



# Asphaltic Concrete Mix Design Marshall Method

Date: February 28, 2011

Project No: VB021711-101

Mix Type/Specification: APWA Type 3-01

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

# Asphaltic Concrete Mix Design – APWA 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 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
PG 64-22 Asphalt	Conoco Phillips, Wood River, IL	February 1, 2011

## Discussion: Mix Design Project VB 021711-101

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 (4.7% AC). 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 3-01 Specification	Mix Properties
Optimum AC Content (%)	NA	4.7 +/- 0.2
Bulk Gravity of Mix ( $G_{mb}$ )	NA	2.363
Mix Density ( $lbs/ft^3$ )	NA	147.4
% Air Voids	3 - 5	4.0
% VMA	NA (AI MS-2: 14 min.)	12.7
% Voids Filled	NA (AI MS-2: 65 - 78)	68.2
Dust Proportion	NA (AI MS-2: 0.6 - 1.2)	1.66
Stability (lbs)	1,500 min.	4,070
Flow (0.01")	8 - 16	13

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

Reviewed by: *Martin R. Burrow*

Date: February 28, 2011

Martin R. Burrow  
Technical Director, Vance Brothers

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Project Number : 021711-101  
 Project Location : Kansas City Vance Brothers  
 Date : 2/17/2011

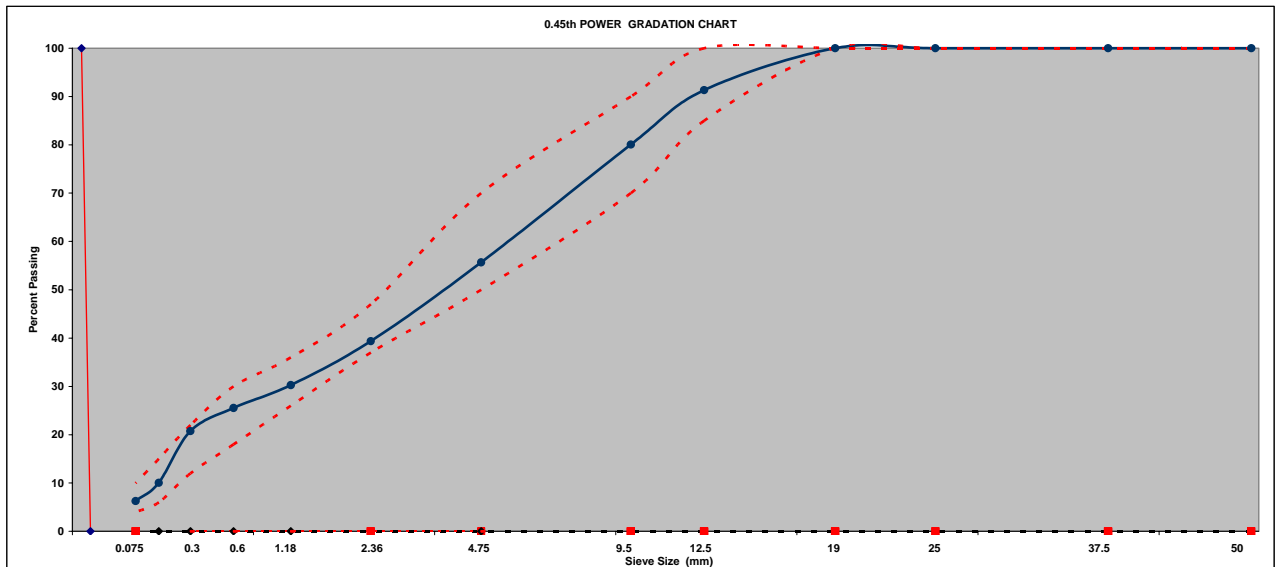


**Material Description**

- Aggregate 1 = 1/2" Quality
- Aggregate 2 = 3/8" Quality
- Aggregate 3 = Quality Lime
- Aggregate 4 = Mid America Sand (F)
- Aggregate 5 =
- Aggregate 6 =
- Aggregate 7 =
- Aggregate 8 =
- Aggregate 9 =
- Aggregate10 =

Enter Estimated Binder %   
 Estimated Mix Cost \$ -

Enter Aggregate Material Data in this Table														
Enter Nominal Maximum Size of the Mixture <input type="text"/> mm														
Stockpile Percentage														
Aggregate Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Sieve Size	25%	25%	35%	15%									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	100
37.5	1 1/2"	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	100
19	3/4"	100.0	100.0	100.0	100.0							100.0	100	100
12.5	1/2"	65.3	100.0	100.0	100.0							91.3	85	100
9.5	3/8"	20.2	100.0	100.0	100.0							80.1	70	90
4.75	#4	1.7	22.2	99.2	99.9							55.7	50	70
2.36	#8	1.5	3.3	66.5	99.3							39.4	37	47
1.18	#16	1.4	2.7	41.5	98.2							30.3	26	36
0.6	#30	1.3	2.6	29.4	95.2							25.5	18	30
0.3	#50	1.2	2.5	21.8	81.3							20.8	12	22
0.15	#100	1.1	2.3	17.4	20.7							10.0	6	15
0.075	#200	1.0	2.2	15.2	1.1							6.3	4.0	10.0



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 Project Number : 021711-101  
 Project Location : Kansas City Vance Brothers

25%	Aggr.1 =	1/2" Quality		Aggr.6 =	
25%	Aggr.2 =	3/8" Quality		Aggr.7 =	
35%	Aggr.3 =	Quality Line		Aggr.8 =	
15%	Aggr.4 =	Mid America Sand (F)		Aggr.9 =	
	Aggr.5 =			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	2456.4	1551.0	2492.2	2.610	2.713	1.46%
2	2456.4	1551.0	2492.2	2.610	2.713	1.46%
Average				2.610	2.713	1.46%

Gsb Fine Sample						
Spec. #	Oven Dry Sp. In Air	Flask + H <sub>2</sub> O + Spec.	FL+H2O + Spec.	Gsb	Gsa	Abs
1	487.5	1261.9	1571.2	2.556	2.736	2.56%
2	487.5	1261.9	1571.2	2.556	2.736	2.56%
Average				2.556	2.736	2.56%

FAA Test	Spec. 1	Spec. 2
Volume of cylinder (cm <sup>3</sup> )		
Wt. of cylinder (g)		
Wt. of cylinder + Sample (g)		
Gsb of fine aggregate	2.556	2.556
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 =	2.580
Combined Gsa =	2.726
Comb. H2O Abs. =	1.92%

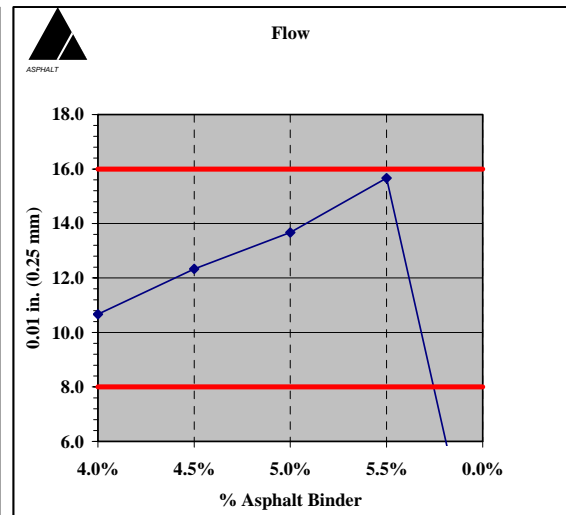
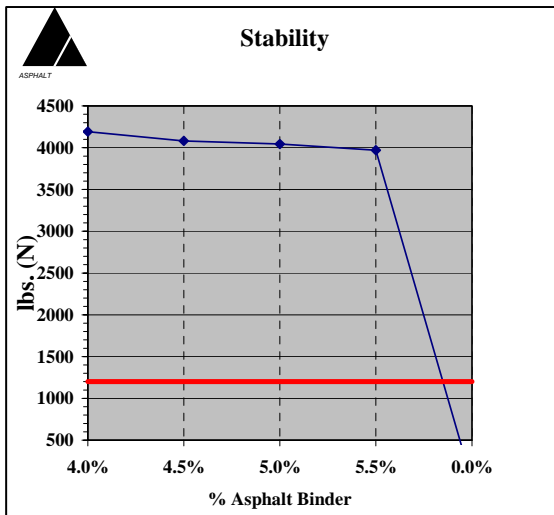
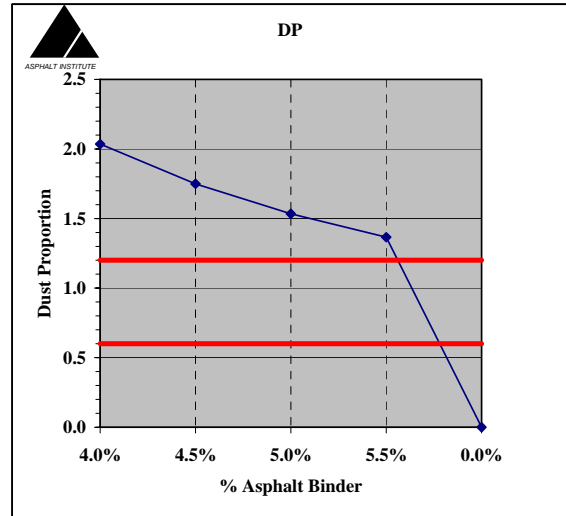
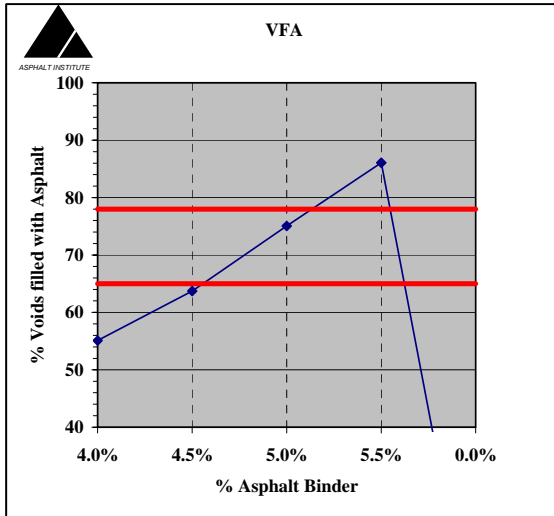
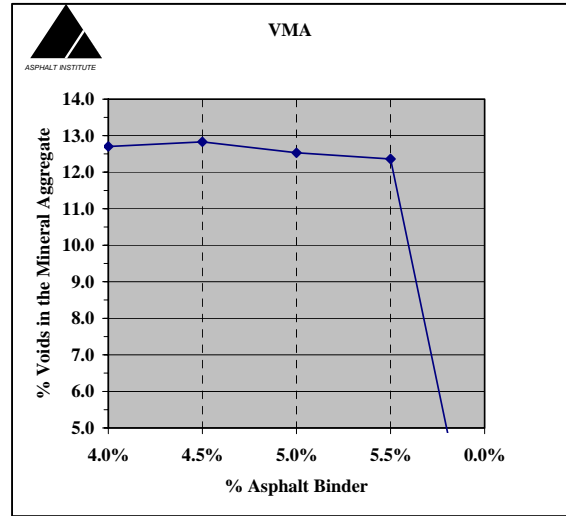
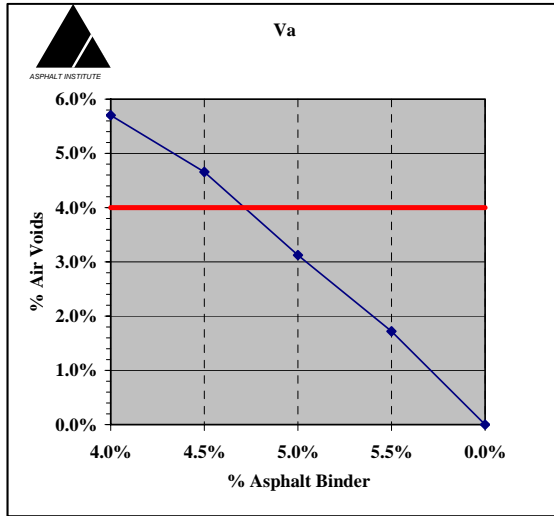
Pb	4.50%
Gmm	2.470
Gb	1.035
Calculate Gse	2.64235
Calculate Pba	0.95

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

G <sub>mm</sub> @	4.50% Asphalt Binder					
Specimen No.	Sample in air	Sample & Bowl in H <sub>2</sub> O	Bowl in H <sub>2</sub> O	Sample in H <sub>2</sub> O	Gmm	Ave. Gmm
1	1500.0	6352.3	5459.0	893.3	2.472	2.470
2	1500.0	6351.0	5459.0	892.0	2.467	

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%	1195.0	695.1	1205.0	2.344	2.346	2.488	5.70%	12.70	55.11	3.09	2.04	4055	4032	508	1.04	4193	10.0	10.7	
1B	4.0%	1192.4	693.2	1201.6	2.345								4025					11.0		
1C	4.0%	1189.2	691.3	1197.6	2.349								4016					11.0		
2A	4.5%	1198.1	695.2	1204.5	2.352	2.355	2.470	4.66%	12.83	63.71	3.59	1.75	3911	3925	507	1.04	4082	12.0	12.3	
2B	4.5%	1193.2	693.8	1199.0	2.362								3925					12.0		
2C	4.5%	1194.0	692.6	1200.7	2.350								3940					13.0		
3A	5.0%	1193.1	692.2	1197.8	2.360	2.375	2.452	3.13%	12.53	75.06	4.10	1.53	3875	3888	503	1.04	4044	14.0	13.7	
3B	5.0%	1196.0	697.3	1198.7	2.385								3900					13.0		
3C	5.0%	1196.4	697.4	1199.9	2.381								3890					14.0		
4A	5.5%	1187.5	693.3	1189.5	2.393	2.393	2.434	1.72%	12.36	86.08	4.60	1.37	3800	3818	497	1.04	3971	16.0	15.7	
4B	5.5%	1195.2	697.3	1197.3	2.390								3823					15.0		
4C	5.5%	1187.9	694.3	1190.5	2.394								3831					16.0		
5A																				
5B																				
5C																				

Project VB021711-101 cont'd.



Project VB021711-101 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	
D-5 Penetration-D5 Pen @25C	mm	68.0			
D-70 Sp. Grav.-D70 @ 60F		5.509			
D-70 Sp. Grav.-D70 @ 15.6C		1.0328			
D-92 GOC Flash-D0002 (FDK) (C)	Deg C	318.	230		
D-2171 Vac Visc-D2171@140F	Poise	1978.			
D-4402 Vac-D4402 @ 135 C	Pa-s	0.383			3
AASHTO T-315-Orig DSR@64C	Rotational Viscosity	1.14	1.00		
	Dynamic Shear (G*/sin d)	kPa			
	Phase Angle	Degrees			
D-2672 RTFO-D2672	Mass Loss	WT %	-1.00	1.00	
AASHTO T-315-RTFO DSR@64C	Dynamic Shear (G*/sin d)	kPa	3.55	2.20	
	Phase Angle	Degrees			5000
AASHTO T-315-PAV DSR@25C	Dynamic Shear (G* sin d)	kPa	3778.		
	Phase Angle	Degrees	43.7		
AASHTO T-313-8BR@-12C	Average Stiffness	M-Pa	147.		300
	Average M-Value		0.320	.300	

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

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