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February 23, 2017

Superior Bowen Asphalt Company, LLC
11030 Hickman Mills Drive
Kansas City, Missouri 64134

Project: Asphaltic Concrete Mix Design
T2RC

Report #:17RN006

Construction Materials Testing Group, (CMTG) has completed a mixture design composition for the asphaltic concrete mixture referenced above. Materials utilized in the composition are noted in the attached tables and were delivered to our laboratory by the client. The Reclaimed Asphalt Pavement (RAP) consists of Fractionated Reclaimed Asphalt Pavement and virgin materials. The mixture was verified at multiple binder contents in general accordance with methods in the Asphalt Institute Manual MS-2, AASHTO T245, and ASTM D2041. The master grade limits, job-mix formula and Marshall properties comply with the American Public Works Standard Specifications, 2017. The Voids in Mineral Aggregate (VMA) is calculated utilizing virgin aggregate bulk and dry specific gravities, and RAP aggregate effective specific gravity. The maximum theoretical specific gravity and Marshall specimens were cured 4 hours at compaction temperature unless otherwise noted. Percent binder is reported on a total mix basis.

It may be necessary to adjust plant settings from designated values due to differences in plant and laboratory produced mixtures or variations in component materials.

Sincerely,
Construction Materials Testing Group, LLC

A handwritten signature in cursive script that reads "Allen Holloway".

Allen Holloway, C.E.T.
Cert # 138801
Laboratory Manager

Copies: Jennifer Breuer
 Matthew Bowen



Mixture: APWA TYPE 2R 40%
Superior Bowen Asphalt Company

Asphalt Source: Phillips 66
Grade: PG52-34

Design #
17RN006

1. AGGREGATE

A/C% = 2.29 TOTAL AC= 4.40

Type	Code #	Producer	Location	Formation
1"	659	Hunt Martin Materials	Randolph	Cedar Valley
3/8"	932	Hunt Martin Materials	Randolph	Cedar Valley
Sand		Holliday Sand & Gravel	Randolph	Missouri River Sand
FRAP		Superior Bowen Asphalt Co.	Randolph	Stockpile
CRAP		Superior Bowen Asphalt Co.	Randolph	Stockpile

2. INDIVIDUAL AGGREGATE GRADATIONS

Materials	1-1/2	1	3/4	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
1"	100.0	100.0	92.0	48.0	27.0	3.0	2.0	2.0	1.0	1.0	1.0	1.0
3/8"	100.0	100.0	100.0	100.0	100.0	78.0	17.0	3.0	2.0	2.0	2.0	1.8
Sand	100.0	100.0	100.0	100.0	100.0	100.0	97.2	86.8	56.1	21.6	5.5	2.2
FRAP	100.0	100.0	100.0	100.0	100.0	90.5	72.4	55.1	40.7	27.0	19.5	15.3
CRAP	100.0	100.0	100.0	95.8	84.6	45.9	31.5	25.6	20.8	14.5	10.3	7.4

3. COMPUTATION OF SINGLE POINT GRADING

TYPE	% MIX	1-1/2	1	3/4	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
1"	30.0	30.0	30.0	27.6	14.4	8.1	0.9	0.6	0.6	0.3	0.3	0.3	0.3
3/8"	13.0	13.0	13.0	13.0	13.0	13.0	10.1	2.2	0.4	0.3	0.3	0.3	0.2
Sand	17.0	17.0	17.0	17.0	17.0	17.0	17.0	16.5	14.8	9.5	3.7	0.9	0.4
FRAP	25.0	25.0	25.0	25.0	25.0	25.0	22.6	18.1	13.8	10.2	6.8	4.9	3.8
CRAP	15.0	15.0	15.0	15.0	14.4	12.7	6.9	4.7	3.8	3.1	2.2	1.5	1.1
TOTAL	100.0	100.0	100.0	97.6	83.8	75.8	57.6	42.2	33.4	23.4	13.2	7.9	5.8
Master Limits	Lower	100.0	100.0	80.0		60.0	48.0	35.0	25.0	18.0	12.0	6.0	3.0
	Upper	100.0	100.0	100.0		80.0	65.0	47.0	36.0	30.0	22.0	14.0	10.0
Productions Limits	Lower		96.0	93.6	79.8	71.8	53.6	39.2	30.4	20.4	10.2	7.9	4.8
	Upper		104.0	101.6	87.8	79.8	61.6	45.2	36.4	26.4	16.2	7.9	6.8
Tolerance (+/-)			4	4	4	4	4	3	3	3	3		1
Difference Between Sieves (APWA 2205.3) (25% MAX)			0.0	2.4	13.8	8.0	18.2	15.4	8.8	10.0	10.2	5.2	2.1

APWA TYPE 2R 40%
Design # 17RN006

Mix Composition Summary

<i>Component</i>	<i>% Total Aggregate</i>	<i>% Total Mix</i>
1"	30.0	28.7
3/8"	13.0	12.4
Sand	17.0	16.3
FRAP	25.0	25.2
CRAP	15.0	15.1
<i>Binder</i>		
Total		4.40
RAP AC		2.11
AC Added		2.29

APWA TYPE 2R 40%
Design # 17RN006

Mix Composition

Component	% Total Mix	% Dry Mix
1"	28.68	30.00
3/8"	12.43	13.00
Sand	16.25	17.00
FRAP	25.23	25.00
CRAP	15.12	15.00
PG52-34	AC Added	2.29

Mix Specific Gravity Data

Component	Specific Gravity
Binder	1.021
Calculated Bulk Gravity of Aggregates	2.666
Calculated Bulk Gravity of Mix @ Binder Content	2.417
Calculated Maximum Theoretical @ Binder Content	2.522

Grain Size Analysis

Sieve Size	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
Opening, mm	37.5	25.0	19.0	12.5	9.5	4.75	2.36	1.18	0.600	0.300	0.150	0.075
Trial Mix Single Point	100.0	100.0	97.6	83.8	75.8	57.6	42.2	33.4	23.4	13.2	7.9	5.8
Master Grade Limits	100	100.00	80-100	---	60-80	48-65	35-47	25-36	18-30	12-20	6-14	3-10
Job-Mix Formula Tolerance												
Tolerance			+/-4	+/-4	+/-4	+/-4	+/-3	+/-3	+/-3	+/-3		+/-1
Difference between sieves		0.0	2.4	13.8	8.0	18.2	15.4	8.8	10.0	10.2	5.2	2.1

Marshall Characteristics Summary

50 blows per face

Laboratory specimen 2 hr cure @ Compaction temp

Mixing Temp 300-310

Comp Temp 280-290

	Trial Mix Data	Specifications
Stability	3395	1500 Minimum
Flow, 1/100 inch	11	8-16
% Voids mix	4.2	3-5 design only
% VMA	13.0	no specification
%VFA	67.9	
Density, pcf (Gmb)	150.8	
minus 200/effective binder ratio	1.56	
% Binder, Total Mix	4.00	



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Component Material Identification

Component	Description				
1"	Source identified at Hunt Martin Materials Randolph Quarry Cedar Valley	Gsb	2.661	% ABS	0.71
3/8"	Source identified at Hunt Martin Materials Randolph Quarry Cedar Valley	Gsb	2.645	% ABS	0.17
Sand	Source identified at Holliday Sand and Gravel natural river sand	Gsb	2.621	% ABS	0.3
FRAP	Source identified at Superior Bowen Fractionated Rap	Gse	2.684		
CRAP	Source identified at Superior Bowen Fractionated Rap	Gse	2.719		
PG52-34	Source identified as Phillips 66. See attached certificate of analysis.	Gb	1.021		



APWA TYPE 2R 40%
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Mix Summary Data

AC Content	3.90	4.40	4.90	4.00
A = Gmm (FIELD)	2.526	2.505	2.481	2.522
B = Gmb (FIELD)	2.375	2.406	2.453	2.417
C = Gsb (JOB MIX)	2.666	2.666	2.666	2.666
D = Ps = Percent Agg. in mix	96.1	95.6	95.1	96.0
E= Gse (FIELD)	2.684	2.681	2.676	2.684
VMA = $100 - (B \times D / C)$	14.39	13.74	12.51	12.98
Va = $100 \times ((A - B) / A)$	5.98	3.94	1.15	4.16
VFA = $((VMA - Va) / VMA) \times 100$	58.46	71.29	90.83	67.89
DENSITY (PCF)	148.2	150.1	153.1	150.8

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AC Content	Air voids
3.9	6.0
4.4	3.9
4.9	1.1

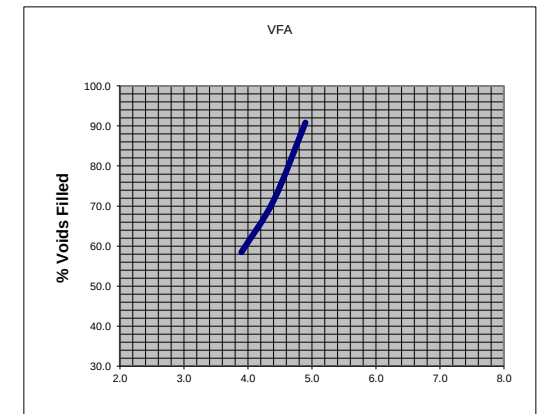
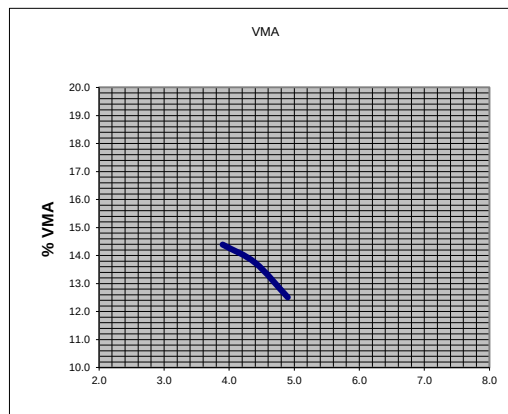
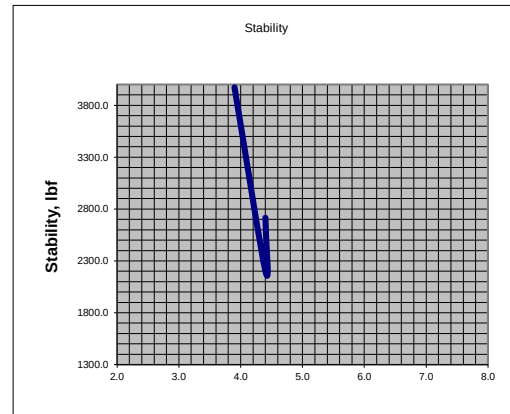
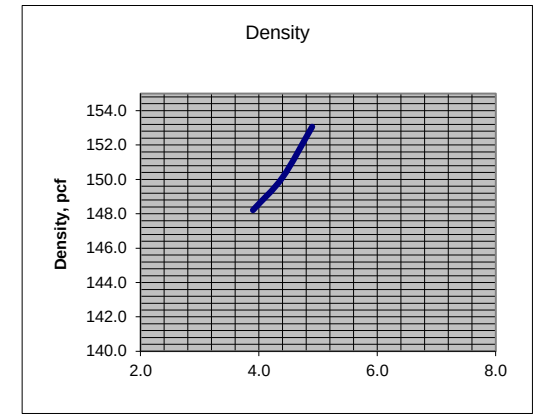
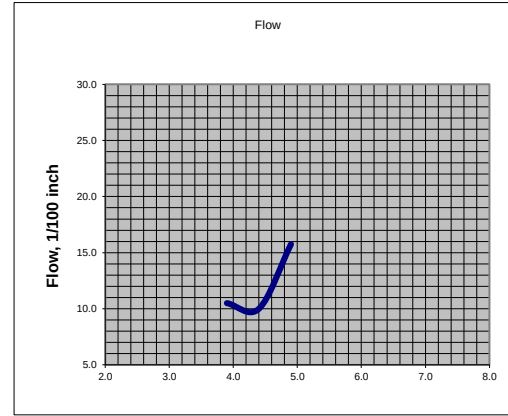
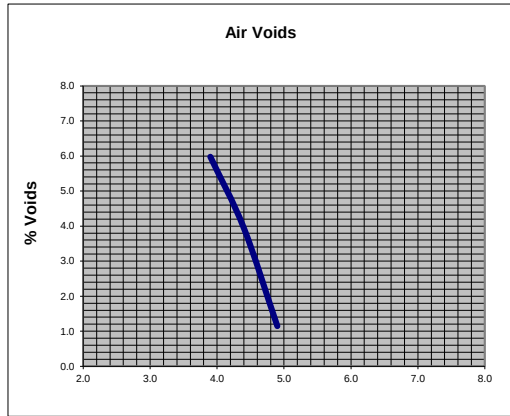
AC Content	Flow
3.9	10.5
4.4	10.0
4.9	15.8

AC Content	Stability
3.9	3972.7
4.4	2203.0
4.4	2716.6

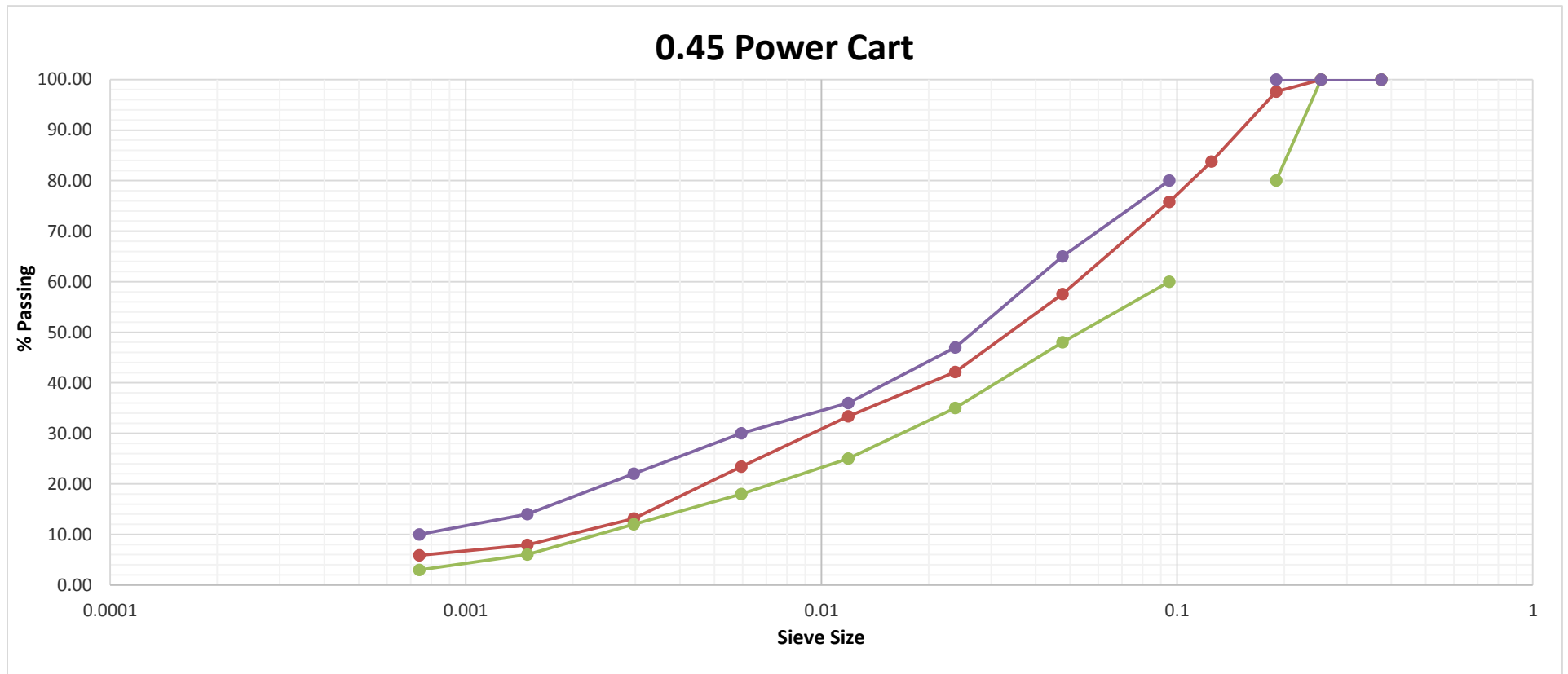
AC Content	VMA
3.9	14.4
4.4	13.7
4.9	12.5

AC Content	VFA
3.9	58.5
4.4	71.3
4.9	90.8

AC Content	Density
3.9	148.2
4.4	150.1
4.9	153.1



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SAMPLE #170055

This binder meets the qualifications of 52-34, AASHTO M320, Table 1



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Phillips 66

Kansas City

Sampled	Received	Finalized
02/14/2017	02/16/2017	02/20/2017

Source ID

KC17-52-34-05

Grade 52-34

Tank Number

PAV Temperature 90°

ORIGINALFlash Point Procedure: AASHTO T48 | Pass Criteria: $\geq 230^{\circ}\text{C}$ Flash Point **284 °C**Rotational Viscosity Procedure: ASTM T316 | Pass Criteria: $\leq 3 \text{ Pa}\cdot\text{s}$

Temperature 135 °C

Viscosity **0.197 Pa·s**Dynamic Shear Rheometer Procedure: AASHTO T315 | Pass Criteria: $\geq 1.0 \text{ kPa}$

Temperature 52.0 °C

G* 1.19 kPa

Phase Angle 86.7 °

G*/Sinδ **1.19 kPa**

Specific Gravity Procedure: ASTM D70 | Pass Criteria:

Temperature 15.6 °C

Specific Gravity **1.021****ROLLING THIN FILM OVEN**Mass Change Procedure: AASHTO T240 | Pass Criteria: $\pm 1.00\% \text{ max}$ % Mass Change Avg **-0.368 %**Dynamic Shear Rheometer Procedure: AASHTO T315 | Pass Criteria: $\geq 2.2 \text{ kPa}$

Temperature 52.0 °C

G* 3.49 kPa

Phase Angle 82.0 °

G*/Sinδ **3.52 kPa****PRESSURE AGING VESSEL**Dynamic Shear Rheometer Procedure: AASHTO T315 | Pass Criteria: $\leq 5000 \text{ kPa}$

Temperature 13.0 °C

G* 4830 kPa

Phase Angle 45.6 °

G*·Sinδ **3451 kPa**Bending Beam Rheometer Procedure: AASHTO T313 | Pass Criteria: $S \leq 300 \text{ MPa}, m \geq 0.300$

Temperature -24 °C

Stiffness Avg **235 MPa**

Temperature -24 °C

M Value Avg **0.323**

By providing my signature, I attest to the accuracy and validity of the data contained on this form
certify no deliberate misrepresentation of test results, in any manner, has occurred.

Wes Cooper, Asphalt Binder Laboratory Manager