

CMT ENGINEERING **LABORATORIES**

Geotechnical • Materials Testing • Special Inspections • Chemical Analysis

MARSHALL METHOD **BITUMINOUS MIX DESIGN** **ASTM D-1559 AND ASPHALT INSTITUTE MS-2**

Prepared for: Asphalt Materials Inc

Mix Design: 1/2" Asphalt PG 58-28

RAP: 15 %

Date Prepared: March 15, 2021

Blows: 50



Bulk Unit Weight	Max Unit Weight (Voidless / Rice)
141.7	146.8

MARSHALL METHOD BITUMINOUS MIX DESIGN ASTM D-1559 AND ASPHALT INSTITUTE MS-2

Prepared for: Asphalt Materials

Lab # : 883053

Project : Various Projects

Date: March 15, 2021

Product: 2017 APWA DM-1/2"

15% Rap

Max Size: 1/2

Project #: 5648

Gentlemen:

CMT Engineering Labs performed an Asphalt Mix Design in accordance with ASTM D-1559 and Asphalt Institute MS-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

Stability:	3147	Recommended Oil Content:	5.61
Flow:	14.6	Virgin Oil Content:	4.97
Air Voids:	3.5	Lottman (TSR):	95%
VMA:	15.0	Binder Supplier:	Sinclair
Anti-Strip:		Virgin Binder Grade: PG	58 -28
Voids Filled VFA:	76.7	Final Binder Grade: PG	58 -28
Dust Asphalt Ratio:	1.36	No. of Blows:	50
Effective Asphalt Content:	5.01	Max. Unit Weight (Rice):	146.8
		Bulk Unit Weight:	141.7

Job Mix Formula

(inch)	(mm)	Percent Passing	DM-1/2"
1	25	100	
3/4"	19	100	
1/2"	12.5	100	100 - 100
3/8"	9.5	96	
#4	4.75	69	60 - 80
#8	2.36	45	
#16	1.18	31	28 - 42
#30	0.6	24	
#50	0.3	19	11 - 23
#100	0.15	14	
#200	0.075	6.8	3 - 7

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Blend # 2

Aggregate Source Proportions

Aggregate Source	Product Name	Proportions (%)
WJP	3/4"	0
POM	1/2"	13
POM	1/4"	27
POM	Sand	45
0	0.00	0
WJP	CA Rap	15
WJP	FR	0
None	Lime	0
Total		100

Aggregate Blend Physical Properties

Test Method	Results	Specification
MgSo4 Soundness (coarse) ASTM C-88	1.90	16 % Max.
MgSo4 Soundness (fine) ASTM C-88	2.70	16 % Max.
Dry Rodded Unit Weight ASTM C29	105.3	75 Min.
Fracture Face Count - Two Face's	90.8	50% Min.
Los Angeles Wear ASTM C-131	20	40% Max.
Sand Equivelent ASTM D-2419	72	45 MIN
Clay Lumps and Friable Particles ASTM C-142	0.0	2 max
Flat or Elongated Particles ASTM D-4791	10.6	20%Max
Plastic Index ASTM D-4318	Non-Plastic	6 Max.
Liquid Limit ASTM D-4316	Non-Plastic	25 Max

Specific Gravity of Aggregates

Product Name	Bulk Specific Gravities	Apparent Specific Gravities	Water Absorption	Proportion
3/4"	2.651	2.702	0.70	0
1/2"	2.464	2.578	1.79	13
1/4"	2.474	2.599	2.30	27
Sand	2.544	2.615	1.08	45
0	0.000	0.000	0.00	0
CA Rap	2.628	2.707	1.11	15
FR	0	0	0	0
None	0	0	0	0
Blend Totals	2.526	2.619	1.51	100

Summary of Paving Mixture Properties

Asphalt Content	Bulk Specific Gravity	Bulk Unit Weight	Stability	Flow	Air Voids	VMA	VFA	Max Specific Gravity	Max Unit Wt. (Rice)
5.20	2.248	139.9	3013	12	5.3	15.7	66.31	2.373	147.7
5.50	2.264	140.9	3143	14	4.2	15.3	72.77	2.363	147.1
5.80	2.296	142.9	3155	15	2.4	14.4	83.40	2.352	146.4
6.10	2.304	143.4	2858	16	1.6	14.4	88.57	2.342	145.8

Summary of Paving Mixture Properties @ Recommended Oil Content

Asphalt Content	Bulk Specific Gravity	Bulk Unit Weight	Stability	Flow	Air Voids	VMA	VFA	Max Specific Gravity	Max Unit Wt. (Rice)
5.61	2.276	141.7	3147	15	3.5	15.0	76.7	2.359	146.8

RAP, M323 Properties

Asphalt contribution from RAP	0.65
Total Binder Recommendation	5.61
Percent Binder from RAP	11.50
Max. Allowable Binder Contribution M323	0.00
AASHTO M323 Compliant	N/A

Paving Mixture Properties

Mixing Temp	300
Compaction Temp	269
Dust to Asphalt Ratio	1.36
Hamburg Loaded Wheel Tes	N/A

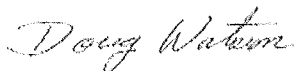
Asphalt Water Susceptibility

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	174.2				
Wet Controls	164.7	94.6%			
1/4% Liquid Anti-Strip					
1% Lime					
1.5% Lime					



 Douglas Watson

