



Asphaltic Concrete Mix Design Marshall Method

Date: May 5, 2010

Project No: VB041910-106

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 3-01 specification (50 compaction blows per face).

Materials

Material	Source	Date Received
1/2" Crushed Limestone	Quality Quarry, KCMO	March 15, 2010
3/8" Crushed Limestone	Quality Quarry, KCMO	March 15, 2010
Limestone Screenings	Quality Quarry, KCMO	March 15, 2010
River Sand	Mid America Sand Co., KCMO	March 15, 2010
RAP	Kansas City Recycled Asphalt	March 15, 2010
PG 64-22 Asphalt	Conoco Phillips, Wood River, IL	December 30, 2009

Discussion: Mix Design Project VB 041910-106

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 (4.4% total – 3.9% virgin AC). The mixing temperature range is 305 to 315°F and the compaction temperature range is 285 to 295°F. All loose mix was aged for 2 hours at compaction temperature before testing. 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	4.4 +/- 0.2
Bulk Gravity of Mix (G_{mb})	NA	2.354
Mix Density (lbs/ft ³)	NA	146.9
% Air Voids	3 - 5	4
% VMA	NA (AI MS-2: 14 min.)	13.0
% Voids Filled	NA (AI MS-2: 65 - 78)	70.0
Dust Proportion	NA (AI MS-2: 0.6 - 1.2)	1.64
Stability (lbs)	1,500 min.	3000
Flow (0.01")	8 - 16	13.0

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

Reviewed by: *Martin R. Burrow*
 Martin R. Burrow
 Technical Director, Vance Brothers

Date: May 5, 2010

Project VB041910-106 cont'd.

Project Number : VB 041910-01
 Project Location : Vance Brothers Kansas City
 Date : 4/19/2010

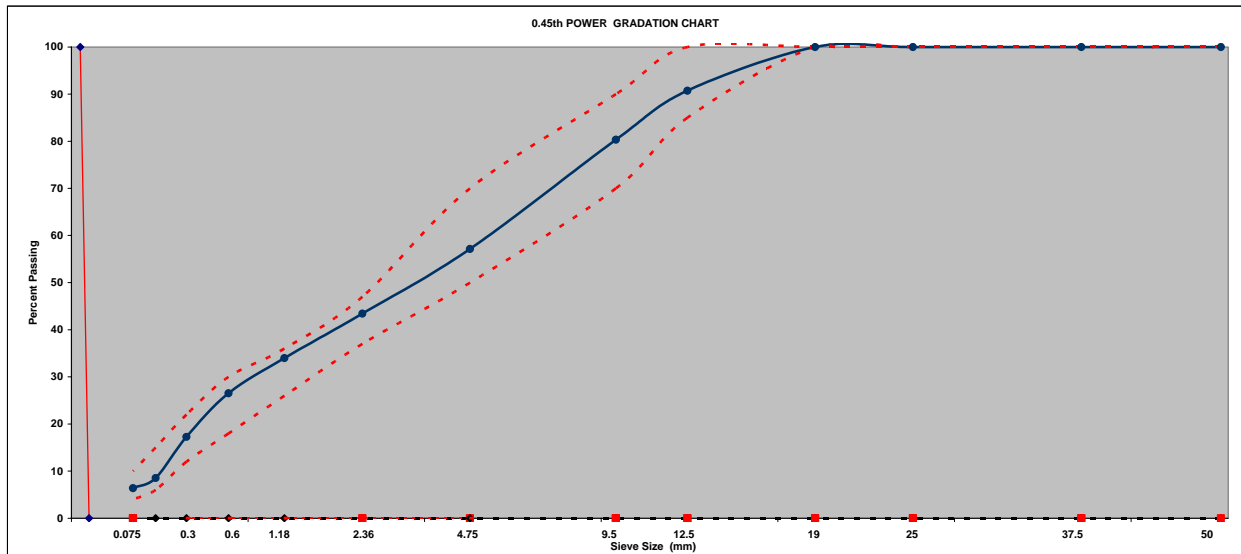
Material Description

- Aggregate 1 = Quality 1/2"
- Aggregate 2 = Quality 3/8"
- Aggregate 3 = Quality Lime
- Aggregate 4 = Mid American Asphalt Sand
- 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%	28%	16%	10%								
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"	60.7	100.0	100.0	100.0	97.7						90.7	85	100
9.5	3/8"	17.3	100.0	100.0	100.0	93.6						80.3	70	90
4.75	#4	1.3	29.3	100.0	99.6	61.7						57.1	50	70
2.36	#8	1.2	5.7	82.2	94.5	37.0						43.4	37	47
1.18	#16	1.2	4.0	57.6	86.0	28.9						34.0	26	36
0.6	#30	1.1	3.4	40.8	73.2	23.4						26.5	18	30
0.3	#50	1.0	3.1	29.1	42.1	14.4						17.3	12	22
0.15	#100	0.9	2.9	21.9	5.5	6.5						8.5	6	15
0.075	#200	0.7	2.7	18.2	0.5	4.3						6.4	4.0	10.0



Project VB041910-106 cont'd.


 Project Number : VB 041910-01
 Project Location : Vance Brothers Kansas City

23%	Aggr.1 =	Quality 1/2"		Aggr.6 =	
23%	Aggr.2 =	Quality 3/8"		Aggr.7 =	
28%	Aggr.3 =	Quality Lime		Aggr.8 =	
16%	Aggr.4 =	Mid American Asphalt Sand		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	2130.6	1347.4	2155.3	2.637	2.720	1.16%
2	2130.6	1347.4	2155.3	2.637	2.720	1.16%
Average				2.637	2.720	1.16%

Gsb Fine Sample						
Spec. #	Oven Dry Sp. In Air	Flask + H ₂ O + Spec.	FL+H20 + Spec.	Gsb	Gsa	Abs
1	494.2	1261.9	1568.0	2.548	2.627	1.17%
2	494.2	1261.9	1568.0	2.548	2.627	1.17%
Average				2.548	2.627	1.17%

FAA Test		
Volume of cylinder (cm ³)	Spec. 1	Spec. 2
Wt. of cylinder (g)		
Wt. of cylinder + Sample (g)		
Gsb of fine aggregate	2.548	2.548
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 =	2.586
Combined Gsa =	2.666
Comb. H2O Abs. =	1.17%

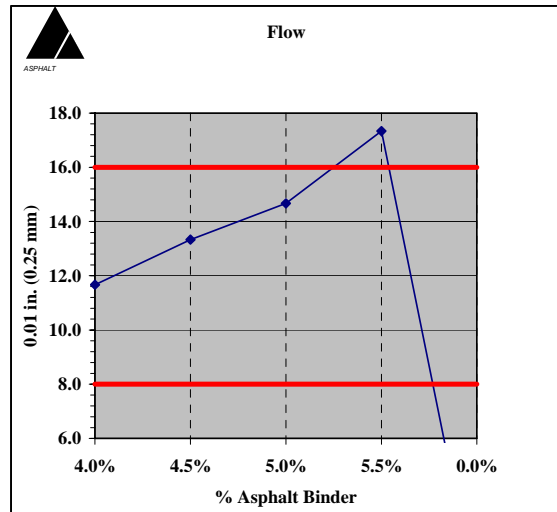
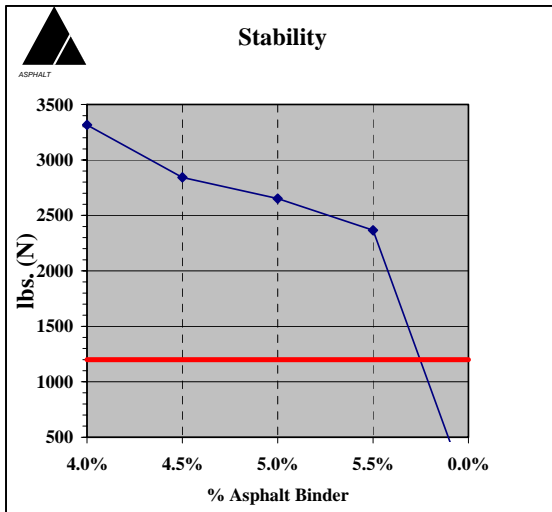
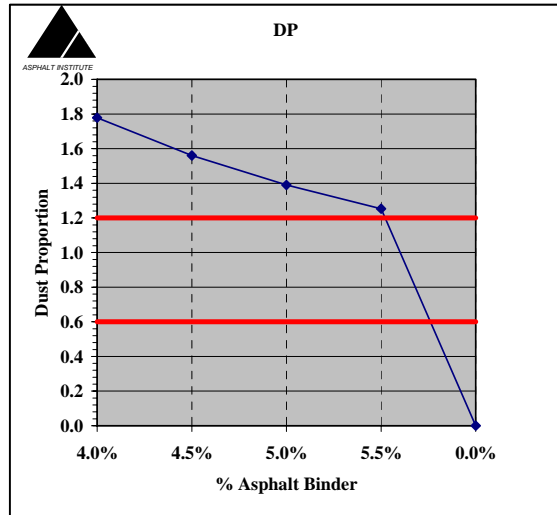
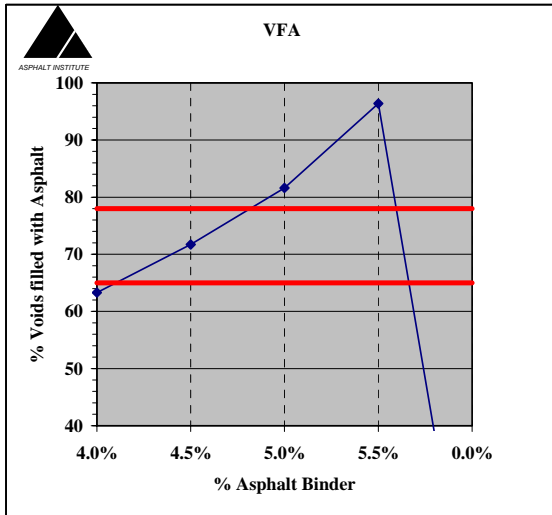
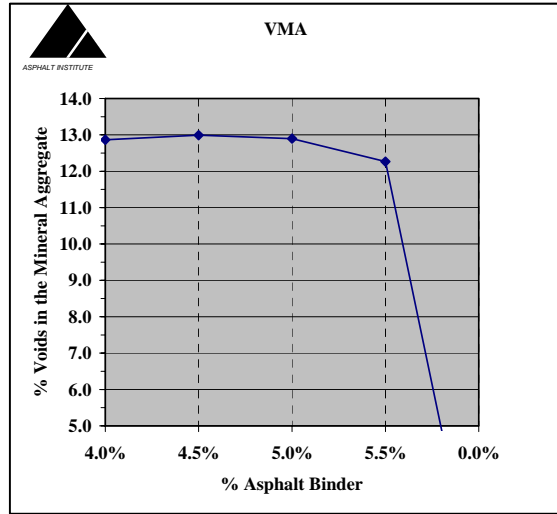
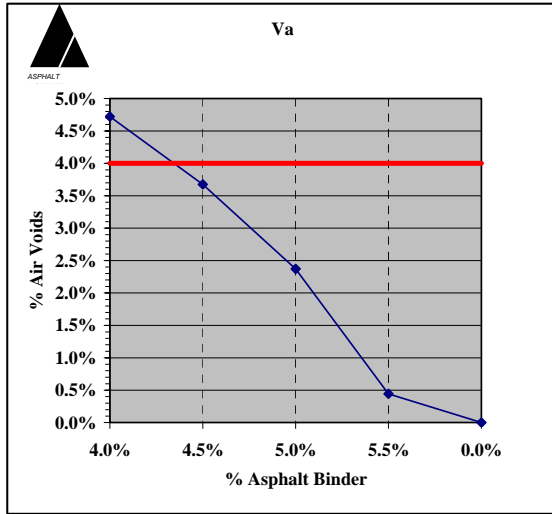
Pb	5.00%
Gmm	2.428
Gb	1.035
Calculate Gse	2.61331
Calculate Pba	0.43

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

G _{mm} @ 5.00% Asphalt Binder						
Specimen No.	Sample in air	Sample & Bowl in H ₂ O	Bowl in H20	Sample in H20	Gmm	Ave. Gmm
1	1500.0	6340.8	5459.0	881.8	2.426	2.428
2	1500.0	6341.7	5459.0	882.7	2.430	

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%	1196.0	696.7	1205.4	2.351	2.347	2.463	4.72%	12.87	63.30	3.59	1.78	3400	3317	509	1.00	3317	13.0	11.7	
1B	4.0%	1194.1	693.9	1203.2	2.345								3275					11.0		
1C	4.0%	1194.1	693.9	1203.2	2.345								3275					11.0		
2A	4.5%	1194.0	693.9	1201.0	2.355	2.356	2.445	3.67%	12.99	71.72	4.09	1.56	2600	2733	508	1.04	2843	14.0	13.3	
2B	4.5%	1201.2	696.5	1206.7	2.354								2700					13.0		
2C	4.5%	1200.2	696.9	1205.9	2.358								2900					13.0		
3A	5.0%	1202.7	697.5	1206.0	2.365	2.371	2.428	2.37%	12.90	81.61	4.60	1.39	2650	2550	507	1.04	2652	15.0	14.7	
3B	5.0%	1201.6	701.9	1206.9	2.379								2550					13.0		
3C	5.0%	1208.2	703.3	1213.7	2.367								2450					16.0		
4A	5.5%	1199.5	700.8	1201.0	2.398	2.400	2.411	0.44%	12.27	96.38	5.10	1.25	2300	2275	501	1.04	2366	17.0	17.3	
4B	5.5%	1197.9	700.8	1199.1	2.404								2325					18.0		
4C	5.5%	1213.5	709.3	1215.1	2.399								2200					17.0		
5A																				
5B																				
5C																				

Project VB041910-106 cont'd.





Project VB041910-106 cont'd.



Wood River Refinery
Roxana, Illinois
Certificate of Analysis

Product Name : Superpave PG 64-22
Product Code : 90084
Customer : BRENNTAG
MID-SOUTH-KANSAS CITY, MO

Report Date : Dec 30 2009 8:12AM
Date Sampled : Dec 13 2009 6:30AM
Date Shipped : 12/30/2009

Sample ID : 5353357
Cert ID : 129502
Blend Tank : A-155

Carrier : GATX36593, UTLX646367, UTLX644031, UTLX645211, SRDX80066

Name	Units	Results	Specs		Notes
			Min	Max	
D-5 Penetration-D5 Pen @25C	Penetration	mm	69.0		
D-70 Sp. Grav.-D70 @ 60F	API Gravity		5.999		
D-70 Sp. Grav.-D70 @ 15.6C	Specific Gravity		1.0291		
D-82 COC Flash-D0082 (C)	Flash Point	Deg C	318.	230	
D-2171 Vac Visc-D2171@140F	Absolute Viscosity	Poise	2009.		
D-4402 Visc-D4402 Rot Visc	Rotational Viscosity	Pa-s	0.393		3
AASHTO T-315-Orig DSR@84C	Dynamic Shear (G*/sin d)	kPa	1.29	1.00	
D-2872 RTFO-D2872	Mass Loss	Wt %	0.059	-1.00	1.00
AASHTO T-315-RTFO DSR@84C	Dynamic Shear (G*/sin d)	kPa	3.09	2.20	
AASHTO T-315-PAV DSR@25C	Dynamic Shear (G* sin d)	kPa	3794.		5000
AASHTO T-313-BBR@-12C	Average Stiffness	M-Pa	168.		300
	Average M-Value		0.324	.300	

Comments :
Certifies above material meets AASHTO M 320 for performance graded (PG) Asphalt. Quality Assurance: Dave Suess 618.255.

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

Feb 16 2010 11:06 BRENNTRGJET FRX 8164543301 p. 1
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