A Producer's Experience with Performance Testing

GREG ROSE – BARRE STONE PRODUCTS, INC.

Barre Stone Products, Inc.

Where did it all start?

Optimized Mix Design for Performance

Northeast Asphalt User Producer Group (NEAUPG)
Annual Meeting
Burlington, Vermont
October 2015

Shane Buchanan
Oldcastle Materials

Balanced Mix Design (BMD)
Task Force Update
FHWA Expert Task Group on Asphalt Mixtures

Dave Newcomb

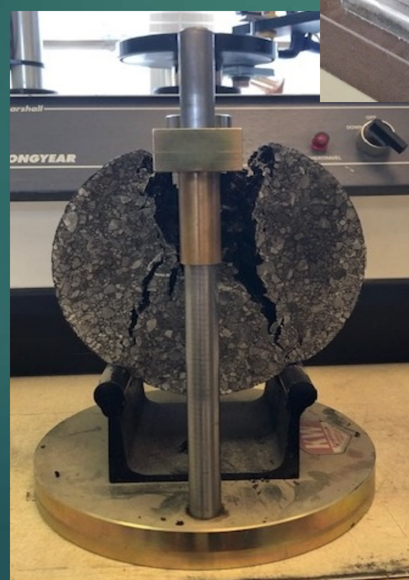
Performance-Related Mixes and Balanced Mix Design

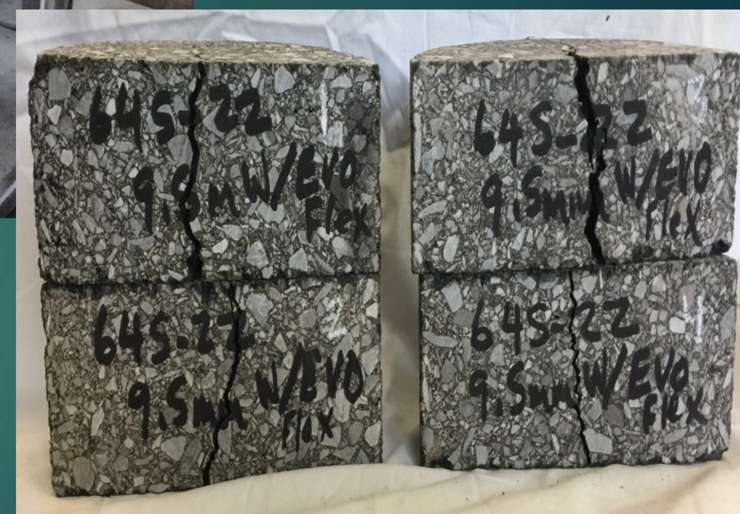
Thomas Bennert, Ph.D.
Rutgers University, NJ

North Eastern States' Materials Engineers Association (NESMEA)
October 18^{th} – 19^{th}, 2016
Newark, DE

Cantabro Testing

SCB Testing





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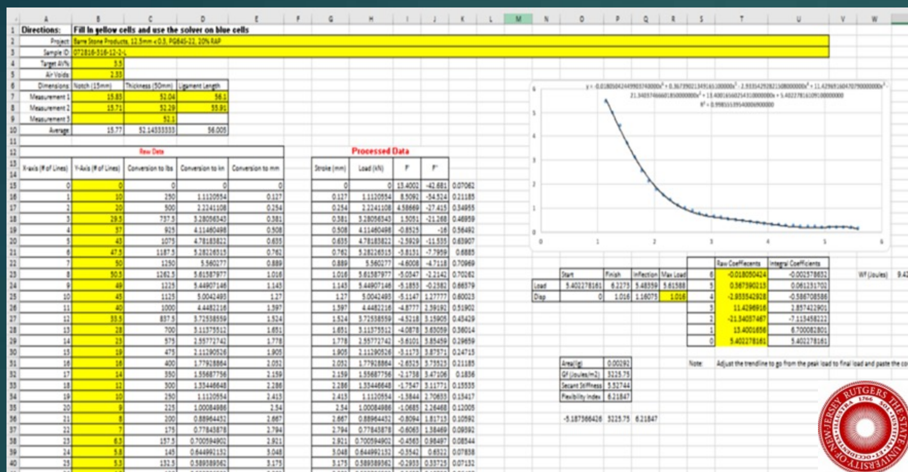
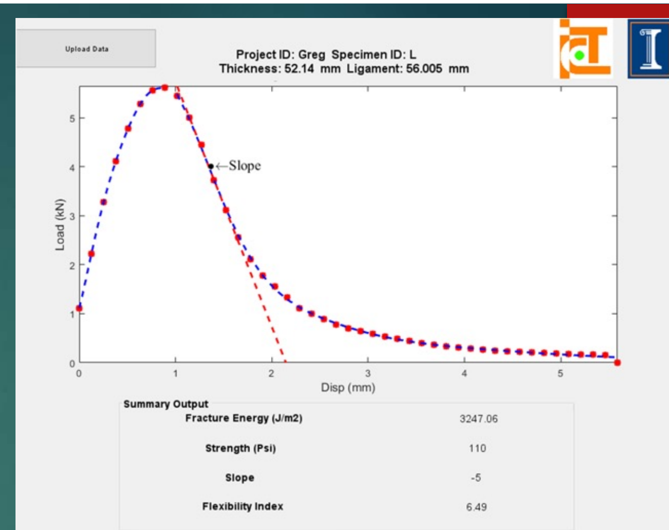
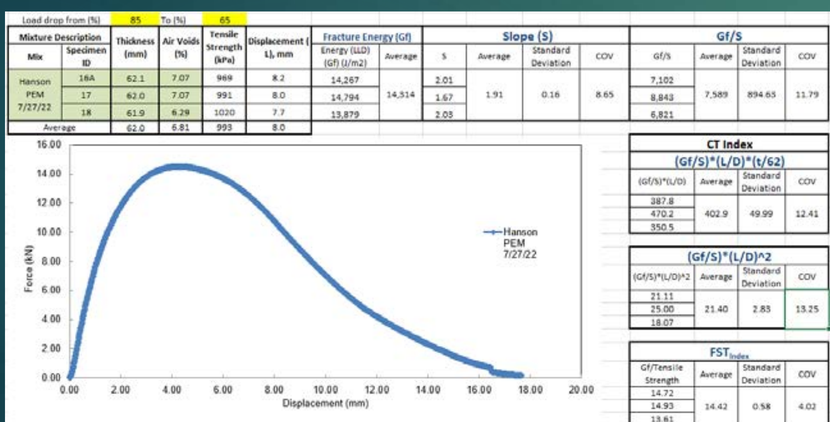




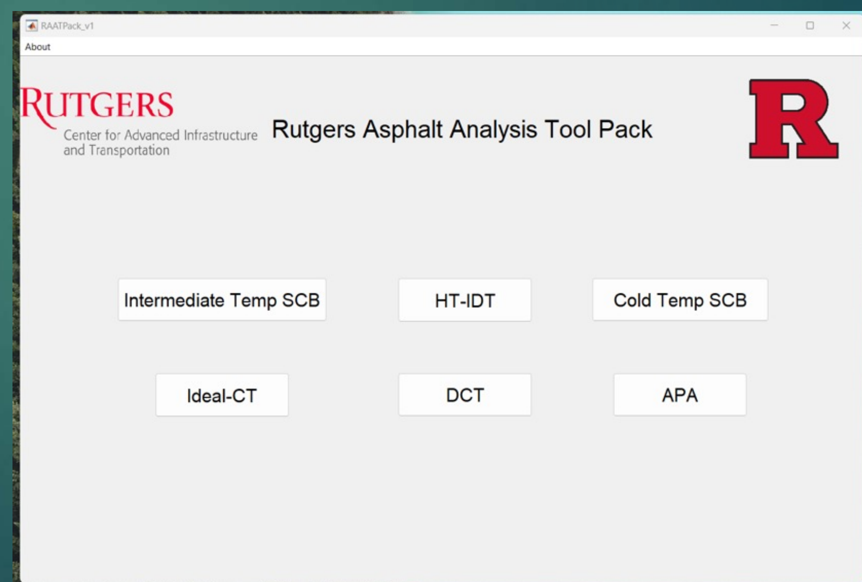


Load drop from (%)	85	To (%)	65												
Mixture Description		Thickness (mm)	Air Voids (%)	Tensile Strength (kPa)	Displacement (L), mm	Fracture Energy (Gf)		Slope (S)				Gf/S			
Mix	Specimen ID					Energy (LLD) (Gf) (J/m2)	Average	S	Average	Standard Deviation	COV	Gf/S	Average	Standard Deviation	COV
Hanson PEM 7/27/22	16A	62.1	7.07	969	8.2	14,267	14,314	2.01	1.91	0.16	8.65	7,102	7,589	894.65	11.79
	17	62.0	7.07	991	8.0	14,794		1.67				8,843			
	18	61.9	6.29	1020	7.7	13,879		2.03				6,821			
Average		62.0	6.81	993	8.0										

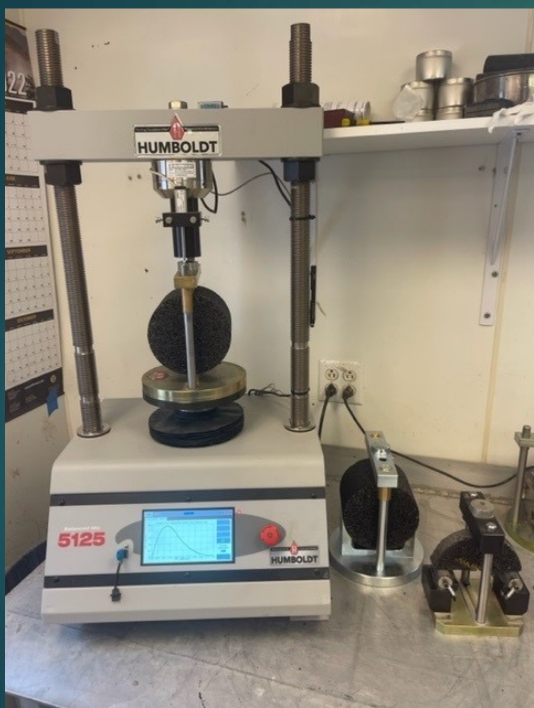
CT Index (Gf/S)*(L/D)*(t/62)			
(Gf/S)*(L/D)	Average	Standard Deviation	COV
387.8	402.9	49.99	12.41
470.2			
350.5			

(Gf/S)*(L/D)^2			
(Gf/S)*(L/D)^2	Average	Standard Deviation	COV
21.11	21.40	2.83	13.25
25.00			
18.07			

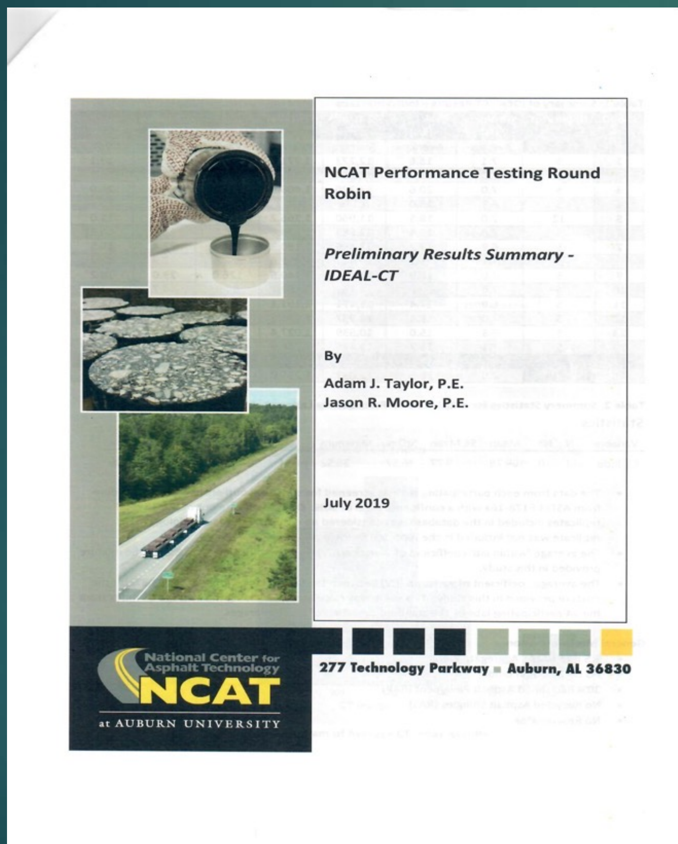
FST_{Index}			
Gf/Tensile Strength	Average	Standard Deviation	COV
14.72	14.42	0.58	4.02
14.93			
13.61			



Upgrade my Equipment



Verify Methods & Practices


NCAT Performance Testing Round Robin

Preliminary Results Summary - IDEAL-CT

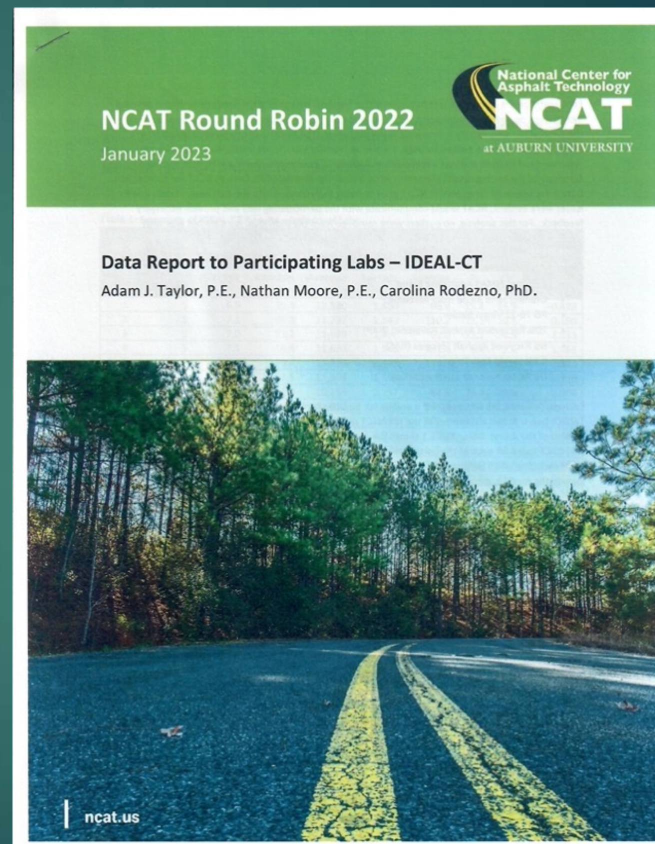
By

Adam J. Taylor, P.E.
Jason R. Moore, P.E.

July 2019

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

277 Technology Parkway ■ Auburn, AL 36830


NCAT Round Robin 2022

January 2023

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

Data Report to Participating Labs – IDEAL-CT

Adam J. Taylor, P.E., Nathan Moore, P.E., Carolina Rodezno, PhD.

ncat.us

2019 Special Note

Task 2. **<u>Number of Specimens (Testing Lab).</u>**

The testing laboratory will make the following number of specimens for performance testing:

a. Overlay Tester – 5 specimens
b. Asphalt Pavement Analyzer (APA) or Hamburg Wheel Tracker – 6 specimens
c. Semi-circular Bend (SCB) – 4 specimens
d. Ideal-CT – 3 specimens
e. High Temperature Indirect Tension – 3 specimens
f. Gradation
g. Asphalt content using chemical extraction.

Task 3. **<u>Number of Specimens (Producer Lab).</u>**

The producer will make the following number of specimens for performance testing:

a. Semi-circular Bend (SCB) – 4 specimens
b. Ideal-CT – 3 specimens
c. High Temperature Indirect Tension – 3 specimens

Task 4.

<u>Test Results.</u> The Producer will submit both the testing lab and Produce lab results to the Materials Bureau once the tests are completed. In addition, the Producer shall submit the volumetric results of the mixture during the production for the day selected. The QAF will be 1.00

Plant Production	Units	Target	Range	Lot 4A	Rutgers *		Lot 4B
Voids	%	3.16	2.5 - 4.5	4.53			3.69
AC Content	%	6.3	6.1 - 6.5	6.5	6.3		6.3

APA Rutting @ 8,000 Cycles @ 64°C	Units	Target	Range	Lot 4A	Rutgers		Lot 4B
Rut Depth	mm		4 - 7	-	4.38		-

Hamburg Rutting at 20,000 Cycles @ 50°C	Units	Target	Range	Lot 4A	Rutgers		Lot 4B
Rut Depth	mm	< 12.5	n/a	-	10.45		-

High Temperature Indirect Tensile Stregth (HT-IDT) @ 42°C	Units	Target	Range	Lot 4A	Rutgers		Lot 4B
Voids	%	7.0	6.5 - 7.5	7.0	7.0		6.9
Thickness	mm	95.0	94.0 - 96.0	94.8	95.5		95.0
HT-IDT	PSI		23 - 47	36.0	33.2		36.1

Overlay Test for Crack Resistance @ 25°C	Units	Target	Range	Lot 4A	Rutgers		Lot 4B
# of Cycles to Failure	Cycles		100 - 700	-	1171		-

Semicircular Bend (SCB)	Units	Target	Range	Lot 4A	Rutgers		Lot 4B
Voids	%	7.0	6.0 - 8.0	7.1	7.1		7.0
Thickness	mm	50.0	49.0 - 51.0	48.6	49.9		48.8
Ligament	mm			57.6	58.1		57.9
Flexibility Index	FI	> 8.0		8.6	18.8		11.4

Proposed Ideal-CT	Units	Target	Range	Lot 4A	Rutgers		Lot 4B
Voids	%	7.0	6.5 - 7.5	7.1	7.0		7.0
Thickness	mm	62.0	61.0 - 63.0	62.1	62.2		62.0
(Gf/S)*(L/D)			70 - 250	176.0	217.5		178.8

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Asphalt Design and Production Task Force (ADP – TF)

NEW YORK STATE OF OPPORTUNITY. | Department of Transportation
MATERIALS BUREAU

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- Tom Kane – NYSDOT
- Karl Vogel – NYSDOT
- Chris Heller – NYSDOT
- Bruce Barkevich – NYCMA
- Greg Rose – Barre Stone
- Massimo Colombai – Dolomite
- Aaron Markham – Gernatt
- Rocco Perretta – Heidelberg
- Jared Borelli – Callanan
- Kai Qualben – Tilcon NY
- Connor Campbell – Suit-Kote
- Mike Moore Jr. – Cobleskill Stone

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Benchmarking NYS Mixes

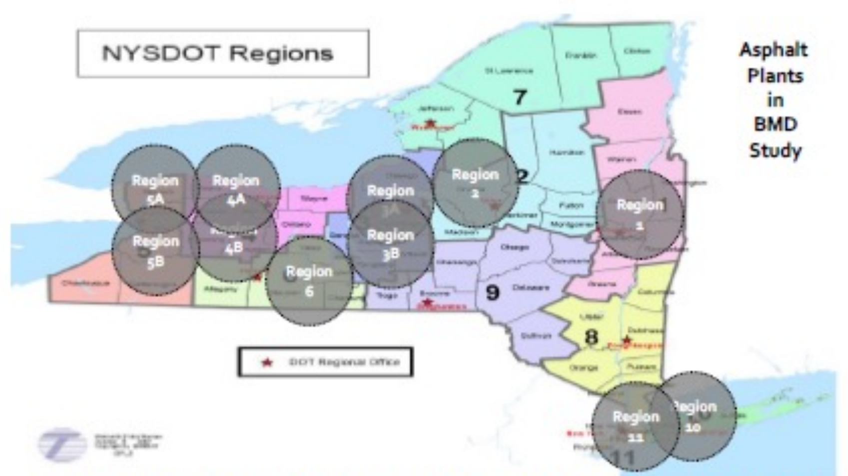
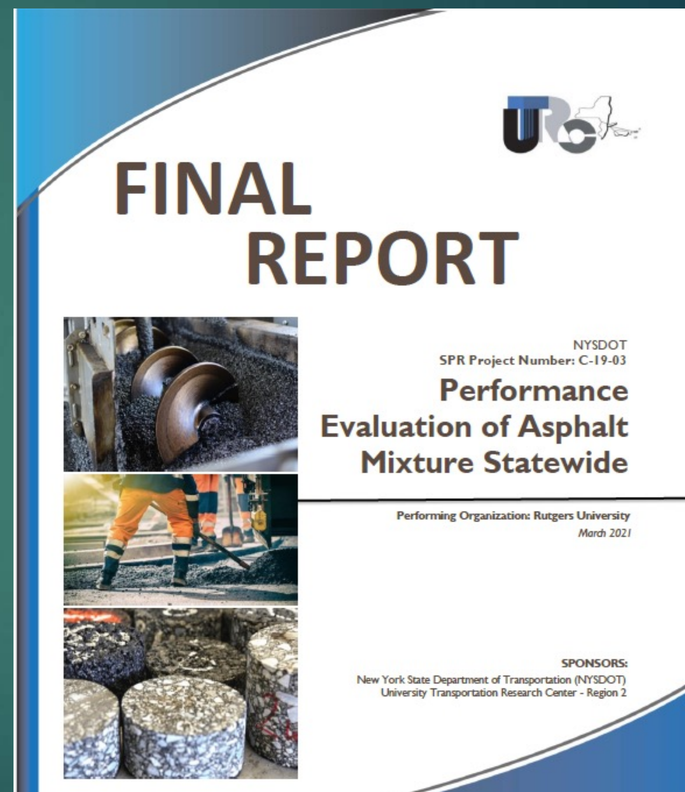


Figure 6 – Regional Locations of Asphalt Mixtures Evaluated in NYSDOT BMD Study


FINAL REPORT

NYSDOT
SPR Project Number: C-19-03

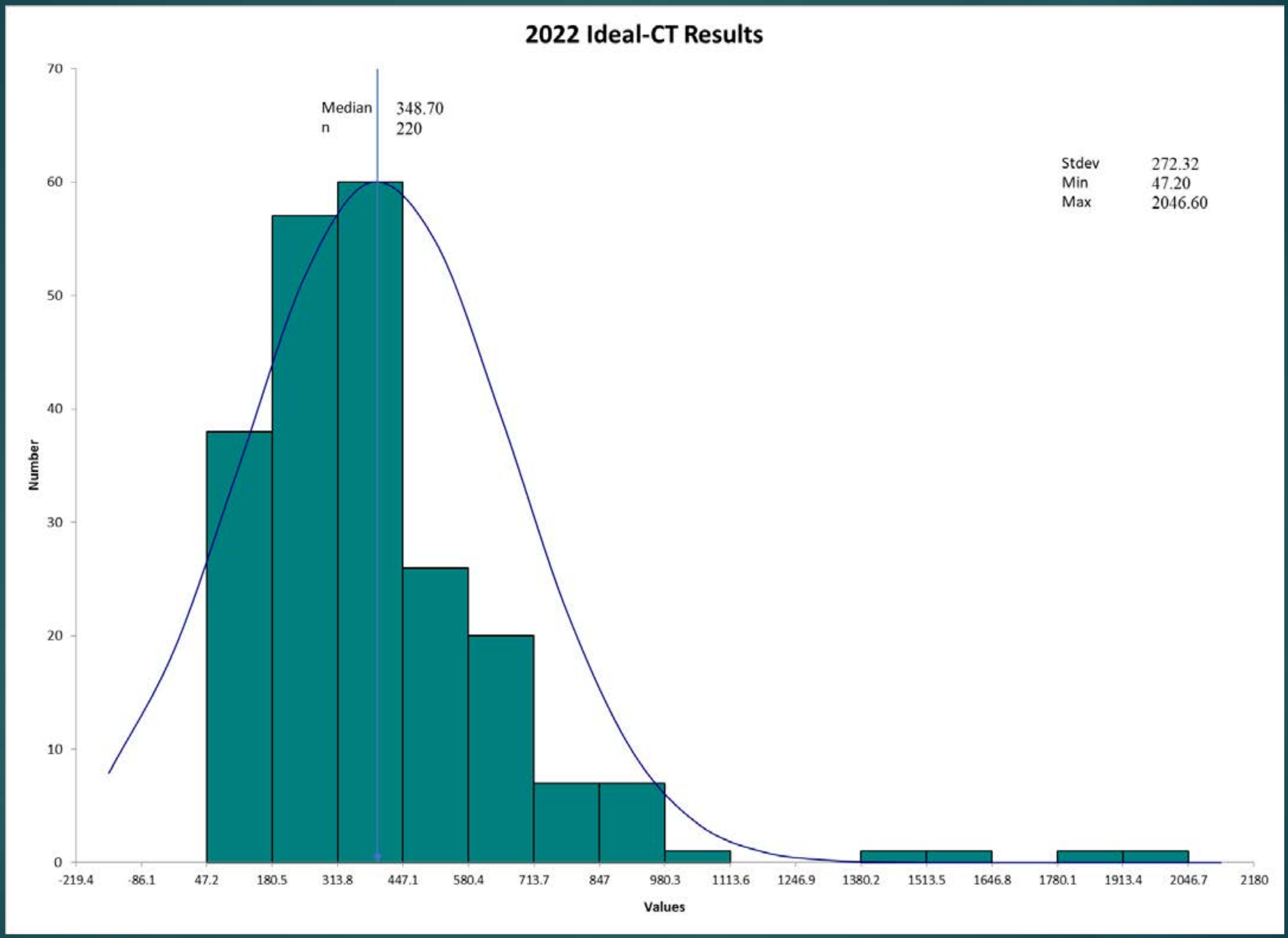
Performance Evaluation of Asphalt Mixture Statewide

Performing Organization: Rutgers University
March 2021

SPONSORS:
New York State Department of Transportation (NYSDOT)
University Transportation Research Center - Region 2

	A	B	E	F	G	H	I	J	K	L	M	N	O
1	IDEAL-CT	Date Sampled	Air Voids	CT Index	QCQA	Mix Size	RAP %	AC %	QA/QC Results		JMF Averages		
2		7/5/2022	6.64	283.6	QA	9.5mm		6.2	Average	376.9333333			
3		7/5/2022	7	478.9	QA	9.5mm		6.2	Std Dev	79.9642559			
4		7/5/2022	7.2	368.3	QA	9.5mm		6.2	COV	21.2%	QA		
5		7/5/2022	6.1	408.8	QC	9.5mm		6.2	Average	320.1666667	Average	419.55	
6		7/5/2022	6.8	300.8	QC	9.5mm		6.2	Std Dev	65.90095261	Std Dev	83.30275606	
7		7/5/2022	6.4	250.9	QC	9.5mm		6.2	COV	20.6%	COV	19.9%	
8		7/8/2022	6.77	539.0	QA	9.5mm		6.2	Average	462.1666667	QC		
9		7/8/2022	6.85	460.5	QA	9.5mm		6.2	Std Dev	62.06493016	Average	300.95	
10		7/8/2022	7.06	387.0	QA	9.5mm		6.2	COV	13.4%	Std Dev	63.81396791	
11		7/8/2022	7	246.1	QC	9.5mm		6.2	Average	281.7333333	COV	21.2%	
12		7/8/2022	7.1	239.2	QC	9.5mm		6.2	Std Dev	55.34391465			
13		7/8/2022	7.1	359.9	QC	9.5mm		6.2	COV	19.6%			
14		5/12/2022	7.20	303.8	QA	9.5mm	0	6.4	Average	240.5			
15		5/12/2022	7.08	291.2	QA	9.5mm	0	6.4	Std Dev	80.77412952			
16		5/12/2022	7.16	126.5	QA	9.5mm	0	6.4	COV	33.6%			
17		5/12/2022	7.30	417.1	QC	9.5mm	0	6.4	Average	378.6666667			
18		5/12/2022	6.60	384.7	QC	9.5mm	0	6.4	Std Dev	34.11161418			
19		5/12/2022	7.00	334.2	QC	9.5mm	0	6.4	COV	9.0%			
20		5/17/2022	7.00	382.6	QA	9.5mm	0	6.4	Average	266.0333333			
21		5/17/2022	6.6	238.0	QA	9.5mm	0	6.4	Std Dev	86.04612458			
22		5/17/2022	7.4	177.5	QA	9.5mm	0	6.4	COV	32.3%			
23		5/17/2022	7	479.7	QC	9.5mm	0	6.4	Average	421.1	QA		
24		5/17/2022	7.5	381.0	QC	9.5mm	0	6.4	Std Dev	42.36437182	Average	335.7916667	
25		5/17/2022	7.3	402.6	QC	9.5mm	0	6.4	COV	10.1%	Std Dev	148.3177869	
26		5/23/2022	7.2	435.8	QA	9.5mm	0	6.4	Average	364.5333333	COV	44.2%	
27		5/23/2022	7.14	332.2	QA	9.5mm	0	6.4	Std Dev	50.46512547	QC		
28		5/23/2022	6.9	325.6	QA	9.5mm	0	6.4	COV	13.8%	Average	365.8666667	
29		5/23/2022	7.4	261.2	QC	9.5mm	0	6.4	Average	255.7333333	Std Dev	65.19762436	
30		5/23/2022	7.4	234.3	QC	9.5mm	0	6.4	Std Dev	15.75020282	COV	17.8%	
31		5/23/2022	7.2	271.7	QC	9.5mm	0	6.4	COV	6.2%			
32		5/26/2022	6.5	210.1	QA	9.5mm	0	6.4	Average	498.0666667			
33		5/26/2022	7.46	623.8	QA	9.5mm	0	6.4	Std Dev	204.1676816			
34		5/26/2022	7.1	660.3	QA	9.5mm	0	6.4	COV	41.0%			
35		5/26/2022	6.8	394.4	QC	9.5mm	0	6.4	Average	380.3666667			
36		5/26/2022	6.8	409.9	QC	9.5mm	0	6.4	Std Dev	31.44946564			
37		5/26/2022	6.6	336.8	QC	9.5mm	0	6.4	COV	8.3%			
38		6/3/2022	7.19	255.7	QA	9.5mm	0	6.4	Average	309.825			
39		6/3/2022	7.15	434.2	QA	9.5mm	0	6.4	Std Dev	113.4890606			
40		6/3/2022	6.75	398.5	QA	9.5mm	0	6.4	COV	37%			
41		6/3/2022	6.5	150.9	QA	9.5mm	0	6.4					

	P	Q	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE
1	HT-IDT	Date Sampled	Air Voids	IDT Strength	QCQA	Mix Size	RAP %	AC %	QA/QC Results		Per Day Results		JMF Averages	
2		7/5/2022	6.70	43.2	QA	9.5mm		6.2	Average	51.5				
3		7/5/2022	7.00	52.0	QA	9.5mm		6.2	Std Dev	6.582299497				
4		7/5/2022	7.00	59.3	QA	9.5mm		6.2	COV	12.8%	Average	42.08333333	QA	
5		7/5/2022	7.00	34.1	QC	9.5mm		6.2	Average	32.66666667	Std Dev	4.03985233	Average	49.16666667
6		7/5/2022	7.40	33.3	QC	9.5mm		6.2	Std Dev	1.497405163	COV	9%	Std Dev	5.405141585
7		7/5/2022	7.20	30.6	QC	9.5mm		6.2	COV	4.6%			COV	11.0%
8		7/8/2022	6.90	44.0	QA	9.5mm		6.2	Average	46.83333333			QC	
9		7/8/2022	7.10	48.8	QA	9.5mm		6.2	Std Dev	2.053181813			Average	34.61666667
10		7/8/2022	7.30	47.7	QA	9.5mm		6.2	COV	4.4%	Average	41.7	Std Dev	2.476164148
11		7/8/2022	6.60	36.7	QC	9.5mm		6.2	Average	36.56666667	Std Dev	1.803693788	COV	7.2%
12		7/8/2022	6.50	34.6	QC	9.5mm		6.2	Std Dev	1.554205764	COV	4%		
13		7/8/2022	6.70	38.4	QC	9.5mm		6.2	COV	4.3%				
14		5/12/2022	6.96	45.2	QA	9.5mm	0	6.4	Average	46.06666667				
15		5/12/2022	7.36	44.5	QA	9.5mm	0	6.4	Std Dev	1.744196727				
16		5/12/2022	7.60	48.5	QA	9.5mm	0	6.4	COV	3.8%	Average	47.03949622		
17		5/12/2022	7.60	42.4	QC	9.5mm	0	6.4	Average	48.01232578	Std Dev	2.898602511		
18		5/12/2022	7.30	49.9	QC	9.5mm	0	6.4	Std Dev	4.053008295	COV	6%		
19		5/12/2022	7.30	51.7	QC	9.5mm	0	6.4	COV	8.4%				
20		5/17/2022	7.05	32.5	QA	9.5mm	0	6.4	Average	38.63333333				
21		5/17/2022	6.49	40.7	QA	9.5mm	0	6.4	Std Dev	4.413111777				
22		5/17/2022	6.53	42.7	QA	9.5mm	0	6.4	COV	11.4%	Average	39.64128831		
23		5/17/2022	7.20	35.3	QC	9.5mm	0	6.4	Average	40.64924329	Std Dev	5.511350006		
24		5/17/2022	7.20	36.7	QC	9.5mm	0	6.4	Std Dev	6.609588236	COV	14%		
25		5/17/2022	7.20	50.0	QC	9.5mm	0	6.4	COV	16.3%				
26		5/23/2022	7.40	29.7	QC	9.5mm	0	6.4	Average	32.99125074				
27		5/23/2022	7.40	33.2	QC	9.5mm	0	6.4	Std Dev	2.604772605				
28		5/23/2022	7.20	36.1	QC	9.5mm	0	6.4	COV	7.9%	Average	35.8289587		
29		5/23/2022	7.43	34.8	QA	9.5mm	0	6.4	Average	38.66666667	Std Dev	2.691230746	QA	
30		5/23/2022	7.35	40.0	QA	9.5mm	0	6.4	Std Dev	2.777688887	COV	8%	Average	39.3952381
31		5/23/2022	7.39	41.2	QA	9.5mm	0	6.4	COV	7.2%			Std Dev	5.764710061
32		5/26/2022	6.70	45.2	QA	9.5mm	0	6.4	Average	34.83333333			COV	14.6%
33		5/26/2022	7.06	27.8	QA	9.5mm	0	6.4	Std Dev	7.484354051			QC	
34		5/26/2022	7.02	31.5	QA	9.5mm	0	6.4	COV	21.5%	Average	34.2676345	Average	37.67306892
35		5/26/2022	7.80	30.7	QC	9.5mm	0	6.4	Average	33.70193566	Std Dev	4.840932954	Std Dev	7.060465013
36		5/26/2022	7.60	35.9	QC	9.5mm	0	6.4	Std Dev	2.197511858	COV	14%	COV	18.7%
37		5/26/2022	7.80	34.5	QC	9.5mm	0	6.4	COV	6.5%				
38		6/3/2022	6.95	44.0	QA	9.5mm	0	6.4	Average	40.66666667				
39		6/3/2022	7.03	39.1	QA	9.5mm	0	6.4	Std Dev	2.358436394				
40		6/3/2022	6.87	38.9	QA	9.5mm	0	6.4	COV	6%	Average	36.83862789		
41		6/3/2022	7.50	31.2	QC	9.5mm	0	6.4	Average	33.01058911	Std Dev	1.943664769		


2022 Ideal-CT Results
Median 348.70
n 220
Stdev 272.32
Min 47.20
Max 2046.60
Number
Values
70
60
50
40
30
20
10
0
-219.4
-86.1
47.2
180.5
313.8
447.1
580.4
713.7
847
980.3
1113.6
1246.9
1380.2
1513.5
1646.8
1780.1
1913.4
2046.7
2180

2024 VPP NYSDOT Specific Projects

2.7 Asphalt Mixture Evaluation Using Performance Testing

This note shall apply to the sites listed below:

Project 4V2311 – Route 33, Genesee County
Project 4V2331 – Route 33A, Monroe County
Project 4V2332 – Route 250, Monroe County
Project 4V2341 – Route 21, Wayne and Ontario Counties
Project 4V2351 – Route 31A, Orleans County
Project 4V2361 – Route 14, Wayne County
Project 4V2371 – Route 39, Wyoming County
Project 5V2432 – Route 277, Erie County
Project 5V2443 – Route 62, Erie County
Project 5V2444 – Route 187, Erie County
Project 5V2452 – Route 324, Erie County
Project 7V2411 – Route 9, Clinton County
Project 7V2412 – Route 9B, Clinton County
Project 7V2413 – Route 22, Clinton County
Project 7V2432 – Route 37, Jefferson County
Project 7V2441 – Route 812, Lewis County
Project 7V2452 – Route 37, St. Lawrence County
Project 7V2456 – Route 420, St. Lawrence County
Project 7V2462 – Route 126, Jefferson County
Project 7V2664 – Route 37, Jefferson County
Project 9HW411 – Route 26, Broome County
Project 9HW421 – Route 206, Chenango County
Project 9HW441 – Route 268, Delaware County
Project 9HW451 – Route 166, Otsego County
Project 9HW461 – Route 28, Delaware County
Project 9HW471 – Route 52, Sullivan County
Project 9V2461 – Route 10, Schoharie County

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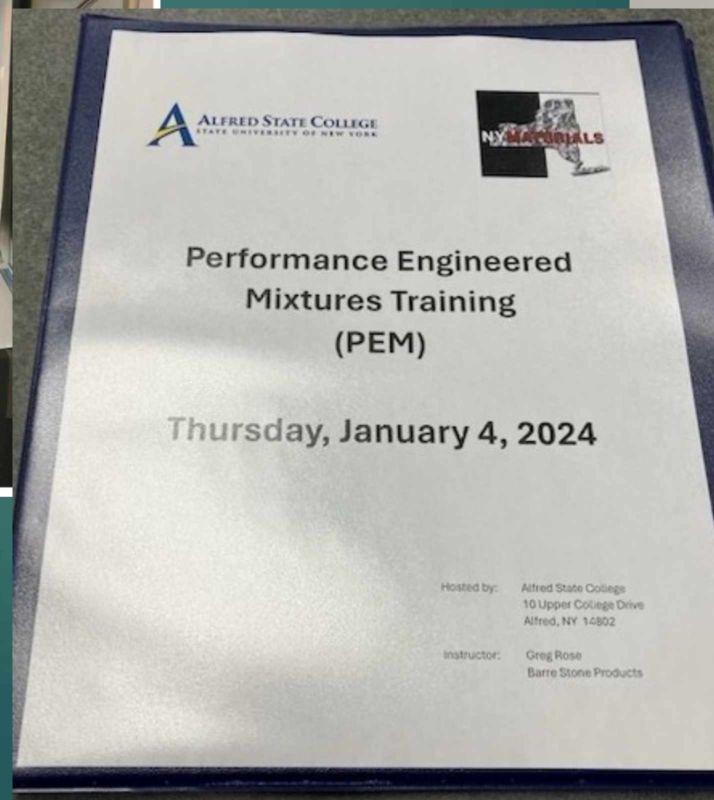
NYCMA PEM Training Class



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PERFORMANCE ENGINEERED MIXTURES (PEM) EVALUATION USING PERFORMANCE TESTING

Description

This note covers the requirements of Performance Engineered mixes (PEM) for Asphalt Top Course mixtures. The requirements are mixture design, verification, and production under a performance testing process. All provisions of Section 401 Asphalt Production of the NYS Standard Specifications apply except as modified below.

Mixture Design Process

Asphalt Mixtures shall be designed to meet the requirements of New York State Materials Method 5.16, *Asphalt Mixture Design and Mixture Verification Procedures,* except as modified. Mixture should meet or exceed the performance testing requirements specified in Table 1, unless waived by the Regional Materials Engineer.

Table 1 – Performance Testing Criteria

Test Methods	Criteria	Min. Design Value	Max. COV

2. **Regional Materials Lab** – The RML will do the following:
    a. Test the Producer fabricated second set samples to determine if they meet the performance criteria referenced in Table 1.
    b. **Additional Cross-Lab Testing:** The RME may elect to fabricate additional samples for cross-lab testing by the Producer, if necessary.

Mixture Design Process

Asphalt mixtures shall be designed to meet the requirements of New York State Materials Method 5.16, *Asphalt Mixture Design and Mixture Verification Procedures* except as modified. Mixture should meet or exceed the performance testing requirements specified in Table 1, unless waived by the Regional Materials Engineer (RME).

Table 1 – Performance Testing Criteria

Test Methods	Criteria	Min. Design Value	Max. COV
AASHTO T 393-21 Flexibility Index Test	Flexibility Index	8	≤40
ASTM D6931-17 Indirect Tensile Strength Test	IDT Strength	30 psi	≤25
ASTM D8225-19 Determination of CT Index	CT Index	135	≤25

Designs may use an air void content between 2% and 5%.

In no case shall the job mix tolerance fall outside the Control Points of the control sieves.

Table 2 - Summary of Testing Criteria for Performance Engineered Mixtures (PEM)				
At the Plant		**High Temperature IDT**	**IDEAL CT index**	**SCB Flexibility Index**
Test Method		ASTM D6931-17 NCHRP 9-33 Report	ASTM D8225-19	AASHTO T 393-21
No. of Samples		3	3	3
Load Rate (mm/min)		50±5	50±2	50±2
Height (mm)		62±1[1]	<= 19 mm NAS = 62±1 >=25 mm NAS = 95±1	50±1
Notch Width (mm)		NA	NA	<2.25
Aging	Lab mixed	2 hours loose mix volumetric Conditioning at Compaction Temperature	4 hours loose mix conditioning at Compaction Temperature	4 hours loose mix conditioning at Compaction Temperature.
	Plant mixed	Reheat loose mix to Compaction Temperature and Compact Specimens or Reheat loose mix to Compaction Temperature	Reheat loose mix to Compaction Temperature and Compact Specimens or Reheat loose mix to Compaction Temperature	Reheat loose mix to Compaction Temperature and Compact Specimens or Reheat loose mix to Compaction Temperature
Compaction Temperature, °C		V Grade = 132°C ± 3°C E Grade = 146°C ± 3°C	V Grade = 132°C ± 3°C E Grade = 146°C ± 3°C	V Grade = 132°C ± 3°C E Grade = 146°C ± 3°C
Air Voids, %		7 ± 1	7 ± 0.5	7 ± 1
Test Temperature, °C		44°C ± 1.0	25°C ± 1.0	25°C ± 1.0
Water Bath Conditioning		44°C for 2 hrs ± 10 min.	25°C for 2 hrs ± 10 min.	25°C for 2 hrs ± 10 min

[1] **Modified height from ASTM D6931-17**

Table 3 - Production Testing and Sampling Table			
Plant Test Property	**Test Method**	**Producer Testing Frequency[1]**	**Department Testing Frequency[2]**
PG Binder Content	Automation, Ignition Oven (NY 400-13C), or AASHTO T 164 Method A or B	Every Sublot	Every Lot
Aggregate Gradation	AASHTO T27	Every Sublot	Every 3 Lots
Air Voids	MM 5.16, AASHTO T269	Every 2 Lots	Every 3 Lots
Indirect Tensile Strength	ASTM D6931-17	Every 2 Lots	Every 3 Lots
Determination of CT Index	ASTM D8225-19	Every 2 Lots	Every 3 Lots

1. All sampling at the plant
2. All sampling at the paver

Mixture Production

Asphalt Mixture requirements are as follows:

Table 4 - Mixture Gradation, Absolute Difference Value			
Limits (Test Value – JMF Value)	Sieve Sizes		
	#50 and Larger (300 µm and Larger)	#100 (150 µm)	#200 (75 µm)
Production	0.0 – 5.0	0.0 – 4.0	0.0 – 2.0
Evaluation	5.0 – 8.0	4.0 – 6.0	2.0 – 4.0
Action	>8.0	>6.0	>4.0

Table 5 - Mixture Performance Limits		
PEM Limits	IDEAL CT	HT-IDT (psi)
Production	≥ 135.0	≥ 30.0
Evaluation	108.0 - 134.9	24.0 - 29.9
Action	< 108.0	< 24.0

Table 6 – Air Void Limits	
Limits	Air Voids
Production	2%-5%
Evaluation	<2% or >5%

Project 4V2351
Rt. 31A VPP Project

- 2.0 Miles from the BSP Asphalt Plant
- 7.7 mile overlay project
  - 4,600 tons of Shim (Scratch), PG64S-22, Warm-Mix
  - 18,650 tons of 12.5 F2 Top, PG64V-22, Warm-Mix
- Performance Engineered Mixture Evaluation using Performance Testing
- 70 Series Compaction (peak the gauge)

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Mix Design Verification

DESIGN	Spec	23 Project	Trial #1	Trial #2	Trial #6	DOT Verification #1	DOT Verification #2
Mixed		Plant	Plant	Plant	Lab	Lab	Lab
Ideal-CT	≥ 135.0	171.3	134.8	164.0	165.6	190.1	213.0
COV	≤ 25.0	6.4	4.8	35.2	16.0	47.5	21.0
HT-IDT	≥ 30.0	-	35.3	27.0	44.1	47.7	-
COV	≤ 25.0	-	6.0	18.3	7.3	4.9	-
I-Fit	≥ 8.0	6.1	5.8	-	7.2	4.4	-
COV	≤ 40.0	25.8	13.6	-	15.8	18.4	-

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NCAT Trial Weight Estimating Spreadsheet

Mix Gmm:	2.489
Specimen Height (mm):	62
Target Air Voids (%)	7
Passing #8 Sieve (%)	37
	CF
Estimated CF	1.037
User Input CF	1.036
Estimated Weight (g):	2,448
Rounded Weight (g):	2,450

Input
Result

Typical Values		
Test	*Specimen Height (mm)*	*Target Air Voids (%)*
HB/IDEAL	62	7.0
APA	75	7.0
TSR	95	7.0
OT/IDT	125	7.5 - 8.0
I-FIT/DCT	160	7.5 - 8.0

Average Starting CF Values	
Height (mm)	*Average CF*
62	1.036
75	
95	
125	
160	

Questions? Please contact:
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National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

Calculate Volume CF from G_{mb} Data

From T166 (Bulk) Test

Dry Specimen Mass (g):	2461.5
Underwater Mass (g):	1409.5
SSD Mass (g):	2467.9
Specimen Diameter (mm):	150
Specimen Height (mm):	62
True G_{mb}:	2.326
Cylinder G_{mb}:	2.247
Mix Specific CF:	1.035

Disclaimer:

The Correction Factor (CF) is specific to each unique mix type, sample height, and target air void content

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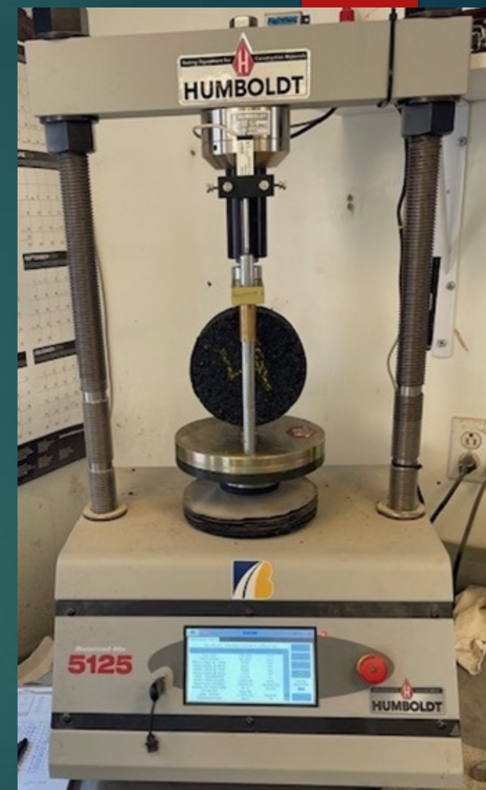

HUMBOLDT
5125
HUMBOLDT

Gradation Results

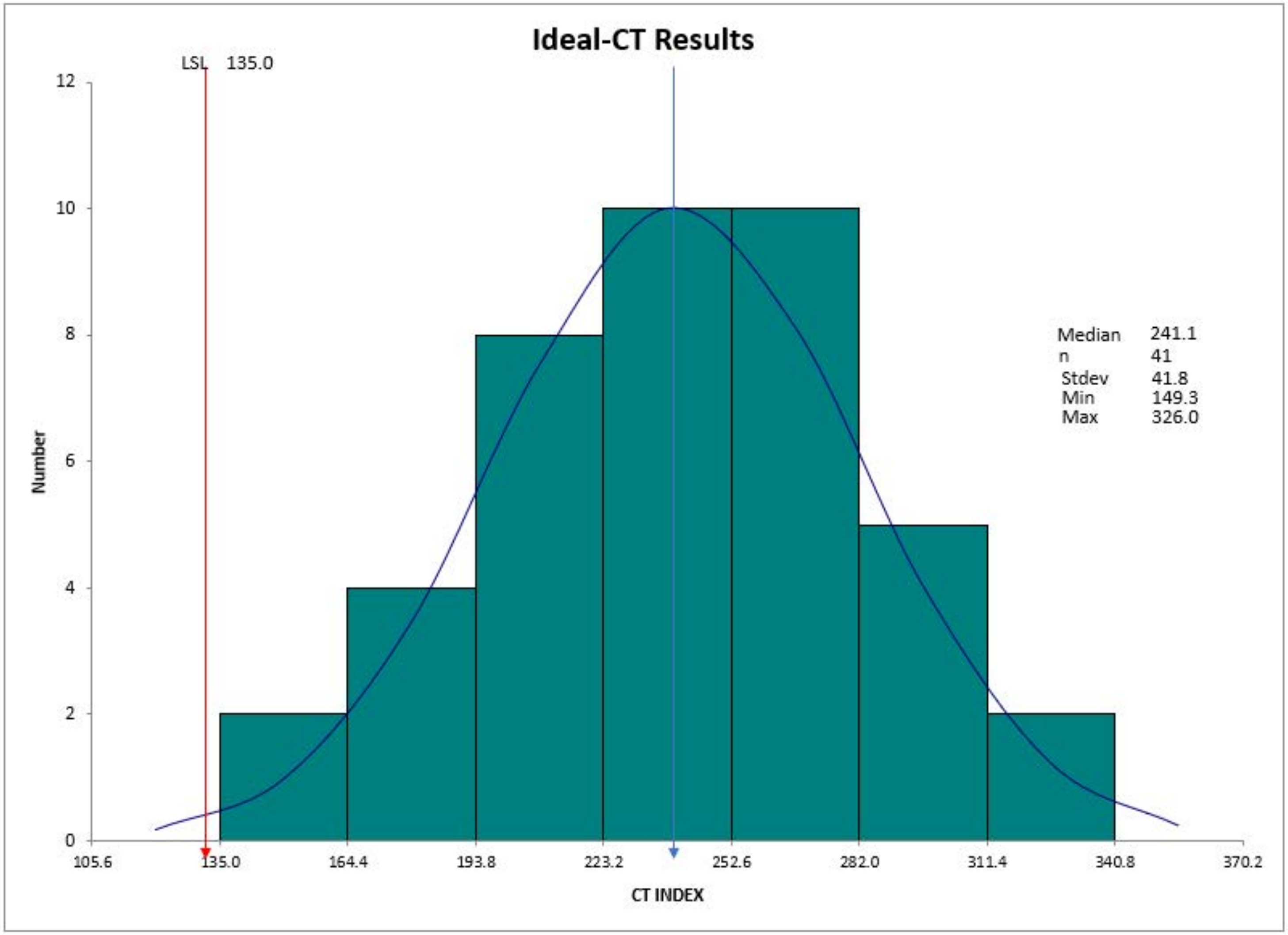
Sieve	Target	Production	BSP Average	DOT Average
#4	57	± 5.0	56.3	57.4
#8	39	± 5.0	39.5	38.1
#50	9	± 5.0	9.4	9.5
#100	6	± 4.0	5.9	5.9
#200	3	± 2.0	3.1	3.0

Volumetric Results

	Minimum	Target Air Voids	Maximum
Production	2.0	**3.5**	5.0
BSP	2.00	**2.52**	3.98
DOT	1.99	**3.28**	4.76

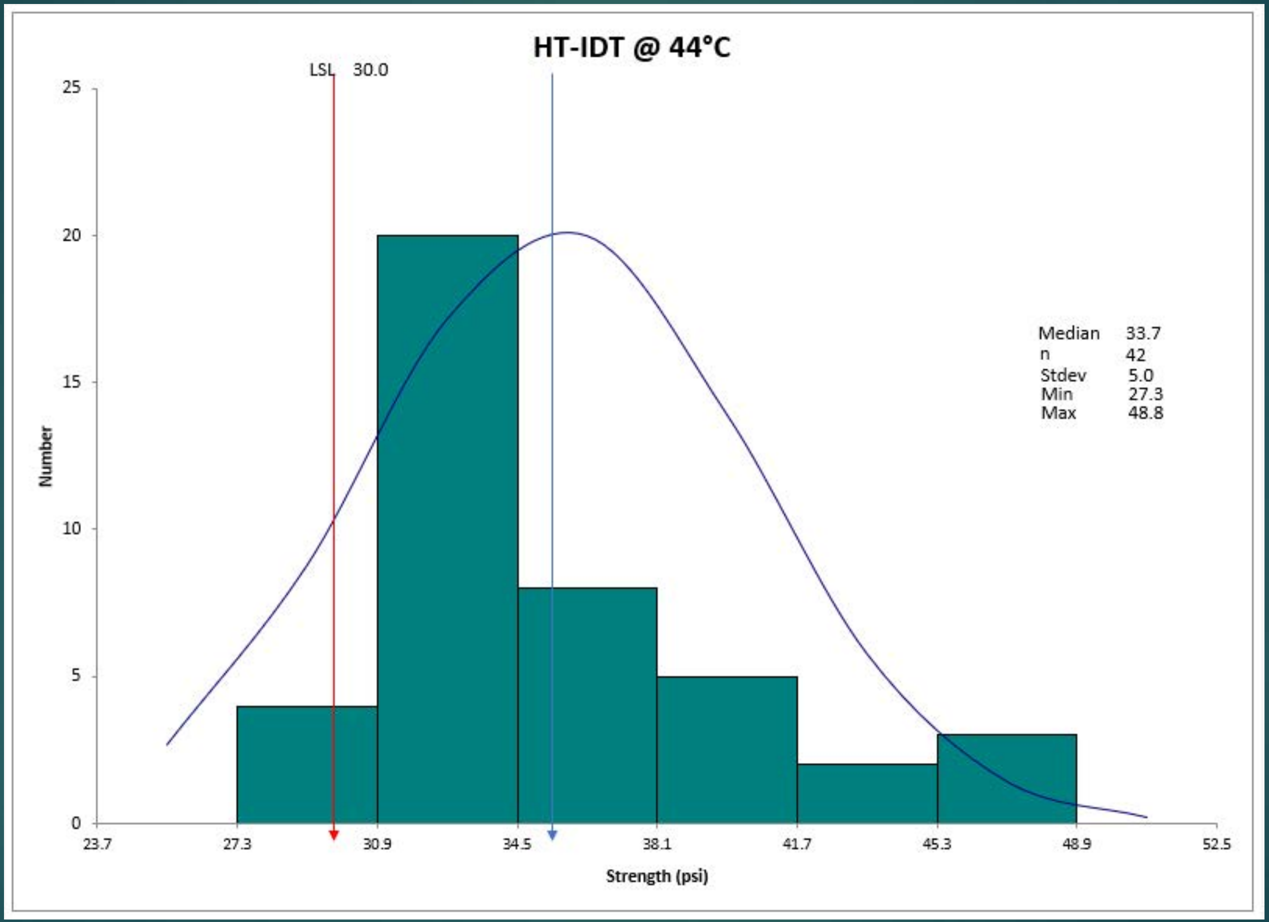
Ideal-CT Results

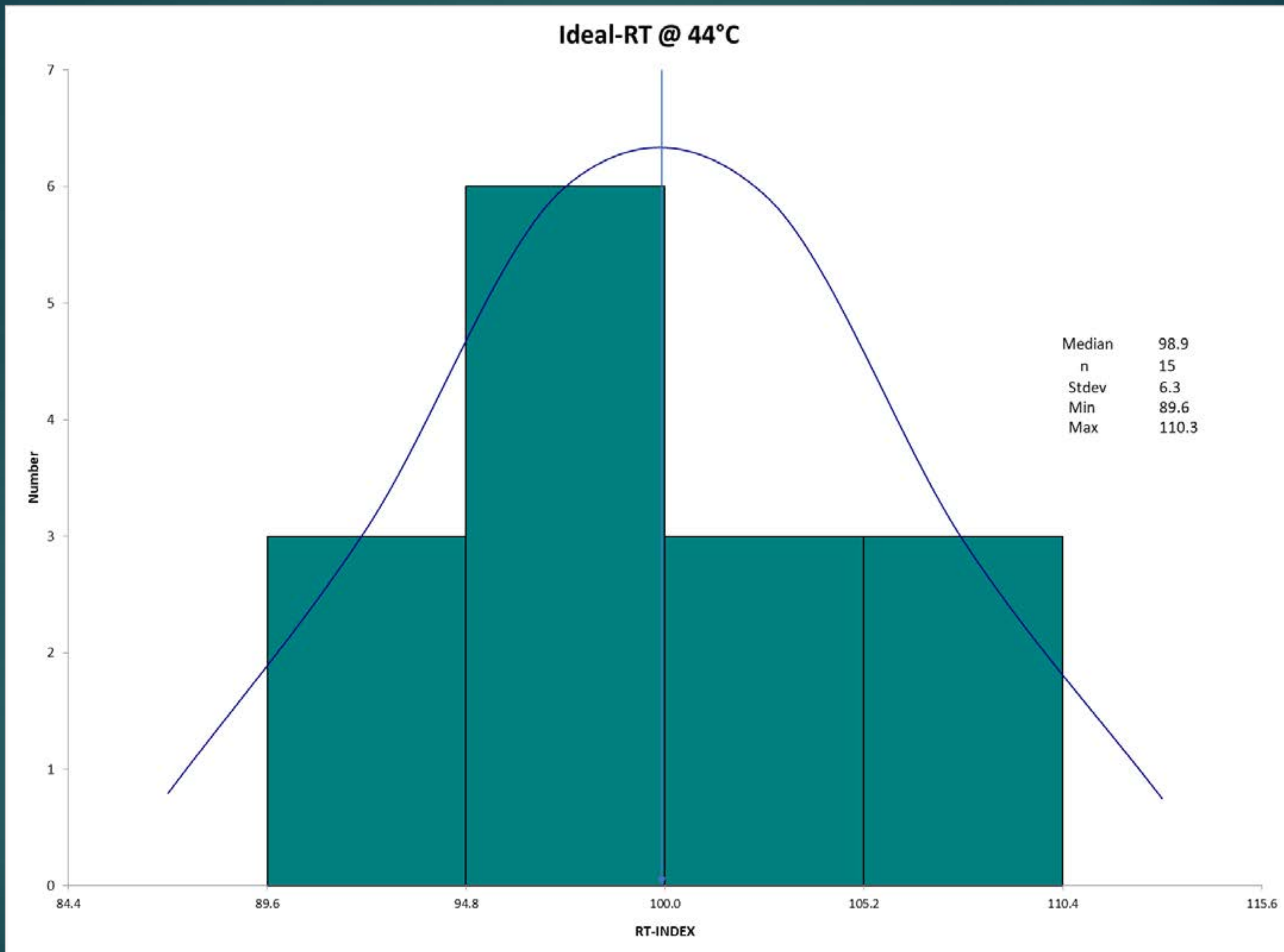
Ideal-CT	Minimum	Average	Maximum
Production		≥ 135.0	
BSP	177.3	**253.3**	326.0
DOT	149.3	**207.9**	291.5


Ideal-CT Results
LSL 135.0
Number
12
10
8
6
4
2
0
105.6
135.0
164.4
193.8
223.2
252.6
282.0
311.4
340.8
370.2
CT INDEX
Median 241.1
n 41
Stdev 41.8
Min 149.3
Max 326.0

HT-IDT Results

HT-IDT	Minimum	Average	Maximum
Production		≥ 30.0	
BSP	27.3	33.0	38.5
DOT	32.0	41.0	48.8


HT-IDT @ 44°C
LSL 30.0
Number
25
20
15
10
5
0
23.7
27.3
30.9
34.5
38.1
41.7
45.3
48.9
52.5
Strength (psi)
Median 33.7
n 42
Stdev 5.0
Min 27.3
Max 48.8


Ideal-RT @ 44°C
Number
RT-INDEX
0
1
2
3
4
5
6
7
84.4
89.6
94.8
100.0
105.2
110.4
115.6
Median 98.9
n 15
Stdev 6.3
Min 89.6
Max 110.3


THANK YOU!
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