



Asphaltic Concrete Mix Design Marshall Method

Date: March 3, 2011

Project No: VB022811-103

Mix Type/Specification: APWA RC-Type 1-01

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

Asphaltic Concrete Mix Design – APWA RC-Type 1-01

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 1-01 specification (50 compaction blows per face).

Materials

Material	Source	Date Received
1" Crushed Limestone	Quality Quarry, KCMO	February 1, 2011
1/2" 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 VB022811-103

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 (4.6% AC – 3.6% 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 1-01 Specification	Mix Properties
Optimum AC Content (%)	NA	4.6 +/- 0.2
Bulk Gravity of Mix (G_{mb})	NA	2.416
Mix Density (lbs/ft ³)	NA	150.8
% Air Voids	3 - 5	4
% VMA	NA (AI MS-2: 14 min.)	11.3
% Voids Filled	NA (AI MS-2: 65 - 78)	64.4
Dust Proportion	NA (AI MS-2: 0.6 - 1.2)	1.6
Stability (lbs)	1,500 min.	2,860
Flow (0.01")	8 - 16	12.7

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

Reviewed by: *Martin R. Burrow*

Date: March 3, 2011

Martin R. Burrow
 Technical Director, Vance Brothers

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Project Number : VB022811-103
 Project Location : Kansas City Vance Brothers
 Date : 2/28/2011

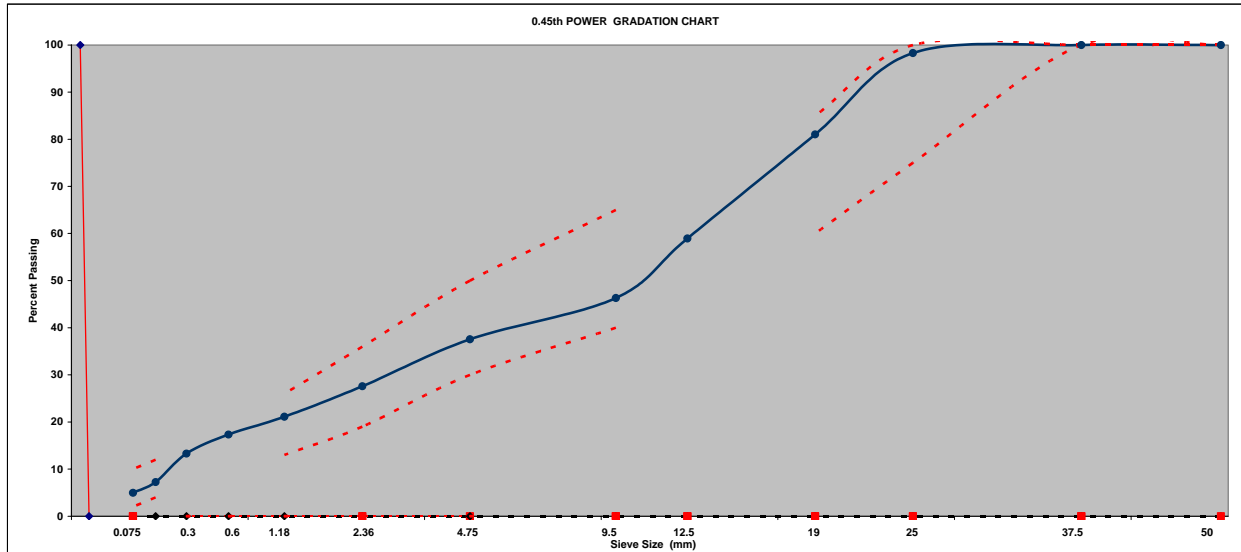


Material Description

- Aggregate 1 = Quality 1"
- Aggregate 2 = Quality 1/2"
- Aggregate 3 = Quality Lime
- Aggregate 4 = MAS 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		32%	25%	18%	6%	19%								
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"	94.7	100.0	100.0	100.0	100.0						98.3	75	100
19	3/4"	40.7	100.0	100.0	100.0	100.0						81.0	60	85
12.5	1/2"	1.9	65.3	100.0	100.0	94.8						58.9		
9.5	3/8"	1.6	20.2	100.0	100.0	88.1						46.3	40	65
4.75	#4	1.5	1.7	99.2	99.9	67.3						37.5	30	50
2.36	#8	1.4	1.5	66.5	99.3	46.5						27.6	19	36
1.18	#16	1.3	1.4	41.5	98.2	36.7						21.1	13	26
0.6	#30	1.2	1.3	29.4	95.2	29.6						17.3		
0.3	#50	1.1	1.2	21.8	81.3	20.2						13.3		
0.15	#100	1.0	1.1	17.4	20.7	12.0						7.2	4	12
0.075	#200	1.0	1.0	15.2	1.1	8.4						5.0	2.0	10.0



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Project Location : Kansas City Vance Brothers

32%	Aggr.1 =	Quality 1"		Aggr.6 =	
25%	Aggr.2 =	Quality 1/2"		Aggr.7 =	
18%	Aggr.3 =	Quality Lime		Aggr.8 =	
6%	Aggr.4 =	MAS Sand (F)		Aggr.9 =	
19%	Aggr.5 =	Kansas City RAP		Aggr.10 =	

Pb	5.00%
Gmm	2.503
Gb	1.035
Calculate Gse	2.70457
Calculate Pba	1.57

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			

FAA Test

	Spec. 1	Spec. 2
Volume of cylinder (cm ³)		
Wt. of cylinder (g)		
Wt. of cylinder + Sample (g)		
Gsb of fine aggregate	2.557	2.557
Percent uncompact voids		
Ave. % Uncompact voids		

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

Gsb Coarse Sample

Spec. #	Dry Wt.	Sub. Wt	SSD Wt.	Gsb	Gsa	Abs
1	2230.0	1410.2	2260.2	2.624	2.720	1.35%
2	2230.0	1410.2	2260.2	2.624	2.720	1.35%
Average			2.624	2.720	1.35%	

Flat and Elongated Particles

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

Gsb Fine Sample

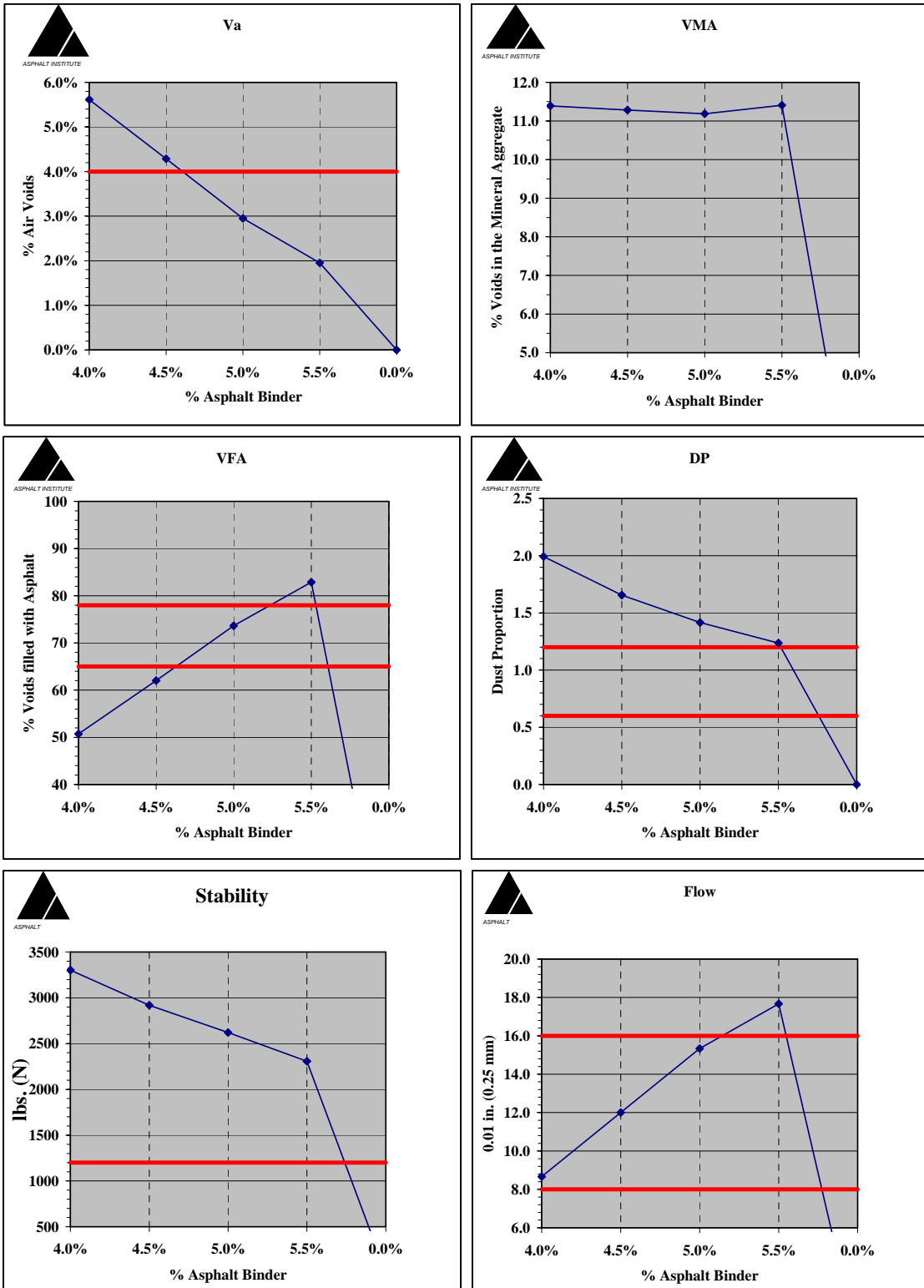
Spec. #	Oven Dry Sp. In Air	Flask + H ₂ O	FL+H ₂ O + Spec.	Gsb	Gsa	Abs
1	488.6	1261.9	1570.8	2.557	2.719	2.33%
2	488.6	1261.9	1570.8	2.557	2.719	2.33%
Average			2.557	2.719	2.33%	

G_{mm} @ 5.00% Asphalt Binder						
Specimen No.	Sample in air	Sample & Bowl in H ₂ O	Bowl in H ₂ O	Sample in H ₂ O	Gmm	Ave. Gmm
1	1500.0	6360.1	5459.0	901.1	2.505	2.503
2	1500.0	6359.2	5459.0	900.2	2.501	

Data Entry

SPEC. NO.	Pb	DRY WT.			Gmb	Ave. Gmb	Volumetric Data					Stab.	Ave. Stab.	Vol.	Corr. Factor	Corr. Stab	Flow	Ave. Flow
		WT.	SUB WT.	SSD WT.			Gmm	Va	VMA	VFA	Pbe							
1A	4.0%	1203.3	708.9	1211.2	2.396							3293						9.0
1B	4.0%	1205.2	708.2	1210.9	2.397	2.398	2.541	5.61%	11.39	50.72	2.49	1.99	2951	3175	502	1.04	3302	8.0
1C	4.0%	1207.7	709.3	1212.3	2.401							3282						9.0
2A	4.5%	1199.0	705.2	1201.7	2.415							2720						11.0
2B	4.5%	1207.1	709.0	1210.1	2.409	2.413	2.522	4.28%	11.28	62.03	3.00	1.66	2909	2806	498	1.04	2919	12.0
2C	4.5%	1204.7	709.1	1207.6	2.417							2790						13.0
3A	5.0%	1193.0	705.0	1196.2	2.429							2346						15.0
3B	5.0%	1212.8	716.5	1216.0	2.428	2.429	2.503	2.95%	11.19	73.63	3.51	1.42	2593	2404	494	1.09	2620	15.0
3C	5.0%	1198.9	708.4	1201.8	2.430							2273						16.0
4A	5.5%	1190.2	702.6	1191.8	2.433							1977						18.0
4B	5.5%	1208.2	714.4	1209.9	2.438	2.436	2.484	1.95%	11.41	82.88	4.02	1.24	2140	2116	492	1.09	2307	17.0
4C	5.5%	1201.5	709.7	1203.0	2.436							2232						18.0
5A																		
5B																		
5C																		

Project VB022811-103 cont'd.



Project VB022811-103 cont'd.



 Wood River Refinery
 Roxana, Illinois
Certificate of Analysis
Product Name : Superpave PG 64-22
Product Code : 90084
Customer : Brenttag
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	
	mm	88.0			
D-5 Penetration-D5 Pen @25C	Penetration	5.509			
D-70 Sp. Grav.-D70 @ 60F	API Gravity	1.0328			
D-70 Sp. Grav.-D70 @ 15.6C	Specific Gravity		230		
D-92 GOC Flash-D0062 (FDK) (C)	Flash Point	316.			
D-2171 Vac Visc-D2171@140F	Absolute Viscosity	1978.			
D-4402 Vac-D4402 @ 135 C	Rotational Viscosity	0.383			3
AASHTO T-315-Orig DSR@64C	Dynamic Shear (G*/sin d)	1.14	1.00		
	Phase Angle	86.8			
	Mass Loss	-0.091	-1.00	1.00	
D-2872 RTFO-D2872	Dynamic Shear (G*/sin d)	3.55	2.20		
AASHTO T-315-RTFO DSR@64C	Phase Angle	82.4			
	Dynamic Shear (G* sin d)	3778.			5000
AASHTO T-315-PAV DSR@25C	Phase Angle	43.7			
	Average Stiffness	147.			300
AASHTO T-313-BBR@-12C	Average M-Value	0.320	.300		

Comments :
 Certifies above material meets AASHTO M 320 for performance graded (PG) Asphalt. Quality Assurance: Dave Suess 618.255.2.

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