Welcome

to the

2013 Special Specification Update

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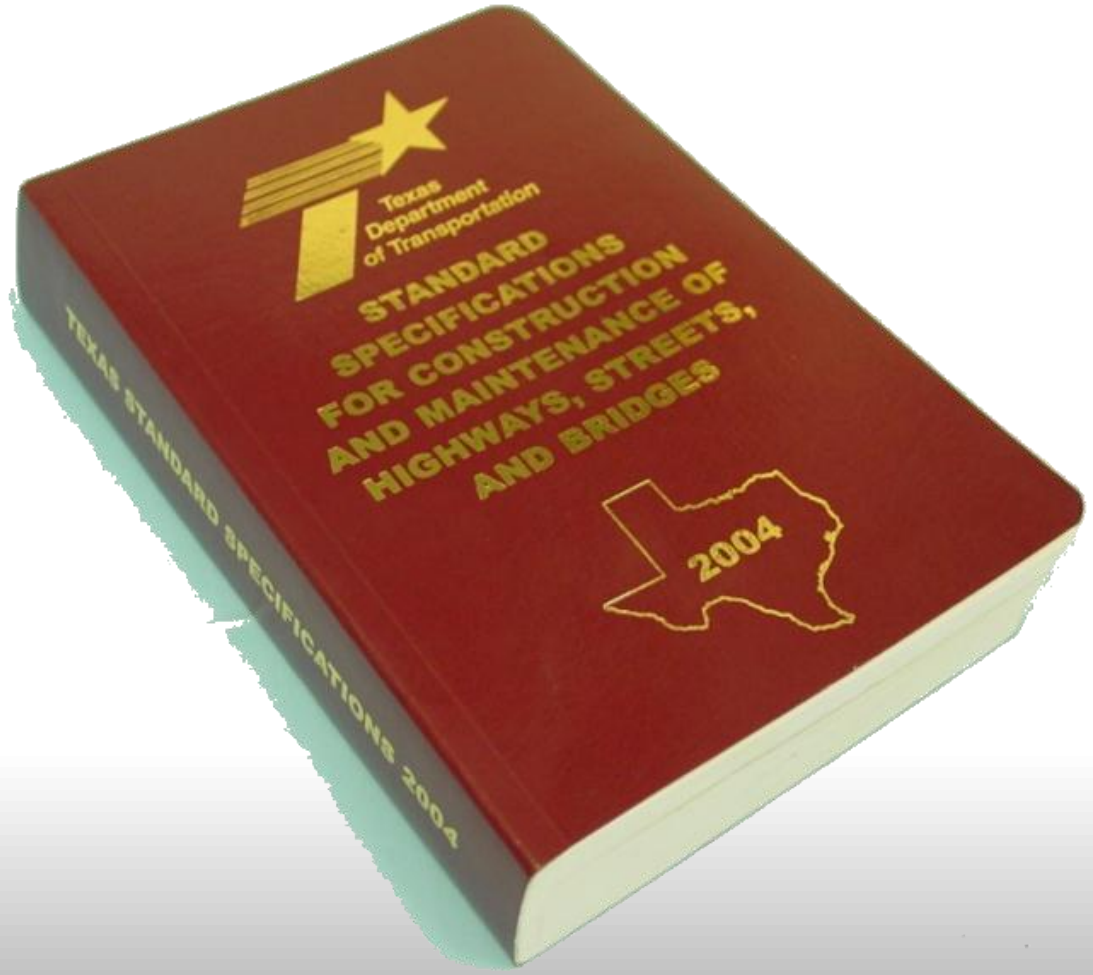

~~2004~~ ~~Jan 2009~~ ~~May 2009~~ ~~Dec 2009~~ ~~July 2011~~

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341-020

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SS 3224

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Mar 2013 — — — — — — 2014

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What Has Changed Since 2004 and Why?

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Why Do We Have to Keep Changing Our HMA Specifications?

Changes in the Past 10 Years

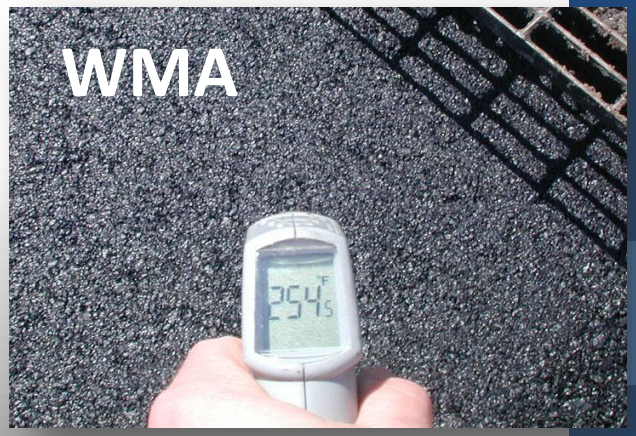
- *Asphalt Prices*
  - *Then (December 2002)*
    - *PG 64-22 cost $179 per ton*
    - *PG 70-22 cost $229 per ton ($50 more than PG64)*
    - *PG 76-22 cost $251 per ton ($72 more than PG64)*
  - *Now (December 2012)*
    - *PG 64-22 cost $584 per ton*
    - *PG 70-22 cost $688 per ton ($104 more than PG64)*
    - *PG 76-22 cost $736 per ton ($152 more than PG64)*

Changes in the Past 10 Years

- *Use of Recycled Materials*
  - *Then*
    - *Too much risk due to material variability*
    - *Not worth the effort….relatively inexpensive HMA*
  - *Now:*
    - *RAP and RAS are common*
    - *Reduces the need to use polymers to prevent rutting*
    - *Recycled materials are essential to control cost increases*
    - *Process improvements such as fractionation of RAP and finer grinding of shingles have dramatically reduced variability*
    - *Over 30 approved shingle processors*
    - *Significant financial and environmental benefits*

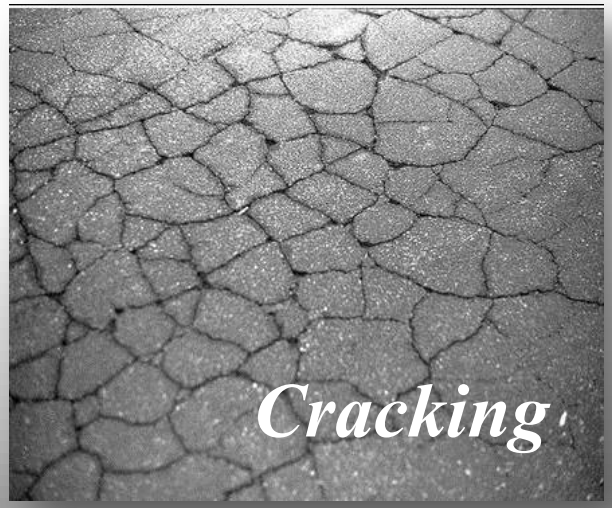
Changes in the Past 10 Years

- *The Environment*
  - *Then:*
    - *100% virgin mixes….the hotter the better*
    - *White smoke was just part of the process*
  - *Now:*
    - *WMA, RAP, RAS, Tire Rubber, In-place recycling…..*
    - *Reduced carbon foot print*
    - *Less use of burner fuel*
    - *It's cool to be "Green"*



Changes in the Past 10 Years

- *Asphalt Binder Grade*
  - *Then: Grade bump to address rutting*
  - *Now: Grade dump to address cracking*

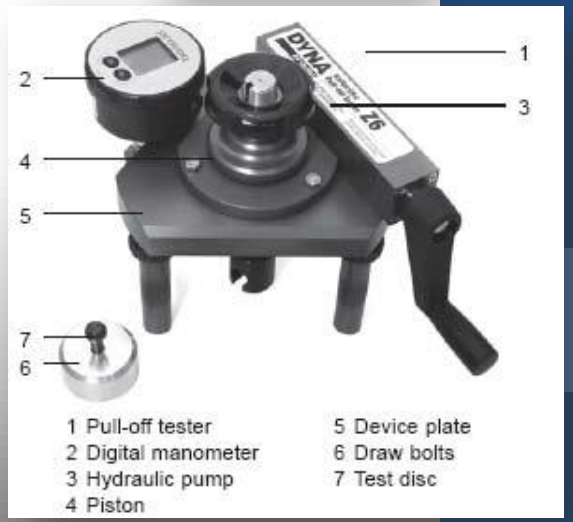


Changes in the Past 10 Years

- *Thermal Segregation (best technology)*
  - *Then*
    - *Infrared camera, measures <1% for >50K*
    - *Handheld infrared thermometer was the best option we had to check for thermal segregation*
  - *Now*
    - *Good infrared camera cost less than $2,000*
    - *Pave-IR system measures 100% for <30K*
    - *Handheld infrared thermometer determined to be a very poor method of detecting thermal segregation*

Changes in the Past 10 Years

- *Tack Coat*
  - *Then*
    - *If used at all choice was diluted SS-1*
    - *UPOD device to measure bond strength*
  - *Now*
    - *Undiluted SS-1H, CSS-1H, or PG binder*
    - *Specialized tack coat such as trackless tack*
    - *Spray paver applied option*
    - *No more UPOD… new improved bond tests coming*

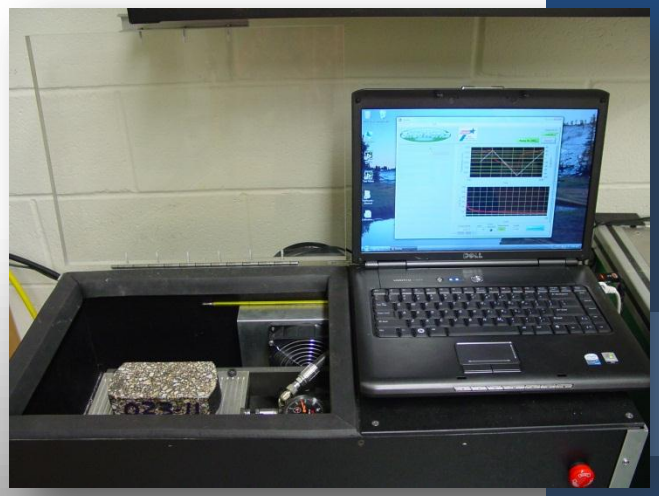


Changes in the Past 10 Years

- *FHWA Oversight*
  - *Then*
    - *No real major issues*
  - *Now*
    - *Sample custody – major issue*
    - *Sample custody bags*
    - *Visual observation of coring operation*
    - *Core trimming on site – visual observation*

Changes in the Past 10 Years

- *Test to Predict Cracking Performance*
  - *Then*
    - *Nothing done at mixture design stage*
  - *Now*
    - *Overlay test for SMA, CAM & TOM*
    - *Overlay test data base being built for all mixes*
    - *Ongoing research to fully implement on all mixes*



Changes in the Past 10 Years

- *Latest, Greatest Mix Types*
  - *Then*
    - *Large stone mixes placed in thick lifts*
    - *Stone filled HMA @ Ndes = 125 (dry mixes)*
    - *Superpave, SMA & CMHB relatively unproven*
  - *Now*
    - *Mixes with high AC% and smaller aggregate sizes placed in thin lifts …….Thin is in!*
    - *SMA-F, PFC-F, CAM, TOM, TBPFC, UTBHMWC, and Type F*

Changes in the Past 10 Years

- *Asphalt Additives*
  - *Then*
    - *Lime or liquid anti-strip*
  - *Now*
    - *Lime or liquid anti-strip*
    - *fibers, fly ash, WMA (foaming), WMA (chemical etc), shingles, RAP, crumb rubber , etc*

Changes in the Past 10 Years

- *Ride Quality Measurement*
  - *Then*
    - *10’ straight edge (in the spec but rarely used)*
    - *Profilograph (push behind) used on a small % of jobs*
  - *Now*
    - *High speed (inertial) profilers used on most jobs*
    - *Increased emphasis on ride quality*
    - *Considered #1 measure of pavement performance*

Changes in the Past 10 Years

- *Pavement Noise Measurements*
  - *Then*
    - *Not a high priority*
    - *Rarely done*
    - *Way side measurement……slow & cumbersome?*
  - *Now*
    - *Increasing public demand for quieter pavements*
    - *On board sound intensity (OBSI)*
    - *Easily measured at highway speeds*

Changes in the Past 10 Years

- *Other Issues*
  - *Micro-Deval for aggregate*
  - *Cantabro test for mix durability*
  - *Toll roads*
  - *CDA*
  - *Design build*
  - *Safety, Safety, Safety*

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If You Use Yesterday's Solutions to Solve Today's Problems, You May Not Be in Business Tomorrow

Summary & Conclusions

- *TxDOT is revising all HMA specifications in a proactive effort to:*
  - ✓ *Improve HMA Quality*
  - ✓ *Reduce HMA Cost*
  - ✓ *Be in Compliance with FHWA Regulations*
  - ✓ *Take Advantage of Technology Improvements*
  - ✓ *Be Better Stewards of Our Environment*

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Special Specification 3268 Dense-Graded Hot-Mix Asphalt (Item 341)

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Summary of Changes

Dense-Graded Hot-Mix Asphalt

SPECIAL SPECIFICATION 3224

Dense-Graded Hot-Mix Asphalt (QC/QA)

1. Description. Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant.

2. Materials. Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

SPECIAL SPECIFICATION 3268

Dense-Graded Hot-Mix Asphalt

1. Description. Construct a hot-mix asphalt (HMA) pavement la... of a comp...

APPROVED

Required for all projects beginning with the March 2013 letting

Description

- Changes the specification's name. Pay adjustments apply to HMA placed under this specification except for "Exempt Production."

SPECIAL SPECIFICATION

3268

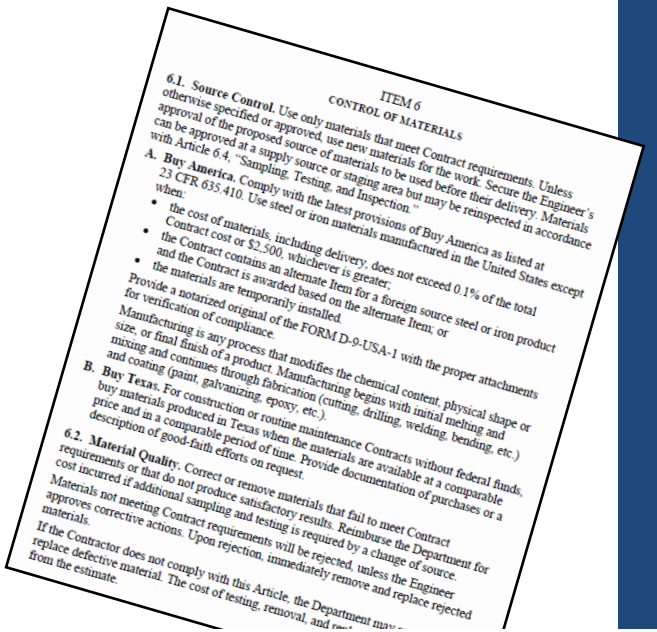
Dense-Graded Hot-Mix Asphalt

SS3224:
Dense-Graded Hot-Mix Asphalt (QC/QA)

1. **Description.** Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant. **Pay adjustments will apply to HMA placed under this specification unless the HMA is deemed exempt in accordance with Section 3268.4.I.4, "Exempt Production."**

Materials

- References Item 6 when sampling and testing project materials.



ITEM 6
CONTROL OF MATERIALS

6.1. Source Control. Use only materials that meet Contract requirements. Unless otherwise specified or approved, use new materials for the work. Secure the Engineer's approval of the proposed source of materials to be used before their delivery. Materials can be approved at a supply source or staging area but may be reinspected in accordance with Article 6.4, "Sampling, Testing, and Inspection."

A. Buy America. Comply with the latest provisions of Buy America as listed at 23 CFR 635.410. Use steel or iron materials manufactured in the United States except when:

- the cost of materials, including delivery, does not exceed 0.1% of the total Contract cost or $2,500, whichever is greater;
- the Contract contains an alternate Item for a foreign source steel or iron product and the Contract is awarded based on the alternate Item; or
- the materials are temporarily installed.

Provide a notarized original of the FORM D-9-USA-1 with the proper attachments for verification of compliance.

Manufacturing is any process that modifies the chemical content, physical shape or size, or final finish of a product. Manufacturing begins with initial melting and mixing and continues through fabrication (cutting, drilling, welding, bending, etc.) and coating (paint, galvanizing, epoxy, etc.).

B. Buy Texas. For construction or routine maintenance Contracts without federal funds, buy materials produced in Texas when the materials are available at a comparable price and in a comparable period of time. Provide documentation of purchases or a description of good-faith efforts on request.

6.2. Material Quality. Correct or remove materials that fail to meet Contract requirements or that do not produce satisfactory results. Reimburse the Department for cost incurred if additional sampling and testing is required by a change of source. Materials not meeting Contract requirements will be rejected, unless the Engineer approves corrective actions. Upon rejection, immediately remove and replace rejected materials.

If the Contractor does not comply with this Article, the Department may replace defective material. The cost of testing, removal, and
from the estimate.

Notify the Engineer of all material sources. Notify the Engineer before changing any material source or formulation. When the Contractor makes a source or formulation change, the Engineer will verify that the specification requirements are met and may require a new laboratory mixture design, trial batch, or both. **The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."**

Aggregate

- Allows intermediate aggregate as well as coarse and fine.
- Allows the Engineer perform tests during production to ensure that at least 50% of No. 4 aggregate comes from the Class A aggregate source.

This color shade signifies wording first seen in SS 3224

Coarse Aggregate

- Lists stockpile's requirements when using coarse aggregate sources not listed on the BRSQC.

For sources not listed on the Department's BRSQC:

- **build an individual stockpile for each material;**
- **request the Department test the stockpile for specification compliance; and**
- **once approved, do not add material to the stockpile unless otherwise approved.**

Micro-Deval Abrasion

- Adds the “Micro-Deval Abrasion” Section.
- Requires the Engineer to perform a minimum of one test for each coarse aggregate source that has a RSSM loss value greater than 15.
- Allows the Engineer to perform additional testing during production.

Micro-Deval Abrasion

- Allows the Engineer to waive all Micro-Deval testing.

b. **Micro-Deval Abrasion**. The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source used in the mixture design that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer will perform testing prior to the start of production and may perform additional testing at any time during production. The Engineer may obtain the coarse aggregate samples from each coarse aggregate source or may require the Contractor to obtain the samples. **The Engineer may elect to waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.**

Tack Coat

- Allows using specialized or preferred tack coat materials.

E. Tack Coat. Furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." **Specialized or preferred tack coat materials may be allowed by the Engineer or required when shown on the plans.** Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

Additives

- Requires providing documentation showing the quantity of additives used in the project.

F. **Additives.** Use the type and rate of additive specified when shown on the plans. Other additives that facilitate mixing, compaction, or improve the quality of the mixture may be allowed when approved. **Provide the Engineer with documentation such as the bill of lading showing the quantity of additives used in the project unless otherwise directed.**

Warm Mix Asphalt

- Defines WMA as mixtures produced within 215°F and 275°F.

2. **Warm Mix Asphalt (WMA).** **Warm Mix Asphalt (WMA) is defined as HMA that is produced within a target temperature discharge range of 215°F and 275°F using Department-approved WMA additives or processes.** The Department's Material Producer List of WMA additives and processes is located at http://www.txdot.gov/business/resources/producer-list.html.

   WMA is allowed for use on all projects and is required when shown on plans. The maximum placement or target discharge temperature for WMA may be set at a value less than 275ºF when shown on the plans.

   Department-approved WMA additives or processes may be used to facilitate mixing and compaction of HMA produced at target discharge temperatures greater than 275°F; however, such mixtures will not be defined as WMA.

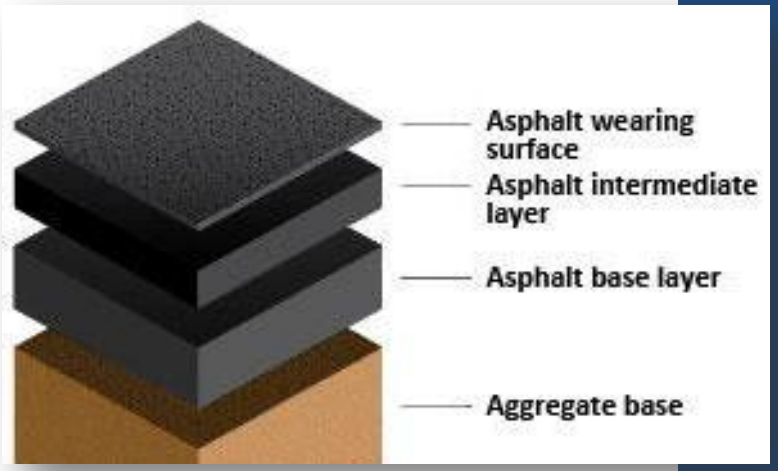
Recycled Materials

- Allows the Engineer to verify the AC of the recycled material stockpiles at any time during production.

G. **Recycled Materials.** Use of RAP and RAS is permitted unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 4. The allowable percentages shown in Table 4 may be decreased or increased when shown on the plans. Determine asphalt content and gradation of the RAP and RAS stockpiles for mixture design purposes in accordance with Tex-236-F. **The Engineer may verify the asphalt content of the stockpiles at any time during production.** Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. When RAP or RAS

Recycled Materials

- Defines “Surface,” “Intermediate,” and “Base” mixes in relation to Tables 4 and 5.



- "Surface" mixes are the final lift or riding surface of the pavement structure;
- "Intermediate" mixes are non-surface mixtures placed less than or equal to 8 inches from the riding surface; and
- "Base" mixes are non-surface mixtures placed greater than 8 inches from the riding surface.

RAP

- Adds a separate table for the Maximum Allowable Amounts of RAP.
- Reduces the maximum allowable unfractionated RAP % for the non-surface mixtures.

Table 4
Maximum Allowable Amounts of RAP[1]

Maximum Allowable Fractionated RAP[2] (%)			Maximum Allowable Unfractionated RAP[3] (%)		
Surface	Intermediate	Base	Surface	Intermediate	Base
20.0	30.0	40.0	10.0	10.0	10.0

1. Must also meet the recycled binder to total binder ratio shown in Table 5.
2. Up to 5% RAS may be used separately or as a replacement for fractionated RAP.
3. Unfractionated RAP may not be combined with fractionated RAP or RAS.

SS3224: 15%

SS3224: 20%

RAS

- Changes the RAS grinding requirement.

Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8 in. sieve when tested in accordance with Tex-200-F, Part I. Perform a sieve analysis on processed RAS material prior to extraction (or ignition) of the asphalt.

SS3224: 100% of the particles pass the ½ in. sieve and 95% pass the 3/8 in. sieve.

RAS

- When RAS is pre-blended, no longer requires showing the RAS and sand or fine RAP as two separates bins.
- Defines a RAS stockpile as any stockpile that contains RAS.

Add sand meeting the requirements of Table 1 and Table 2 or fine RAP to RAS stockpiles if needed to keep the processed material workable. **For any stockpile that contains RAS, the entire stockpile will be considered a RAS stockpile and be limited to no more than 5.0% of the HMA mixture in accordance with Table 4.**

RAS

- Reduces the allowable deleterious material in RAS to 0.5%.

Certify compliance of the RAS with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials (NRM) Guidelines." If the RAS has not come into contact with any hazardous materials, treat it as an established NRM. Use RAS from shingle sources on the Department's Material Producer List of NRM located at http://www.txdot.gov/business/resources/producer-list.html. Prior to use, remove substantially all materials that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with Tex-217-F, Part III. **Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS unless otherwise approved.** Submit a sample for approval to the Engineer prior to

SS3224: 1.5%

Updated Test Procedure

Tex 217-F

wood

Updated Test Procedure

» Tex-217F, Part III , “Determining Deleterious Material in Recycled Asphalt Shingles”

Recycled Materials

(Table 5)

- Reduces the maximum recycled binder based on the PG binder.
- Changes the allowable substitute binders based on the recycled binder % and discharge temperature.
- Adds a note stating that no more than 20% recycled binder can be used when using the PG binder originally specified.

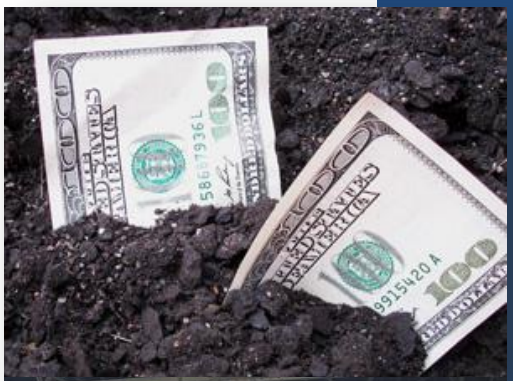


Table 5

Allowable Substitute PG Binders and Maximum Recycled Binder Ratios

Originally Specified PG Binder	Allowable Substitute PG Binder	Maximum Ratio of Recycled Binder to Total Binder (%)		
		Surface	Intermediate	Base
		HMA		
76-22[2]	70-22 or 64-22	20.0	20.0	20.0
	70-28 or 64-28	30.0	35.0	40.0
70-22[2]	64-22	20.0	20.0	20.0
	64-28 or 58-28	30.0	35.0	40.0
64-22[2]	58-28	30.0	35.0	40.0
76-28[2]	70-28 or 64-28	20.0	20.0	20.0
	64-34	30.0	35.0	40.0
70-28[2]	64-28 or 58-28	20.0	20.0	20.0
	64-34 or 58-34	30.0	35.0	40.0
64-28[2]	58-28	20.0	20.0	20.0
	58-34	30.0	35.0	40.0

Use no more than 20.0% recycled binder when using this originally specified PG binder.

Combined recycled binder from RAP and RAS

SS3224: 35%

SS3224: 40%

SS3224: 45%

Table 5
Allowable Substitute PG Binders and Maximum Recycled Binder Ratios

Originally Specified PG Binder	Allowable Substitute PG Binder	Maximum Ratio of Recycled Binder[1] to Total Binder (%)		
		Surface	Intermediate	Base
WMA[3]				
76-22[2]	70-22 or 64-22	30.0	35.0	40.0
70-22[2]	64-22 or 58-28	30.0	35.0	40.0
64-22[4]	58-28	30.0	35.0	40.0
76-28[2]	70-28 or 64-28	30.0	35.0	40.0
70-28[2]	64-28 or 58-28	30.0	35.0	40.0
64-28[4]	58-28	30.0	35.0	40.0

As defined in Section 3268.2.F.2, "Warm Mix Asphalt (WMA)."

When used with WMA, this originally specified PG binder is allowed for use at the maximum recycled binder ratios shown in this table.

RAP, RAS & WMA UPDATE

2013 HMA Specifications Update Conference

WMA APPROVAL REQUIREMENTS

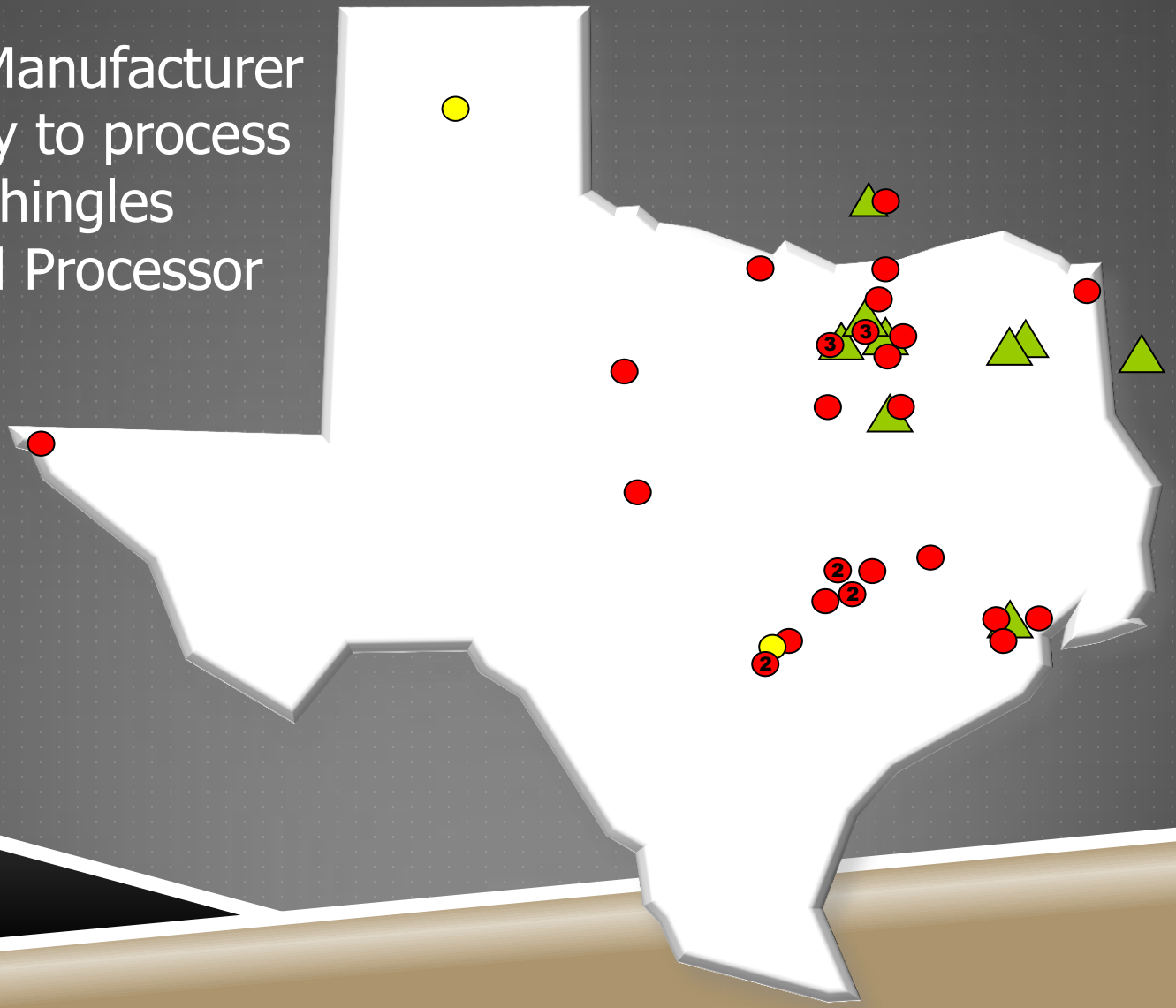
- Submit Project Documentation
  - From:
    - Three Projects
    - Preferably One with TxDOT
  - Include:
    - Mix Design
    - Mechanical Property Test Results
    - QC/QA Test Results
- Or Recognized by One of the Following Organizations
  - Federal Highway Administration (FHWA),
  - National Center for Asphalt Technology (NCAT),
  - National Asphalt Pavement Association (NAPA), or
  - Warm-Mix Technical Working Group (WMA - TWG)

REGULATIONS AND REQUIREMENTS

- Permit By Rule, 106.261 – Facilities (emissions limitations)
  - Form PI-7
- New Source Review Permit
  - Form PI-1
- TCEQ requirements
  - Asbestos Testing
  - Delivery Certification Forms
- DMS - 11000 - Nonhazardous Recyclable Materials
  - Chemical of Concern (COC)
  - NRM-2 and NRM-3 Forms
  - Prequalified Processor List
- Special Specification requirements
  - Gradation – 100% minus 3/8”
  - Deleterious Materials < 0.5%

PLANTS & PROCESSORS

- Shingle Manufacturer
- Capability to process asphalt shingles
- Removed Processor



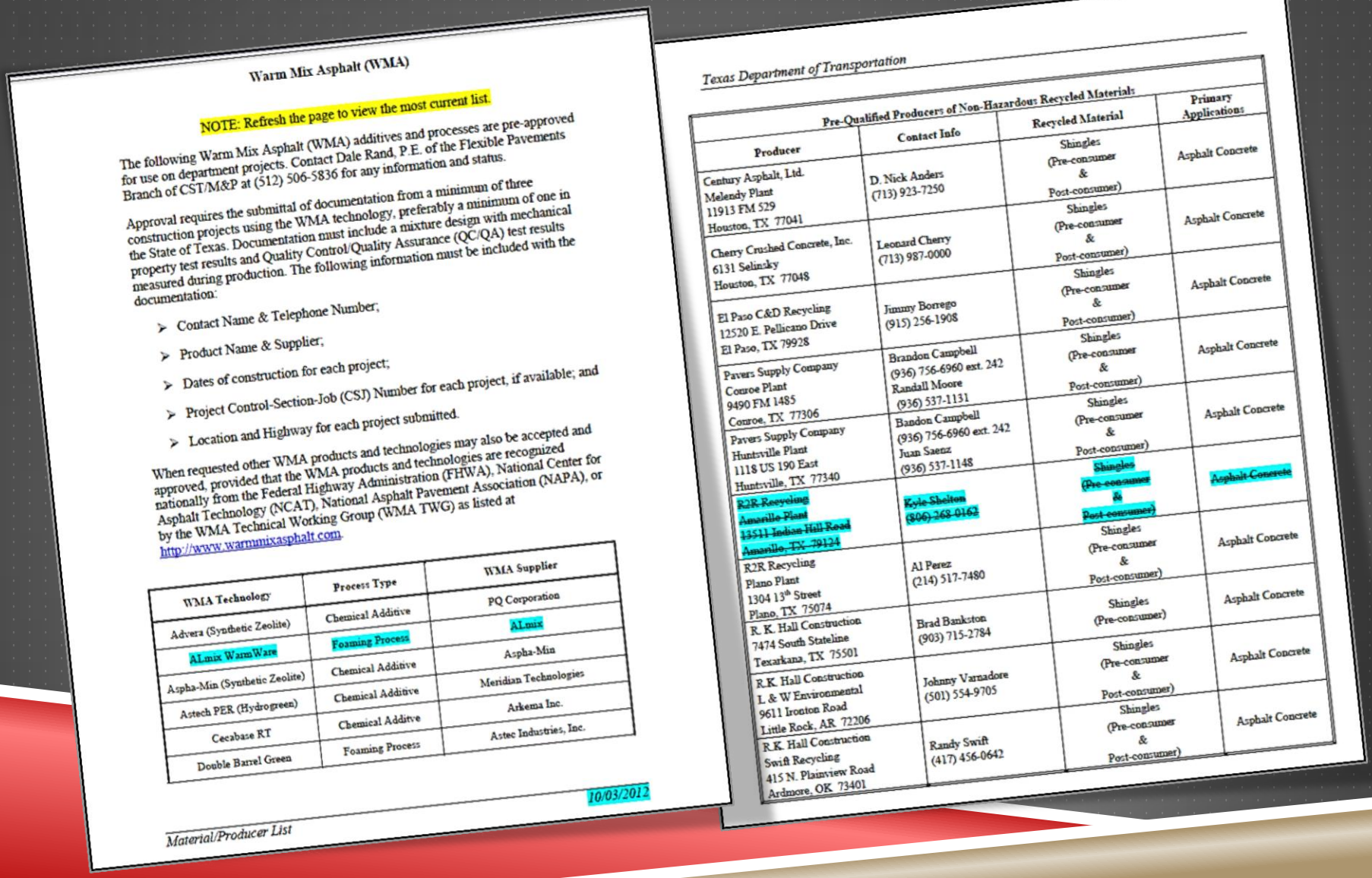
Small Business and Local Government Assistance

SMALL BUSINESS AND ENVIRONMENTAL ASSISTANCE DIVISION

Brian Christian
Division Director

Andy Gardner
Section Manager

APPROVED LISTS



Warm Mix Asphalt (WMA)

NOTE: Refresh the page to view the most current list.

The following Warm Mix Asphalt (WMA) additives and processes are pre-approved for use on department projects. Contact Dale Rand, P.E. of the Flexible Pavements Branch of CST/M&P at (512) 506-5836 for any information and status.

Approval requires the submittal of documentation from a minimum of three construction projects using the WMA technology, preferably a minimum of one in the State of Texas. Documentation must include a mixture design with mechanical property test results and Quality Control/Quality Assurance (QC/QA) test results measured during production. The following information must be included with the documentation:

- Contact Name & Telephone Number;
- Product Name & Supplier;
- Dates of construction for each project;
- Project Control-Section-Job (CSJ) Number for each project, if available; and
- Location and Highway for each project submitted.

When requested other WMA products and technologies may also be accepted and approved, provided that the WMA products and technologies are recognized nationally from the Federal Highway Administration (FHWA), National Center for Asphalt Technology (NCAT), National Asphalt Pavement Association (NAPA), or by the WMA Technical Working Group (WMA TWG) as listed at http://www.warmmixasphalt.com.

WMA Technology	Process Type	WMA Supplier
Advera (Synthetic Zeolite)	Chemical Additive	PQ Corporation
ALmix WarmWare	Foaming Process	ALmix
Aspha-Min (Synthetic Zeolite)	Chemical Additive	Aspha-Min
Astech PER (Hydrogreen)	Chemical Additive	Meridian Technologies
Cecabase RT	Chemical Additive	Arkema Inc.
Double Barrel Green	Foaming Process	Astec Industries, Inc.

Material/Producer List 10/03/2012

Texas Department of Transportation

Pre-Qualified Producers of Non-Hazardous Recycled Materials

Producer	Contact Info	Recycled Material	Primary Applications
Century Asphalt, Ltd. Melendy Plant 11913 FM 529 Houston, TX 77041	D. Nick Anders (713) 923-7250	Shingles (Pre-consumer & Post-consumer)	Asphalt Concrete
Cherry Crushed Concrete, Inc. 6131 Selinsky Houston, TX 77048	Leonard Cherry (713) 987-0000	Shingles (Pre-consumer & Post-consumer)	Asphalt Concrete
El Paso C&D Recycling 12520 E. Pellicano Drive El Paso, TX 79928	Jimmy Borrego (915) 256-1908	Shingles (Pre-consumer & Post-consumer)	Asphalt Concrete
Pavers Supply Company Conroe Plant 9490 FM 1485 Conroe, TX 77306	Brandon Campbell (936) 756-6960 ext. 242 Randall Moore (936) 537-1131	Shingles (Pre-consumer & Post-consumer)	Asphalt Concrete
Pavers Supply Company Huntsville Plant 1118 US 190 East Huntsville, TX 77340	Brandon Campbell (936) 756-6960 ext. 242 Juan Saenz (936) 537-1148	Shingles (Pre-consumer & Post-consumer)	Asphalt Concrete
R2R Receiving Amarillo Plant 13511 Indian Hill Road Amarillo, TX 79124	Kyle Shelton (806) 268-0162	Shingles (Pre-consumer & Post-consumer)	Asphalt Concrete
R2R Recycling Plano Plant 1304 13th Street Plano, TX 75074	Al Perez (214) 517-7480	Shingles (Pre-consumer & Post-consumer)	Asphalt Concrete
R.K. Hall Construction 7474 South Stateline Texarkana, TX 75501	Brad Bankston (903) 715-2784	Shingles (Pre-consumer)	Asphalt Concrete
R.K. Hall Construction L & W Environmental 9611 Ironton Road Little Rock, AR 72206	Johnny Varnadore (501) 554-9705	Shingles (Pre-consumer & Post-consumer)	Asphalt Concrete
R.K. Hall Construction Swift Recycling 415 N. Plainview Road Ardmore, OK 73401	Randy Swift (417) 456-0642	Shingles (Pre-consumer & Post-consumer)	Asphalt Concrete

RECYCLED MATERIALS TABLES

from Special Specifications

3267 & 3268 DENSE GRADED

Mixture Description & Location	Maximum Ratio of Recycled Binder to Total Binder (%)	Maximum Allowable Weight % (Percent by Weight of Total Mixture)		
		Unfractionated RAP	Fractionated RAP	RAS
Surface	20 (30[1])	10	20	5
Intermediate	20 (35[1])	10	30	5
Base	20 (40[1])	10	40	5

1. Allowed when using WMA or softer low temperature binder grade.

3269 PFC

Mixture Description & Location	Maximum Ratio of Recycled Binder to Total Binder (%)	Maximum Allowable Weight % (Percent by Weight of Total Mixture)		
		Unfractionated RAP	Fractionated RAP	RAS
Surface	15	0	10	5

3270 SUPERPAVE

Mixture Description & Location	Maximum Ratio of Recycled Binder to Total Binder (%)	Maximum Allowable Weight % (Percent by Weight of Total Mixture)		
		Unfractionated RAP	Fractionated RAP	RAS
Surface	20 (30[1])	10	20	5
Intermediate	20 (35[1])	10	25	5
Base	20 (40[1])	10	30	5

1. Allowed when using WMA or softer low temperature binder grade.

3271 SMA

Mixture Description & Location	Maximum Ratio of Recycled Binder to Total Binder (%)	Maximum Allowable Weight % (Percent by Weight of Total Mixture)		
		Unfractionated RAP	Fractionated RAP	RAS
Surface	15	0	15	5
Non-surface	20	0	20	5

SPECIFICATION CHANGES
REGARDING RAS, RAP & WMA

- During HMA production, use a separate cold feed bin for each stockpile of RAP and RAS.

SPECIFICATION CHANGES
REGARDING RAS, RAP & WMA

- ~~When WMA is specified on the plans, at the Contractor's request, the Engineer has the option to assign all sublots a production pay adjustment factor of 1.000.~~

PROJECT RECORDS & TESTING

	Mix Design	Trial Batch	Production
RAP	AC% & Gradation (SP) Decant & PI % Used	Recycled Binder Ratio (Mix)	Recycled Binder Ratio AC% & Gradation (SP) AC% > 0.5% Higher
RAS	Approved List Source Asbestos Test AC% & Gradation (SP) Deleterious % Used	Recycled Binder Ratio (Mix)	Recycled Binder Ratio AC% & Gradation (SP) AC% > 2.0% Higher
WMA	Approved List "Required or Allowed"	Additive or Process Rate Production Temp.	Production Temp.

Recycled Materials Blending Program - Dense Graded Mixes

Enter Fields Highlighted In Blue

Mixture Information

% Asphalt from JMF	5.0
Layer	Surface
Binder Grade	PG 70

Virgin Material Costs

	$ / Ton
Aggregate	12.00
PG 76	736.00
PG 70	688.00
PG 64	584.00
Other	642.00
Price / Ton of Mix	$ 45.80

Recycled Material Costs

		$ / Ton	% Asphalt
1)	Coarse RAP	15.00	4.0
2)	Fine RAP	20.00	6.0
3)	RAS	25.00	20.0

Blends

	Virgin	Blend 1	Blend 2	Blend 3	Blend 4
Binder Grade	PG 70	PG 64	PG 64	PG 64	Other
% Coarse RAP	0.0		20.0	10.0	16.0
% Fine RAP	0.0				
% RAS	0.0	5.0	0.0	3.0	4.0
% Recyled Material Limit			**20**		
% Recycled Binder	0.0	20.0	16.0	20.0	28.8
% Recycled Binder Limit			**30**		

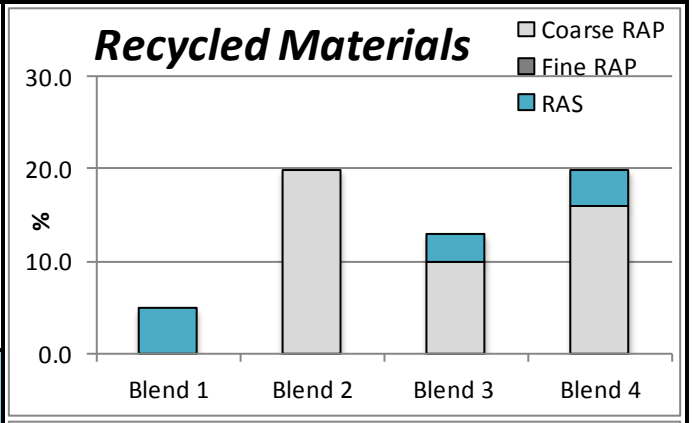
Economics (Mix Savings)

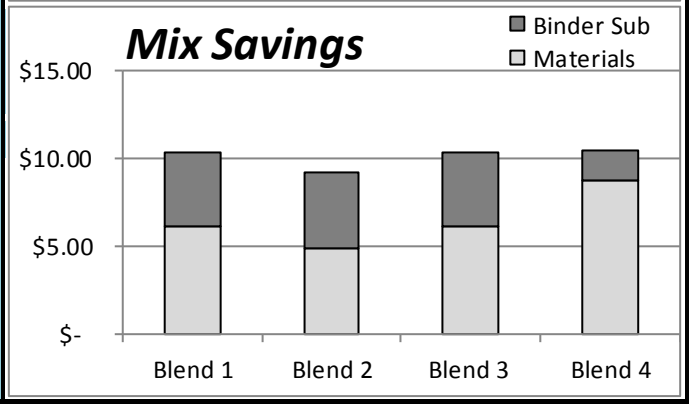
	Virgin	Blend 1	Blend 2	Blend 3	Blend 4
Recycle Material Savings	$ -	$ 6.11	$ 4.81	$ 6.07	$ 8.73
Binder Substitution Savings	$ -	$ 4.16	$ 4.37	$ 4.16	$ 1.64
Total Savings	$ -	$ 10.27	$ 9.18	$ 10.23	$ 10.37
Adjusted Price/Ton	$ 45.80	$ 35.53	$ 36.62	$ 35.57	$ 35.43

Economics (Value of Recycled Material)

(Replacement Value - Cost)

Coarse RAP	$ 24.04
Fine RAP	$ 32.56
RAS	$ 122.20





EFFECT OF ASPHALT PRICING (USING ADDITIONAL RECYCLED BINDER)

Original Substitute Binder (xx-22) 20% Recycled Binder ($/ton of AC)	$ 584	$ 584	$ 584
Alternate Substitute Binder (xx-28) 30% Recycled Binder ($/ton of AC)	$ 599	$ 609	$ 634
Cost Difference ($/ton of AC)	$ 15	$ 25	$ 50
Mix Savings ($/ton of mix)	**$ 11.90 ($ 1.67)**	**$ 11.55 ($ 1.32)**	**$ 10.66 ($ 0.43)**

Dense Graded – Surface Mixture

QUESTIONS?

1. What is the Maximum Allowed Ratio of Recycled Binder to Total Binder When Placing a Surface Mix with a Substitute PG 70-22 instead of a PG 76-22 Produced at a Temperature > 275°F with WMA?

a) 20%
b) 30%
c) 35%
d) 40%

2. **What is the Maximum Allowed Ratio of Recycled Binder to Total Binder When Placing a Surface Mix with a Substitute PG 70-22 instead of a PG 76-22 Produced at a Temperature < 275°F with WMA?**

a) 20%
b) 30%
c) 35%
d) 40%

Substitute Binders

- Adds the "Substitute Binders" Section.

H. **Substitute Binders.** Unless otherwise shown on the plans, the Contractor may use a substitute PG binder listed in Table 5 in lieu of the PG binder originally specified, if the substitute PG binder and mixture made with the substitute PG binder meet the following:

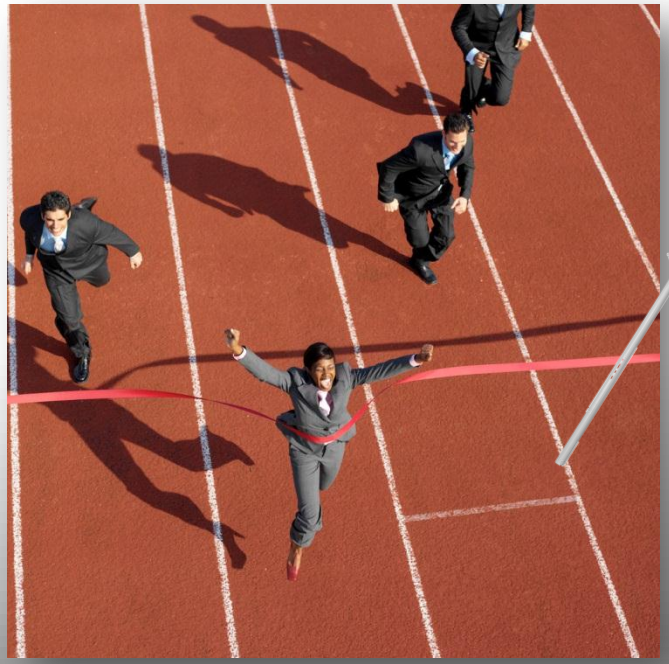
- the substitute binder meets the specification requirements for the substitute binder grade in accordance with Section 300.2.J, "Performance-Graded Binders";
- the substitute binder has an un-aged dynamic shear value less than or equal to 2.00 kPa and an RTFO aged dynamic shear value less than or equal to 5.00 kPa at the PG test temperature; and
- the mixture has less than 10.0 mm of rutting on the Hamburg Wheel test (Tex-242-F) after the number of passes required for the originally specified binder. Use of substitute PG binders may only be allowed at the discretion of the Engineer if the Hamburg Wheel test results are between 10.0 mm and 12.5 mm.

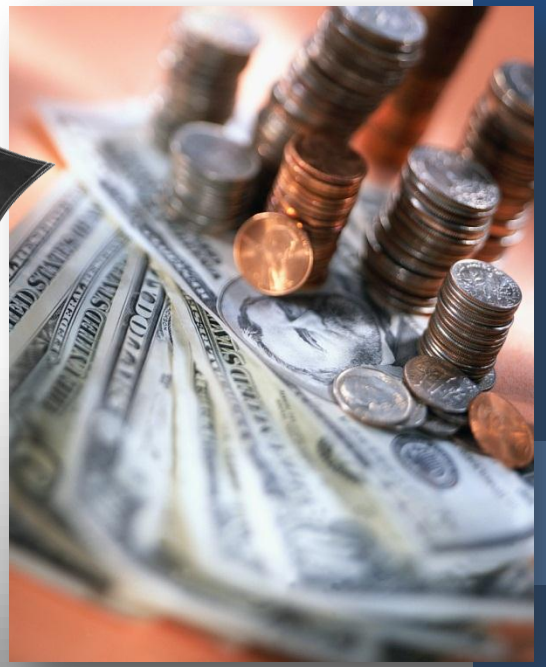
Construction

- Allows the Contractor to perform other QC tests in addition to the required tests.
- Allows the Engineer to perform production and placement tests as deemed necessary.

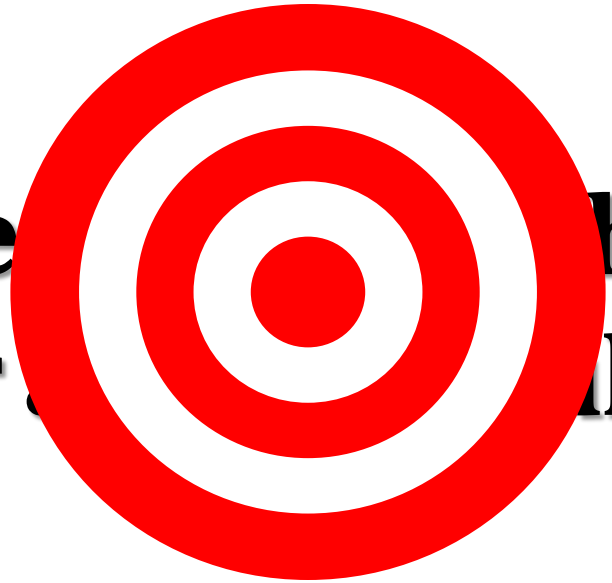
4. **Construction.** Produce, haul, place, and compact the specified paving mixture. In addition to tests required by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." On or before the first day of paving, it is mandatory to schedule and participate in a pre-paving meeting with the Engineer unless otherwise shown on the plans.

Preparing for Success
The Pre-Pave Meeting





For You Pe hat Do You Consider l Project?



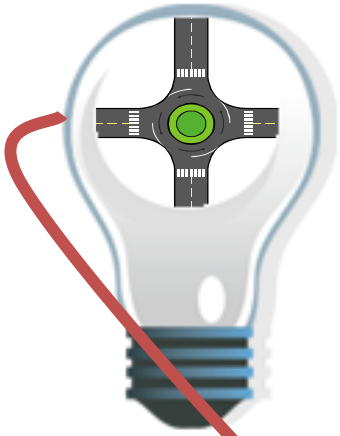
- Director(s) of Construction
  - “An incident free project constructed with the highest quality by the Inspector and Superintendent with minimal management involvement”.
  - Safely built for our employees, contractor’s employees and the traveling public.
  - No outstanding claims or disputes.
  - Rides good, looks pretty and uniform.
  - Completed on time.

- District Lab Engineer(s)
  - Everyone (TxDOT, Contractor & Traveling Public) goes home safely, uninjured and without incident, we accomplished our first goal of success.
  - If both TxDOT and Contractor can walk away from a project after a conscience effort of partnering, and believe their best efforts were given, which resulted in a final product with long-term performance, then everyone (Taxpayers, TxDOT and Contractors) profits and benefits.

- TxDOT Technician(s)
  - One that the traveling public is satisfied.
  - All of the parameters were accomplished to the standards as set forth by the department.

A project cannot be a success until all that are involved have a similar attitude, working in one accord (TxDOT and Contractor) to achieve the common goal of producing the best product achievable.

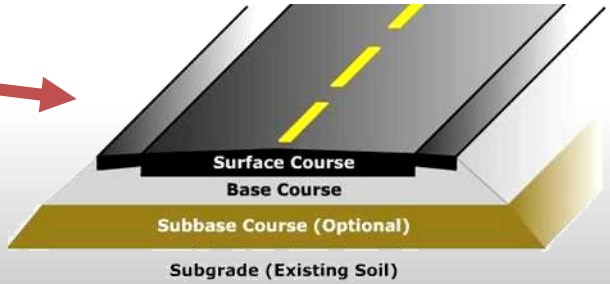
THE PLANNING PROCESS



Identify Need for Roadway Project

Type of Project

Project Planning



Pavement Design

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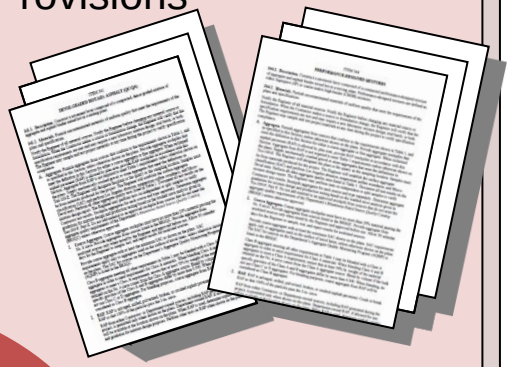
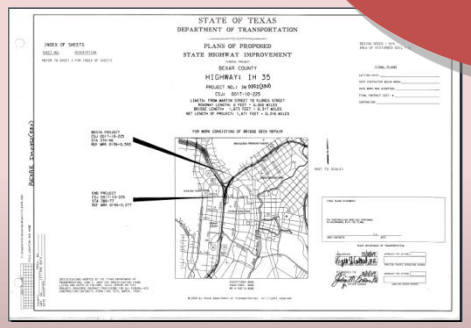
Decision Making Tools

Standard Specifications

Special Provisions

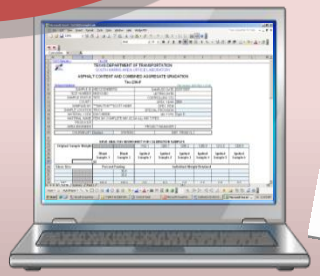


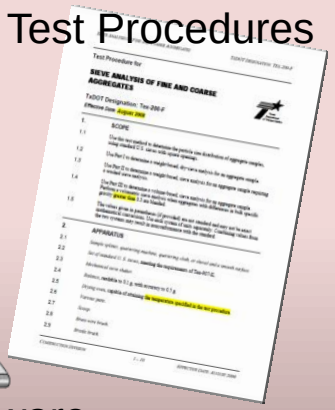
Special Specifications



Contract Plans & General Notes

Test Procedures





Department Software

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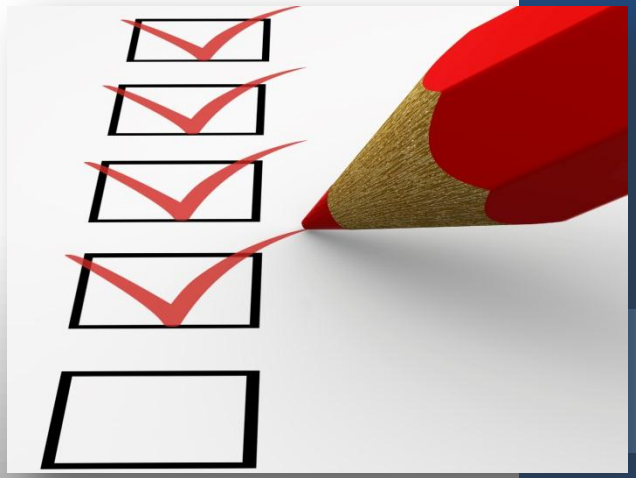
Pre-Pave Meeting

Pre-Pave Meeting

- Suggested Topics for Discussion
  - Project Specific Issues
  - Time Specific Issues
  - General Notes
  - WMA, RAP, RAS
  - Binder Substitution – Hamburg Requirement
  - Lab Density Changes
  - Correction Factors
  - Lot Sizes
  - Tack Coat – Type and Rate
  - Pave-IR
  - Sample Custody
  - Reporting & Documentation
  - SP to Item 6 –Contract Lab Option



Pre-Pave Meeting

- Have the Right People Involved
  - People that are on the actual project
  - People that are responsible for executing the project
  - People that have decision-making rights

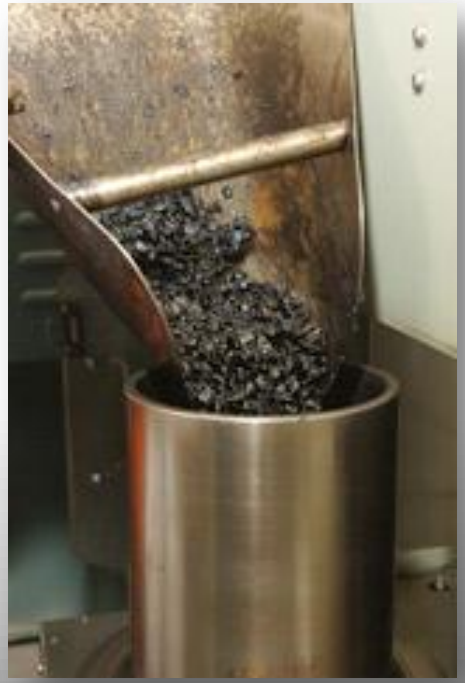
- Time Specific Issues
  - Day vs. night work
  - Allowable work hours
  - Date specific milestone for the project

- General Notes
  - Is there anything special in the general notes that are not common
  - If so, make sure everyone is on the same page
  - Let your people know

WMA, RAP, RAS

- Are mix designs submitted and approved?
- Has trial batch been performed and approved?

- Lab Density Changes
  - 96.5% or has it been adjusted?
  - Is this change reflected in the mix design?



- Correction Factors
  - Tex-204-F – requires washed gradations
  - Specification allows dry gradations
  - Specification requires correction factors
  - You are correlating a washed gradation to a dry gradation

Tack Coat – Type and Rate

- What are we using and how much?
- Does it correlate with the conditions of the existing surface?
- Is a special tack coat required or allowed?

- Pave-IR
  - For specification compliance or a compaction tool for the contractor?

- Sample Custody
  - Use Department's protocol

Reporting & Documentation

- Maximum time to exchange test data
  - Production – 1 Working Day of completion of sublot
  - Placement – 1 Working Day of completion of lot
    - In Place Density – 1 Working Day* of receipt of trimmed cores

* 2 Days are Allowed if Cores Cannot Be Dried to Constant Weight Within 1 Day

- Reporting & Documentation
  - Do it in accordance with the Specification

BECAUSE . . .

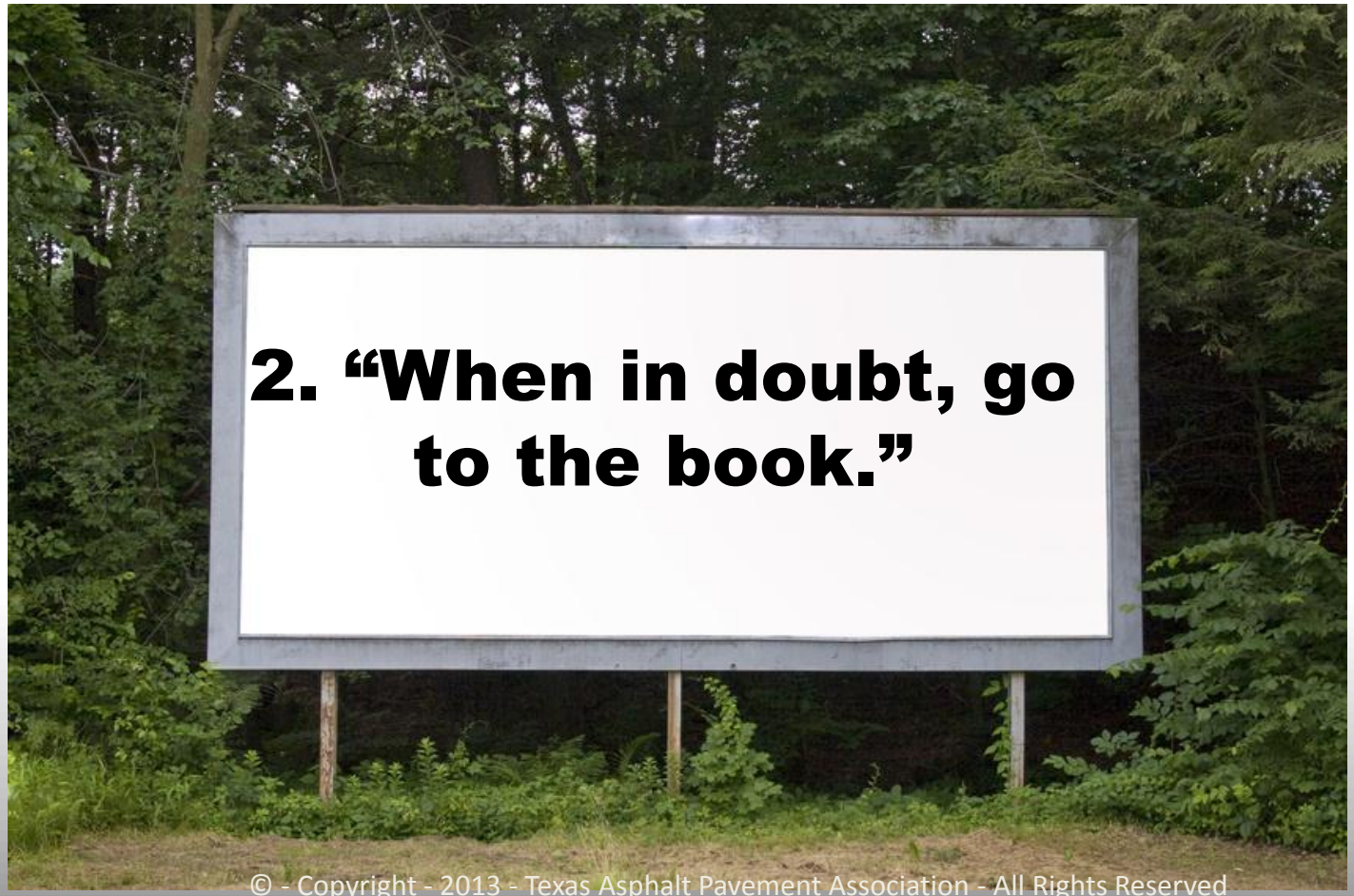
- Payment
  - Applicable Pay Adjustment Bonuses Will Only be Paid for Sublots When the Contractor Supplies the Engineer with the Required Documentation for Production and Placement QC/QA, Thermal Profiles, Segregation Density Profiles and Longitudinal Joint Density in Accordance with Section 3268 4. B., “Reporting and Responsibilities”.

Using a Commercial Testing Lab

- Special Provision 006-047 – Control of Materials
  - Article 6.4. Sampling, Testing and Inspection
  - Meet With Engineer and Choose
  - Either Department or Department-Selected Commercial Lab (CL)
  - Project Level Sampling and Testing
  - Selection May Be Test by Test

KEYS TO A SUCCESSFUL PROJECT

KEYS TO A SUCCESSFUL PROJECT



KEYS TO A SUCCESSFUL PROJECT

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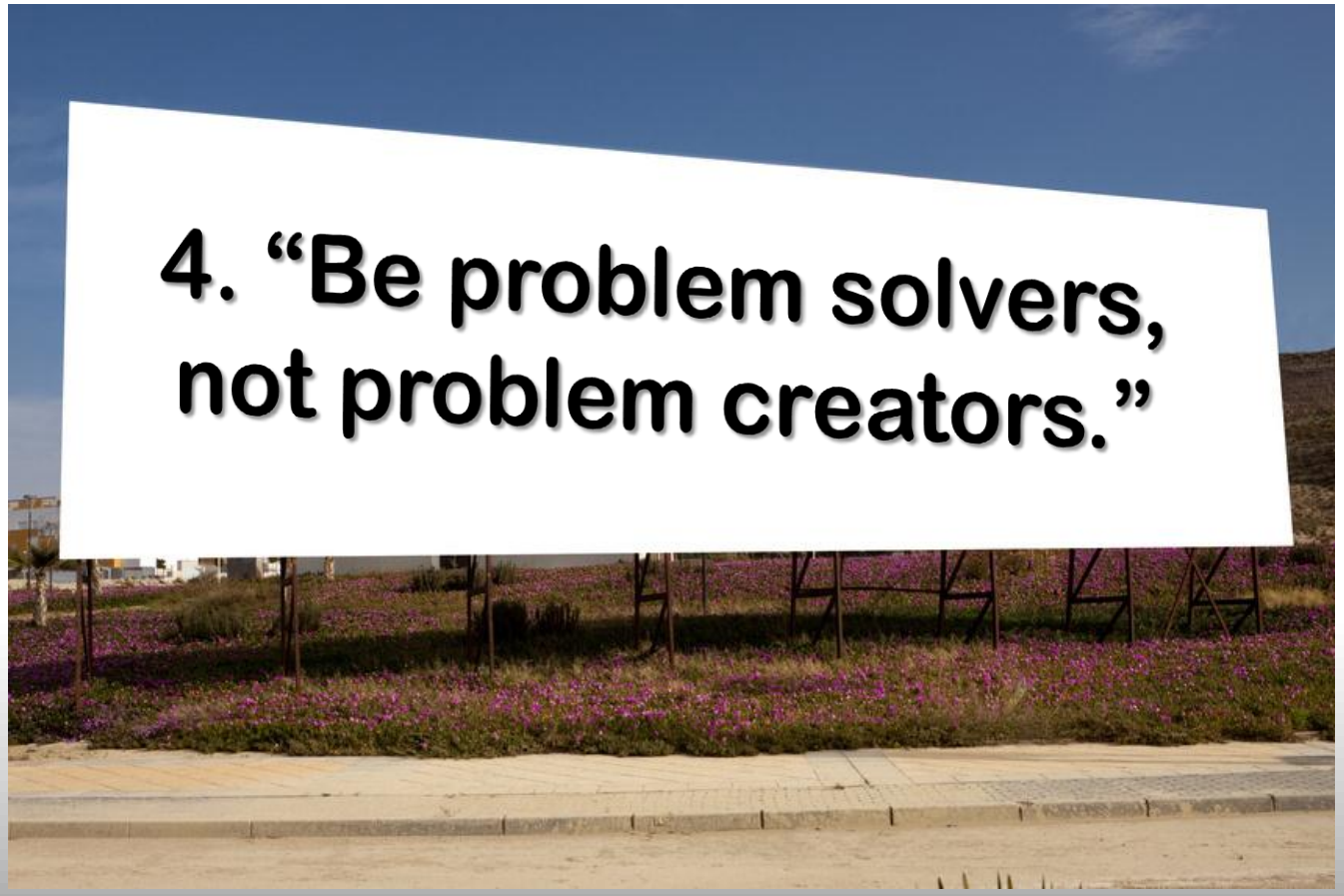
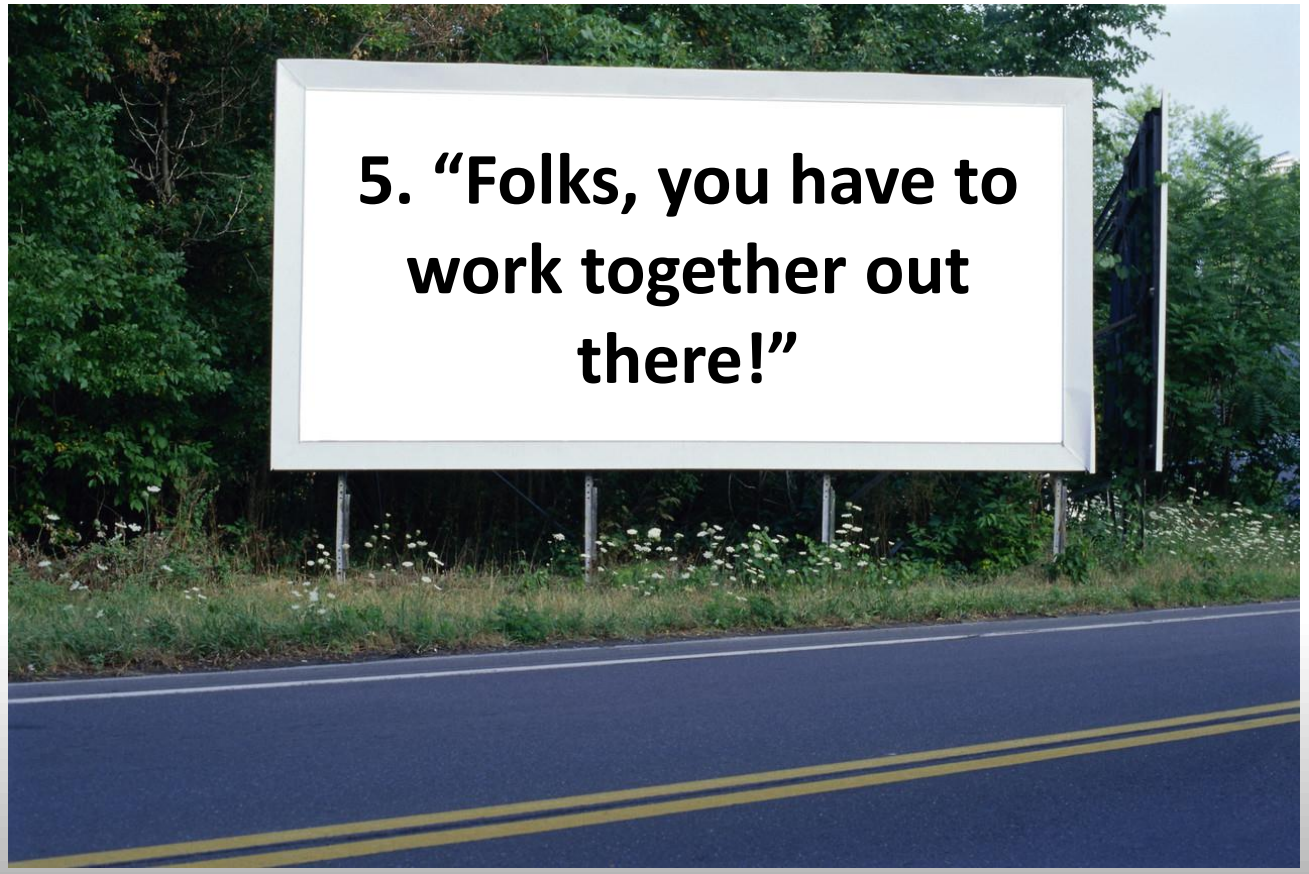
KEYS TO A SUCCESSFUL PROJECT



KEYS TO A SUCCESSFUL PROJECT



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STAY SAFE !!!

Certification

(Table 6)

- Requires that a level 1A technician performs the deleterious and decantation testing.
- Removes the tack coat adhesion test from the spec.
- Requires the profiler and operator to be certified in order to perform ride quality measurements when Test Type B is specified.

SS3224: Level 2

Reporting and Responsibilities

- Adds the "Reporting and Responsibilities" Section.
- Requires using the Department-provided Excel templates for reporting.

B. Reporting and Responsibilities. **Use Department-provided Excel templates to record and calculate all test data including but not limited to mixture design, production and placement QC/QA, control charts, thermal profiles, segregation density profiles, and longitudinal joint density.** Obtain the latest version of the Excel templates at http://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. The maximum allowable time for the Contractor and Engineer to exchange test data is as given in Table 7 unless otherwise approved. The Engineer and the Contractor will immediately report to the other party any test result that requires suspension of production or placement, a payment penalty, or that fails to meet the specification requirements. **Record and submit all test results and pertinent information on Department-provided Excel templates to the Engineer electronically by means of a portable USB flash drive, compact disc, or via email.**

Reporting and Responsibilities

- Requires reporting placement quality control test results within 1 working day of completion of the lot.

SS3224: Reported at the completion of each lot.

Table 7
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Quality Control			
Gradation[1] Asphalt content[1] Laboratory-molded density[2] Moisture content[3] Boil test[3]	Contractor	Engineer	1 working day of completion of the sublot
Production Quality Assurance			
Gradation[3] Asphalt content[3] Laboratory-molded density[1] Hamburg wheel test[2] Boil test[3] Binder tests[2]	Engineer	Contractor	1 working day of completion of the sublot
Placement Quality Control			
In-place air voids[2] Segregation[1] Longitudinal joint density[1] Thermal profile[1]	Contractor	Engineer	1 working day of completion of the lot
Placement Quality Assurance			
In-place air voids[1] Segregation[2] Longitudinal joint density[2] Thermal profile[2] Aging ratio[2]	Engineer	Contractor	1 working day of receipt of the trimmed cores for in-place air voids[4]
Pay adjustment summary	Engineer	Contractor	2 working days of performing all required tests and receiving Contractor test data

1. These tests are required on every sublot.
2. Optional test. To be reported as soon as results become available.
3. To be performed at the frequency specified on the plans.
4. 2 days are allowed if cores cannot be dried to constant weight within 1 day.

Quality Control Plan

- Requires including copies of certification documents.

1. **Project Personnel.** For project personnel, include:
   - a list of individuals responsible for QC with authority to take corrective action;
   - contact information for each individual listed; and
   - **copies of certification documents for individuals performing specified QC functions.**

- Requires including a proposed paving plan.

5. **Placement and Compaction.** For placement and compaction, include:
   - proposed agenda for mandatory pre-paving meeting, including date and location;
   - **proposed paving plan (e.g., paving widths and lift thicknesses);**

Mixture Design

- Allows increasing the target lab-molded density (TGC) and reducing the Ndesign level (SGC) at the Contractor's discretion.

a. **Target Laboratory Molded Density When The TGC Is Used.** Design the mixture at a 96.5% target laboratory-molded density or as noted in Table 9. **The target laboratory-molded density may be increased in 0.5% increments, not to exceed 97.0%, at the Contractor's discretion.**

b. **Design Number of Gyrations (Ndesign) When The SGC Is Used.** Design the mixture at 50 gyrations (Ndesign). Use a target laboratory-molded density of 96.0% to design the mixture; however, adjustments can be made to the Ndesign value as noted in Table 9. **The Ndesign level may be reduced to no less than 35 gyrations at the Contractor's discretion.**

Mixture Design

- Requires including the AC and aggregate gradation of RAP and RAS stockpiles in the mixture design report.

Provide the Engineer with a mixture design report using the Department-provided Excel template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- **asphalt content and aggregate gradation of RAP and RAS stockpiles;**
- the target laboratory-molded density (or Ndesign level when using the SGC);
- results of all applicable tests;
- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

4. What is the Tolerance on the Maximum Sieve Size?

a) ± 2%
b) ± 5%
c) 98% Passing
d) No Tolerance

Mixture Design

- Identifies the maximum sieve size for each mix type.

Table 8
Master Gradation Limits (% Passing by Weight or Volume) and VMA Requirements

Sieve Size	A Coarse Base	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture
2"	**100.0[1]**	–	–	–	–
1-1/2"	98.0–100.0	**100.0[1]**	–	–	–
1"	78.0–94.0	98.0–100.0	**100.0[1]**	–	–
3/4"	64.0–85.0	84.0–98.0	95.0–100.0	**100.0[1]**	–
1/2"	50.0–70.0	–	–	98.0–100.0	**100.0[1]**
3/8"	–	60.0–80.0	70.0–85.0	85.0–100.0	98.0–100.0
#4	30.0–50.0	40.0–60.0	43.0–63.0	50.0–70.0	70.0–90.0
#8	22.0–36.0	29.0–43.0	32.0–44.0	35.0–46.0	38.0–48.0
#30	8.0–23.0	13.0–28.0	14.0–28.0	15.0–29.0	12.0–27.0
#50	3.0–19.0	6.0–20.0	7.0–21.0	7.0–20.0	6.0–19.0
#200	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0
Design VMA, % Minimum					
–	12.0	13.0	14.0	15.0	16.0
Production (Plant-Produced) VMA, % Minimum					
–	11.0	12.0	13.0	14.0	15.0

1. Defined as maximum sieve size. No tolerance allowed.

Master Gradation Limits – Type D Mix

Sieve Size	1982 Specification	1993 Specification	2004 Specification	SS3224	SS3268
1"			–	–	–
3/4"			–	100.0	100.0[1]
1/2"	100.0	100.0*	98.0–100.0	98.0–100.0	98.0–100.0
3/8"	85.0–100.0	85.0–100.0	85.0–100.0	85.0–100.0	85.0–100.0
NOTES:	No mention of any tolerance	*A tolerance of 2 percent is allowed on the sieve size for each mixture type which shows 100 percent passing.	No upper limit mentioned	No mention of any tolerance	1. Defined as maximum sieve size. No tolerance allowed.

Mixture Design

(Table 9)

- Allows adjusting the target lab density (TGC) when shown on the plans or specification or when mutually agreed between the Engineer and Contractor.
- Allows adjusting Ndesign when mutually agreed between the Engineer and Contractor.
- Allows the Engineer to accept IDT results exceeding 200 psi if the Hamburg rut depth is greater than 3.0mm and less than 12.5 mm.

Mixture Design

Table 9
Laboratory Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, % (TGC)	Tex-207-F	96.5[1]
Design gyrations (Ndesign for SGC)	Tex-241-F	50[2]
Indirect tensile strength (dry), psi	Tex-226-F	85–200[3]
Boil test[4]	Tex-530-C	–

1. May be adjusted in 0.5% increments within a range of 96.0% to 97.5% when shown on the plans or specification or when mutually agreed between the Engineer and Contractor.
2. May be adjusted within a range of 35–100 gyrations when shown on the plans or specification or when mutually agreed between the Engineer and Contractor.
3. The Engineer may allow the IDT strength to exceed 200 psi if the corresponding Hamburg Wheel rut depth is greater than 3.0 mm and less than 12.5 mm.
4. Used to establish baseline for comparison to production results. May be waived when approved.

SS3224: 97.0%

SS3224: 4.00 mm

Mixture Design

- Allows the Engineer to increase the target lab density (TGC) or lower the Ndesign level when the Hamburg rut depth is less than 3 mm.

Table 10
Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Test Method	Minimum # of Passes[1] @ 12.5 mm[2] Rut Depth, Tested @ 50°C
PG 64 or lower	Tex-242-F	10,000
PG 70		15,000
PG 76 or higher		20,000

1. May be decreased or waived when shown on the plans.
2. When the rut depth at the required minimum number of passes is less than 3 mm, the Engineer may require the Contractor to increase the target laboratory-molded density (TGC) by 0.5% to no more than 97.5% or lower the Ndesign level (SGC) to no less than 35 gyrations.

Job-Mix Formula Approval

- Requires the trial batch and any adjusted JMF to meet the allowable amount of recycled material and the recycled binder ratio.
- Allows the Engineer to accept test results from a recent production in lieu of a new trial batch.

(8) **Trial Batch Production.** Upon receiving conditional approval of JMF1 and authorization from the Engineer to produce a trial batch, provide a plant-produced trial batch, including the WMA additive or process, if applicable, for verification testing of JMF1 and development of JMF2. Produce a trial batch mixture that meets the requirements in Table 4, Table 5, and Table 11. In lieu of a new trial batch, the Engineer may accept test results from recent production of the same mixture.

SPECIFICATION CHANGES
REGARDING RAS, RAP & WMA

- **JMF Adjustments.** If necessary, adjust the JMF before beginning a new lot. The adjusted JMF must:
  - be provided to the Engineer in writing before the start of a new lot;
  - be numbered in sequence to the previous JMF;
  - meet the mixture requirements in Table 4 and Table 5;
  - meet the master gradation limits shown in Table 6; and
  - be within the operational tolerances of JMF2 listed in Table 9.

Production Operations

- Requires a new mix design and trial batch if the measured AC of the RAP and RAS stockpiles are higher than the reported values.

E. **Production Operations.** Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification. **Submit a new mix design and perform a new trial batch when the asphalt content of:**

- **either RAP stockpile used in the mix is more than 0.5% higher than the value shown on the mixture design report; or**
- **RAS stockpile used in the mix is more than 2.0% higher than the value shown on the mixture design report.**

Placement Operations

- Requires the Contractor to collect haul tickets from each load.
- Requires recording the temperature of the mixture and the station number or GPS coordinates on each ticket.

G. **Placement Operations.** Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed by the Engineer. **When the Pave-IR system is not used for specification compliance, use a non-contact infrared thermometer to measure and record the internal temperature of the mixture as discharged from the truck or material transfer device prior to or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket.** Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

5. When Using a Pave-IR System for Specification Compliance, the Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 32°F; however, the Engineer may restrict the Contractor from paving surface mixtures…

a) if the ambient temperature is likely to drop below 32°F within 12 hours of paving.
b) if the surface temperature is likely to drop below 32°F within 12 hours of paving.

Weather Conditions

- Allows the Engineer to restrict the Contractor from paving due to weather conditions.

1. Weather Conditions.

   a. **When Using a Pave-IR System for Specification Compliance.** The Contractor may pave any time the roadway is dry and the roadway surface temperature is at least 32°F; however, the Engineer may restrict the Contractor from paving surface mixtures if the ambient temperature is likely to drop below 32°F within 12 hours of paving. Operate the Pave-IR system in accordance with Tex-244-F and demonstrate to the Engineer that no recurring severe thermal segregation exists. Provide the Engineer with the automated report described in Tex-244-F on a daily basis unless otherwise directed.

   b. **When Not Using a Pave-IR System for Specification Compliance.** Place mixture when the roadway surface temperature is equal to or higher than the temperatures listed in Table 13 unless otherwise approved or as shown on the plans. Measure the roadway surface temperature with a handheld infrared thermometer. The Engineer may allow mixture placement to begin prior to the roadway surface reaching the required temperature requirements, if conditions are such that the roadway surface will reach the required temperature within 2 hours of beginning placement operations. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the Engineer. The Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hours of paving.

Thermal Profile

- No longer allows waiving the thermal profile.
- Requires the Engineer to test at least once per project.
- Requires providing documentation for every sublot.

3. Lay-Down Operations.

a. Thermal Profile. Use a thermal camera or an infrared thermometer to obtain thermal profiles on each sublot in accordance with Tex-244-F. **When the Pave-IR system is not used for specification compliance, the Engineer will obtain a thermal profile at least once per project.** Thermal profiles are not applicable in areas described in Section 3268.4.I.3.a(4), "Miscellaneous Areas."

Within 1 working day of the completion of each lot, provide the Engineer with the thermal profile of every sublot within the lot. Report the results of each thermal profile in accordance with Section 3268.4.B, "Reporting and Responsibilities."

Thermal Profile – Pave-IR System

- Addresses the Contractor using the system for specification compliance or for informational only.

(3) **Use of the Pave-IR System.** In lieu of obtaining thermal profiles on each sublot using a thermal camera or an infrared thermometer, the Contractor may use the Pave-IR system (paver mounted infrared bar) to obtain a continuous thermal profile in accordance with Tex-244-F. **When electing to use the Pave-IR system, notify the Engineer prior to beginning placement operations and specify if using the Pave-IR system for specification compliance or for information only. When electing to use the Pave-IR system for information only, use a thermal camera or an infrared thermometer to obtain thermal profiles in accordance with Tex-244-F. When electing to use the Pave-IR system for information only, segregation density profiles are applicable.**

Thermal Profile – Pave-IR System

- Stipulates reporting requirements.

Modify the paving process as necessary to eliminate any recurring (moderate or severe) thermal segregation identified by the Pave-IR system. The Engineer may suspend paving operations if the Contractor cannot successfully modify the paving process to eliminate recurring severe thermal segregation. Density profiles are not required and are not applicable when using the Pave-IR system for specification compliance. **Upon completion of use of the Pave-IR system for specification compliance or as requested by the Engineer, provide the Engineer with electronic copies of all daily data files that can be used with the Pave-IR system software to generate temperature profile plots.**

Thermal Segregation

- Segregation (both physical and thermal) significantly reduces the performance of asphalt pavements
- Segregation still remains one of if not the #1 preventable cause of premature failures in asphalt pavements
- Knowing you have a problem is the first step to solving it and the Pave-IR is the best available technology to identify segregation

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The Value of Thermal Imaging

What Can You See?

- With the Handheld Infrared Thermometer
- Thermal Imaging Camera
- Paver Mounted Infrared Bar

What are the Benefits?

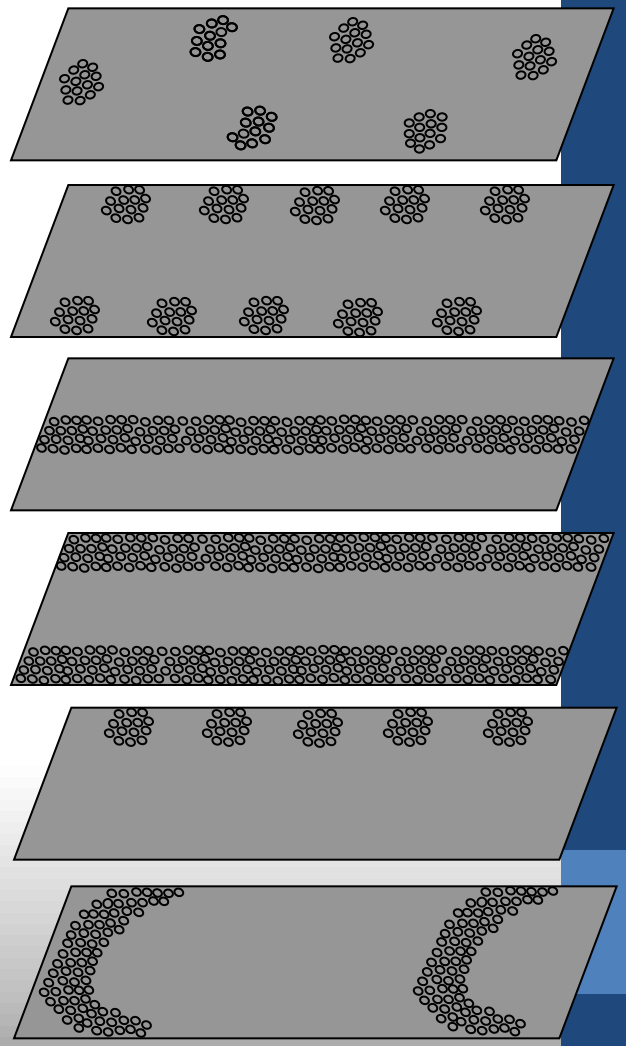
- With the Handheld Infrared Thermometer
- Thermal Imaging Camera
- Paver Mounted Infrared Bar

- Thermal Segregation can be an Indicator of
  - Low Densities
  - Physical Segregation
  - Irregularities
  - Affect Ride Quality

SEGREGATION

TYPES

- random
- each side (evenly spaced)
- centerline
- each side (continuous)
- one side
- end of load

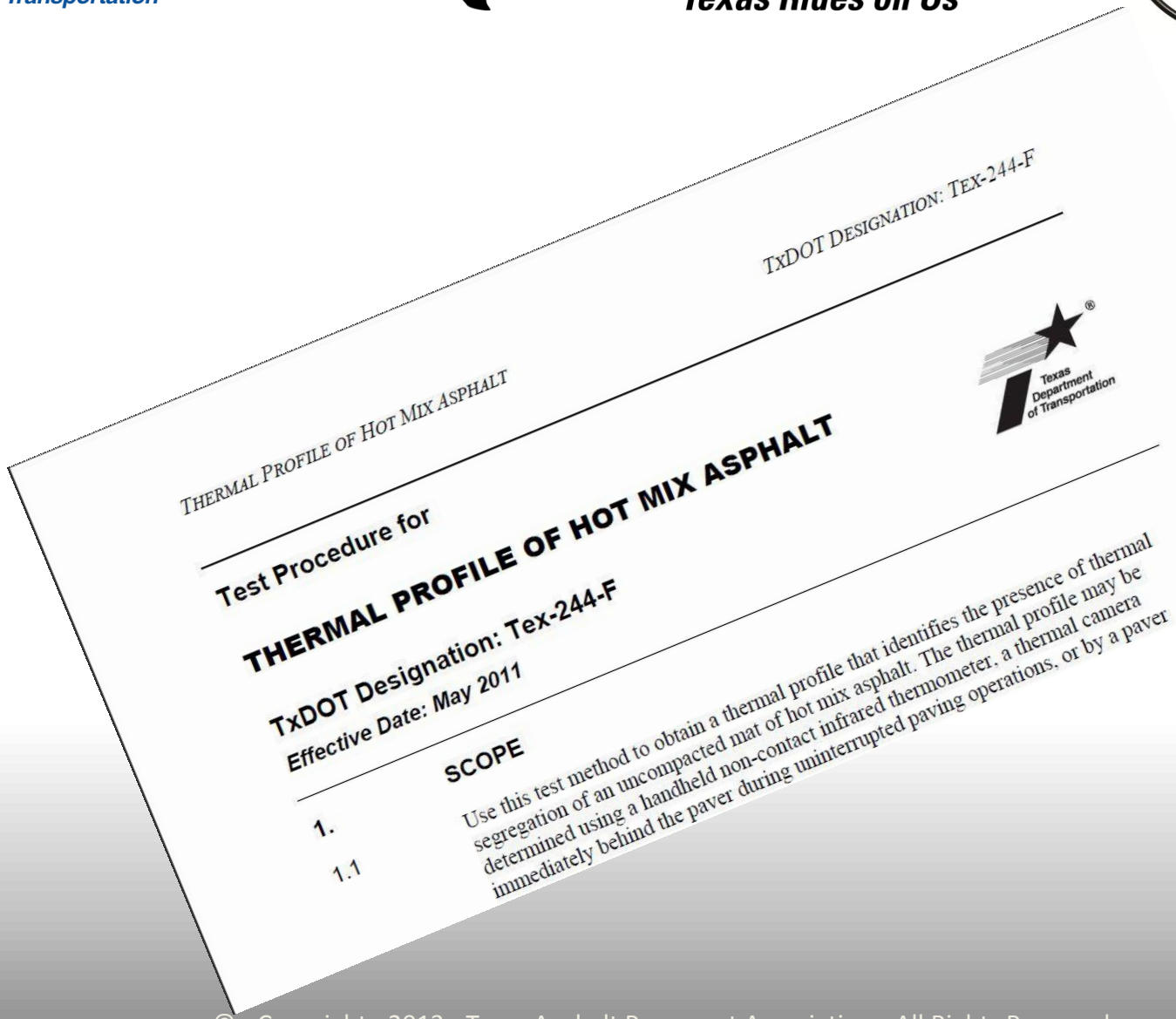


Possible Causes

- Segregated Stockpiles at the Plant
- Varying Moisture in the Stockpiles
- Inconsistent Plant Operations (TPH)
- Inconsistent Trucking
- Lack of Tarps
- End of Load Segregation
- Stop & Start Paving
- Dumping of Wings

Classification of Thermal Segregation

None	Moderate	Severe
0° - 25°	**25.1° - 50°**	**> 50°**



THERMAL PROFILE OF HOT MIX ASPHALT

TXDOT DESIGNATION: TEX-244-F

Test Procedure for

THERMAL PROFILE OF HOT MIX ASPHALT

TxDOT Designation: Tex-244-F

Effective Date: May 2011

SCOPE

1. Use this test method to obtain a thermal profile that identifies the presence of thermal segregation of an uncompacted mat of hot mix asphalt. The thermal profile may be determined using a handheld non-contact infrared thermometer, a thermal camera immediately behind the paver during uninterrupted paving operations, or by a paver

1.1

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20 ft. 130 ft.

313°

288°

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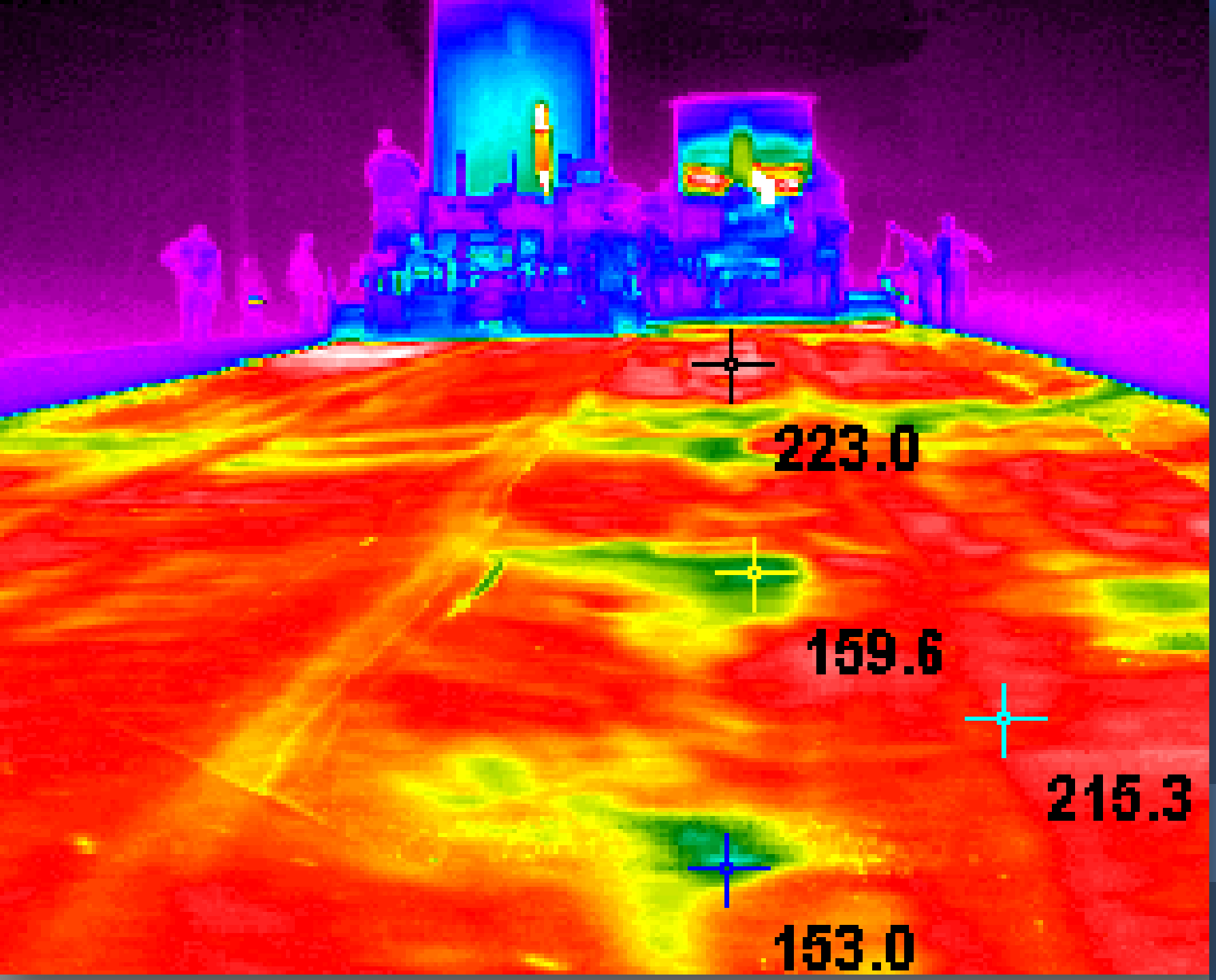
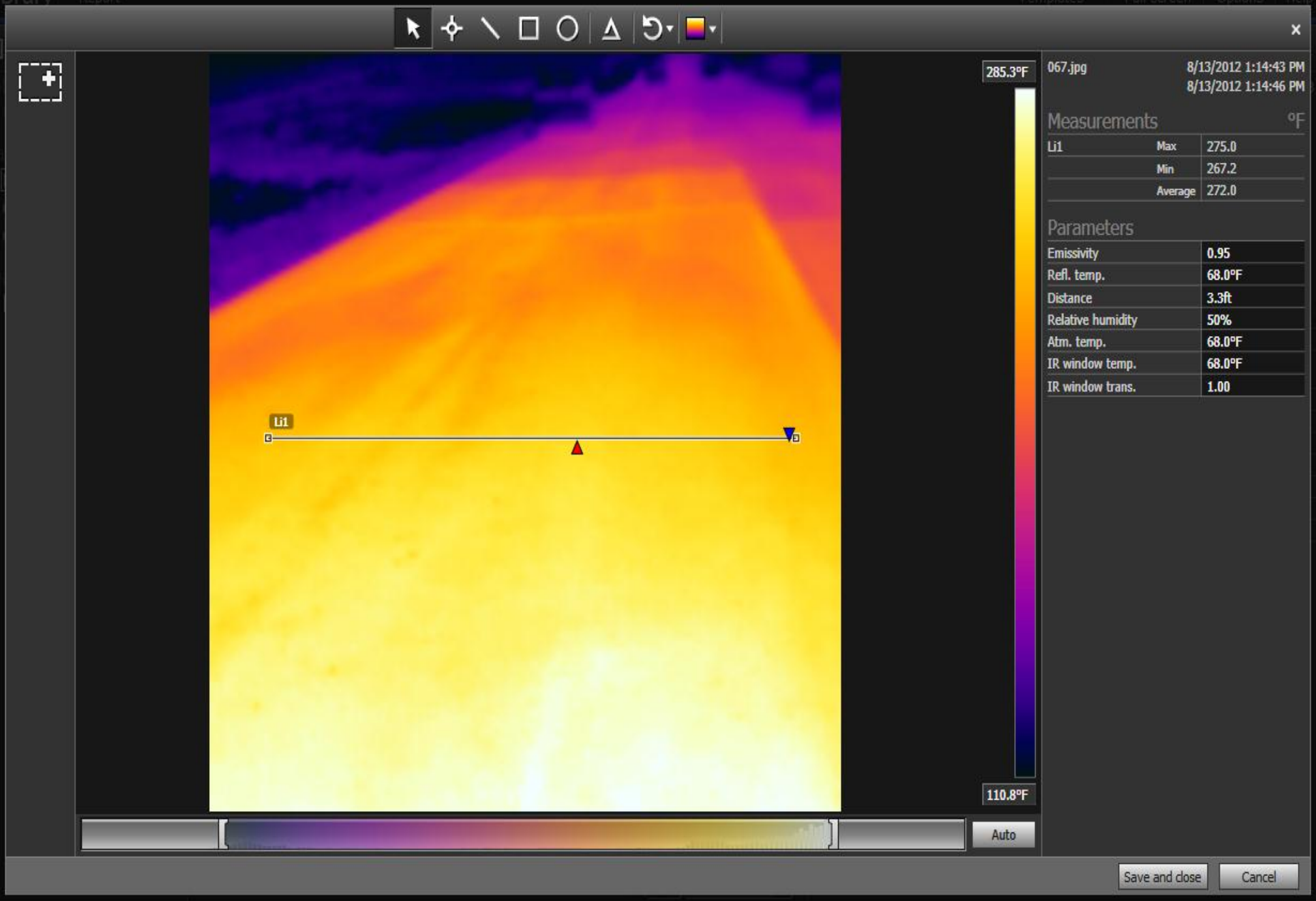

223.0
159.6
215.3
153.0

FLIR Tools

Library Report Templates Full screen Options Help



067.jpg
8/13/2012 1:14:43 PM
8/13/2012 1:14:46 PM

Measurements °F

Li1	Max	275.0
	Min	267.2
	Average	272.0

Parameters

Emissivity	0.95
Refl. temp.	68.0°F
Distance	3.3ft
Relative humidity	50%
Atm. temp.	68.0°F
IR window temp.	68.0°F
IR window trans.	1.00

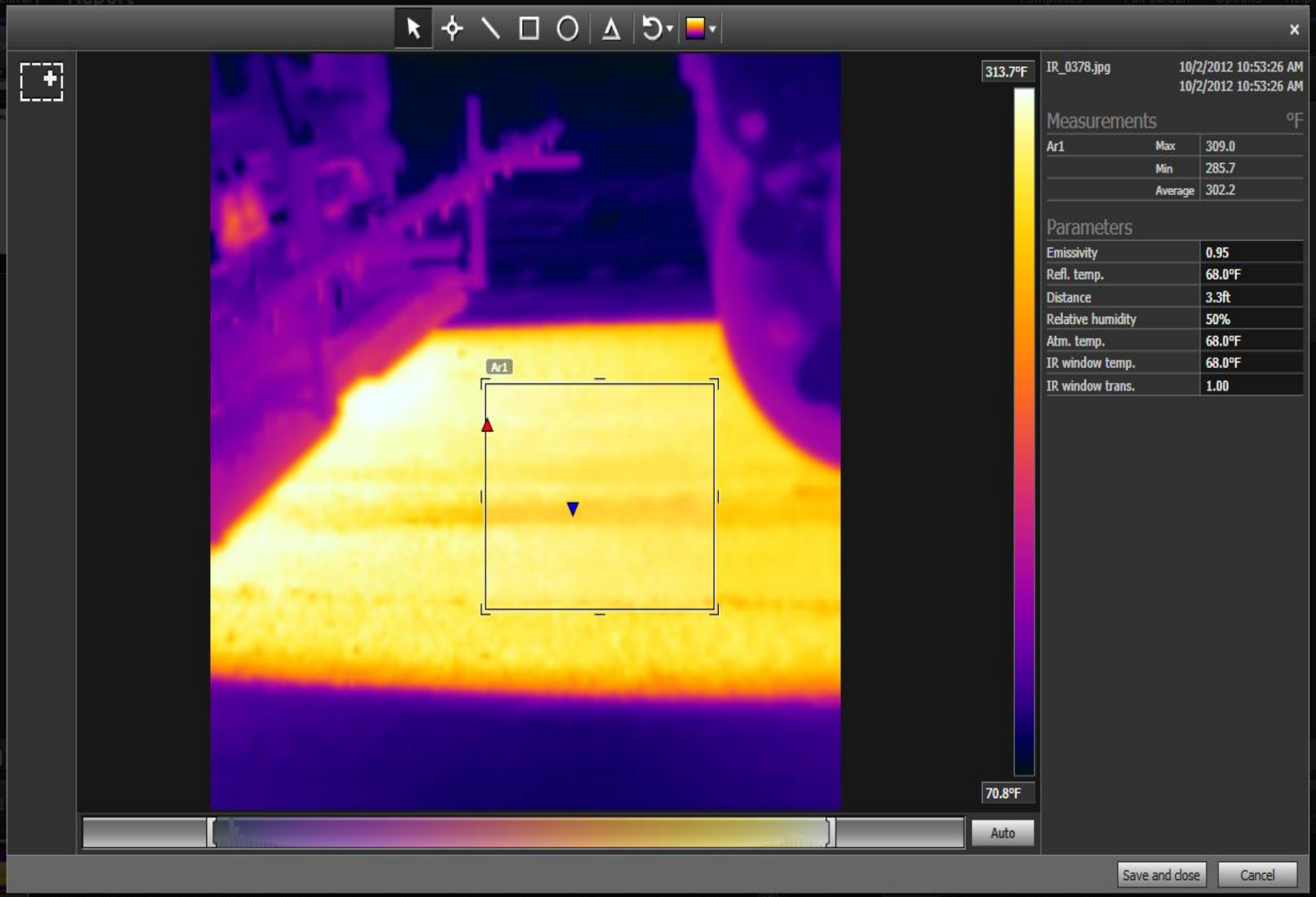
Save and close Cancel

25 items (1 selected)

Start 3:01 PM

FLIR Tools

Library Report Templates Full screen Options Help



IR_0378.jpg
10/2/2012 10:53:26 AM
10/2/2012 10:53:26 AM

Measurements °F

Ar1	Max	309.0
	Min	285.7
	Average	302.2

Parameters

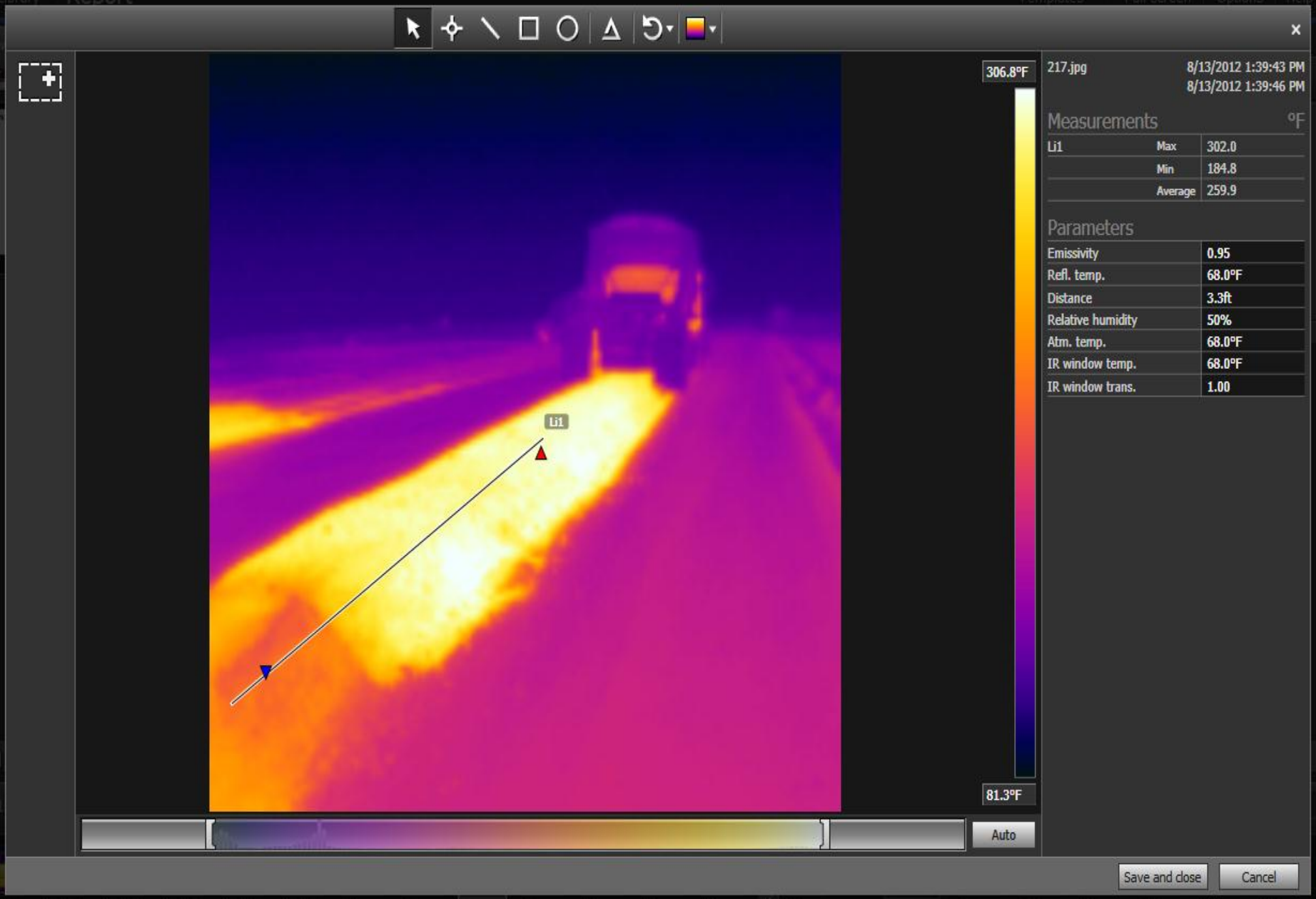
Emissivity	0.95
Refl. temp.	68.0°F
Distance	3.3ft
Relative humidity	50%
Atm. temp.	68.0°F
IR window temp.	68.0°F
IR window trans.	1.00

Save and close Cancel

Start 3:17 PM

FLIR Tools

Library Report Templates Full screen Options Help



217.jpg
8/13/2012 1:39:43 PM
8/13/2012 1:39:46 PM

Measurements °F

Li1	Max	302.0
	Min	184.8
	Average	259.9

Parameters

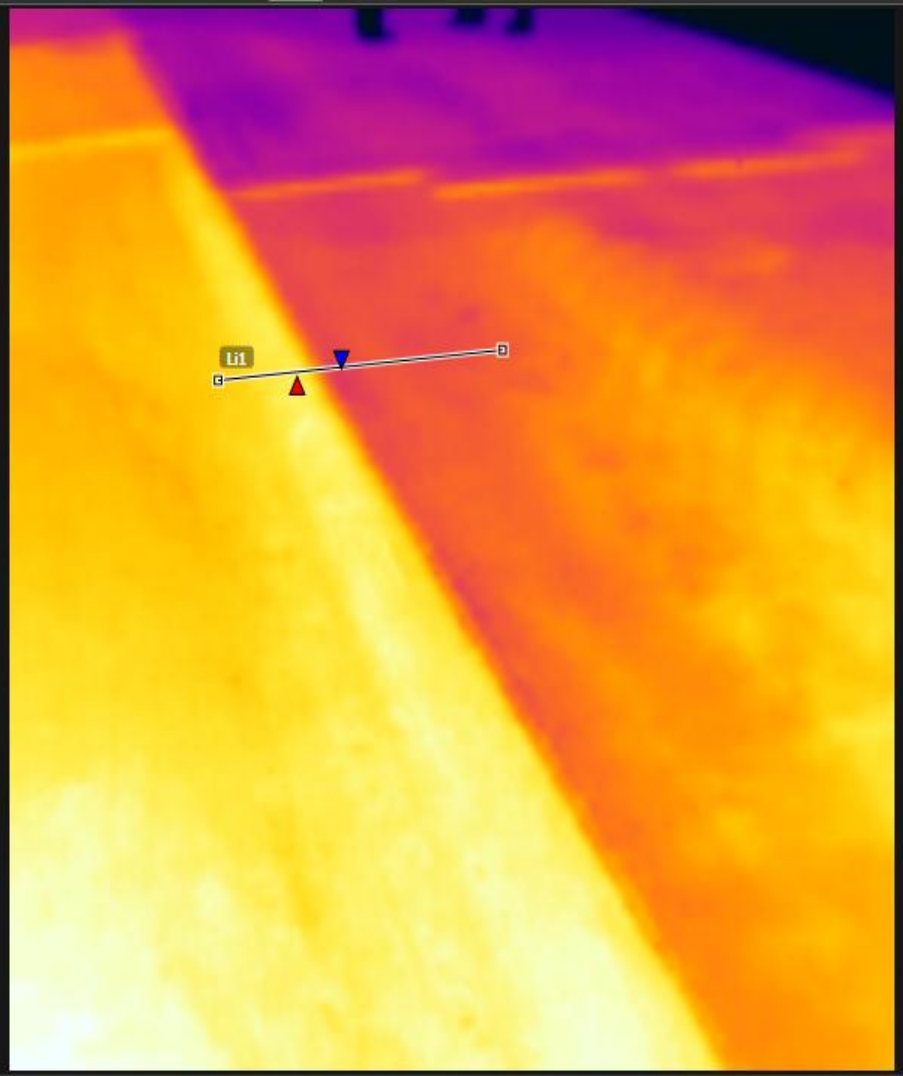
Emissivity	0.95
Refl. temp.	68.0°F
Distance	3.3ft
Relative humidity	50%
Atm. temp.	68.0°F
IR window temp.	68.0°F
IR window trans.	1.00

Save and close Cancel

Start 3:21 PM

FLIR Tools

Library Report Templates Full screen Options Help



282.1°F

140.4°F

Auto

259.jpg 8/13/2012 1:13:31 PM
8/14/2012 9:58:06 AM

Measurements °F

Li1	Max	275.1
	Min	246.1
	Average	257.7

Parameters

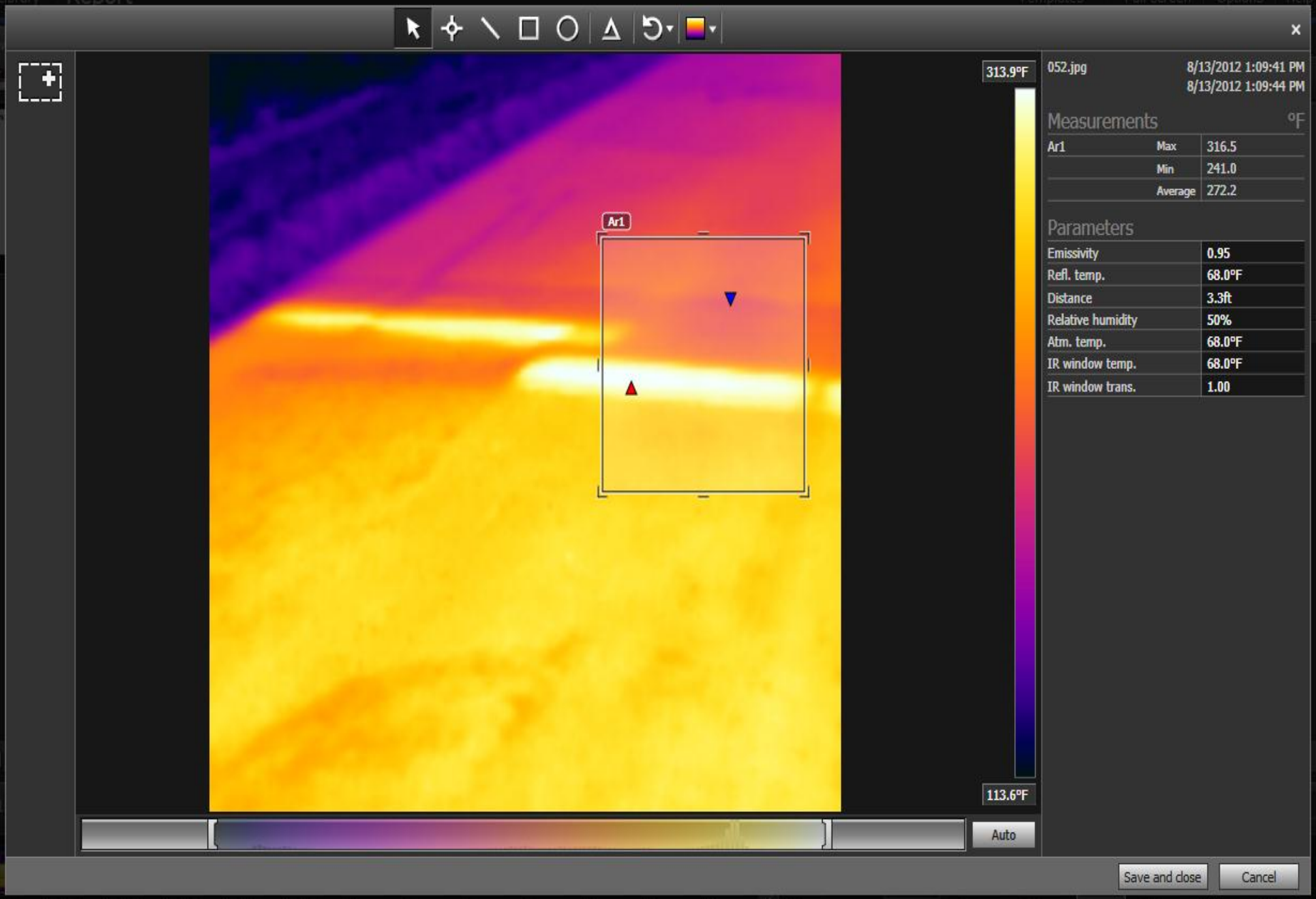
Emissivity	0.95
Refl. temp.	68.0°F
Distance	3.3ft
Relative humidity	50%
Atm. temp.	68.0°F
IR window temp.	68.0°F
IR window trans.	1.00

Save and close Cancel

Start 3:25 PM

FLIR Tools

Library Report Templates Full screen Options Help



052.jpg
8/13/2012 1:09:41 PM
8/13/2012 1:09:44 PM

Measurements °F

Ar1	Max	316.5
	Min	241.0
	Average	272.2

Parameters

Emissivity	0.95
Refl. temp.	68.0°F
Distance	3.3ft
Relative humidity	50%
Atm. temp.	68.0°F
IR window temp.	68.0°F
IR window trans.	1.00

Save and close Cancel

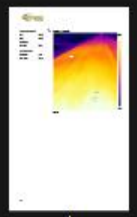
Start 3:27 PM

FLIR Tools

Library | Report | Templates | Full screen | Options | Help

New Report 1

Export | Print



1

Click to add header

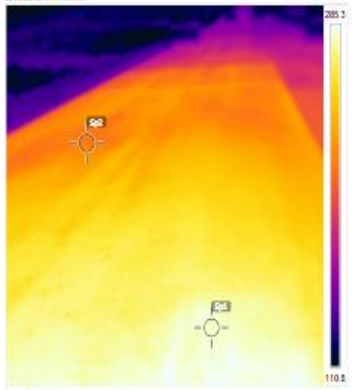
Measurements °F

Sp1	283.4
Sp2	252.8
Difference	
Sp1-Sp2	30.6

Parameters

Emissivity	0.95
Refl. temp	68 °F

8/13/2012 1:14:43 PM



067.jpg

Page setup

Page size: A4

Logo

Browse... | Use default

Object details

Page 1 of 1

50%

8/13/2012 - 10/2/2012

Search in library

Start

3:15 PM

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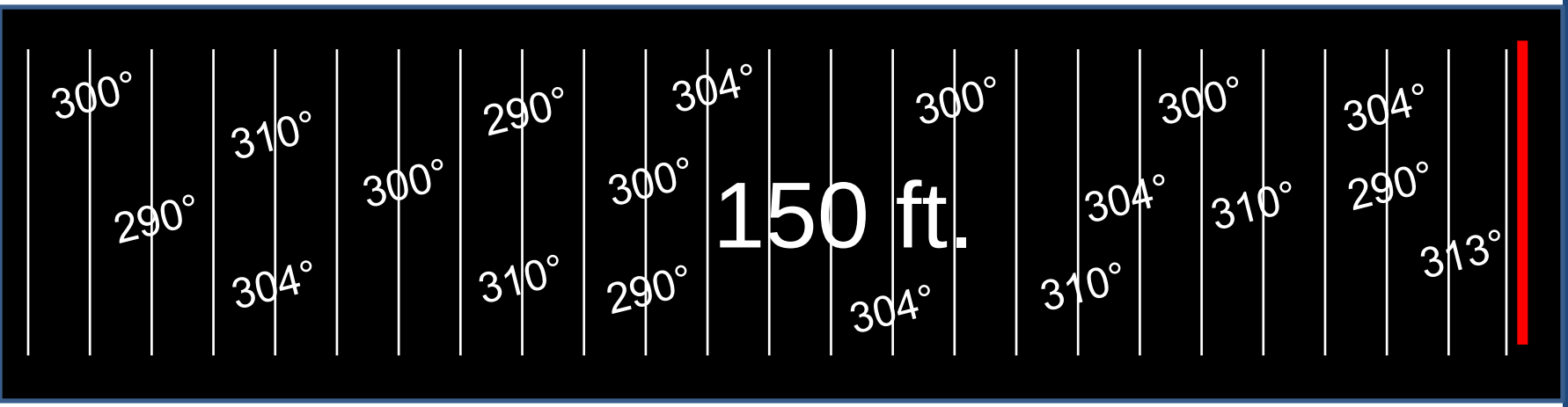
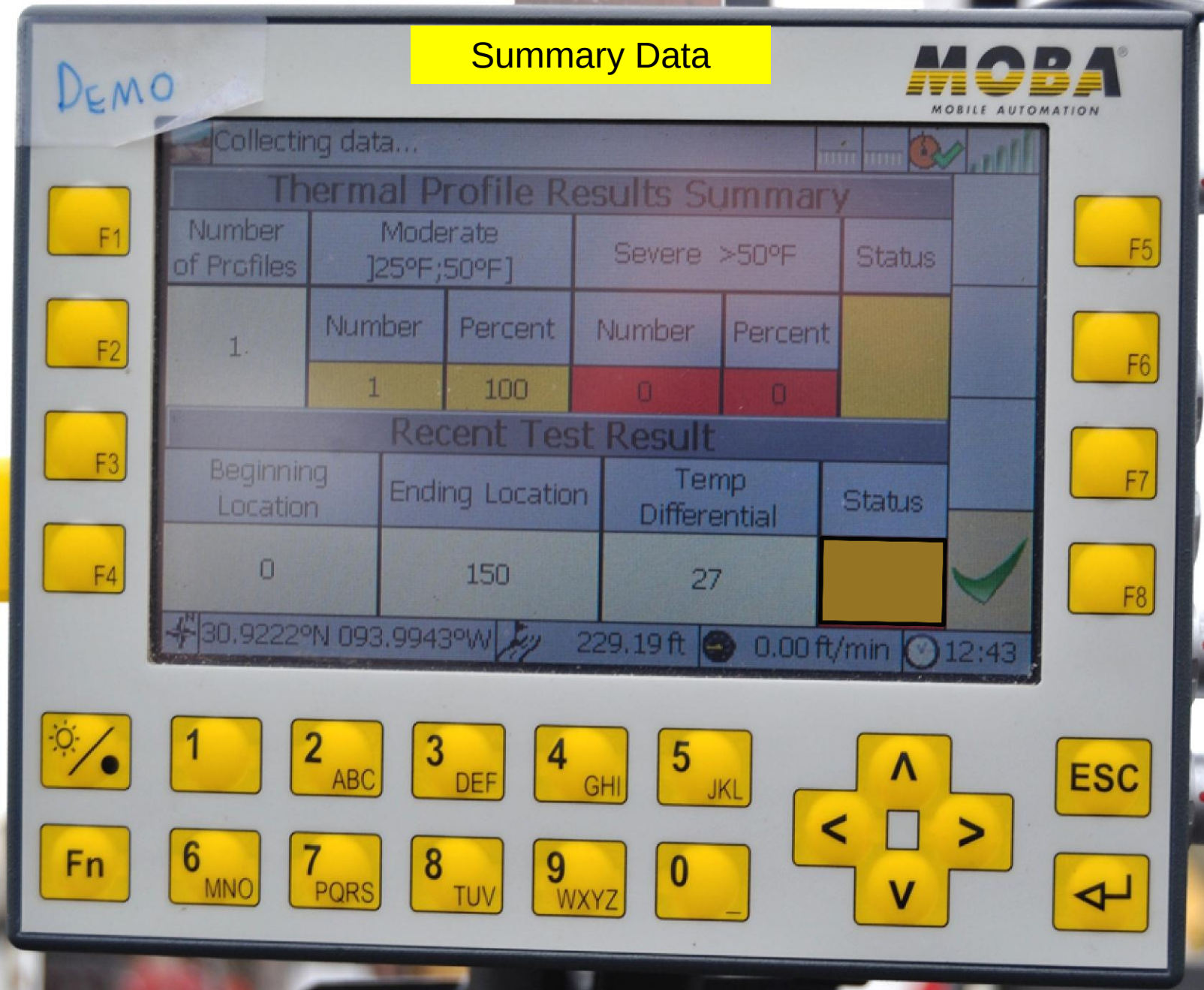
PAVE-IR System



Summary Data



Thermal Profile Results Summary

Number of Profiles	Moderate 25 °F < differential ≤ 50 °F		Severe differential > 50 °F		Status
	Number	Percent	Number	Percent	
50	10	20	5	10	

Recent Test Result

Beginning Location	Ending Location	Temp Differential	Status
5550	5700	22	

Pave Project Manager - Pave_20092491337.log

File View Report Help

Co...

347°F

203°F

Thermal Profile

0.00ft 9970.15ft

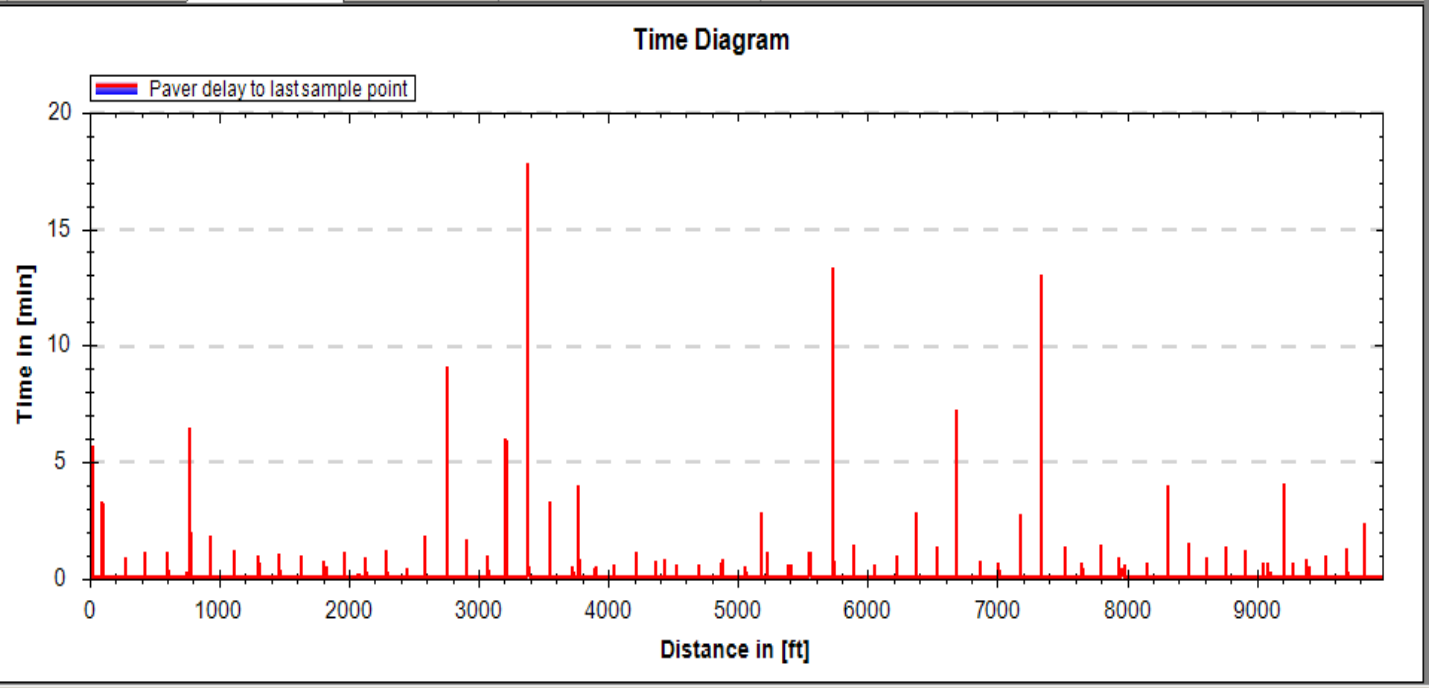
Properties

Thermal Profile

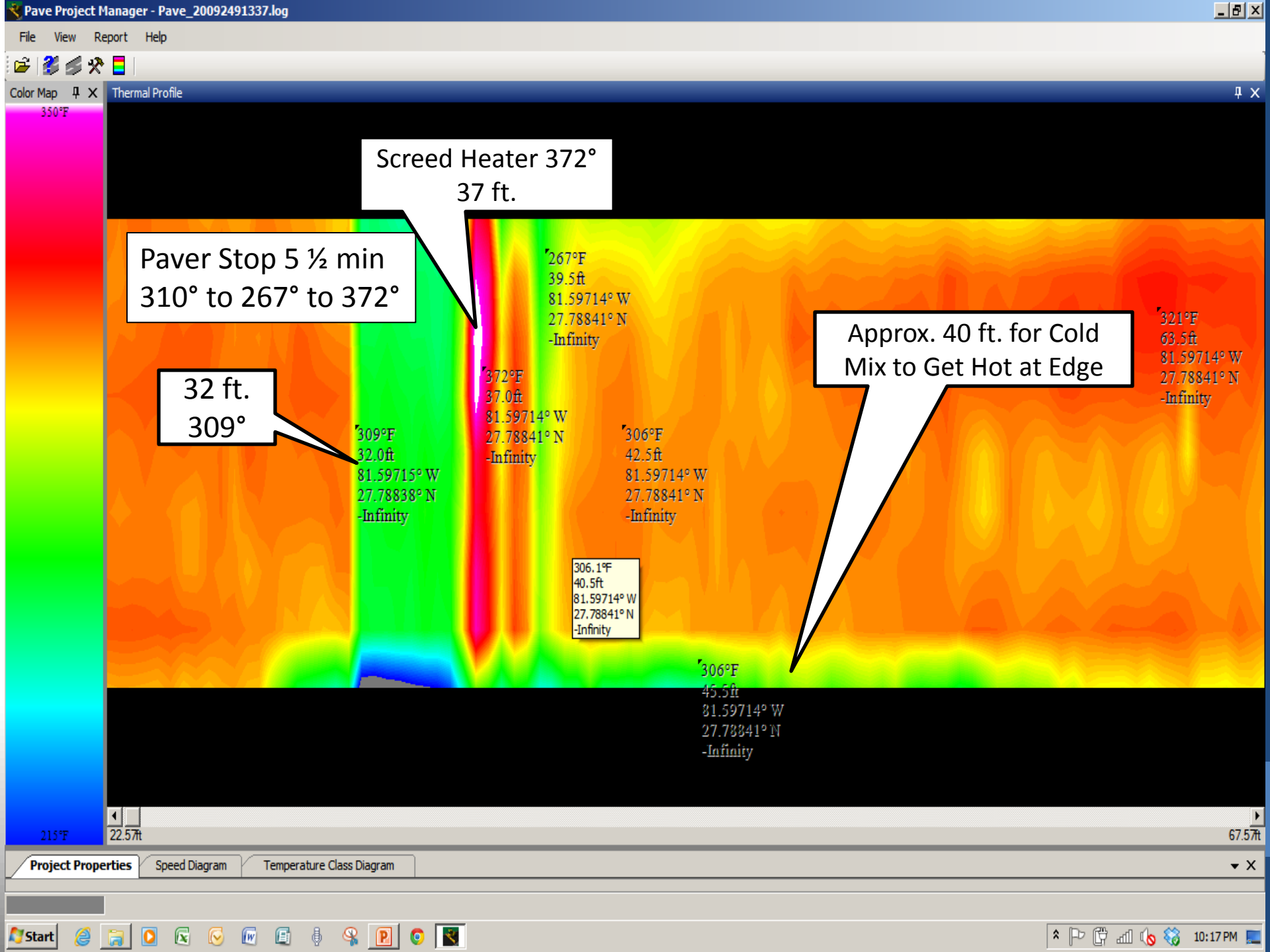
Actions	
Interpolation	**Linear**
Sample Spots of Interest	Enabled
Stations	**Show**
Tooltip	Visible
Profile View	
Ignored Sensors	**1-2; 11-12;**
Length	**9970.15ft**
Start	**0.00ft**
Units	**Feet**
Zoom	**100.0%**

Ignored Sensors
Enter the sensor IDs you don't want to be displayed. ID 1 is the outer left sensor. Examples: "1;2;11;12", "1-3;10-12"

Project Properties | Time Diagram | Speed Diagram | Temperature Class Diagram



Start 9:25 PM


Pave Project Manager - Pave_20092491337.log
File
View
Report
Help
Color Map
350°F
215°F
Thermal Profile
Screed Heater 372°
37 ft.
Paver Stop 5 ½ min
310° to 267° to 372°
32 ft.
309°
Approx. 40 ft. for Cold
Mix to Get Hot at Edge
267°F
39.5ft
81.59714° W
27.78841° N
-Infinity
372°F
37.0ft
81.59714° W
27.78841° N
-Infinity
309°F
32.0ft
81.59715° W
27.78838° N
-Infinity
306°F
42.5ft
81.59714° W
27.78841° N
-Infinity
321°F
63.5ft
81.59714° W
27.78841° N
-Infinity
306.1°F
40.5ft
81.59714° W
27.78841° N
-Infinity
306°F
45.5ft
81.59714° W
27.78841° N
-Infinity
22.5ft
67.5ft
Project Properties
Speed Diagram
Temperature Class Diagram
Start
10:17 PM

Thermal Segregation w/o Pave-IR

Moderate

Corrective Action

Density Profile

Severe

Suspend Operations

No Production or Placement Bonus

Density Profile

If Density Profile Passes

Correct and Resume as per Engineer

If Density Profile Fails

Remove & Replace

Thermal Segregation with Pave-IR

Moderate – Modify to Eliminate

Severe – Modify to Eliminate

Recurring Severe – If Contractor Cannot Successfully Modify, Engineer can Suspend

- **Handheld**
  - Better than Nothing
- **Camera**
  - Portable
  - Instant Temps
  - Picture Any Angle
  - Post Analysis
- **Pave-IR**
  - Pic of Entire Mat
  - Paver Stops
  - GPS
  - Post Analysis

Handheld

Camera

- All Other Testing Required
- Cannot Pave at Lower Temps
- Requires Technician
- Subject to Losing Bonus

Pave-IR

- Density Profiles N/A
- 32°F Surface Temp
- Do Not Lose Bonus
- No Requirement to Suspend
- No Technician

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Contractor's Choice...

Handheld Non-Contact Infrared Thermometer

Hauling Equipment

- Adds the "Hauling Equipment" Section.
- Allows using dump trucks only when an MTD or a Pave-IR system is used.

c. **Hauling Equipment.** The Contractor may elect to use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, **end dump trucks are only allowed when used in conjunction with an MTD with remixing capability or when a Pave-IR system is used for specification compliance unless otherwise allowed by the Engineer.**

6. If the paver stops for more than 5 minutes, turn off screed heaters to…

a) prevent overheating of the mat
b) prevent overheating of your burritos

Screed Heaters

- Adds the "Screed Heaters" Section.
- Addresses potential damage caused by screed heaters being left on during long paver stops.

d. Screed Heaters. **If the paver stops for more than 5 minutes, turn off screed heaters to prevent overheating of the mat.** If the screed heater remains on for more than 5 minutes while the paver is stopped, the Engineer may evaluate the suspect area in accordance with Section 3268.4.I.3.c(4),"Recovered Asphalt Dynamic Shear Rheometer (DSR)."

Compaction

- Specifies when to take immediate corrective action and when to suspend operations based on in-place air voids.

H. **Compaction.** Uniformly compact the pavement to contain between 3.8% and 8.5% in-place air voids. **When the in-place air voids exceed the range of 3.8% and 8.5%, take immediate corrective action to bring the operation within these tolerances.** Areas defined in Section 3268.4.I.3.a(4), "Miscellaneous Areas," are not subject to in-place air void determination. **In all other areas, the Engineer may obtain and test cores and may suspend operations or require removal and replacement if the in-place air voids are less than 2.7% or greater than 9.9%.** The Engineer will allow paving to resume when the proposed corrective action is likely to yield between 3.8% and 8.5% in-place air voids.

Referee Testing

- Allows requesting referee testing if the Engineer's test results require suspension of production and the Contractor's test results are within specification limits.

1. **Referee Testing.** The Construction Division is the referee laboratory. The Contractor may request referee testing if a "remove and replace" condition is determined based on the Engineer's test results, or if the differences between Contractor and Engineer test results exceed the maximum allowable difference shown in Table 11 and the differences cannot be resolved. **The Contractor may also request referee testing if the Engineer's test results require suspension of production and the Contractor's test results are within specification limits.** Make the request within 5 working days after receiving test results and cores from the Engineer. Referee tests will be performed only on the sublot in question and only for the particular tests in question. Allow 10 working days from the time the

7. **What is the Maximum Allowable Lot Size for Lot 1?**

a) 4000

Production Lot

- Allows Lot 1 to be larger than 1,000 tons.

2. Production Acceptance.

a. Production Lot. A production lot consists of four equal sublots. **The default quantity for Lot 1 is 1,000 tons; however, when requested by the Contractor, the Engineer may increase the quantity for Lot 1 to no more than 4,000 tons.** The Engineer will select subsequent lot sizes based on the anticipated daily production such that approximately three to four sublots are produced each day. The lot size will be between 1,000 tons and 4,000 tons. The Engineer may change the lot size before the Contractor begins any lot.

Mixture Sampling

- Requires the Engineer to obtain or witness all production sampling and retain custody of samples.

(1) **Mixture Sampling.** Obtain hot mix samples from trucks at the plant in accordance with Tex-222-F. The sampler will split each sample into three equal portions in accordance with Tex-200-F and label these portions as "Contractor," "Engineer," and "Referee." **The Engineer will perform or witness the sample splitting and take immediate possession of the samples labeled "Engineer" and "Referee." The Engineer will maintain the custody of the samples labeled "Engineer" and "Referee" until the Department's testing is completed.**

Blind Sample

- Allows testing either the "blind" or the random sample.
- Referee testing will be based on the "blind" samples.

(b) Blind Sample. For one sublot per lot, the Engineer will obtain and test a "blind" sample in lieu of the random sample collected by the Contractor. **The Contractor may test either the "blind" or the random sample; however, referee testing (if applicable) will be based on a comparison of results from the "blind" sample**. The location of the Engineer's "blind" sample will not be disclosed to the Contractor. The Engineer's "blind" sample may be randomly selected in accordance with Tex-225-F for any sublot or selected at the discretion of the Engineer. The Engineer will use the Contractor's split sample for sublots not sampled by the Engineer.

8. During the first week of production, randomly select one sublot from Lot 2 or higher for Cantabro and Overlay testing. Obtain and provide the Engineer with approximately 150 lb. (70 kg) of mixture in sealed containers, boxes, or bags labeled with CSJ, mixture type, lot, and sublot number. The Engineer will ship the mixture to the Construction Division for Cantabro and Overlay testing. Results from these tests…

a) will be used for specification compliance

b) will not be used for specification compliance

Cantabro and Overlay Testing

- Stipulates when the Contractor will obtain samples for Cantabro and Overlay testing.
- States that results will not be used for specification compliance.

(2) **Informational Cantabro and Overlay Testing.** **During the first week of production, randomly select one sublot from Lot 2 or higher for Cantabro and Overlay testing.** Obtain and provide the Engineer with approximately 150 lb. (70 kg) of mixture in sealed containers, boxes, or bags labeled with CSJ, mixture type, lot, and sublot number. The Engineer will ship the mixture to the Construction Division for Cantabro and Overlay testing. **Results from these tests will not be used for specification compliance.**

Production Testing

- For exempt production, requires the Engineer to test at the frequency listed in the Guide Schedule and the specification.

Table 14
Production and Placement Testing Frequency

Description	Test Method	Minimum Contractor Testing Frequency	Minimum Engineer Testing Frequency[1]
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	1 per sublot	1 per 12 sublots
Individual % retained for sieves smaller than #8 and larger than #200			
% passing the #200 sieve			
Laboratory-molded density	Tex-207-F	N/A	1 per sublot
Laboratory-molded bulk specific gravity			
In-place air voids			
VMA	Tex-204-F		
Segregation (density profile)[5]	Tex-207-F, Part V	1 per sublot	1 per project
Longitudinal joint density	Tex-207-F, Part VII		
Moisture content	Tex-212-F, Part II	When directed	
Theoretical maximum specific (Rice) gravity	Tex-227-F	N/A	1 per sublot
Asphalt content	Tex-236-F	1 per sublot	1 per lot
Hamburg Wheel test	Tex-242-F	N/A	1 per project
Recycled Asphalt Shingles (RAS)[2]	Tex-217-F, Part III	N/A	
Thermal profile[5]	Tex-244-F	1 per sublot	
Asphalt binder sampling and testing	Tex-500-C	1 per lot (sample only)	
Tack coat sampling and testing	Tex-500-C, Part III	N/A	
Boil test[3]	Tex-530-C	1 per lot	
Cantabro loss[4]	Tex-245-F	1 per project (sample only)	
Overlay test[4]	Tex-248-F		

1. For production defined in Section 3268.I.4, "Exempt Production," the Engineer will test at the frequency listed in the Department's *Guide Schedule of Sampling and Testing* and this specification.

Operational Tolerances - Gradation

- Requires suspending operation and taking corrective action if any aggregate is retained on the maximum sieve size.

(1) **Gradation.** Suspend operation and take corrective action if any aggregate is retained on the maximum sieve size shown in Table 8. A sublot is defined as out of tolerance if either the Engineer's or the Contractor's test results are out of operational tolerance. Unless otherwise directed, suspend production when test results for gradation exceed the operational tolerances for three consecutive sublots on the same sieve or four consecutive sublots on any sieve. The consecutive sublots may be from more than one lot.

Operational Tolerances – AC

- States that no bonus will be paid for any sublot that is out of operational tolerance for AC.

(2) **Asphalt Content.** A sublot is defined as out of operational tolerance if either the Engineer's or the Contractor's test results exceed the values listed in Table 11. **No production or placement bonus will be paid for any sublot that is out of operational tolerance for asphalt content.** Suspend production and shipment of the mixture if the Engineer's or the Contractor's asphalt content deviates from the current JMF by more than 0.5% for any sublot.

Operational Tolerances – VMA

- Adds a VMA Section under Operational Tolerances.
- Addresses the consequences of VMA being out of spec.

(3) **Voids in Mineral Aggregates (VMA).** The Engineer will determine the VMA for every sublot. For sublots when the Engineer does not determine asphalt content, the Engineer will use the asphalt content results from quality control testing performed by the Contractor to determine VMA.

Take immediate corrective action if the VMA value for any sublot is less than the minimum VMA requirement for production listed in Table 8. **Suspend production and shipment of the mixture if the Engineer's VMA results on two consecutive sublots are below the minimum VMA requirement for production listed in Table 8. No production or placement bonus will be paid for any sublot that does not meet the minimum VMA requirement for production listed in Table 8 based on the Engineer's VMA determination**.

Suspend production and shipment of the mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production listed in Table 8. In addition to suspending production, the Engineer may require removal and replacement or may allow the sublot to be left in place without payment.

Miscellaneous Areas

- States that temporary detours are subject to in-place air void determination.

(4) **Miscellaneous Areas.** Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. **Temporary detours are subject to in-place air void determination when shown on the plans.** Miscellaneous areas also include level-ups and thin overlays when the layer thickness specified on the plans is less than the minimum untrimmed core height eligible for testing shown in Table 12. The specified layer thickness is based on the rate of 110 lb./sq. yd. for each inch of pavement unless another rate is shown on the plans.

Miscellaneous Areas

- States that miscellaneous areas are not subject to in-place air void determination, thermal profiles, density profiles, or longitudinal joint density evaluations.

Miscellaneous areas are not eligible for random placement sampling locations. Compact miscellaneous areas in accordance with Section 3268.4.H, "Compaction." **Miscellaneous areas are not subject to in-place air void determination, thermal profiles testing, segregation (density profiles), or longitudinal joint density evaluations.**

Placement Sampling

- Requires providing equipment to obtain and trim cores onsite.

Provide the equipment and means to obtain and trim roadway cores on site. On site is defined as in close proximity to where the cores are taken. Obtain the cores within 1 working day of the time the placement sublot is completed unless otherwise approved. Obtain two 6-in. diameter cores side-by-side from within 1 ft. of the random location provided for the placement sublot.

- Requires the Engineer to witness coring operations.

The Engineer will witness the coring operation and measurement of the core thickness. Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. If an adequate bond does not exist between the current and underlying layer, take corrective action to ensure that an adequate bond will be achieved during subsequent placement operations.

Placement Sampling

- Requires onsite trimming of cores.
- Requires the Engineer to take custody of the cores after they are trimmed.

Immediately after obtaining the cores from the roadway, trim the cores in accordance with Tex-207-F if the core heights meet the minimum untrimmed values listed in Table 12. **Trim the cores on site in the presence of the Engineer.** Use a permanent marker or paint pen to record the lot and sublot numbers on each core as well as the designation as Core A or B. The Engineer may require additional information to be marked on the core and may choose to sign or initial the core. **The Engineer will take custody of the cores immediately after they are trimmed and will retain custody of the cores until the Department's testing is completed.** Prior to turning the trimmed cores over to the Engineer, the Contractor may elect to wrap the trimmed cores or secure them in a manner that will reduce the risk of possible damage occurring during transport by the Engineer. After testing, the Engineer will return the cores to the Contractor.

Placement Sampling

- Allows trimming at an alternate location.
- Allows the Engineer to use the CST protocol when the cores will be out of the Engineer's possession.

The Engineer may elect to have the cores transported back to the Department's laboratory at the HMA plant via the Contractor's haul truck or other designated vehicle. **In such cases where the cores will be out of the Engineer's possession during transport, the Engineer will use the Construction Division's protocol to provide a secure means and process that protects the integrity of the cores during transport.**

Segregation (Density Profile)

- Requires performing a density profile when the paver stops for more than 60 seconds.

Unless otherwise approved, **perform a density profile every time the paver stops for more than 60 seconds**, on areas that are identified by either the Contractor or the Engineer as having thermal segregation, and on any visibly segregated areas. **If the paver does not stop for more than 60 seconds**, and there are no visibly segregated areas or areas that are identified as having thermal segregation, perform a minimum of one profile per sublot.

Segregation (Density Profile)

- Requires to test every sublot.
- Disallows waiving testing.
- Requires providing documentation for every sublot.

Within 1 working day of the completion of each lot, provide the Engineer with the density profile of every sublot within the lot. Report the results of each density profile in accordance with Section 3268.4.B, "Reporting and Responsibilities."

Longitudinal Joint Density

- Requires to test every sublot.
- Requires providing documentation for every sublot.

Within 1 working day of the completion of each lot, provide the Engineer with the joint density of every sublot within the lot.
Report the results of each joint density in accordance with Section 3268.4.B, "Reporting and Responsibilities."

Recovered Asphalt DSR

- Allows the Engineer to take samples to determine recovered asphalt properties when the Pave-IR is not used for specification compliance.

(4) Recovered Asphalt Dynamic Shear Rheometer (DSR). **When the Pave-IR system is not used for specification compliance, the Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties.** Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Construction Division. The aging ratio is the DSR value of the extracted binder divided by the DSR value of the original unaged binder.

Exempt Production

- Replaces “Small Quantity Production” with “Exempt Production.”
- Relieves the Contractor of all sampling/testing and requires 1.000 pay factors.
- Requires the Engineer to perform acceptance tests according to the Guide Schedule.
- When the Contractor elects not to use the Pave-IR system for specification compliance, the Engineer may perform segregation and thermal profiles.

Exempt Production

4. **Exempt Production. When the anticipated daily production is less than 1,000 tons, the total production for the project is less than 5,000 tons, or when mutually agreed between the Engineer and the Contractor, the Engineer may deem the mixture as exempt production. Production may also be exempt when shown on the plans.**

For exempt production, the Contractor is relieved of all production and placement sampling and testing requirements, and the production and placement pay factors are 1.000. All other specification requirements apply, and the Engineer will perform acceptance tests for production and placement listed in Table 14 at the frequency listed in the Department's *Guide Schedule of Sampling and Testing.*

For exempt production:

- produce, haul, place, and compact the mixture in compliance with the specification and as directed by the Engineer;
- control mixture production to yield a laboratory-molded density that is within ± 1.0% of the target laboratory-molded density as tested by the Engineer;
- **compact the mixture in accordance with Section 3268.4.H, "Compaction"**; and
- **when the Contractor elects not to use the Pave-IR system for specification compliance, the Engineer may perform segregation (density profiles) and thermal profiles in accordance with the specification.**

Payment

- Requires to provide the required testing documentation in order to receive bonuses.
- States that documentation is not required for some testing when the Pave-IR system is used for specification compliance.

Applicable pay adjustment bonuses will only be paid for sublots when the Contractor supplies the Engineer with the required documentation for production and placement QC/QA, thermal profiles, segregation density profiles, and longitudinal joint density in accordance with Section 3268.4.B, "Reporting and Responsibilities." If the Contractor uses the Pave-IR system for specification compliance, documentation is not required for thermal profiles or segregation density profiles on individual sublots; however, the Pave-IR system automated reports described in Tex-244-F are required.

Production Pay Factors

- Requires to take corrective action if the lab density is less than 95% or greater than 98%.

Table 16
Production Pay Adjustment Factors for Laboratory-Molded Density[1]

Absolute Deviation from Target Laboratory-Molded Density	Production Pay Adjustment Factor (Target Laboratory-Molded Density)
0.0	1.050
0.1	1.050
0.2	1.050
0.3	1.044
0.4	1.038
0.5	1.031
0.6	1.025
0.7	1.019
0.8	1.013
0.9	1.006
1.0	1.000
1.1	0.965
1.2	0.930
1.3	0.895
1.4	0.860
1.5	0.825
1.6	0.790
1.7	0.755
1.8	0.720
> 1.8	Remove and replace

1. If the Engineer's laboratory-molded density on any sublot is less than 95.0% or greater than 98.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

Placement Sublots Subject to Removal and Replacement

- Allows the Engineer to let failing placement sublots to be left in place without payment.

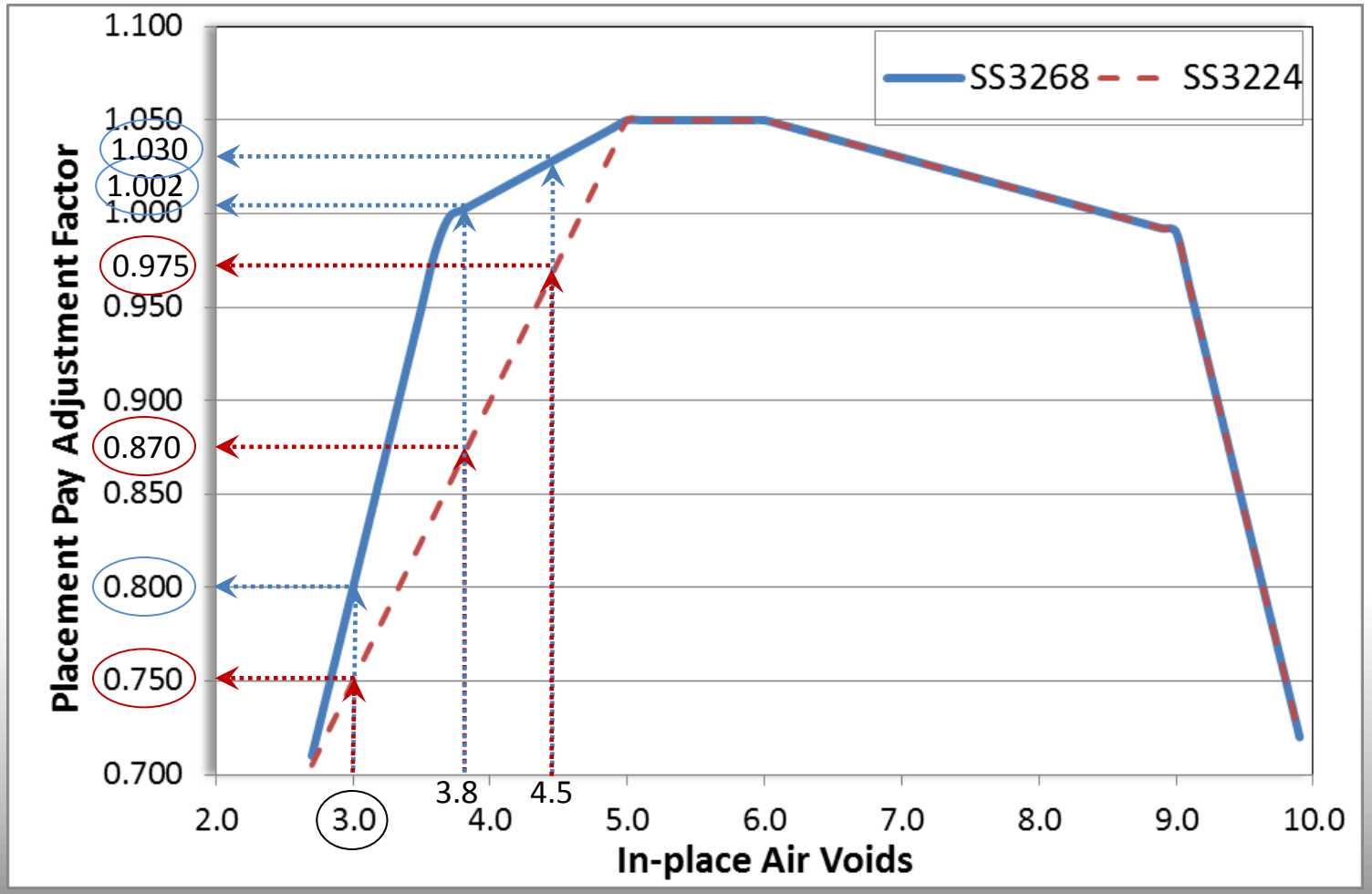
Placement Pay Factors

- Removes the Contractor's option to request a production pay adjustment factor of 1.000 when WMA is specified.
- Modifies the placement pay adjustment factors.

Table 17
Placement Pay Adjustment Factors for In-place Air Voids

In-place Air Voids	Placement Pay Adjustment Factor	In-place Air Voids	Placement Pay Adjustment Factor
< 2.7	Remove and Replace	6.4	1.042
2.7	0.710	6.5	1.040
2.8	0.740	6.6	1.038
2.9	0.770	6.7	1.036
3.0	0.800	6.8	1.034
3.1	0.830	6.9	1.032
3.2	0.860	7.0	1.030
3.3	0.890	7.1	1.028
3.4	0.920	7.2	1.026
3.5	0.950	7.3	1.024
3.6	0.980	7.4	1.022
3.7	0.998	7.5	1.020
3.8	1.002	7.6	1.018
3.9	1.006	7.7	1.016
4.0	1.010	7.8	1.014
4.1	1.014	7.9	1.012
4.2	1.018	8.0	1.010
4.3	1.022	8.1	1.008
4.4	1.026	8.2	1.006
4.5	1.030	8.3	1.004
4.6	1.034	8.4	1.002
4.7	1.038	8.5	1.000
4.8	1.042	8.6	0.998
4.9	1.046	8.7	0.996
5.0	1.050	8.8	0.994
5.1	1.050	8.9	0.992
5.2	1.050	9.0	0.990
5.3	1.050	9.1	0.960
5.4	1.050	9.2	0.930
5.5	1.050	9.3	0.900
5.6	1.050	9.4	0.870
5.7	1.050	9.5	0.840
5.8	1.050	9.6	0.810
5.9	1.050	9.7	0.780
6.0	1.050	9.8	0.750
6.1	1.048	9.9	0.720
6.2	1.046	> 9.9	Remove and Replace
6.3	1.044		

Placement Pay Adjustment Factors



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Things You Need to Remember That Can Keep You Out Of Trouble

10. THIS QC/QA SPECIFICATION IS INTENDED FOR HMA DENSE-GRADED PROJECTS GREATER THAN 5,000 TONS.

9. PROVIDE THE ENGINEER WITH DOCUMENTATION SHOWING THE QUANTITY OF ADDITIVES USED IN THE PROJECT UNLESS OTHERWISE DIRECTED.

8. PROCESS RAS SUCH THAT 100% OF THE PARTICLES PASS THE 3/8 IN. SIEVE.

7. FOR ANY STOCKPILE THAT CONTAINS RAS, THE ENTIRE STOCKPILE WILL BE CONSIDERED A RAS STOCKPILE.
6. USE NO MORE THAN 20% RECYCLED BINDER WHEN USING THE PG BINDER ORIGINALLY SPECIFIED (NO WMA, NO BINDER SUBSTITUTION).
5. THE RECYCLED BINDER RATIO AND AMOUNT OF RECYCLED MATERIAL REQUIREMENTS MUST BE MET AT THE DESIGN, THE TRIAL BATCH AND DURING PRODUCTION.

4. THE CONTRACTOR MAY REQUEST REFEREE TESTING IF THE ENGINEER'S TEST RESULTS REQUIRE SUSPENSION OF PRODUCTION AND THE CONTRACTOR'S TEST RESULTS ARE WITHIN SPECIFICATION LIMITS.

3. SUSPEND OPERATION AND TAKE CORRECTIVE ACTION IF ANY AGGREGATE IS RETAINED ON THE MAXIMUM SIEVE SIZE.

2. UNLESS OTHERWISE APPROVED, PERFORM A DENSITY PROFILE WHEN THE PAVER STOPS FOR MORE THAN 60 SECONDS.

1. EXEMPT PRODUCTION CLAUSE CAN BE USED FOR ANY SITUATION. EXAMPLE: BOND BREAKER, SMALL QUANTITY, ETC. ELIMINATES THE NEED TO HAVE ITEM 340 (3267).

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Special Specifications

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Special Specifications

SS 3267 (Item 340), Dense-Graded Hot -Mix Asphalt (Small Quantity)

SS 3268 (Item 341), Dense-Graded Hot- Mix Asphalt

SS 3269 (Item 342), Permeable Friction Course (PFC)

SS 3270 (Item 344), Superpave Mixtures

SS 3271 (Item 346), Stone –Matrix Asphalt

Summary of Changes

- Special specifications include many of the changes made in SS 3224 and SS 3268 (Item 341), Dense-Graded Hot-Mix Asphalt, as well as additional changes that are specific to each item.
- The changes outlined in this presentation reflect new modifications that only apply to these items.

Dense Graded Hot-Mix Asphalt (Small Quantity)

SS 3267 (Item 340) Dense-Graded Hot-Mix Asphalt (Small Quantity)

- Changes the specification's name to "Dense-Graded Hot-Mix Asphalt (Small Quantity)." This specification is intended for small quantity projects typically under 5,000 tons total production.

SPECIAL SPECIFICATION

3267

Dense-Graded Hot-Mix Asphalt (Small Quantity)

Item 340: Dense-Graded Hot-Mix Asphalt (Method)

1. **Description.** Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant. This specification is intended for small quantity (SQ) HMA projects, typically under 5,000 tons total production.

SS 3267 (Item 340)

Materials

- Micro-Deval Abrasion is an optional test used by the Engineer as an indicator of the need for further investigation (Table 1).
- Requires the same maximum allowable amounts of recycled materials and ratios of recycled binder as SS3268 (Item 341) in Tables 4 & 5.
- Adds the “Certification” section and Table 6, “Test Methods, Test Responsibility, and Minimum Certification Levels.”
- Adds the “Reporting, Testing, and Responsibilities” section and Table 7, “Reporting Schedule.”

SS 3267 (Item 340)
Mixture Design

- Allows designing the mixture using the TGC and SGC. Same mixture design requirements as SS3268 (Item 341).
- Adds the allowable difference between trial batch and JMF1 target in Table 11.

Table 11
Operational Tolerances

Description	Test Method	Allowable Difference Between Trial Batch and JMF1 Target	Allowable Difference from Current JMF Target
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be Within Master Grading Limits in Table 8	±5.0[1,2]
Individual % retained for sieves smaller than #8 and larger than #200			±3.0[1,2]
% passing the #200 sieve			±2.0[1,2]
Asphalt content, %	Tex-236-F	±0.5	±0.3[2]
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0
VMA, %, min	Tex-204-F	Note 3	Note 3

1. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
2. Only applies to mixture produced for Lot 1 and higher.
3. Mixture is required to meet Table 8 requirements.

SS 3267 (Item 340)

Production and Placement Operations

- Not subject to QCP, thermal profiles or Pave-IR system, density profiles, longitudinal joint densities, and recovered asphalt DSR testing.

SS 3267 (Item 340) Compaction

- Specifies when to take immediate corrective action and when to suspend operations based on in-place air voids.

G. **Compaction.** Uniformly compact the pavement to contain between 3.8% and 8.5% in-place air voids. **When the in-place air voids exceed the range of 3.8% and 8.5%, take immediate corrective action to bring the operation within these tolerances.** Areas defined in Section 3267.I.2 "Miscellaneous Areas," are not subject to in-place air void determination. **In all other areas, the Engineer may obtain and test cores and may suspend operations or require removal and replacement if the in-place air voids are less than 2.7% or greater than 9.9%.** The Engineer will allow paving to resume when the proposed corrective action is likely to yield between 3.8% and 8.5% in-place air voids.

- Removes the Ordinary Compaction Control Section.

SS 3267 (Item 340)
Production Acceptance

- Adds the "Production Acceptance" section. Defines production lot, sampling, and testing.

1. **Production Lot.** Each day of production is defined as a production lot. Lots will be sequentially numbered and will correspond to each new day of production. Note that lots are not subdivided into sublots for this specification.

3. **Production Testing.** The Engineer will test at the frequency listed in the Department's Guide Schedule of Sampling and Testing and this specification. The Engineer may suspend production if production tests do not meet specifications or are not within operational tolerances listed in Table 11. If the Engineer's laboratory-molded density on any sample is less than 95.0% or greater than 98.0%, take immediate corrective action to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

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Table 11
Operational Tolerances

Description	Test Method	Allowable Difference Between Trial Batch and JMF1 Target	Allowable Difference from Current JMF Target
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be Within Master Grading Limits in Table 8	±5.0[1,2]
Individual % retained for sieves smaller than #8 and larger than #200			±3.0[1,2]
% passing the #200 sieve			±2.0[1,2]
Asphalt content, %	Tex-236-F	±0.5	±0.3[2]
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0
VMA, %, min	Tex-204-F	Note 3	Note 3

1. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
2. Only applies to mixture produced for Lot 1 and higher.
3. Mixture is required to meet Table 8 requirements.

SS 3267 (Item 340)
Placement Acceptance

- Adds the "Placement Acceptance" section. Defines placement lot, miscellaneous areas, sampling, and testing.

1. **Placement Lot.** A placement lot is defined as the area placed during a production lot (one day's production). Placement lot numbers will correspond with production lot numbers.

4. **Placement Testing.** The Engineer may measure in-place air voids at any time during the project to verify specification compliance.

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PFC

SS 3269 (Item 342)
Permeable Friction Course (PFC)

- Disallows using intermediate aggregate.
- Permits disallowing Class B virgin (non-recycled) aggregate.

a. **Blending Class A and Class B Aggregates.** **Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate in order to meet requirements for Class A materials; however, Class B virgin (non-recycled) aggregate may be disallowed when shown on the plans.** When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. Coarse aggregate from RAP and Recycled Asphalt Shingles (RAS) will be considered as Class B aggregate.

SS 3269 (Item 342)
Permeable Friction Course (PFC)

- Requires providing the A-R binder blend design and documentation showing the quantity of CRM used.

2. **Asphalt-Rubber (A-R) Binder.** When A-R is specified, provide A-R binder that meets the Type I or Type II requirements of Section 300.2.I, "Asphalt-Rubber Binders," unless otherwise shown on the plans. Use at least 15.0% by weight of Crumb Rubber Modifier (CRM) that meets the Grade B or Grade C requirements of Section 300.2.G, "Crumb Rubber Modifier," unless otherwise shown on the plans. **Provide the Engineer the A-R binder blend design with the mix design (JMF1) submittal. Provide the Engineer with documentation such as the bill of lading showing the quantity of CRM used in the project unless otherwise directed.**

SS 3269 (Item 342)
Materials

- Allows pre-blending the fibers into the binder at the asphalt supply terminal.
- Allows using RAP and RAS. Disallows using unfractionated RAP. Adds Table 2.

Table 2
Maximum Allowable Amounts of Recycled Binder, RAP, and RAS

Maximum Ratio of Recycled Binder to Total Binder[1] (%)	Maximum Allowable Recycled Material[2] (%)	
	Fractionated RAP[3]	RAS[4]
15.0	10.0	5.0

1. Combined recycled binder from fractionated RAP and RAS.
2. Unfractionated RAP is not allowed in PFC mixtures
3. May replace up to 5% fractionated RAP with RAS.
4. May be used separately or as a replacement for no more than 5% of the allowable fractionated RAP.

SS 3269 (Item 342)
Equipment

- Requires providing a means to calibrate the mass flow meter.

3. **Equipment.** Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement." When A-R binder is specified, equip the hot-mix plant with an in-line viscosity-measuring device located between the blending unit and the mixing drum. **When an asphalt mass flow meter is used, provide a means to calibrate the meter on site.**

SS 3269 (Item 342) Mix Design

- Adds the master gradation limits and design properties for the new fine PFC (PFC-F) and coarse PFC A-R (PFCR-C) mixes.
- Add Hamburg and Overlay testing requirements for PFC-F.
- Requires performing Hamburg and Overlay for informational purposes for all other PFC mixes.
- Requires no more than 0.10% drain-down for all mixes.
- Requires molding the Hamburg and Overlay test samples to Ndesign.
- Allows reducing the amount of fibers depending on drain-down results.

Mold test specimens to Ndesign at the OAC. Perform the test for informational purposes only when no minimum number is specified.

When at least 3% RAS is used in the mixture, the Contractor may reduce the amount of fibers to no less than 0.10% provided the mixture meets the drain-down requirement.

Unless otherwise shown on the plans or waived by the Engineer based on Hamburg Wheel results.

Table 4
Master Gradation Limits (% Passing by Weight or Volume) and Laboratory Mixture Design Properties

Sieve Size	PG 76 Mixtures		A-R Mixtures		Test Procedure
	Fine (PFC-F)	Coarse (PFC-C)	Fine (PFCR-F)	Coarse (PFCR-C)	
3/4"	–	100.0[1]	100.0[1]	100.0[1]	Tex-200-F
1/2"	100.0[1]	80.0-100.0	95.0-100.0	80.0-100.0	
3/8"	95.0-100.0	35.0-60.0	50.0-80.0	35.0-60.0	
#4	20.0-55.0	1.0-20.0	0.0-8.0	0.0-20.0	
#8	1.0-10.0	1.0-10.0	0.0-4.0	0.0-10.0	
#200	1.0-4.0	1.0-4.0	0.0-4.0	0.0-4.0	
Mixture Properties					
Binder content, %	6.0-7.0	6.0-7.0	8.0-10.0	7.0-9.0	–
Design gyrations (Ndesign)	50	50	50	50	Tex-241-F
Lab-molded density, %	78.0 max	82.0 max	82.0 max	82.0 max	Tex-207-F
Hamburg Wheel test[2], passes at 12.5 mm rut depth	10,000 min	Note 2	Note 2	Note 2	Tex-242-F
Overlay tester[2], number of cycles	300 min	Note 2	Note 2	Note 2	Tex-248-F
Drain-down, %	0.10 max	0.10 max	0.10 max	0.10 max	Tex-235-F
Fiber content, % by wt. of total PG 76 mixture	0.20[3]-0.50	0.20[3]-0.50	–	–	Calculated
Lime content, % by wt. of total aggregate	1.0[4]	1.0[4]	1.0[4]	1.0[4]	Calculated
CRM content, % by wt. of A-R binder	–	–	15.0 min	15.0 min	Calculated
Boil test[5]	–	–	–	–	Tex-530-C
Cantabro loss, %	20.0 max	20.0 max	20.0 max	20.0 max	Tex-245-F

SS 3269 (Item 342)
Hamburg and Overlay Testing

- Requires providing Hamburg results with the design or requesting the Department to perform the test.
- Requires providing mixture and requesting the Department to perform the Overlay test.

(3) **Hamburg and Overlay Testing.** Use an approved laboratory to perform the Hamburg Wheel test and provide results with the mixture design, or provide 10,000 g of the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Department maintains the Material Producer List of approved laboratories located at http://www.txdot.gov/business/resources/producer-list.html.

Provide 25,000 g of the laboratory mixture and request that the Department perform the Overlay test.

SS 3269 (Item 342)
Job-Mix Formula Approval

- Requires including Hamburg and Overlay results when submitting JMF1.
- States that the AC correction factor takes into account the % fibers in the mixture.

(7) **Ignition Oven Correction Factors.** Determine the aggregate and asphalt correction factors from the ignition oven in accordance with Tex-236-F. **Note that the asphalt content correction factor takes into account the percent fibers in the mixture so that the fibers are excluded from the binder content determination.** Prior to the trial batch production, provide

- Adds the Cantabro and tack coat sampling and testing frequency and tolerances (Table 5).

SS 3269 (Item 342)

Job-Mix Formula Approval

- Allows the Engineer to require adjustments to the target binder by no more than 0.3% from the current JMF.

(10) Binder Content Adjustments. For JMF2 and above, the Engineer may require the Contractor to adjust the target binder content by no more than 0.3% from the current JMF.

Production Operations

- Requires that the A-R binder maintains a viscosity between 2,500 and 4,000 centipoise. Requires recording the viscosity at least once an hour and providing the Engineer with a daily summary unless otherwise directed.

SS 3269 (Item 342)

Acceptance Plan

- Increases the production requirement for lot 1 to 2,000 tons. Subsequent lot sizes should be between 2,000 and 4,000 tons.
- Requires suspending production and placement when results exceed the tolerances in Table 5.

Measurement

- Requires providing a daily summary of the asphalt mass flow meter readings for A-R mixes.
- Requires using the average measured asphalt % from each sublot for payment.

2. **Measured Percentage.** The averaged measured asphalt percentage from each sublot will be used for payment for that lot's production when the measured percentage for any sublot is more than 0.3 percentage points below the JMF target asphalt percentage or less than the minimum percentage specified in Table 4.

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SUPERPAVE

SS 3270 (Item 344)
Superpave Mixtures

- Changes the specification's name to "Superpave Mixtures." CMHB and RBL mixtures were removed from the specification.

SPECIAL SPECIFICATION

3270

Superpave Mixtures

Item 344: Performance-Designed Mixtures

1. **Description.** Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, Superpave (SP) mixture of aggregate and asphalt binder mixed hot in a mixing plant. Pay adjustments will apply to HMA placed under this specification unless the HMA is deemed exempt in accordance with Section 3270.4.I.4, "Exempt Production."

SS 3270 (Item 344)
Recycled Materials

- Requires lower allowable amount of fractionated RAP than SS3268 (Item 341). Same unfractionated RAP, RAS, and recycled binder requirements as SS3268.

Table 4
Maximum Allowable Amounts of RAP[1]

Maximum Allowable Fractionated RAP[2] (%)			Maximum Allowable Unfractionated RAP[3] (%)		
Surface	Intermediate	Base	Surface	Intermediate	Base
20.0	25.0	30.0	10.0	10.0	10.0

SS3268: 30%

SS3268: 40%

1. Must also meet the recycled binder to total binder ratio shown in Table 5.
2. Up to 5% RAS may be used separately or as a replacement for fractionated RAP.
3. Unfractionated RAP may not be combined with fractionated RAP or RAS.

SS 3270 (Item 344)

Mix Design

- Adds the #4 sieve in the master gradation limits.
- Removes the VFA design requirement.

Production Testing

- Requires taking corrective action if the Engineer's lab-molded density is less than 95% or greater than 97%.

SS3268: 98%

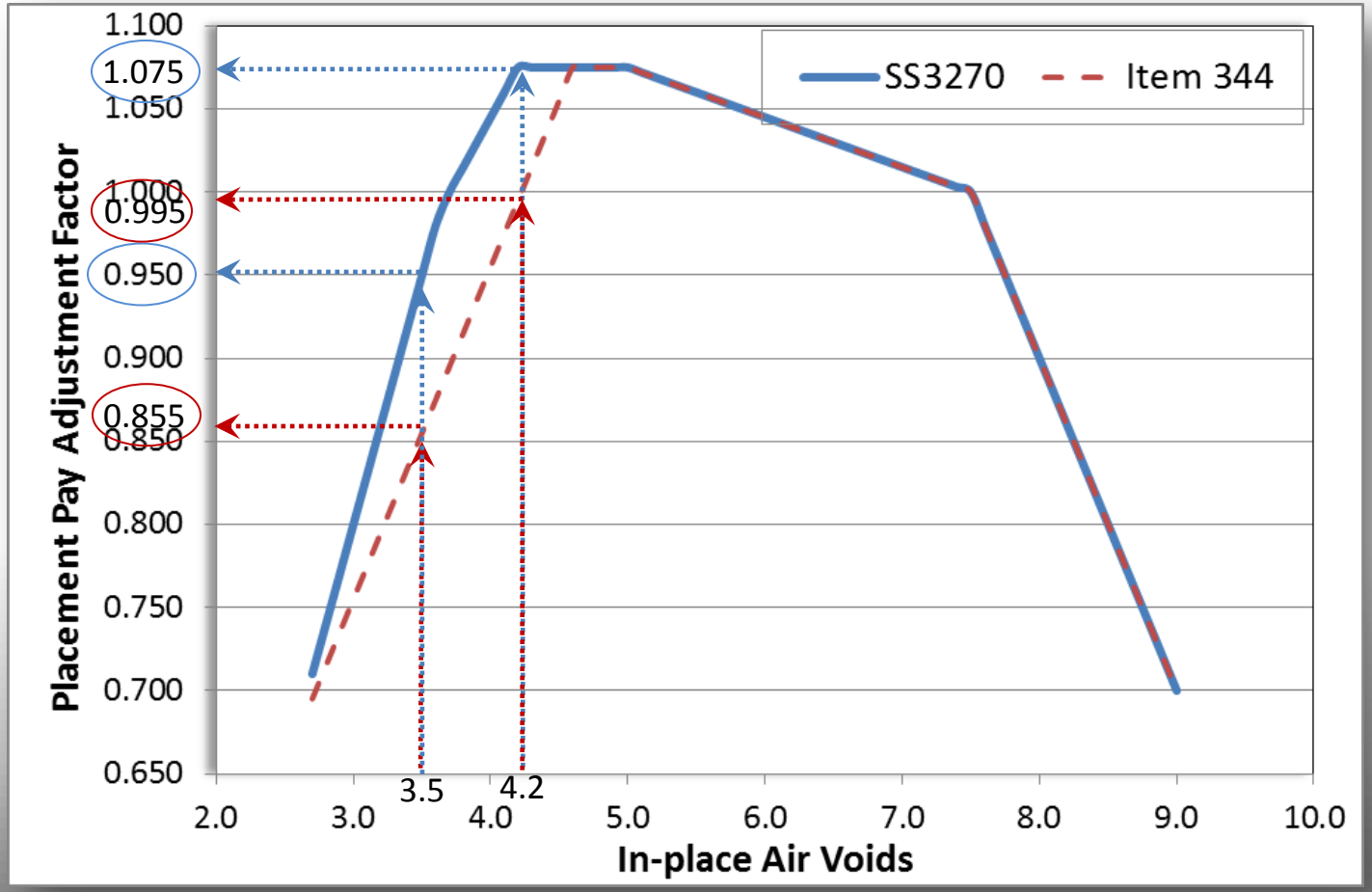
Table 8
Master Gradation Limits (% Passing by Weight or Volume) and VMA Requirements

Sieve Size	SP-A Base	SP-B Intermediate	SP-C Surface	SP-D Fine Mixture
2"	100.0[1]	–	–	–
1-1/2"	98.0–100.0	100.0[1]	–	–
1"	90.0–100.0	98.0–100.0	100.0[1]	–
3/4"	Note 2	90.0–100.0	98.0–100.0	100.0[1]
1/2"	–	Note 2	90.0–100.0	98.0–100.0
3/8"	–	–	Note 2	90.0–100.0
#4	**19.0–90.0**	**23.0–90.0**	**28.0–90.0**	**32.0–90.0**
#8	19.0–45.0	23.0–49.0	28.0–58.0	32.0–67.0
#16	1.0–45.0	2.0–49.0	2.0–58.0	2.0–67.0
#30	1.0–45.0	2.0–49.0	2.0–58.0	2.0–67.0
#50	1.0–45.0	2.0–49.0	2.0–58.0	2.0–67.0
#200	1.0–7.0	2.0–8.0	2.0–10.0	2.0–10.0
Design VMA, % Minimum				
	13.0	14.0	15.0	16.0
Production (Plant-Produced) VMA, % Minimum				
	12.5	13.5	14.5	15.5

1. Defined as maximum sieve size. No tolerance allowed.
2. Must retain at least 10% cumulative.

Payment

- Modifies the placement pay adjustment factors.



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SMA

SS 3271 (Item 346)
Stone-Matrix Asphalt

- Permits disallowing Class B virgin (non-recycled) aggregate.
- Disallows using more than 5% fly ash.

B. Mineral Filler. Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, hydrated lime, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Do not use more than 2% hydrated lime unless otherwise shown on the plans. **Do not use more than 5% fly ash unless otherwise shown on the plans.** Test all mineral fillers except hydrated lime and fly ash in accordance with Tex-107-E to ensure specification compliance. The plans may require or disallow specific mineral fillers. When used, provide mineral filler that:

- Requires providing the A-R binder blend design and documentation showing the quantity of CRM used.

SS 3271 (Item 346) Materials

- Allows pre-blending the fibers into the binder at the asphalt supply terminal unless otherwise shown on the plans.

Recycled Materials

- Disallows unfractionated RAP, reduces allowable amount of fractionated RAP, and allows RAS.

Table 4
Maximum Allowable Amounts of Recycled Binder, RAP, and RAS

Mixture Description & Location	Maximum Ratio of Recycled Binder to Total Binder[1] (%)	Maximum Allowable Recycled Material[2] (%)	
		Fractionated RAP[3]	RAS[4]
Surface	15.0	15.0	5.0
Non-Surface	20.0	20.0	5.0

Item 346: 20%

Item 346: 30%

1. Combined recycled binder from fractionated RAP and RAS.
2. Unfractionated RAP is not allowed in SMA or SMAR mixtures
3. May replace up to 5% fractionated RAP with RAS.
4. May be used separately or as a replacement for no more than 5% of the allowable fractionated RAP.

SS 3271 (Item 346)
Equipment

- Requires providing a means to calibrate the mass flow meter.

Mix Design

- Requires the mixture to be design at 50 gyrations. Allows reducing Ndesign to no less than 35 gyrations at the Contractor's discretion.

Design SMA or SMAR mixtures using a Superpave Gyratory Compactor (SGC) at 50 gyrations as the design number of gyrations (Ndesign). The Ndesign level may be reduced to no less than 35 gyrations at the Contractor's discretion.

SS 3271 (Item 346), Mix Design

- Requires providing mixture and requesting the Department to perform the Overlay test.
- Modifies the master gradation limits of the SMA-F mixture.
- Changes the target lab-molded density for SMAR from 97% to 96%.

Table 7
Master Gradation Limits (% Passing by Weight or Volume) and VMA Requirements

Sieve Size	SMA-C Coarse	SMA-D Medium	SMA-F Fine	SMAR-C Coarse	SMAR-F Fine
3/4"	100.0[1]	100.0[1]	–	100.0[1]	–
1/2"	80.0–90.0	85.0–99.0	100.0[1]	72.0–85.0	100.0[1]
3/8"	25.0–60.0	50.0–75.0	70.0–**100.0**	50.0–70.0	95.0–100.0
#4	20.0–28.0	20.0–32.0	30.0–**60.0**	30.0–45.0	40.0–50.0
#8	14.0–20.0	16.0–28.0	20.0–**40.0**	17.0–27.0	17.0–27.0
#16	8.0–20.0	8.0–28.0	**6.0**–30.0	12.0–22.0	12.0–22.0
#30	8.0–20.0	8.0–28.0	**6.0**–30.0	8.0–20.0	8.0–20.0
#50	8.0–20.0	8.0–28.0	**6.0**–30.0	6.0–15.0	6.0–15.0
#200	8.0–12.0	8.0–12.0	**6.0–12.0**	5.0–9.0	5.0–9.0
Design VMA, % Minimum					
	17.5	17.5	17.5	19.0	19.0
Production (Plant-Produced) VMA, % Minimum					
	17.0	17.0	17.0	18.5	18.5

1. Defined as maximum sieve size. No tolerance allowed.

SS 3271 (Item 346) Mix Design

- Adds an AC low limit for the SMAR.
- Reduces the maximum drain-down requirement.
- Allows reducing the amount of fibers depending on drain-down results.
- Adds an Overlay test requirement and removes IDT.

Table 8
Laboratory Mixture Design Properties

Mixture Property	SMA Mixtures	SMAR Mixtures	Test
Design gyrations, (Ndesign)[1]	50	50	
Target laboratory-molded density, %	96.0	**96.0**	Tex-207-F
Asphalt binder content, %	6.0-7.0	**7.0**-10.0	–
Drain-down, %	**0.10 max**	**0.10 max**	Tex-235-F
Fiber content, % by wt. of total mixture	0.20[2]-0.50	–	
CRM content, % by wt. of A-R binder	–	15.0 min	
Hamburg Wheel test[3], rut depth @ 20,000 passes tested @ 50°C, mm	12.5 max	12.5 max	Tex-242-F
Overlay test, number of cycles	**200 min**	**200 min**	Tex-248-F
Boil test[4]	–	–	Tex-530-C

Item 346: 97%

Item 346: 0.20

1. May be adjusted within a range of 35–100 gyrations when shown on the plans or specification or allowed by the Engineer.
2. **When at least 3% RAS is used in the mixture, the Contractor may reduce the amount of fibers to no less than 0.10% provided the mixture meets the drain-down requirement.**
3. For SMAR mixes, the number of passes required for the Hamburg Wheel test may be decreased. Other tests may be required for SMAR mixes instead of or in addition to the Hamburg Wheel test when shown on the plans.
4. Used to establish baseline for comparison to production results. May be waived when approved.

SS 3271 (Item 346)
Job-Mix Formula Approval

- Requires providing lab mix and requesting the Department to perform the Overlay test when submitting JMF1.
- States that the AC correction factor takes into account the % fibers in the mixture.
- Requires providing documentation to verify the calibration or accuracy of the asphalt mass flow meter.

SS 3271 (Item 346)
Job-Mix Formula Approval

- Allows the Engineer to perform the Overlay test for the JMF2 approval.

> (7) **Approval of JMF2.** The Engineer will approve JMF2 within 1 working day if the mixture meets the requirements in Table 4 and the master grading limits shown in Table 7. The asphalt content established for JMF2 is not required to be within any tolerance of the optimum asphalt content established for JMF1; however, mixture produced using JMF2 must meet the VMA requirements shown in Table 7. **If the optimum asphalt content for JMF2 is more than 0.5% lower than the optimum asphalt content for JMF1, the Engineer may perform Tex-248-F on Lot 1 to confirm the mixture meets the Overlay test requirement of 200 cycles.**

- Requires determining the binder AC from asphalt mass flow meter readouts for SMAR mixtures.

SS 3271 (Item 346), Job-Mix Formula Approval

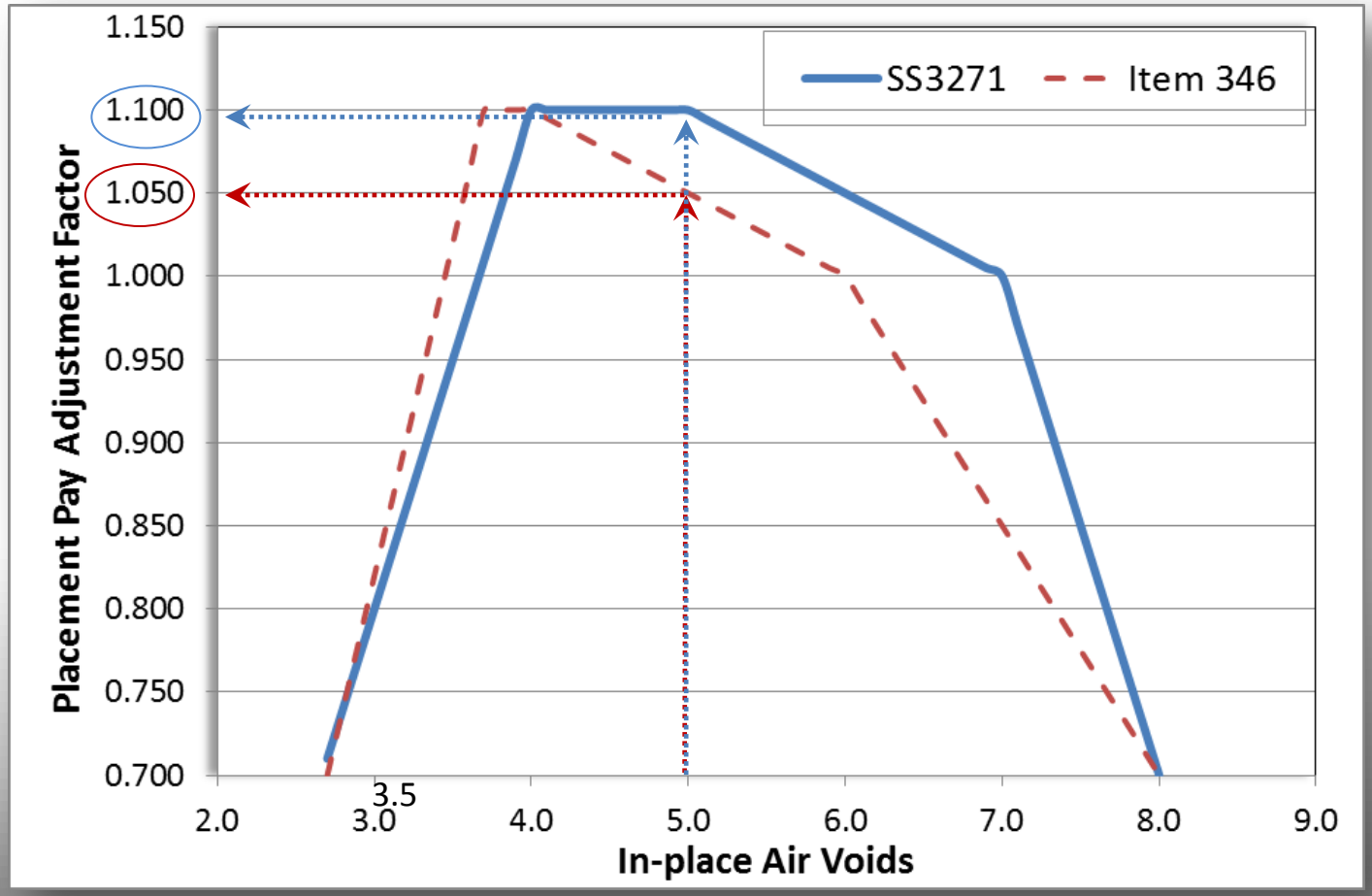
- Requires the Engineer to mold samples and perform the Overlay test for JMF1.
- Gives the Engineer the option to perform the Overlay test on the trial batch.

Production Testing

- Requires that the A-R binder maintains a viscosity between 2,500 and 4,000. Requires recording the viscosity at least once an hour and providing the Engineer with a daily summary unless otherwise directed.

Payment

- Modifies the placement pay adjustment factors.



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MIX SELECTION & DURABILITY

2013 HMA SPECIFICATIONS UPDATE CONFERENCE

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TYPICAL PERPETUAL PAVEMENT CONCEPT

TYPICAL STAGE CONSTRUCTION

Built in the 60's and 70's

Using mainly unmodified asphalts

Larger nominal size mixes

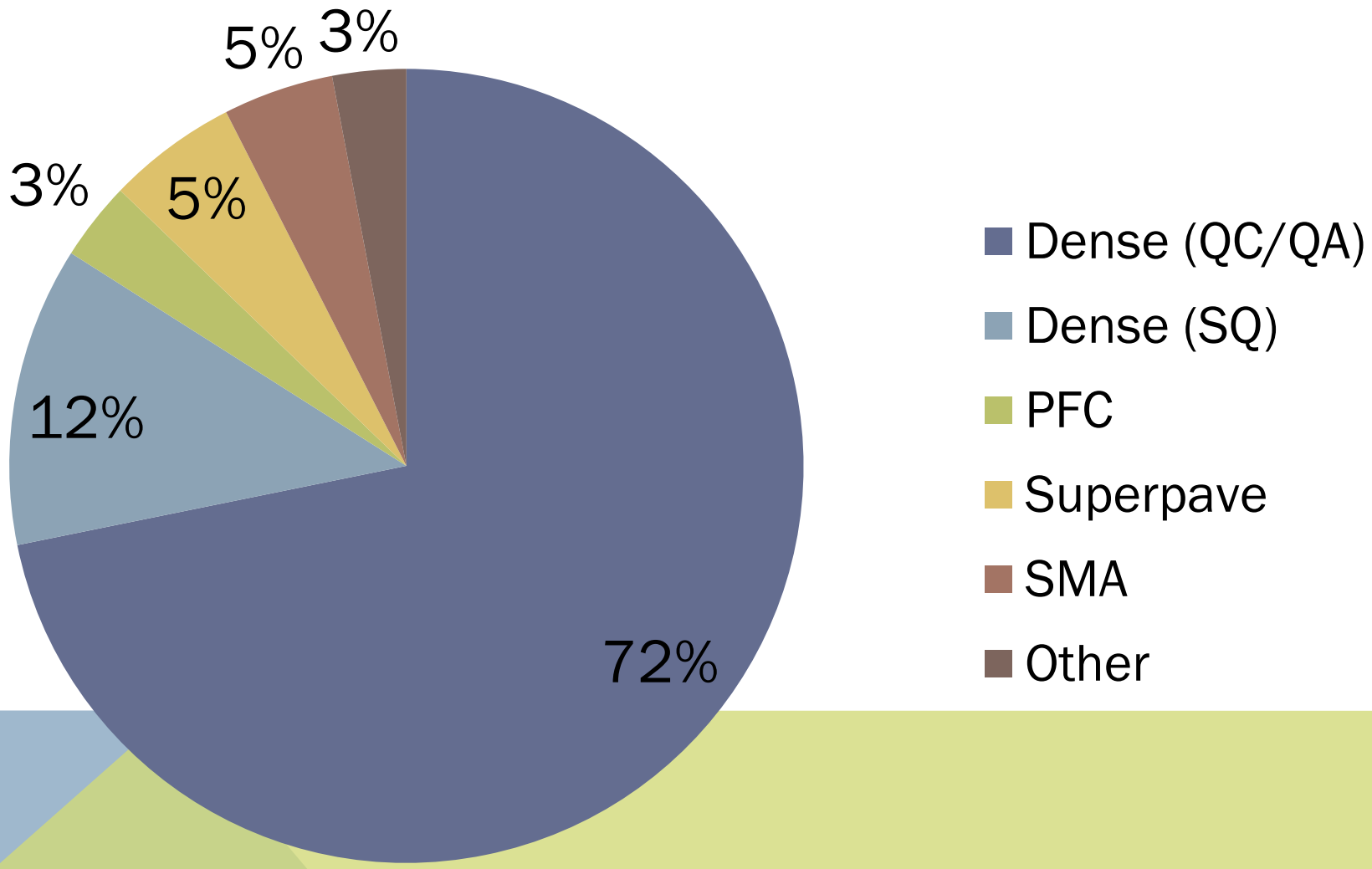
Lower traffic volumes

Bias ply tires

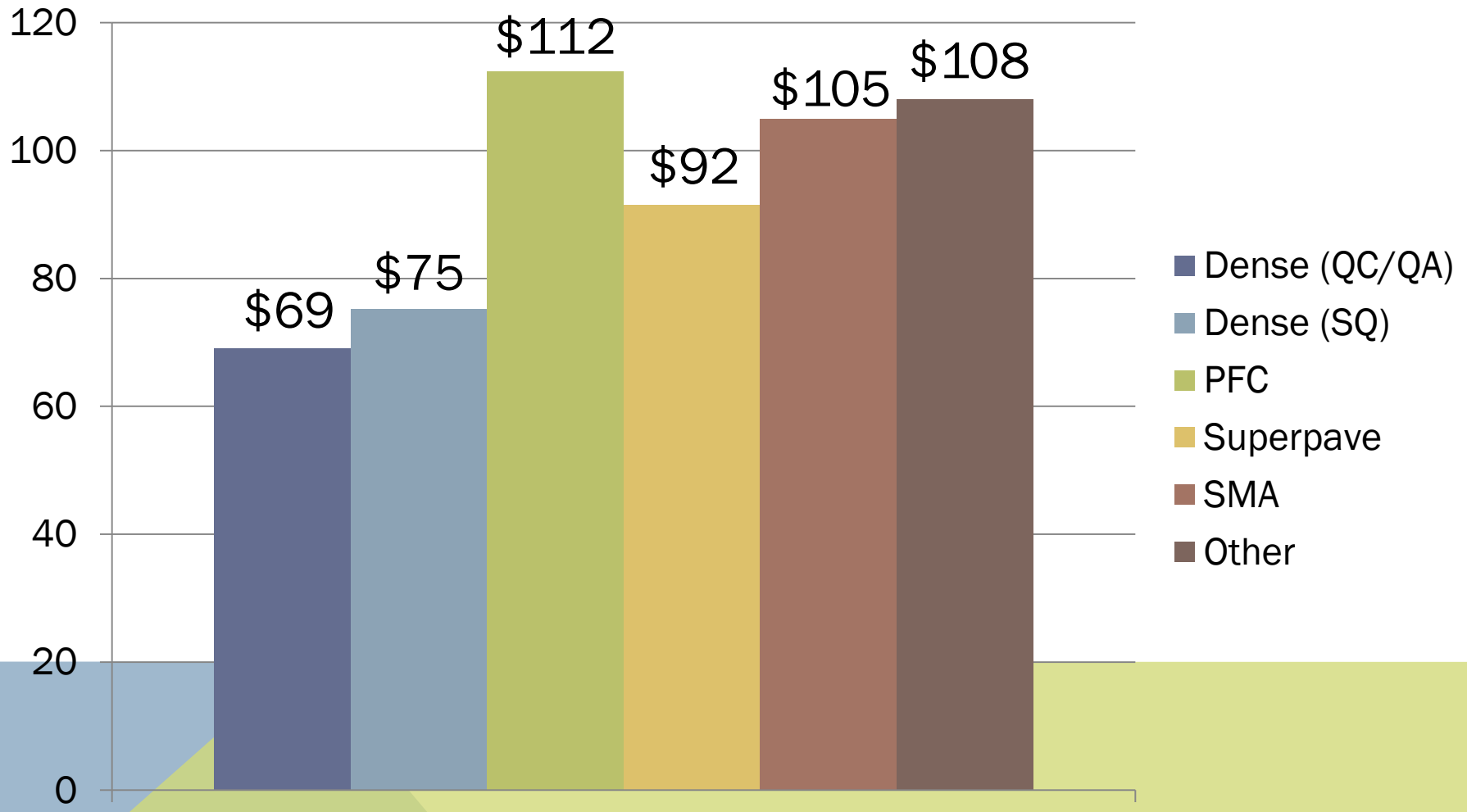
Lower truck weights

TYPICAL STAGE CONSTRUCTION /OVERLAY STRATEGY

MIX USE (%) - 2012



AVERAGE MIX COST ($/TON) - 2012



MIXTURE SELECTION CRITERIA

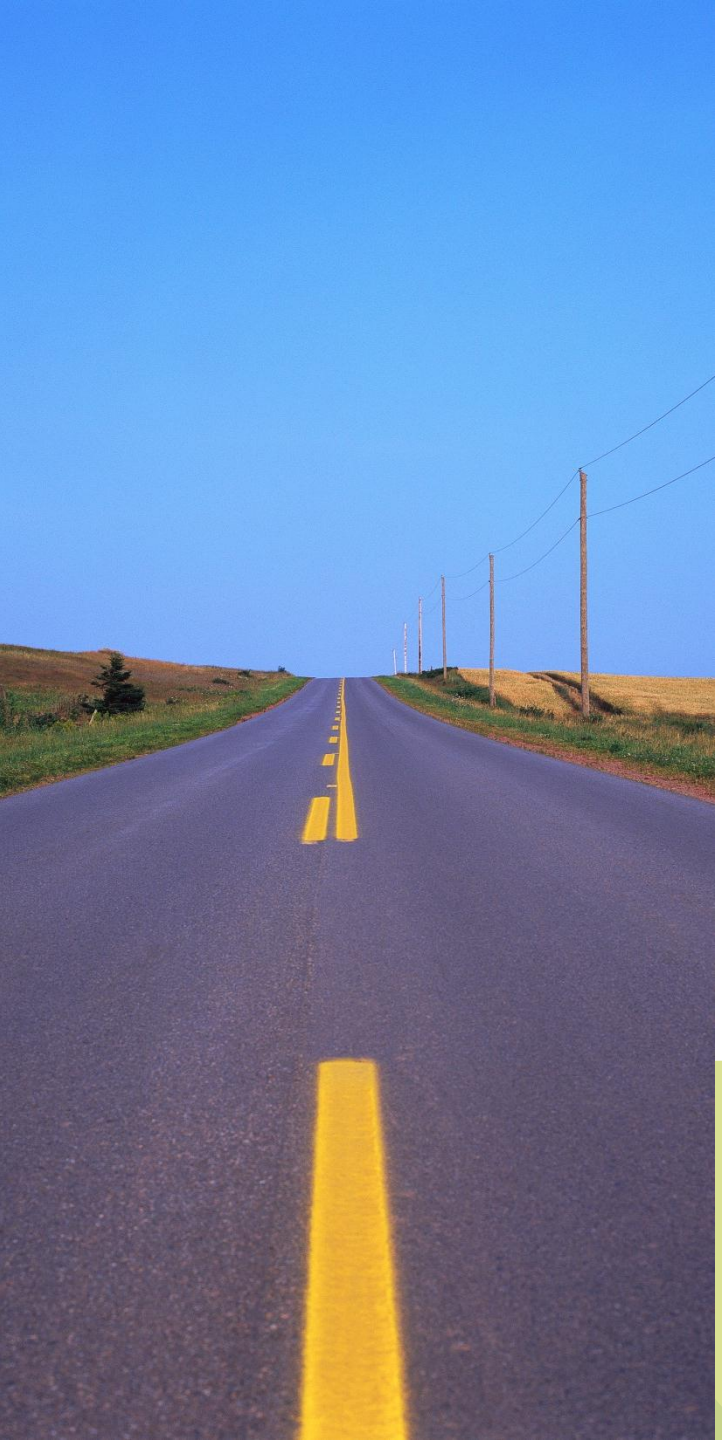
TXDOT	CONTRACTOR
Type of Mix	Aggregate Type
Size of Mix	Substitute Binder
Lift Thickness	WMA (if not required)
Binder Grade	Recycled Materials
WMA required	

MIXTURE SELECTION GOALS

Performance

Functionality

Cost



SS 3267 - DENSE-GRADED HOT-MIX ASPHALT (SMALL QUANTITY)

Typical Use

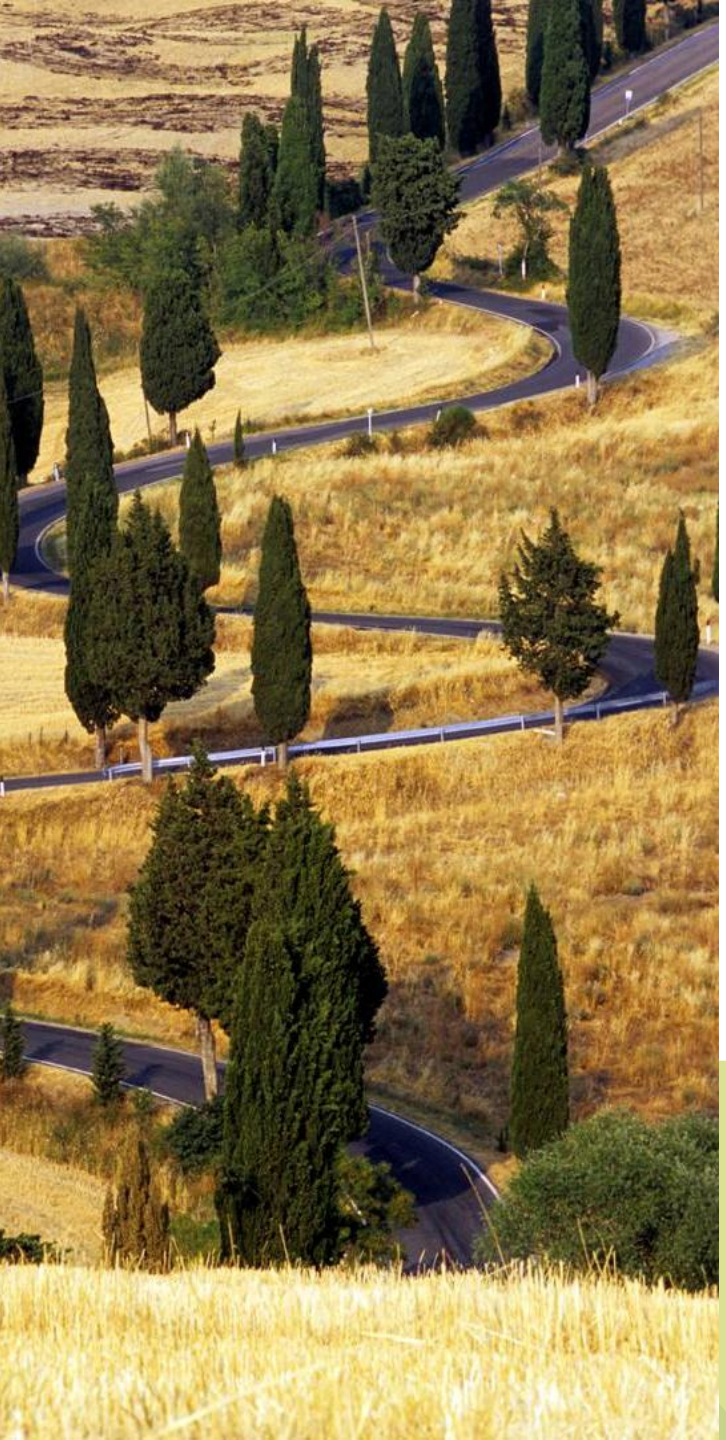
- SS 3267 is typically used for projects with small quantities (less than 5000 tons) of hot mix asphalt (HMA).
- It is recommended for miscellaneous applications such as routine maintenance work, backfilling utility cuts, driveways, etc.

Advantages

- Lower initial cost
- More experience & familiarity

Disadvantages

- Cannot accommodate high AC contents
- No stone on stone contact
- Lower texture for surface mixtures (Type C, D, and F)
- can either rut resistant or crack resistant, but not both.



SS 3268 - DENSE-GRADED HOT-MIX ASPHALT

Typical Use

- SS 3268 can be used for a variety of applications ranging from new construction to overlays.
- Applied to high volume and low volume roads.
- Used as base, intermediate or surface layers.

Advantages

- Lower initial cost
- More experience & familiarity

Disadvantages

- Cannot accommodate high AC contents
- No stone on stone contact
- Low texture of dense graded surface mixtures (Type C, D, and F)
- can either rut resistant or crack resistant, but not both.

SS 3269 – PERMEABLE FRICTION COURSE (PFC)

Typical Use

- SS 3269 is normally used as a surface course on high-speed roadways (>45mph).
- PFCR is recommend as an overlay on existing concrete pavement, when a high degree of noise reduction is required and as an overlay on a pavement that has high severity cracking.

Advantages

- Reduced water spray,
- Improved wet weather visibility
- Improved visibility of pavement markings,
- Reduced tire noise, and
- Restored ride quality.

Disadvantages

- A higher initial cost (PFCR > PFC)
- Additives require modifications to typical HMA production processes.
- They must be placed on a pavement that is structurally sound and relatively impermeable.
- They freeze faster and thaw slower than other mixtures.
- PFC mixtures are not as resistant to high shearing forces.

SS 3270 - SUPERPAVE MIXTURES

Typical Use

- Versatile mix used for a variety of applications ranging from high volume to low volume roadways; from new construction to overlays.
- Used as base, intermediate and surface layers.

Advantages

- Can be used on medium to high volume roadways.
- The binder content can be adjusted by adjusting the N-des level.
- Stone on stone contact
- The coarse surface texture can be beneficial for wet weather traction.

Disadvantages

- More difficult to compact.
- May have intermediate temperature tenderness (tender-zone).
- Gradation is not as “gap graded” as an SMA mixture.
- More susceptible to cracking and water infiltration than SMA mixtures

SS 3271 - STONE MATRIX ASPHALT

Typical Use

- Used as a surface mix or intermediate layer in the pavement structure on high volume roadways.
- SMAR is recommend as an overlay on existing concrete pavement and as an overlay on a pavement that has high severity cracking.

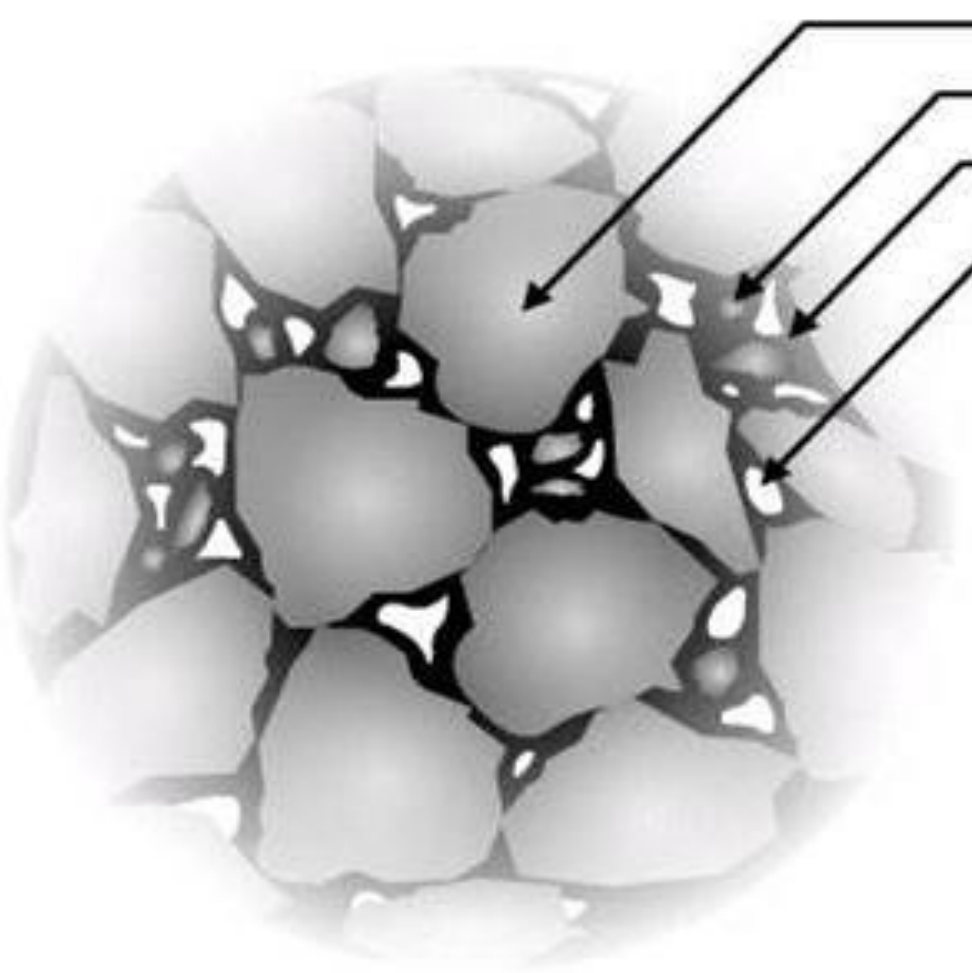
Advantages

- Excellent rut resistance and crack resistance.
- Stone on stone contact.
- Usually more impermeable than performance design mixtures.
- High degree of surface texture beneficial for wet weather traction.

Disadvantages

- Higher initial cost compared to other mixtures.
- Additives require modifications to typical HMA production processes.
- SMA mixtures can be particularly difficult to place and compact in cool weather.

STONE ON STONE CONCEPT



1. The structure begins with a coarse aggregate skeleton which supports loads through stone-on-stone contact. This greatly reduces rutting.

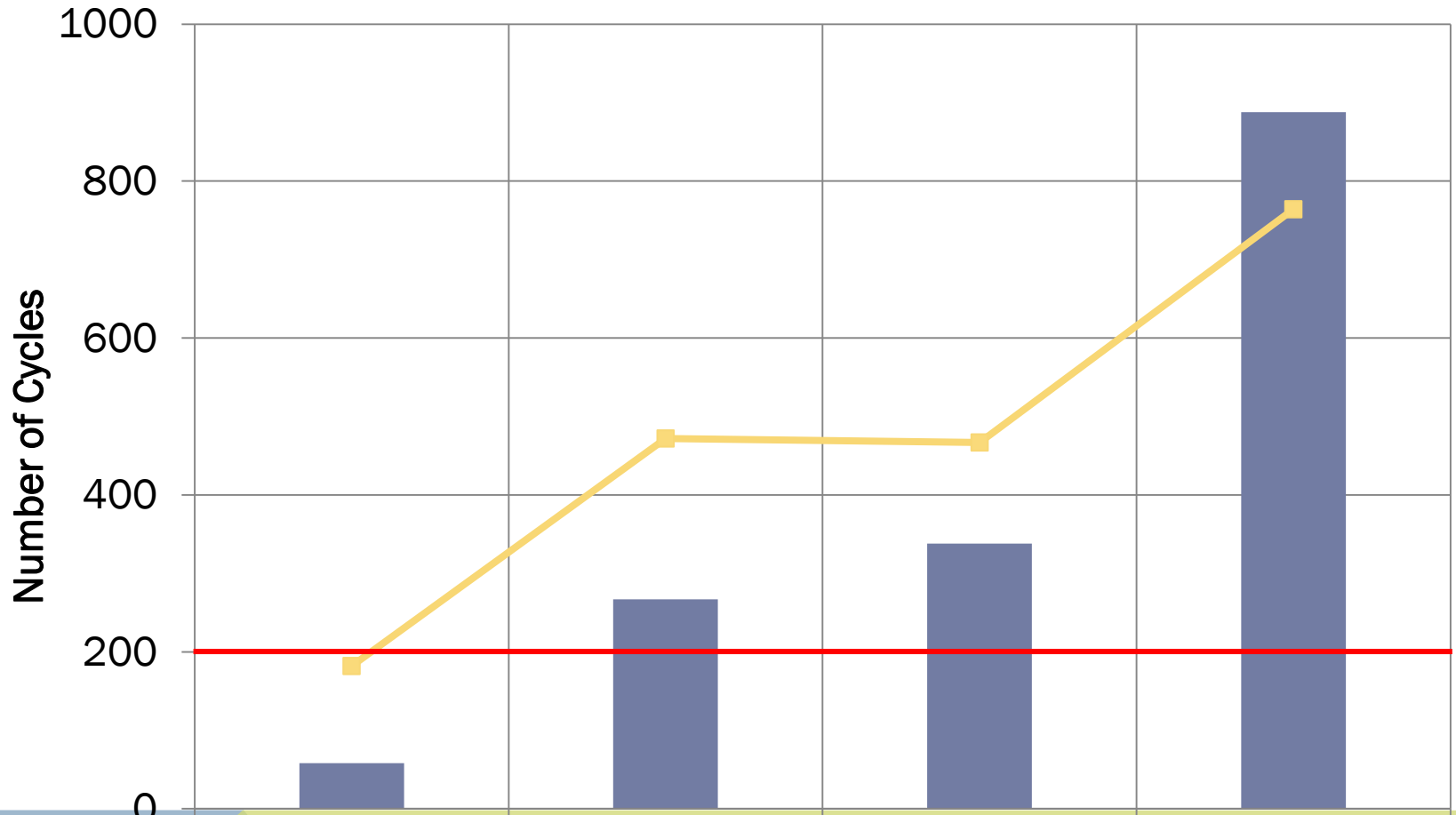
2. This structure is held together by a mortar of:
   - *Inactive particles* (smaller aggreate that do not participate in the coarse aggregate skeleton)
   - *Asphalt binder* (a relatively high amount - usually 6% minimum).

3. The resulting mix has a high VMA (17% minimum) but low air voids (about 4%) because most of the VMA is filled with asphalt binder. The binder is usually modified to prevent draindown.

PREDICTING CRACKING PERFORMANCE WITH THE OVERLAY TESTER

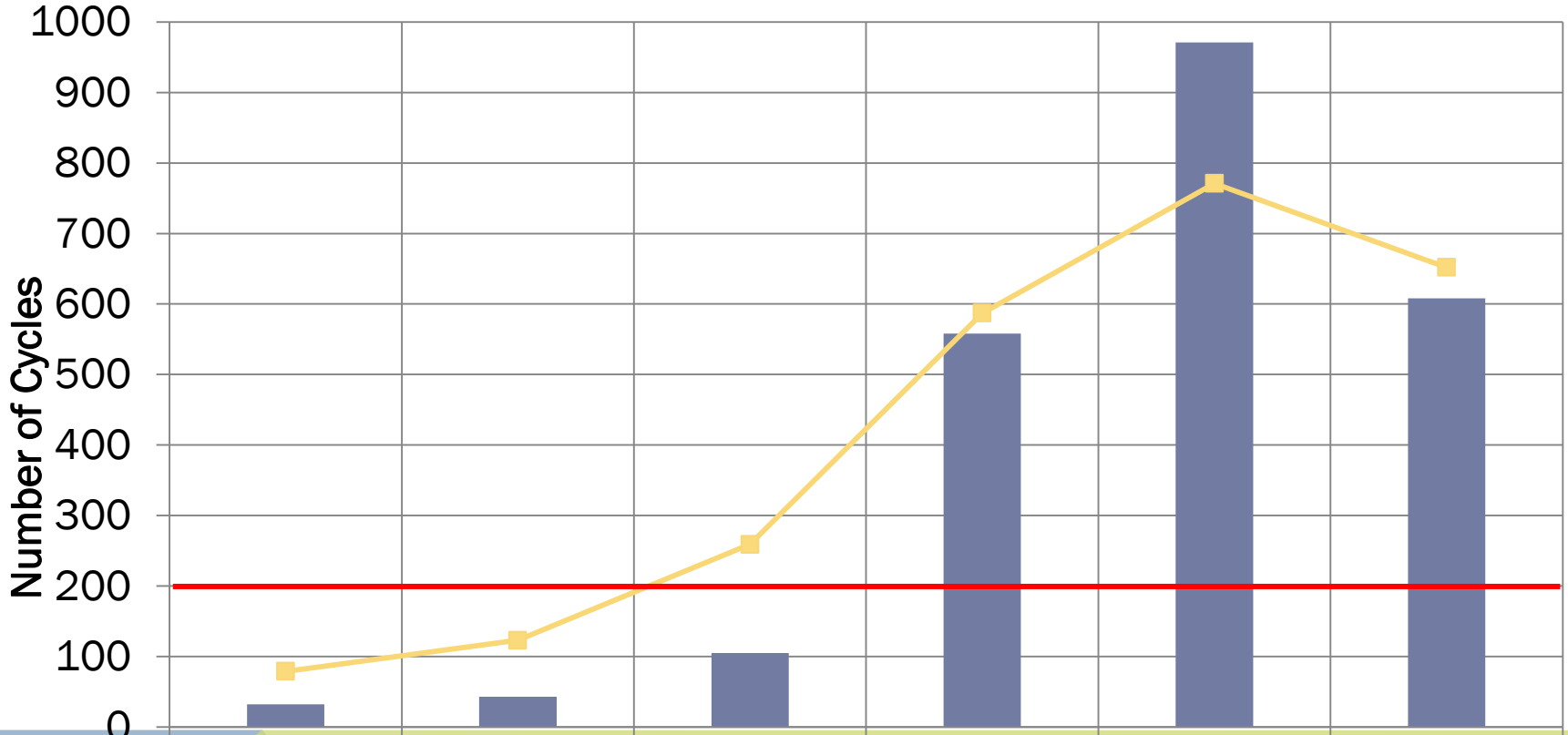
- Research by Tom Scullion at TTI shows there is a good correlation between the Overlay Test result and field performance in terms of reflective cracking
- Initial research showed that mixes that went more than 200 cycles in the Overlay Test generally performed well in the field
- The test has relatively high variability so "look at the trends" rather than the exact numbers. The results can easily vary 50 cycles or more.

OVERLAY TEST - INFLUENCE OF MIX TYPE



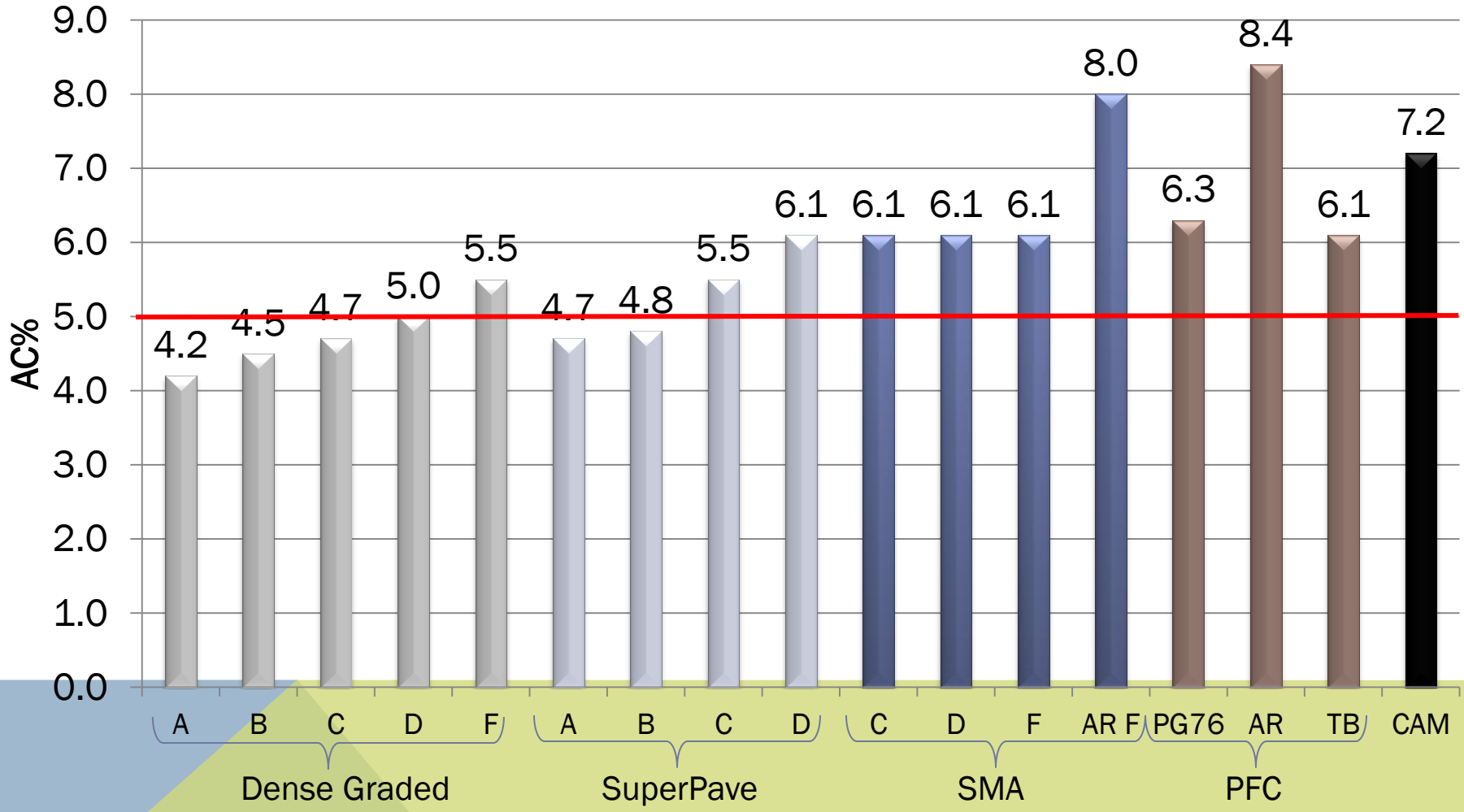
	Dense Graded	Performance Designed	Stone-Matrix Asphalt	RBL/CAM
Median	58	267	338	888
Average	182	472	467	764
Count	476	70	49	101

OVERLAY TEST - INFLUENCE OF ASPHALT CONTENT



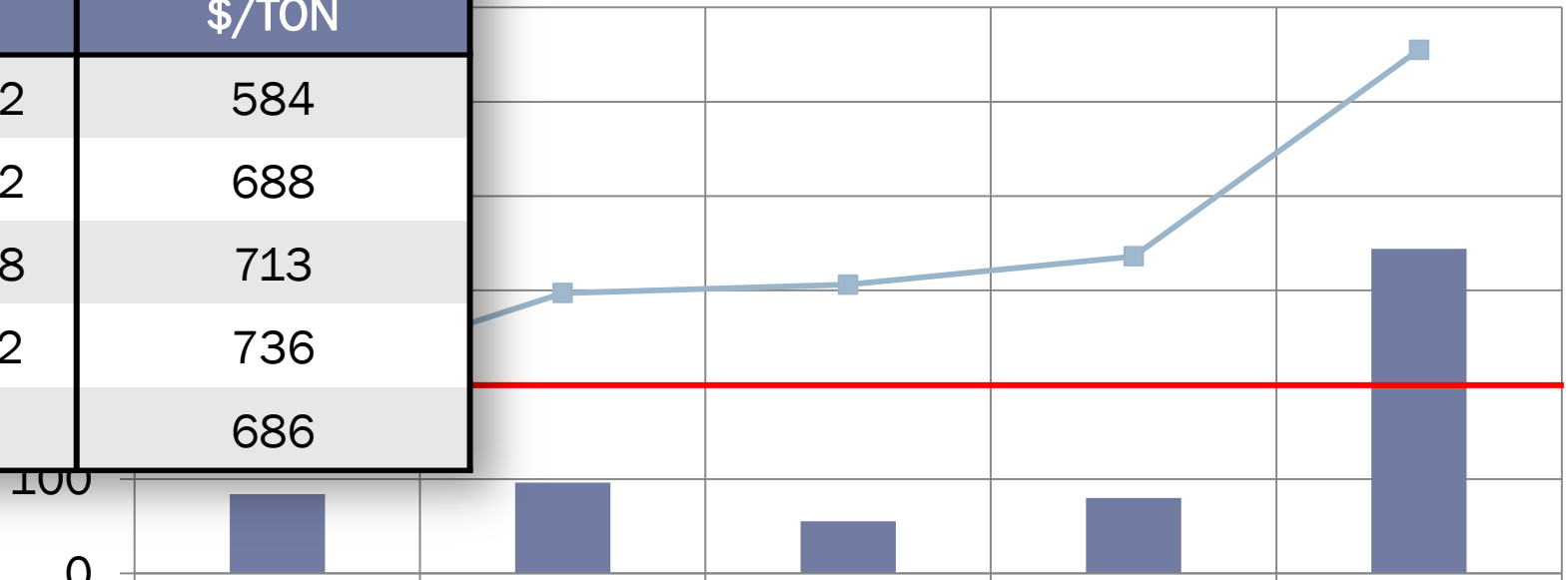
	3.0%-3.9%	4.0%-4.9%	5.0%-5.9%	6.0%-6.9%	7.0%-7.9%	>8.0%
Median	32	43	105	558	971	608
Average	79	123	259	587	771	652
Count	12	223	218	54	79	20

BINDER CONTENT – STATEWIDE AVERAGES



OVERLAY TEST - INFLUENCE OF ASPHALT

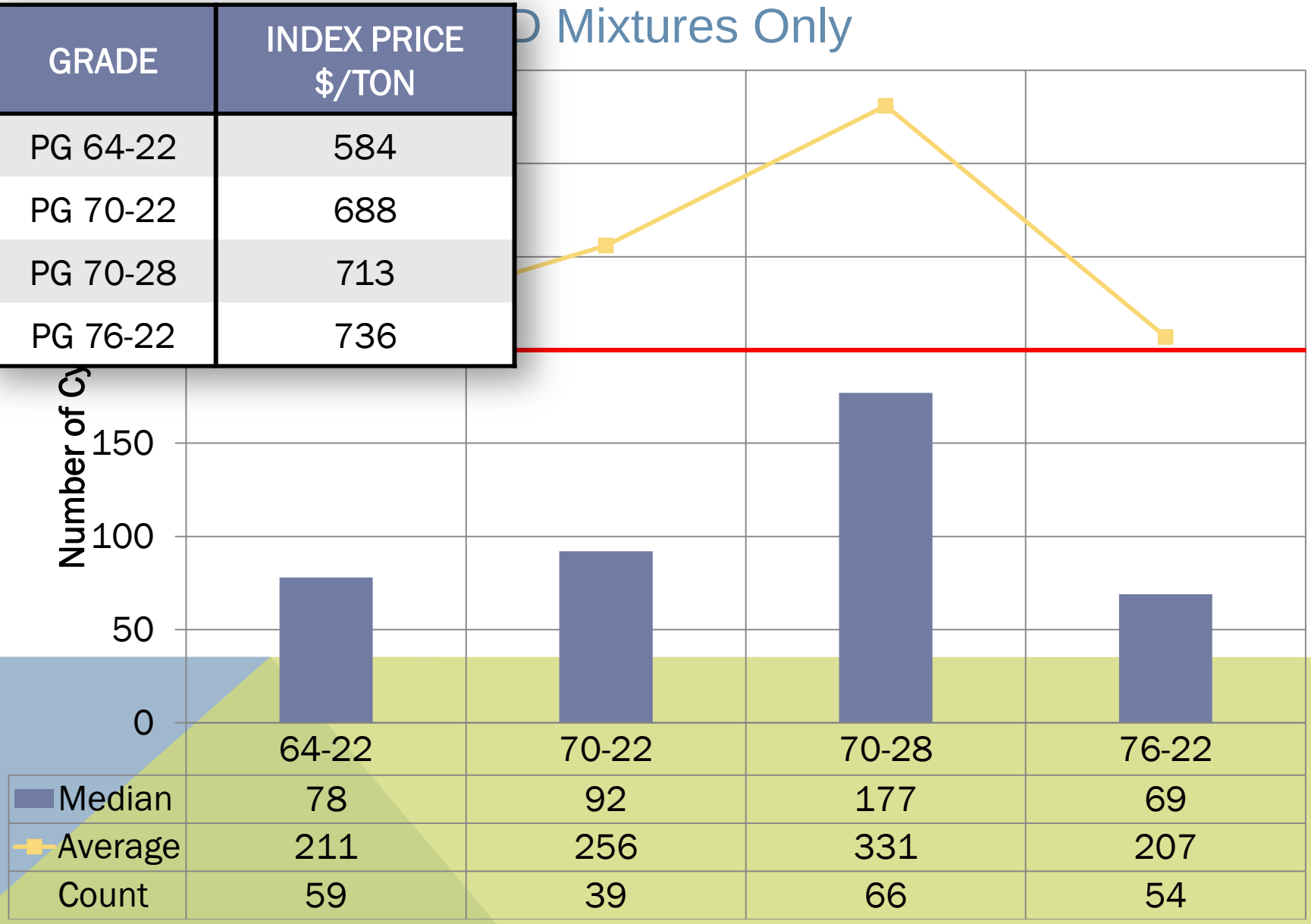
GRADE	INDEX PRICE $/TON
PG 64-22	584
PG 70-22	688
PG 70-28	713
PG 76-22	736
CRM	686



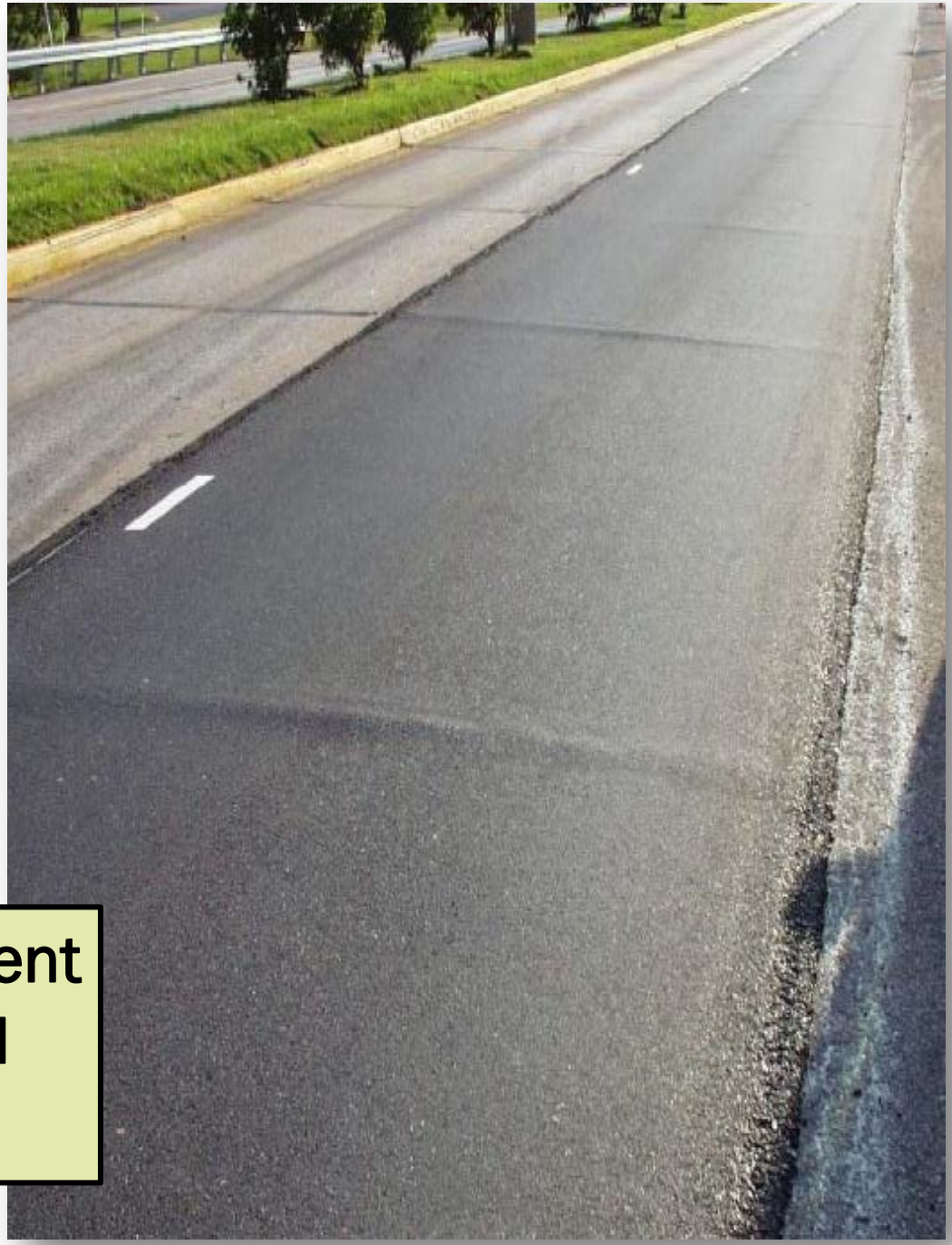
	64-22	70-22	70-28	76-22	CRM
Median	84	96	55	80	344
Count	119	156	69	172	21
Minimum	2	1	2	2	14
Maximum	1200	1200	1200	1200	1200
Average	199	297	306	336	555

OVERLAY TEST - INFLUENCE OF ASPHALT

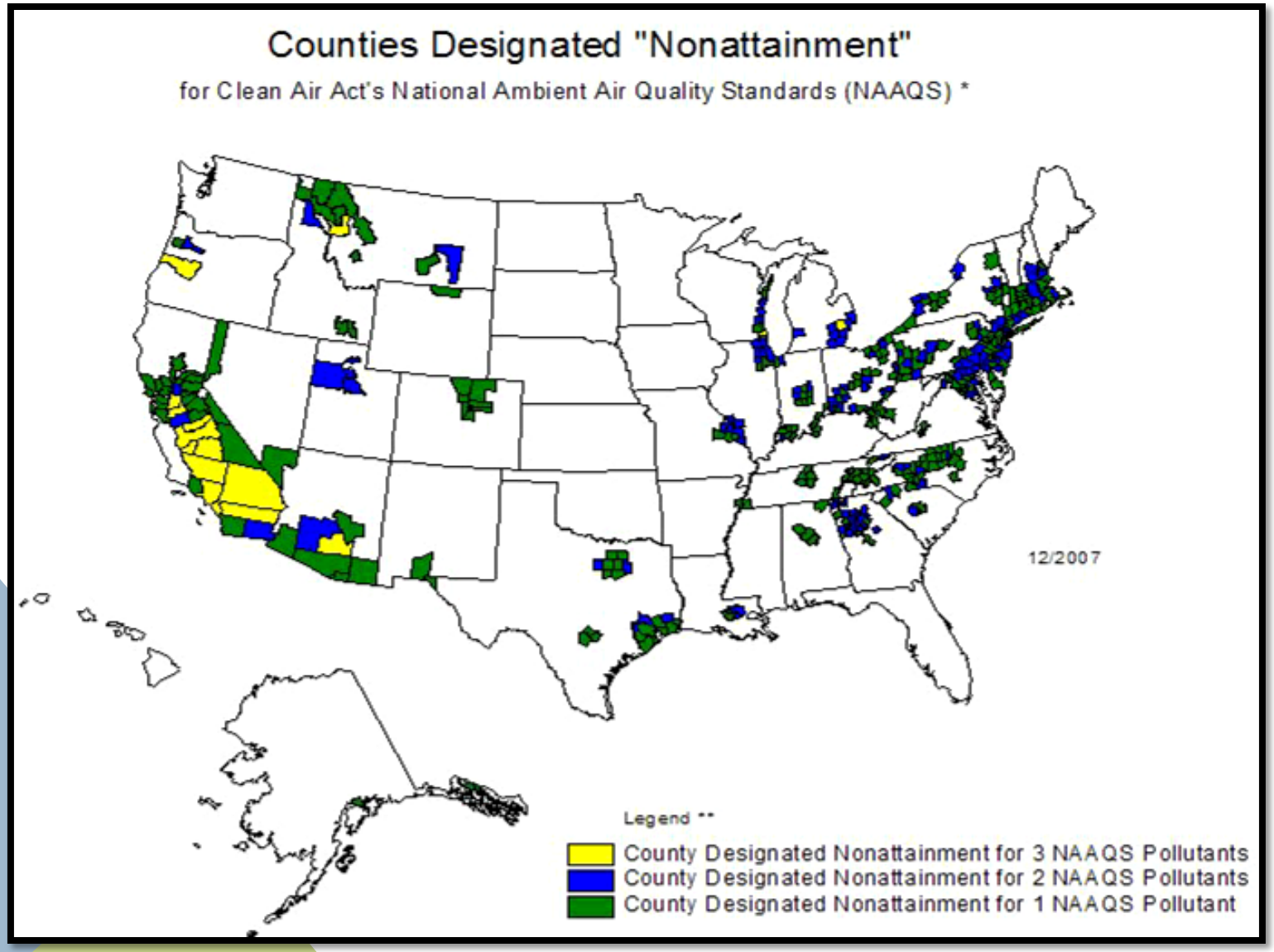
GRADE	INDEX PRICE $/TON
PG 64-22	584
PG 70-22	688
PG 70-28	713
PG 76-22	736



WMA (REQUIRED)



Jointed Concrete Pavement with Rubber Joint Seal Material under HMA



CURRENT NON-ATTAINMENT AREAS

HMA

WMA

MIXTURE SELECTION CRITERIA

TXDOT	CONTRACTOR
Type of Mix	Aggregate Type
Size of Mix	Substitute Binder
Lift Thickness	WMA (if not required)
Binder Grade	Recycled Materials
WMA required	

MIXTURE SELECTION GOALS

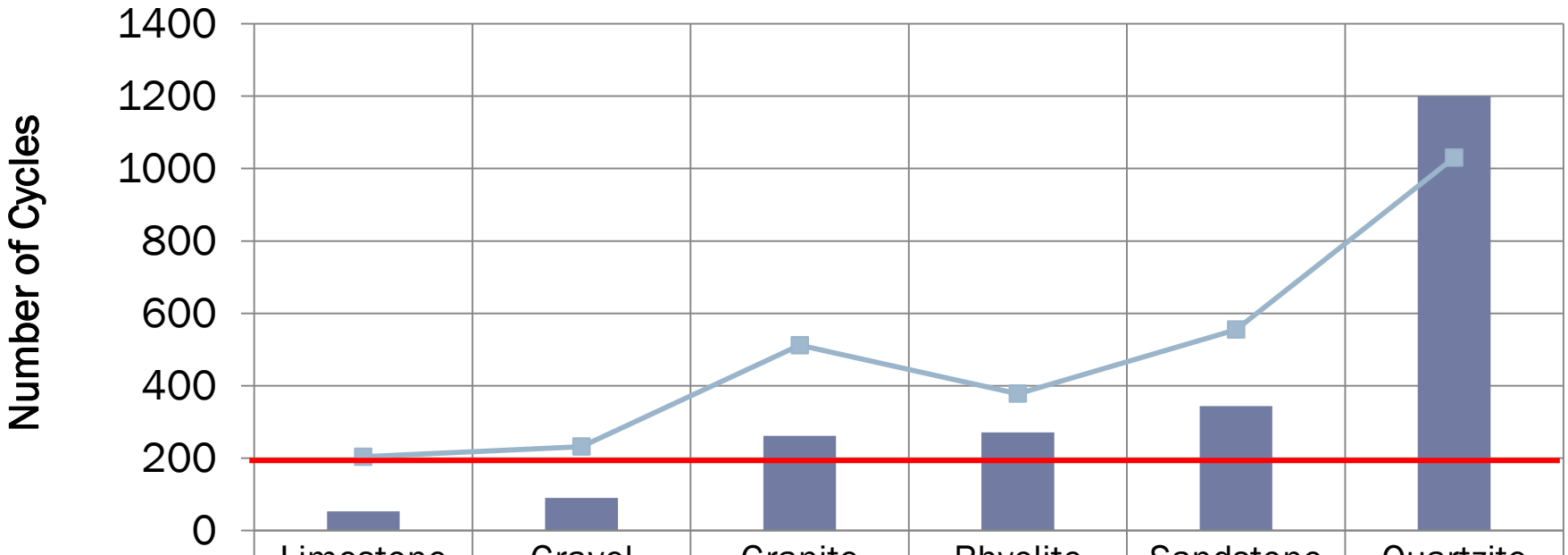
Performance

Functionality

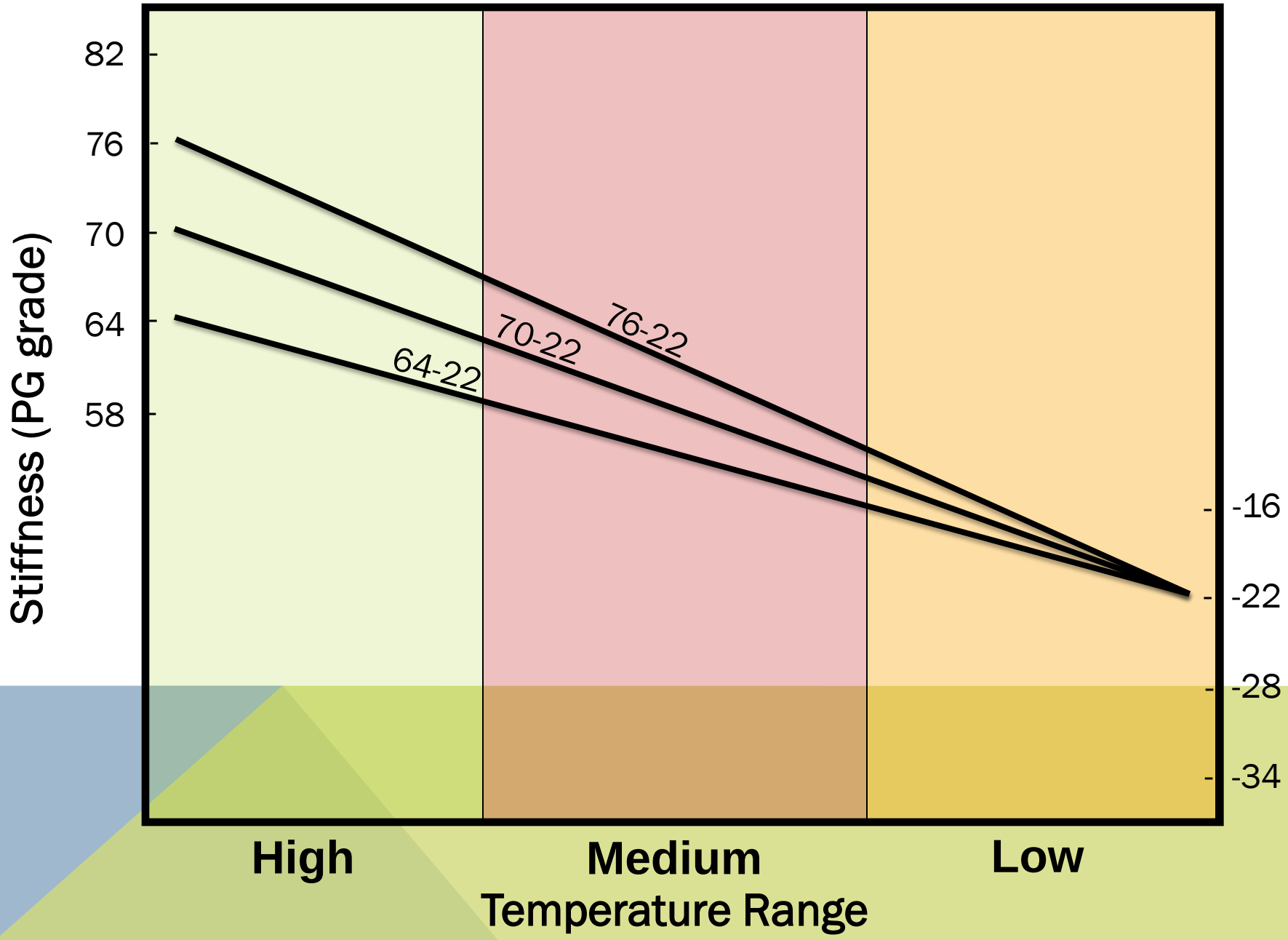
Cost

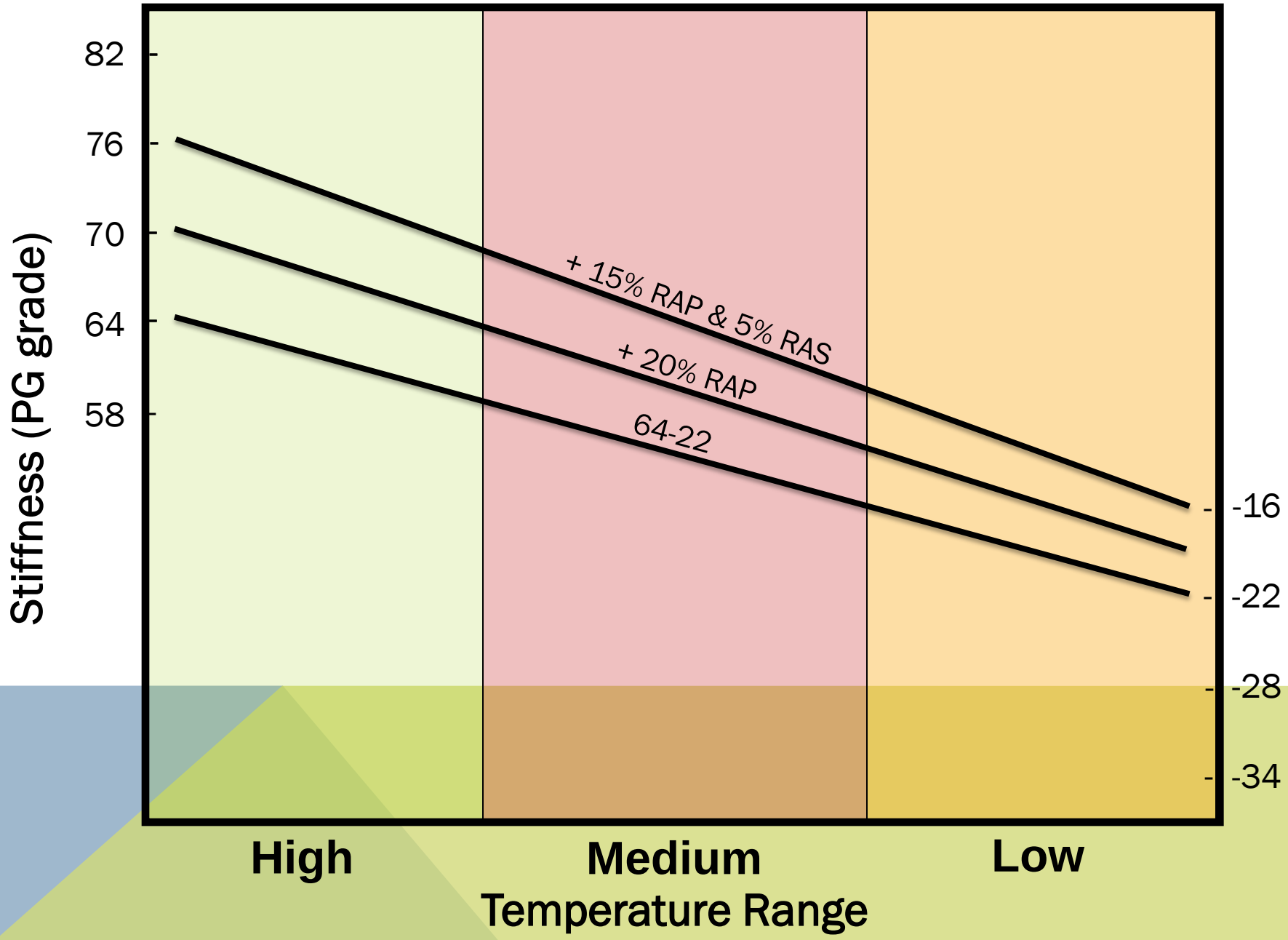
OVERLAY TEST - INFLUENCE OF AGGREGATE TYPE

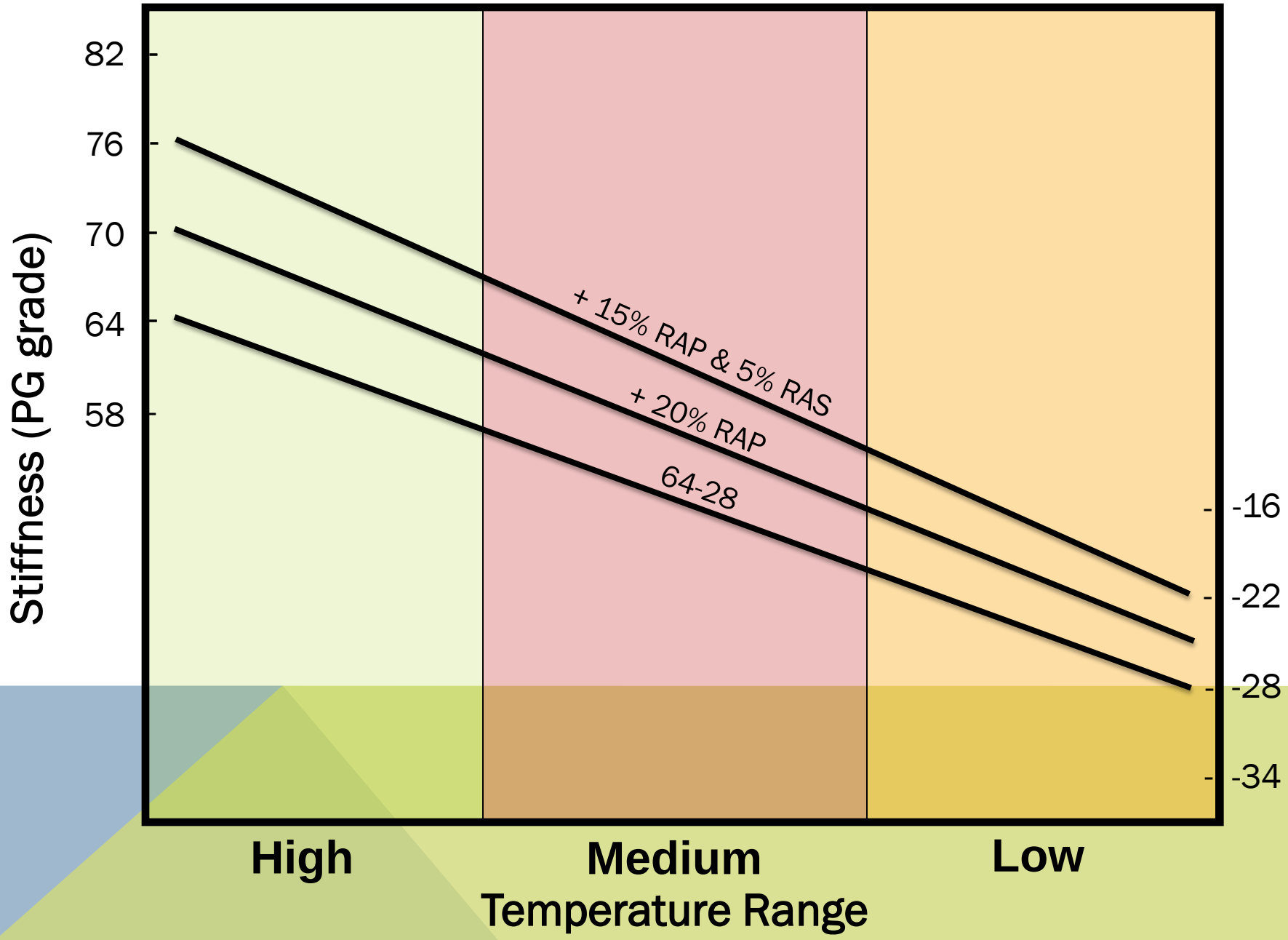
All Mixtures



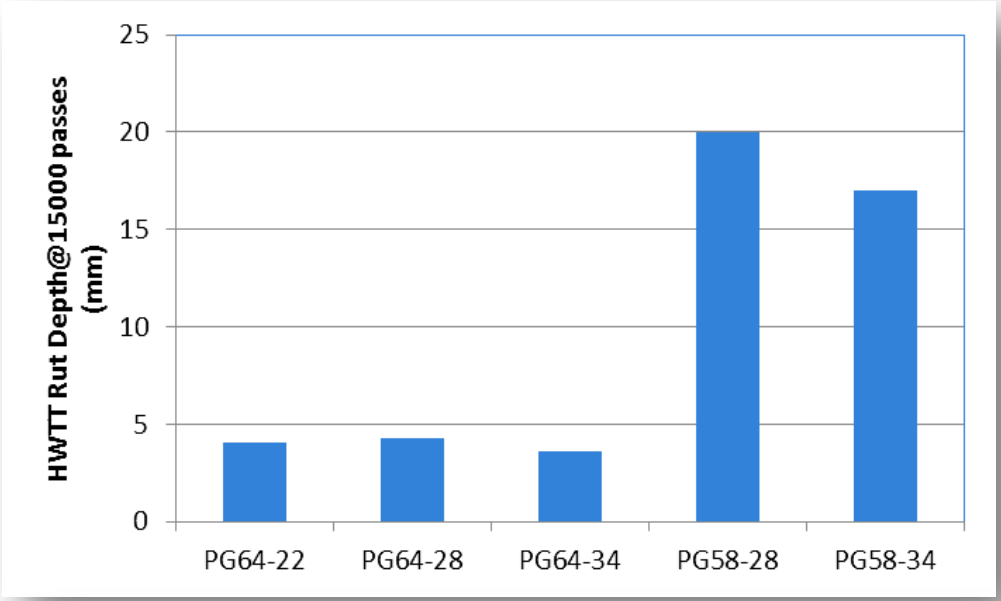
	Limestone	Gravel	Granite	Rhyolite	Sandstone	Quartzite
Median	53	90	262	271	344	1200
Count	147	62	80	15	25	14
Minimum	2	2	2	80	10	457
Maximum	1200	1200	1200	1200	1200	1200
Average	204	232	512	378	555	1030

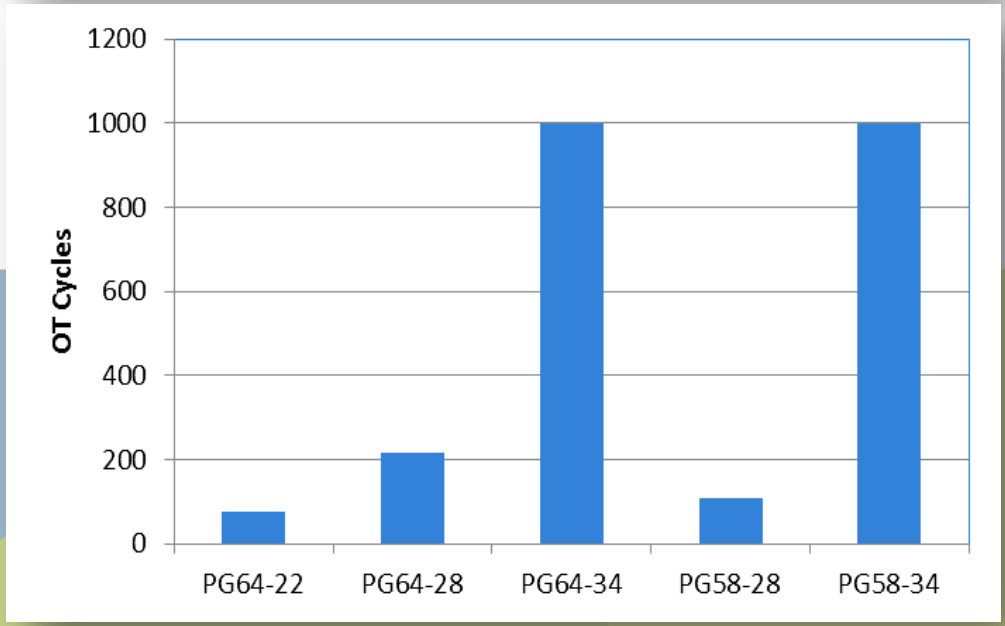

Stiffness (PG grade)
82
76
70
64
58
76-22
70-22
64-22
-16
-22
-28
-34
High
Medium
Low
Temperature Range


Stiffness (PG grade)
82
76
70
64
58
+ 15% RAP & 5% RAS
+ 20% RAP
64-22
-16
-22
-28
-34
High
Medium
Low
Temperature Range


82
76
70
64
58
Stiffness (PG grade)
+ 15% RAP & 5% RAS
+ 20% RAP
64-28
-16
-22
-28
-34
High
Medium
Low
Temperature Range

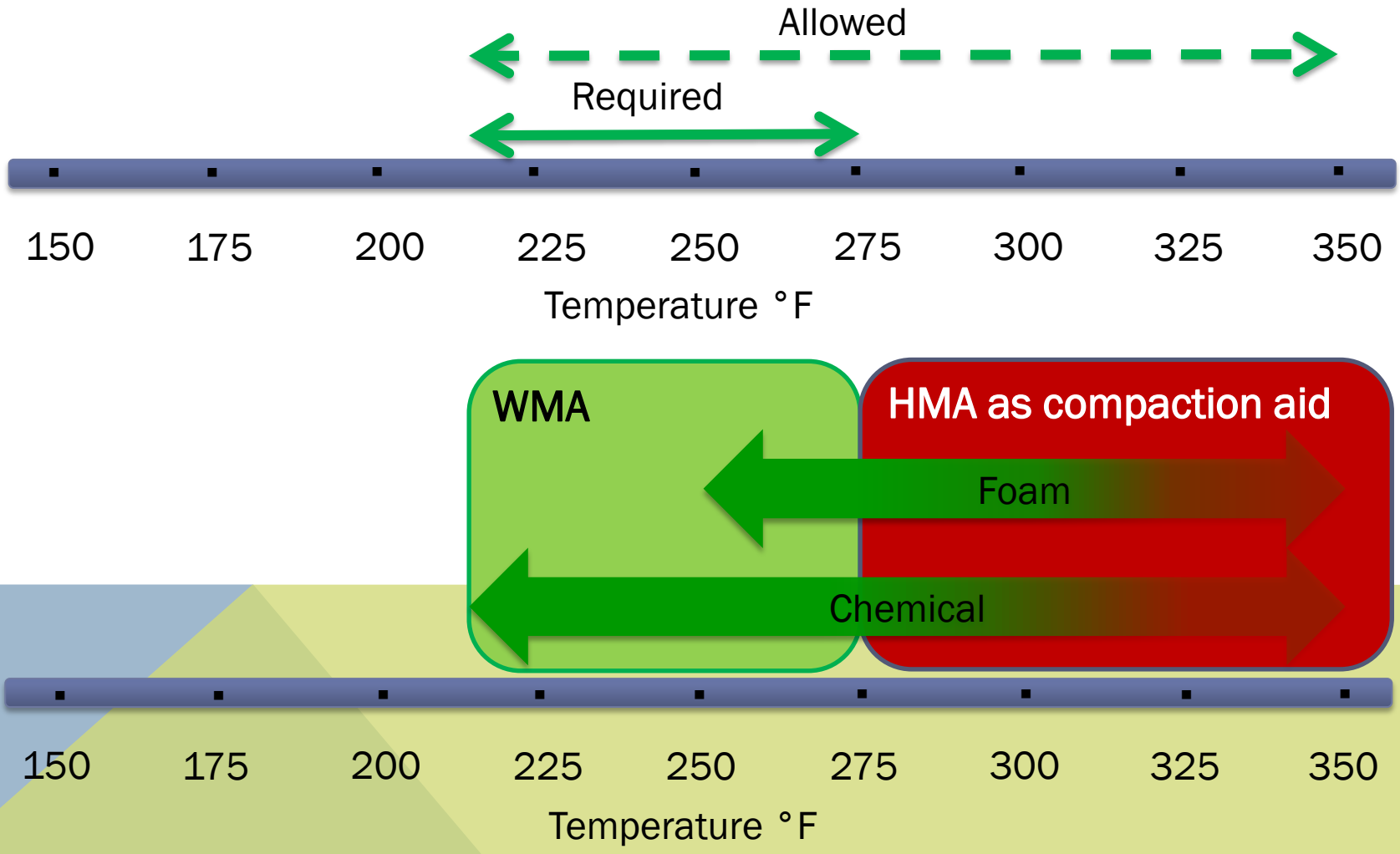
INFLUENCE OF SOFTER BINDER





Aggregate	Sandstone
Density	96.5%
AC Grade	Varies
RAP	15%

WMA TEMPERATURE BASICS



FRACTIONATE

GRIND FINE

ASPHALT COMPONENTS

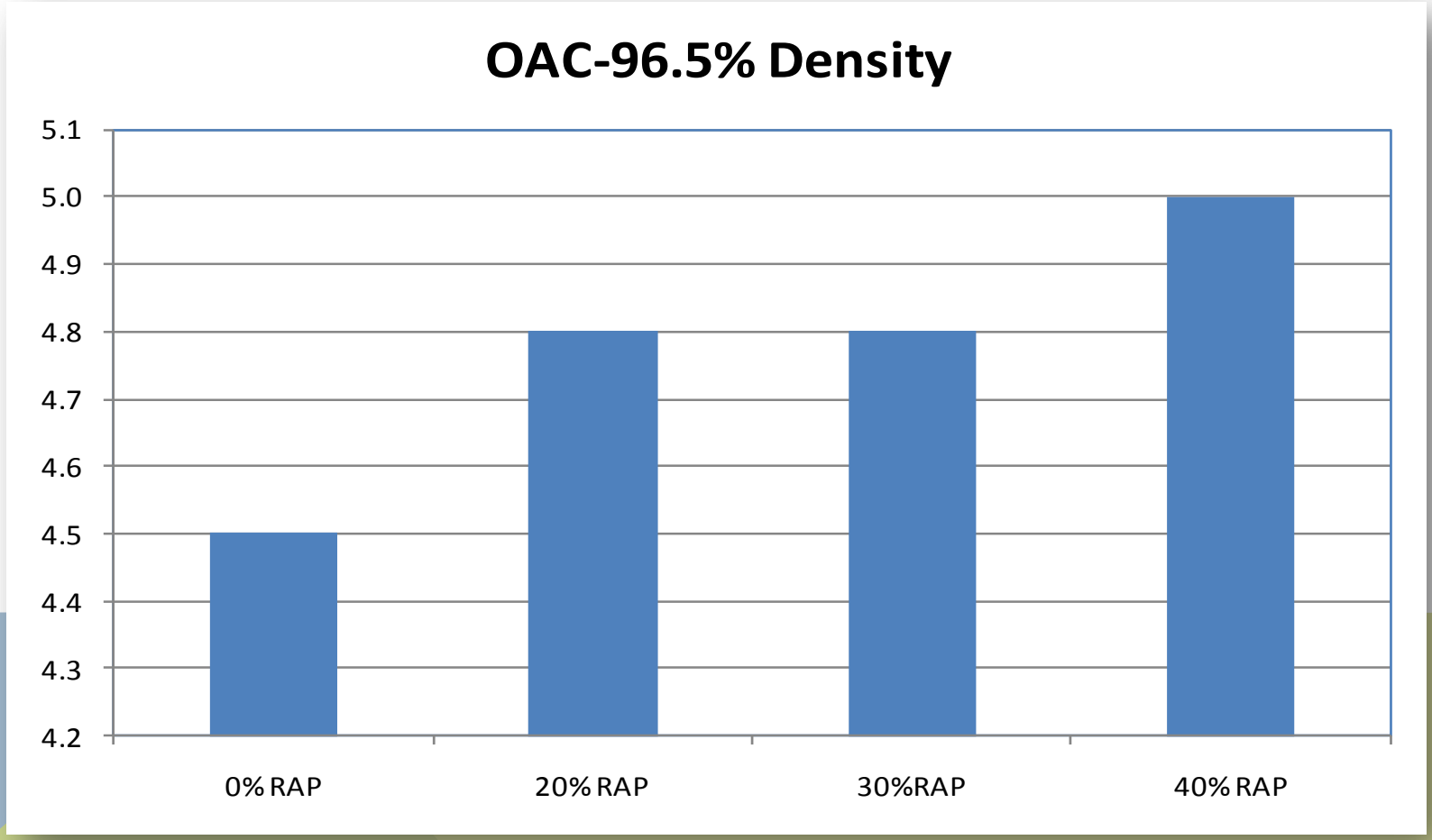
Saturates Oleifins Aromatics Polar Compounds Asphaltenes

Light Ends

Maltenes

INFLUENCE OF RAP ON OAC

Not All Recycled Binder Becomes Effective Asphalt



EVERY MIX SHOULD BE DESIGNED TO FIT THE PROJECT IT WILL BE USED ON!

VARIABLES

Climate

Traffic

Base and Subgrade Conditions

Intended Use - Functionality

Location in the Pavement

Available Materials

Cost

APPROACHES TO MIX SELECTION

Theoretical:

- Start by doing a pavement design (thickness)
- Consider all the variables
- Select the right mix for the right job

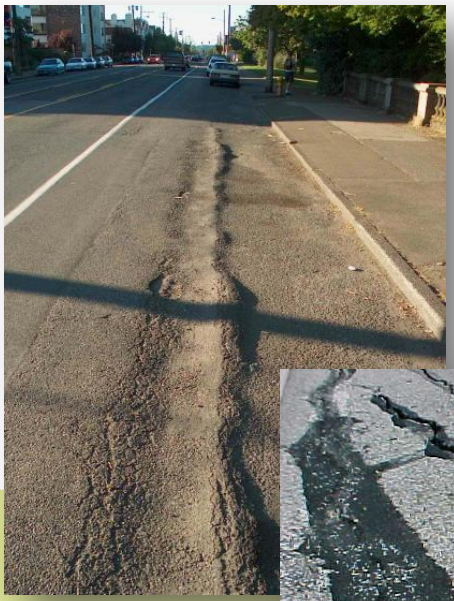
Reality:

- Divide the amount of money available for the project by the number of square yards and do the best you can with what you have to work with
- Avoid rutting at all cost
- Hope and pray for durability (stay below the radar on cracking, raveling etc.)

GETTING STARTED

Questions to Consider:

- Is the problem a function of inadequate structure (thickness)
- Is the problem a function of something unrelated to the surface mix type such as
  - Poor drainage
  - Debonding
  - Segregation
  - Poor ride quality
  - Sulfate heaving
  - Environment factors (thermal cracks, shrinkage cracks)
  - Etc.



ASSUMPTIONS FOR THIS PRESENTATION

- The pavement is structurally adequate
- The primary focus is on improving the crack resistance of the surface layer
- There is some flexibility on the selecting the lift thickness. Example: you could use 1.25” of SMA versus 2.5” of Type C

MIX TYPES – SIZE MATTERS

SS 3267 Dense Graded (Small Quantity)

- Type A
- Type B
- Type C
- Type D
- Type F

SS 3268 Dense Graded

- Type A
- Type B
- Type C
- Type D
- Type F

SS 3269 Permeable Friction Course

- PFC-F
- PFC-C
- PFCR-F
- PFCR-C

SS 3270 Superpave Mixtures

- SP-A
- SP-B
- SP-C
- SP-D
- CM-B
- [illegible]

SS 3271 Stone-Matrix Asphalt

- SMA-C
- SMA-D
- SMA-F
- SMAR-C
- SMAR-F

FIRST CHOICE: SELECTING THE RIGHT MIX

(BASED ON OVERLAY RESULTS)

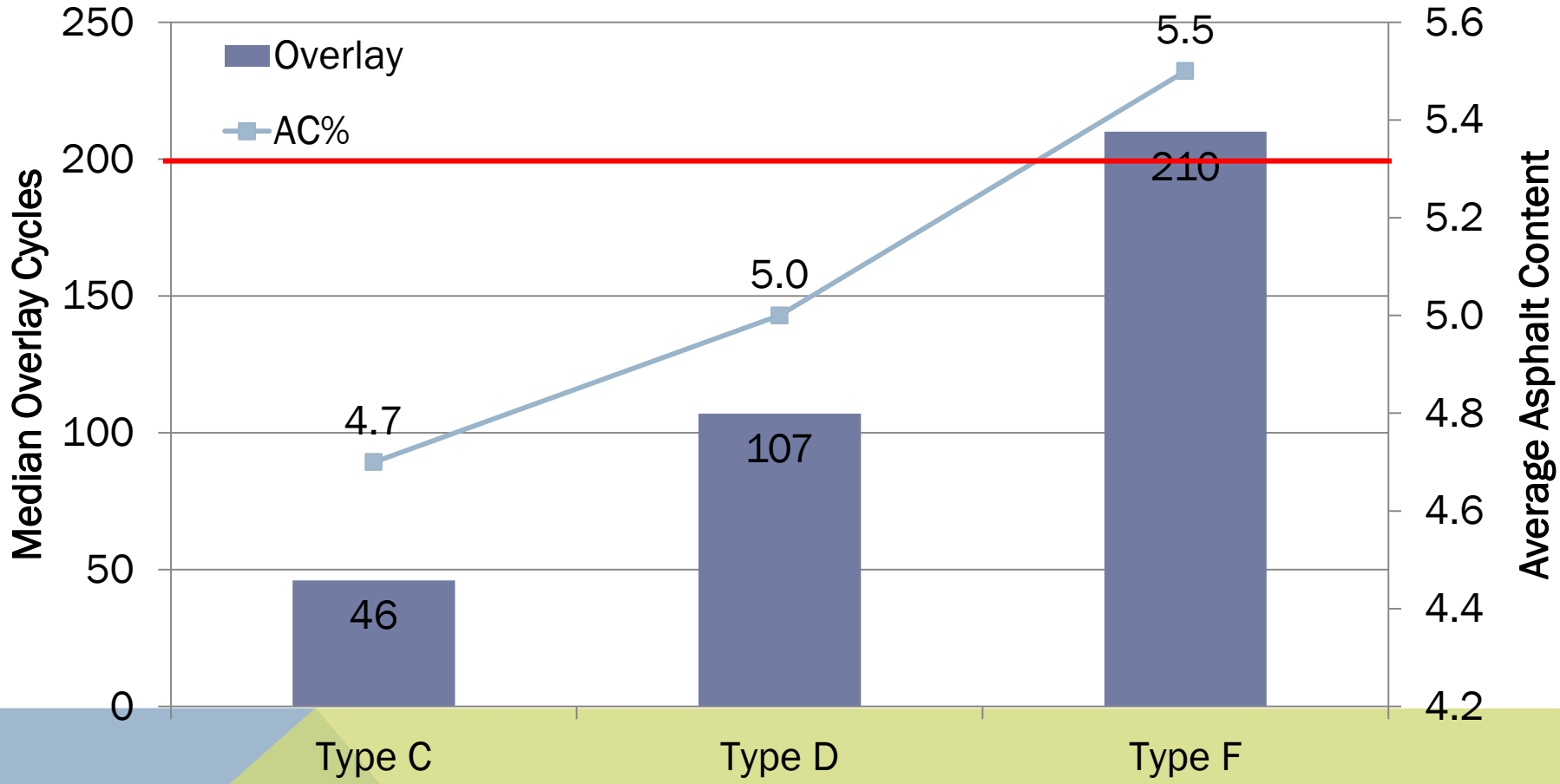
GOOD
Type C
Type D
Type F

BETTER
SP-C
SP-D

BEST
SMA-C
SMA-D
SMA-F
SMAR-C
SMAR-F

SPECIALTY
PFC-C
PFC-F
PFCR-C
PFCR-F
TOM

HOW GOOD ARE THE “GOOD” MIXES?



ARE FINER MIXES WORTH THE COST INCREASE?

Mix Type	Asphalt Content	Cost Increase Over Type C	% Cost Increase Over Type C	Average Overlay Cycles	% Increase Over Type C
Type C	4.7	-	-	46	-
Type D	5.0	+ $2.20	3.1%	107	133%
Type F	5.5	+ $26.13	37.0%	210	350%

Is it worth the cost?

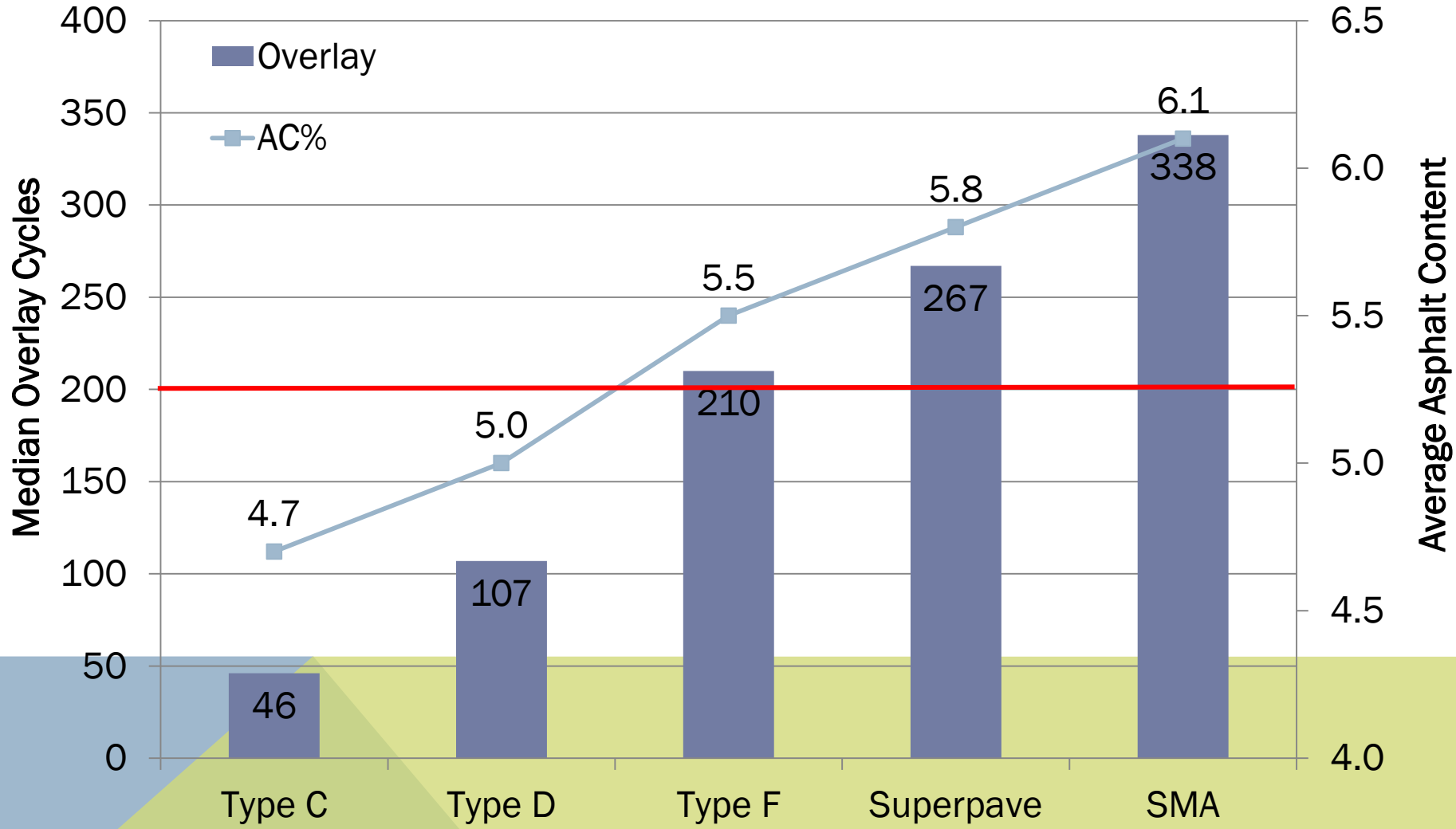
MIX THICKNESS – EFFECT ON MIX COST

Mix Type	Dense Graded			Superpave	
	Type C	Type D	Type F	SP-C	SP-D
Cost/Ton	$71	$73	$97	$92	$92
Cost/SY/Inch	$3.90	$4.01	$5.35	$5.06	5.06
Typical Lift Thickness (in.)	2.5	2.0	1.5	2.0	1.75
Cost/SY/Lift	$9.76	$8.02	$8.00	$10.12	$8.85

OTHER REASONS TO SELECT THE FINER MIX

- Finer mixes generally have equal performance in terms of rutting resistance and superior performance in terms of cracking resistance
- Advantages:
  - Finer mixes can be placed in thinner lifts which reduces the cost per square yard
  - Thinner lifts often produce better ride quality
  - Less truck transitions, paver stops, vertical joints
  - Thinner lifts usually have better density at the joints… they are less permeable
  - Finer mixes are more uniform and less prone to segregation
  - They are less prone to raveling
  - And more workable (transitions, raking etc.)
- The down side: They cool quicker… you have less available time for compaction
- These trends also apply to Superpave, PFC, and SMA

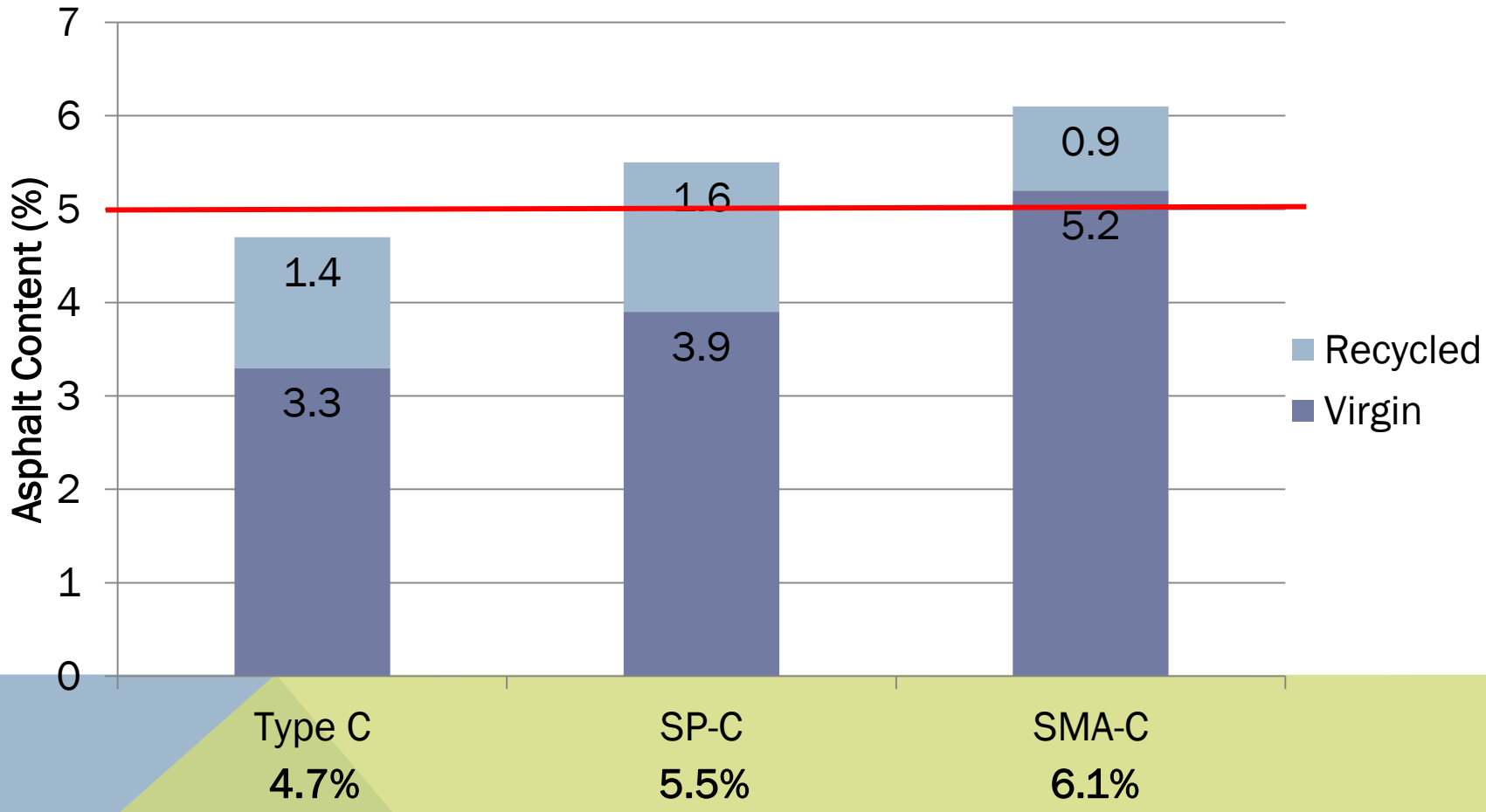
HOW MUCH BETTER ARE THE “BETTER” MIXES?



MIX THICKNESS – EFFECT ON MIX COST

Mix Type	2” Dense Graded Type D	1.5” PFC PFC-C	1.0” PFC PFC-F	2” SMA SMA-D	1” SMA SMA-F
Cost/Ton	$73	$112	$112	$105	$105
Cost/SY/Lift	$8.02	$7.56	$5.04	$11.55	$5.77
Cost /Mile	$56,460	$53,222	$35,482	$81,312	$40,621

OTHER ADVANTAGES TO USING SUPERPAVE AND SMA



Note: Only SMA has a minimum overlay requirement of 200 cycles.

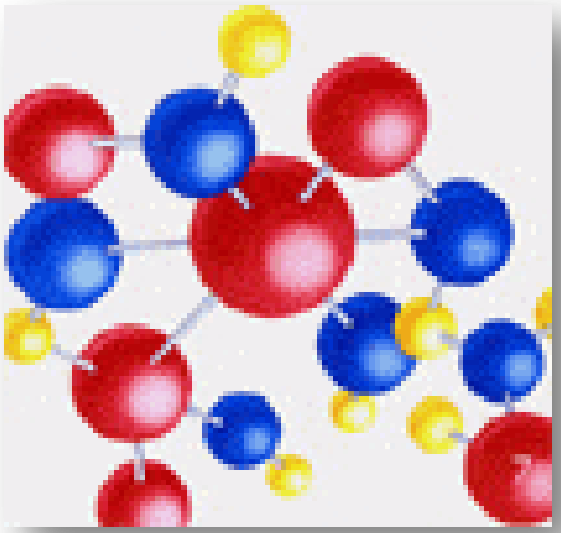
WHY CAN'T I JUST PUT MORE ASPHALT IN MY TYPE D MIX?

- Requires Raising The Target Lab Density
- Maximum Target Lab Density is 97.5%
- Start Running the Risk of Rutting/Flushing
- Dense Graded Mixes Will Not Accommodate High Asphalt Binder Percentages
- TGC Tends to Produce Lean Mixes

IF I CAN'T PUT MORE ASPHALT IN MY DENSE GRADED MIX, CAN I USE A BETTER OR SOFTER ASPHALT?

Additives/Modifiers

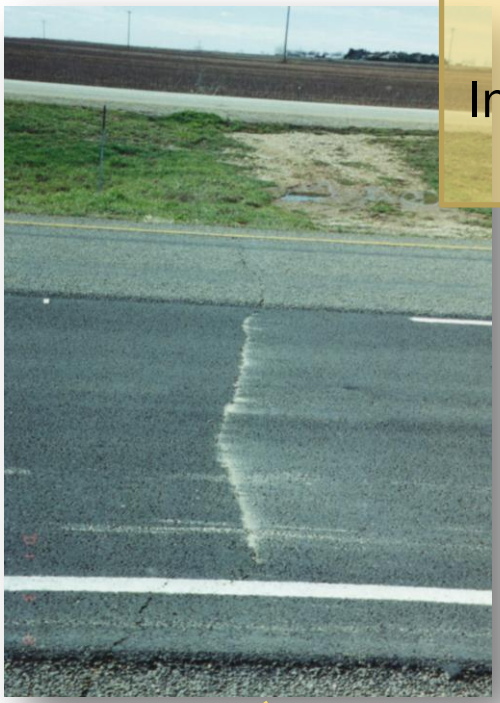
- SBS
- Tire Rubber (Terminal Blend)
- SBR (Latex)
- Asphalt Rubber (Wet Process)
- Additives/Modifiers



Softer Asphalt Binder

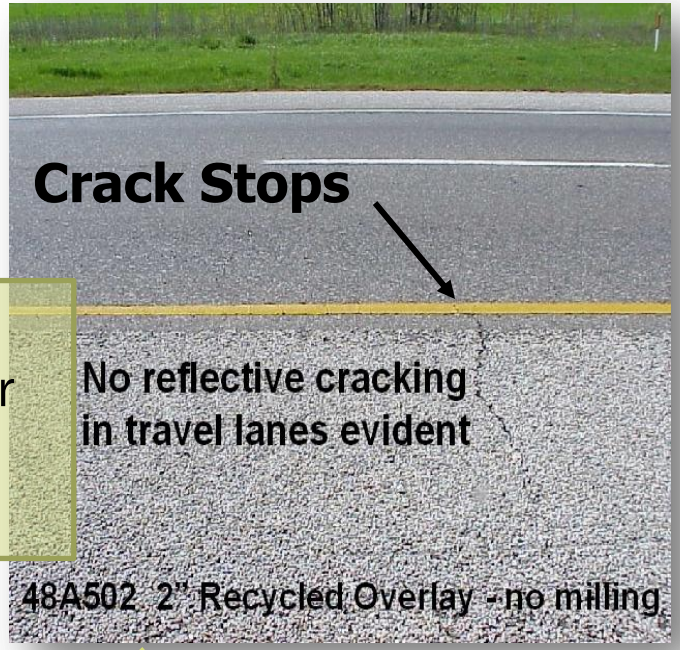
- PG 76-22 versus PG 64-22 (high temp. grade dump)
- PG 70-22 versus PG 70-28 (low temp. grade bump)

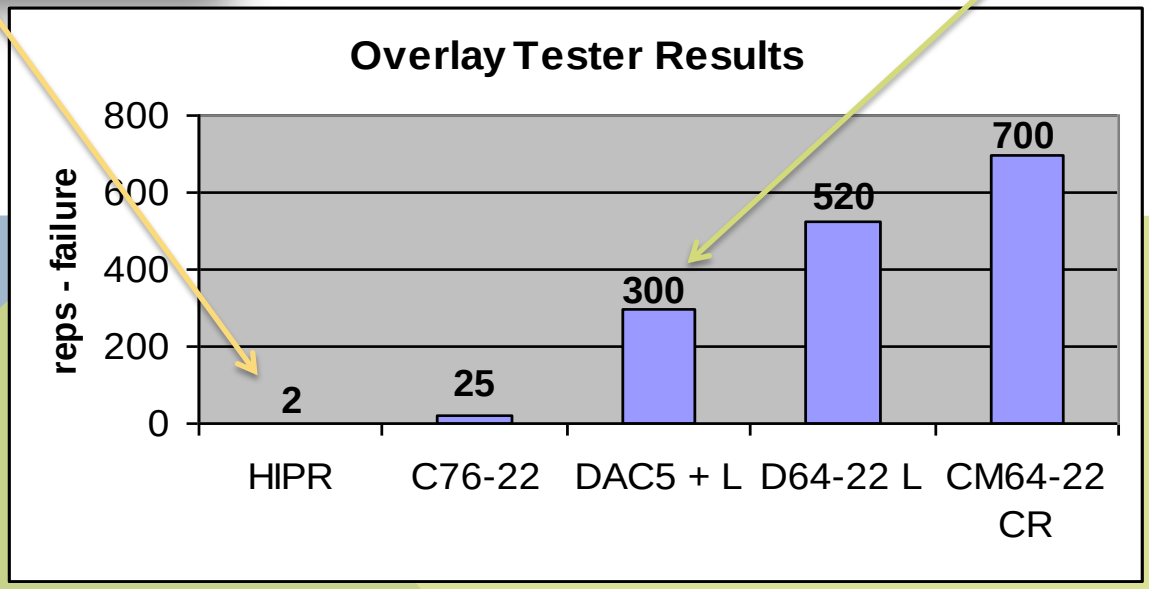
STATEWIDE EVALUATION OF GOOD/BAD REFLECTION CRACKING PROJECTS



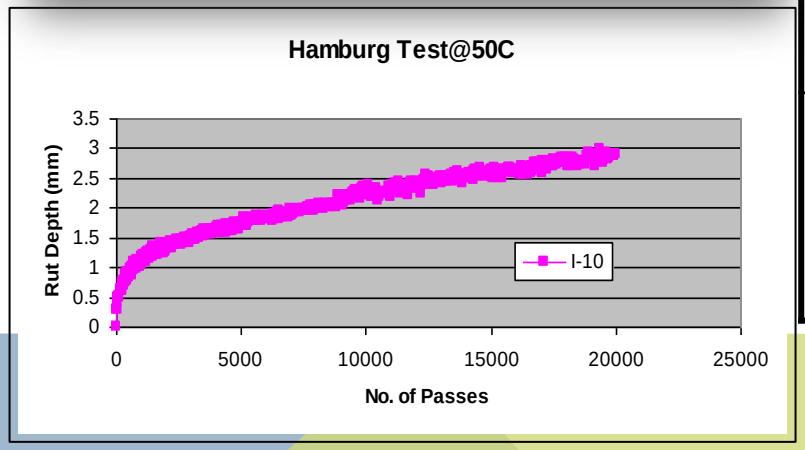
US 84, Abilene
In place Recycling
(at 6 months)

US 175, Dallas
Latex Modified Binder
with RAP
(after 10 years)





IH-10 TYPE C (PG76-22L), 4.4%AC



Properties	Result	Target
Cracking (overlay tester cycles to failure)	2	>200
Rutting (APA rutting after 8000 cycles)	2.6 mm	<6mm
Rutting Hamburg (Hamburg cycles to 0.5 inch rut)	>20K	>20K

- Rut resistance mix (4 in thick) placed on IH 10 in 2002 heavy traffic
- Reflective cracking in 2004

HMA Recipes for Disaster

Now with Extra Sarcasm!

10. CHOOSE TYPE C MIX FOR THE SURFACE. IT HELPS PREVENT RUTTING … AND JUST LOOK AT THE MONEY WE'LL SAVE ON ASPHALT.

9. PLACE THE MIX REALLY THIN ON TOP OF A DROUGHT STABILIZED SUBGRADE. " HEY, WE'RE IN A DROUGHT … WHY WORRY ABOUT DRAINAGE."

8. USE THE LOWEST LAB DENSITY YOU CAN WITH THE TEXAS GYRATORY … THE SPECIFICATION ALLOWS 96.0%. HEY, LESS ASPHALT = LESS MONEY

7. SPECIFY THE THE LOWEST PG BINDER GRADE YOU CAN. DON'T WASTE MONEY ON THOSE PG 76-22 MIXES. PG 64-22 GIVES YOU BETTER CRACKING RESISTANCE ANYWAY.

6. WAIVE THE MAXIMUM TENSILE STRENGTH REQUIREMENT … HIGHER STRENGTH MEANS LESS RUTTING. “WITH ENOUGH RAP AND RAS IN THIS BABY, WE CAN MAKE BLACK CONCRETE!”
5. PLACE THE MIX ON A REALLY COLD DAY AND USE THE RAY CHARLES METHOD TO TEST FOR THERMAL SEGREGATION. “HEY, I BEEN DOING THIS FOR 30 YEARS AND I’VE NEVER SEEN THIS SO CALLED “THERMAL SEGREGATION.” IF YOU GET THE MIX HOT ENOUGH, YOU WON’T HAVE TO WORRY ABOUT IT.”

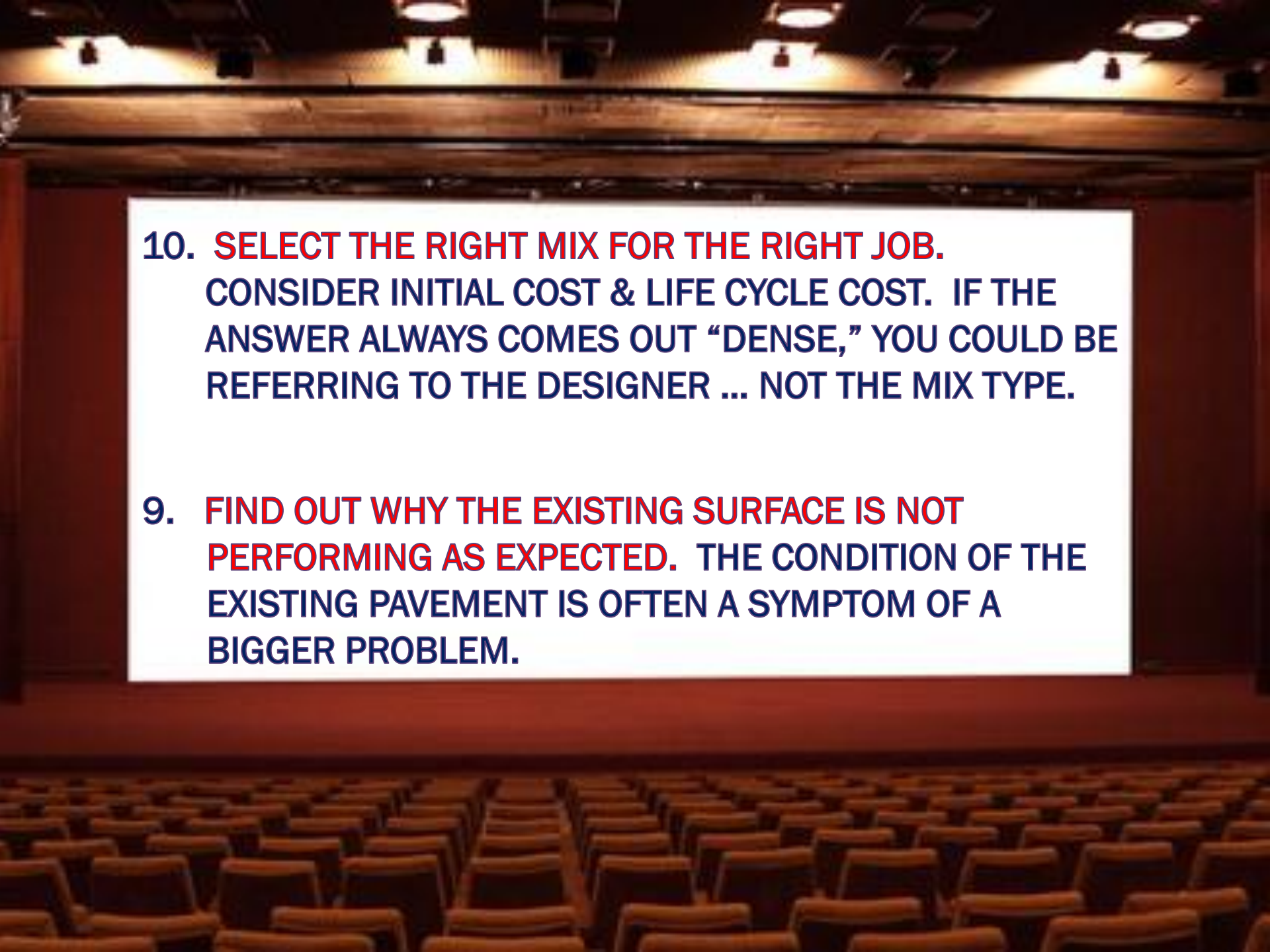
4. BLOW OFF THE IGNITION OVEN CORRECTION FACTORS... THEY'RE JUST A WASTE OF TIME. BESIDES, "IF WE ALREADY KNOW THE ANSWER... WHAT'S THERE TO CORRECT?"

3. SAVE MONEY BY WAIVING THE REQUIREMENT FOR TACK COAT. "THE HOT MIX SHOULD BE STICKY ENOUGH TO BOND TO THE EXISTING PAVEMENT. TACK COAT JUST MAKES A MESS."


2. FORGET DOING A PAVEMENT DESIGN. IT'S JUST AN OVERLAY... "THAT FATIGUE CRACKING IS FROM OLD AGE, NOT FROM ENOUGH PAVEMENT STRUCTURE."
1. "QUIT CHECKING, QUIT ASKING!"...THE NEW DEFINITION OF QC/QA.

HMA Recipes for Success

low sodium & just a hint of irony!


10. SELECT THE RIGHT MIX FOR THE RIGHT JOB. CONSIDER INITIAL COST & LIFE CYCLE COST. IF THE ANSWER ALWAYS COMES OUT "DENSE," YOU COULD BE REFERRING TO THE DESIGNER ... NOT THE MIX TYPE.
9. FIND OUT WHY THE EXISTING SURFACE IS NOT PERFORMING AS EXPECTED. THE CONDITION OF THE EXISTING PAVEMENT IS OFTEN A SYMPTOM OF A BIGGER PROBLEM.

8. IF YOU DECIDE ON A DENSE GRADED MIX, SPECIFY A TARGET LAB DENSITY OF 97.0% OR 97.5%. MORE ASPHALT = BETTER CRACKING RESISTANCE.

7. SPECIFY THE HIGH TEMPERATURE PG BINDER GRADE BASED ON WHAT YOU NEED FOR RUTTING RESISTANCE AND THE LOW TEMPERATURE GRADE BASED ON WHAT YOU NEED FOR THERMAL CRACKING RESISTANCE. ADDRESS REFLECTIVE CRACKING BY SELECTING A MIX TYPE WITH A HIGHER ASPHALT CONTENT.

6. VERIFY THE MIX IS NOT OVERLY STIFF BY CHECKING THE TENSILE STRENGTH (< 200 PSI) ... ESPECIALLY WHEN USING RAP AND RAS IN THE MIX.

5. USE THE PAVE-IR SYSTEM OR INFRARED CAMERA TO INSURE THAT THERMAL SEGREGATION IS NOT A PROBLEM... ESPECIALLY ON COLD DAYS OR LONG HAUL DISTANCES. IN SUCH CASES, AVOID COOKING THE LIFE OUT OF THE MIX. USE WMA RATHER THAN MORE HEAT TO FACILITATE MIXING & COMPACTION.

4. ALWAYS DO IGNITION OVEN CORRECTION FACTORS. IT'S THE ONLY WAY TO CORRECT TO A WASHED GRADATION, TO ACCOUNT FOR AGGREGATE BREAK DOWN AND DETERMINE THE CORRECT ASPHALT CONTENT. DOING THE WORK UP FRONT SAVES HEADACHES LATER.

3. ENSURE THE MIX FORMS A GOOD BOND WITH THE UNDERLYING LAYER. USE A TACK COAT THAT WORKS WELL AND MAKE SURE IT'S APPLIED AT THE RIGHT RATE TO A CLEAN SURFACE.

2. PERFORM A PAVEMENT DESIGN AND VERIFY THE PAVEMENT STRUCTURE IS ADEQUATE. ASK THE CONSTRUCTION DIVISION FOR ASSISTANCE WITH FWD, GPR, ETC. IF NEEDED.

1. ENSURE THE PAVEMENT IS BEING CONSTRUCTED PROPERLY… DO THE REQUIRED QC/QA TESTING AND INSPECTION. BE A “PARTNER IN QUALITY.”

QUESTIONS?

Emerging Issues

Dale Rand P.E. - Director of Flexible Pavements – TxDOT - 512-506-5836 - dale.rand@txdot.gov

Robert E. Lee P.E. - Sr. Materials Engineer of Flexible Pavements Branch – TxDOT - 512-506-5938 - robert.lee@txdot.gov

Kyle Swaner - Vice President of Technical Programs – TXAPA - 512-312-2099 - kswaner@texasasphalt.org

Emerging Issues

- 2014 Standard Specification rewrite is under way
- Richard Izzo of the Flexible Pavements Branch is the chairman of the 300 series
- We do not anticipate too many big changes to items 340, 341, 342, 344, or 346 with a few notable exceptions
- The most significant proposed change is to require the use of the Pave-IR system on all HMA projects that have more than 5,000 tons
- Plan to remove option of using hand held infrared thermometer to detect thermal segregation
- Proactive plan to increase use of Superpave and/or eliminate the use of the Texas Gyratory Compactor

Why Require the Pave-IR System

- Improve the Quality of HMA Pavements
- Improve Safety Within the Construction Zone

Notice Any Worker Hazards?

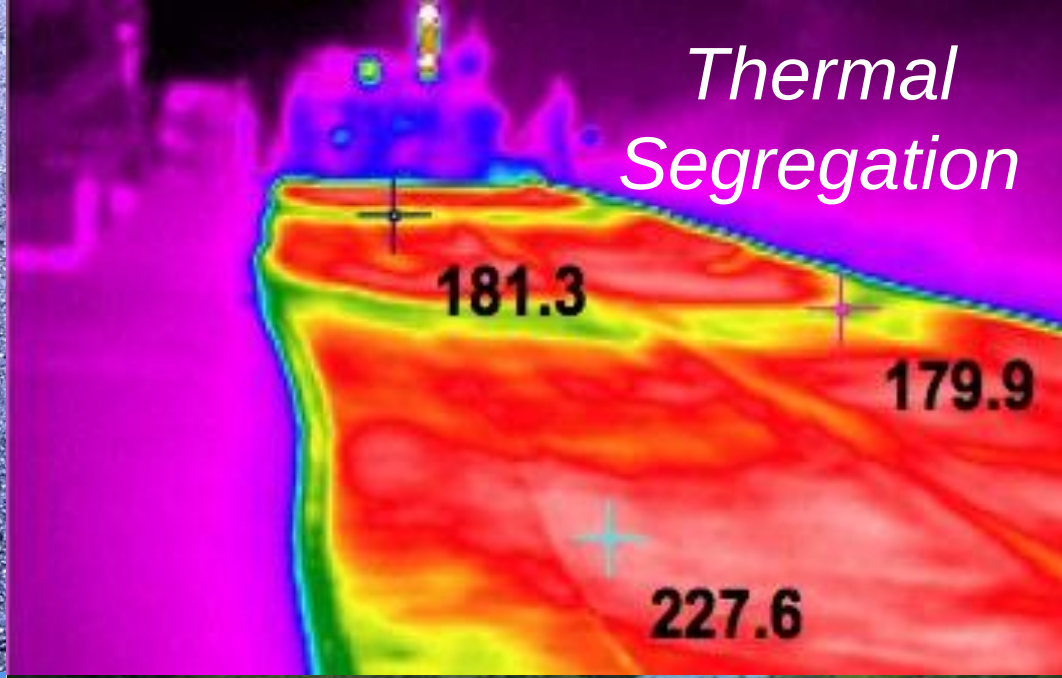
Using the Pave-IR to Improve Safety

- HMA paving involves a lot of equipment and people and often a lot of traffic
- Numerous fatalities occur each year in highway construction zones, most are preventable

Additional Work Required When Not Using the Pave-IR System

- *When the Pave-IR system is not used for specification compliance, use a non-contact infrared thermometer to measure and record the internal temperature of the mixture as discharged from the truck or material transfer device prior to or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket.*
- Thermal Profiles Every Sublot
- Density Profiles at Least Every Sublot
- Documentation of Thermal and Density Profiles in Order to Receive Applicable QC/QA Bonus

Visibly Segregated Areas



Thermal Segregation

Paver Stops > 60 seconds

Placement Testing

Segregation (Density Profile)

At least 1 per sublot

Safety Benefits

- Gets some of the workers with the greatest exposure out of harms way
- Reduces worker exposure to potential injury or death
- Helps TxDOT vision of Mission Zero
- There are approximately 40 Pave-IR systems currently in use in Texas
- *"What starts in Texas changes the world"*
- At least 19 other states have used are in the process of using the Pave-IR system

Other Emerging Issues

- Move away from traditional dense graded mixture to Superpave mixes (and above) to improve performance
- Move to phase out the Texas Gyratory Compactor
- Tack Coat
- Bond Coat
- Spray Paver Option for Dense HMA
- Rejuvenators?