

February 22, 2021



**EARTH ENGINEERING
CONSULTANTS, LLC**

Connell Resources, Inc.
7785 Highland Meadows Parkway, Suite 100
Fort Collins, Colorado 80528

Attn: Mr. Ed Wells (ewells@connellresources.com)

Re: Connell Resources, Inc. - 2021 Asphalt Mix Designs
Mix #22050, Grading S 75 (Jebro 58-28) with Lime
EEC Project No. 1215002A-7

Mr. Wells:

Earth Engineering Consultants, LLC (EEC) personnel have completed the requested laboratory Superpave mix design for the referenced asphaltic concrete mix. The mix design was carried out in general accordance with Colorado Department of Transportation, Asphalt Institute, and/or Larimer County Urban Area Street Standards mix design procedures. The mix design was performed using a Superpave Gyratory Compactor with a compaction angle of 1.25 degrees and 100-mm molds. In addition, specified tests were completed on the component aggregate. Results of the testing completed for this mix and recommendations for the job mix formula are included on the attached mix design summary sheets.

The asphaltic concrete job mix formula provided with this report is based on testing completed with specific materials, gradations, and design procedures. Variation in laboratory test results can occur due to multi-laboratory precision, variation in materials and slight changes in design procedures. These factors should be considered when job mix verification of laboratory mixes is performed. The physical properties of the mix should be retested and re-evaluated for hot plant produced material. It is often necessary to make adjustments to the job mix formula to account for the changed environment between the laboratory and field produced material. Should the source or physical characteristics of the materials change substantially, the development of a new or revised job mix formula is recommended.

We appreciate the opportunity to be of service to you. If you have any questions regarding this report, or if we can be of further service to you in any other way, please do not hesitate to contact us.

Very truly yours,
Earth Engineering Consultants, LLC



Ethan P. Wiechert, P.E.
Senior Project Engineer

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EARTH ENGINEERING CONSULTANTS, LLC
ASPHALTIC MIX DESIGN
 Connell Resources, Inc. - Mix No. 22050
 Superpave Mix Design: Grading S 75 (Jebro PG 58-28) with Lime

TABLE I - AGGREGATE GRADATIONS

Sieve Size	Connell Carr 3/4"	Connell Carr Crusher Fines	Connell Carr W. Crusher Fines	Burnco Windsor Washed Sand	Connell Timnath RAP AC=4.93%			Pete Lien Lime	Composite	Job Mix Tolerance	Target Master Range
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)	100	100	100	100	100			100	100	90 - 100	90 - 100
1/2" (12.5 mm)	64	100	100	100	93			100	89	83 - 95	
3/8" (9.5 mm)	32	100	100	100	88			100	80	74 - 86	
No. 4 (4.75 mm)	4	78	78	100	67			100	60	55 - 65	
No. 8 (2.36 mm)	2	55	50	94	53			100	46	41 - 51	23 - 49
No. 16 (1.18 mm)	2	38	32	72	41			100	34		
No. 30 (600 µm)	2	28	19	45	31			100	24	20 - 28	
No. 50 (300 µm)	2	19	10	20	21			100	15		
No. 100 (150 µm)	1	13	5	7	13			98	9		
No. 200 (75 µm)	1.2	9.2	2.8	2.5	7.4			97.0	5.9	3.9 - 7.9	2 - 8
Used	26%	27%	12%	14%	20%			1%	100%		
Combined Dry Sp. Gr.	2.644	2.637	2.629	2.609	2.669			2.380	2.637		
Combined Apparent Sp. Gr.	2.698	2.689	2.681	2.678	2.712			2.380	2.690		
Combined Water Absorption (%)	0.7	0.7	0.8	1.0					0.6		
Coarse Dry Sp. Gr.	2.644	2.635	2.622		2.669				2.645		
Coarse Apparent Sp. Gr.	2.698	2.685	2.669		2.712				2.696		
Coarse Water Absorption (%)	0.7	0.7	0.7						0.6		
Fine Dry Sp. Gr.	2.644	2.637	2.631	2.609	2.669			2.380	2.632		
Fine Apparent Sp. Gr.	2.698	2.690	2.685	2.678	2.712			2.380	2.686		
Fine Water Absorption (%)	0.7	0.7	0.8	1.0					0.6		
Effective Mix Sp. Gr.									2.667		
LA Abrasion (%)	19								19	45 Max.	
Liquid Limit		NL	NL	NL					NL		
Plasticity Index		NP	NP	NP					NP	NP	

Note: The RAP specific gravity was back-calculated using an assumed aggregate asphalt absorption.

TABLE II - PHYSICAL PROPERTIES OF AGGREGATE

Test Description and Designation	Composite Results		Mix Design Target
Micro-Deval (CP-L 4211) (%)	5.3		18 Max.
Fractured Face Count (Two Faces) (CP 45) (%)	100		90 Min.
Fine Aggregate Angularity (AASHTO T 304)	45.0		45.0 Min.
Flat And Elongated Particles (5:1) (ASTM D 4791) (%)	None		10 Max.
Sand Equivalent (AASHTO T 176 / CP 37) (%)	81		45 Min.
Clay Lumps & Friable Particles (AASHTO T 112) (%)	<1		--
Adherent Coating (ASTM D 5711) (%)	0.36		--
Magnesium Sulfate Soundness (5 cycles) (AASHTO T 104) (%)	Coarse: 4	Fine: 7	--

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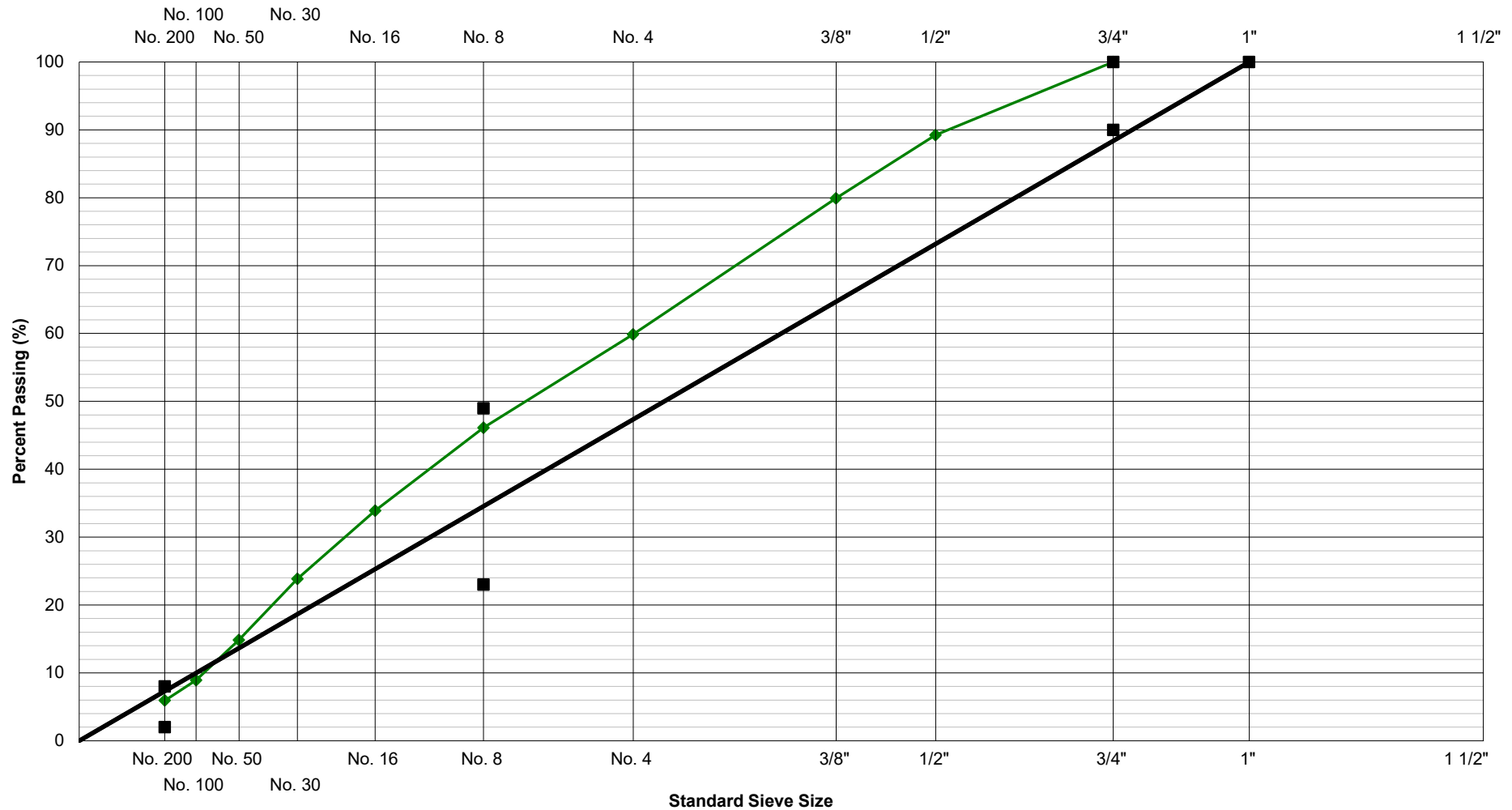
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ASPHALTIC MIX DESIGN

Connell Resources, Inc. - Mix No. 22050

Superpave Mix Design: Grading S 75 (Jebro PG 58-28) with Lime

FIGURE I: AGGREGATE GRADATION .45 POWER CURVE



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TABLE III: SHARP SUPERPAVE PROPERTIES

Asphalt Content (%)		4.3	4.8	5.3	5.8
Maximum Specific Gravity		2.498	2.480	2.462	2.444
Maximum Unit Weight (pcf)		155.9	154.8	153.6	152.5
N_{ini}	Bulk Specific Gravity	2.173	2.190	2.208	2.216
	Voids (%)	13.0	11.7	10.3	9.3
N_{des}	Bulk Specific Gravity	2.344	2.371	2.391	2.407
	Unit Weight (pcf)	146.3	147.9	149.2	150.2
	Height (mm)	65.6	64.2	63.5	62.4
	Voids (%)	6.2	4.4	2.9	1.5
	VMA (%)	14.9	14.4	14.1	14.0
	VFA (%)	59	69	80	89
	Hveem Stability	33	33	34	33
Dust to Asphalt Ratio		1.3	1.1	1.0	0.9

TABLE IV: PROPERTIES AT OPTIMUM ASPHALT CONTENT

Test		Design Properties	Mix Design Target
Asphalt Content ¹ (%)		4.9	--
Maximum Specific Gravity		2.477	--
Maximum Unit Weight (pcf)		154.5	--
N_{ini}	Bulk Specific Gravity	2.194	--
	Voids (%)	11.4	--
N_{des}	Bulk Specific Gravity	2.375	--
	Unit Weight (pcf)	148.2	--
	Height (mm)	64.1	--
	Voids (%)	4.1	3.5 - 4.5
	VMA (%)	14.4	14.1 Min.
	VFA (%)	71	65 - 80
	Hveem Stability	33	28 Min.
Dust to Asphalt Ratio		1.1	0.6 - 1.2
Mixing Temperature		310 °F	310 ±5 °F
Compaction Temperature		280 °F	280 ±5 °F

**TABLE V: RESISTANCE TO MOISTURE-INDUCED DAMAGE
 AT OPTIMUM ASPHALT CONTENT (CP-L 5109)**

Tensile Strength Retention (%)	93	80 Min.
Dry Tensile Strength (psi)	66.5	30 Min.
Conditioned Tensile Strength (psi)	61.7	--
Average Specimen Saturation (%)	82	--
Average Specimen Voids (%)	6.3	6.0 - 8.0

¹Asphalt Specific Gravity (Jebro Performance Grade PG 58-28) = 1.037

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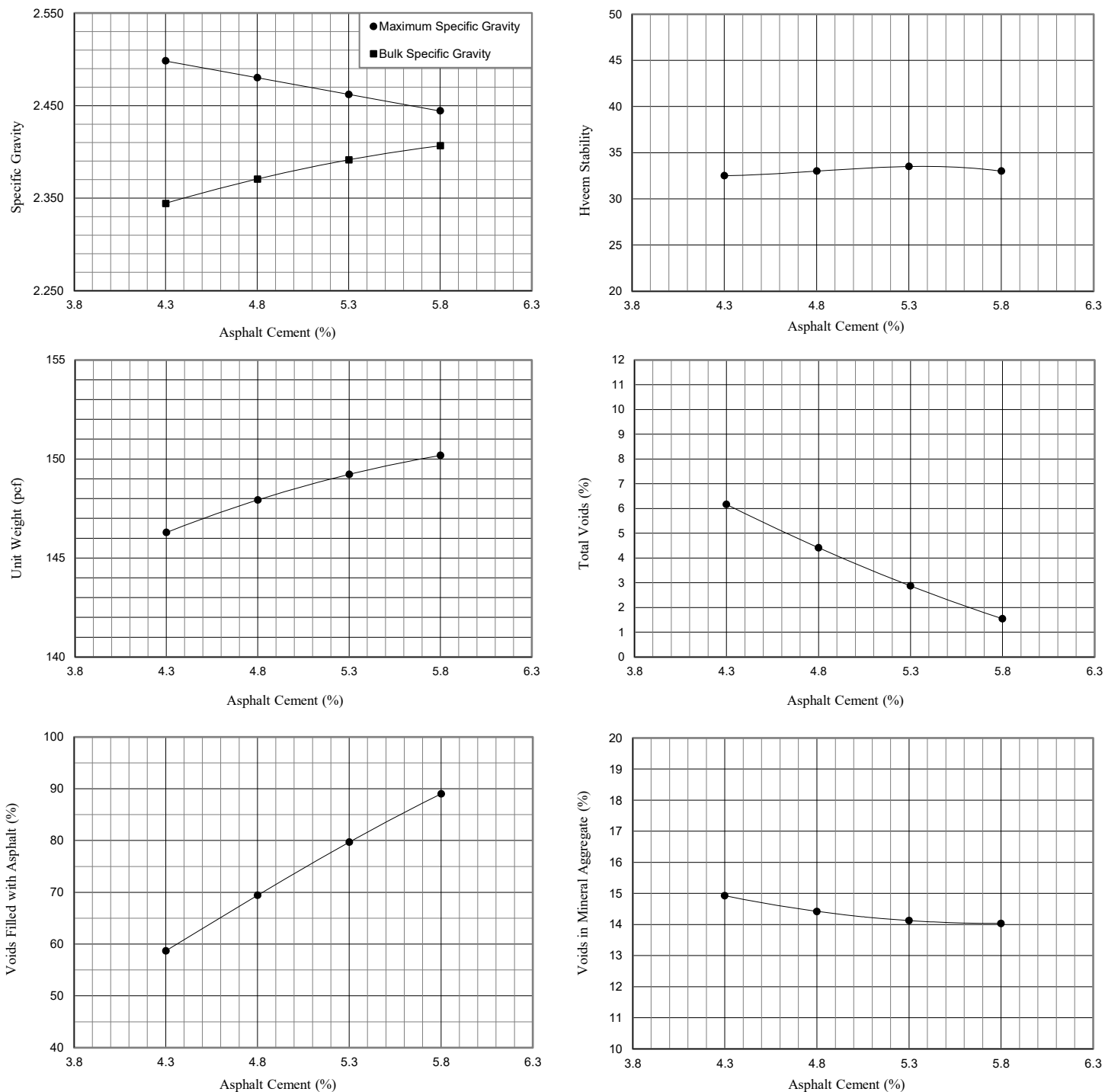
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FIGURE II: ASPHALT PROPERTIES VS. ASPHALT CONTENT



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