SUBMITTAL

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Submittal number	034.0	Date	06/21/2021
Project	TRAILS AT CROWFOOT F9	6454 N. Crowfoot Valley Road Parker, CO	
Project number	202103		
Spec section			
Subsection		Status	Open
Current action	Submitted	Ball in court	
Topic	Asphalt Paving Mix Design		

Submitter	MICHAEL TOMAS SNYDER
Reviewer	
Cc	

Date submitted	06/21/2021	Submission due date	06/21/2021
Released for review	06/21/2021	Review due date	06/28/2021
Date returned		Required on site date	06/28/2021
Date closed			

Notes

Please see attached Asphalt Paving Mix Designs:

Reference Attached:
1) Product No. 5493, Mix Design No. 2243, Description: (3/4)SP75(64-22)20%, Dated 3/31/2021
2) Product No. 5462, Mix Design No. 1243, Description: (1/2)SP75(64-22)20%, Dated 3/31/2020

Martin Marietta

3/31/2021

Martin Marietta
1627 Cole Blvd, Suite 200
Lakewood, CO 80401

Attn: Mr. Pat Hartshorn

Re: Hot Mix Asphalt Mix Design

Grading:	3/4" NMAS (S)
Method/Type:	Superpave 75 Gyrations
Aggregate:	Spec Agg/Riverbend/Platte/RAP
Plant Number(s):	Spec Agg/Gordon/Monaghan (16318, 16321, 16431)
Mix Design Number:	2243
Product Number:	5493
Ticket Description:	(3/4)SP75(64-22)20%

This letter represents the results of a hot mix asphalt mixture design by the Superpave Method utilizing 75 Gyrations at 1.25° in accordance with Colorado Department of Transportation Manual of Test Procedures and as outlined by Asphalt Institute Manual, Asphalt Mix Design Methods (MS-2), 7th Edition.

The Spec Agg/Riverbend/Platte/RAP aggregates and Suncor PG 64-22 asphalt cement used in this mix design were proportioned in accordance with your request as detailed in the blend table of this design.

Properties of this mixture are:

Asphalt Content (%AC):	4.90	
Max. Theoretical Specific Gravity (Gmm):	2.508	(156.5 pcf)
Air Voids (%Va):	3.5	
Voids in Mineral Aggregate (%VMA):	13.9	
Voids Filled with Asphalt (%VFA):	74.5	
Tensile Strength Ratio, TSR (%):	97	
Hveem Stability:	41	

The aggregate blend sheet, mix design physical properties, mix design property curves, and combined aggregate properties are presented on the enclosed forms.

Please do not hesitate to contact us with any questions concerning this report.

Sincerely,
Martin Marietta - Central Laboratory
An AASHTO Accredited Lab

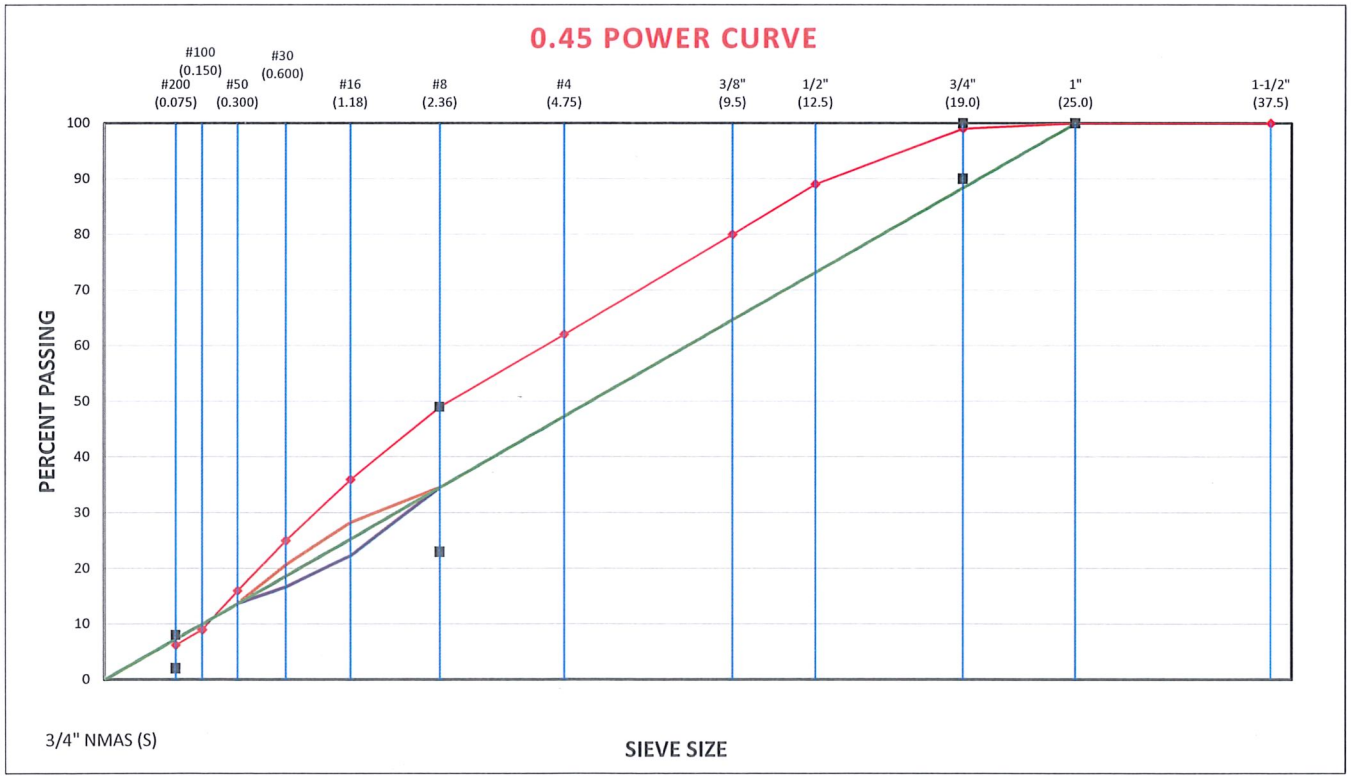
Todd M. Genovese, P.E.
Director of Technical Services
West Division
Enclosures (4)

AASHTO ACCREDITED

Martin Marietta

Date:	3/31/2021	**Client:**	Metro Asphalt
Design Number:	2243	**Binder:**	PG 64-22
Grading:	3/4" NMAS (S)	**Binder Supplier:**	Suncor
Design Type:	Superpave 75 Gyrations	**Specific Gravity:**	1.037
Aggregate Source:	Spec Agg/Riverbend/Platte/RAP	**Antistrip Agent:**	Lime

% Material Used:	15%	12%	23%	11%	18%		20%	1.0%	100.00%	
Material Type:	57/67 Rock	1/2" Rock	Crusher Fines	Crushed Squeegee	Washed Sand		Crushed RAP	Hydrated Lime	JMF	Control Points
Supplier:	Spec Agg	Spec Agg	Spec Agg	Riverbend	Platte		Metro	Pete Lien		
1-1/2" (37.5 mm)	100	100	100	100	100		100	100	100	
1" (25.0 mm)	100	100	100	100	100		100	100	100	100
3/4" (19.0 mm)	91	100	100	100	100		100	100	99	90-100
1/2" (12.5 mm)	36	92	100	100	100		96	100	89	
3/8" (9.5 mm)	20	56	98	100	100		91	100	80	
#4 (4.75 mm)	4	6	75	91	100		74	100	62	
#8 (2.36 mm)	3	4	49	62	95		61	100	49	23-49
#16 (1.18 mm)	2	2	34	38	74		47	100	36	
#30 (600 µm)	2	2	27	24	45		35	100	25	
#50 (300 µm)	2	2	21	14	18		24	100	16	
#100 (150 µm)	2	2	15	8	3		15	100	9	
#200 (75 µm)	1.3	1.3	10.2	4.8	1.1		9.0	98.0	6.2	2.0-8.0
Bulk Specific Gravity	2.740	2.738	2.724	2.562	2.604		2.666	2.380	2.672	
App. Specific Gravity	2.784	2.788	2.785	2.630	2.660		2.708	2.380	2.724	
Absorption (%)	0.6	0.7	0.8	1.0	0.8					
LA Abrasion (%)	20	22								
Plasticity Index			NP	NP	NP					
Percent Asphalt in Recycled Material							4.62			



Martin Marietta

HOT MIX ASPHALT MIX DESIGN PHYSICAL PROPERTIES

Client:	Metro Asphalt		
Mix Grading:	3/4" NMAS (S)		
Aggregate Source:	Spec Agg/Riverbend/Platte/RAP		
Asphalt Cement Source:	Suncor		
Asphalt Cement Grade:	PG 64-22	*Asphalt Cement Specific Gravity:*	1.037
Additive Type:	Lime		
Compaction Method:	Superpave 75 Gyrations		
Lab Temperature Mixing (°F) =	325	*Lab Compaction (°F) =*	300

Asphalt Content (%AC):	4.2	4.7	5.2	5.7
Bulk Specific Gravity (Gmb):	2.389	2.412	2.428	2.437
Max. Specific Gravity (Gmm):	2.534	2.515	2.497	2.478
Theoretical Max Unit Wt. (pcf):	158.1	156.9	155.8	154.6
Air Voids @ N-Design (%Va):	5.7	4.1	2.8	1.6
Specimen Heights (mm)	65.3	64.6	63.7	62.9
Voids in Mineral Aggregate (%VMA):	14.4	14.0	13.9	14.0
Voids Filled with Asphalt (%VFA):	60.0	70.7	80.1	88.3
Dust to Asphalt Ratio (D/A):	1.4	1.2	1.1	1.0
Hveem Stability:	39	40	41	38

	Properties at Optimum	*Specifications*
Asphalt Content (%AC):	4.90	
Bulk Specific Gravity (Gmb):	2.419	
Max. Specific Gravity (Gmm):	2.508	
Aggregate Effective Specific Gravity (Gse):	2.706	
Theoretical Max Unit Wt. (pcf):	156.5	
Air Voids @ N-Design (%Va):	3.5	*3.5 to 4.5*
Voids in Mineral Aggregate (%VMA):	13.9	*13.6 min. @ 3.5 voids*
Voids Filled with Asphalt (%VFA):	74.5	*65-78*
Dust to Asphalt Ratio (D/A):	1.17	*0.6-1.2*
Hveem Stability:	41	*28 min.*

Effect of Moisture on Hot Mix Asphalt

Method:	*CDOT (CP-L 5109)*	
Asphalt Content (%):	4.90	
Additive Type:	*Lime*	
Air Voids (%):	6.8	*6.0 to 8.0*
Saturation (%):	91.5	
Indirect Tensile Strength (Wet) (psi):	105	
Indirect Tensile Strength (Dry) (psi):	108	*30 min.*
Tensile Strength Ratio (%):	97	*80 min.*

Optimum properties are based on a best fit curve of all data points.

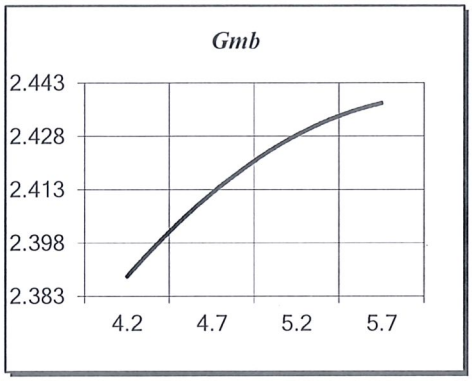
HMA Design #2243

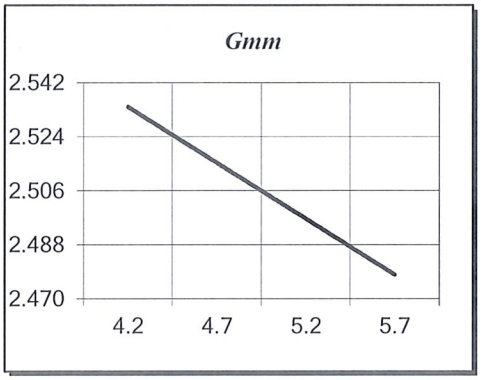
Martin Marietta

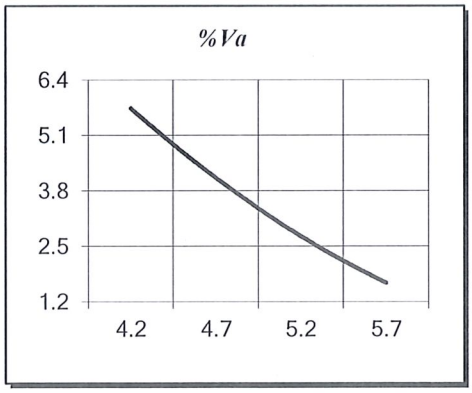
MIX PROPERTY CURVES

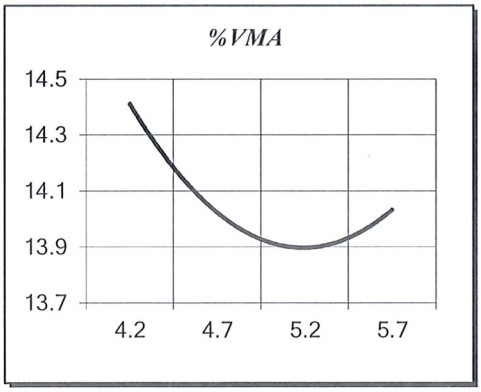
Client: Metro Asphalt
Grading: 3/4" NMAS (S)
Agg Source: Spec Agg/Riverbend/Platte/RAP

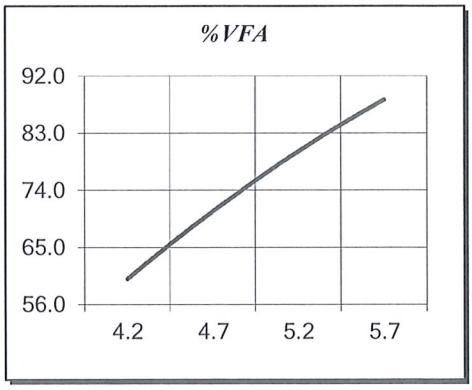
Asphalt Content (%AC):	4.90
Bulk Specific Gravity (Gmb):	2.419
Max. Specific Gravity (Gmm):	2.508
Theoretical Max Unit Wt. (pcf):	156.5
Air Voids @ N-Design (%Va):	3.5
Voids in Mineral Aggregate (%VMA):	13.9
Voids Filled with Asphalt (%VFA):	74.5
Hveem Stability:	41

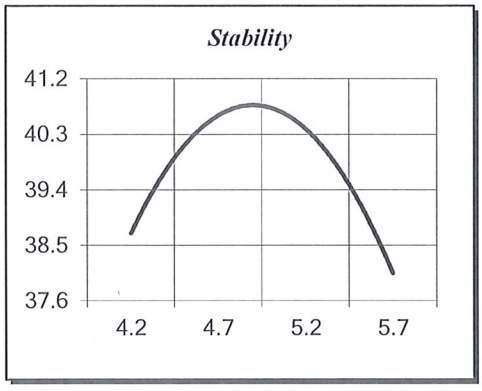












Mix Design # 2243

Martin Marietta

AGGREGATE PHYSICAL PROPERTIES
(does not include Lime or RAP)

Client: Metro Asphalt
Aggregate Source: Spec Agg/Riverbend/Platte/RAP
Grading: 3/4" NMAS (S)

		Combined Blend	Specifications
Bulk Specific Gravity (Agg):		2.679	
Apparent Specific Gravity (Agg):		2.735	
Bulk Specific Gravity Plus #4 (Agg):	AASHTO (T 85)	2.731	
Bulk Specific Gravity Minus #4 (Agg):	CDOT (CP-L 4102)	2.643	
Combined Blend Absorption (Agg):		0.76	
L.A. Abrasion Plus #4 Material (%):	AASHTO (T 96)	21	**45 max.**
Sodium Sulfate Soundness (%):	ASTM (C 88)	4.4	**12 max.**
Fractured Faces (2 or more) (%):	CDOT (CP 45)	98	**80 min.**
Fine Aggregate Angularity, Method A:	CDOT (CP-L 5113)	45	**45 min.**
Plasticity Index:	AASHTO (T 90)	NP	**Non-plastic**
Sand Equivalent:	ASTM (D 2419)	73	**45 min.**
Flat and Elongated Particles (%):	CDOT (CP 33)	1.2	**10 max.**
Adherent Fines (%):	ASTM (D 5711)	0.24	
Micro-Deval (%):	CDOT (CP-L 4211)	10.8	**18% max.**

Mix Design # 2243

Martin Marietta

3/31/2021

Martin Marietta
1627 Cole Blvd, Suite 200
Lakewood, CO 80401

Attn: Mr. Pat Hartshorn

Re: Hot Mix Asphalt Mix Design

Grading:	1/2" NMAS (SX)
Method/Type:	Superpave 75 Gyrations
Aggregate:	Spec Agg/Riverbend/Platte/RAP
Plant Number(s):	Spec Agg/Gordon/Monaghan (16318, 16321, 16431)
Mix Design Number:	1243
Product Number:	5462
Ticket Description:	(1/2)SP75(64-22)20%

This letter represents the results of a hot mix asphalt mixture design by the Superpave Method utilizing 75 Gyrations at 1.25° in accordance with Colorado Department of Transportation Manual of Test Procedures and as outlined by Asphalt Institute Manual, Asphalt Mix Design Methods (MS-2), 7th Edition.

The Spec Agg/Riverbend/Platte/RAP aggregates and Suncor PG 64-22 asphalt cement used in this mix design were proportioned in accordance with your request as detailed in the blend table of this design.

Properties of this mixture are:

Asphalt Content (%AC):	5.40	
Max. Theoretical Specific Gravity (Gmm):	2.490	(155.4 pcf)
Air Voids (%Va):	3.6	
Voids in Mineral Aggregate (%VMA):	14.8	
Voids Filled with Asphalt (%VFA):	75.6	
Tensile Strength Ratio, TSR (%):	98	
Hveem Stability:	40	

The aggregate blend sheet, mix design physical properties, mix design property curves, and combined aggregate properties are presented on the enclosed forms. All results contained herein as well as any supporting documentation submitted for aggregate and RAP components of this design are all obtained under the responsible charge of the Professional Engineer whose stamp is on this page. All materials used for this lab trial were obtained at the start of the design testing process. The process was completed upon final review by the Professional Engineer on the date at the top of this page.

Please do not hesitate to contact us with any questions concerning this report.

Sincerely,
Martin Marietta - Central Laboratory
An AASHTO Accredited Lab

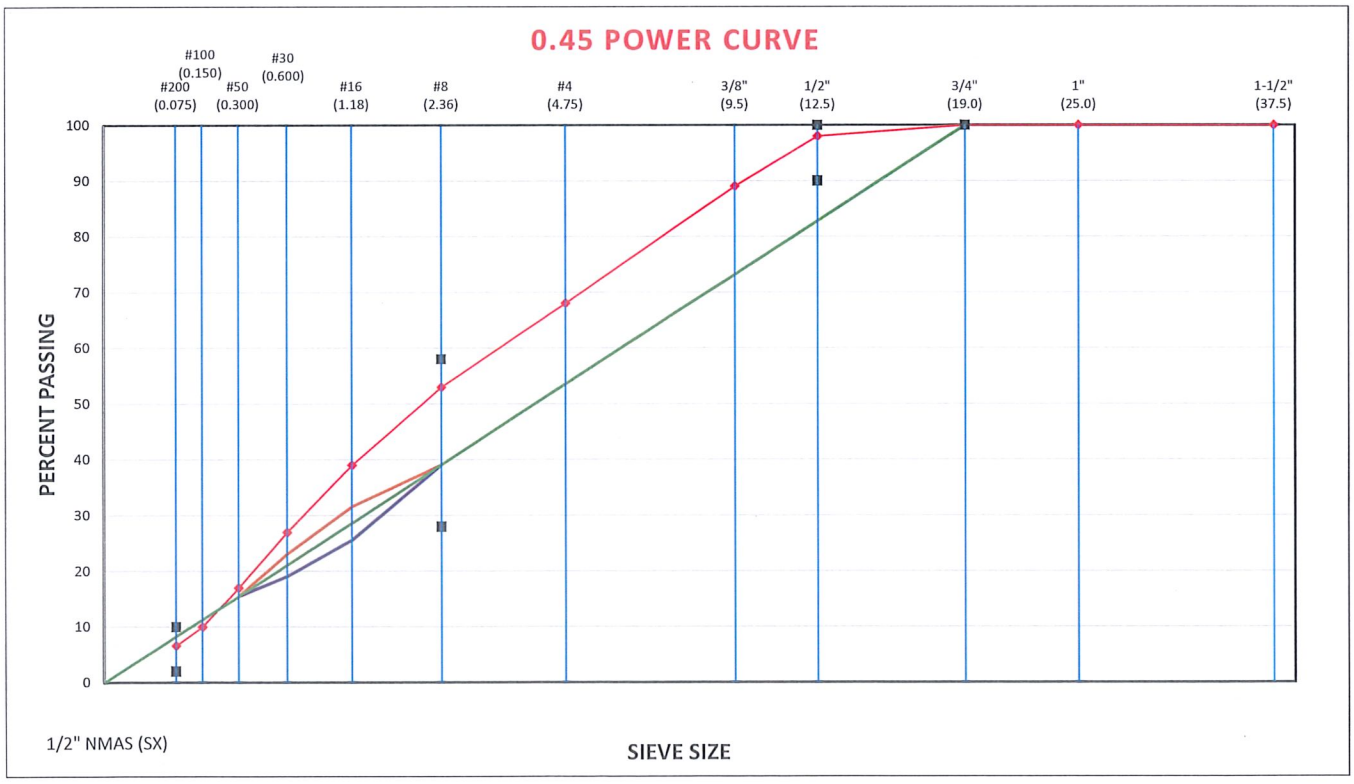
Todd M. Genovese, P.E.
Director of Technical Services
West Division
Enclosures (4)

AASHTO ACCREDITED

Martin Marietta

Date:	3/31/2021	**Client:**	Metro Asphalt
Design Number:	1243	**Binder:**	PG 64-22
Grading:	1/2" NMAS (SX)	**Binder Supplier:**	Suncor
Design Type:	Superpave 75 Gyrations	**Specific Gravity:**	1.037
Aggregate Source:	Spec Agg/Riverbend/Platte/RAP	**Antistrip Agent:**	Lime

% Material Used:	20%	26%	14%	19%			20%	1.0%	100.00%	
Material Type:	1/2" Rock	Crusher Fines	Crushed Squeegee	Washed Sand			Crushed RAP	Hydrated Lime	JMF	Control Points
Supplier:	Spec Agg	Spec Agg	Riverbend	Platte			Metro	Pete Lien		
1-1/2" (37.5 mm)	100	100	100	100			100	100	100	
1" (25.0 mm)	100	100	100	100			100	100	100	
3/4" (19.0 mm)	100	100	100	100			100	100	100	100
1/2" (12.5 mm)	92	100	100	100			96	100	98	90-100
3/8" (9.5 mm)	56	98	100	100			91	100	89	
#4 (4.75 mm)	6	75	91	100			74	100	68	
#8 (2.36 mm)	4	49	62	95			61	100	53	28-58
#16 (1.18 mm)	2	34	38	74			47	100	39	
#30 (600 µm)	2	27	24	45			35	100	27	
#50 (300 µm)	2	21	14	18			24	100	17	
#100 (150 µm)	2	15	8	3			15	100	10	
#200 (75 µm)	1.3	10.2	4.8	1.1			9.0	98.0	6.6	2.0-10.0
Bulk Specific Gravity	2.738	2.724	2.562	2.604			2.666	2.380	2.664	
App. Specific Gravity	2.788	2.785	2.630	2.660			2.708	2.380	2.719	
Absorption (%)	0.7	0.8	1.0	0.8						
LA Abrasion (%)	22									
Plasticity Index		NP	NP	NP						
Percent Asphalt in Recycled Material							4.62			



Martin Marietta

HOT MIX ASPHALT MIX DESIGN PHYSICAL PROPERTIES

Client:	Metro Asphalt		
Mix Grading:	1/2" NMAS (SX)		
Aggregate Source:	Spec Agg/Riverbend/Platte/RAP		
Asphalt Cement Source:	Suncor		
Asphalt Cement Grade:	PG 64-22	*Asphalt Cement Specific Gravity:*	1.037
Additive Type:	Lime		
Compaction Method:	Superpave 75 Gyrations		
Lab Temperature Mixing (°F) =	325	*Lab Compaction (°F) =*	300

Asphalt Content (%AC):	4.7	5.2	5.7	6.2
Bulk Specific Gravity (Gmb):	2.373	2.392	2.410	2.420
Max. Specific Gravity (Gmm):	2.516	2.497	2.479	2.461
Theoretical Max Unit Wt. (pcf):	157.0	155.8	154.7	153.6
Air Voids @ N-Design (%Va):	5.7	4.2	2.8	1.7
Specimen Heights (mm)	65.5	64.3	63.3	62.4
Voids in Mineral Aggregate (%VMA):	15.1	14.9	14.7	14.8
Voids Filled with Asphalt (%VFA):	62.4	71.7	81.0	88.7
Dust to Asphalt Ratio (D/A):	1.4	1.2	1.1	1.0
Hveem Stability:	39	40	39	37

	Properties at Optimum	*Specifications*
Asphalt Content (%AC):	5.40	
Bulk Specific Gravity (Gmb):	2.400	
Max. Specific Gravity (Gmm):	2.490	
Aggregate Effective Specific Gravity (Gse):	2.706	
Theoretical Max Unit Wt. (pcf):	155.4	
Air Voids @ N-Design (%Va):	3.6	*3.5 to 4.5*
Voids in Mineral Aggregate (%VMA):	14.8	*14.6 min. @ 3.6 voids*
Voids Filled with Asphalt (%VFA):	75.6	*65-78*
Dust to Asphalt Ratio (D/A):	1.16	*0.6-1.2*
Hveem Stability:	40	*28 min.*

Effect of Moisture on Hot Mix Asphalt

Method:	*CDOT (CP-L 5109)*	
Asphalt Content (%):	5.40	
Additive Type:	*Lime*	
Air Voids (%):	6.8	*6.0 to 8.0*
Saturation (%):	87.7	
Indirect Tensile Strength (Wet) (psi):	108	
Indirect Tensile Strength (Dry) (psi):	110	*30 min.*
Tensile Strength Ratio (%):	98	*80 min.*

Optimum properties are based on a best fit curve of all data points.

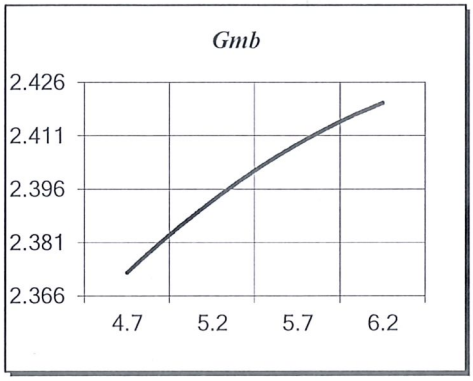
HMA Design #1243

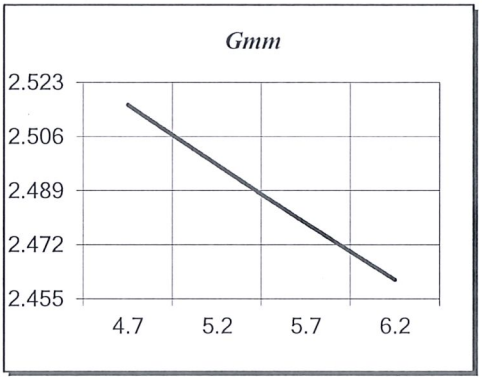
Martin Marietta

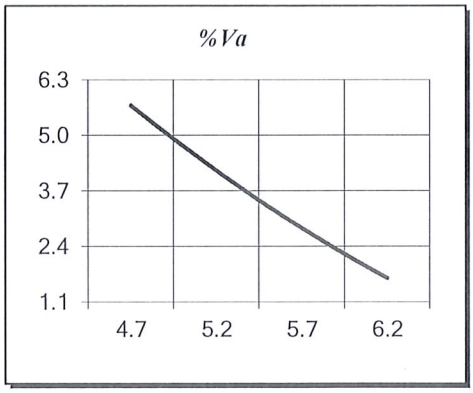
MIX PROPERTY CURVES

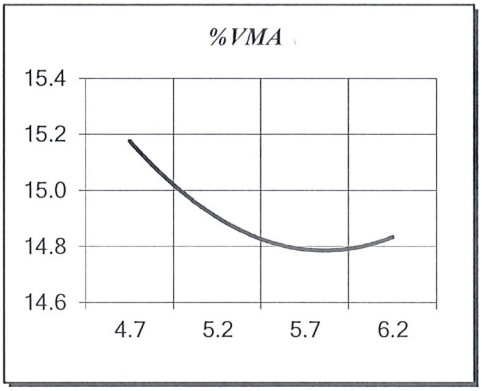
Client: Metro Asphalt
Grading: 1/2" NMAS (SX)
Agg Source: Spec Agg/Riverbend/Platte/RAP

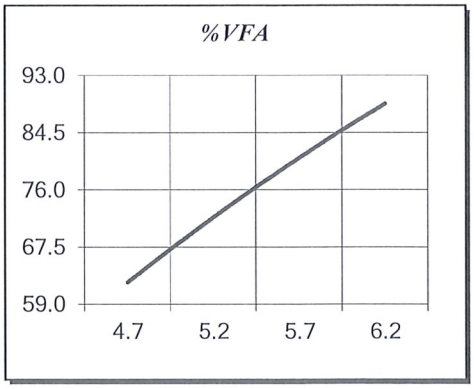
Asphalt Content (%AC):	5.40
Bulk Specific Gravity (Gmb):	2.400
Max. Specific Gravity (Gmm):	2.490
Theoretical Max Unit Wt. (pcf):	155.4
Air Voids @ N-Design (%Va):	3.6
Voids in Mineral Aggregate (%VMA):	14.8
Voids Filled with Asphalt (%VFA):	75.6
Hveem Stability:	40

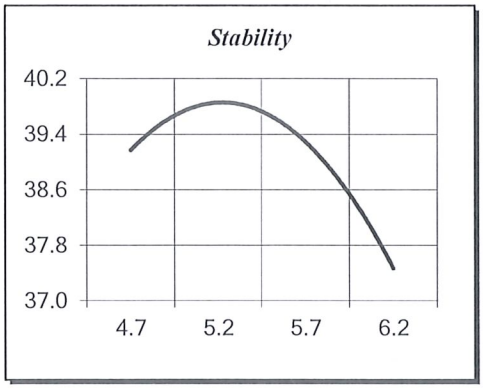












Mix Design # 1243

Martin Marietta

AGGREGATE PHYSICAL PROPERTIES
(does not include Lime or RAP)

Client: Metro Asphalt
Aggregate Source: Spec Agg/Riverbend/Platte/RAP
Grading: 1/2" NMAS (SX)

		Combined Blend	Specifications
Bulk Specific Gravity (Agg):		2.670	
Apparent Specific Gravity (Agg):		2.728	
Bulk Specific Gravity Plus #4 (Agg):	AASHTO (T 85)	2.726	
Bulk Specific Gravity Minus #4 (Agg):	CDOT (CP-L 4102)	2.641	
Combined Blend Absorption (Agg):		0.80	
L.A. Abrasion Plus #4 Material (%):	AASHTO (T 96)	22	**45 max.**
Sodium Sulfate Soundness (%):	ASTM (C 88)	4.4	**12 max.**
Fractured Faces (2 or more) (%):	CDOT (CP 45)	97	**80 min.**
Fine Aggregate Angularity, Method A:	CDOT (CP-L 5113)	45	**45 min.**
Plasticity Index:	AASHTO (T 90)	NP	**Non-plastic**
Sand Equivalent:	ASTM (D 2419)	66	**45 min.**
Flat and Elongated Particles (%):	CDOT (CP 33)	4.6	**10 max.**
Adherent Fines (%):	ASTM (D 5711)	0.28	
Micro-Deval (%):	CDOT (CP-L 4211)	10.3	**18% max.**