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June 15, 2017

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

Project: Asphaltic Concrete Mix Design
T3V

Report #:17RN013

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 Association Specifications, 2017. The Voids in Mineral Aggregate (VMA) is calculated utilizing virgin aggregate bulk and dry specific gravities. 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 3V
Superior Bowen Asphalt Company

Asphalt Source: Phillips 66
Grade: PG64-22

Design #
17RN013

1. AGGREGATE

A/C% = 4.60 TOTAL AC% = 4.60

Type	Code #	Producer	Location	Formation
3/4"	754	Hunt Martin Materials	Randolph	Cedar Valley
Dust	981	Hunt Martin Materials	Randolph	Cedar Valley
3/8"	932	Hunt Martin Materials	Randolph	Cedar Valley
Sand		Holliday Sand & Gravel	Randolph	Missouri River Sand

2. INDIVIDUAL AGGREGATE GRADATIONS

Materials	1-1/2	1	3/4	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
3/4"	100.0	100.0	100.0	63.0	35.0	3.0	2.0	2.0	1.0	1.0	1.0	1.0
Dust	100.0	100.0	100.0	100.0	100.0	97.0	75.0	53.0	36.0	25.0	19.0	15.7
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

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
3/4"	27.0	27.0	27.0	27.0	17.0	9.5	0.8	0.5	0.5	0.3	0.3	0.3	0.3
Dust	25.0	25.0	25.0	25.0	25.0	25.0	24.3	18.8	13.3	9.0	6.3	4.8	3.9
3/8"	25.0	25.0	25.0	25.0	25.0	25.0	19.5	4.3	0.8	0.5	0.5	0.5	0.5
Sand	23.0	23.0	23.0	23.0	23.0	23.0	23.0	22.4	20.0	12.9	5.0	1.3	0.5
TOTAL	100.0	100.0	100.0	100.0	90.0	82.5	67.6	45.9	34.5	22.7	12.0	6.8	5.2
Master Limits	Lower	100.0	100.0	100.0	85.0	70.0	50.0	37.0	26.0	18.0	12.0	6.0	4.0
	Upper	100.0	100.0	100.0	100.0	90.0	70.0	47.0	36.0	30.0	22.0	15.0	10.0
Productions Limits	Lower		96.0	96.0	86.0	78.5	63.6	42.9	31.5	19.7	9.0	6.8	4.2
	Upper		104.0	104.0	94.0	86.5	71.6	48.9	37.5	25.7	15.0	6.8	6.2
Tolerance (+/-)			4	4	4	4	4	3	3	3	3		1
Difference Between Sieves (APWA 2205.3) (25% MAX)			0.0	0.0	10.0	7.6	14.9	21.7	11.4	11.8	10.7	5.2	1.6

APWA TYPE 3V
Design # 17RN013

Mix Composition Summary

<i>Component</i>	<i>% Total Aggregate</i>	<i>% Total Mix</i>
3/4"	27.0	25.8
Dust	25.0	23.9
3/8"	25.0	23.9
Sand	23.0	21.9

<i>Binder</i>	
Total	4.60
AC Added	4.60

APWA TYPE 3V
Design # 17RN013

Mix Composition

Component	% Total Mix	% Dry Mix
3/4"	25.76	27.00
Dust	23.85	25.00
3/8"	23.85	25.00
Sand	21.94	23.00
PG64-22	AC Added	4.60

Mix Specific Gravity Data

Component	Specific Gravity
Binder	1.033
Calculated Bulk Gravity of Aggregates	2.601
Calculated Bulk Gravity of Mix @ Binder Content	2.401
Calculated Maximum Theoretical @ Binder Content	2.500

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	100.0	90.0	82.5	67.6	45.9	34.5	22.7	12.0	6.8	5.2
Master Grade Limits	100	100.00	100.00	85-100	70-90	50-70	37-47	26-36	18-30	12-22	6-15	4-10
Job-Mix Formula Tolerance												
Tolerance		+/-4	+/-4	+/-4	+/-4	+/-4	+/-3	+/-3	+/-3	+/-3		+/-1
Difference between sieves		0.0	0.0	10.0	7.6	14.9	21.7	11.4	11.8	10.7	5.2	1.6

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	2394	1500 Minimum
Flow, 1/100 inch	11	8-16
% Voids mix	4.0	3-5 design only
% VMA	11.9	no specification
%VFA	66.8	
Density, pcf (Gmb)	149.8	
minus 200/effective binder ratio	1.52	
% Binder, Total Mix	4.60	



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Component Material Identification

Component	Description				
3/4"	Source identified at Hunt Martin Materials Randolph Quarry Cedar Valley	Gsb	2.672	% ABS	0.71
Dust	Source identified at Hunt Martin Materials Randolph Quarry Cedar Valley	Gsb	2.471	% ABS	3.54
3/8"	Source identified at Hunt Martin Materials Randolph Quarry Cedar Valley	Gsb	2.645	% ABS	0.71
Sand	Source identified at Holliday Sand and Gravel natural river sand	Gsb	2.621	% ABS	0.30
PG64-22	Source identified as Phillips 66. See attached certificate of analysis.	Gb	1.033		

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Mix Summary Data

AC Content	4.10	4.60	5.10
A = Gmm (FIELD)	2.515	2.500	2.478
B = Gmb (FIELD)	2.385	2.401	2.429
C = Gsb (JOB MIX)	2.601	2.601	2.601
D = Ps = Percent Agg. in mix	95.9	95.4	94.9
E= Gse (FIELD)	2.682	2.687	2.683
VMA = $100 - (B \times D / C)$	12.06	11.91	11.36
Va = $100 \times ((A - B) / A)$	5.18	3.95	1.97
VFA = $((VMA - Va) / VMA) \times 100$	57.06	66.828	82.63
DENSITY (PCF)	148.8	149.8	151.6

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AC Content	Air voids
4.1	5.2
4.6	4.0
5.1	2.0

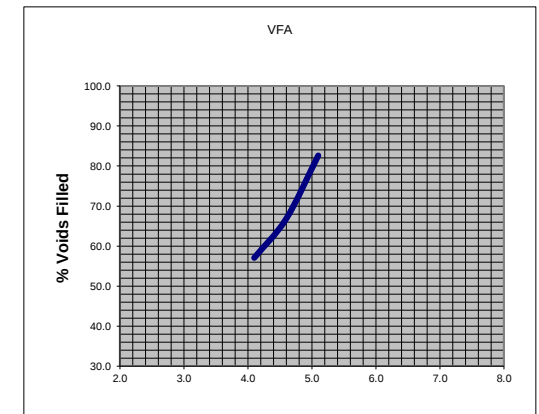
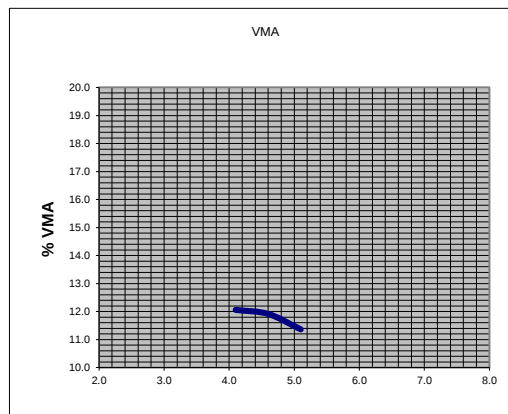
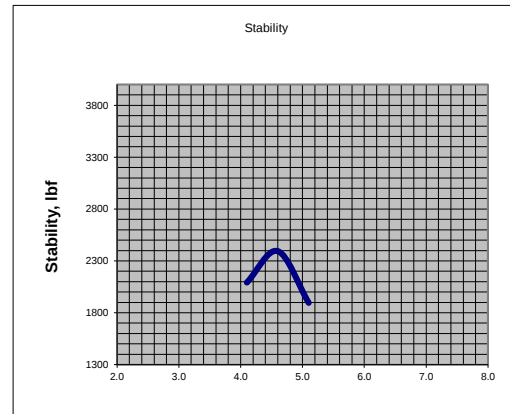
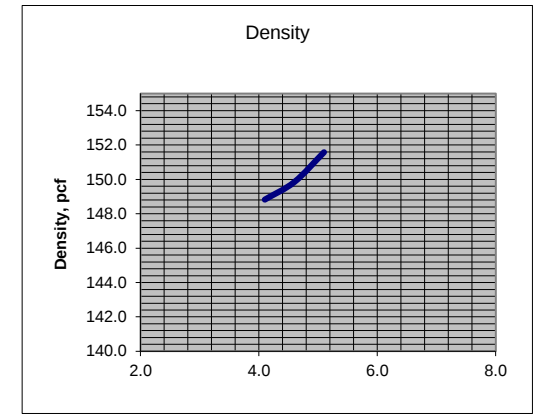
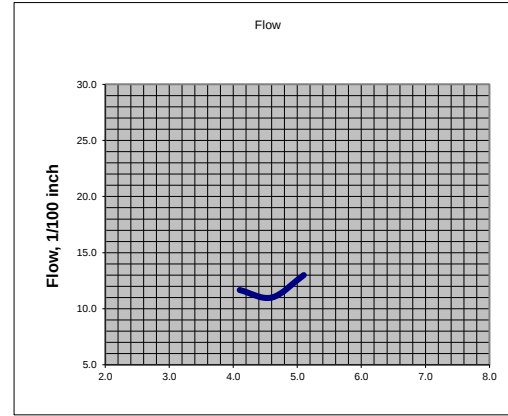
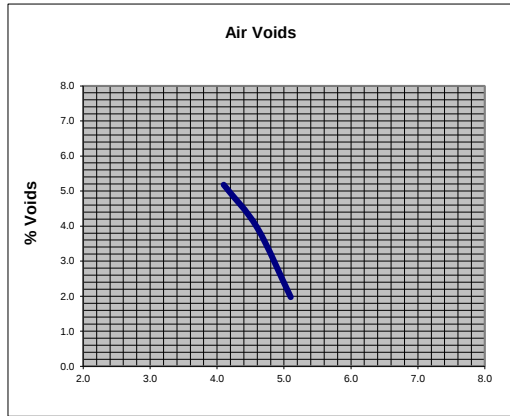
AC Content	Flow
4.1	11.7
4.6	11.0
5.1	13.0

AC Content	Stability
4.1	2092
4.6	2394
5.1	1896

AC Content	VMA
4.1	12.1
4.6	11.9
5.1	11.4

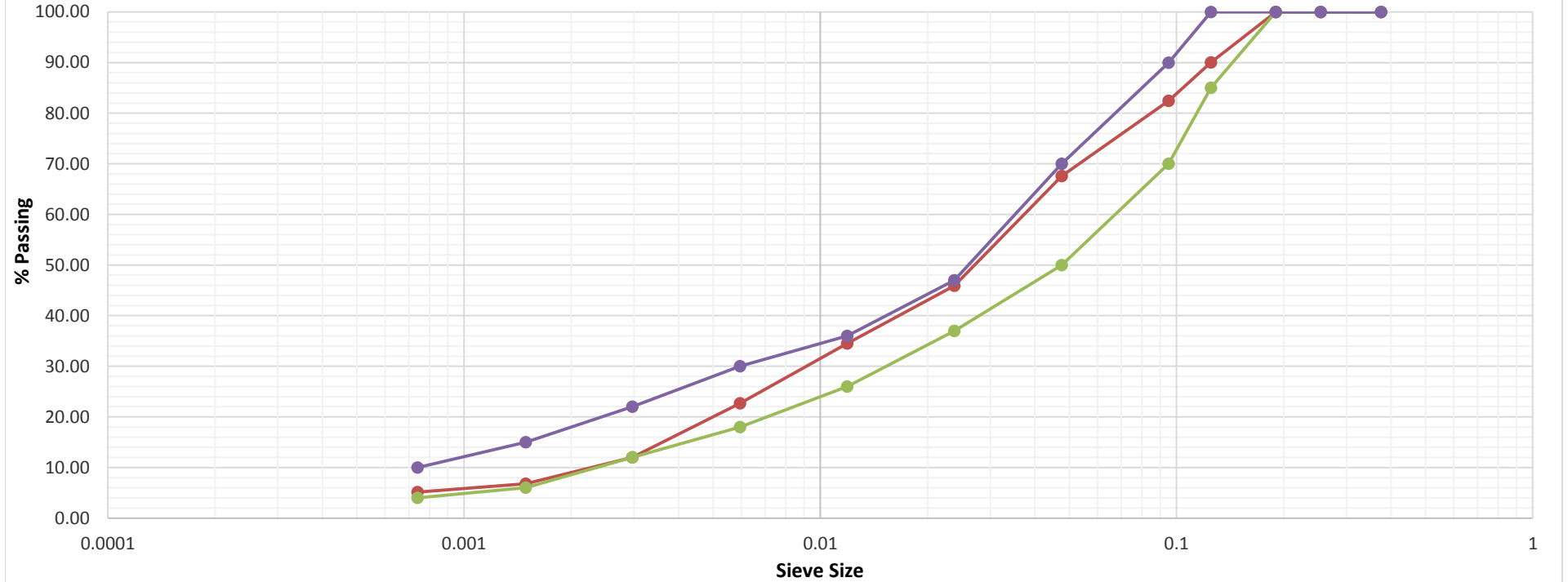
AC Content	VFA
4.1	57.1
4.6	66.8
5.1	82.6

AC Content	Density
4.1	148.8
4.6	149.8
5.1	151.6



APWA TYPE 3V
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0.45 Power Cart



Sample #170008

SAMPLE #170008

This binder meets the qualifications of 64-22, AASHTO M320, Table 1



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Phillips 66**Kansas City**Sampled
01/10/2017Received
01/11/2017Finalized
01/16/2017

Source ID

KC17-64-22-01

Grade 64-22

Tank Number

PAV Temperature 100°

ORIGINALFlash Point Procedure: AASHTO T48 | Pass Criteria: $\geq 230^{\circ}\text{C}$

Flash Point 313 °C

Rotational Viscosity Procedure: ASTM T316 | Pass Criteria: $\leq 3 \text{ Pa}\cdot\text{s}$

Temperature 135 °C

Viscosity 0.427 Pa·s

Dynamic Shear Rheometer Procedure: AASHTO T315 | Pass Criteria: $\geq 1.0 \text{ kPa}$

Temperature 64.0 °C

G* 1.42 kPa

Phase Angle 86.6 °

G*/Sinδ 1.42 kPa

Specific Gravity Procedure: ASTM D70 | Pass Criteria:

Temperature 15.6 °C

Specific Gravity 1.033

ROLLING THIN FILM OVENMass Change Procedure: AASHTO T240 | Pass Criteria: $\pm 1.00\% \text{ max}$

% Mass Change Avg -0.148 %

Dynamic Shear Rheometer Procedure: AASHTO T315 | Pass Criteria: $\geq 2.2 \text{ kPa}$

Temperature 64.0 °C

G* 3.92 kPa

Phase Angle 81.8 °

G*/Sinδ 3.96 kPa

PRESSURE AGING VESSELDynamic Shear Rheometer Procedure: AASHTO T315 | Pass Criteria: $\geq 5000 \text{ kPa}$

Temperature 25.0 °C

G* 5070 kPa

Phase Angle 45.0 °

G*/Sinδ 3585 kPa

Bending Beam Rheometer Procedure: AASHTO T313 | Pass Criteria: $S \leq 300 \text{ MPa}, m \geq 0.300$

Temperature -12 °C

Stiffness Avg 151 MPa

Temperature -12 °C

M Value Avg 0.332

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