+05		Sta 243+05		Sta 248+05		Sta 253+05		Sta 258+05		Sta 263+05		Sta 268+05		Sta 273+05		Sta 278+05	
Pb	6.1	6.05		6.21		6.15		6.09		6.30		6.51		6.39		6.20		6.01		6.07		5.98	
3/4 “	100	100		100		100		100		100		100		100		100		100		100		100	
1/2"	95	94		95		96		94		93		94		94		95		94		93		95	
3/8”	89	88		88		89		87		86		85		88		89		87		86		87	
No. 4	66	65		66		66		65		64		64		65		65		65		65		66	
No.8	45	44		45		46		45		44		43		44		44		45		46		46	
No. 16	32	30		30		31		31		30		29		29		30		30		31		32	
No. 30	24	23		24		24		23		22		21		22		23		24		24		24	
No. 50	18	17		16		18		17		16		17		17		19		18		19		18	
No. 100	7	6		7		6		6		5		4		5		6		6		7		6	
No. 200	2.9	2.3		2.4		2.5		2.4		2.7		3.4		3.4		3.1		3.0		2.9		2.7	
Gmm	2.399	2.403		2.401		2.405		2.397		2.397		2.383		2.392		2.405		2.403		2.399		2.400	
Gmb	2.231	BWP	WP	BWP	WP	BWP	WP	BWP	WP	BWP	WP	BWP	WP	BWP	WP	BWP	WP	BWP	WP	BWP	WP	BWP	WP
		2.231	2.235	2.224	2.223	2.220	2.218	2.230	2.235	2.221	2.215	2.209	2.215	2.220	2.218	2.215	2.210	2.231	2.235	2.236	2.239	2.240	2.245
%Gmm	93.00	92.84	93.01	92.63	92.59	92.31	92.22	93.03	93.24	92.66	92.41	92.70	92.95	92.81	92.73	92.10	91.89	92.84	93.01	93.21	93.33	93.33	93.54