

# Asphalt Mix ETG Oklahoma Update

Fairfield Inn & Suites  
Oklahoma City Airport  
September 16, 2015

Kenneth Ray Hobson, P.E.

# Summary

- REOB
- Mix Fatigue
  - LTPP SPS-10 WMA
- NCAT 2015 Cycle Sponsorship

# Summary

- HFST
- Common Asphalt Spreadsheets
- AASHTO T 283 Change?

# REOB

- Mix Tests?
  - OHD L-55 Hamburg Rut Test
  - AASHTO T 283
  - Fatigue

# Mix Fatigue

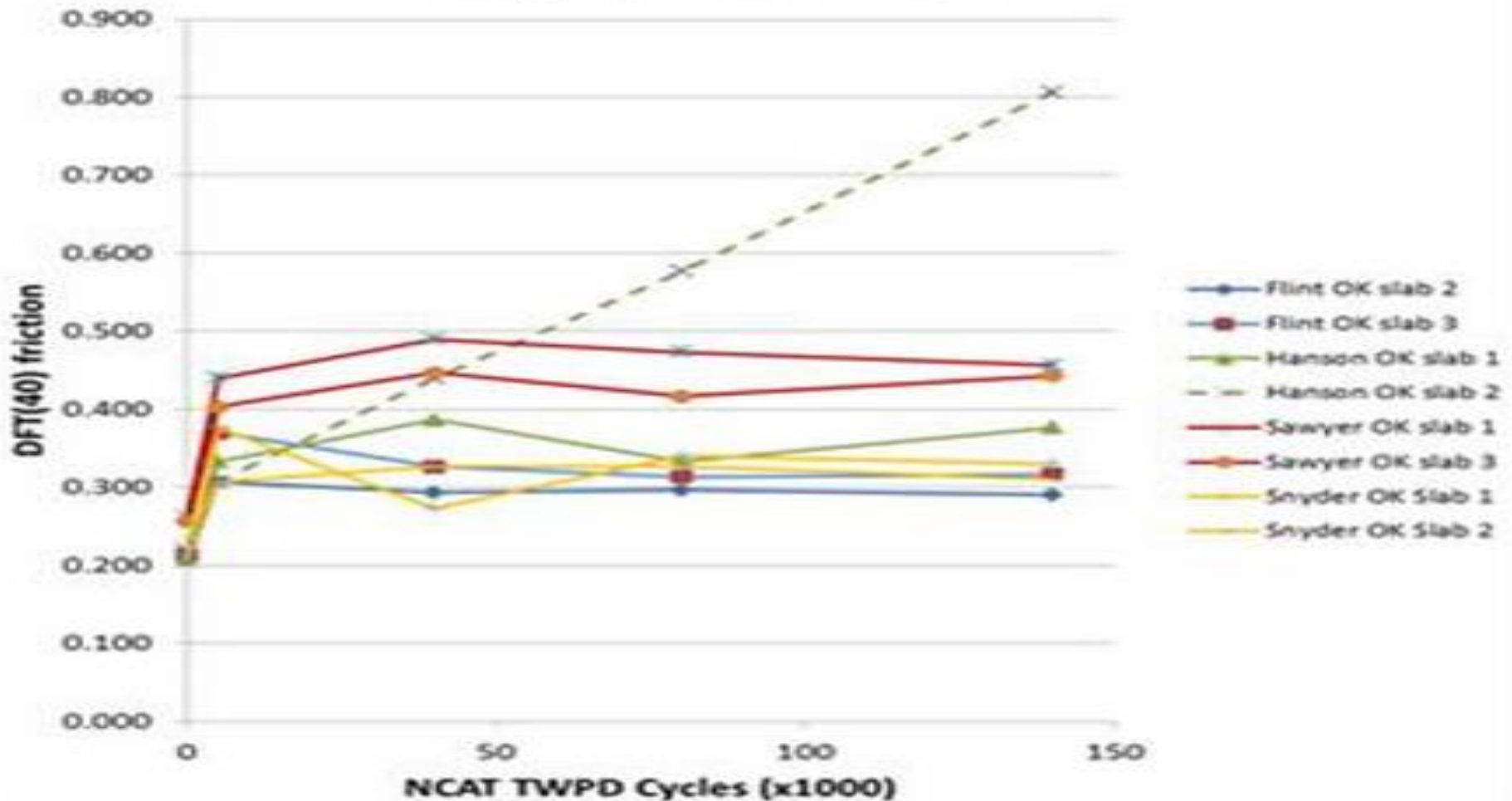
- University of Oklahoma 3 Year Research Nearly Complete
  - AMPT Deliverable
  - Chose SCB (LTRC, Illinois)
  - Extended 1 Year
    - SCB Testing for LTPP SPS-10 at Yukon, OK

# NCAT 2015 Cycle Sponsorship

- High Friction OGFSC Sec. N9
  - Micro-Mill
  - NTHAP 0.08 gal/SY, 0.15
  - 0.3% Cellulose Fibers
  - 7.0% PG 76-28

# NCAT 2015 Cycle Sponsorship

## DFT(40) Measurements



**OKLAHOMA DEPARTMENT OF TRANSPORTATION Mix Design Report**

O.G.F.S.C.	asco024	Insoluble
(Material Full Name and Material Code)		(Design Type)
NCAT Test Track		Osc00931500100
(Producer/Supplier and P/S Code)		(Mix ID)
East Alabama Paving Company		30+
(Plant Name and Plant ID)		(ESALs)

MATERIAL	SOURCE	%USED
Grade 4	Martin Marietta @ Sawyer, OK (m002311206)	75
Pile 5	Martin Marietta @ Sawyer, OK (m002311206)	25
Cellulose Fiber	Road-Cell, InerFibe Corp.(Portage, Michigan)	
AntiStrip Add.(AD-HERE LA-2)	ARR-MAZ @ Winter Haven, FL(m00070)	
Asphalt Cement (PG76-28OK)	Valero @ Ardmore, OK(m00352)	

Aggregate Percent Passing	'D' Rock	Pile 5	Comb. Spec.	Combined Aggregate	Job Formula	JMF Tolerance
3/4"	100	100	100	100	100	± 0
1/2"	100	78	80-100	95	95	± 7
3/8"	73	20	35-60	60	60	± 7
No. 4	5	5	10-25	5	5	± 7
No. 8	4	5	5-10	4	4	± 5
No. 16	4	4	-	4	4	± 4
No. 30	4	4	-	4	4	± 4
No. 50	4	4	-	4	4	± 4
No. 100	4	4	-	4	4	± 3
No. 200	3.2	3.6	0-5	3.3	0.3	± 2
Fiber			0.2-0.5	0.3	0.3	
%AC (PG76-28OK)					7.0	± 0.3
%AntiStrip Add. by Weight of Asphalt Cement					0.5	
Mix Temperature @ discharge from Mixer, °F					325	± 20
Optimum Roadway Compaction Temperature, °F					305	
Laboratory Mixing Temperature, °F					325	
Laboratory Compaction Temperature, °F					300	

**Tests on Asphalt Cement:**

Spec. Grav. @ 77 °F	Found
	1.0100 est.

**Tests on Mixture at JMF Pb:**

Gyr.	50	Spec. Wt.	3120 g
%Draindown	0.01	<	0.20
%Cantabro	4	<	10

**Tests on Aggregates:**

	Found	Required
Sand Equivalent. ....		N/A
L.A. Abrasion. ....	35	40 Max.
Durability (DC). ....	85	40 Min.
IOC.....		NA
Insoluble Residue. ....	100	90 Min.
Fractured Faces. ....	100	75 w/2
Gse.....	2.518	
Gsb.....	2.471	

**Tests on Compressed Mixtures:**

Percent Asphalt	Gmb	Gmm	Dens. % of mm	Dens. % of Req'd of Gmm	V.M.A. (%)	V.M.A. (Min.%)	%VFA	%VFA Req'd	%DP	%DP Req'd
6.0	1.796	2.315	77.6							
6.5	1.803	2.295	78.6	80						
7.0	1.826	2.280	80.1							

Compacted Wt. 83.2\_ lbs/sq.yd/1" thickness



Oklahoma Department of Transportation





# NCAT 2015 Cycle Sponsorship

- Pavement Preservation Group
- Cracking Group

# HFST I-40 WB TAFB



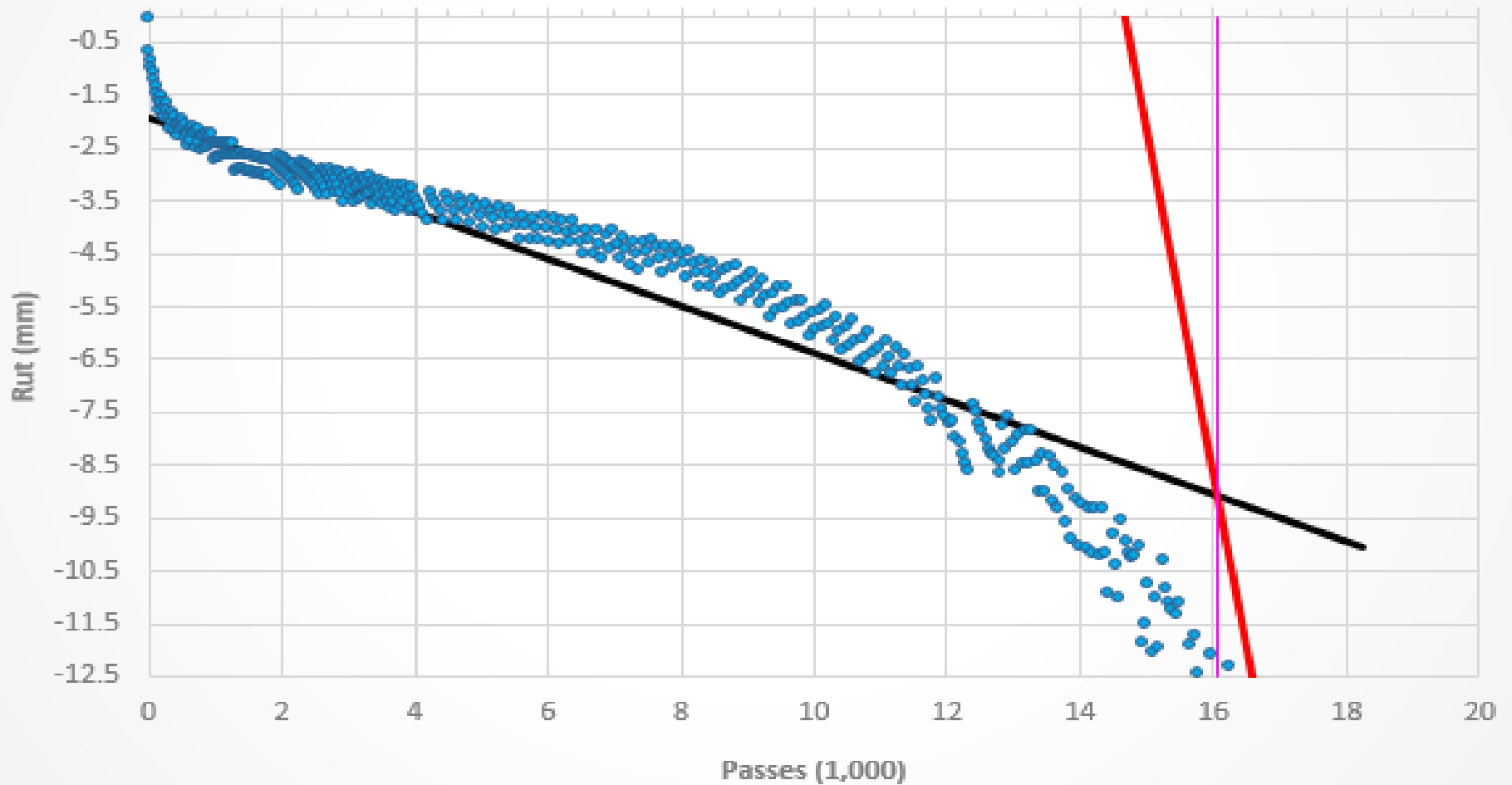
# Common Asphalt Spreadsheets

- Hamburg – OHD L-55
- Nuclear Density Correlation
- PWL – 3<sup>rd</sup> Generation
- F&T – Acceptance of Contractor Test Results
- Shot Record
  - LISST?

# Hamburg

Pt. 6 - Run 1

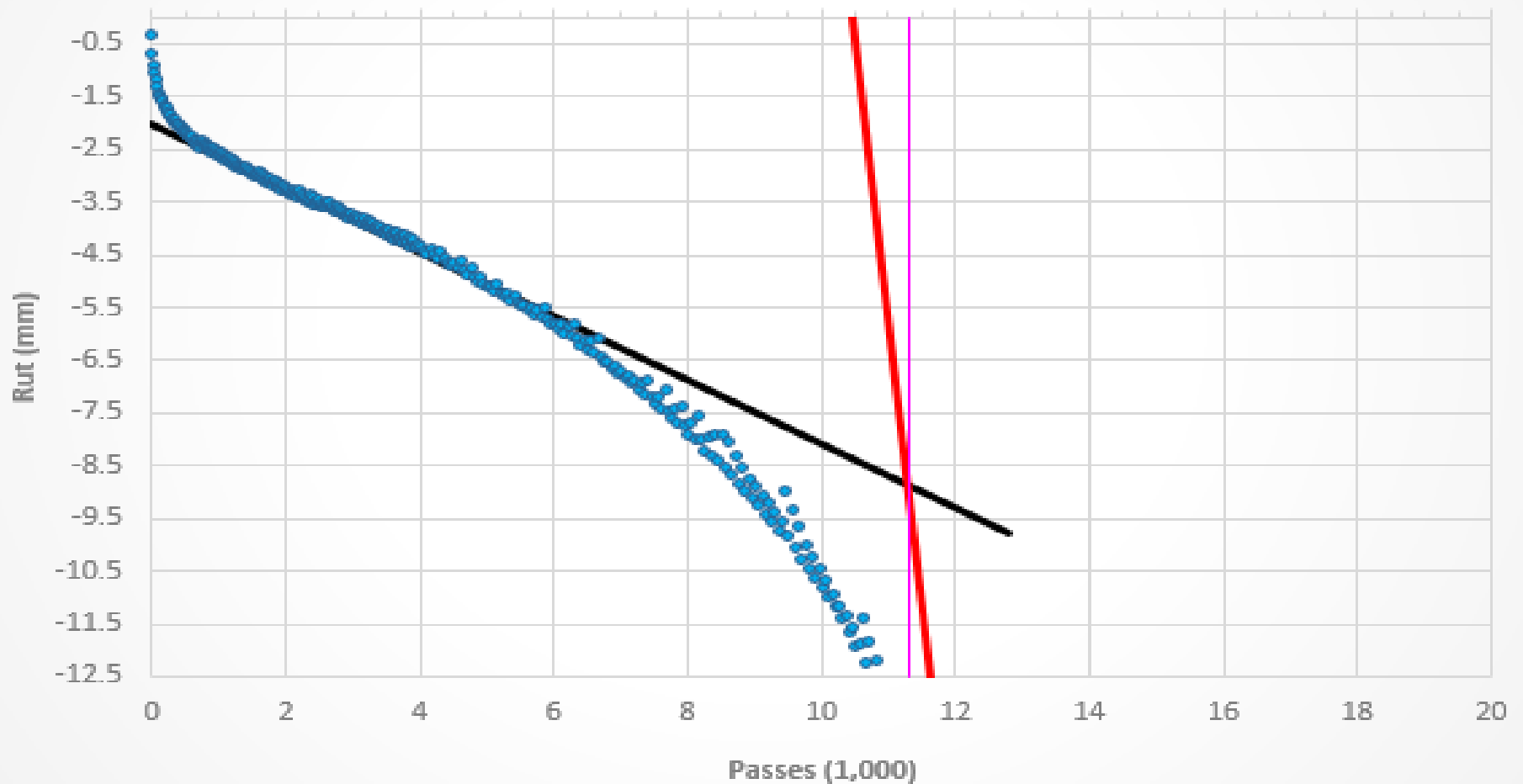
● Rut    — Creep    — Strip    — SIP



# Hamburg

Pt. 6 - Run 2

● Rut — Creep — Strip — SIP



# Hamburg

v 1.4

## SUMMARY OF OHD L-55 RUT TEST RESULTS

### ODOT Materials & Research Division

Print

Project No.	
Contractor	
Sample ID	
Binder Type	PG 64-22 OK
Min. Passes	10,000

J.P. No.	
Producer	
Mix Type	S4
Run 1	4-D
Wheel 1	Left

Contract No.	
Plant Location	
Design No.	
Run 2	4-D
Wheel 2	Right

Passes	Run 1	Run 2	Avg. mm
5,000	3.75	4.95	4.35
10,000	5.55	9.99	7.77
15,000	11.27	55.47	33.37
20,000	33.76	259.51	146.64

Calc and Plot

Creep/Strip	Run 1	Run 2	Avg.
Creep Slope <sup>-1</sup>	2249	1650	1,950
Strip Slope <sup>-1</sup>	153	93	123
S/C Slope Ratio	14.7	17.8	16.2
SIP	16066	11295	13,680



# Hamburg

Creep:Strip	Run 1	Run 2	Avg.
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# Hamburg

Passes	Run 1	Run 2	Avg. mm
5,000	3.75	4.95	4.35
10,000	5.55	9.99	7.77
15,000	11.27	55.47	33.37
20,000	33.76	259.51	146.64

# Nuclear Density Correlation

- $R^2 \geq 0.50$ 
  - Select Diverse Air Void Locations
- Max. 10% Air Voids
- Outliers ASTM E 178

# Nuclear Density Correlation

v.102

OKLAHOMA DEPARTMENT OF TRANSPORTATION

McAlester Residency

Correlation of Nuclear Gauge with Roadway Cores  
OHD L-14 Appendix A

Project \_\_\_\_\_ Job Piece \_\_\_\_\_ Contract \_\_\_\_\_  
 Contractor \_\_\_\_\_ Producer \_\_\_\_\_ Plant Location \_\_\_\_\_  
 Mix Type \_\_\_\_\_ Design No. \_\_\_\_\_ Date Reported \_\_\_\_\_  
 Gauge Nuclear Gauge ID \_\_\_\_\_ Correlation No. \_\_\_\_\_

Avg. G... 2.485

Avg. Corr. PG... 94.0

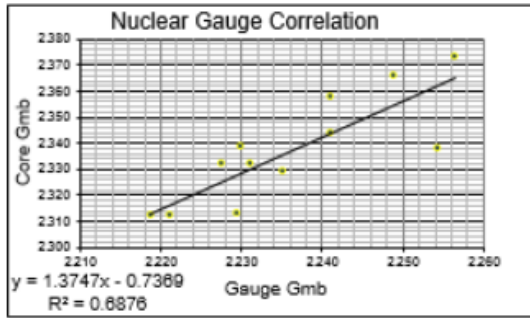
Results of Correlation

m	1.3747
b	-0.7369
R <sup>2</sup>	0.69
Gauge Correlates to Cores	TRUE

Lot Number	Sublot Number	Location Test/Core Number	Nuclear Gauge Readings					Known <sub>NS</sub>	OHD L-14					ASTM	ASTM	D 321	Known <sub>NS</sub>	ASTM			
			Unit Weight (PCF)						Roadway Core Weights (grams)					D 3549	D 3549						
			1	2	3	4	Avg.	Nuclear Gauge Gmb	Air	Water	SSD	Initial Air	Sealed Air	Sealed H2O	Dia. mm	Height in.	%Abs.	SSD Gmb	Vacuum Gmb	Core Gmb	Correlated Gmb
1	1	1	139.0	139.2	139.4	139.0	139.2	2.230	1215.0	697.7	1227.8	1214.2	1258.4	685.1	150	1.16	2.41	2.292	2.339	2.339	2.329
1	1	2	141.8	136.2	139.9	141.5	139.9	2.241	1217.0	699.0	1218.3				150	1.16	0.25	2.344	#N/A	2.344	2.344
1	1	3	139.1	138.9	141.6	141.7	140.3	2.249	1212.5	702.4	1214.9				150	1.14	0.47	2.366	#N/A	2.366	2.355
1	2	1	138.4	141.7	139.5	139.8	139.9	2.241	1216.1	702.8	1218.6				150	1.15	0.48	2.358	#N/A	2.358	2.344
1	2	2	138.7	139.8	140.7	138.7	139.5	2.235	1213.3	694.1	1215.0				150	1.16	0.33	2.329	#N/A	2.329	2.336
1	2	3	141.4	139.5	140.2	141.6	140.7	2.254	1218.9	698.8	1220.2				150	1.16	0.25	2.338	#N/A	2.338	2.362
1	3	1	142.1	141.8	141.0	138.3	140.8	2.256	1214.4	704.3	1216.1				150	1.14	0.33	2.373	#N/A	2.373	2.365
1	3	2	136.3	140.7	140.0	139.5	139.1	2.230	1215.8	691.9	1217.5				150	1.17	0.32	2.313	#N/A	2.313	2.328
1	3	3	140.2	136.4	138.4	139.4	138.6	2.221	1211.6	689.0	1213.1				150	1.17	0.29	2.312	#N/A	2.312	2.317
1	4	1	138.8	136.5	139.7	141.0	139.0	2.228	1217.7	697.2	1219.4				150	1.16	0.33	2.332	#N/A	2.332	2.325
1	4	2	135.7	137.4	139.7	141.0	138.5	2.219	1211.6	689.0	1213.1				150	1.17	0.29	2.312	#N/A	2.312	2.313
1	4	3	136.9	139.3	139.7	141.0	139.2	2.231	1217.7	697.2	1219.4				150	1.16	0.33	2.332	#N/A	2.332	2.330
								#N/A										#N/A	#N/A	#N/A	#N/A
								#N/A										#N/A	#N/A	#N/A	#N/A
								#N/A										#N/A	#N/A	#N/A	#N/A

Linear Regression Input:  
 X Values: Gauge Gsb  
 Y Values: Core Gsb

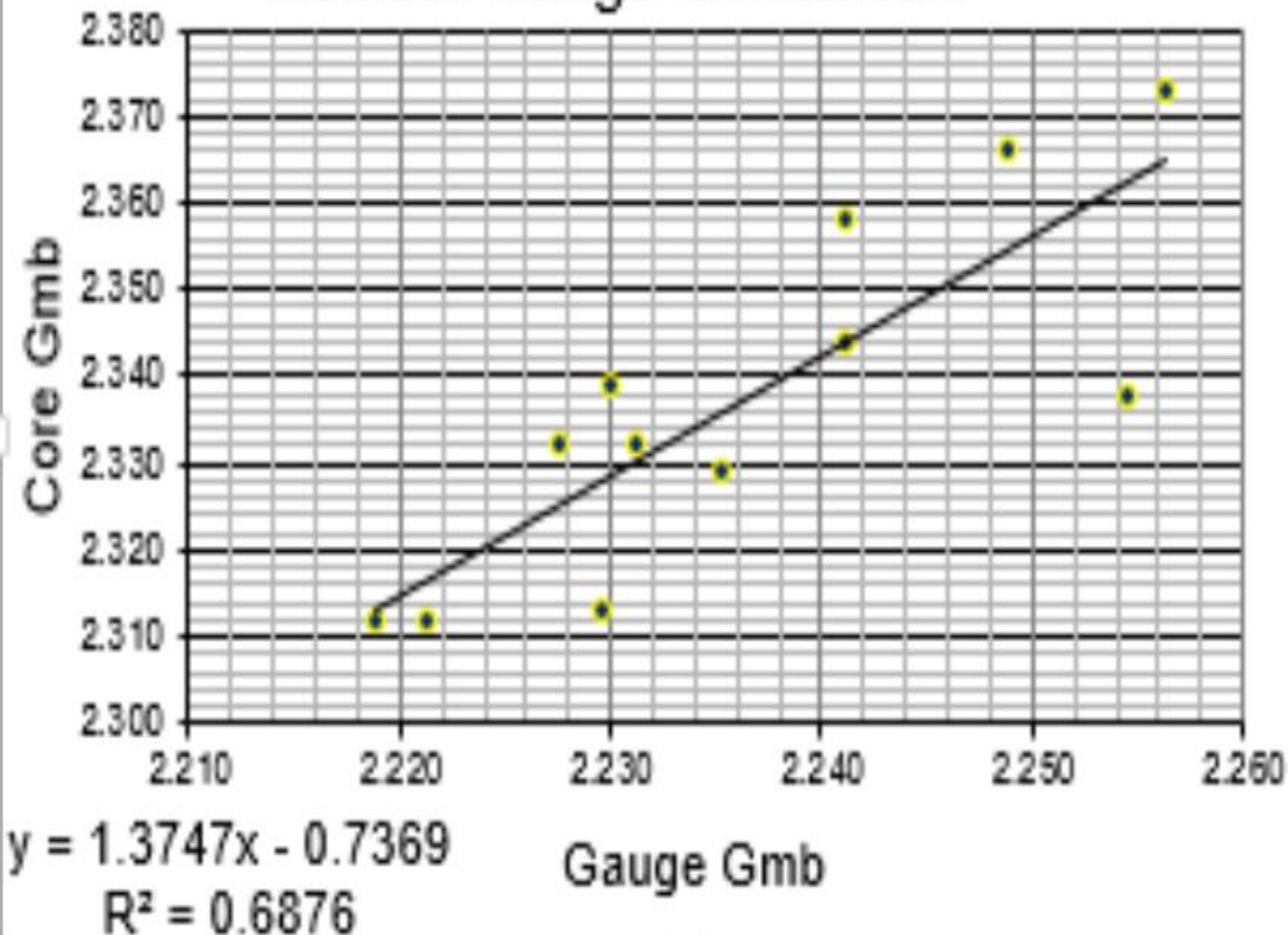
Linear Regression Output:  
 Slope (m) 1.3747  
 Y intercept (b) -0.7369  
 R<sup>2</sup> 0.6876



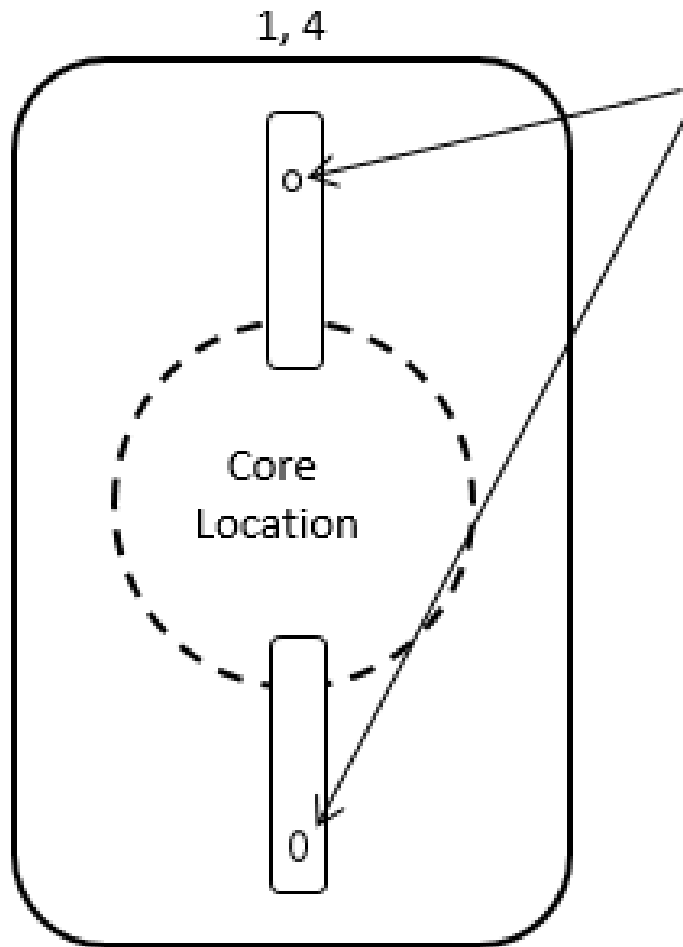
# Nuclear Density Correlation

		<b>m</b>	1.3747
		<b>b</b>	-0.7369
Avg. $G_{mm}$	<b>2.485</b>	$R^2$	0.69
Avg. Corr. $PG_{mm}$	94.0	Gauge Correlates to Cores	TRUE

# Nuclear Gauge Correlation



# Nuclear Density Correlation



Radiation source for the two gauge orientations that differ by  $180^\circ$  for 2-4 readings.

Direction of Travel



2, 3  
Not to Scale

# PWL

v 0.2

Print

## OKLAHOMA DEPARTMENT OF TRANSPORTATION ASPHALT CONCRETE PAVING

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PROJECT NO: \_\_\_\_\_ COUNTY: \_\_\_\_\_ DATE: \_\_\_\_\_

CONTRACTOR: \_\_\_\_\_ ASPHALT DESIGN NO: [S3pv026100400](#)

<b>ID</b>	<b>LOT NO.</b>	<b>1</b>	<b>Total Tons</b>	<b>4,000.00</b>
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DESIGN		SUBLOT 1	SUBLOT 2	SUBLOT 3	SUBLOT 4	SUBLOT 5	SUBLOT 6	PFs	Reason to Waive PF
SIEVE SIZE	JMF	Test Result	Test Result	Test Result	Test Result	Test Result	Test Result		
1"	100	0	0	0	0				
3/4"	100	0	0	0	39				
1/2"	89	201	185	322	280				
3/8"	81	348	326	455	444				
No. 4	63	749	729	813	811				
No. 8	46	1101	1088	1140	1165				
No. 16	36	1323	1310	1344	1371				
No. 30	26	1488	1772	1494	1522				
No. 50	16	1625	1604	1614	1651				
No. 100	9	1750	1724	1722	1771				
No. 200	5.4	7.5	7.5	6.8	6.7				
% AC	4.3	4.5	4.2	4.1	4.2			1.05	
% VMA	12.5	12.7	12.7	12.9	12.1			1.05	
% Air Voids	4.0	3.0	3.8	4.2	3.0			1.04	
PG <sub>mm</sub> Core 1		93.6	92.6	92.3	93.2				
PG <sub>mm</sub> Core 2		92.3	92.6	92.2	93.1				
PG <sub>mm</sub> Core 3		92.5	92.4	92.0	91.9				
Avg. PG <sub>mm</sub>	94.0	92.8	92.5	92.2	92.7			1.05	
Final PFs	PG <sub>mm</sub>	1.05	% Air Voids	1.04	% AC	1.05	VMA	1.05	
CPF	1.05	CUP	\$63.81		Pay Adjustment on Lot	\$12,762.00			



# PWL

% AC	4.3	4.5	4.2	4.1	4.2			1.05
% VMA	12.5	12.7	12.7	12.9	12.1			1.05
% Air Voids	4.0	3.0	3.8	4.2	3.0			1.04
PG <sub>mm</sub> Core 1		93.6	92.6	92.3	93.2			
PG <sub>mm</sub> Core 2		92.3	92.6	92.2	93.1			
PG <sub>mm</sub> Core 3		92.5	92.4	92.0	91.9			
Avg. PG <sub>mm</sub>	94.0	92.8	92.5	92.2	92.7			1.05
Final PFs	PG <sub>mm</sub>	1.05	% Air Voids	1.04	% AC	1.05	VMA	1.05
CPF	1.05	CUP	\$63.81		Pay Adjustment on Lot		\$12,762.00	



# F&T

Qual. Char.	LOT/ID	Begin Set	End Set	$\bar{x}_p$	$N_p$	$D_r$	$s_p$	$t_{crit}$	$t_p$	Accept	Date
Rdy. Dens.	1	1	4	0.175	4	3	0.350	5.841	1.000	TRUE	3/23/2015
AV	1	1	4	0.325	4	3	0.427	5.841	1.522	TRUE	3/23/2015
AC	1	1	4	0.125	4	3	0.096	5.841	2.611	TRUE	3/23/2015
VMA	1	1	4	0.050	4	3	0.480	5.841	0.209	TRUE	3/23/2015

Qual. Char.	LOT/ID	Begin Set	End Set	F	$F_{crit}$	$F \leq F_{crit}$	t	$t_{crit}$	$t \leq t_{crit}$	Accept	Date
Rdy. Dens.	2	1	8	1.079	199.250	TRUE	0.546	3.707	TRUE	TRUE	3/26/2015
AV	2	1	8	5.498	26.284	TRUE	0.895	3.707	TRUE	TRUE	3/26/2015
AC	2	1	8	2.100	199.250	TRUE	2.642	3.707	TRUE	TRUE	3/26/2015
VMA	2	1	8	1.626	199.250	TRUE	0.792	3.707	TRUE	TRUE	3/26/2015

Qual. Char.	LOT/ID	Begin Set	End Set	F	$F_{crit}$	$F \leq F_{crit}$	t	$t_{crit}$	$t \leq t_{crit}$	Accept	Date
Rdy. Dens.	3	1	11	1.023	10.882	TRUE	0.358	3.169	TRUE	TRUE	3/27/2015
AV	3	1	11	3.491	10.882	TRUE	1.308	3.169	TRUE	TRUE	3/27/2015
AC	3	1	11	4.286	44.434	TRUE	2.697	3.169	TRUE	TRUE	3/27/2015
VMA	3	1	11	1.340	44.434	TRUE	1.019	3.169	TRUE	TRUE	3/27/2015

Qual. Char.	LOT/ID	Begin Set	End Set	F	$F_{crit}$	$F \leq F_{crit}$	t	$t_{crit}$	$t \leq t_{crit}$	Accept	Date
Rdy. Dens.	4	1	15	1.147	6.881	TRUE	0.367	2.947	TRUE	TRUE	3/28/2015
AV	4	1	15	1.672	6.881	TRUE	1.818	2.947	TRUE	TRUE	3/28/2015
AC	4	1	15	1.621	20.824	TRUE	3.487	2.947	FALSE	FALSE	3/28/2015
VMA	4	1	15	1.897	20.824	TRUE	0.161	2.947	TRUE	TRUE	3/28/2015

Qual. Char.	LOT/ID	Begin Set	End Set	F	$F_{crit}$	$F \leq F_{crit}$	t	$t_{crit}$	$t \leq t_{crit}$	Accept	Date
Rdy. Dens.	5	1	19	1.170	5.372	TRUE	0.154	2.845	TRUE	TRUE	3/29/2015
AV	5	1	19	1.866	5.372	TRUE	2.648	2.845	TRUE	TRUE	3/30/2015
AC	5	1	19	17.466	5.372	FALSE	0.065	2.845	TRUE	FALSE	3/31/2015
VMA	5	1	19	2.115	13.146	TRUE	0.044	2.845	TRUE	TRUE	4/1/2015

# Shot Record

v.12

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## OKLAHOMA DEPARTMENT OF TRANSPORTATION

### Shot Record

Lab		J.P. No.		%Residual	54.0%	%Shot	50.0%
Project No.		Contract		Specific Gravity	1.0100	Binder Tpe	Emulsion
Contractor		P/S code		Spec. Rate Gal/SY	0.150	Use Type	Tack Coat
P/S Name						Spec. Type	Diluted

DATE	BEGINNING STATION	ENDING STATION	Ft. LENGTH	Ft. WIDTH	SQUARE YARDS	GAL. START	GAL. STOP	GAL. SHOT	OIL (F) TEMP	TEMP. CORR.	CORR. GAL.	GAL. @ 50%	RESIDUAL GAL.	ACC. GAL.	Diluted Gal/SY	Raw Gal/SY	Residual Gal/SY	Lane or Comments
9/15/2015	00+00.00	10+00.00	1000.00	12	1,333.33	1000	795	205.00	160	0.97500	199.88	99.94	53.97	99.94	0.150	0.075	0.040	



# Shot Record

						%Shot	50.0%	
	%Residual	54.0%				Binder Tpe	Emulsion	
	Specific Gravity	1.0100				Use Type	Tack Coat	
	Spec. Rate Gal/SY	0.150				Spec. Type	Diluted	
<b>TEMP.</b>	<b>CORR.</b>	<b>GAL. @</b>	<b>RESIDUAL</b>	<b>ACC.</b>	<b>Diluted</b>	<b>Raw</b>	<b>Residual</b>	<b>Lane or</b>
<b>CORR.</b>	<b>GAL.</b>	<b>50%</b>	<b>GAL.</b>	<b>GAL.</b>	<b>Gal/SY</b>	<b>Gal/SY</b>	<b>Gal/SY</b>	<b>Comments</b>
0.97500	199.88	99.94	53.97	99.94	0.150	0.075	0.040	

# AASHTO T 283 Change?

- Test Controls Min. of 24 Hours after Molding, or better...
- Controls and Pre-Conditioned Specimens Tested at Same Temperature the Same Day

# Questions?

[http://www.ok.gov/odot/Doing\\_Business/Construction/Materials\\_&\\_Testing\\_e-Guide/index.html](http://www.ok.gov/odot/Doing_Business/Construction/Materials_&_Testing_e-Guide/index.html)



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