

Project 0-6658:

# Collection of Materials and Performance Data for Texas Flexible Pavements and Overlays

---

Progress Meeting Update# 07

Task 8: **Data Collection**

---

by

Lubinda & Tom

PD: Brett Haggerty (TxDOT)

June 2<sup>nd</sup>, 2011

# Agenda

---

- 1) Update on the Test Sections
- 2) Lab Testing for US 59 (Atlanta District)
- 3) Miscellaneous issues & discussions



# Test Section Matrix

#	Hwy	PVMNT Type				PVMNT Thickness		Traffic Level??		Climate-Environment					Age		PVMNT Category			
		A1	A2	A3	A4	B1	B2	C1	C2	D1	D2	D3	D4	D5	F1	F2	G1	G2	G3	G4
1	SH 114	√				√		√				√				√	√			
2	SH 114	√				√		√				√				√	√			
3	US 59	√					√					√			√				√	
4	IH 35	√				√		√		√						√	√			
5	IH 35	√				√		√		√						√	√			
6	IH 20						√					√			√					√
7	US 190	√						√					√		√				√	
8	SH 121	√																		
9	US 271						√		√			√			√					√
10	Loop 480		√			√		√		√					√			√		
11	IH 35		√			√		√						√	√			√		
12	US 82		√			√		√				√			√			√		
100																				
Total		7	3	0	0	7	3	8	1	3	0	6	1	1	7	4	4	3	2	2

## Legend:

A1	HMA on HMA	B1	Thick	D1	DW - Dry Wet	D5	Mixed	G1	Perpetual
A2	HMA on Treated Base	B2	Thin (≤ 3")	D2	DC - Dry Cold	F1	New	G2	Typical flexible HMA
A3	HMA on Granular Base	C1	High??	D3	WC - Wet Cold	F2	Old (existing)	G3	Overlay (AC-AC)
A4	Surface Treatment	C2	Low??	D4	WW - Wet Wet			G4	Overlay (AC-PCC)

# US 59 – Atlanta District

---

## Test Sections on US 59 (Atlanta District)

- 1) Construction data
- 2) Lab testing & data analyses
- 3) Field testing & data analyses
- 4) Traffic & environmental data
- 5) MS access data storage system
- 6) Raw data files
- 7) Miscellaneous issues & discussions

### Laboratory Tests :

---

- 1) Asphalt-binders
- 2) HMA mixes

### Field Tests :

---

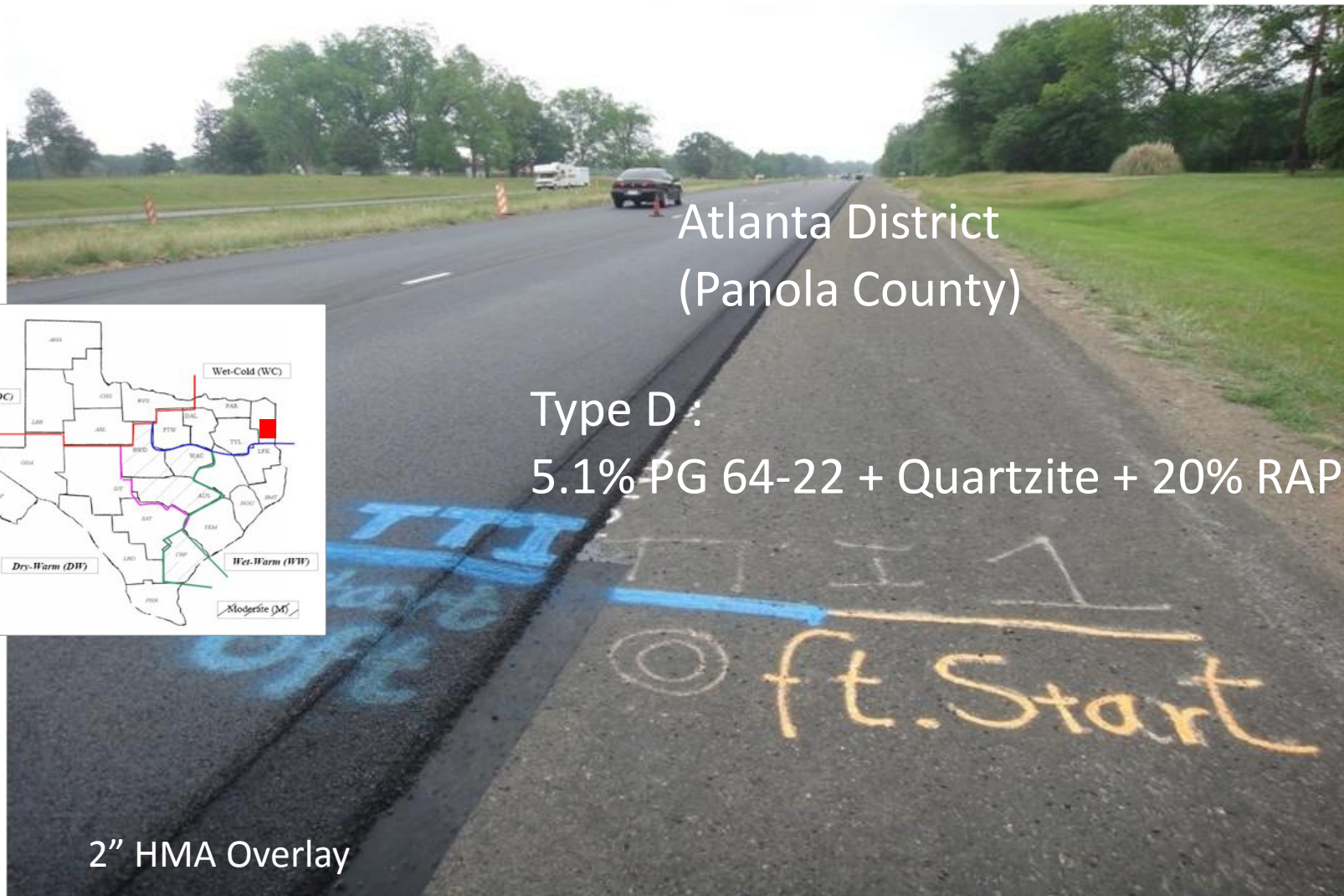
- 1) GPR
- 2) FWD
- 3) DCP
- 4) Coring
- 5) Crack surveys
- 6) Rut measurements
- 7) Surface profiles

# US59 – Atlanta District





# US 59: AC Overlay-HMA



# Test Section Details

District: Atlanta (Panola County)  
 Hwy: US 59 SB (both lanes)  
 PVMNT type: AC overlay over AC over treated base

## Location Details

Item	Start	End
Mile marker	Between 308 and 310	
GPS	N 32° 12' 13.96" W 094° 20' 38. 63"	N 32° 11' 58" W 094° 20' 32"
Physical landmark	Intersection of CO RD 203 <sup>500</sup> & US 59S	-

## PVMNT Structure

New Overlay (Type D)	2.0"
Existing HMA (4 layers)	11.5"
Existing base1 (LFA)	10.0"
Existing base2 (LFA)	8.0 "
Subgrade	



# Construction



# Construction Data.

Overlay thickness: 2 inches

HMA mix: Type D=**5.1%**PG 64-22 + Quartzite + 20% RAP

Item	Description
Contractor	Madden
Date of Construction	April 20 thru 25 <sup>th</sup> 2011
HMA truck type	Dump trucks
MTD	Yes (Roadtec)
IR bar	Yes
Joint roller	200 lbs
Breakdown rollers	4 vibratory passes (2 rollers, 12.15 ton each)
Finishing roller	1 static pass (12.15 ton)
HMA mat thickness	2 inches
Target density	97%

# Construction Data..

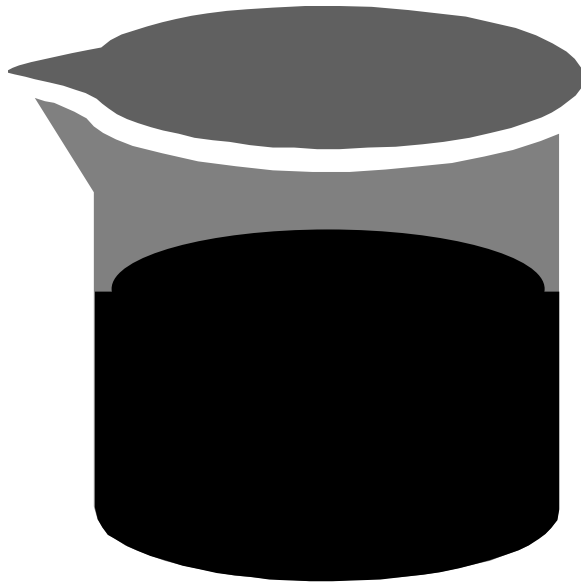
Overlay thickness: 2 inches

HMA mix: Type D=5.1%PG 64-22 + Quartzite + 20% RAP

Item	Measurement					Avg.	COV
	#1	#2	#3	#4	#5		
HMA mix temp	280°F	279°F	290°F	280°F	289°F	283.6°F	1.9%
PVMNT surface temperature	146°F	143°F	140°F	150°F	148°F	145.4°F	2.7%
Air temperature	78°F	81°F	86°F	88°F	90°F	84.6°F	5.9%
Core density	94.3%	94.0%	94.2%	93.7%	93.5%	93.9%	0.37%

# Asphalt-Binder Testing

---



# Asphalt-Binder Tests

Test	Spec
1) Specific Gravity	T 228
2) Viscosity	T 316
3) DSR: Original, RTFO, & PAV	T 315, T 240, R 28
4) RTFO-MSCR	TP 70 ???
5) BBR	T 313, R 28
6) Elastic recovery	D 6084 Method A
7) PG grading	Item 300, M 320, MP 19

Replicates:  $\geq 3$  for all tests

# Specific Gravity (T 228)

Asphalt-Binder: PG 64-22 (Lion), US 59 (Atlanta)

	Specific Gravity
Sample# 1	1.023
Sample# 2	1.023
Sample# 3	1.022
<b>Avg.</b>	<b>1.023</b>
<b>COV</b>	<b>0.06%</b>



# Viscosity @ 135 °C (T 316)

Asphalt-Binder: PG 64-22 (Lion), US 59 (Atlanta)

	Viscosity (Pa.s)			Avg
	Run# 1	Run# 2	Run# 3	
Sample# 1	0.095	0.095	0.093	0.094
Sample# 2	0.088	0.088	0.085	0.087
Sample# 3	0.095	0.093	0.093	0.093
Avg.				0.91
COV				4.50%

Threshold: Viscosity  $\leq$  3.00 Pa.s

# DSR (T 315): Original

Asphalt-Binder: PG 64-22 (Lion), US 59 (Atlanta)



	T#1 = 58 °C			T#2 = 64 °C			T#3 = 70 °C			TruGrade Temp (°C)
	$G^*$	$\delta(^{\circ})$	$G^*/\sin(\delta)$	$G^*$	$\delta(^{\circ})$	$G^*/\sin(\delta)$	$G^*$	$\delta(^{\circ})$	$G^*/\sin(\delta)$	
Sample# 1	3.40	87.50	3.40	1.47	88.60	1.47	0.68	89.20	0.68	66.96
Sample# 2	3.46	87.50	3.47	1.49	88.50	1.49	0.69	89.00	0.69	67.07
Sample# 3	3.45	87.40	3.45	1.49	88.50	1.49	0.70	89.20	0.70	67.17
Avg.	3.44	87.47	3.44	1.48	88.53	1.48	0.69	89.13	0.69	67.07
COV	0.94%	0.07%	1.05%	0.78%	0.07%	0.78%	1.87%	0.13%	1.87%	0.16%

Legend:  $G^*$  = complex modulus (kPa);  $\delta$  = phase angle ( $^{\circ}$ )

Threshold:  $G^*/\sin(\delta) \geq 1.00$  kPa

# DSR (T 315): RTFO

Asphalt-Binder: PG 64-22 (Lion), US 59 (Atlanta)



	T#1 = 58 °C			T#2 = 64 °C			T#3 = 70 °C			TruGrade Temp (°C)
	G*	$\delta(^{\circ})$	G*/Sin ( $\delta$ )	G*	$\delta(^{\circ})$	G*/Sin ( $\delta$ )	G*	$\delta(^{\circ})$	G*/Sin ( $\delta$ )	
Sample# 1	6.52	84.70	6.55	2.69	86.50	2.70	1.19	87.60	1.20	65.50
Sample# 2	6.48	84.90	6.50	2.75	86.60	2.76	1.25	87.70	1.25	65.69
Sample# 3	6.46	84.90	6.48	2.80	86.60	2.81	1.25	87.70	1.25	65.79
Avg.	6.49	84.83	6.51	2.75	86.57	2.76	1.23	87.67	1.23	65.66
COV	0.47%	0.14%	0.55%	2.01%	0.07%	2.00%	2.82%	0.07%	2.34%	0.22%

Legend: G\* = complex modulus (kPa);  $\delta$  = phase angle ( $^{\circ}$ )

Threshold: G\*/Sin ( $\delta$ )  $\geq$  2.20 kPa

# DSR (T 315): PAV

Asphalt-Binder: PG 64-22 (Lion), US 59 (Atlanta)



	T#1 = 25 °C			T#2 = 22 °C			TruGrade Temp (°C)
	G*	$\delta(^{\circ})$	G*.Sin ( $\delta$ )	G*	$\delta(^{\circ})$	G*.Sin ( $\delta$ )	
Sample# 1	3130	50.1	3130	4900	46.5	3560	19.20
Sample# 2	3660	49.8	2810	5740	46.4	4150	20.50
Sample# 3	4990	49.70	3810	7760	46.1	5590	22.89
Avg.	3927	50	3250	6133	46	4433	19.85
COV	9.54%	0.43%	6.96%	9.68%	0.15%	9.41%	4.63%

Legend: G\* = complex modulus (kPa);  $\delta$  = phase angle ( $^{\circ}$ )

Threshold: G\*.Sin ( $\delta$ )  $\leq$  5 000 kPa

# DSR (T 315): PAV

Asphalt-Binder: PG 64-22 (Lion), US 59 (Atlanta)



	T#1 = 25 °C			T#2 = 22 °C			T#3 = 19 °C			TruGrade Temp (°C)
	G*	$\delta(^{\circ})$	G*.Sin ( $\delta$ )	G*	$\delta(^{\circ})$	G*.Sin ( $\delta$ )	G*	$\delta(^{\circ})$	G*.Sin ( $\delta$ )	
Sample# 1	3130	50.1	3130	4900	46.5	3560	7570	42.9	5150	19.20
Sample# 2	3660	49.8	2810	5740	46.4	4150	8930	42.6	6040	20.50
Sample# 3	4990	49.70	3810	7760	46.1	5590	-	-	-	22.89
Avg.	3927	50	3250	6133	46	4433	8250	43	5595	19.85
COV	9.54%	0.43%	6.96%	9.68%	0.15%	9.41%	11.66%	0.50%	11.25%	4.63%

Legend: G\* = complex modulus (kPa);  $\delta$  = phase angle ( $^{\circ}$ )

Threshold:  $G^* \cdot \sin(\delta) \leq 5\,000$  kPa

# RTFO – MSCR (TP 70)

Asphalt-Binder: PG 64-22 (Lion), US 59 (Atlanta)



Sample Set# 1



Sample Set# 2



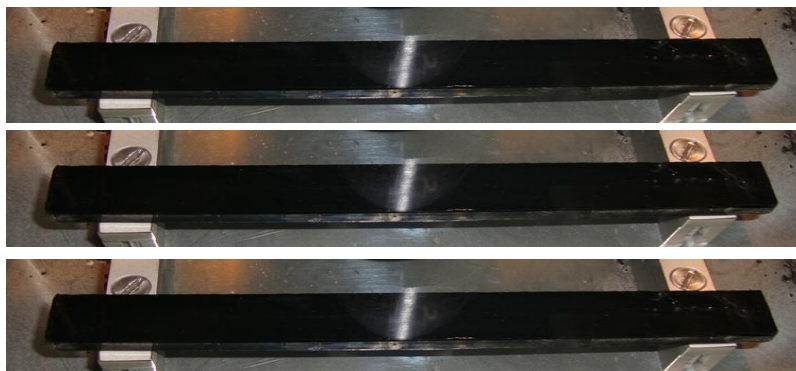
Sample Set# 3

	Sample Set# 1, T= 52 °C						Sample Set# 2, T= 58 °C						Sample Set# 3, T= 64 °C					
	R100	R3200	R <sub>diff</sub> (%)	J <sub>nr</sub> 100	J <sub>nr</sub> 3200	J <sub>nr-diff</sub> (%)	R100	R3200	R <sub>diff</sub> (%)	J <sub>nr</sub> 100	J <sub>nr</sub> 3200	J <sub>nr-diff</sub> (%)	R100	R3200	R <sub>diff</sub> (%)	J <sub>nr</sub> 100	J <sub>nr</sub> 3200	J <sub>nr-diff</sub> (%)
Sample# 1	6.9	5.6	18.8	7.207E-06	7.142E-06	-0.9	3.55	1.76	50.51	1.861E-05	1.906E-05	2.42	1.86	0.51	72.85	4.571E-05	4.890E-05	6.98
Sample# 2	7.4	5.7	23.3	6.809E-06	6.927E-06	1.7	3.35	1.67	50.33	1.875E-05	1.928E-05	2.78	1.80	0.49	73.04	4.677E-05	4.807E-05	2.78
Sample# 3	6.9	6.0	12.9	6.290E-06	6.232E-06	-0.9	3.52	1.79	49.27	1.822E-05	1.881E-05	3.22	1.62	0.46	71.74	4.697E-05	4.930E-05	4.97
Avg.	7.07	5.76	18.33	6.768E-06	6.767E-06	-0.04	3.48	1.74	50.04	1.853E-05	1.905E-05	2.81	1.76	0.48	72.54	4.648E-05	4.876E-05	4.91
COV	3.85%	3.44%	28.58%	6.79%	7.03%	-	3.03%	3.60%	1.33%	1.50%	1.24%	14.28%	7.20%	5.02%	0.97%	1.46%	1.29%	42.78%

Threshold:  $J_{nr} 3200 \leq 4.0 \text{ kPa}^{-1}$ ;  $J_{nr-diff} (\%) \leq 75$



# BBR (T 313, R28)



Asphalt-Binder:

PG 64-22 (Lion),  
US 59 (Atlanta)

	T#1 = -18 °C		T#2 = -12 °C	
	Stiffness (MPa)	m-value	Stiffness (MPa)	m-value
Sample# 1	388	0.229	188	0.315
Sample# 2	404	0.219	237	0.307
Sample# 3	395	0.225	201	0.312
Avg.	396	0.224	209	0.311
COV	2.03%	2.24%	12.16%	1.30%

Threshold: Stiffness  $\leq$  300 MPa; m-value  $\geq$  0.300

# Elastic Recovery (D 6084 - A)



Machine too old;  
need to refurbish or  
buy new one!!

5 cm/min @ 25 °C

Asphalt-Binder:

PG 64-22 (Lion),  
US 59 (Atlanta)

	$E_{\text{original}}$ (cm)	$X_{\text{AfterCut}}$ (cm)	%age Recovery
Sample# 1	10	5.75	42.50%
Sample# 2	10	5.71	42.90%
Sample# 3	10	5.55	44.50%
Avg.		5.67	43.30%
COV		1.90%	2.40%

Number slook suspicious;  
tests currently being  
re-run!!!

Threshold:

# PG Grading

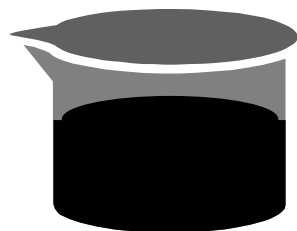
Asphalt-Binder: PG 64-22 (Lion), US 59 (Atlanta)

	Final PG Grade
Item 300	PG 64-22
AASHTO M320	PG 64-22
AASHTO MP 19	PG 64-22

# Time Input & Manpower - Binders

Test	Spec	Replicates	Min Time Estimate (Hrs)	
			Sample Prep	Testing
1) Specific Gravity	T 228	3	2	2
2) Viscosity	T 316	3	1	1
3) DSR: Original	T 315	3	2	3
4) DSR: RTFO	T 240	3	4	3
5) DSR: PAV	R 28	3	24	3
6) RTFO-MSCR	TP 70	9	4	6
7) BBR	T 313 R28	6	26	4
8) Elastic recovery	(D 6084 Method A)	3	8	2
9) PG grading	M 320, Item 300, MP 19	-	-	-
		Total	71	24

# HMA Mix Testing



+



Raw materials



Plant-mix materials



Field cores

# HMA Mix Tests

Test	Spec
1) HMA volumetrics	TxDOT QC/QA charts
2) AC extraction & gradations	Tex-210, 206, 200 -F
3) Hamburg	Tex-242-F
4) Overlay (OT)	Tex-248-F
5) OT fracture properties, A & n	Report 0-5798-2, <b>PP 97</b>
6) Dynamic modulus (DM)	AASHTO TP 62-03
7) RLPD – permanent def.	Report 0-5798 ( <b>New</b> )
8) Indirect-tension (IDT)	Tex-226-F
9) Thermal coefficient	<b>Tex-428-A</b>

Replicates:

≥ 3 for all tests



# HMA Volumetrics



	Description
Mix type	Type D (Item 341), Fine surface
Asphalt-binder	PG 64-22 (Lion)
Aggregates	Quartzite (Jones Mill)
RAP	Fractionated = 10.2% Coarse + 9.9% Fine
Design AC content	5.1%
AC content in RAP	3.2% in Coarse & 5.6% in Fine
Design lab density	97%
VMA @ OAC ( $\geq 14$ )	14.8
Rice specific gravity	2.483
QA/QC AC content	5.2%
In-situ density	94.3%

# AC Extractions (Tex-206, 210-F).. ---



Sample Set #1



Sample Set #2

Type D: PM

**5.1%**PG 64-22 + Quartzite + 20% RAP

US 59 SB (Atlanta District; Panola County)

	AC Content	
	Sample Set# 1, Tex-206-F	Sample Set# 2, Tex-210-F
Sample# 1	5.0%	5.4%
Sample# 2	5.1%	5.5%
Sample# 3	4.8%	5.4%
Avg.	5.0%	5.4%
COV	3.2%	1.06%

# Gradations Extractions (Tex-206, 210-F).



Sample Set #1



Sample Set #2

Type D: PM

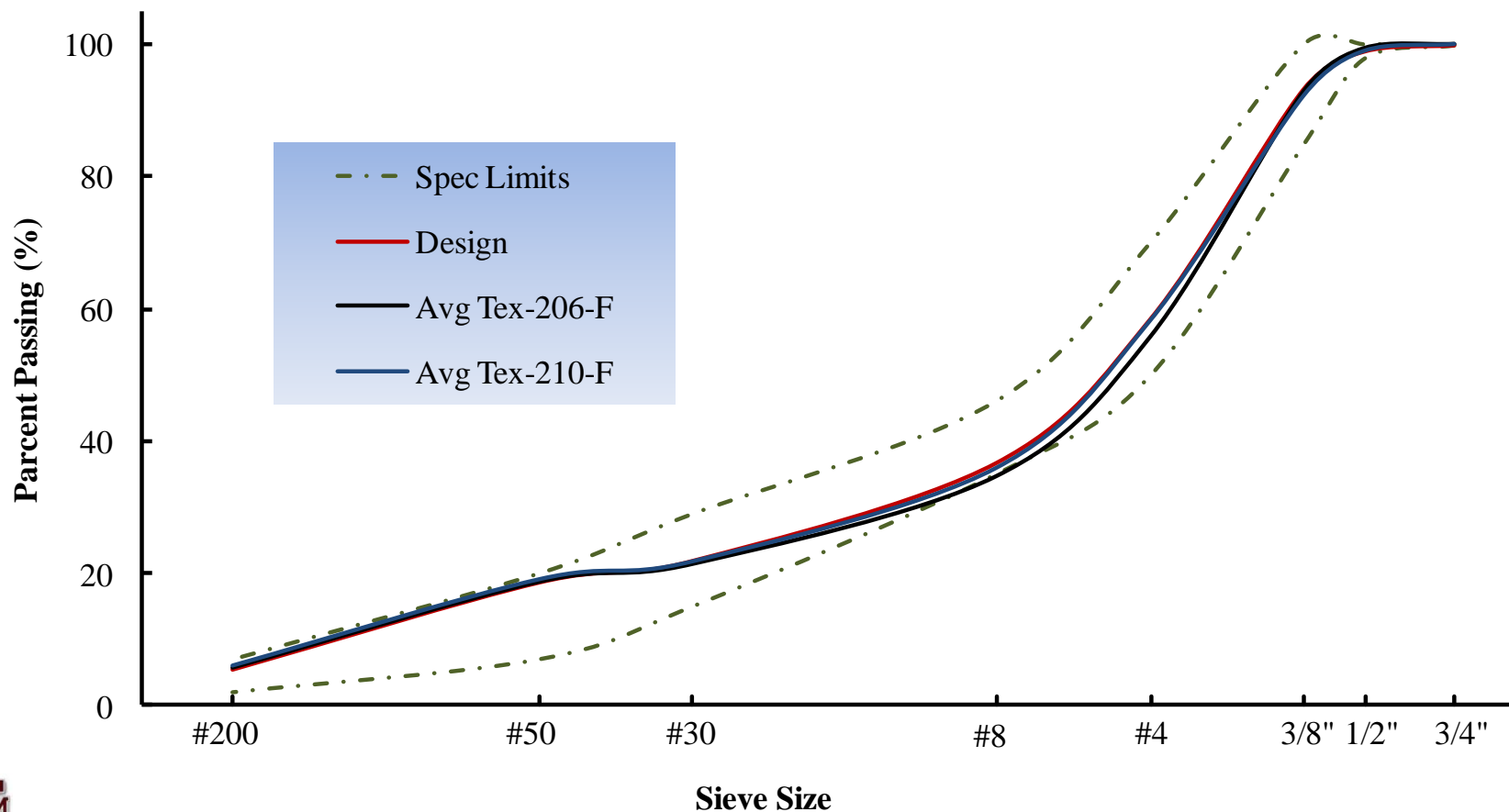
5.1%PG 64-22 + Quartzite + 20% RAP

US 59 SB (Atlanta District; Panola County)

Sieve Size	Spec		Design
	Lower Limit	Upper Limit	
3/4"	100.0	100.0	100.0
1/2"	98.0	100.0	99.1
3/8"	85.0	100.0	93.4
No. 4	50.0	70.0	58.6
No. 8	35.0	46.0	36.8
No. 30	15.0	29.0	22.0
No. 50	7.0	20.0	18.7
No. 200	2.0	7.0	5.6

Tex-206-F					Tex-210-F				
Sample# 1	Sample# 2	Sample# 3	Avg.	COV	Sample# 1	Sample# 2	Sample# 3	Avg.	COV
100.0	100.0	100.0	100.0	0.0%	100.0	100.0	100.0	100.0	0.0%
99.2	99.9	99.1	99.4	0.4%	98.9	99.4	98.6	99.0	0.4%
92.2	94.5	92.0	92.9	1.5%	90.5	94.0	92.3	92.3	1.9%
54.3	57.1	55.9	55.8	2.5%	57.4	60.1	57.2	58.3	2.8%
34.0	35.1	34.7	34.6	1.5%	35.5	36.9	35.2	35.9	2.5%
21.2	21.4	21.6	21.4	0.9%	21.6	22.2	21.5	21.8	1.8%
18.6	18.6	18.9	18.7	0.8%	19.0	19.4	18.8	19.1	1.8%
5.8	5.3	6.0	5.7	6.2%	6.0	6.1	5.9	6.0	1.9%

# Gradations Extraction-Curves (Tex-206, 210-F).



# Hamburg (Tex-242-F).



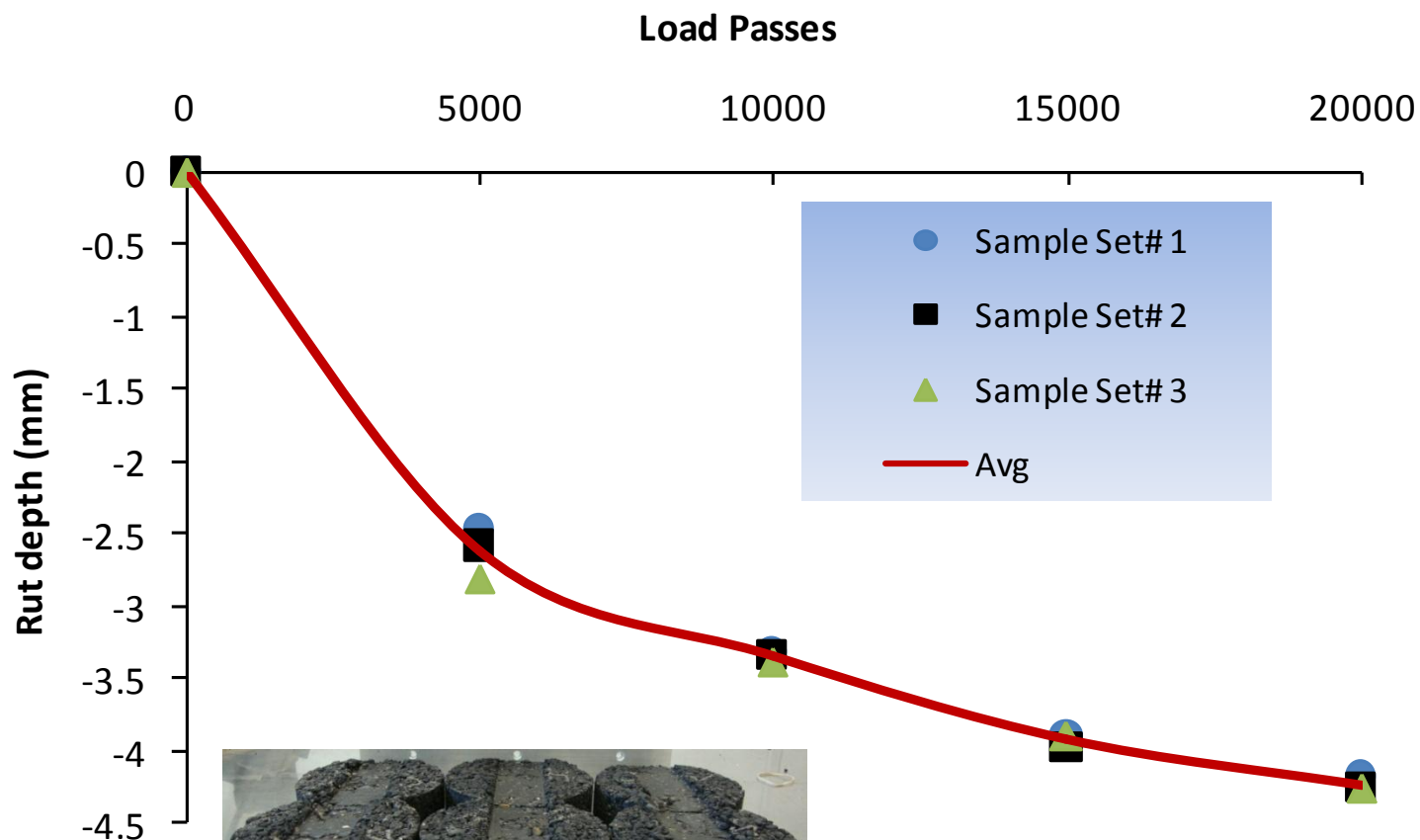
Type D:

5.1%PG 64-22 + Quartzite + 20% RAP

US 59 SB (Atlanta District; Panola County)

	AV (7±1)	Rut Depth (mm)				
		0 000	5 000	10 000	15 000	20 000
Sample set# 1	7.2%	0.0	2.6	3.4	4.0	4.3
Sample set# 2	7.5%	0.0	2.5	3.3	3.9	4.2
Sample set #3	6.9%	0.0	2.8	3.4	3.9	4.3
Avg.	7.2%	0.0	2.6	3.4	3.9	4.3
COV	4.2%	0.0%	5.8%	1.7%	1.5%	1.4%

# Hamburg Graphs (Tex-242-F).. ---



Type D



# OT (Tex-248-F)

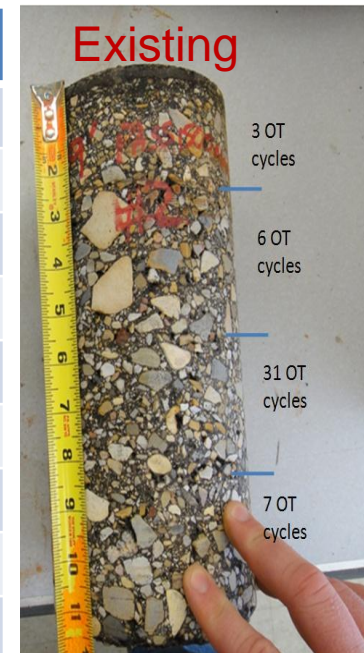


Type D:

5.1%PG 64-22 + Quartzite + 20% RAP

US 59 SB (Atlanta District; Panola County)

	AV (7±1)	Peak Load (lbs)	OT Cycles
Sample# 1	6.8%	695	309
Sample# 2	6.1%	700	121
Sample# 3	6.4%	773	334
Sample# 4	6.3%	757	269
Sample# 5	6.6%	839	240
Avg (all)	6.4%	753	255
COV (all)	4.3%	7.9%	32.6%
Avg (best 3)	6.4%	717	304
COV (best 3)	2.4%	5.0%	11%



# OT Fracture Properties (0-5798)



Type D:

5.1%PG 64-22 + Quartzite + 20% RAP

US 59 SB (Atlanta District; Panola County)

	AV (7±1)	A	n
Sample# 1	6.0 %	4.45E-08	4.90
Sample# 2	6.3 %	1.67E-08	5.46
Sample# 3	6.0 %	1.69E-08	5.37
Sample# 4	6.0 %	Test still running	Test still running
Sample# 5	6.0 %	Test still running	Test still running
Avg (all)	6.1 %	2.60E-08	5.24
COV (all)	2.0 %	61.4%	5.7%
Avg (best 3)	6.0 %		
COV (best 3)	0.0 %		

Threshold:

# Dynamic Modulus (TP 62-03).



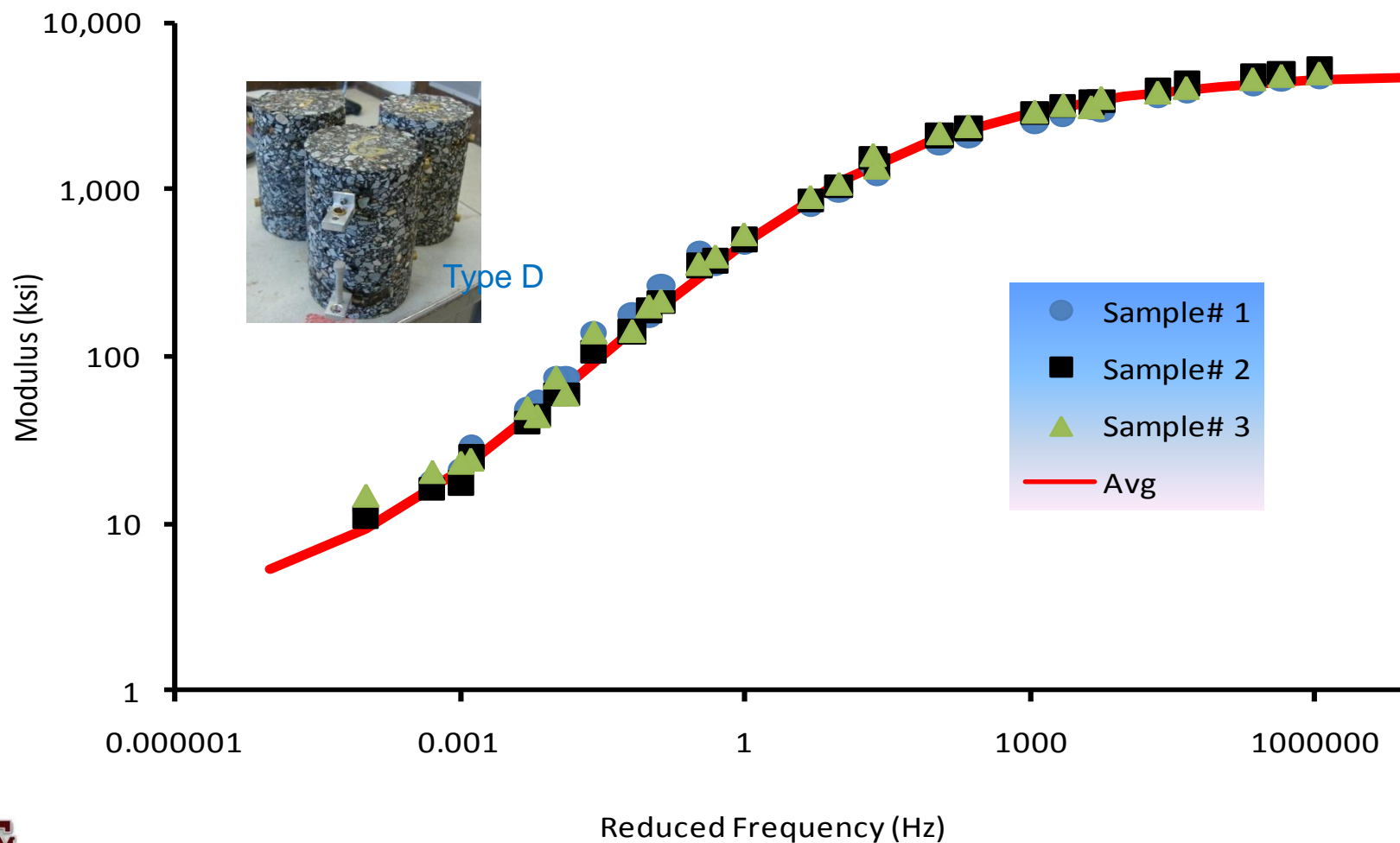
Type D:

5.1%PG 64-22 + Quartzite + 20% RAP

US 59 SB (Atlanta District; Panola County)

	AV (7±1)	E*  @ 77 F, 10 Hz (ksi)	E*  @ 130 F, 5 Hz (ksi)
Sample# 1	8.0 %	817	48
Sample# 2	7.9 %	848	40
Sample# 3	7.3 %	875	49
Avg.	7.7 %	847	46
COV	4.90 %	3.43%	11.04%

# |E\*| Master Curve (TP 62-03)..



# DM Data (TP 62-03)...

TEMP. & LOADING FREQ.		
Temperature	Freq. (Hz)	
(C)	(F)	
-10	14	25
-10	14	10
-10	14	5
-10	14	1
-10	14	0.5
-10	14	0.1
4.4	40	25
4.4	40	10
4.4	40	5
4.4	40	1
4.4	40	0.5
4.4	40	0.1
21.1	70	25
21.1	70	10
21.1	70	5
21.1	70	1
21.1	70	0.5
21.1	70	0.1
37.8	100	25
37.8	100	10
37.8	100	5
37.8	100	1
37.8	100	0.5
37.8	100	0.1
54.4	130	25
54.4	130	10
54.4	130	5
54.4	130	1
54.4	130	0.5
54.4	130	0.1

E*  ksi		
Sample# 1	Sample# 2	Sample# 3
4,657	5,366	4,930
4,527	5,095	4,763
4,271	4,867	4,549
3,847	4,354	4,034
3,626	4,053	3,785
3,071	3,352	3,095
2,947	3,449	3,517
2,770	3,183	3,177
2,575	2,891	2,906
2,081	2,340	2,383
1,864	2,121	2,159
1,426	1,572	1,601
1,227	1,384	1,346
985	1,042	1,076
821	873	898
485	505	537
355	375	396
177	188	199
417	351	357
265	212	215
177	140	142
75	59	59
54	44	44
29	25	24
140	107	139
74	60	75
48	40	49
21	17	23
18	16	20
12	11	15

Avg	COV
4,984	7.17%
4,795	5.95%
4,562	6.53%
4,078	6.29%
3,821	5.65%
3,173	4.91%
3,304	9.43%
3,044	7.77%
2,791	6.71%
2,268	7.22%
2,048	7.85%
1,533	6.10%
1,319	6.18%
1,034	4.46%
864	4.53%
509	5.16%
375	5.41%
188	5.95%
375	9.87%
231	12.93%
153	13.74%
65	14.52%
47	12.06%
26	9.65%
129	14.31%
70	12.35%
46	11.04%
20	13.98%
18	12.18%
13	15.23%

# Repeated Loading (Report 0-5798).



40 °C, 20 psi  
10 000 cycles



50 °C, 10 psi  
10 000 cycles

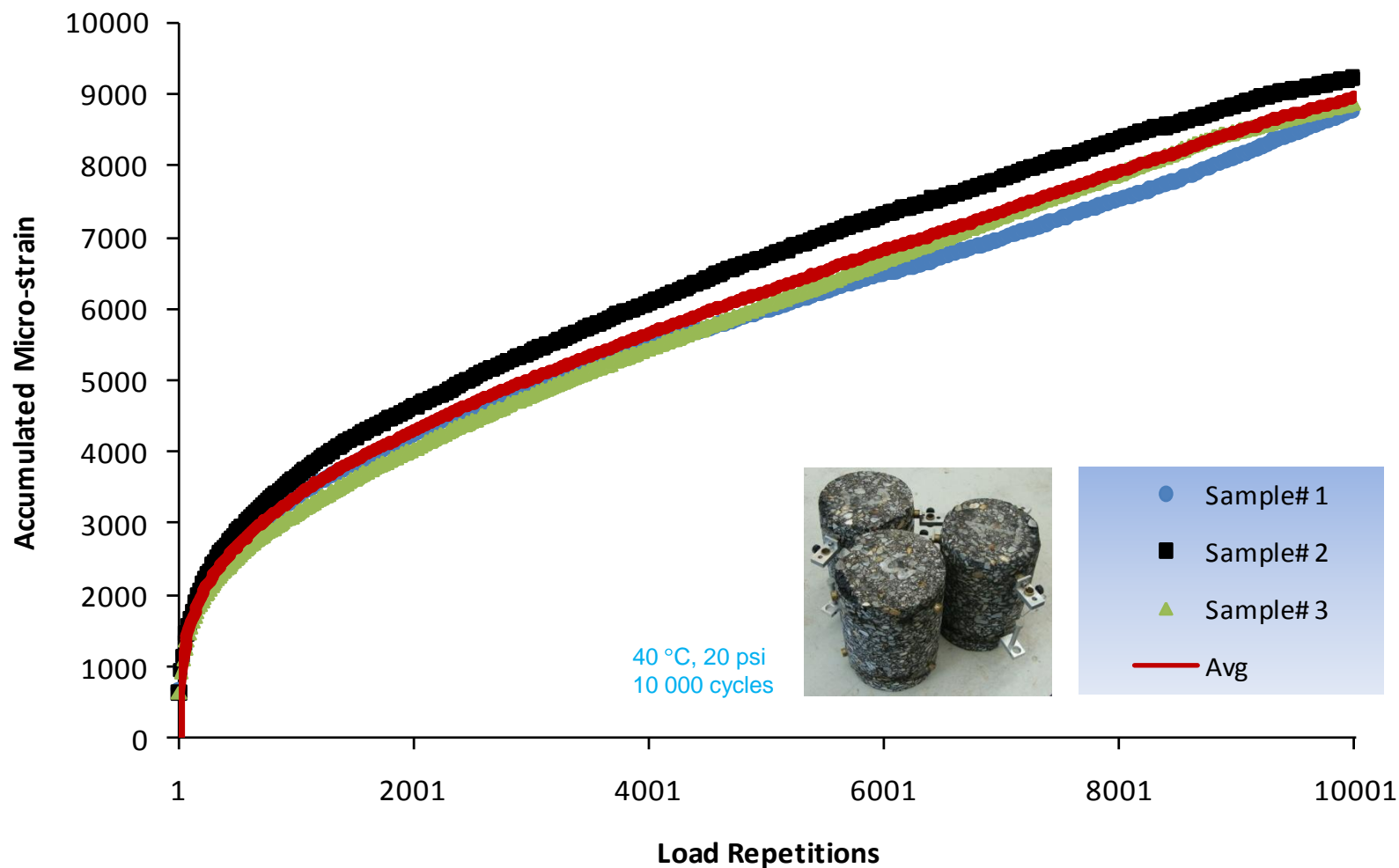
Type D:

5.1%PG 64-22 + Quartzite + 20% RAP

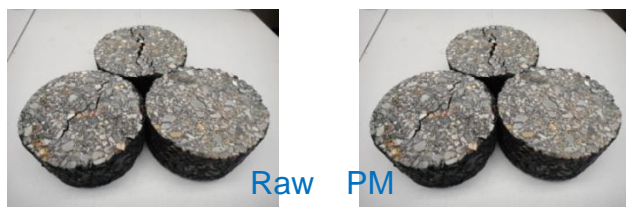
US 59 SB (Atlanta District; Panola County)

	Sample Set# 1, T= 40 °C			Sample Set# 2, T= 50 °C		
	AV (7±1)	Alpha ( $\alpha$ )	mu ( $\mu$ )	AV (7±1)	Alpha ( $\alpha$ )	mu ( $\mu$ )
Sample# 1	8.0%	0.6436	0.58	7.2%	0.5912	0.31
Sample# 2	7.9%	0.6218	0.51	6.9%	0.6872	0.49
Sample# 3	7.3%	0.6145	0.50	7.5%	0.7073	0.65
Avg.	7.7%	0.6266	0.53	7.2%	0.6619	0.48
COV	3.9%	2.4%	8.0%	3.6%	9.4%	35.2%

# RLPD Graph (Report 0-5798).



# IDT (Tex-226-F)



Type D:

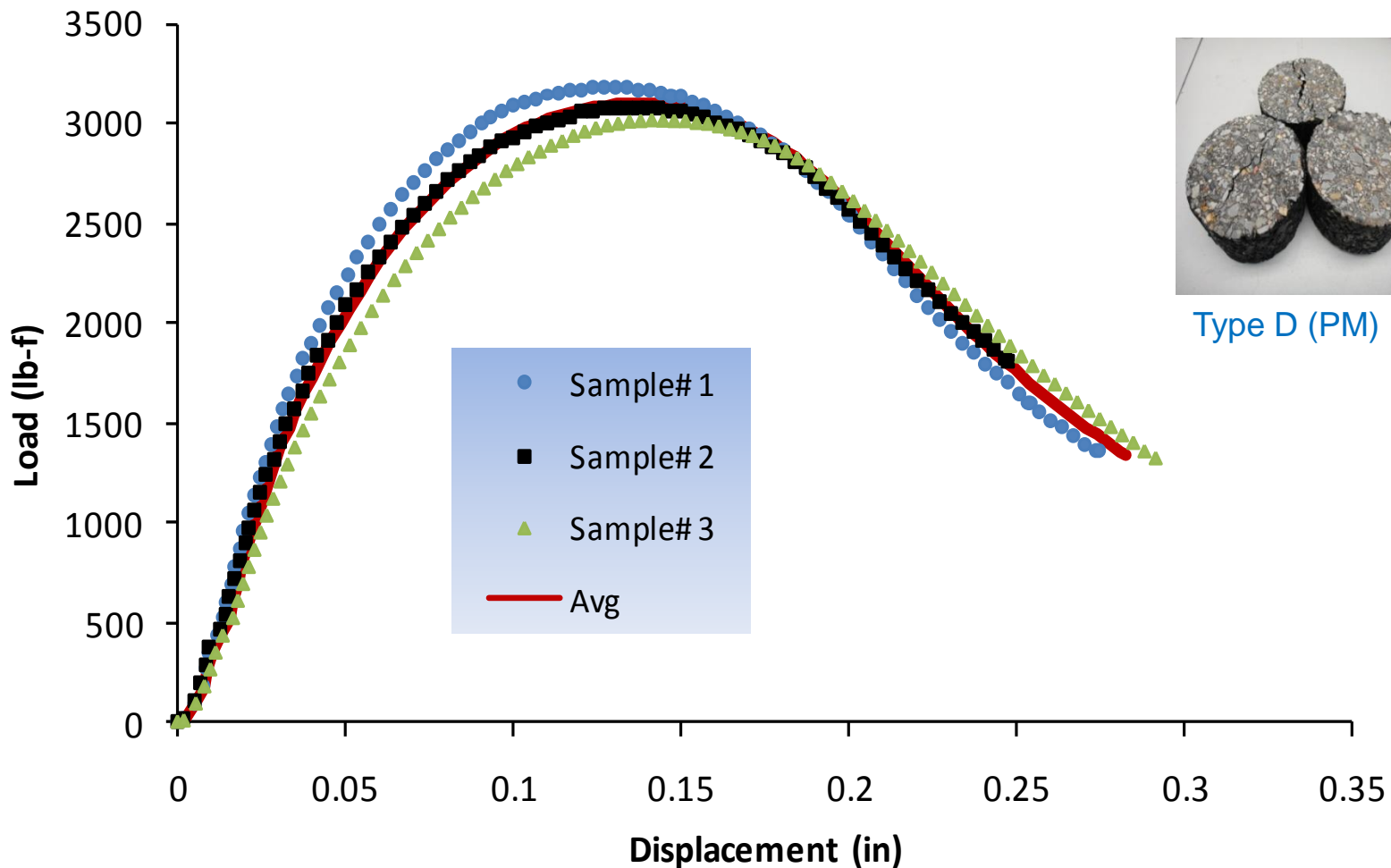
5.1%PG 64-22 + Quartzite + 20% RAP

US 59 SB (Atlanta District; Panola County)

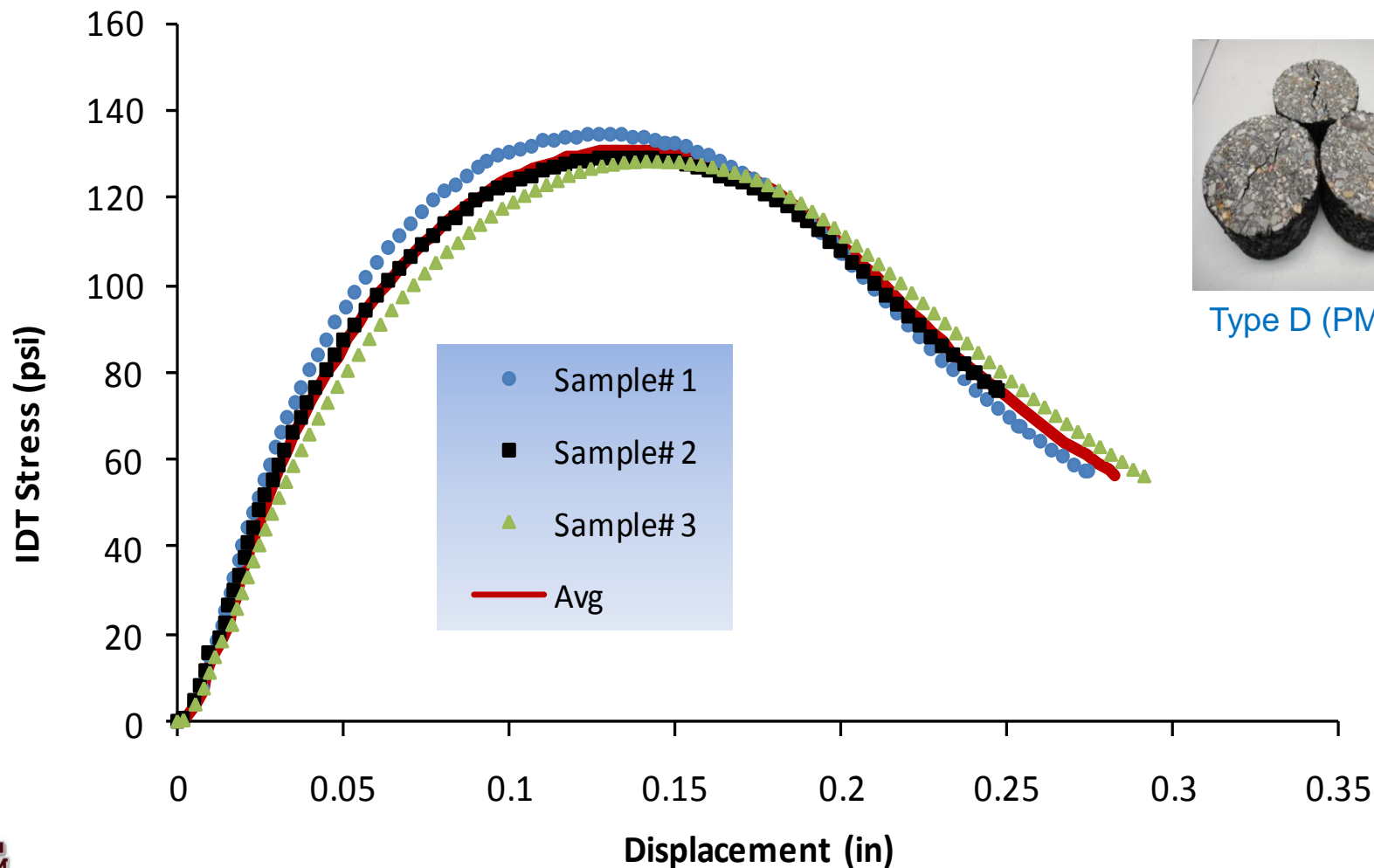
	AV		IDT Strength (psi)	
	Raw Materials	PM	Raw Materials	PM
Sample# 1	7.3%	7.2%	131	135
Sample# 2	7.1%	7.8%	133	129
Sample# 3	6.9%	7.8%	136	129
Avg.	7.1%	7.6%	134	131
COV	2.8%	4.7%	1.9%	2.6%



# IDT Graph (Tex-226-F)



# IDT Graph (Tex-226-F)



Type D (PM)

# Thermal Coefficient



Temp. range tried:  
-10 °C to +40 °C

Type D:

5.1%PG 64-22 + Quartzite + 20% RAP

US 59 SB (Atlanta District; Panola County)

Sample	AV (7±1)	$\alpha$ (in/in/°F)
Sample 1	7.4%	1.05E-05
Sample 2	6.9%	1.92E-05
Sample 3	7.3%	0.93E-05
Avg.	7.2%	1.30E-05
COV	3.3%	41.5%

# Time Input & Manpower - HMA

Test	Spec	Replicates	Min Time Estimates (Hrs)	
			Sample Prep* (minus batching/mixing)	Testing
1) AC extraction	Tex-210-F	3	2	16
2) AC extraction	Tex-206-F	3	2	5
3) Gradation	Tex-200-F	3	14	1
4) Hamburg	Tex-242-F	3	24	14
5) Overlay Test (OT)	Tex-248-F	5	72	36
6) OT fracture properties, A & n	Report 0-5798-2, PP 97 (DM + OT)	5	80	14
7) Dynamic modulus (DM)	AASHTO TP 62-03	3	72	120
8) RLPD – permanent def.	Report 0-5798 (New)	6	72	27
9) Indirect-tension (IDT)	Tex-226-F	3	72	2
10) Thermal coefficient	Tex-428-A	3	72	36
		Total	482 hours (482+ 84)	271 hours

\*For raw materials, add 12 hrs to each of the Items 4 to 10 for batching/mixing.

Manpower requirement: ≥ 3 persons (experienced, dedicated, & hardworking)

# Field Testing

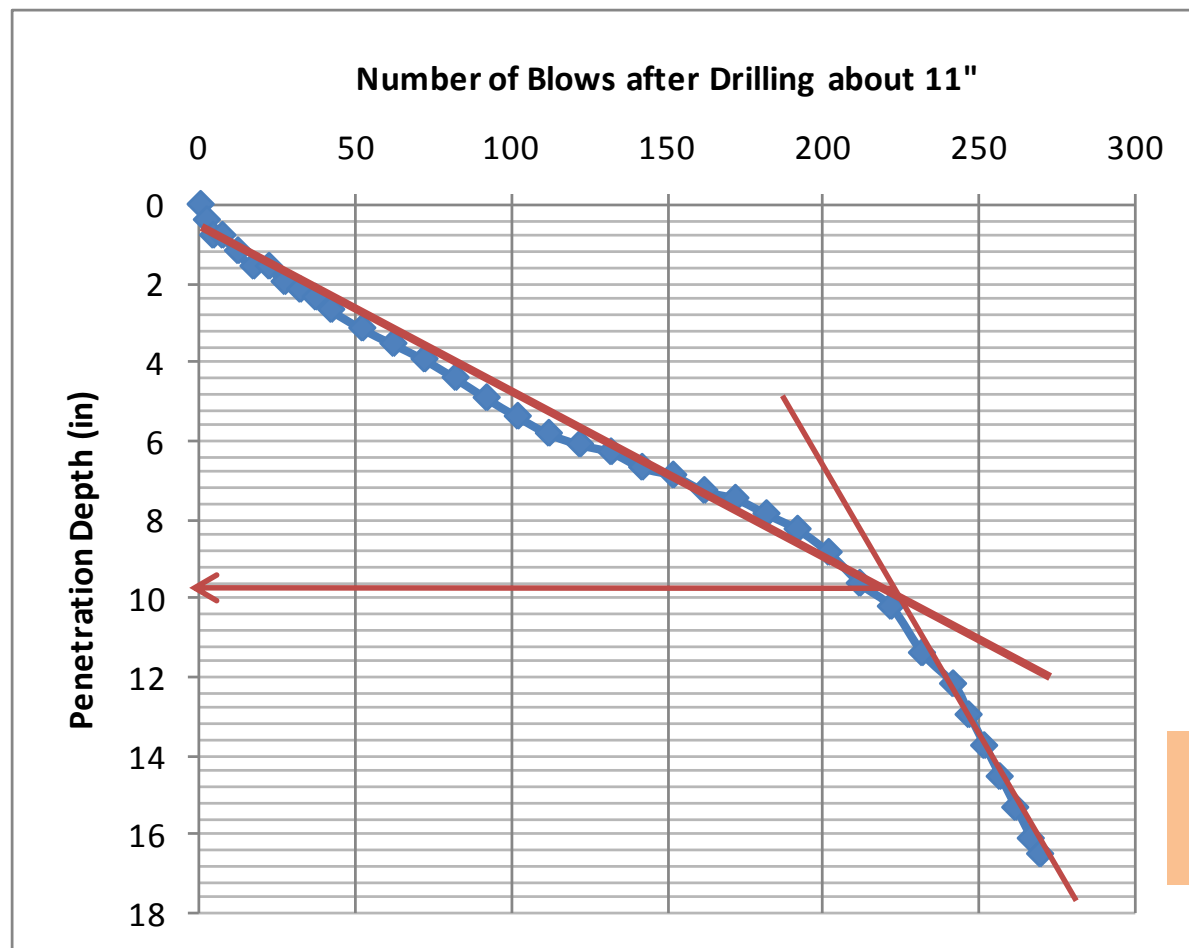


# Field Performance Tests

Test	Spec
1) Cracking	Visual/walking
2) Rutting	Straightedge
3) Other distresses	Visual/walking
4) GPR	
5) FWD	
6) Surface profiles	
7) DCP	
8) Coring	

Min: 2 No.  $\times$  500 ft test sections per selected Hwy

# DCP



Layer	Thick. (in)	DCPI (in/blow)
1	10	0.04259
2	8	0.1188

# FWD Modulus

	Uncorrected Modulus (ksi)
HMA	657
Base# 1	129
Base# 2	69
Subgrade	28

TTI MODULUS ANALYSIS SYSTEM (SUMMARY REPORT)												(Version 6.1)			
District:				MODULI RANGE(psi)											
County :				Thickness(in)				Minimum		Maximum		Poisson Ratio Values			
Highway/Road: US0059S				Pavement:		11.00		110,000		1,040,000		H1: v = 0.38			
				Base:		10.00		10,000		150,000		H2: v = 0.35			
				Subbase:		8.00		25,000		75,000		H3: v = 0.35			
				Subgrade:		141.49(by DB)				10,000		H4: v = 0.40			
station	Load (lbs)	Measured Deflection (mils):							Calculated Moduli values (ksi):				Absolute Dpth to		
		R1	R2	R3	R4	R5	R6	R7	SURF(E1)	BASE(E2)	SUBB(E3)	SUBG(E4)	ERR/Sens	Bedrock	
Mean:		4.79	2.83	2.22	1.76	1.40	1.13	0.92	675.3	128.9	69.2	27.8	8.26	170.5	
Std. Dev:		1.28	0.76	0.59	0.46	0.35	0.27	0.19	298.2	35.8	9.6	9.2	5.80	53.7	
Var Coeff(%):		26.70	26.96	26.72	25.91	24.89	23.55	20.90	44.2	27.8	13.9	32.9	70.18	31.5	



# Surface Profiles: IRI (in/mi).

## US 59 (Atlanta): TTI Sections (SB)

	Oustide Lane			Inside Lane		
	LW	RW	Avg.	LW	RW	Avg.
Prior to Construction (April 2011)	58	76	67	77	68	73
Just after Construction (May 2011)	47	51	49	53	46	50

## TruePave Sections (SB)

	Oustide Lane			Inside Lane		
	LW	RW	Avg.	LW	RW	Avg.
Prior to Construction (April 2011)	60	73	67	69	68	69
Just after Construction (May 2011)	47	60	54	54	52	53

## Entire Project (SB & NB)

	SB Outside Lane			SB Inside Lane			NB Inside Lane		
	LW	RW	Avg.	LW	RW	Avg.	LW	RW	Avg.
Prior to Construction (April 2011)	66	74	70	70	67	69	66	63	65
Just after Construction (May 2011)	55	49	52	58	55	57	58	51	55

# Data Storage

---

# Input from TxDOT

---

## Comments on the slides!!

- Sample prep & testing time
- Number of replicates (Do we need three; given the repeatability of all the binder tests and HWTT)

## Review & advise if we are on right-track!!

# Ongoing/Planned Work

---

Continue with Test Section sourcing & data collection:

- 1) Field & lab testing
- 2) Data analyses & storage

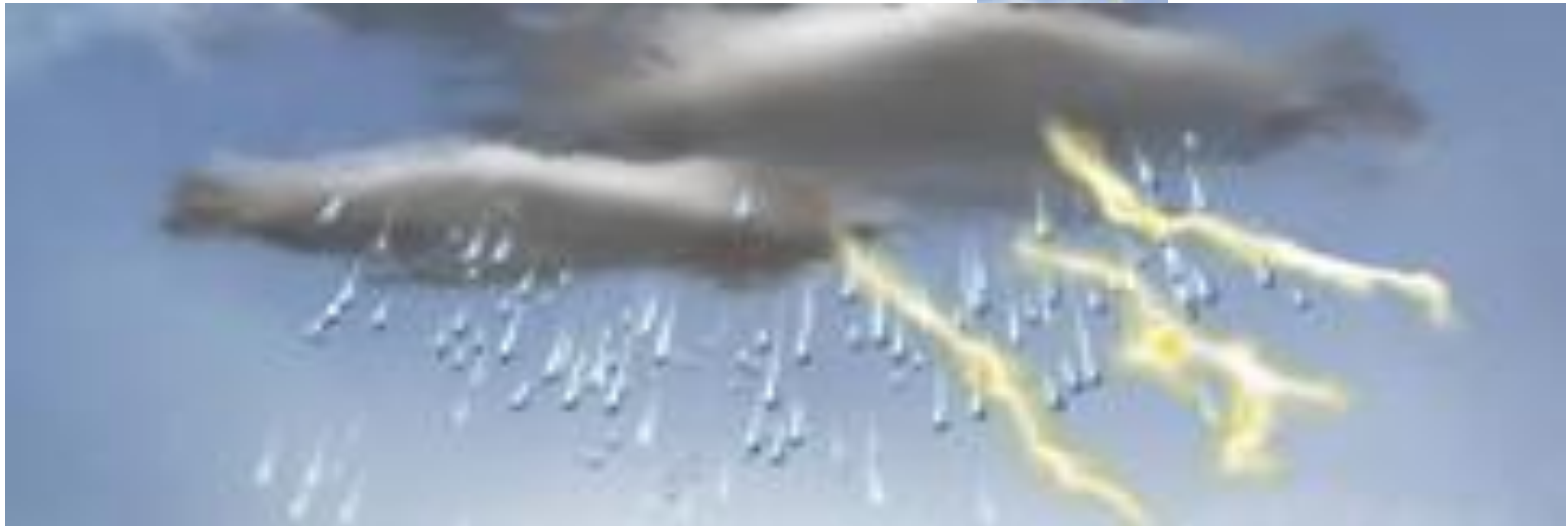
Agenda for Next progress update meeting:

- 1) Base & soil tests
- 2) Traffic data
- 3) MS Access data storage system

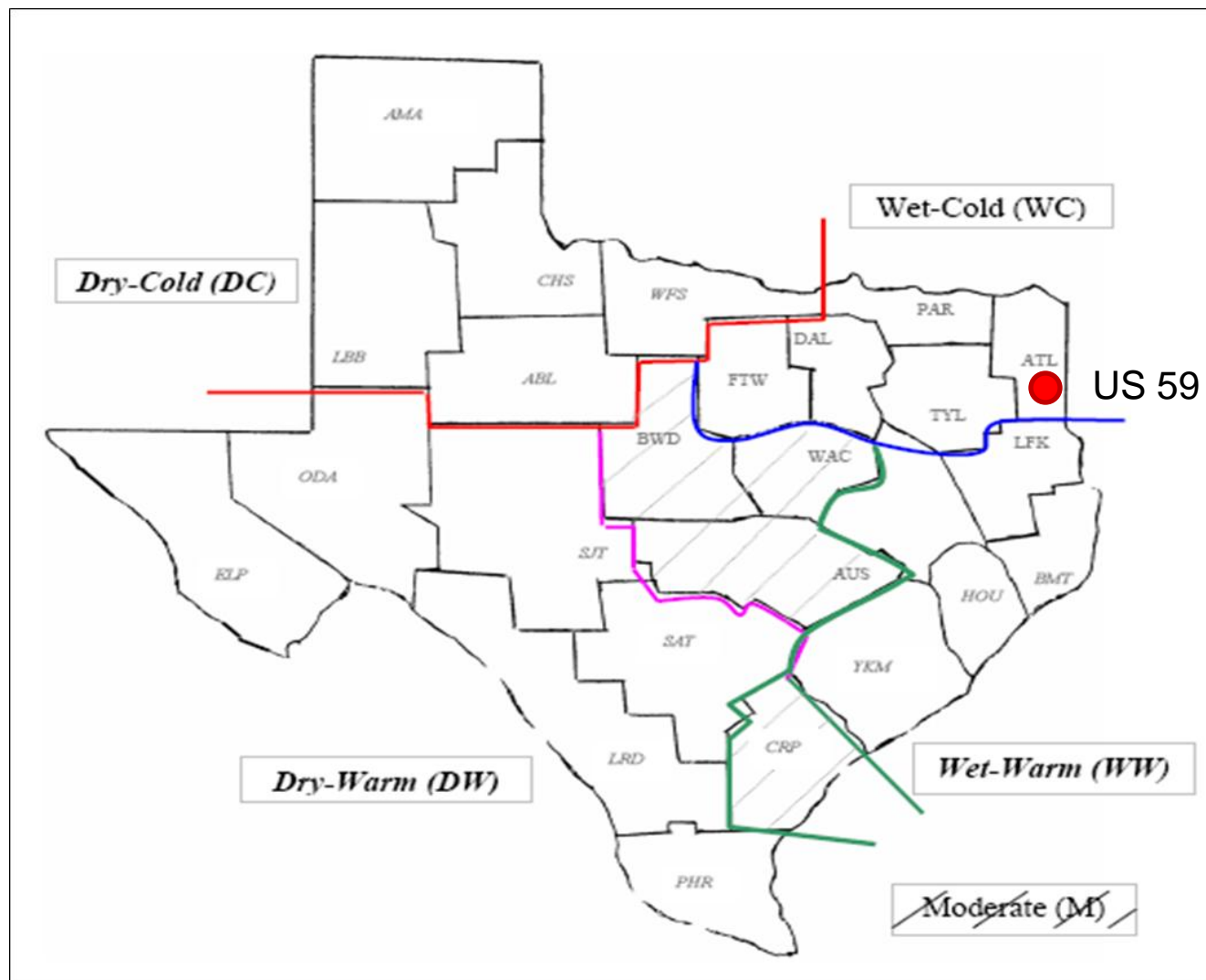
# Miscellaneous Issues & Discussions

---

# Environmental & Climatic Data



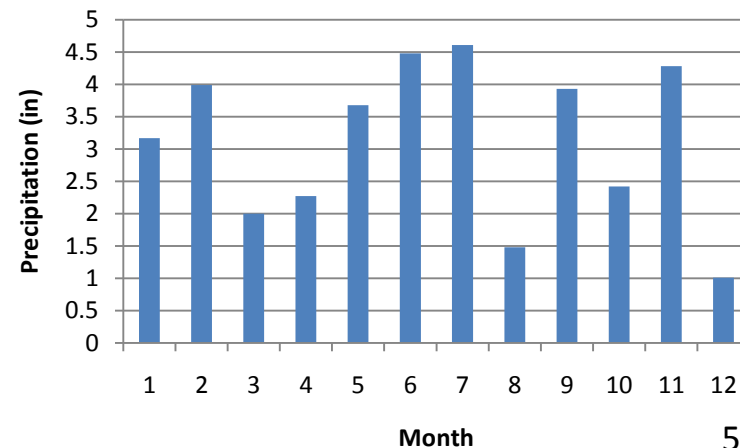
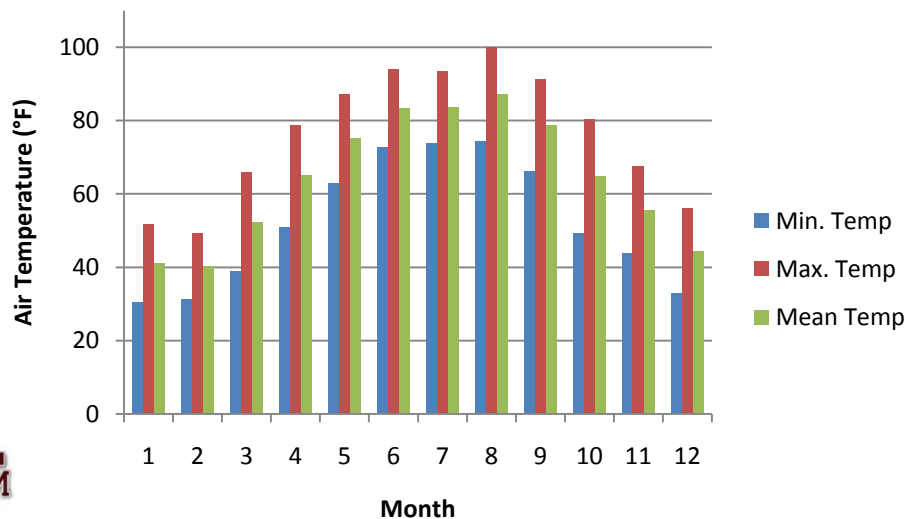
# Environmental Zone



# Example Monthly Average

Year-Monthly Average: 2010													Stats	
Month	1	2	3	4	5	6	7	8	9	10	11	12	Overall Avg	COV
Min. Air Temp.(°F)	30.4	31.3	38.8	50.9	62.7	72.7	73.6	74.4	66.1	49.3	43.7	32.8	52.2	17.1
Max. Air Temp.(°F)	51.6	49.2	65.8	78.8	87.3	94.1	93.3	100.0	91.1	80.3	67.5	56.0	76.3	17.8
Average Air Temp.(°F)	41.0	40.3	52.3	64.9	75.0	83.4	83.5	87.2	78.6	64.8	55.6	44.4	64.2	17.4
Precipitation (in)	3.17	3.99	2.00	2.27	3.68	4.48	4.61	1.48	3.93	2.42	4.28	1.01	3.11	1.23

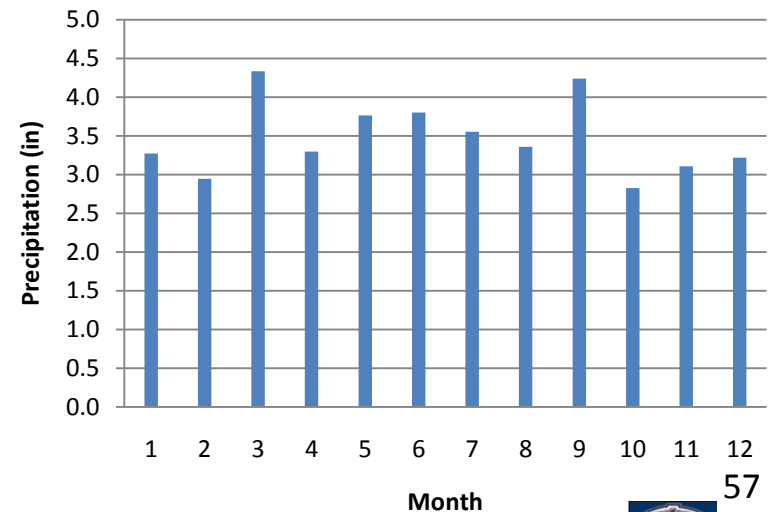
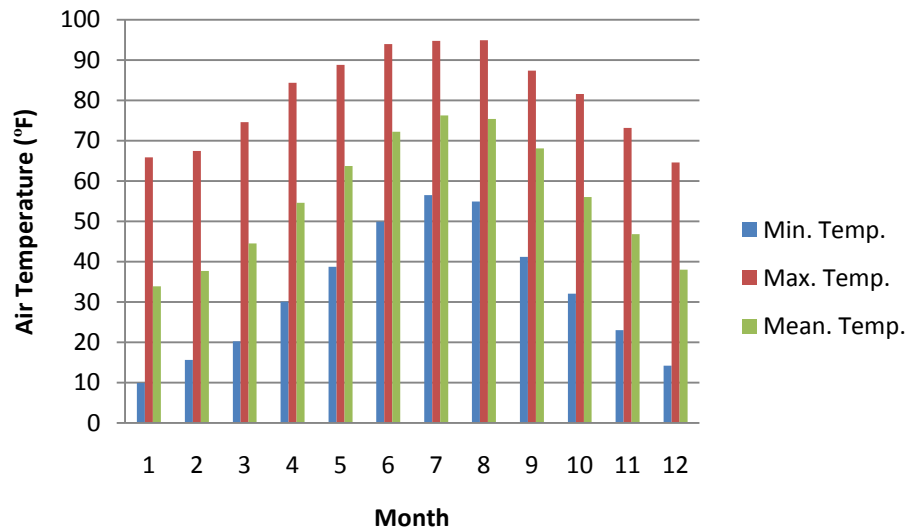
<http://cdo.ncdc.noaa.gov/ancsum/ACS>





# Monthly Average

10 Year-Monthly Average: 1996 - 2006													Stats	
Month	1	2	3	4	5	6	7	8	9	10	11	12	Overall Avg	COV
Min. Air Temp.(°F)	9.9	15.6	20.2	30.1	38.7	49.9	56.5	54.9	41.2	32.1	23.0	14.2	32.2	50.2%
Max. Air Temp.(°F)	65.9	67.5	74.6	84.4	88.8	94.0	94.8	94.9	87.4	81.6	73.2	64.6	81.0	14.2%
Average Air Temp.(°F)	33.9	37.7	44.5	54.6	63.7	72.2	76.3	75.4	68.1	56.0	46.8	38.0	55.6	27.8%
Precipitation (in)	3.3	2.9	4.3	3.3	3.8	3.8	3.6	3.4	4.2	2.8	3.1	3.2	3.5	13.7%



# Ground Water Table



**USGS**  
science for a changing world

**National Water Information System: Web Interface**

USGS Water Resources

News updated April, 2011

**USGS Texas News**

[See gages threatened by potential funding shortfalls...](#)

**Search Results -- No sites were found that meet the following criteria...**

Parameter codes = 72019  
 Site type = Well, Collector or Ranney type well, Extensometer well, Hyporheic-zone well, Interconnected wells, Multiple wells, Test hole  
 County = Panola

[Return To Previous Page](#)

The database are not comprehensive..

# Ground Water Table

## Partial analyses of water from wells in Panola County, Texas

(Analyzed at the University of Texas under the direction of Dr. E. P. Schoch, Director of the Bureau of Industrial Chemistry; by J. E. Stulken, D. F. Riddell, H. T. Davidson, Floyd H. Ward, and F. G. Steer, Chemists; and J. A. Harmaza, Martin Wieland, and Jack Ramsey, Assistant Chemists. Nitrate determined by E. W. Lohr, U. S. Geological Survey. Results are in parts per million. Well numbers correspond to numbers in table of well records.)

Well No.	Owner	Depth of well (ft.)	Date of collection	Total dissolved solids (calculated)	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na + K) (calculated)	Bicarbonate (HCO <sub>3</sub> )	Sulphate (SO <sub>4</sub> )	Chloride (Cl)	Nitrate (NO <sub>3</sub> )	Total hardness as CaCO <sub>3</sub> (calculated)
1	W. P. A. test	44	Jan. 8, 1937	46	-	-	-	24	7	10	b/	-
2	do.	40	Jan. 13, 1937	-	-	-	-	-	6	5	49	-
3	W. W. Phillips	41	Jan. 12, 1937	23	-	-	-	18	a/	5	b/	-
4	Arthur Kuykendall	50	Jan. 18, 1937	464	34	15	87	12	a/	112	210	148
6	Paul Bath	9	do.	93	-	-	-	49	20	16	b/	-
7	Aaron Morton	30	Jan. 12, 1937	54	-	-	-	24	a/	8	b/	-
8	W. B. Pelham Est.	30	do.	31	-	-	-	24	a/	7	b/	-
9	Lester S. Smith	17	do.	47	-	-	-	24	11	7	b/	-
12	J. J. Hardy	85	do.	72	-	-	-	37	14	14	b/	-
13	do.	44	do.	45	-	-	-	18	a/	12	b/	-
15	Aubrey Phillips	38	Apr. 16, 1937	221	48	5	18	65	a/	30	75	138
17	M. L. Metcalf	16	do.	577	51	28	108	61	24	216	120	242
18	E. L. Briggs	42	Jan. 19, 1937	135	12	-	37	37	a/	42	26	30
19	W. P. A. test	19	Jan. 20, 1937	65	-	-	-	24	25	6	b/	-
20	do.	22	do.	112	22	4	-	-	a/	20	60	72
21	Mrs. L. M. Yarbrough	20	Apr. 15, 1937	612	26	13	172	43	30	236	114	118
23	W. P. Lee	56	Jan. 20, 1937	375	50	24	43	171	46	47	81	226
24	T. H. Davidson	31	Jan. 19, 1937	350	31	12	66	12	77	90	68	128
26	Mrs. N. J. Majors	57	Jan. 18, 1937	706	58	39	134	6	22	340	110	304
27	Gus & Gladys Parker	46	Jan. 20, 1937	33	-	-	-	24	a/	5	b/	-
29	J. W. Cooke	47	Jan. 19, 1937	146	21	2	23	24	a/	35	49	62
30	Marshall Lumber Co.	20	Jan. 20, 1937	59	-	-	-	37	a/	8	b/	-
31	J. W. Cooke	16	Feb. 25, 1937	37	-	-	-	24	a/	6	b/	-
32	W. P. A. test	18	Mar. 2, 1937	414	-	-	-	49	25	214	b/	-
33	do.	35	Mar. 1, 1937	90	-	-	-	12	11	7	40	-
35	Tom Beaty	19	do.	223	96	33	136	146	38	246	202	375
37	Asa Johnson	28	do.	164	-	-	-	122	10	18	b/	-
38	W. P. A. test	31	Apr. 1, 1937	55	-	-	-	73	a/	13	b/	-
40	do.	20	Mar. 3, 1937	179	24	2	25	61	22	36	b/	70
43	Annie Black	27	Jan. 19, 1937	103	-	-	-	18	a/	56	b/	-

a/ Sulphate less than 10 parts per million.

b/ Nitrate less than 20 parts per million.

# Elastic Recovery (D 6084 - A)

---

Asphalt-Binder: PG 64-22 (Lion), US 59 (Atlanta)

# Viscosity @ 135 °C (T 316)

Asphalt-Binder:

PG 64-22 (Lion), US 59 (Atlanta)

	Viscosity (mPas)
Sample# 1	95.0
	95.0
	92.5
<b>Avg</b>	<b>94.2</b>
Sample# 2	87.5
	87.5
	85.0
<b>Avg.</b>	<b>86.7</b>
Sample# 3	95.0
	92.5
	92.5
<b>Avg.</b>	<b>93.3</b>
<b>Overall avg.</b>	<b>91.4</b>
<b>COV</b>	<b>4.50%</b>



# Surface Profiles.

## US 59 (Atlanta): TTI Sections (SB)

