



Asphaltic Concrete Mix Design Marshall Method

Date: March 2, 2011

Project No: VB022211-102

Mix Type/Specification: APWA RC-Type 3-01

For: Mr. Leland Smith
Vance Brothers, Inc.
5201 Brighton Ave.
Kansas City, MO 64130

Asphaltic Concrete Mix Design – APWA RC-Type 3-01

Objective

Perform a Marshall Mix Design per the Asphalt Institute MS-2 Manual and AASHTO test methods conforming to the Kansas City Metropolitan Chapter of the American Public Works Association, 2001 Edition, APWA RC-Type 3-01 specification (50 compaction blows per face).

Materials

Material	Source	Date Received
1/2" Crushed Limestone	Quality Quarry, KCMO	February 1, 2011
3/8" Crushed Limestone	Quality Quarry, KCMO	February 1, 2011
Limestone Screenings	Quality Quarry, KCMO	February 1, 2011
River Sand	Mid America Sand Co., KCMO	February 1, 2011
RAP	Vance Brothers, KCMO	February 1, 2011
PG 64-22 Asphalt	Conoco Phillips, Wood River, IL	February 1, 2011

Discussion: Mix Design Project VB022211-102

The mix design was optimized using four asphalt contents (4.0, 4.5, 5.0, 5.5% AC). The table below lists the mix properties at the optimum asphalt content chosen (4.8% AC – 4.3% virgin). The mixing temperature range is 305 to 315°F and the compaction temperature range is 285 to 295°F. As with any mix, compaction and compaction temperatures should be determined by roller test patterns and density measurements. These test results apply only to the laboratory samples as received. Adjustments may be necessary in the plant/field due to raw material variation, conditions in the plant/field, etc. Mix design tables and graphs are on pages 2 – 5.

Property	APWA RC 3-01 Specification	Mix Properties
Optimum AC Content (%)	NA	4.8 +/- 0.2
Bulk Gravity of Mix (G_{mb})	NA	2.360
Mix Density (lbs/ft ³)	NA	147.3
% Air Voids	3 - 5	4
% VMA	NA (AI MS-2: 14 min.)	12.7
% Voids Filled	NA (AI MS-2: 65 - 78)	68.4
Dust Proportion	NA (AI MS-2: 0.6 - 1.2)	1.65
Stability (lbs)	1,500 min.	3,780
Flow (0.01")	8 - 16	13.3

Note: NA = Not Applicable - AI MS-2 Specifications are provided for information only.

Reviewed by: *Martin R. Burrow*

Date: March 2, 2011

Martin R. Burrow
Technical Director, Vance Brothers

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Project Number : 022211-102

Project Location : Kansas City Vance Brothers

Date : 2/22/2011

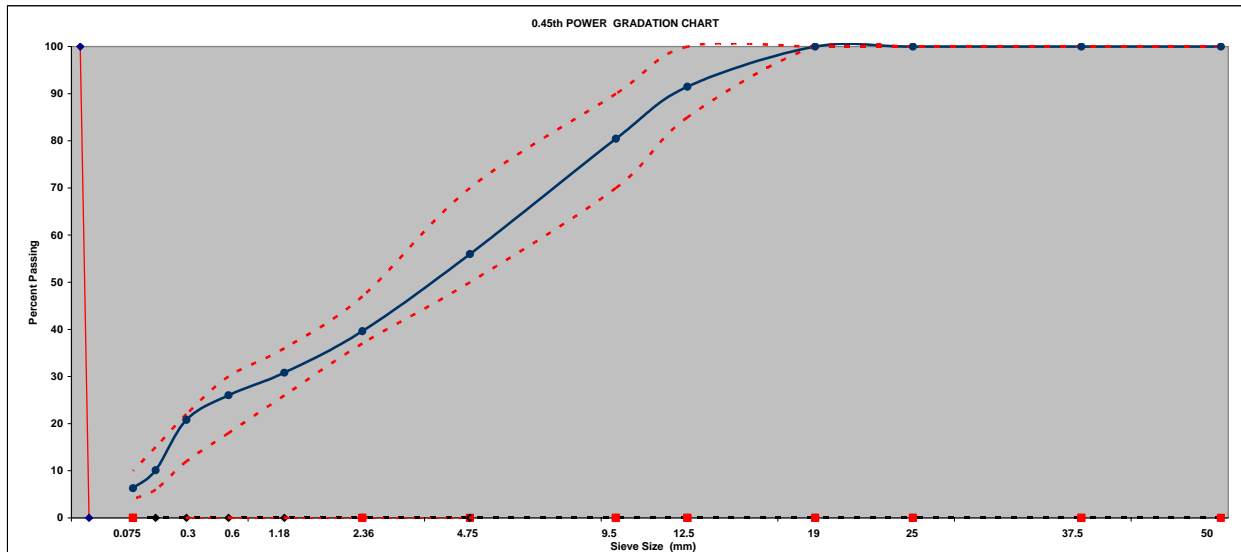
Material Description

- Aggregate 1 = Quality 1/2"
- Aggregate 2 = Quality 3/8"
- Aggregate 3 = Quality Lime
- Aggregate 4 = Mid America Sand (F)
- Aggregate 5 = Kansas City RAP
- Aggregate 6 =
- Aggregate 7 =
- Aggregate 8 =
- Aggregate 9 =
- Aggregate 10 =



Enter Estimated Binder %
Estimated Mix Cost \$ -

Enter Aggregate Material Data in this Table														
Enter Nominal Maximum Size of the Mixture												mm		
Stockpile Percentage														
Aggregate Cost		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
Sieve Size		23%	23%	30%	14%	10%								Specifications
mm	US	Agg.1	Agg.2	Agg.3	Agg.4	Agg.5	Agg.6	Agg.7	Agg.8	Agg.9	Agg.10	Composite	Min.	Max.
50	2"	100.0	100.0	100.0	100.0	100.0						100.0	100	100
37.5	1 1/2"	100.0	100.0	100.0	100.0	100.0						100.0	100	100
25	1"	100.0	100.0	100.0	100.0	100.0						100.0	100	100
19	3/4"	100.0	100.0	100.0	100.0	100.0						100.0	100	100
12.5	1/2"	65.3	100.0	100.0	100.0	94.8						91.5	85	100
9.5	3/8"	20.2	100.0	100.0	100.0	88.1						80.5	70	90
4.75	#4	1.7	22.2	99.2	99.9	67.3						56.0	50	70
2.36	#8	1.5	3.3	66.5	99.3	46.5						39.6	37	47
1.18	#16	1.4	2.7	41.5	98.2	36.7						30.8	26	36
0.6	#30	1.3	2.6	29.4	95.2	29.6						26.0	18	30
0.3	#50	1.2	2.5	21.8	81.3	20.2						20.8	12	22
0.15	#100	1.1	2.3	17.4	20.7	12.0						10.1	6	15
0.075	#200	1.0	2.2	15.2	1.1	8.4						6.3	4.0	10.0



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Project Number : 022211-102
Project Location : Kansas City Vance Brothers

23%	Aggr.1 =	Quality 1/2"		Aggr.6 =	
23%	Aggr.2 =	Quality 3/8"		Aggr.7 =	
30%	Aggr.3 =	Quality Lime		Aggr.8 =	
14%	Aggr.4 =	Mid America Sand (F)		Aggr.9 =	
10%	Aggr.5 =	Kansas City RAP		Aggr.10 =	

CAA Test			
Weight of 1- Frac Face sample		percent 1 or more FF	
Weight of 2- Frac Face sample		percent 2 or more FF	
Total dry weight of sample			

Gsb Coarse Sample						
Spec. #	Dry Wt.	Sub. Wt	SSD Wt.	Gsb	Gsa	Abs
1	2275.6	1432.6	2310.5	2.592	2.699	1.53%
2	2275.6	1432.6	2310.5	2.592	2.699	1.53%
Average				2.592	2.699	1.53%

Gsb Fine Sample						
Spec. #	Oven Dry Sp. In Air	Flask + H ₂ O + Spec.	FL+H2O + Spec.	Gsb	Gsa	Abs
1	487.7	1261.9	1571.6	2.563	2.740	2.52%
2	487.7	1261.9	1571.6	2.563	2.740	2.52%
Average				2.563	2.740	2.52%

FAA Test	Spec. 1	Spec. 2
Volume of cylinder (cm ³)		
Wt. of cylinder (g)		
Wt. of cylinder + Sample (g)		
Gsb of fine aggregate	2.563	2.563
Percent uncompact voids		
Ave. % Uncompact voids		

Flat and Elongated Particles	
Total weight of dry sample	
Dry wt. of elongated particles	
% of Elong. Particles	

Combined Gsb =	2.576
Combined Gsa =	2.722
Comb. H2O Abs. =	1.96%

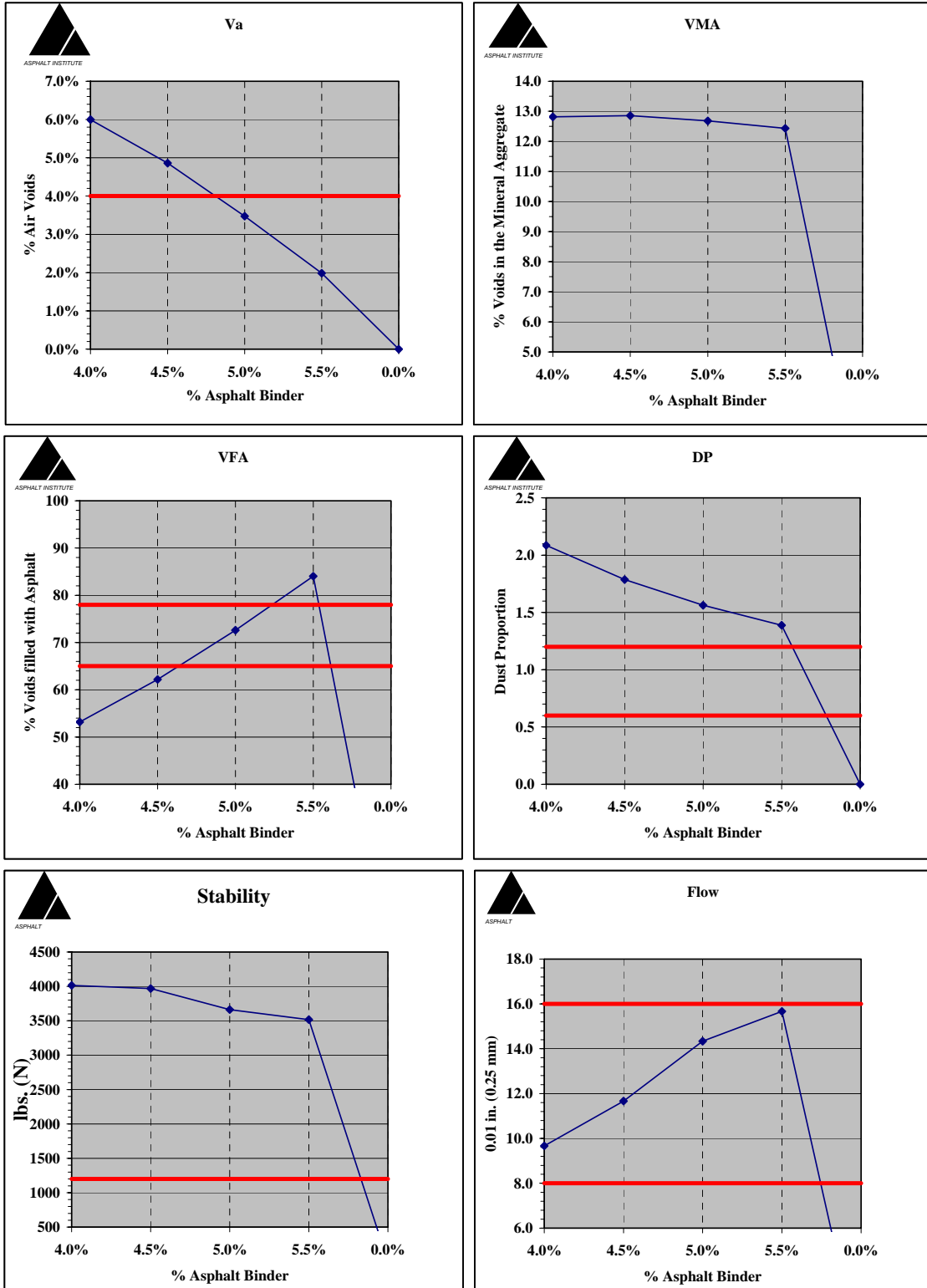
Pb	4.50%
Gmm	2.470
Gb	1.035
Calculate Gse	2.64307
Calculate Pba	1.03

Sand Equiv. Test			
Sand Rdg.	Clay Rdg.	S.E.	
Reading #1			
Reading #2			
Reading #3			
Average			

G _{mm} @ 4.50% Asphalt Binder						
Specimen No.	Sample in air	Sample & Bowl in H ₂ O	Bowl in H2O	Sample in H2O	Gmm	Ave. Gmm
1	1500.0	6351.5	5459.0	892.5	2.469	2.470
2	1500.0	6352.1	5459.0	893.1	2.472	

SPEC. NO.	Pb	Data Entry				Gmb	Ave. Gmb	Volumetric Data						Stab.	Ave. Stab.	Vol.	Corr. Factor	Corr. Stab	Flow	Ave. Flow
		DRY WT.	SUB WT.	SSD WT.				Gmm	Va	VMA	VFA	Pbe	DP							
1A	4.0%	1197.7	694.5	1206.1	2.341	2.339	2.488	6.00%	12.81	53.18	3.02	2.09	3968	4014	512	1.00	4014	9.0	9.7	
1B	4.0%	1199.6	695.7	1208.0	2.342								4068					10.0		
1C	4.0%	1198.9	695.1	1208.6	2.335								4006					10.0		
2A	4.5%	1201.8	696.8	1207.5	2.353	2.350	2.470	4.86%	12.85	62.20	3.52	1.79	3966	3968	510	1.00	3968	11.0	11.7	
2B	4.5%	1198.1	695.6	1206.1	2.347								3979					12.0		
2C	4.5%	1202.2	696.3	1207.7	2.351								3960					12.0		
3A	5.0%	1198.0	697.1	1202.4	2.371	2.367	2.453	3.47%	12.68	72.60	4.03	1.56	3571	3521	506	1.04	3662	14.0	14.3	
3B	5.0%	1198.2	695.3	1200.9	2.370								3441					14.0		
3C	5.0%	1200.0	695.0	1203.2	2.361								3552					15.0		
4A	5.5%	1195.0	696.0	1196.7	2.387	2.387	2.435	1.99%	12.43	84.03	4.53	1.39	3327	3382	502	1.04	3517	16.0	15.7	
4B	5.5%	1198.9	699.0	1201.3	2.387								3461					15.0		
4C	5.5%	1200.4	699.8	1202.8	2.386								3357					16.0		
5A																				
5B																				
5C																				

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Project VB022211-102 cont'd.



 Wood River Refinery
 Roxana, Illinois
Certificate of Analysis
Product Name : Superpave PG 64-22
Product Code : 90084
Customer : Brentag
Destination : Kansas City, MO
Transport ID : MM-52
Trip # : WR 10189 CUS10-11-494
Report Date : Nov 8 2010 8:09AM
Date Sampled : Nov 6 2010 9:30AM
Date Shipped : 11/06/2010
Sample ID : 6397107
Cert ID : 153985
Load Tank : A-148

Name	Units	Results	Specs		Notes
			Min	Max	
		88.0			
D-5 Penetration•Ds Pen @25C	Penetration	5.509			
D-70 Sp. Grav.•D70 @ 60F	API Gravity	1.0328			
D-70 Sp. Grav.•D70 @ 15.9C	Specific Gravity		230		
D-92 COC Flash•D0062 (FDK) (C)	Flash Point	1978.			
D-2171 Vac Visc•D2171@140F	Absolute Viscosity	0.383		3	
D-4402 Vac•D4402 @ 135 C	Rotational Viscosity	1.14	1.00		
AASHTO T-315•Orig DSR@64C	Dynamic Shear (G*/sin d)	86.8			
	Phase Angle	-0.091	-1.00	1.00	
D-2872 RTFO•D2872	Mass Loss	3.55	2.20		
AASHTO T-315•RTFO DSR@64C	Dynamic Shear (G*/sin d)	82.4			
	Phase Angle	3778.		5000	
AASHTO T-315•PAV DSR@25C	Dynamic Shear (G* sin d)	43.7			
	Phase Angle	147.		300	
AASHTO T-313•BBR@-12C	Average Stiffness	0.320	.300		
	Average M-V value				

 Comments :
 Certifies above material meets AASHTO M 320 for performance graded (PG) Asphalt. Quality Assurance: Dave Suess 618.255.21

Please direct questions to David Suess at (618) 255-2758 or Dave.Suess@ConocoPhillips.com