LUKE draily
construction company, inc.

construction managers general contractors design builders

SUBMITTAL REVIEW
Project # 417 The Residences at Echelon

Date:	November 7, 2017
Submittal Number:	32 1216 02 Asphalt Paving Type 2 Base
Sequence Number:	17
Subcontractor:	Calverts Paving Rod Calvert
Submit To:	NSPJ Architects Tim Hauschild

SUBMITTAL FOR APPROVAL

Job Name/No: 417 The Residences at Echelon

X REVIEWED ☐ REVISE & RESUBMIT

☐ REVIEWED& NOTED ☐ REJECTED

Submittal received for general compliance with the Contract Documents. Contractor's review does not relieve sub/vendor of responsibility for dimension, quantities, accuracy or completion of submittals or from any responsibilities required by terms and conditions of Subcontract/PO with Luke Draily Construction Co., Inc.. Sub/Vendors shall follow all manufacturer installation instructions. Installing contractor shall be responsible to coordinate with trades for hookup, supports, routing, etc.

By: JDW Date: 11/7/17

Engineering Solutions *Shop Drawing Review*

Project: Aldersgate Date: 11-10-17

Submittal# PVMT 1 By: MJS

X ☐ APPROVED ☐ REJECTED

☐ APPROVED AS NOTED

75 NW Business Park Lane, Riverside, MO 64150 Tel: (816) 459-8531 Fax: (816) 459-8533
www.lukedraily.com

Alternate Base Material - Asphalt Base required for vertical construction by fire marshal. Type 2 may be more resilient during the winter and spring months. Based upon cost and timing, this may be used - JDW

Hot Mix Materials, Inc.
2701 E. 85th Street
Kansas city, MO 64132

Project: Asphaltic Concrete Mix Design
APWA Type 2-01RS

Report #03532442-10-A1

Report date: July 7, 2017

Lab No: 4935 A

The mix design was performed utilizing Marshall design procedures in general accordance with methods in the Asphalt Institute Manual MS-2, AASHTO T245 and ASTM D2041. The Recycled Asphalt Concrete (RAC) is comprised of Reclaimed Asphalt Pavement (RAP), Reclaimed Asphalt Shingles (RAS) and virgin materials. The master grade limits, job mix formula tolerances and Marshall characteristic requirements comply with Kansas City Metropolitan Chapter of American Public Works Association Standard Specifications, 2001 edition. The VMA is calculated utilizing virgin aggregate bulk, dry specific gravities and RAP and RAS aggregate effective specific gravity. The maximum theoretical specific gravity and Marshall specimens were cured 2 hours at compaction temperature prior to testing. Percent binder is reported on a total mix basis except where noted.

It may be necessary to adjust plant settings from designed values due to differences in plant and laboratory produced mixtures or variations in component materials.

Reviewed by
Professional Service Industries, Inc.

Eileen Peterson
Project Manager

Kelly E Rotert, PE, DBIA
Vice President

cc: Mr. Allen Conway

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SUMMARY OF MIX DATA

MIX COMPOSITION

Component	% Agg	% Total Mix	% Dry Mix
#754 3/4"	41.8	39.7	41.0
#932 3/8" CHIPS	11.2	10.6	11.0
#981 DUST	15.3	14.5	15.0
SAND	13.3	12.6	13.1
RAP	15.4	15.5	16.0
RAS	3.0	3.8	4.0
PG 64-22		3.2 added	3.3 added

MIX SPECIFIC GRAVITY DATA

Component	Specific Gravity
binder	1.032
calculated bulk of composite mix aggregates	2.583
calculated apparent of composite mix aggregates	2.682
calculated effective of mix aggregates	2.651
calculated maximum theoretical at recommended percent binder	2.458

GRAIN SIZE ANALYSIS - (percent passing)

Sieve Size	1 1/2	1	3/4	1/2	3/8	No 4	No 8	No 16	No 30	No 50	No 100	No 200
Opening, mm	37.5	25.0	19.0	12.5	9.5	4.75	2.36	1.18	0.600	0.300	0.150	0.075
TRIAL MIX SINGLE POINT		100	100	86	70	51	38	30	23	13	8	6.2
MASTER GRADE LIMITS		100-	80-100	-	60-80	48-65	35-47	25-36	18-30	12-22	6-14	3-10
JOB-MIX FORMULA TOLERANCE		100-	96-100	82-90	66-74	48-55	35-41	27-33	20-26	10-16	6-14	5.2-7.2
TOLERANCE (+/-)		0	4	4	4	4	3	3	3	3		1
Difference between sieves (25% maximum)				14	16	19	13	8	7	9	6	

MARSHALL CHARACTERISTICS SUMMARY

50 Compaction blows per face
Cure parameters: 2 hrs @ compaction temperature
(laboratory only)
mixing temperature oF 300-310
compaction temperature oF 280-290

	Trial Mix Data	Specification
Stability, lbs	4420	1500 minimum
Flow, 1/100 inch	11	8-16
% Voids total mix	3.2	3-5 design only
% Voids in mineral aggregate (VMA)	12.5	no specification
% Voids filled with asphalt (VFA)	74.1	--
Density, pcf / Gmb	148.0 / 2.378	--
minus 200/effective binder ratio	1.3	--
% Binder, total mix basis	5.00	aggregate basis 5.3

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COMPONENT MATERIAL IDENTIFICATION

#754 3/4"	Crushed limestone aggregate delivered to the laboratory March, 2017. Source identified as Martin Marietta Greenwood Quarry Gsb = 2.59, % Absorption = 1.7
#932 3/8" CHIPS	Crushed limestone aggregate delivered to the laboratory March, 2017. Source identified as Martin Marietta Greenwood Quarry Gsb = 2.56, % Absorption = 2.1
#981 DUST	Crushed limestone aggregate delivered to the laboratory March, 2017. Source identified as Martin Marietta Greenwood Quarry Gsb = 2.53, % Absorption = 2.7
SAND	Natural sand aggregate delivered to the laboratory March, 2017. Source identified as Holliday Sand & Gravel. Gsb = 2.60, % Absorption = 0.6
RAP	Reclaimed asphalt product delivered to the laboratory March, 2017. Gse = 2.66, % binder = 5.3
RAS	Reclaimed asphalt product delivered to the laboratory March, 2017. Gse = 2.33, % binder = 25.6
PG 64-22	Asphalt cement binder delivered to the laboratory March, 2017. See certificate of analysis.

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GRAIN SIZE ANALYSIS

	Sieve Size		1 1/2	1	3/4	1/2	3/8	No 4	No 8	No 16	No 30	No 50	No 100	No 200
	Opening, mm			25.0	19.0	12.5	9.5	4.75	2.36	1.18	0.600	0.300	0.150	0.075
MIX COMPONENT	ORIGINAL GRADATIONS (percent passing)													
#754 3/4"				100	100	66	29	3	2	2	2	1	1	1.4
#932 3/8" CHIPS				100	100	100	100	51	7	3	3	3	2	2.4
#981 DUST				100	100	100	100	100	83	56	40	30	23	19.5
SAND				100	100	100	100	99	93	82	60	20	1	0.6
RAP				100	100	99	96	81	56	44	35	23	12	7.9
RAS				100	100	100	100	100	99	82	62	55	46	34.6
MIX COMPONENT	% in Trial	% in Mix		% in trial										
#754 3/4"	41.8	41.8		42	42	28	12	1	1	1	1	0	0	0.6
#932 3/8" CHIPS	11.2	11.2		11	11	11	11	6	1	0	0	0	0	0.3
#981 DUST	15.3	15.3		15	15	15	15	15	13	9	6	5	4	3.0
SAND	13.3	13.3		13	13	13	13	13	12	11	8	3	0	0.1
RAP	15.4	15.4		15	15	15	15	12	9	7	5	4	2	1.2
RAS	3.0	3.0		3	3	3	3	3	3	2	2	2	1	1.0
TRIAL MIX SINGLE POINT	100.0	100.0		100	100	86	70	51	38	30	23	13	8	6.2
MASTER GRADE LIMITS				100-	80-100	-	60-80	48-65	35-47	25-36	18-30	12-22	6-14	3-10
JOB-MIX FORMULA				100-	96-100	82-90	66-74	48-55	35-41	27-33	20-26	10-16	6-14	5.2-7.2
TOLERANCE (+/-)				0	4	4	4	4	3	3	3	3		1
VIRGIN SINGLE POINT				100	100	83	64	43	33	25	19	10	5	4.8
VIRGIN SINGLE POINT JOB-MIX BAND				100-100	96-100	79-87	60-68	39-47	30-36	22-28	16-22	7-13		3.8-5.8

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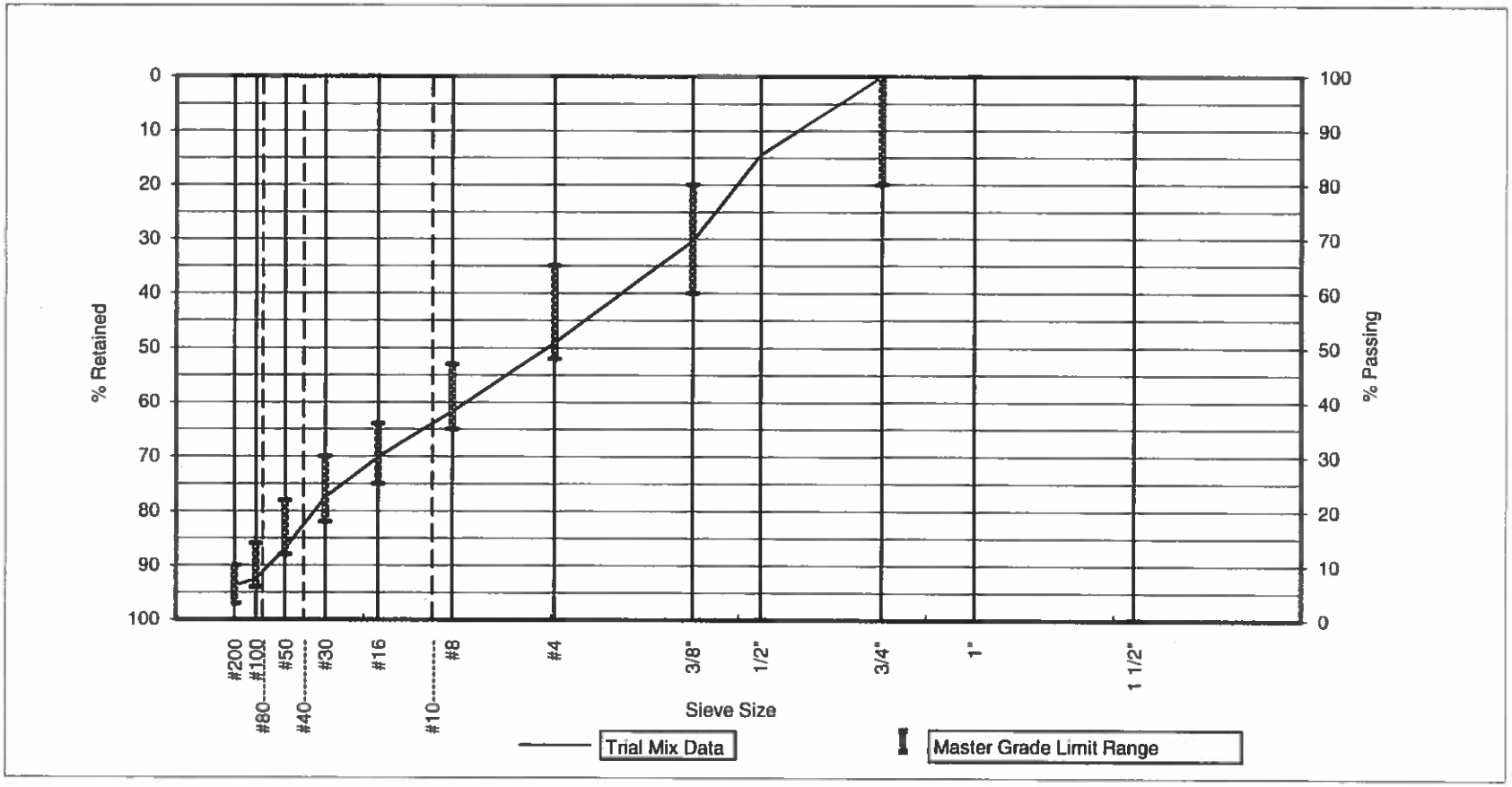
0.45 POWER GRAPH of GRAIN SIZE ANALYSIS



Phillips 66

12/2/2016 8:36

Certificate of Analysis

Petroleum Fuel & Terminal Granite City, IL

Ship Date:		Customer:	
Product Name:	PG64-22	Destination:	
Product Code:		Transport ID:	
Lablynx Log ID		Trip Number:	
Report Date:	11/29/2016	PINS NO:	
Date Sampled:	11/28/2016	Carrier:	
Centerpoint Terminal Sample ID	2016849	Rail Car Number:	
Tank :	80-6		

Method	Determinate	Results	Units
T228 Sp. Gravity. @ 15.6 °C	Specific Gravity	1.032	
API @ 15.6 °C	API	5.612	
T48 COC Flash, °C	Flash Point	310	°C
T202 Vacuum Visc. @ 60.0 °C	Absolute Viscosity	NA	Pa-s
T316 Viscosity @ 135 °C	Rotational Viscosity	0.370	Pa-s
T49 Penetration	Penetration	NA	dmm
T53 Softening Point	Softening Point	NA	°C
T315-DSR @ 64° C	G*	1.13	kPa
T315-Phase Angle @	Phase Angle @ Orig	87.7	Degrees
T315-DSR @ 64° C	G*/sin D	1.13	kPa
T240 RTFO	Mass Loss	-0.188	Wt %
T315-RTFO DSR @ 64° C	G*	3.19	kPa
T315-Phase angle on RTFO	Phase Angle on RTFO	83.8	Degrees
T315-RTFO DSR @ 64° C	G*/sin D RTFO	3.21	kPa
		100°C	
T315-PAV DSR @ 25.0° C	G*	5357	
T315-Phase angle on PAV	Phase Angle on PAV	44.8	Degrees
T315-PAV DSR @ 25.0° C	G*/sin D PAV	3774	kPa
T313-BBR Stiffness @ -12.0° C	S	166	MPa
T313-BBR m-Value @ -12.0° C	m-Value	0.313	
T301 -Elastic Recovery	ER on RTFO	NA	Percent
T350 - MSCR @ 64 °C	Jnr @ 0.1kPa	2.709	1/kPa
T350 - MSCR @ 64 °C	Jnr @ 3.2kPa	3.027	1/kPa
T350 - MSCR @ 64 °C	Jnr % Diff	11.7	%
T350 - MSCR @ 64 °C	Ave Recovery @0.1kPa	6.62	%

Material was found to meet AASHTO M320 Table 1 unless otherwise noted.
Material analyzed by AMRL certified Center Point Terminal Company in Granite City, IL.
T202 performed by Phillips 66

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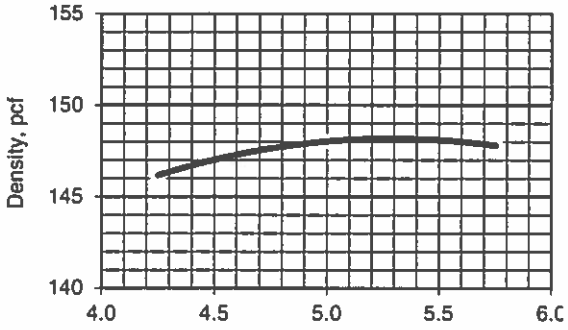

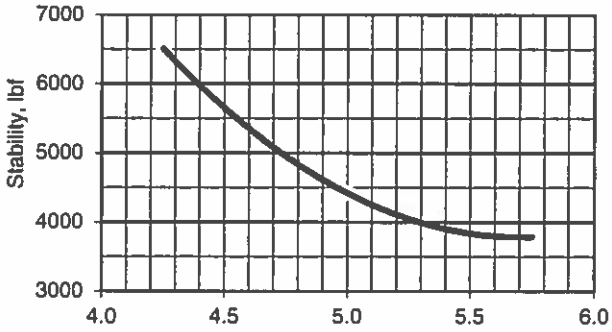

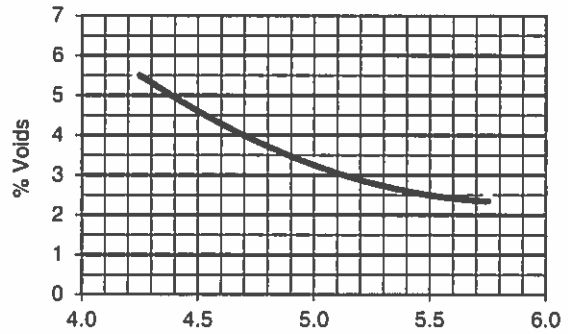

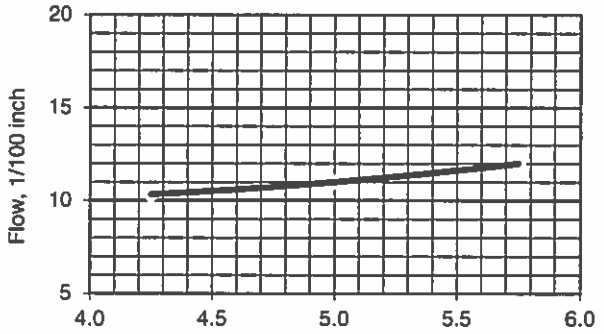

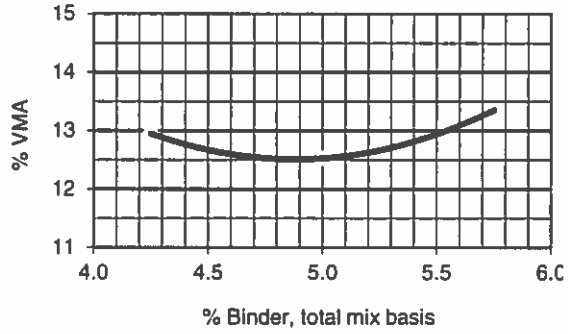

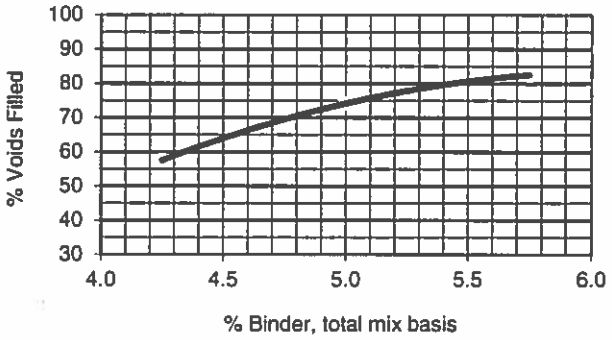

Summary Trial Mix Data

% Binder	4.25	5.00	5.75		
Effective % binder	3.27	4.03	4.79		
Bulk specific gravity	2.348	2.378	2.375		
Maximum theoretical specific gravity	2.485	2.458	2.432		
Density, pcf	146.2	148.0	147.8		
% Voids	5.5	3.2	2.3		
% Voids in mineral aggregate (VMA)	12.9	12.5	13.4		
% Voids filled with asphalt (VFA)	57.5	74.1	82.5		
Stability, lbf	6510	4420	3790		
Flow, 1/100 inch	10	11	12		
Dust/Binder ratio	1.9	1.5	1.3		

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MARSHALL CHARACTERISTIC DATA

	% Binder	Trial 1	Trial 2	Trial 3	Average	% Binder	Trial 1	Trial 2	Trial 3	Average
Weight in air, g	4.25	1223.1	1223.3	1220.5		5.00	1231.5	1226.1	1226.6	
SSD weight in air, g		1229.2	1230.3	1225.6			1233.8	1229.3	1228.2	
Weight in water, g		708.7	708.0	706.9			715.8	712.3	714.1	
Volume, cc		520.5	522.3	518.7			518.0	517.0	514.1	
Bulk specific gravity		2.350	2.342	2.353	2.348		2.377	2.372	2.386	2.378
Theoretical specific gravity		2.485	2.485	2.485			2.458	2.458	2.458	
Density, pcf		146.3	145.8	146.5	146.2		148.0	147.6	148.5	148.0
% Voids		5.4	5.8	5.3	5.5		3.3	3.5	2.9	3.2
% VMA		12.9	13.2	12.8	12.9		12.6	12.8	12.2	12.5
% VEA		7.4	7.4	7.5			9.3	9.3	9.3	
% Voids filled with asphalt		57.8	56.3	58.4	57.5		73.9	72.5	76.0	74.1
Stability dial reading		1327	1223	1192			862	799	878	
Corrected Stability, lbf		6924	6382	6220	6510		4498	4169	4581	4420
Thickness, inch		2 1/2	2 1/2	2 1/2			2 1/2	2 1/2	2 1/2	
Flow, 1/100 inch		10	11	10	10		11	11	11	11
Weight in air, g	5.75	1228.1	1227.8	1228.2						
SSD weight in air, g		1230.3	1230.1	1230.1						
Weight in water, g		711.6	712.5	714.9						
Volume, cc		518.7	517.6	515.2						
Bulk specific gravity		2.368	2.372	2.384	2.375					
Theoretical specific gravity		2.432	2.432	2.432						
Density, pcf		147.4	147.6	148.4	147.8					
% Voids		2.6	2.4	2.0	2.3					
% VMA		13.6	13.4	13.0	13.4					
% VEA		11.0	11.0	11.1						
% Voids filled with asphalt		80.7	81.8	85.0	82.5					
Stability dial reading		453	382	374						
Corrected Stability, lbf		4256	3589	3513	3790					
Thickness, inch		2 1/2	2 1/2	2 1/2						
Flow, 1/100 inch		12	12	12	12					