

SHRP LEVEL 1 METHOD
BITUMINOUS MIX DESIGN

Prepared for: Asphalt Materials Inc

Super-Pave Mix Design
1/2" Asphalt PG 64-28 Oil

RAP: 15 %

Date Prepared: June 20, 2019

N Design: 75

Max Unit Wt. (Rice): 149.5

Bulk Unit Wt. 144.2



VOLUMETRIC METHOD BITUMINOUS MIX DESIGN

ASTM D-312 AND ASPHALT INSTITUTE SP-2

Prepared for: Asphalt Materials

Lab #: 4444

Project: Saratoga

Date: June 20, 2019

Product: 2017 APWA SP -1/2" 15% Rap

Max Size: 1/2

Project #: 5648

Gentlemen:

CMT Engineering Labs performed an Superpave Mix Design in accordance with ASTM D-312 and Asphalt Institute SP-2, to determine the optimum binder content for the Job Mix Target listed below.

The aggregate physical properties were determined and are listed on page 2, the asphalt physical properties were measured and are provided on page 3.

RECOMMENDED DESIGN CRITERIA

Air Voids:	3.5	Recommended Oil Content:	5.40
VMA:	14.6	Virgin Oil Content:	4.63
Voids Filled VFA:	75.9	Binder Supplier:	Peak
Dust Effective Asphalt Ratio:	1.38	Virgin Binder Grade: PG	64 -28
Effective Asphalt Content:	4.86	Blend Binder Grade: PG	64 -28
Hamburg	6.09 mm	Esal's	<0.3
Anti-Strip:	None Required	Gyrations	N _{Initial} : 7
Max. Unit Weight (Rice):	149.5 pcf	N _{Design} :	75
Bulk Unit Weight:	144.2 pcf	N _{Max} :	115
Volume of Effective Binder:	11.0 %		

Job Mix Formula

<u>(inch)</u>	<u>(mm)</u>	<u>Percent Passing</u>	<u>SP -1/2"</u>
1	25	100	
3/4"	19	100	100 - 100
1/2"	12.5	96	90 - 100
3/8"	9.5	90	- 90
#4	4.75	65	
#8	2.36	43	28 - 58
#16	1.18	28	
#30	0.6	21	
#50	0.3	16	
#100	0.15	12	
#200	0.075	6.7	2 - 10

Aggregate Source Proportions

Aggregate Source	Product Name	Proportions (%)
Parleys	3/4	8
P.O.M	1/2	7
P.O.M	1/4	30
P.O.M	Sand	40
0		0
Hot Plant	RAP 1	15
0	0.00	0
Lime-None	Lime	0
Total		100

Aggregate Blend Physical Properties

Test Method	Results	Specification
MgSo4 Soundness (coarse) AASHTO T 104	0.43	16 % Max.
MgSo4 Soundness (fine) AASHTO T 104	2.40	16 % Max.
Dry Rodded Unit Weight AASHTO T19	119.1	75 Lb/cu ft Min.
Fracture Face Count - One Face AASHTO T 335	98.6	95% Min. Artrial 90% Min. Residential
Fracture Face Count - Two Face's AASHTO T 335	95.8	90% Min. Artrial 80% Min. Residential
Los Angeles Wear AASHTO T 96	22	35 % Max.
Sand Equivelent AASHTO T 176 W.M	64	45 Min.
Clay Lumps and Friable Particles AASHTO T 112	0.0	2 % Max
Flat or Elongated Particles ASTM D 4791, 3:1 R	1.0	20 % Max.
Plastic Index ASTM D-4318	Non-Plastic	Non-Plastic
Liquid Limit ASTM D-4316	Non-Plastic	Non-Plastic
Fine Aggergate Angularity		

Specific Gravity of Aggregates

Product Name	Bulk Specific Gravities	Apparent Specific	Water Absorpti	Proportion
3/4	2.651	2.713	0.90	8
1/2	2.467	2.599	2.05	7
1/4	2.466	2.591	2.00	30
Sand	2.614	2.625	0.30	40
	0.000	0.000	0.00	0
RAP 1	2.567	2.615	1.10	15
0.00	0	0	0	0
Lime-None	0	0	0	0
Blend Totals	2.553	2.618	1.10	100

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Aggregate Products

	3/4	1/2	1/4	Sand	0	RAP 1	0	Lime	Bag House Offset	JMF	Min	Max
Percent Selected	8.0	7.0	30.0	40.0	0.0	15.0	0.0	0.0			SP -1/2"	
I	100	100	100	100	0	100	0	100	0	100		
3/4"	100	100	100	100	0	100	0	100	0	100	100	100
1/2"	47	100	100	100	0	100	0	100	0	96	90	100
3/8"	7	70	100	100	0	97	0	100	0	90		90
#4	3	3	46	99	0	75	0	100	0	65		
#8	2	2	6	83	0	56	0	100	0	43	28	58
#16	2	2	4	52	0	40	0	100	0	28		
#30	2	2	3	38	0	32	0	100	0	21		
#50	1	2	3	29	0	24	0	100	0	16		
#100	1	2	3	21	0	16	0	99	0	12		
#200	1.2	1.5	2.3	11.0	0.0	9.4	0.0	98.0	0.0	6.7	2	10

Summary of Trial Mixture Bin Ratios

Trial Blend #	3/4	1/2	1/4	Sand	0	RAP 1	0	Lime	Total
1	15	10	24	36	0	15	0	0	100
2	8	7	30	40	0	15	0	0	100
3	5	20	24	36	0	15	0	0	100
4	16	17	11	41	0	15	0	0	100
5	5	25	25	30	0	15	0	0	100

Summary of Trial Mixture Propertys

Trial #	Asphalt Content	Bulk Specific Gravity	Bulk Unit Weight	Air Voids	VMA	VFA	Max Specific Gravity	Max Unit Wt. (Rice)
1	5.10	2.324	144.7	3.47	13.85	74.92	2.408	149.9
2	5.25	2.315	144.1	3.64	14.08	74.12	2.403	149.6
3	5.10	2.305	143.5	4.25	13.93	69.46	2.408	149.9
4	5.10	2.358	146.8	2.06	12.91	84.04	2.408	149.9
5	0.00							

Summary of Paving Mixture Properties

Asphalt Content	Bulk Specific Gravity	Bulk Unit Weight	Air Voids	VMA	VFA	Max Specific Gravity	Max Unit Wt. (Rice)	Binder Volume Effective
4.75	2.284	142.2	5.4	14.8	63.36	2.415	150.3	9.38
5.25	2.323	144.6	3.1	13.8	77.40	2.398	149.3	10.67
5.75	2.337	145.4	1.9	13.7	86.34	2.372	147.6	11.87
6.25	2.340	145.7	1.0	14.1	92.57	2.365	147.2	13.02

Summary of Paving Mixture Properties @ Recommended Oil Content

Asphalt Content	Bulk Specific Gravity	Bulk Unit Weight	Air Voids	VMA	VFA	Max Specific Gravity	Max Unit Wt. (Rice)	Binder Volume (Effective)
5.40	2.316	144.2	3.5	14.6	75.9	2.401	149.5	11.0

RAP, M323 Properties

Asphalt contribution from RAP	0.77
Total Binder Recommendation	5.40
Percent Binder from RAP	14.22
Max. Allowable Binder Contribution M323	NotApplicable
AASHTO M323 Compliant	Yes

Paving Mixture Properties

Mixing Temp	305
Compaction Temp	271
Dust to Effective Asphalt Ratio	1.38
Hamburg Loaded Wheel Tes	6.09

Asphalt Water Susceptibility

Lottman AASHTO T-283-89:

Immersion Compression
ASTM C-1074,1075

Test Specimen	Tensile Strength (PSI)	Retained Strength %	Stripping Index	Dry Strength (PSI)	Retained Strength %
Dry Controls	0.0				
Wet Controls	0.0	#DIV/0!			
1/4% Liquid Anti-Strip					
1% Lime					
1.5% Lime					

Doug Watson

Douglas Watson

AASHTO M 323

Customer: Asphalt Materials

Project: Saratoga

2017 APWA

Date of Analysis: 3/15/18

BLENDING WITH A KNOWN VIRGIN BINDER (M323 - X1.4.)

Known Parameters

1. Specified Final Blended Binder Grade	PG	64-28
2. Virgin Asphalt Binder Grade	PG	64-28
3. Recovered RAP Binder Properties	PG	89.2-17.5

$T_{Virgin\ High}$ = Critical High Temp of Virgin Asphalt Binder	56	Virgin Binder
$T_{Virgin\ Inter}$ = Critical Inter Temp of Virgin Asphalt Binder	19	
$T_{Virgin\ Low}$ = Critical Low Temp of Virgin Asphalt Binder	-29	
$T_{Spec\ High}$ = Critical High Temp of Blended Asphalt Binder	64	Spec Binder
$T_{Spec\ Inter}$ = Critical Inter Temp of Blended Asphalt Binder	25	
$T_{Spec\ Low}$ = Critical Low Temp of Blended Asphalt Binder	-28	
$T_{RAP\ High}$ = Critical High Temp of RAP Binder	89.2	RAP Binder
$T_{RAP\ Inter}$ = Critical Inter Temp of RAP Binder	29.7	
$T_{RAP\ Low}$ = Critical Low Temp of RAP Binder	-17.5	

Maximum Allowable Binder Contribution %

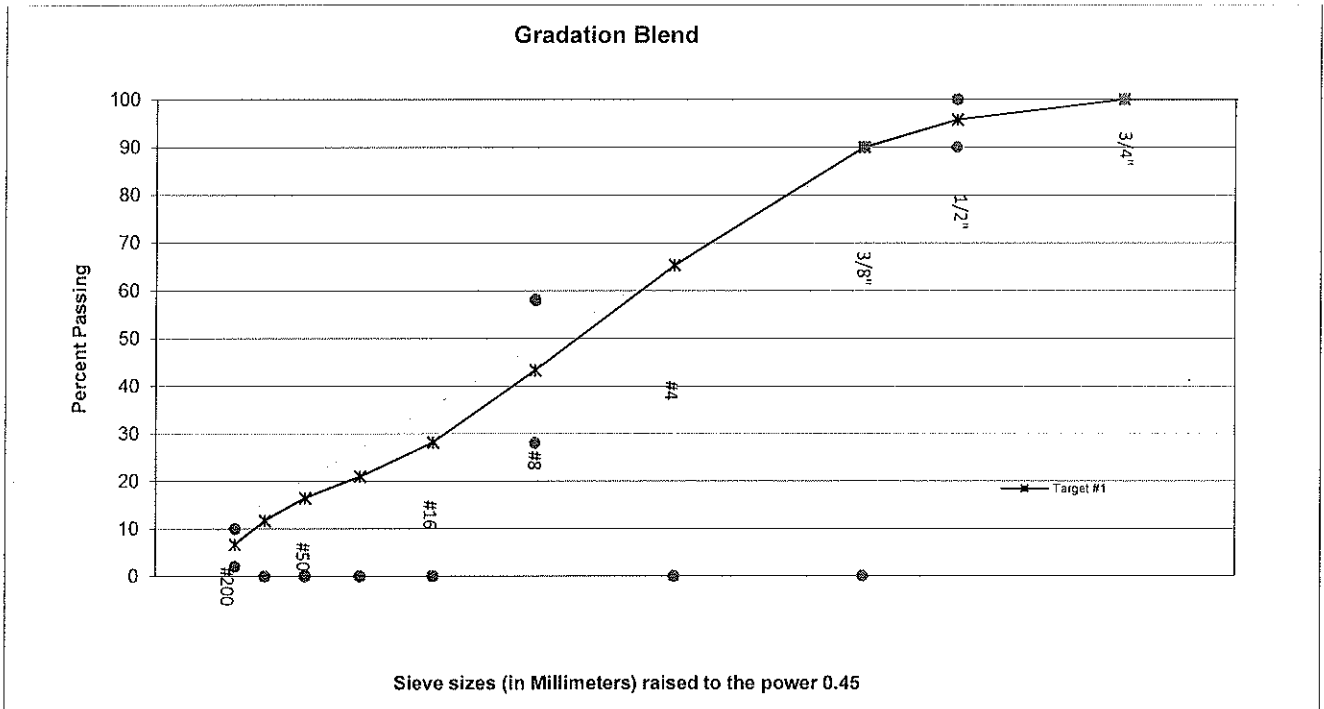
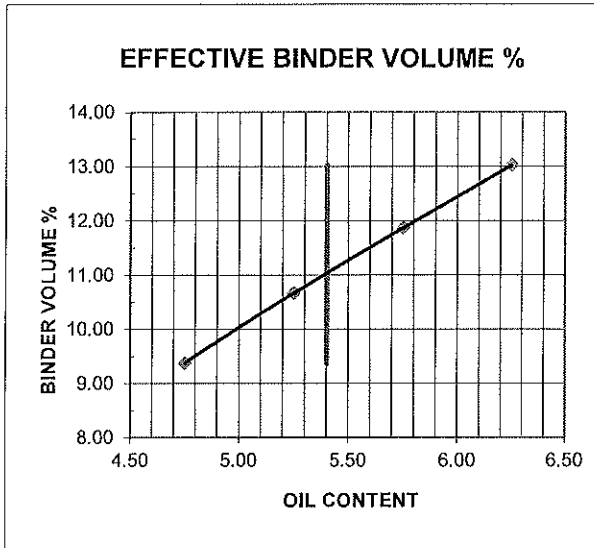
% RAP _{High} =	24.10	% Binder
% RAP _{Inter} =	56.07	
% RAP _{Low} =	8.70	

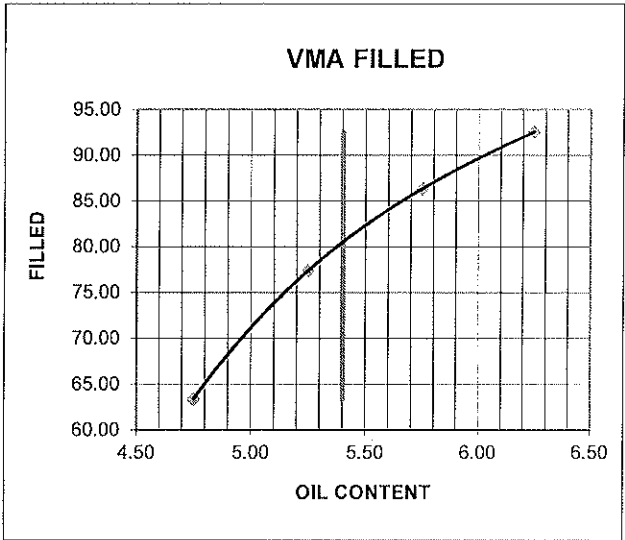
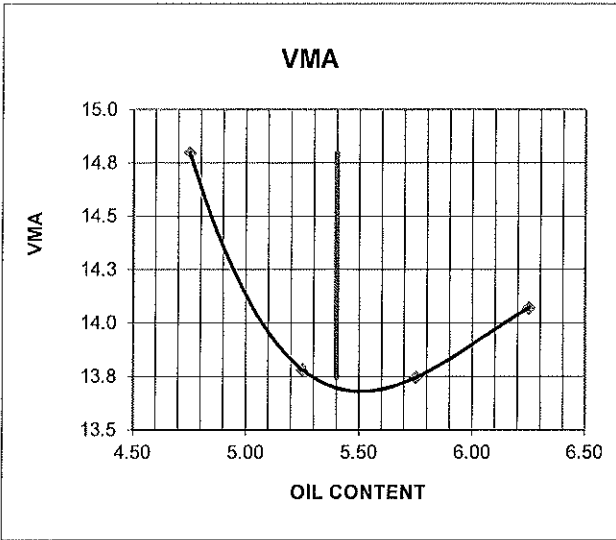
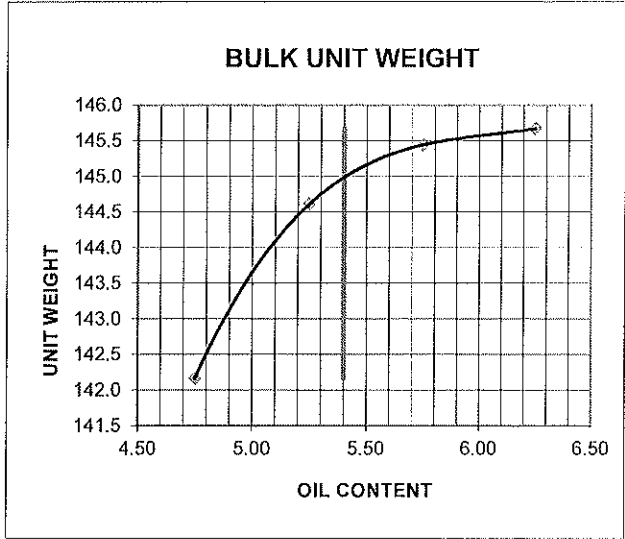
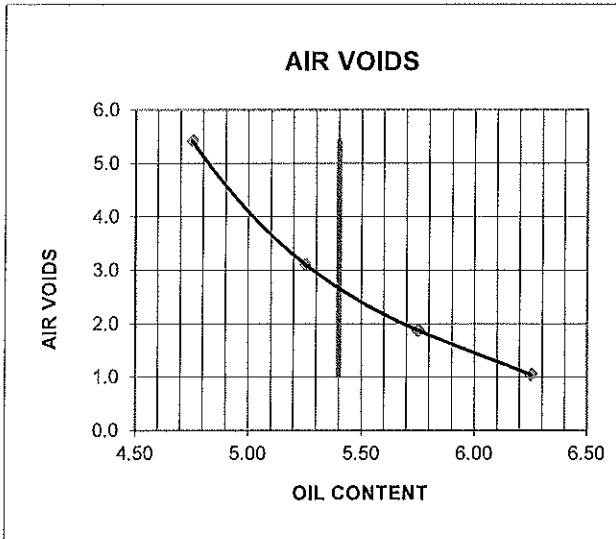
Max % Binder **8.70**

$$T_{Virgin} = \frac{T_{Blend} - (\%RAP \times T_{RAP})}{(1 - \%RAP)}$$

$$\%RAP = \frac{T_{Blend} - T_{Virgin}}{T_{RAP} - T_{Virgin}}$$

Lab#: 4444





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HAMBURG WHEEL TRACKER

Test Temperature: 50C

Hamburg Wheel Tracker	Air Voids	Rutt	Specification
Right Track	7.5	-5.22	10mm
Left Track	7.4	-6.96	
Average	7.45	-6.09	Pass

