Highly-Modified, Low Air Void Projects in Utah and Montana

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Hey Howard, Tell us What You Think...

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Past Experience With Highly Modified and/or Thick Lifts

- South Carolina
  - Single-lift at 7.9 inched
  - Consistent densities ~95%
- NCAT
  - South Carolina & Kraton sponsored
  - Unmodified & Highly Modified
  - Great densities top to bottom
  - Great performance
    - 5.75-inch Kraton section gave perpetual performance
- Utah
  - Past laboratory work
    - Hamburg driven
    - Typical 12.5 mm mix
    - Multiple samples up to 6.8% binder
    - 40,000 passes
    - No Hamburg failures (<10 mm)
  - Two secondary highways
    - Simply substituted binder into the mix design
    - Constructed in 2017
    - Typical lift thicknesses
    - Excellent performance

The Binder Specification

Table 10

PG76-34 Highly Modified	
Original Binder	
Dynamic Shear Rheometer, AASHTO T 315 @ 76° C, G*, kPa	1.30 Min.
@ 76° C, phase angle, degrees	70.0 Max.
Rotational Viscometer, AASHTO T 316 @ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48 °C	260 Min.
RTFO Residue, AASHTO T 240	
Dynamic Shear Rheometer, AASHTO T 315 @ 76° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a) %	90 Min.
PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28	
Dynamic Shear Rheometer, AASHTO T 315 @ 25° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313 @ -24° C, S, MPa	300 Max. 150 Min.
@ -24° C, m-value	0.300 Min.
Delta Tc from additional BBR test, ASTM D7643 @ -30° C	-1.0 Min.

+/- 5% SBS

(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.

Wendover Pilot Project Overview

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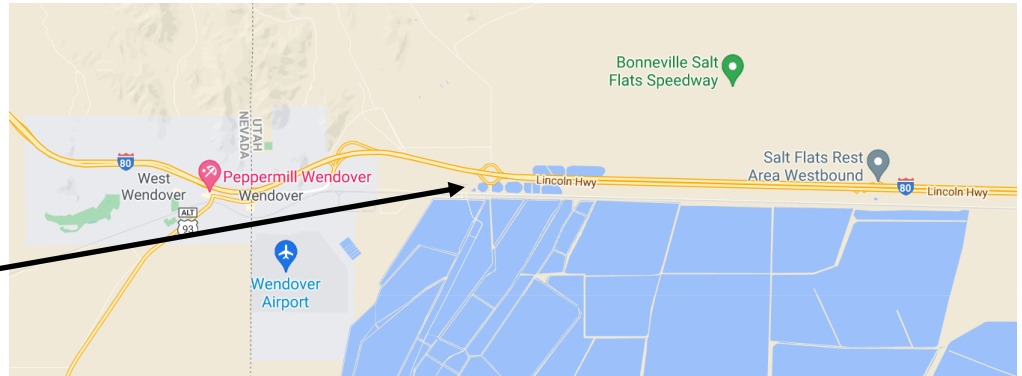
- Location Information
  - Port of Entry on I-80 Near Wendover, UT
  - High Truck Volume (51%), AADT 7,900
  - 2-2.5 Million ESALs/year
  - Very Hot in the Summer
  - LTPPBind = PG64-28 (98% reliability)
- Project Scope
  - Mill and Inlay 6.0 Inches of PCC
  - ~330 Ton Project
  - Highly Modified Binder
  - Dense-Graded Mixture
  - Construct in a Single Lift
  - ~2-Hour One-Way Haul

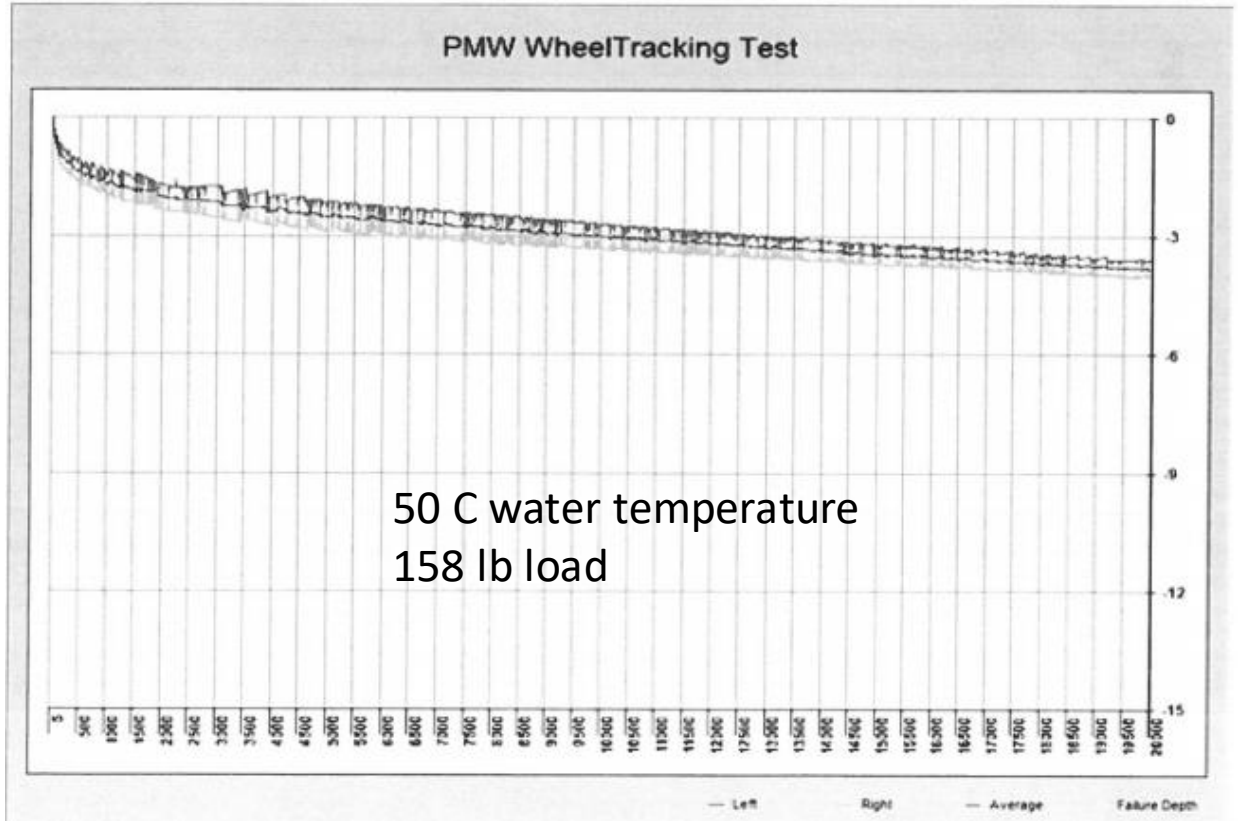
Project Location



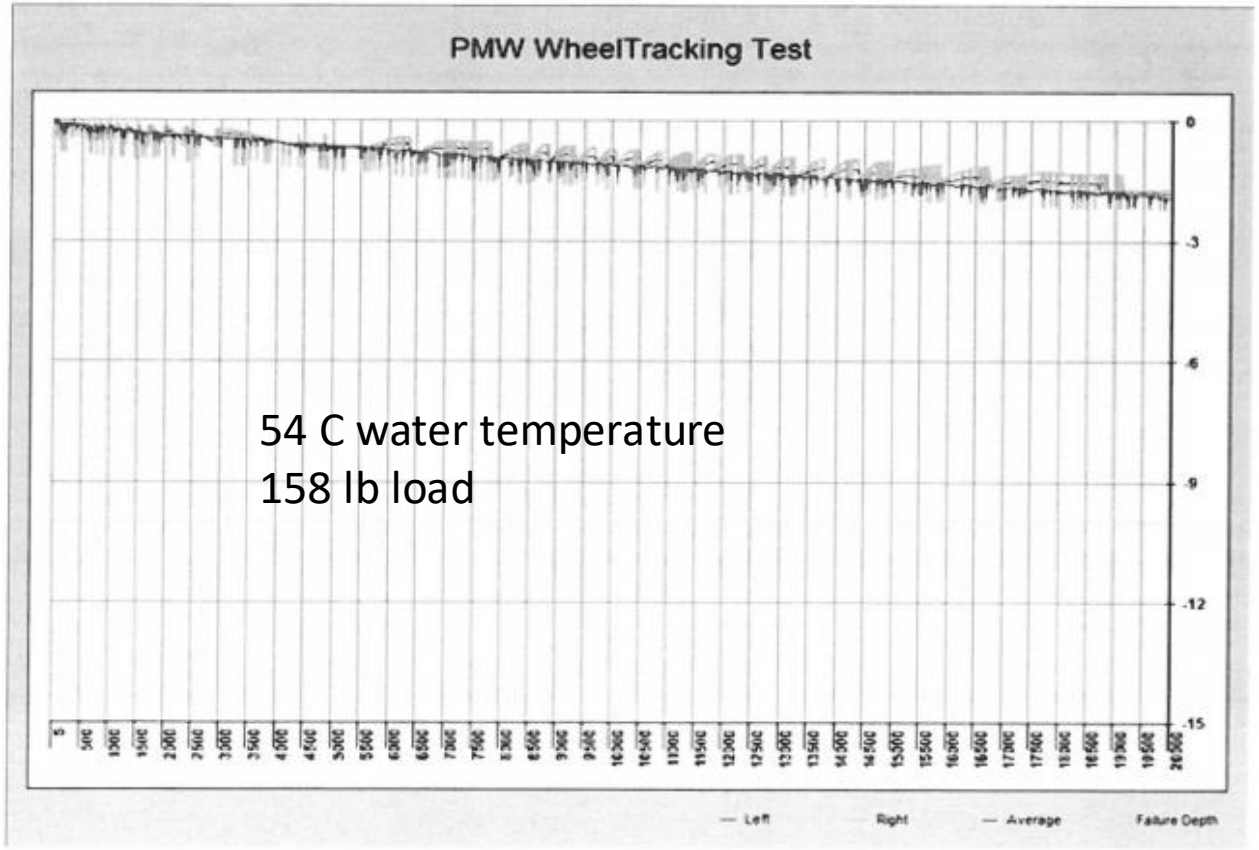
Google Maps

Property	Mix Design Requirement	Mix Design Value
Asphalt Binder	PG 76-34	PG 76-34
Gyrations	50	50
NMAS Crushed Aggregates	12.5 mm 100%	12.5 mm 100%
Asphalt Content	6.0 % minimum	6.0% (5.33% Virgin, 0.67% RAP Binder)
Air Voids	1.0	1.0% (0.1% at 75 gyrations)
Voids in Mineral Aggregate	15.0-17.0	15.3
Voids Filled with Asphalt	90.0-95-0%	93.3%
Drain Down	0.3% max	0.0%
RAP	15% max	15%
Hamburg Depth (note bath temperature increased from 50 to 54°C for second 20,000 passes) Slab Void target 4 %	7.0 mm max after 20,000 passes	3.9 mm
	10.0 mm max after 40,000 passes	6.1 mm

Hamburg Graphs

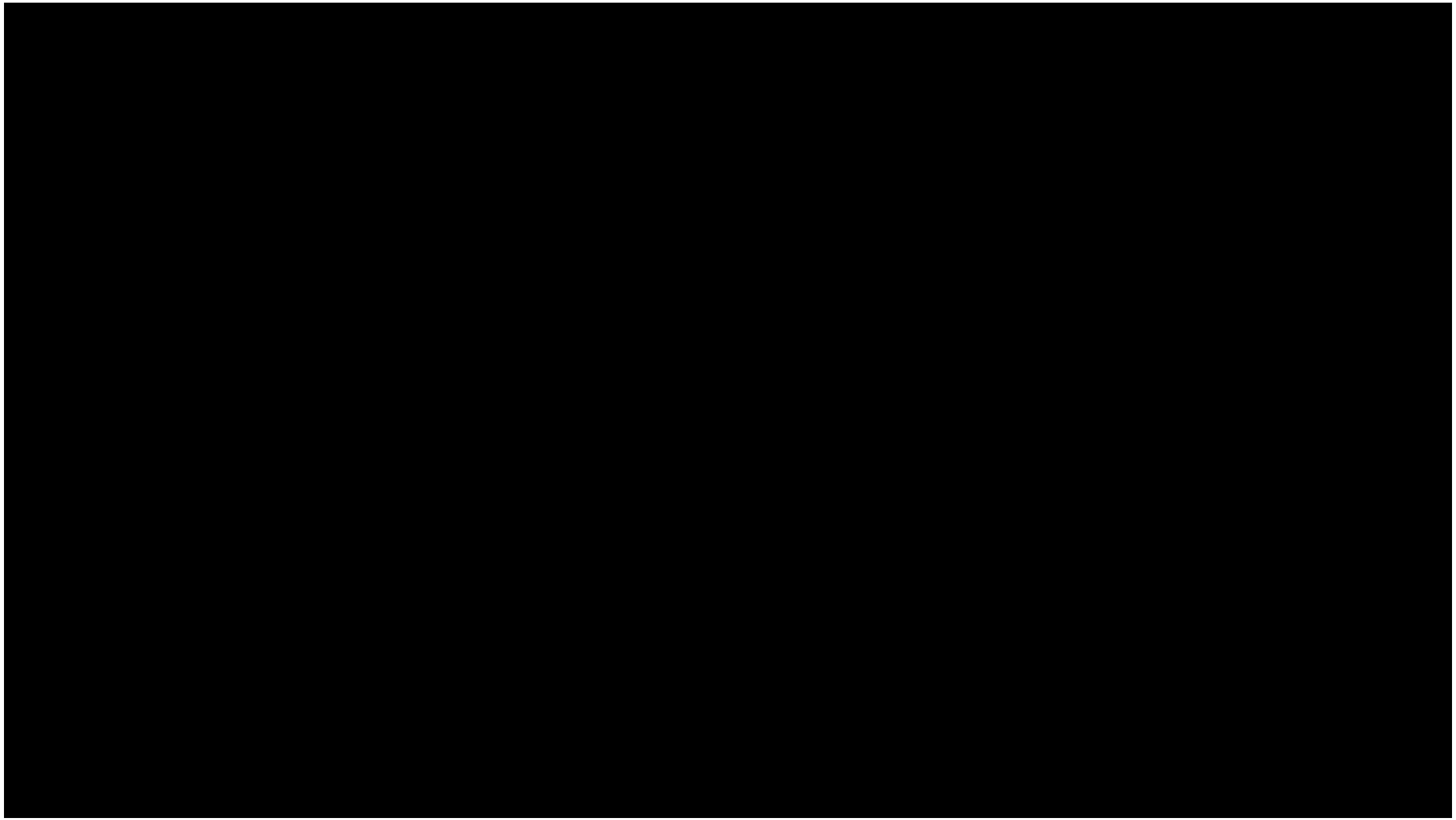


First 20,000 Passes



Second 20,000 Passes – same specimen

Hi-Mod binders minimize rutting



Test Strip Construction

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- At Staker-Parson's Beck Street Facility
- Aggregate base vs. Portland cement concrete
- Virtually no haul vs. 2+ hours

Test Strip Construction

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Staker Plant Test Strip

June 2, 2021

Test Strip Construction

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Test Strip Lessons Learned

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- Density of 97% or more was easily achieved
- Regular rolling equipment and procedures followed
- Feeding while placing such a large volume of mix was achieved, but had challenges
- Mix was stable even with roller overhang
- No significant issues encountered

Wendover Construction

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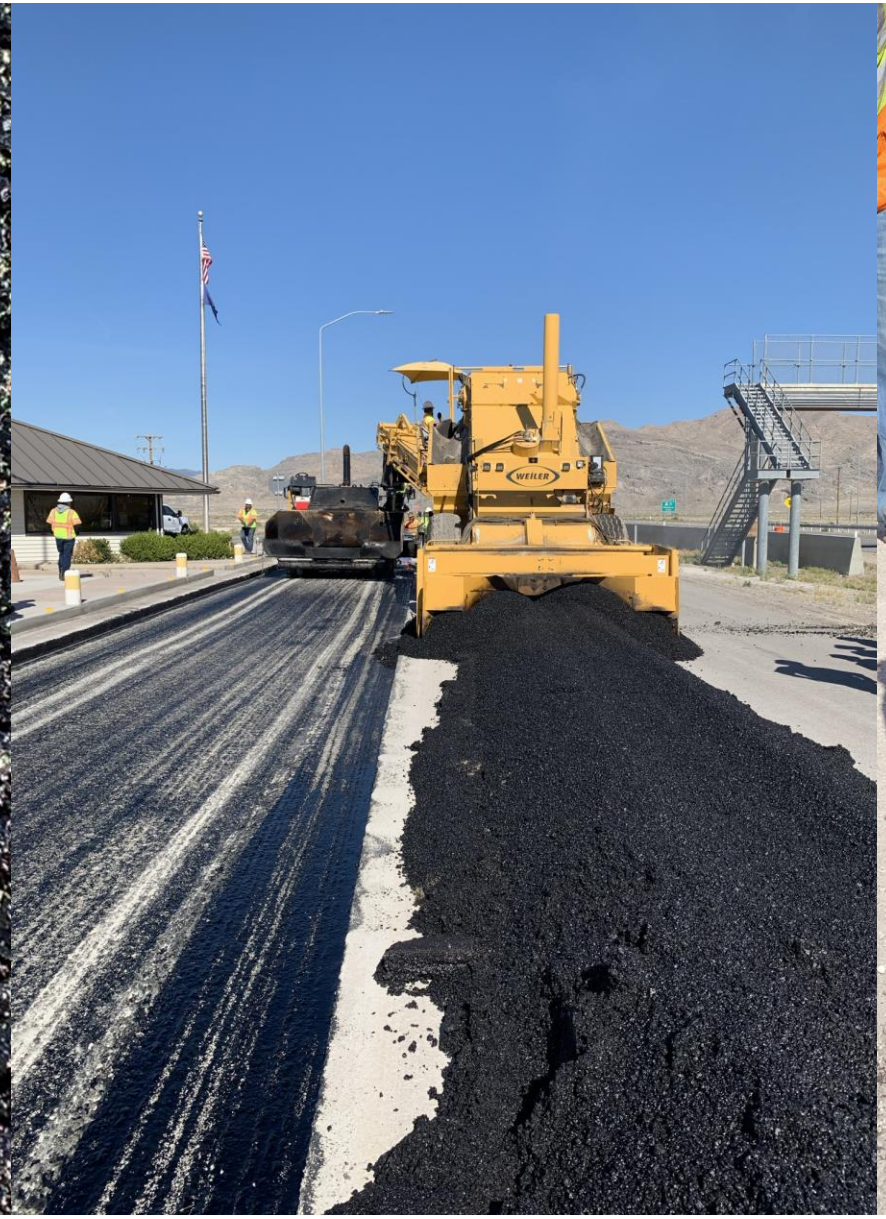

Western Section Coming Off I-80

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Eastern Section Off the Scale

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Paving Operations

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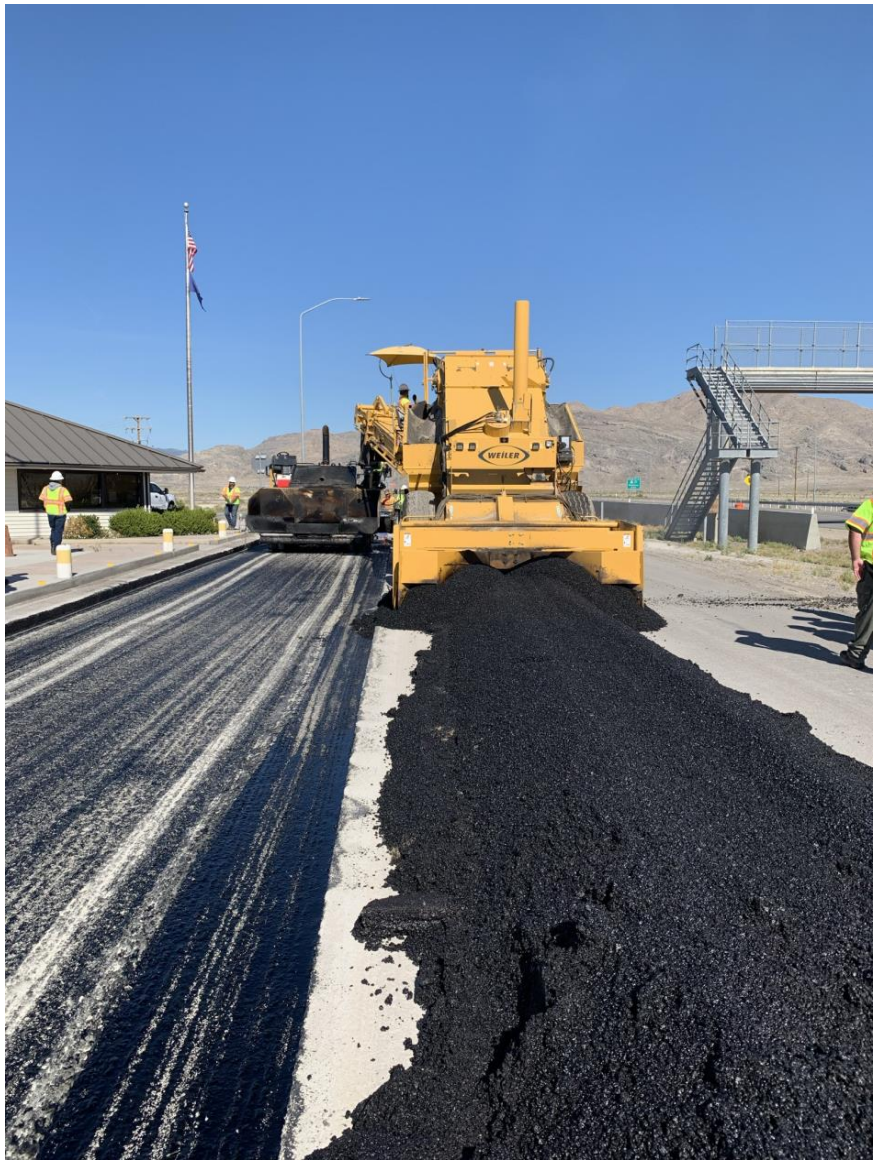

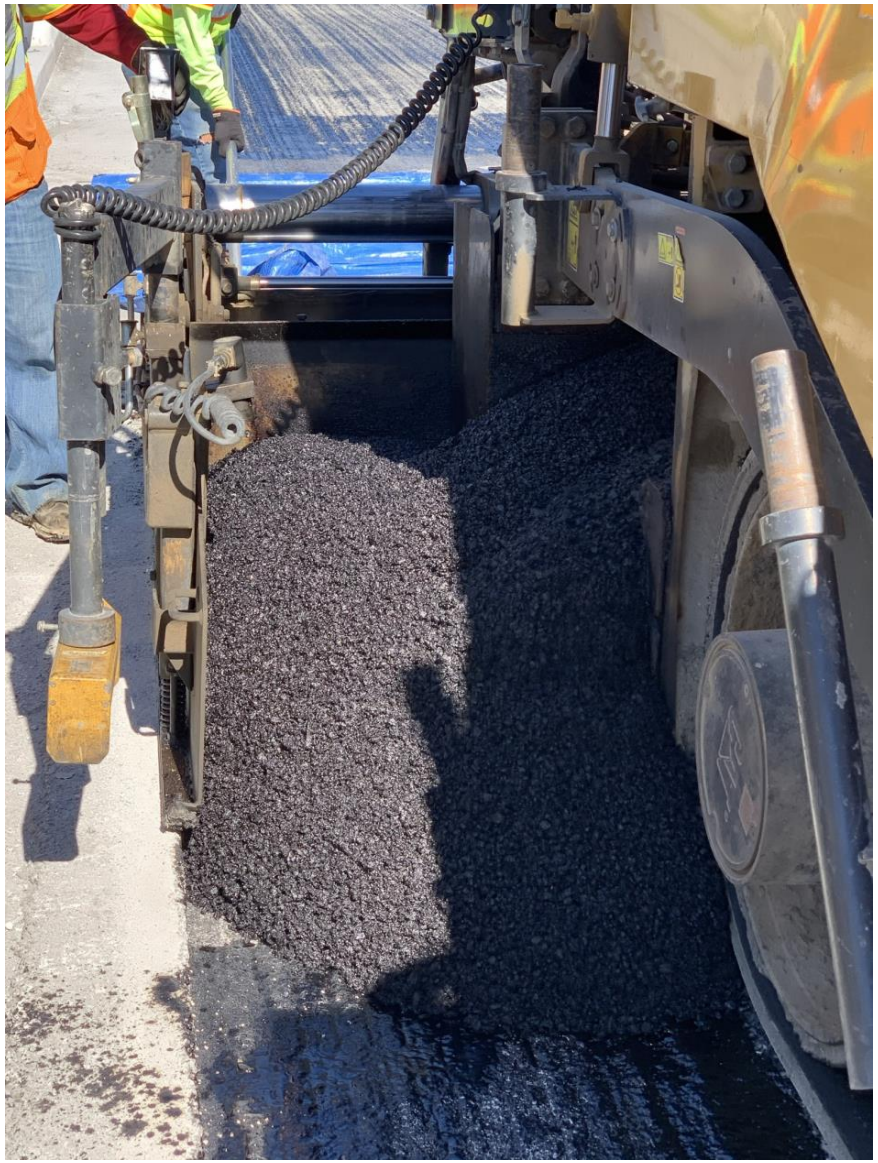

Paving Operations

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Paving Operations

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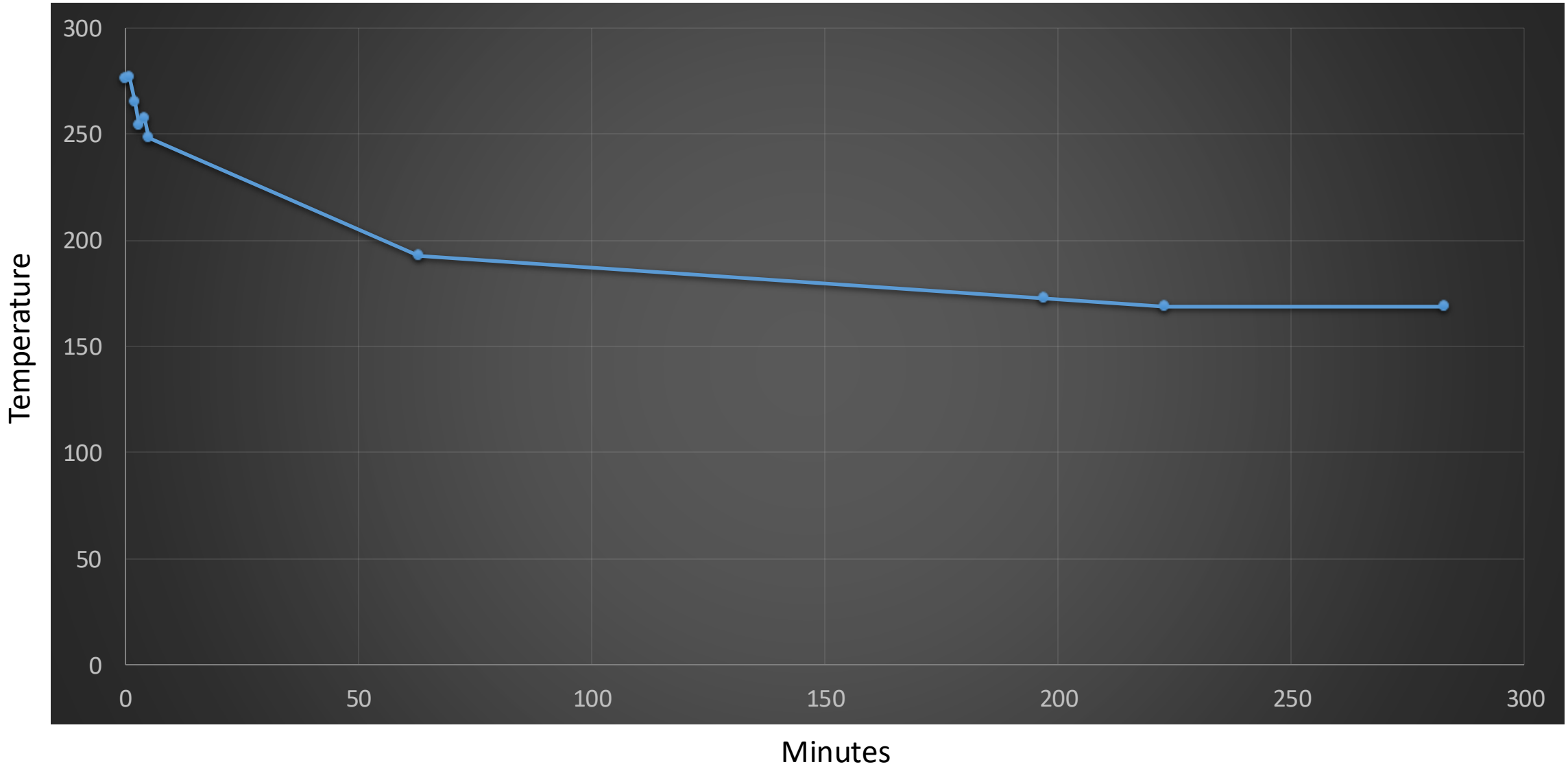
Time vs. Temperature



Density Results

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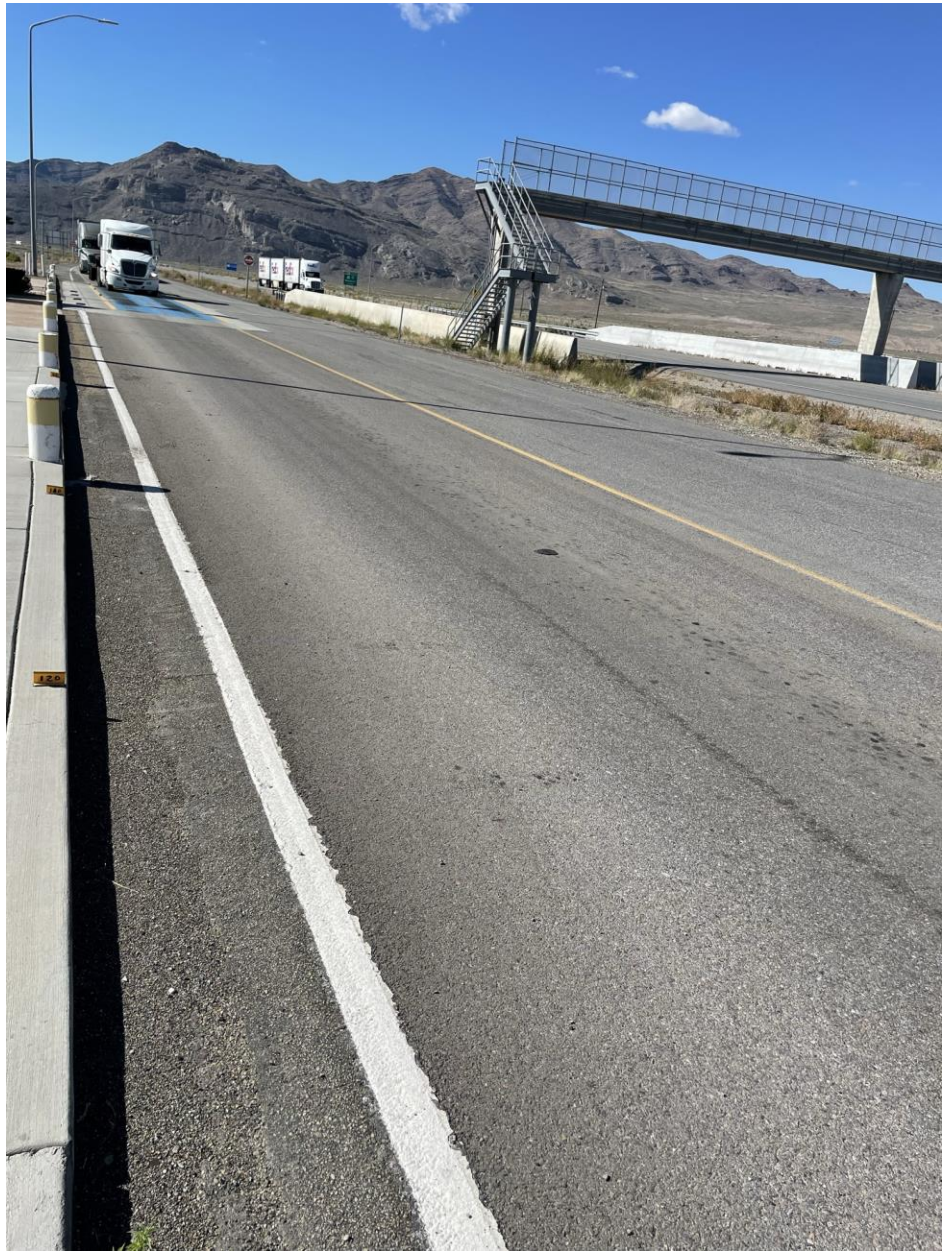
Core	Total Thickness	Top Half Density	Bottom Half Density
1	6.27 inches	97.9%	98.0%
2	6.27 inches	97.8%	94.4%
3	6.1 Inches	97.2%	92.8%
4	6.1 Inches	97.3%	97.6%

Lessons Learned – Early Post Traffic Performance

- Highly modified asphalt can be successfully constructed even with a 2+ hour haul
- High densities were easily achieved
- Exceptional performance
  - Approximately **6 million** commercial trucks over 4+ years
  - **No discernable movement**
  - **No cracking**
  - **ZERO distress**



Highly Modified, High Density, Low Air Void Installations in Utah 2021-2023

Project Description	Pavement Description	Design Thickness	Construction Year	HiMod Tonnage	Observed Density
Wendover	Port of Entry off I-80	6 Inches	2021	330	+97%
I-15 near Parish Lane	Overlay of PCC both NB and SB	3 Inches	2022 and 2023	2,216 NB 1,258 SB	+96.5%
SR-196; MP 24 to 80 F-0196(7)24	13-mile Overlay	1.5 Inches	2023	15,506	+96%
SR 173; 4800 W. to Bangerter Highway F-0173(42)4	Overlay	1.5 Inches	2023	5,001	+96%
I-80, I-15, I-215 Bridge Decks	7 Bridge Decks, Contractor Change Ordered	3-4 Inches	2023	unknown	+96%

PCCP Test Section on I-15 in 2022

- 3-inch lift directly over very poor PCCP that had only crack sealing done prior to the overlay.
- Same mix, same contractor as Wendover
  - Average thickness = 2.97 inches
  - Average binder content = 5.94%,
  - Average VMA = 15.7
  - Average density of = 97.3%
- Planned overlay installed in SMA 2024 – no distresses were present
- Excellent performance at the 3-year mark

2024 Bid Lettings – Dominate Asphalt Mixture in Utah

Project Description	Pavement Description	Design Thickness	Construction Year	HiMod Tonnage	Has Thick Lift?
US 6 Interchange F-0006(230)174	High Traffic Interchange	5 inches	2024	4,123	Yes, 5 inch
I-80 MP 41 to 50 F-I80-2(82)41	9-mile Overlay	1.5 inches	2024	38,932	No
I-215 Ramps; State, Fashion F-R299(458)	Overlay of Concrete	3 inches	2024	1,673	No
US 40 East of Duchesne	10-mile Overlay	2 inches	2024	18,000 (estimate)	No
US 6 Tucker to Soldier Summit F-0006(245)204	7-mile mill and Overlay truck lane Overlay entire road	4 inches – truck lane Plus 2-inch to Truck lane and rest of road	2024	52,666	Yes, 4 inch
I-80: Near Airport Entrance Bridge Preservation F-R299(270)	Overlay of 19 bridge decks	3 inches	2024	4,603	No
SR-276 and SR-95 F-R499(457)	45 -Mile Overlay	2 Inches	2024	84,764	No
SR-261 and SR-276 Near Bluff	Overlay	2 inches	2024-2025	204,728	Yes, 7 inch
US-191: Dry Valley to Hatch Wash F-0191(206)89	Overlay	2 inches	2024	16,969	No
SR-171; 700 W. to State Street F-0171(72)9	Overlay	1.5 inches	2024	4,752	No
SR-190; Pavement Preservation F-0190(29)2	Overlay	1.5 inches	2024	11,105	No
US-89: Passing Lanes near Buckskin Wash S-0089(572)35	Overlay	2 inches	2024	17,906	Yes, 5 inch
US-89, SR-204 to SR-134	SMA changing to HiMod	2 inches	2024	11,500	No
SR 35 F-0035(13)0	Overlay	1.5 inch	2024	14,000 (estimate)	No
I-215 Reconstruction	Rubblize PCC Pavement and Overlay	5.5 inches	2025	In design	Yes, 4 inch
			Total:	**+500,000**	

Focus on I-215 Reconstruction

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- Originally – remove and replace with PCC
- Evaluated an option with asphalt
  - Rubblize existing PCC
  - Overlay with Highly-Modified, Low Air Void Mixture (5.5 inches)
    - 1.5-inch leveling course
    - 4-inch overlay
  - **$40 Million Dollar Savings over PCC option!**
- **Using the savings to extend project 17 miles for ramp reconstructions**
- Recently awarded to Granite Construction ($111M)

AI Beam Fatigue Testing

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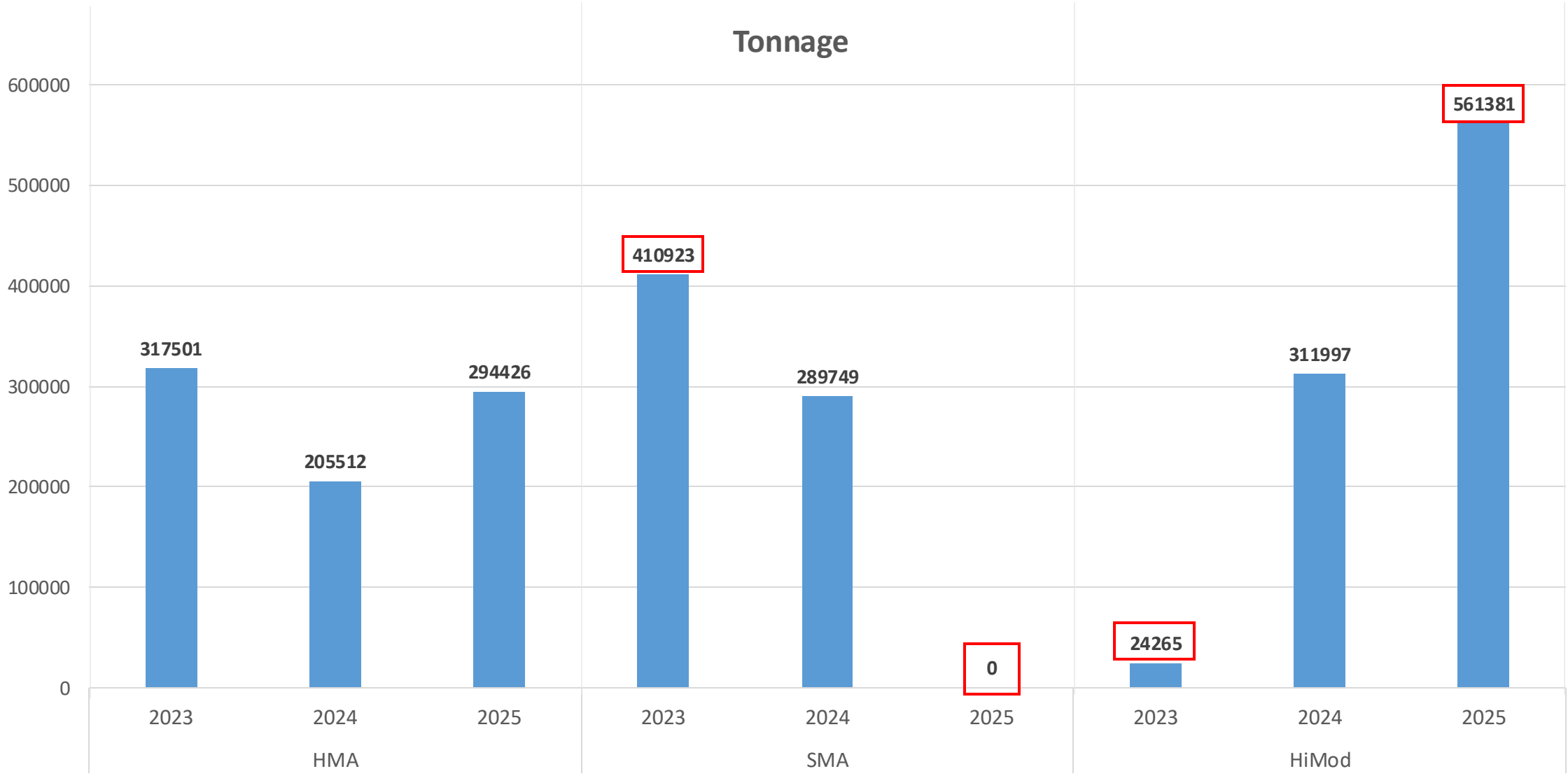
Mixture	Specimen	Air Voids (%)	Strain (με)	Flexural Modulus at 50 cycles, MPa	Cycles to Failure (N_f) Cycles*Modulus (AASHTO T321)
				Test Data	Test Data
PG 64-34 - Typical Mix	1	7.7	300	7,491	1,199,504
	2	7.1	400	7,879	162,013
	3	6.9	475	7,542	171,958
	4	6.8	525	7,482	23,894
	5	7.4	600	7,360	12,162
PG 76-34 - HiMod Mix	1	4.2	475	6,104	7,817,272
	2	3.8	525	6,320	1,200,843
	3	3.9	600	5,882	913,716
	4	4.0	675	5,655	276,589
	5	4.3	750	5,030	20,180

Lessons Learned

- Density of 96+% is common
- Regular rolling equipment and procedures followed
- Feeding while placing of a large volume of mix was achieved
  - Requires careful planning
- Mix is stable and workable
- Thin lift (1.5”) projects are becoming common
- Bridge decks
- No distresses to date nor problematic installations
  - Longitudinal joints (94%) on thinner lifts sometimes a challenge
- DOT and Utah Contractors love this mix

Utah Mixture Trends



Utah Mixture Trends (Highway Only)

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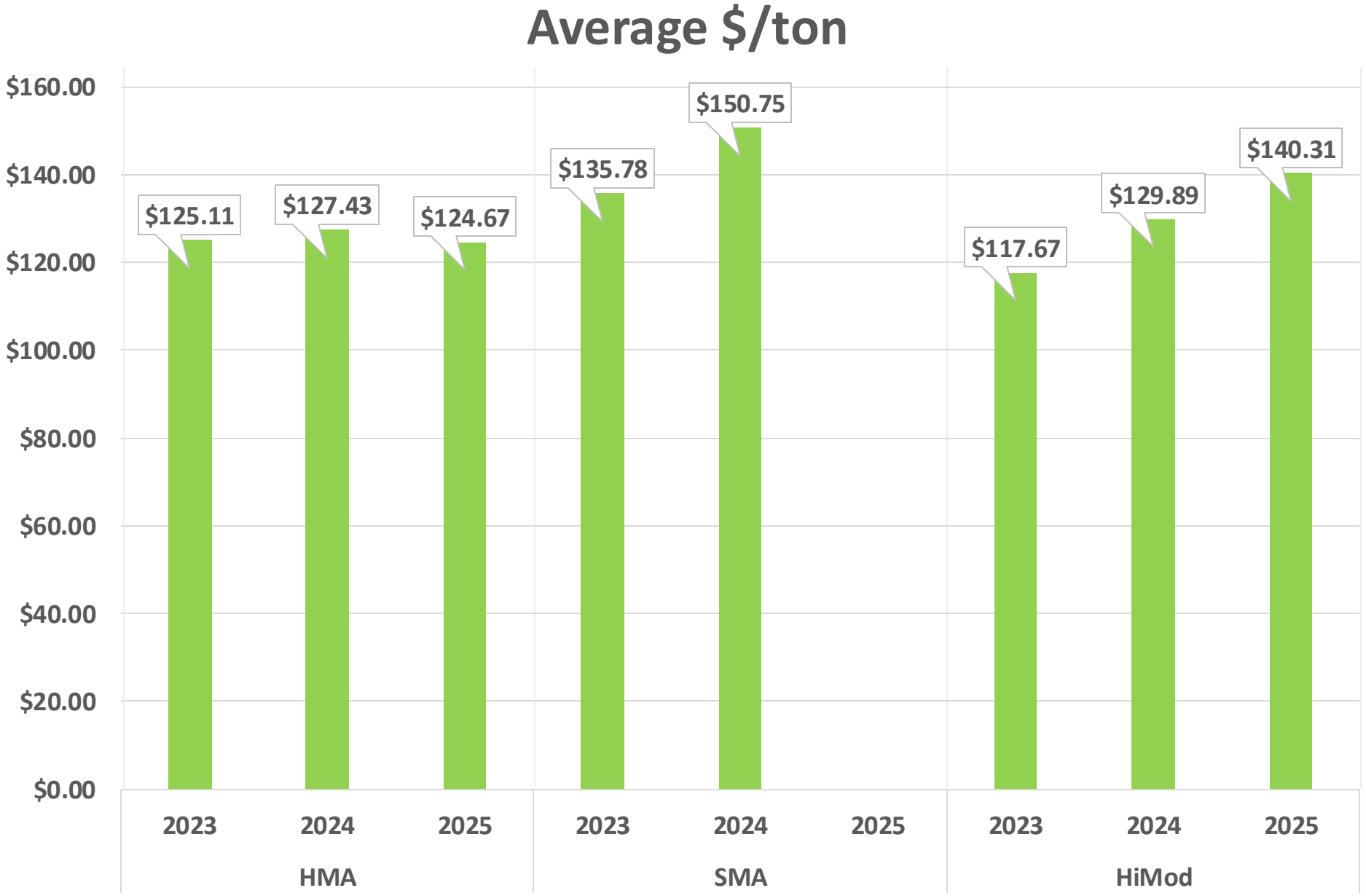

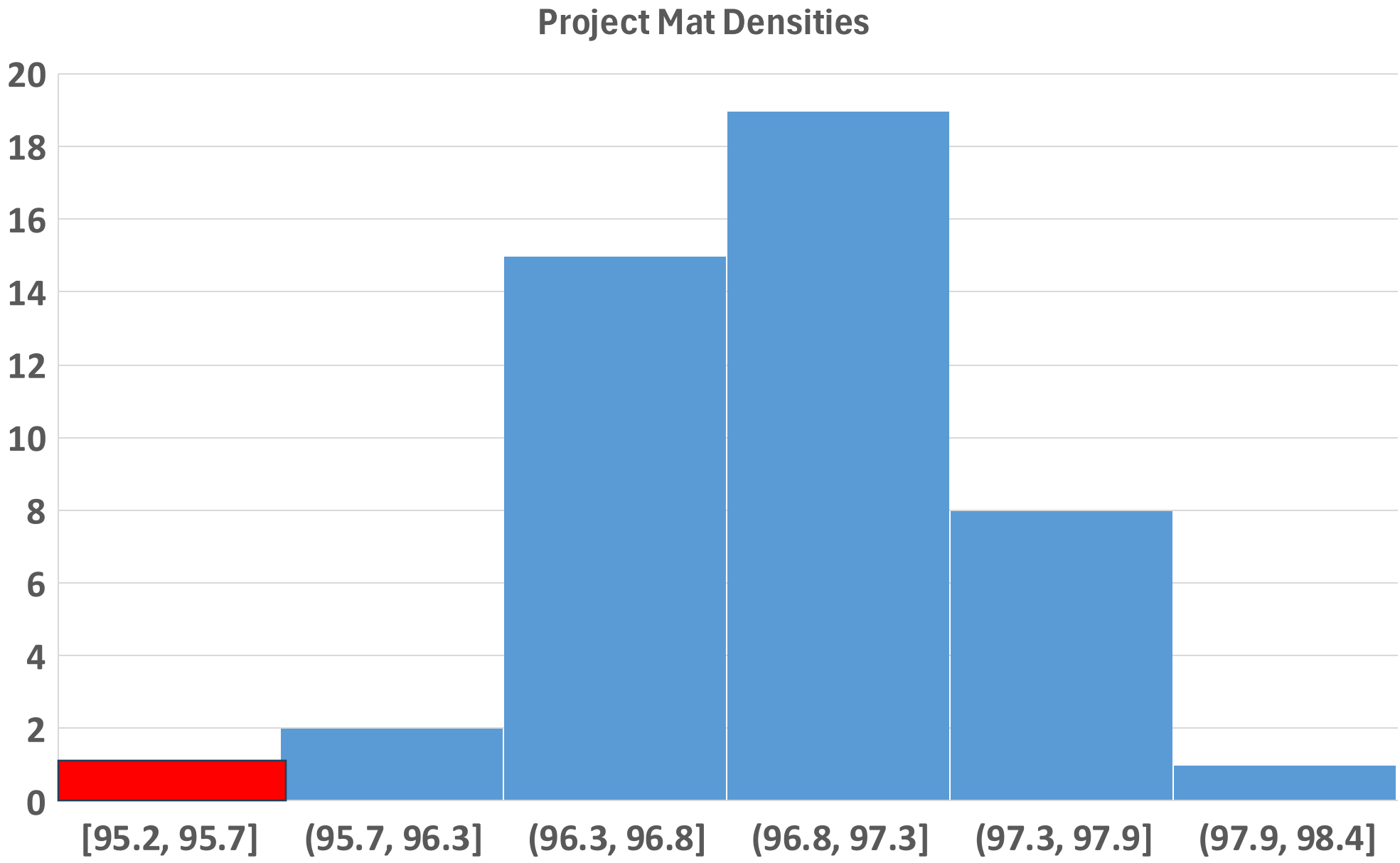
Project Mat Densities
20
18
16
14
12
10
8
6
4
2
0
[95.2, 95.7]
(95.7, 96.3]
(96.3, 96.8]
(96.8, 97.3]
(97.3, 97.9]
(97.9, 98.4]

Other Projects in the Rockies

- Montana Department of Transportation
  - 19th Street in Bozeman
  - Emulated the Utah specification
  - MSCR PG 64E-34
  - 9.5 mm
  - Project awarded 75%
    < Engineer's Estimate
  - 2025 construction
- More in a moment

- Idaho Transportation Department
  - Initial project identified
  - Emulating the Utah Specification
  - 2026 construction target
- Colorado Department of Transportation
  - Scoping for candidate project
  - Emulating the Utah Specification
  - 2026 construction target

Thanks to our Members !

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Contact Info

Thank You - Questions ?