



Hamilton

# HIGH RAP TRIALS CITY OF HAMILTON EXPERIENCE

OAPC Asphalt Technical Symposium

June 13, 2023



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SESSION SPONSOR



LUNCH AND NETWORKING  
BREAK SPONSOR



BREAKFAST AND  
REFRESHMENT SPONSOR



SESSION SPONSOR

# The City of Hamilton

- The City of Hamilton has 6,491 lane kilometers of road
- Asset of approximately \$4.2B
- In 2019 City of Hamilton Declared a Climate Change Emergency



# Book Road Trial



Google Street View June 2019

# Book Road Trial



Google Maps 2023

# Book Road Trial

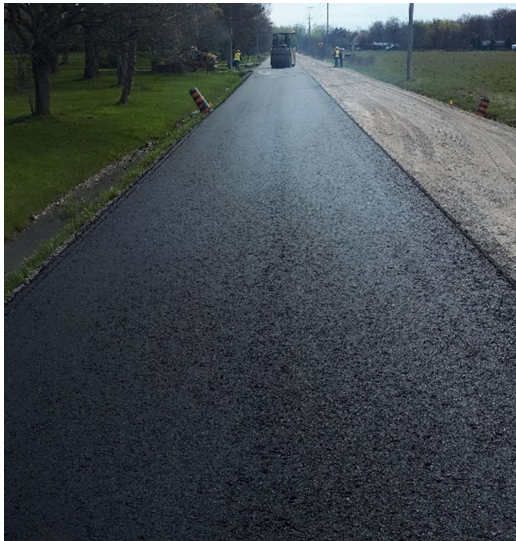
## Control Mix:

SP19

Traffic Category C

4.8% PGAC 58-28

15% RAP



## Trial Mix:

SP19

Traffic Category C

4.8% PGAC 58-28

40% RAP



## Surface Mix:

SP12.5

Traffic Category C

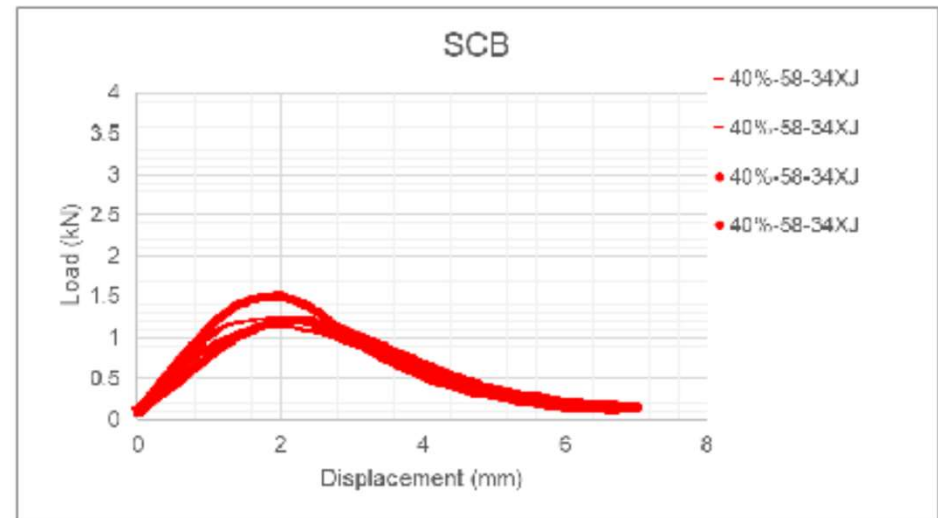
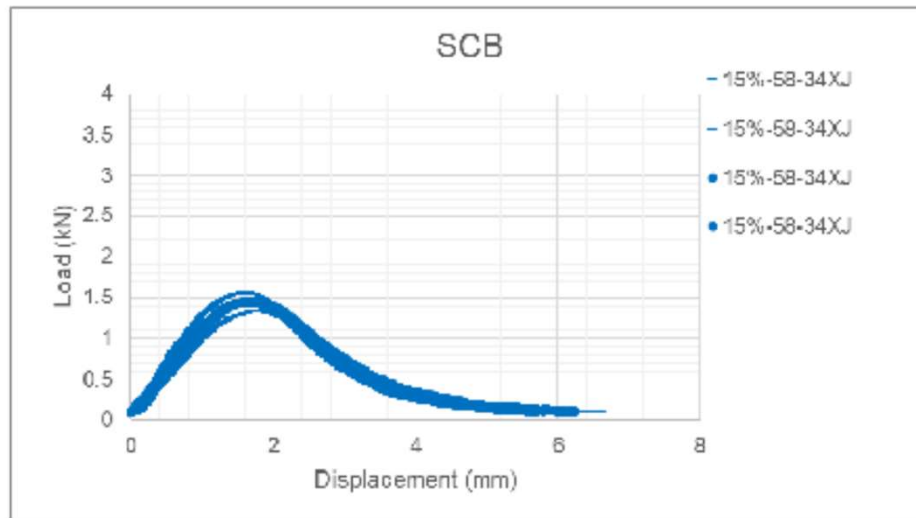
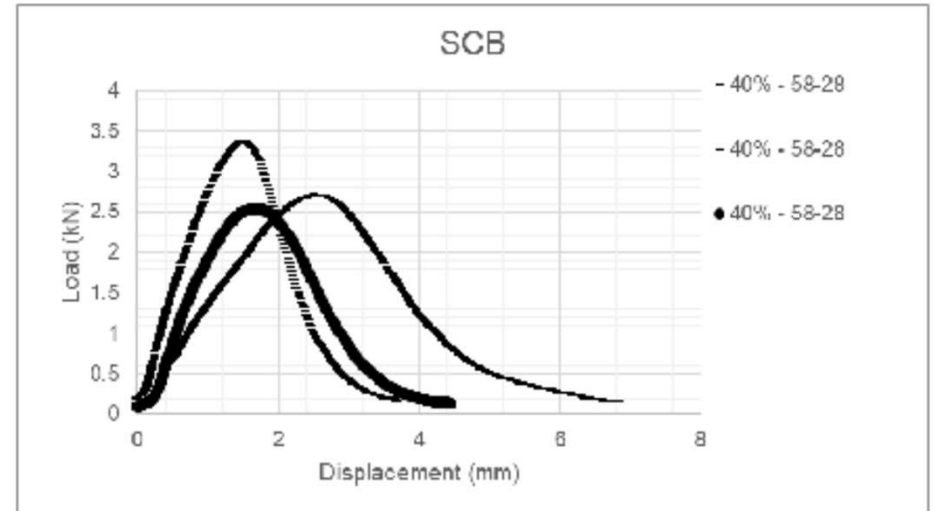
5.0% PGAC 58-28

15% RAP



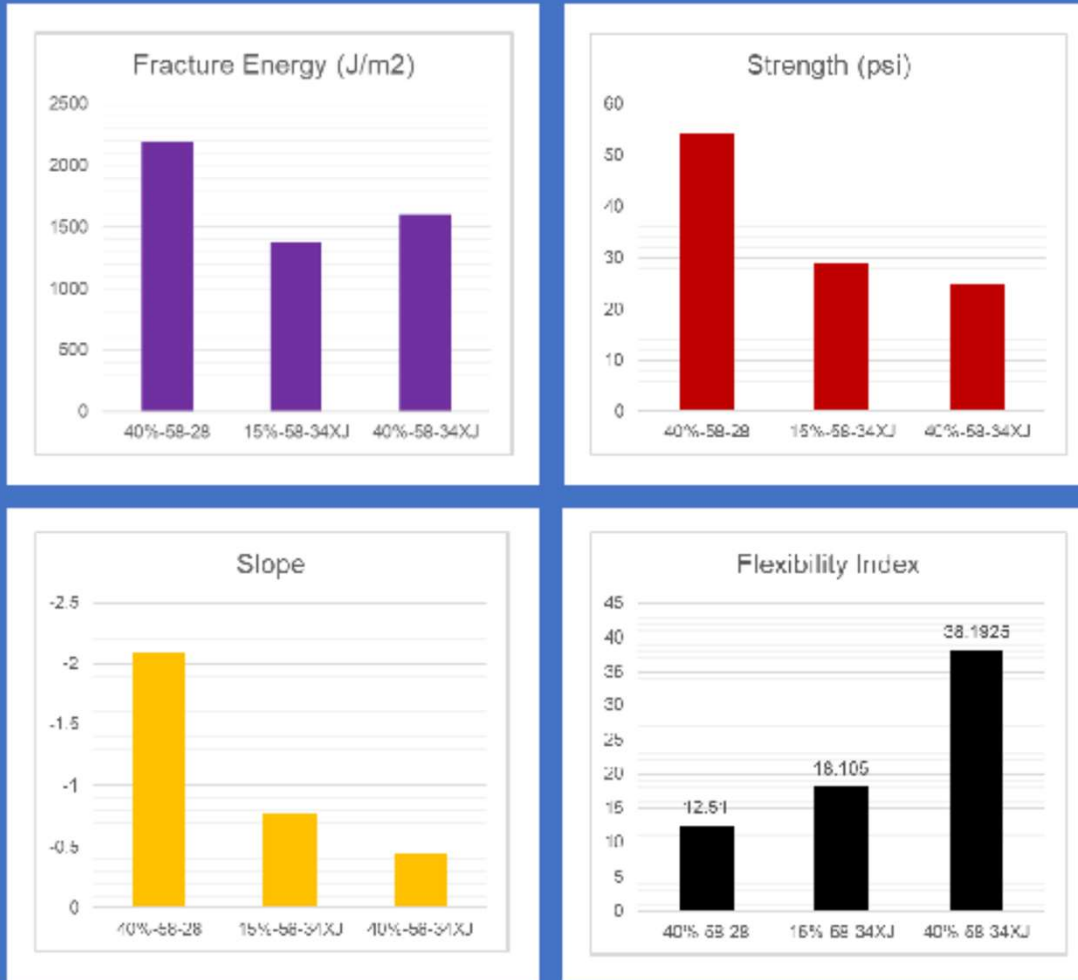
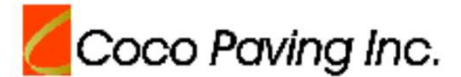


## SCB Test Repeatability



High RAP Mix , Mix Performance Results, Coco Paving

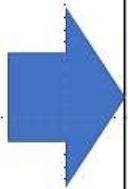
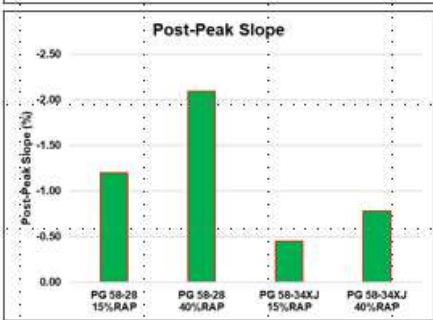
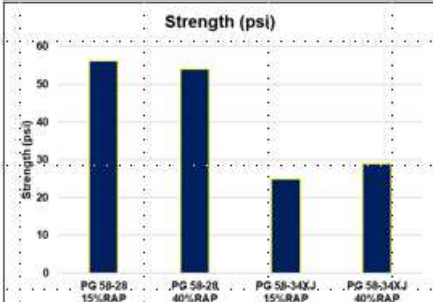
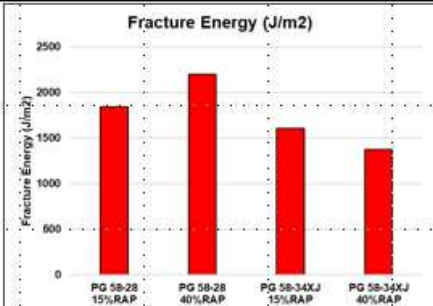
# Book Road Trial



## SCB Results

High RAP Mix , Mix Performance Results, Coco Paving

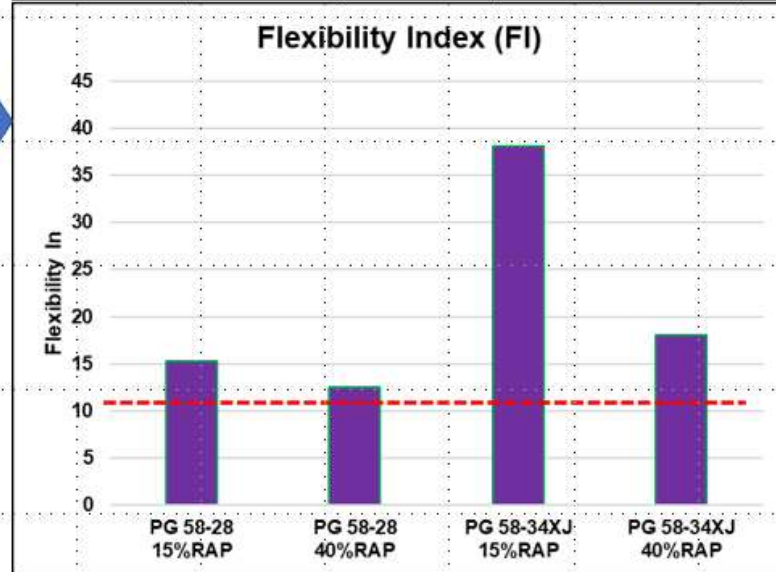
## Book Road – Lab Compaction



Mix Semi-Circular Bending Test at 25°C							
Mix	AC	RAP		SCB Results			
		Source	Content (%)	Fracture Energy (J/m²)	Strength (psi)	Post-Peak Slope	Flexibility Index (FI)
SP 19.0	58-28	Nebo	15	1841.20	56.23	-1.20	15.34
			40	2200.51	54.11	-2.09	12.51
	58-34XJ	Nebo	15	1605.96	24.92	-0.45	38.19
			40	1373.65	29.01	-0.78	18.10



2.8



FI=11 (for Laboratory Mixes)

High RAP Mix Coco's Experience, Coco Paving



# Book Road Trial

The Control Mix was placed on the May 6 2020

The Trial Mix was placed on May 7, 2020

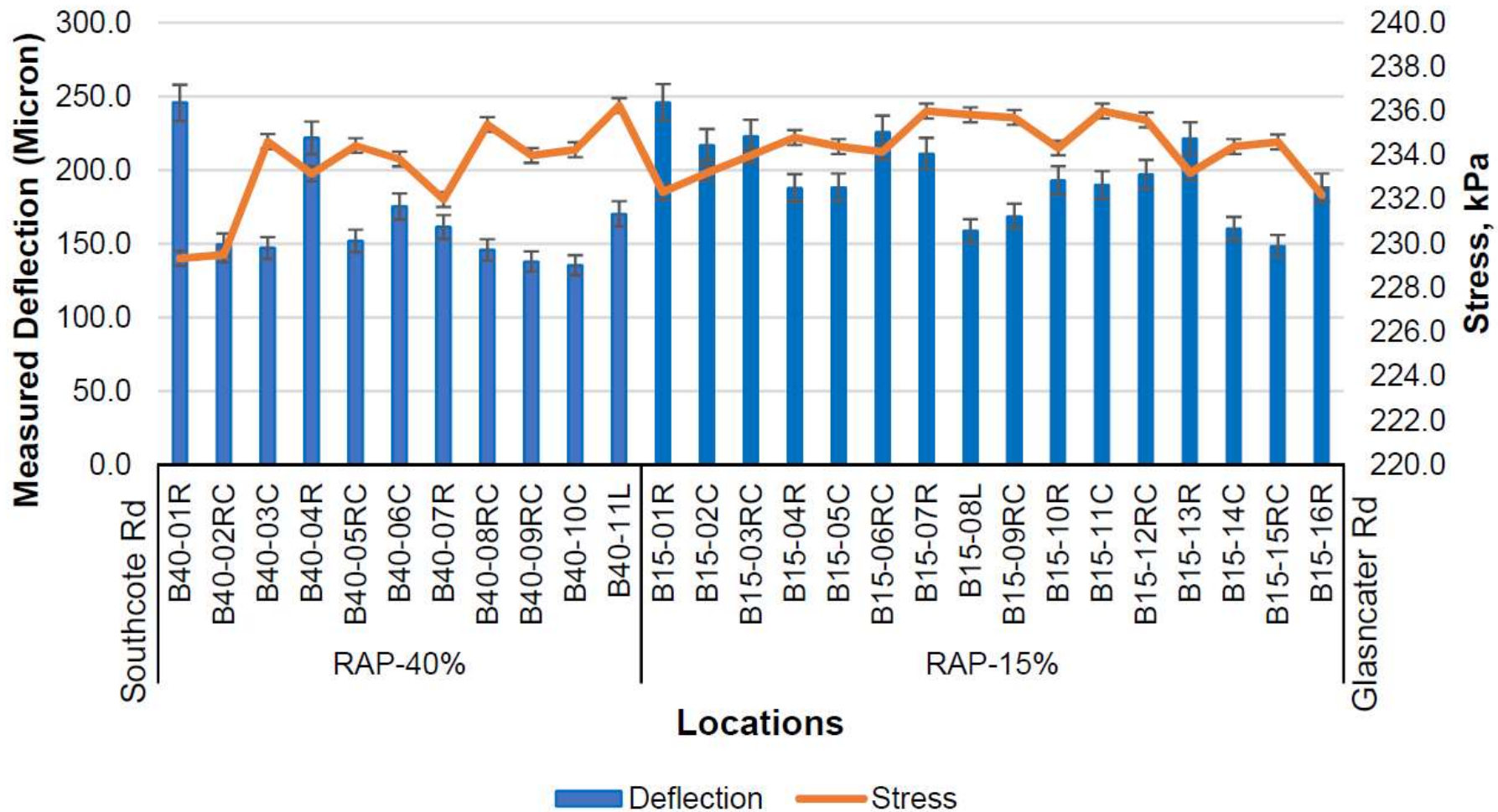
The surface course was place on May 20, 2020.



# Book Road QA Results

SAMPLE DATE	Time	LAB SAMPLE NO.	STREET	Mix Temp °C	12.5 mm								19 mm													
					12.5 mm Cat C 58-28								19 mm Cat C 58-28				19 mm Cat C 58-28 HIGH RAP TRIAL									
					A/C %	9.5 mm	4.75 mm	600 µm	75 µm	% AV	VMA	A/C %	12.5 mm	4.75 mm	600 µm	75 µm	% AV	VMA	A/C %	12.5 mm	4.75 mm	600 µm	75 µm	% AV	VMA	
Average				149°	5.09	83.6	58.4	20.3	4.5	4.0	14.0	4.80	83.6	56.7	19.0	4.4	4.0	13.0	4.80	86.8	58.3	19.1	5.4	4.0	13.0	
06-May-20	8:30 AM	2050342	Book Rd, 0586299 4782597, WBL	144°								4.88	84.7	59.9	19.9	5.7	3.6	13.3								
06-May-20	11:15 AM	2050343	Book Rd, 0585873 4782487, WBL	155°								4.72	86.2	58.1	21.0	5.4	3.0	12.5								
06-May-20	2:45 PM	2050344	Book Rd, 0586143 4782560, EBL	158°								4.84	86.7	59.9	21.4	5.5	3.2	13.0								
06-May-20	4:45 PM	2050345	Book Rd, 0585820 4782477, EBL	152°								4.89	80.2	55.9	20.9	5.4	3.3	13.3								
07-May-20	8:15 AM	2050350	Book Rd, 0585465 4782385, EBL	142°															5.00	86.3	64.9	21.1	6.5	4.0	14.3	
07-May-20	9:30 AM	2050353	Book Rd, 0585260 4782332, EBL	144°															4.68	85.5	58.9	20.8	6.4	3.7	13.8	
07-May-20	11:00 AM	2050355	Book Rd, 0585523 4782394, WBL	148°															4.75	83.0	55.5	20.2	6.6	4.1	14.0	
07-May-20	12:30 PM	2050357	Book Rd, 0585287 4782336, WBL	147°															5.06	88.4	64.0	21.4	6.6	3.6	14.4	
20-May-20	8:05 AM	2050400	Book Rd, 0585170 4782313	148°	5.09	82.2	59.3	23.2	5.4	4.5	14.5															
20-May-20	10:05 AM	2050401	Book Rd, 0585790 4782467	151°	4.86	83.8	58.8	22.7	5.0	4.3	13.8															
20-May-20	12:30 PM	2050402	Book Rd, 0586393 4782618	140°	5.27	85.1	63.4	23.9	5.6	3.2	14.1															
20-May-20	2:45 PM	2050403	Book Rd, 0585292 4782341	156°	5.03	86.6	64.8	25.0	6.2	3.1	13.7															
20-May-20	3:45 PM	2050404	Book Rd, 0585741 478245	150°	4.96	78.8	54.3	22.3	5.3	2.9	13.1															
20-May-20	5:40 PM	2050405	Book Rd, 0586395 4782618	156°	5.34	84.8	62.4	23.1	5.9	2.8	13.7															

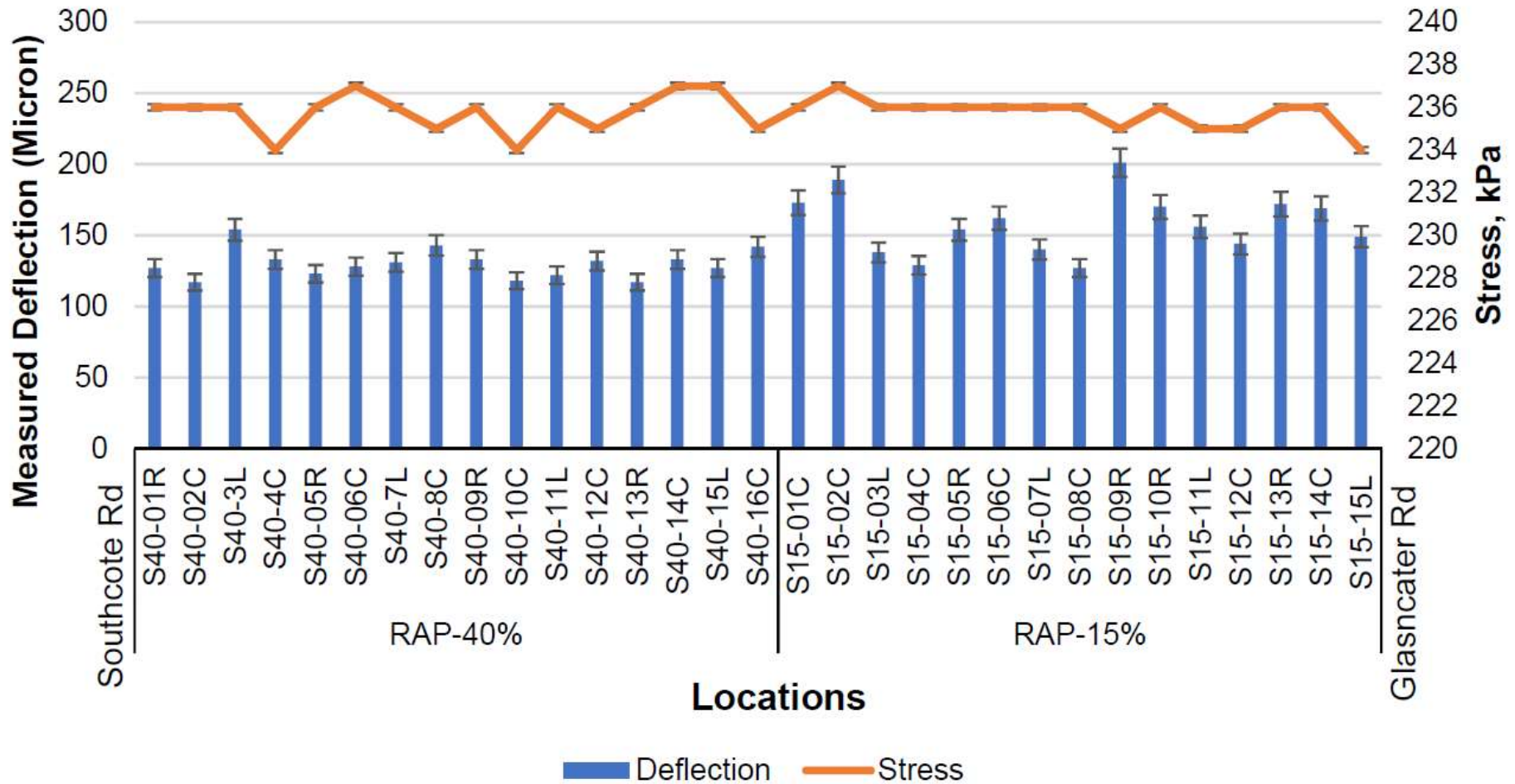
# Book Road LWD Results



## Measured Deflection and Stress on the Binder Course

Evaluation of High RAP Content Binder Course Mix , CPATT, June 2020

# Book Road LWD Results



## Measured Deflection and Stress on the Surface Course

Evaluation of High RAP Content Binder Course Mix , CPATT, June 2020

# Book Road 2020 Construction



# Book Road 2022 Condition



# Book Road 2022 Condition



# Book Road 2022 Condition





# Book Road 2022 Condition



# Book Road 2023 Current Condition



# Book Road 2023 Current Condition



# Book Road 2023 Current Condition



# Book Road 2023 Current Condition

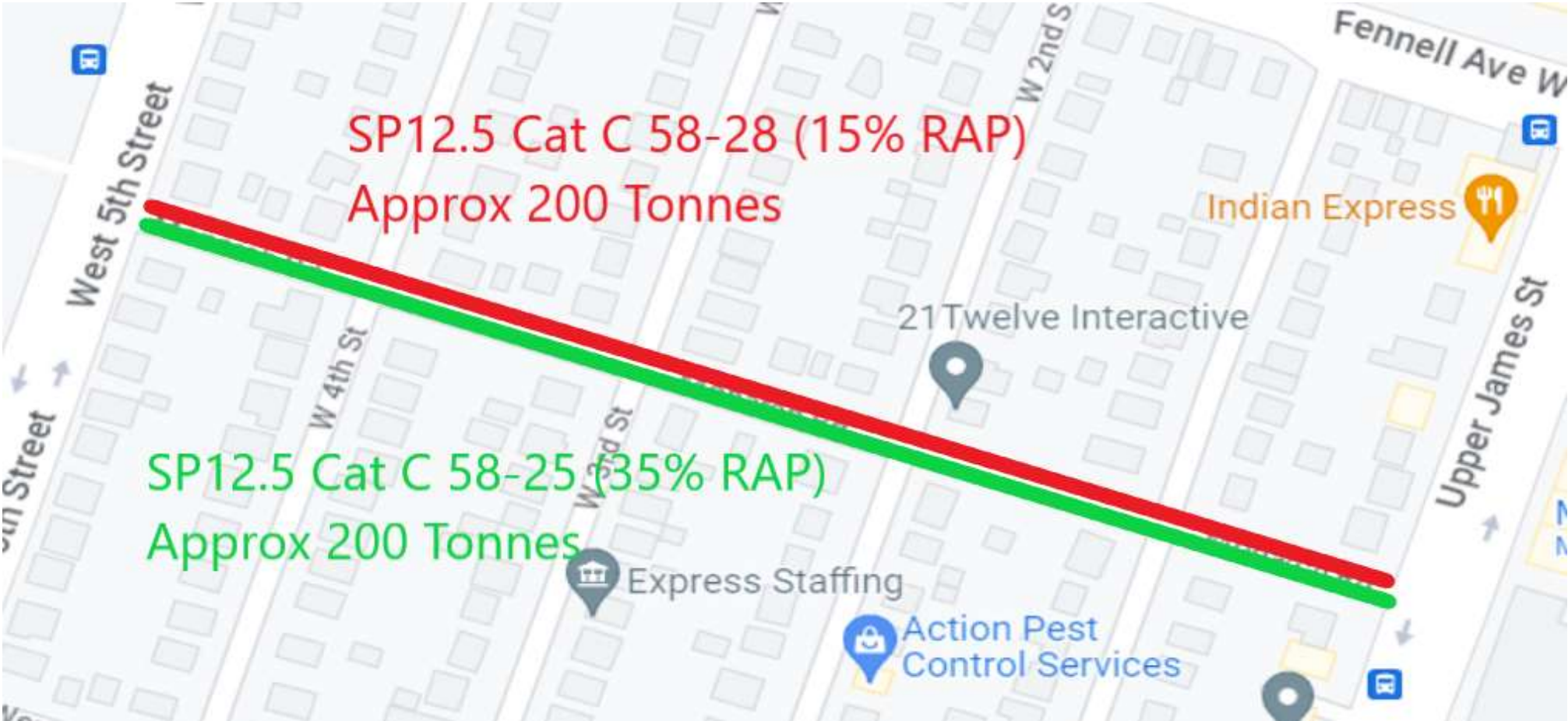


# Monarch 2021 Pre-Construction



Google Street View October 2020

# Monarch Road Trial



Google Maps 2023

# Book Road Trial

## Control Mix:

SP12.5

Traffic Category C

5.0% PGAC 58-28

15% RAP

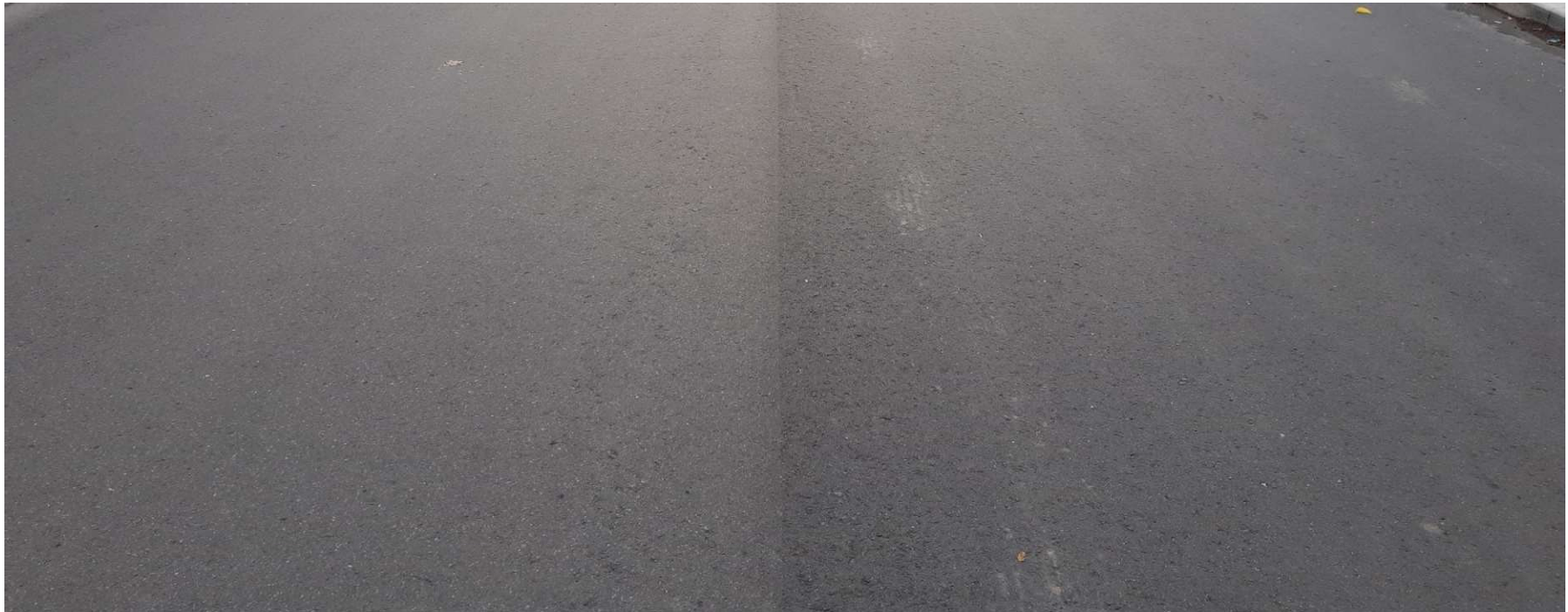
## Trial Mix:

SP12.5

Traffic Category C

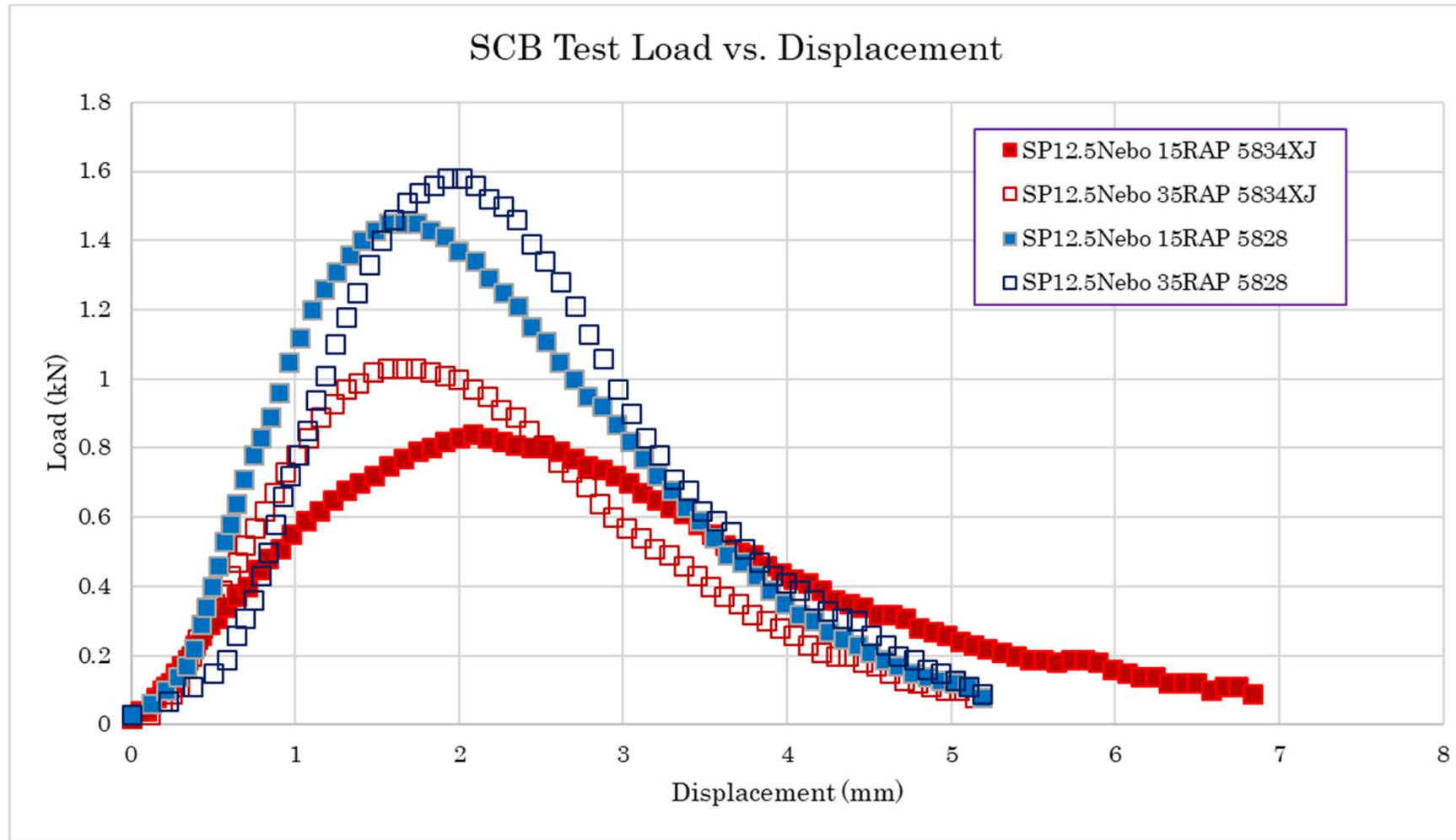
5.0% PGAC 58-28

35% RAP



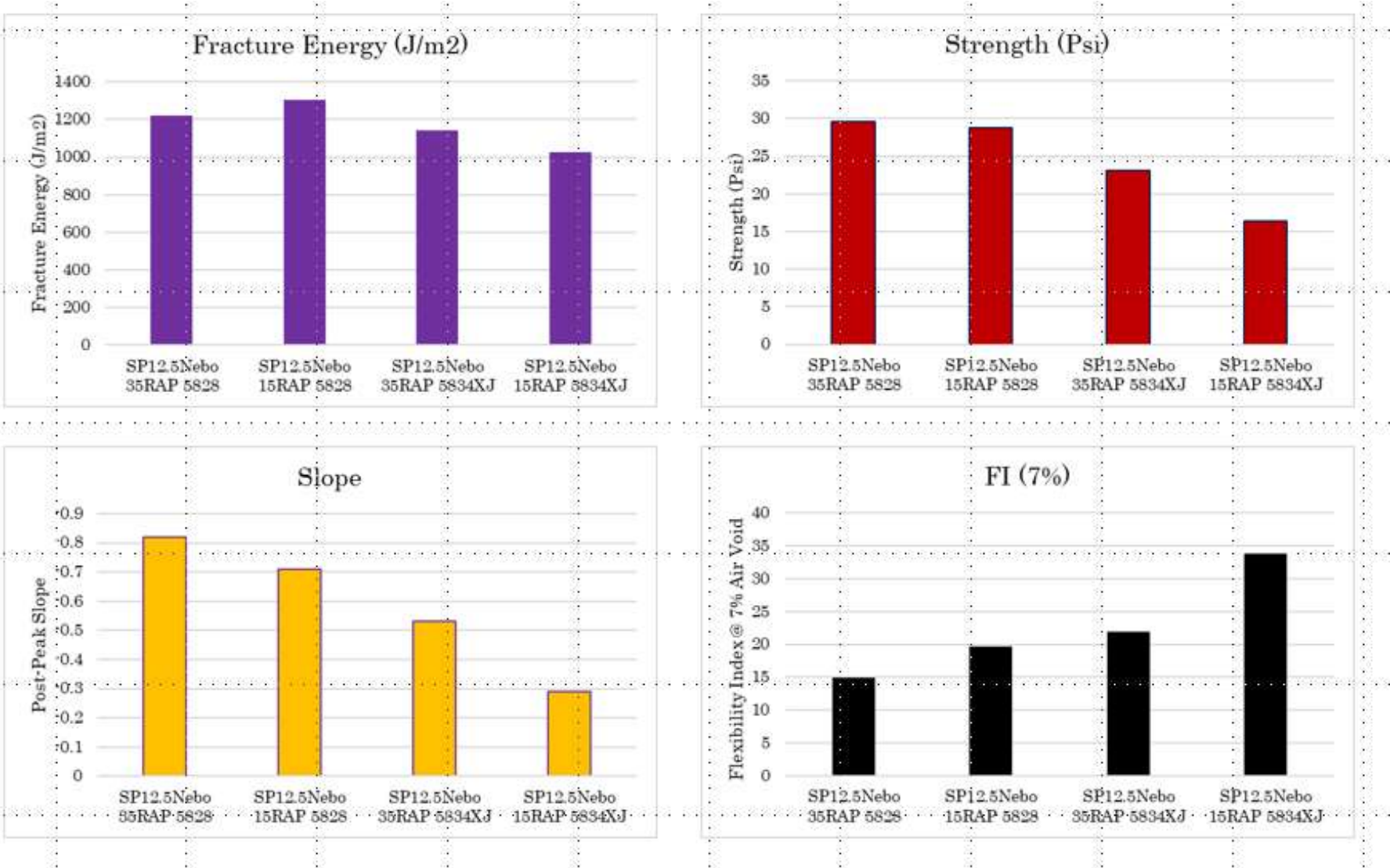


# Monarch Road Trial



High RAP Surface Mix, Mix Performance Results, Coco Paving

# Monarch Road Trial

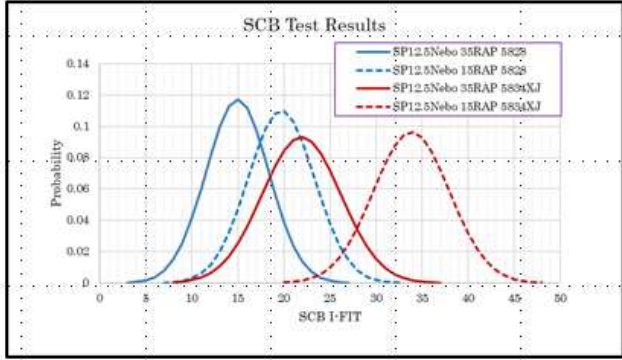
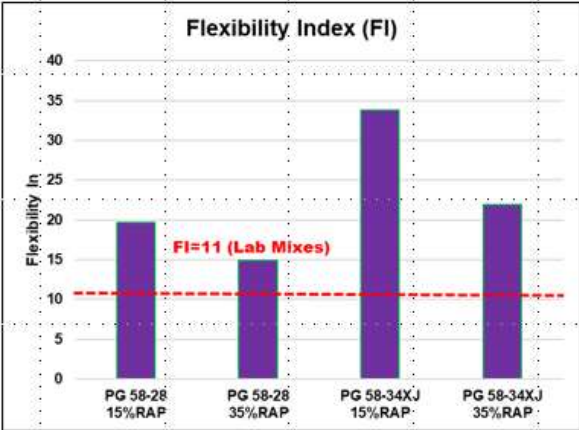
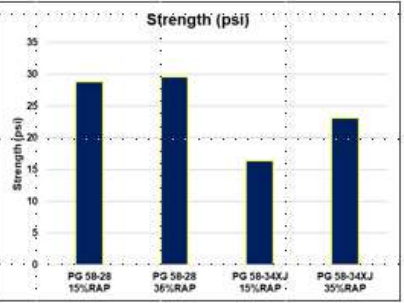
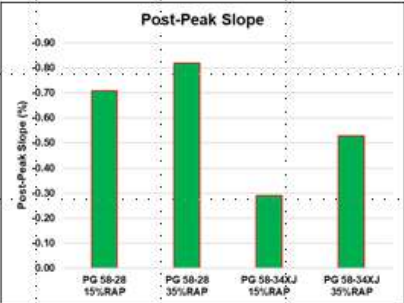
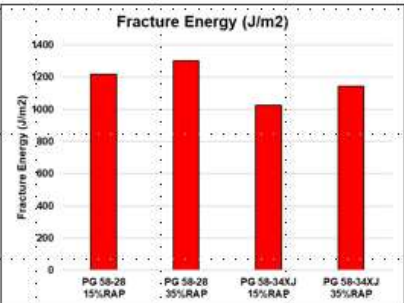


High RAP Surface Mix, Mix Performance Results, Coco Paving

## Monarch Rd. – Laboratory Mix SCB

Mix Semi-Circular Bending Test at 25°C							
Mix	AC	RAP		SCB Results			
		Source	Content (%)	Fracture Energy (J/m <sup>2</sup> )	Strength (psi)	Post-Peak Slope	Flexibility Index (FI)
SP 12.5	58-28	Nebo	15	1217.77	28.82	-0.71	19.7
			35	1302.68	29.54	-0.82	14.9
	58-34XJ	Nebo	15	1026.40	16.39	-0.29	33.8
			35	1142.02	23.08	-0.53	21.9

4.8



Coco Paving High RAP Mix Coco's Experience



# Book Road Trial

The mixes were placed in 2 lifts.

The first lift on July 9, 2021

The Second lift on July 15, 2012



# Monarch Road QA Results

SAMPLE DATE	Time	STREET	Mix Temp °C	12.5 mm													
				12.5 mm Cat C 58-28						12.5 mm Cat C 58-28 HIGH RAP							
				A/C %	9.5 mm	4.75 mm	600 µm	75 µm	% AV	VMA	A/C %	9.5 mm	4.75 mm	600 µm	75 µm	% AV	VMA
Average			153°	4.93	87.2	65.1	23.2	5.4	4.6	14.3	5.09	88.2	68.7	22.5	7.3	3.5	13.7
9-Jul-21	11:00 AM	W4th and Monarch, on W4th, SBL	156°								5.03	88.1	70.5	22.1	7.2	4.0	14.1
9-Jul-21	11:30 AM	W3rd and Monarch Intersection, SBL	145°								5.06	88.1	69.3	21.2	7.2	3.6	13.9
9-Jul-21	11:45 AM	30m W of Int. W2nd and Monarch, EBL	159°								5.22	89.7	70.3	21.5	7.3	4.2	14.2
9-Jul-21	1:30 PM	Int. W4th and Monarch, NBL	155°	4.89	88.5	64.2	21.7	6.2	3.7	13.1							
9-Jul-21	2:00 PM	Int. W3rd and Monarch, WBL	149°	5.07	87.8	65.9	22.8	5.3	3.4	13.5							
9-Jul-21	2:20 PM	Int. W2nd and Monarch, WBL	153°	4.94	86.7	64.0	22.5	5.6	4.2	14.1							
15-Jul-21	9:55 AM	20m E of W1st on Monarch, EBL	135°								5.08	88.0	66.6	23.1	7.4	2.5	13.2
15-Jul-21	10:15 AM	20m E of W2nd and Monarch, EBL	156°								5.22	88.6	69.6	24.3	7.6	2.7	13.2
15-Jul-21	11:10 AM	W3rd and Monarch	154°								4.95	86.4	65.8	22.5	7.0	3.9	13.6
15-Jul-21	12:10 PM	20m E of W2nd on Monarch, WBL	152°	4.90	89.8	70.7	26.0	5.1	6.8	16.3							
15-Jul-21	12:35 PM	20m E of W2nd and Monarch, WBL	155°	4.87	87.0	65.2	23.3	4.9	5.5	15.0							
15-Jul-21	1:15 PM	10m W of W3rd on Monarch, WBL	156°	4.90	83.3	60.6	23.0	5.5	3.8	13.8							

# Monarch Road 2021 Construction



# Monarch Road 2022 Condition



Trial Mix

Control Mix

# Monarch Road 2022 Condition



Trial Mix

Control Mix



# Monarch Road 2022 Condition



Control Mix

Trial Mix

# Monarch Road 2023 Condition



Control Mix

Trial Mix

# Monarch Road 2023 Condition



# Monarch Road 2023 Condition



Control Mix

Trial Mix

# Monarch Road 2023 Condition



Control Mix

Trial Mix

# Sources and Thanks

High RAP Mix, Mix Performance Results, Coco Paving, , Yashar Azimi Alamdary 2020

High RAP Surface Mix, Mix Performance Results, Coco Paving, Yashar Azimi Alamdary, 2021

High RAP Mix, Coco's Experience, Coco Paving, , Yashar Azimi Alamdary

Evaluation of High RAP Content Binder Mix, E. Melese Et.Al. June 2020





QUESTIONS?



THANK YOU

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