Appendices for Determining Pavement Design Criteria for Recycled Aggregate Base and Large Stone Subbase

NRRA GEOTECHNICAL TEAM

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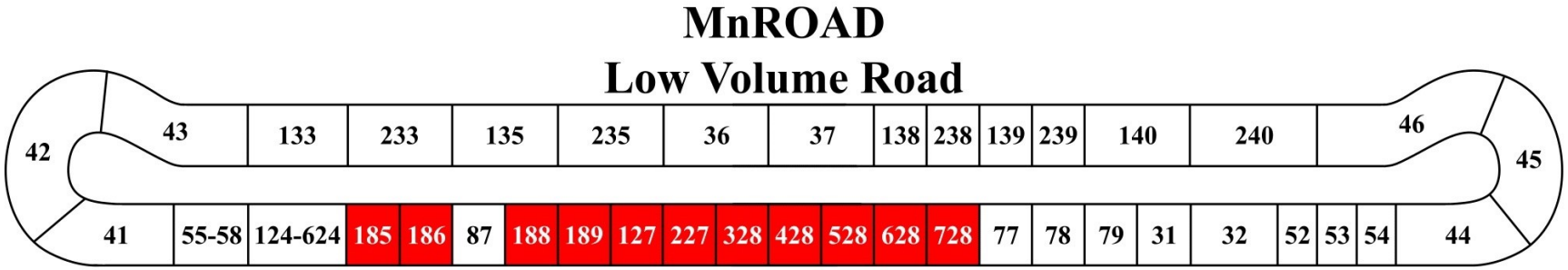
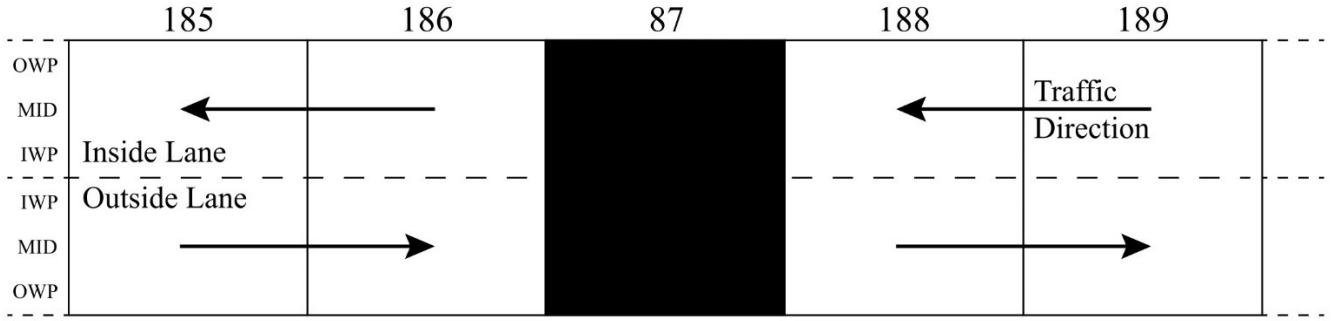
APPENDICES

APPENDIX A
TEST CELLS ON MINNESOTA ROAD RESEARCH PROJECT (MNROAD) LOW VOLUME ROAD (LVR) AND ROAD LANES



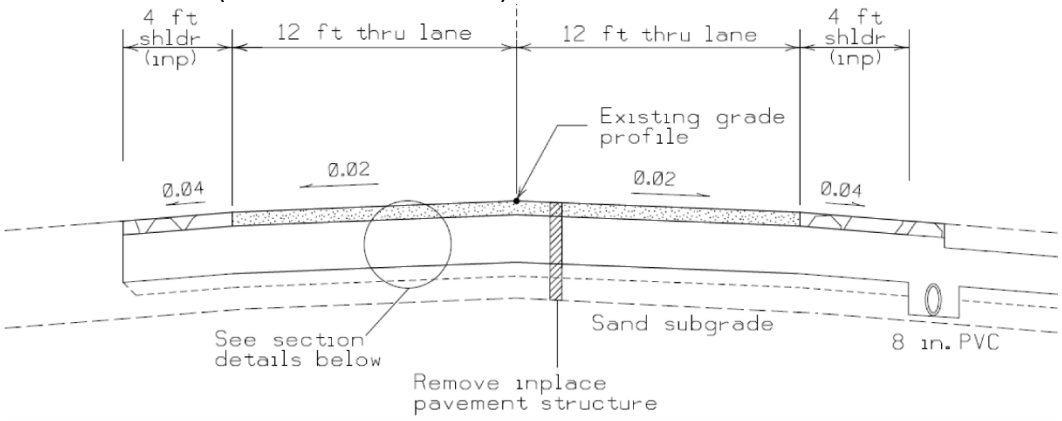
NOTE: Test cells shown in red are related to this project.



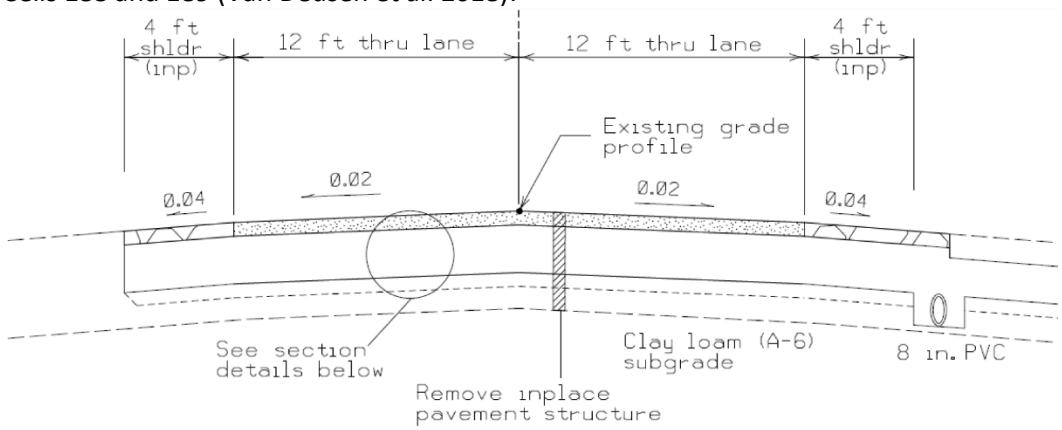
NOTE: OWP: outer wheel path, MID: midline, IWP: inner wheel path

APPENDIX B
CROSS-SECTIONAL ELEMENTS OF TEST CELLS

Cells 185 and 186 (Van Deusen et al. 2018):

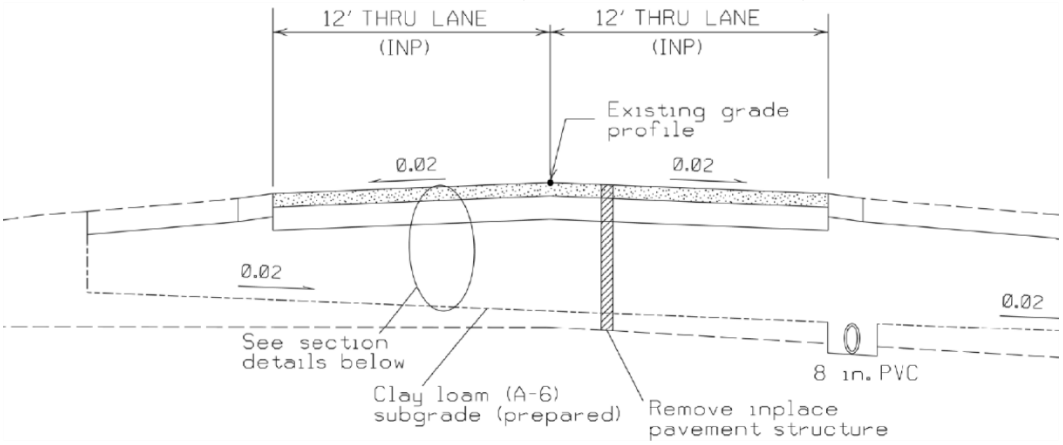


Cells 188 and 189 (Van Deusen et al. 2018):



Recycled Aggregate Base (RAB) Group			
185	186	188	189
3.5 in Asphalt	3.5 in Asphalt	3.5 in Asphalt	3.5 in Asphalt
12 in Coarse RCA	12 in Fine RCA	12 in Limestone	12 in RCA+RAP
3.5 in S. Granular Borrow	3.5 in S. Granular Borrow	3.5 in S. Granular Borrow	3.5 in S. Granular Borrow
Sand	Sand	Clay Loam	Clay Loam

Cells 127, 227, 328, 428, 528, 628, and 728 (Van Deusen et al. 2018):



Large Stone Subbase (LSSB) Group		LSSB with Geosynthetics Group				
127	227	328	428	528	628	728
3.5 in Asphalt	3.5 in Asphalt	3.5 in Asphalt	3.5 in Asphalt	3.5 in Asphalt	3.5 in Asphalt	3.5 in Asphalt
6 in Class 6 Aggregate	6 in Class 6 Aggregate	6 in Class 5Q Aggregate	6 in Class 5Q Aggregate	6 in Class 5Q Aggregate	6 in Class 5Q Aggregate	6 in Class 5Q Aggregate
18 in LSSB	18 in LSSB	9 in LSSB TX	9 in LSSB TX+GT	9 in LSSB BX+GT	9 in LSSB BX	9 in LSSB
Clay Loam	Clay Loam	Clay Loam	Clay Loam	Clay Loam	Clay Loam	Clay Loam

APPENDIX C
START AND END STATIONS OF TEST CELLS

	Cell Number	Position	Station	Length (ft)
Recycled Aggregate Base (RAB) Group	185	Start	16368	201
		End	16569	
	186	Start	16619	201
		End	16820	
	188	Start	17046	201
		End	17247	
	189	Start	17297	200
		End	17497	
Large Stone Subbase (LSSB) Group	127	Start	17498	258
		End	17756	
	227	Start	17805	260
		End	18065	
LSSB with Geosynthetics Group	328	Start	18065	109
		End	18174	
	428	Start	18174	109
		End	18283	
	528	Start	18283	108
		End	18391	
	628	Start	18391	113
		End	18504	
	728	Start	18504	131
		End	18635	

APPENDIX D
CONSTRUCTION TIMELINE OF TEST CELLS

Cells 185, 186, 188, and 189 (Van Deusen et al. 2018):

Activity \ Date	June				July					August				September			
	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25
Erosion Control	X																
Strip Topsoil																	
Pavement Removal		X	X			X											
Common Excavation						X	X										
Subsurface Drain							X										
Place Conduits and Handholes							X										
Place Risers and Sensors							X			X							
Place Aggregate Base									X								
HMA Paving												X				X	

Cells 127, 227, 128, 228, 328, 428, 528, 628, 728 (Van Deusen et al. 2018):

Activity \ Date	June				July					August				September			
	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25
Erosion Control	X																
Strip Topsoil							X										
Pavement Removal							X										
Common Excavation								X	X	X							
Subsurface Drain										X							
Place Conduits and Handholes																	
Subgrade Preparation											X						
Place Large Aggregate Subbase											X						
Place Risers and Sensors																	
Place Aggregate Base											X						
HMA Paving												X					
Remove Failed Cells (128-228)													X				
Reconstruct Cells (328-628)													X	X			
Final HMA Paving																X	

NOTE: Cells 128 and 228 failed and Cells 328, 428, 528, and 628 were reconstructed in place of them. Cell 728 is a remnant from Cell 228.

Construction Dates of Each Cell (Van Deusen et al. 2018):

Layer / Cell Number	Subgrade	Base	HMA (1st Layer)	HMA (2nd Layer)
185	7/14/2017	8/10/2017	8/21/2017	9/19/2017
186				
188				
189				
127	8/15/2017	8/19/2017	8/21/2017	9/19/2017
227				
128 (Failed)				
228 (Failed)				
328 (Reconst.)	8/28/2017	8/31/2017	9/19/2017	9/19/2017
428 (Reconst.)				
528 (Reconst.)				
628 (Reconst.)				
728 (Remnant)	8/15/2017	8/19/2017	8/21/2017	9/19/2017

NOTE: Cells 128 and 228 failed and Cells 328, 428, 528, and 628 were reconstructed in place of them. Cell 728 is a remnant from Cell 228.

APPENDIX E
CONSTRUCTION OF CELLS 128 (9-IN LSSB) AND 228 (9-IN LSSB)

Rutting on LSSB layer and subgrade soil pumping under construction traffic (White and Vennapusa 2017):

Rutting on LSSB layer and subgrade soil pumping under construction traffic (White and Vennapusa 2017):

Aggregate base layer rutting (White and Vennapusa 2017):

APPENDIX F
GEOSYNTHETICS AND CONSTRUCTION OF CELLS 328 (9-IN LSSB - TX), 428 (9-IN LSSB - TX+GT), 528 (9-IN LSSB - BX+GT), AND 628 (9-IN LSSB - BX)

Properties of geosynthetics (as reported by manufacturers)

Geosynthetic Type	Property	Test Method	Values
Tensar TriAx TX190L (Triaxial Geogrid)	Rib Pitch[a, b]	NA	2.4 in (60 mm)
	Junction Efficiency[c]	ASTM D7737	93%
	Isotropic Stiffness Ratio[d]	NA	0.6
	Radial Stiffness at 0.5% Strain	ASTM D6637	23,989 lb/ft (350 kN/m)
Tensar BX1300 (Biaxial Geogrid)	Aperture Dimensions[a, e]	NA	1.8 in (46 mm)
	Minimum Rib Thickness[a, e]	NA	0.05 in (1.27 mm)
	Tensile Strength at 5% Strain[e]	ASTM D6637	720 lb/ft (10.5 kN/m)
	Ultimate Tensile Strength[e]	ASTM D6637	1,100 lb/ft (16 kN/m)
	Junction Efficiency[c]	ASTM D7737	93%
SKAPS GT-116 (Needle-Punched Nonwoven Geotextile)	Grab Tensile Strength	ASTM D4632	380 lb (1.690 kN)
	Grab Elongation	ASTM D4632	50%
	Trapezoid Tear Strength	ASTM D4533	145 lb (0.644 kN)
	CBR Puncture Resistance	ASTM D6241	1,080 lb (4.804 kN)
	Permittivity [f]	ASTM D4491	0.7 sec^{-1}
	Apparent Opening Size [f, g]	ASTM D4751	0.0059 in (0.150 mm)

NOTE: NA = not available.

[a]Nominal dimensions

[b]Longitudinal and diagonal

[c]Load transfer capability expressed as a percentage of ultimate tensile strength

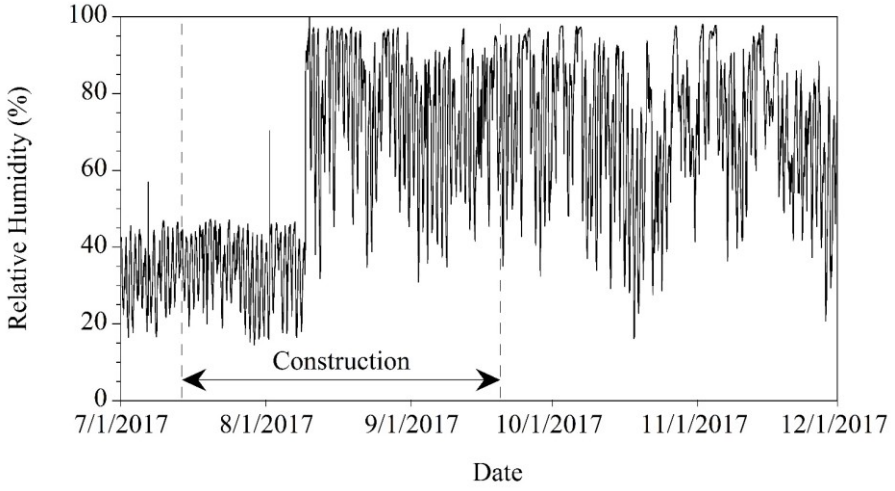
[d]Ratio between the minimum and maximum radial stiffness values at 0.5% strain

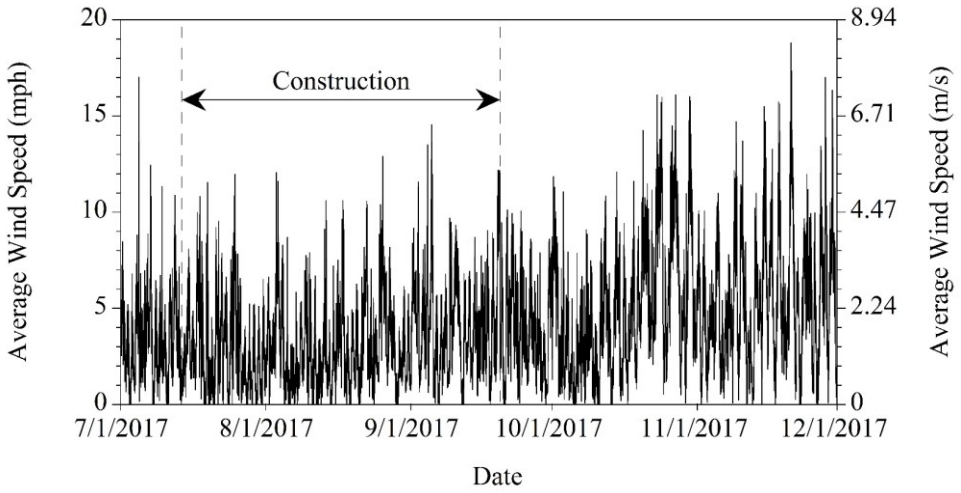
[e]Machine direction

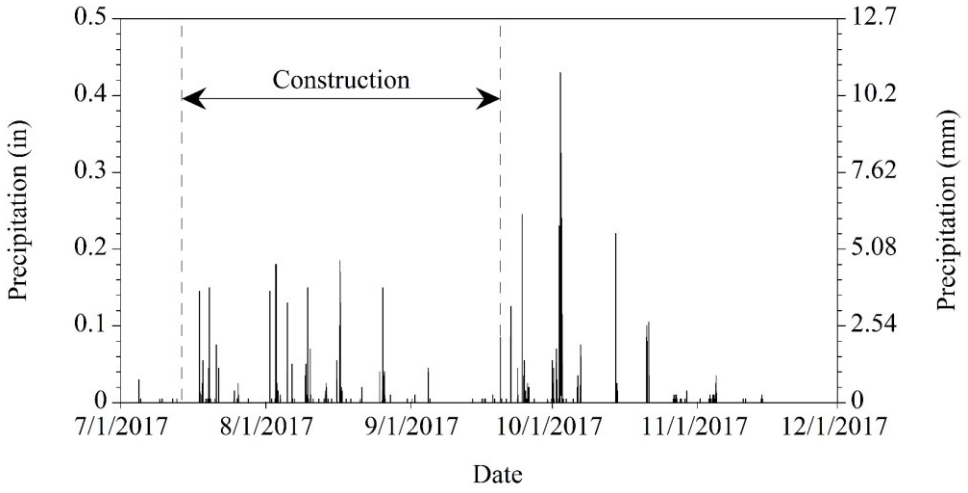
[f]At time of manufacturing. Results may change after handling.

[M]inimum average roll value.

APPENDIX G
RELATIVE HUMIDITY, AVERAGE WIND SPEED, AND PRECIPITATION DATA DURING AND SHORTLY AFTER CONSTRUCTION

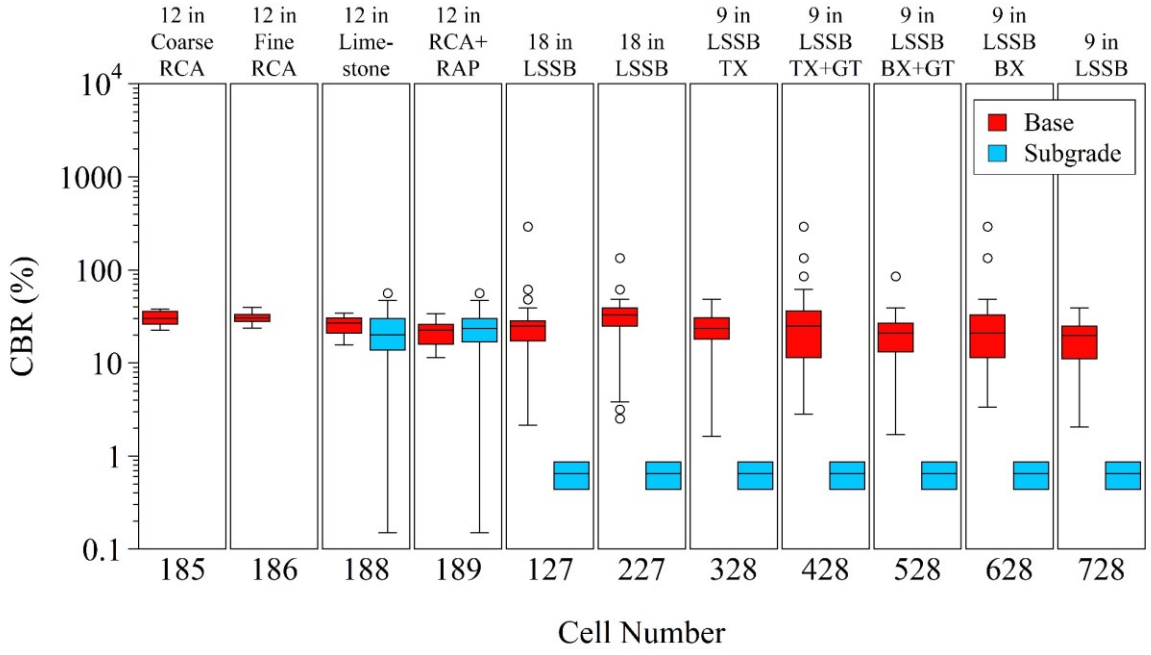

Relative Humidity (%)
100
80
60
40
20
0
Construction
7/1/2017
8/1/2017
9/1/2017
10/1/2017
11/1/2017
12/1/2017
Date


Average Wind Speed (mph)
20
15
10
5
0
Construction
8.94
6.71
4.47
2.24
0
Average Wind Speed (m/s)
7/1/2017
8/1/2017
9/1/2017
10/1/2017
11/1/2017
12/1/2017
Date

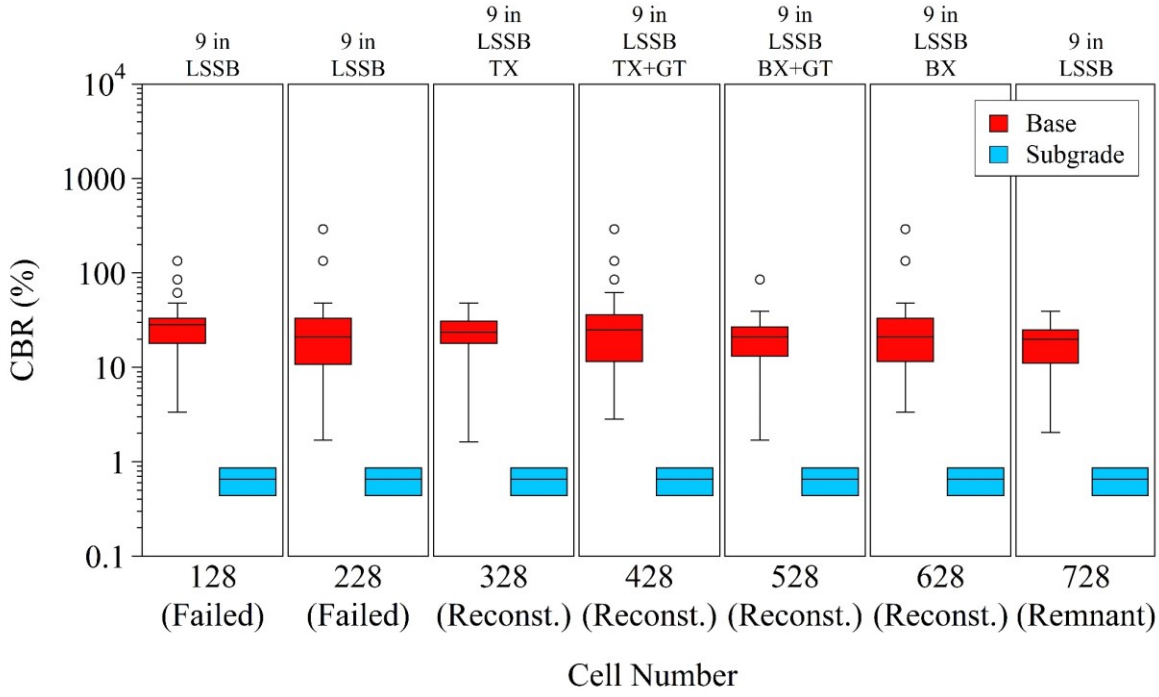

Precipitation (in)
0.5
0.4
0.3
0.2
0.1
0
Construction
12.7
10.2
7.62
5.08
2.54
0
Precipitation (mm)
7/1/2017
8/1/2017
9/1/2017
10/1/2017
11/1/2017
12/1/2017
Date

APPENDIX H
CALIFORNIA BEARING RATIO (CBR) VALUES ESTIMATED FROM DYNAMIC CONE PENETRATION (DCP) TEST DATA

CBR values of all test cells:

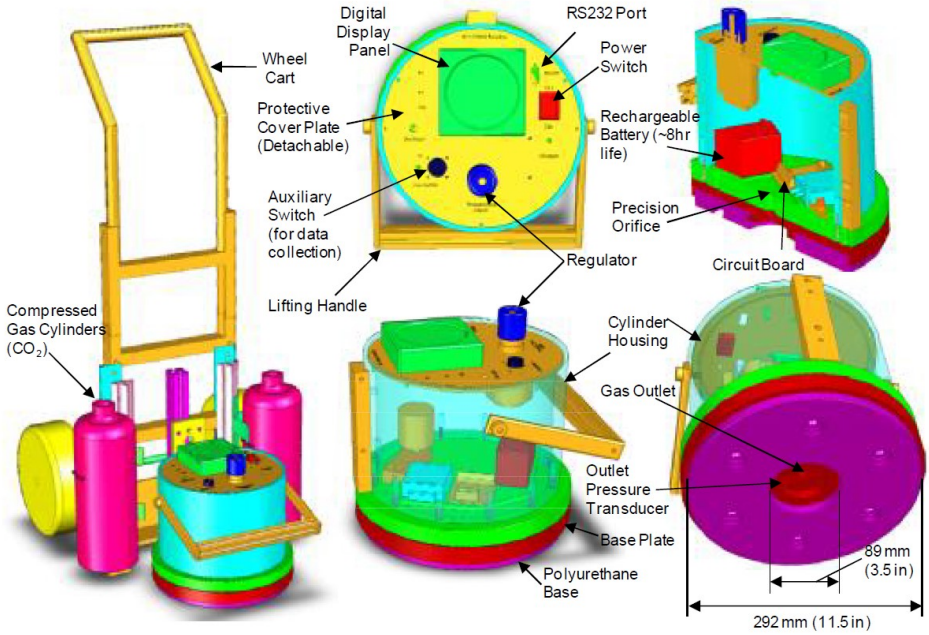


CBR values of failed (Cells 128 and 228) and reconstructed (Cells 328 to 628) test cells:

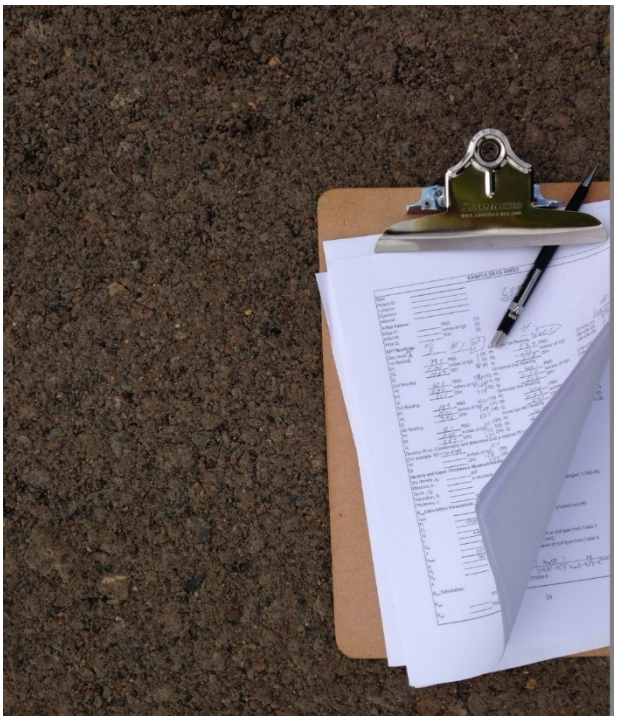


APPENDIX I
GAS PERMEAMETER TEST (GPT) EQUIPMENT AND TEST SURFACE TEXTURES

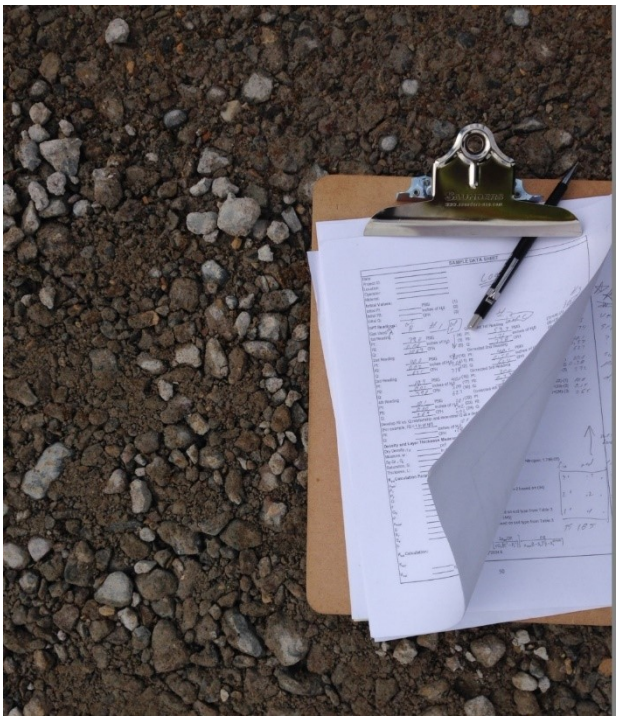
GPT equipment (White et al. 2010):



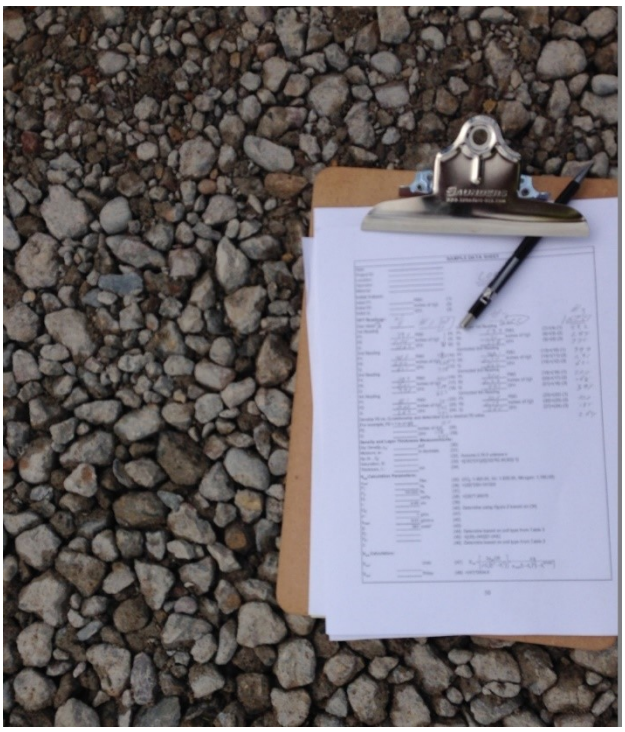
Fine surface texture



Medium surface texture



Coarse surface texture



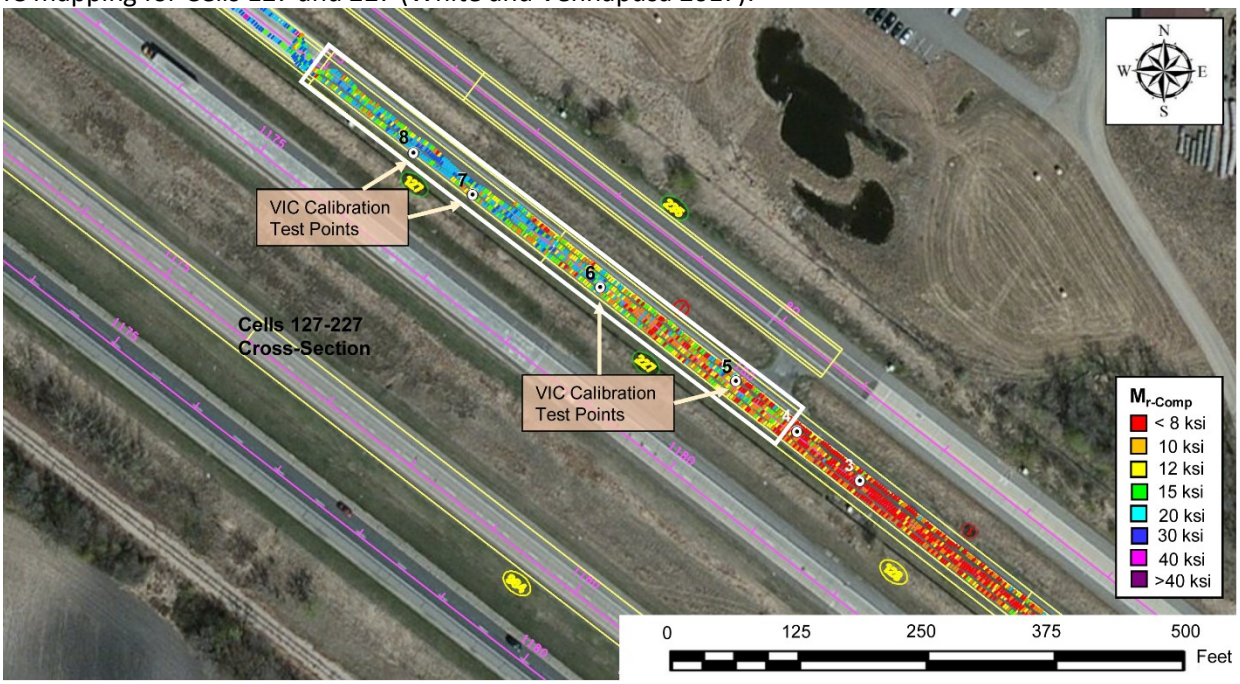
APPENDIX J
INTELLIGENT COMPACTION (IC) AND ITS CALIBRATION

APLT test system at the MnROAD LVR (White and Vennapusa 2017):

APLT test setup and deflection basin measurement kit with center plate (White and Vennapusa 2017):

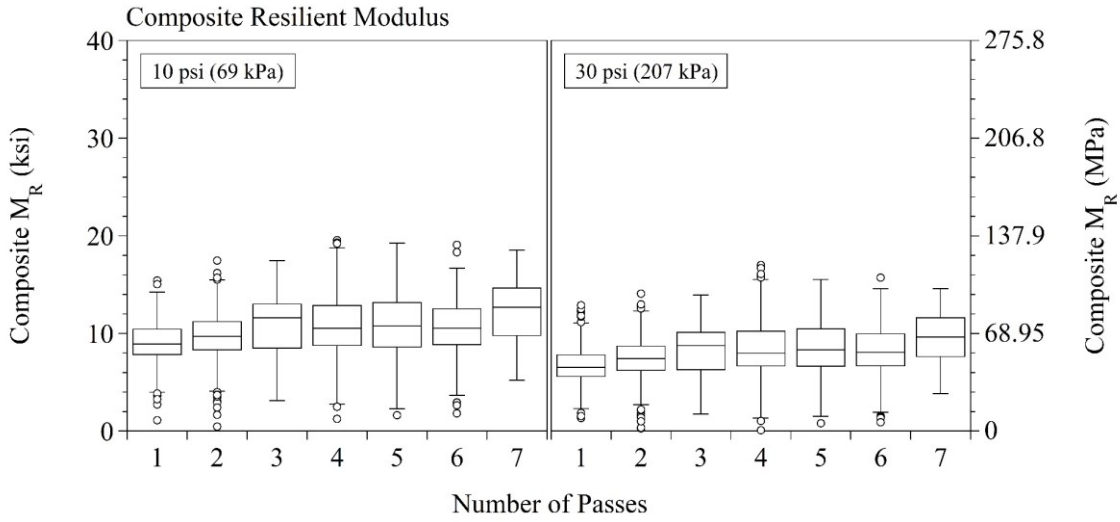
Caterpillar CS56 vibratory smooth drum roller outfitted with Ingios VIC system and RTK-GPS (White and Vennapusa 2017):

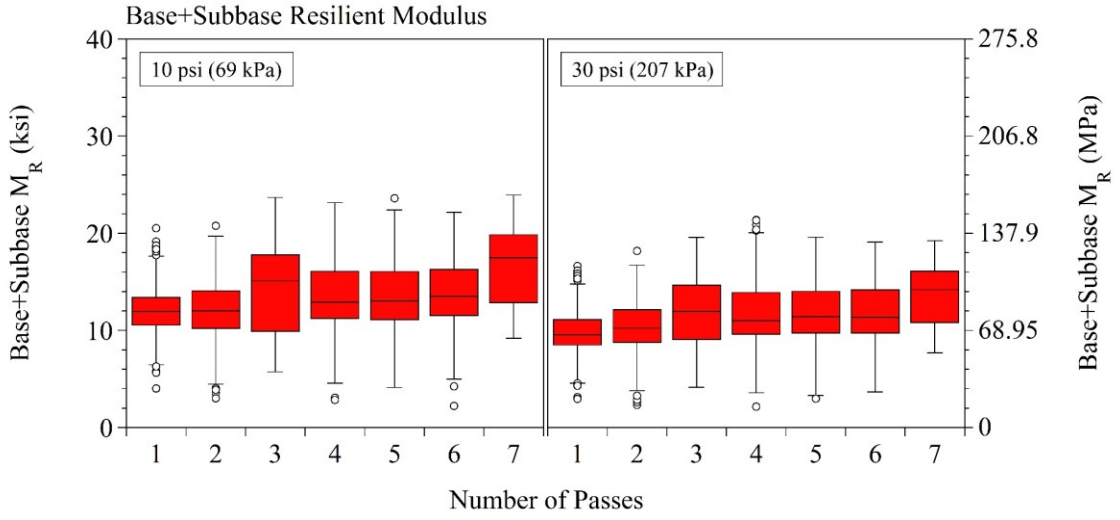
IC mapping for Cells 127 and 227 (White and Vennapusa 2017):

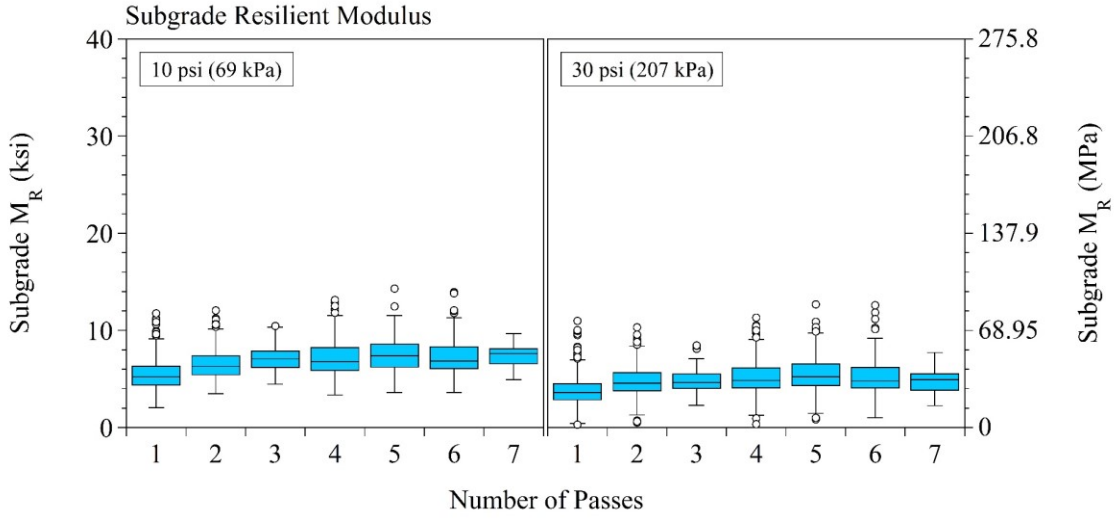


APPENDIX K
RESILIENT MODULUS (M_R) OF RECONSTRUCTED CELLS AT EACH PASS

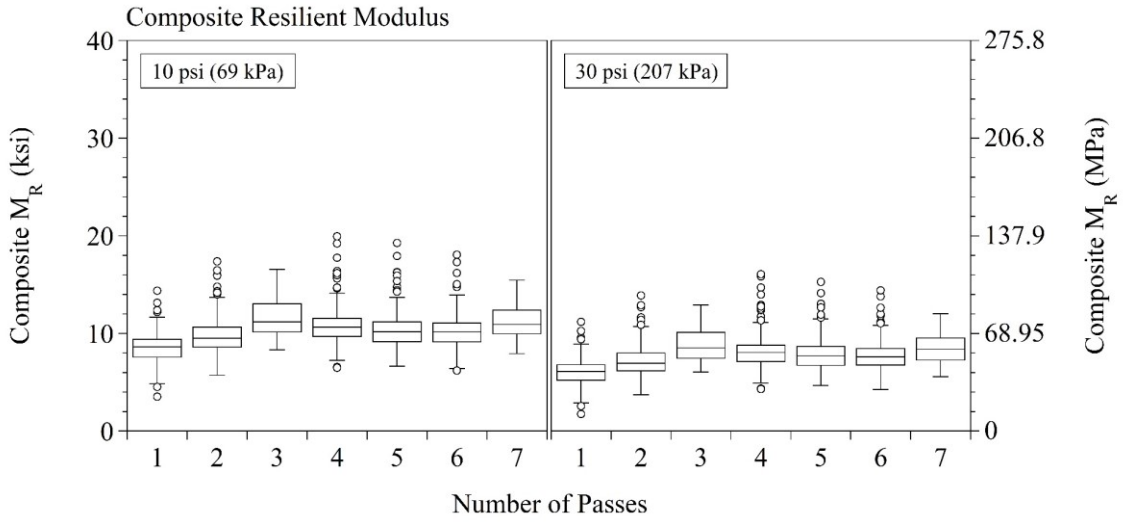
Cell 328:

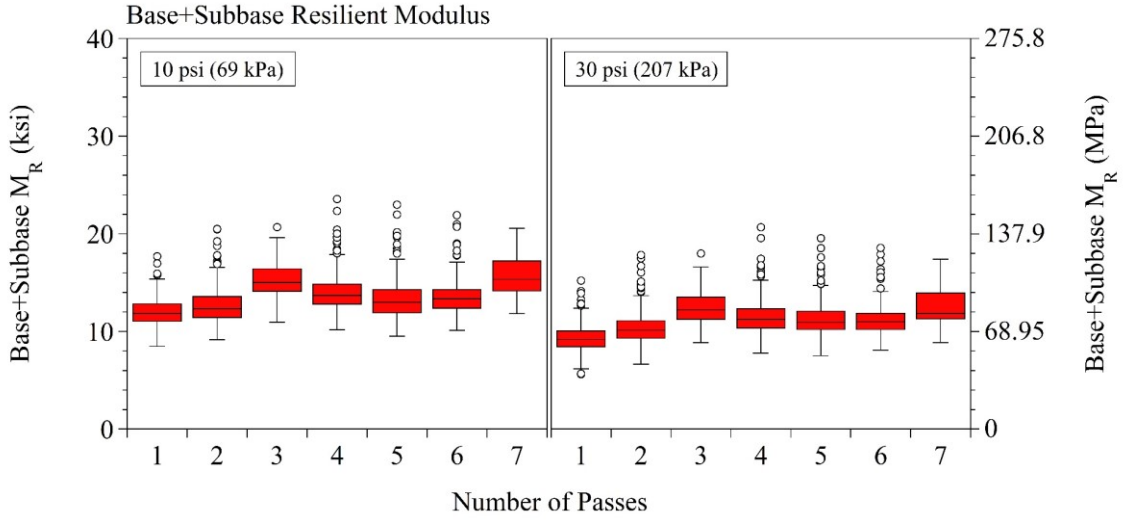

Composite Resilient Modulus
10 psi (69 kPa)
30 psi (207 kPa)
Composite M_R (ksi)
Composite M_R (MPa)
0
10
20
30
40
0
68.95
137.9
206.8
275.8
1 2 3 4 5 6 7 1 2 3 4 5 6 7
Number of Passes

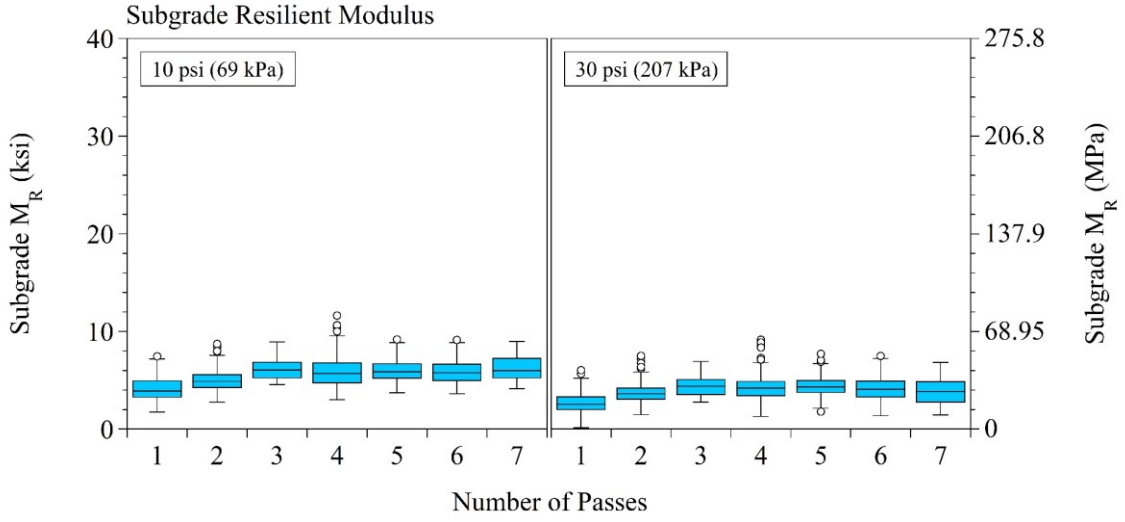

Base+Subbase Resilient Modulus
10 psi (69 kPa)
30 psi (207 kPa)
Base+Subbase M_R (ksi)
Base+Subbase M_R (MPa)
0
10
20
30
40
0
68.95
137.9
206.8
275.8
1 2 3 4 5 6 7 1 2 3 4 5 6 7
Number of Passes


Subgrade Resilient Modulus
10 psi (69 kPa)
30 psi (207 kPa)
Subgrade M_R (ksi)
Subgrade M_R (MPa)
0
10
20
30
40
0
68.95
137.9
206.8
275.8
1 2 3 4 5 6 7 1 2 3 4 5 6 7
Number of Passes

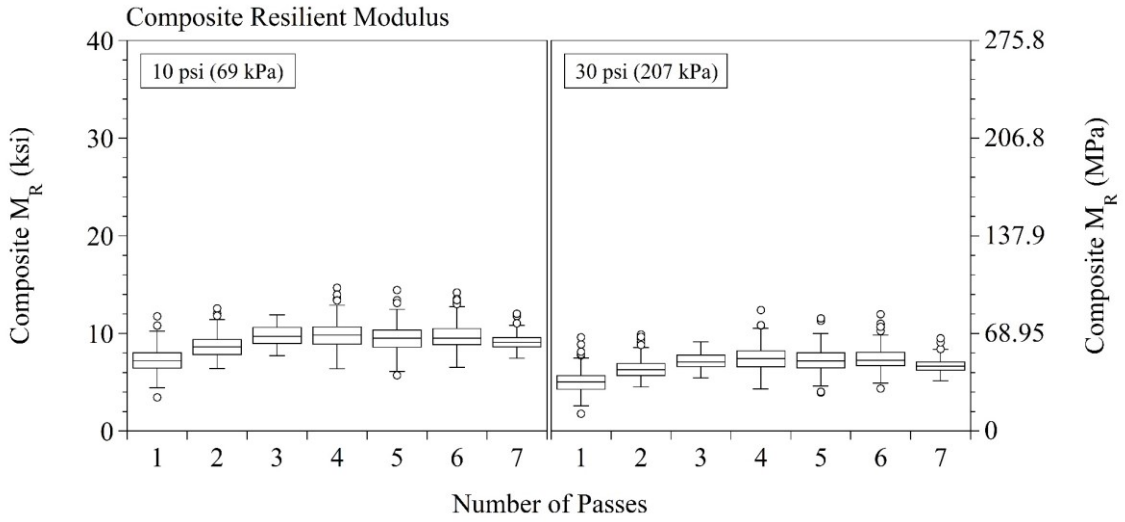
Cell 428:

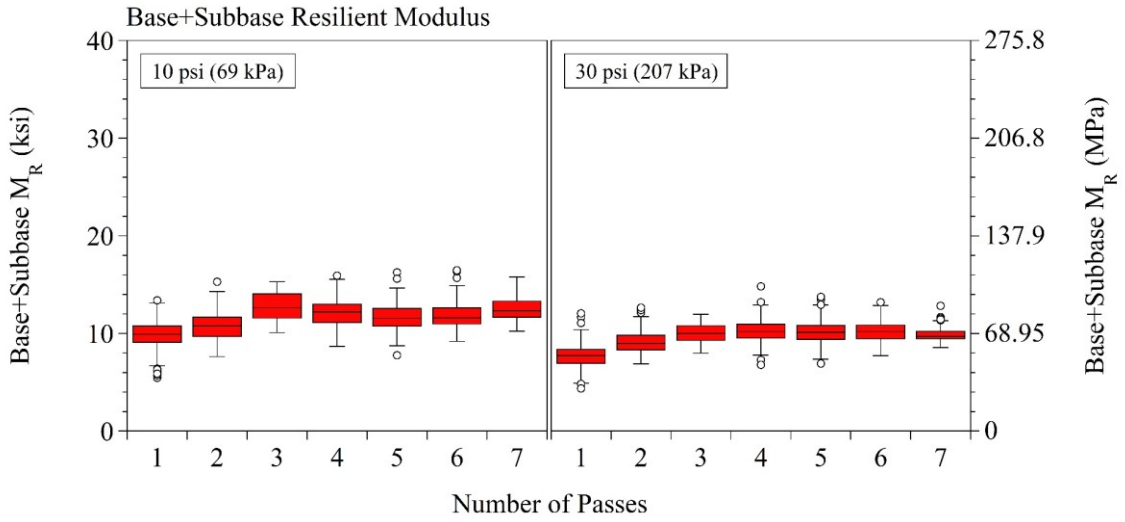

Composite Resilient Modulus
10 psi (69 kPa)
30 psi (207 kPa)
Composite M_R (ksi)
Composite M_R (MPa)
0
10
20
30
40
0
68.95
137.9
206.8
275.8
1 2 3 4 5 6 7 1 2 3 4 5 6 7
Number of Passes

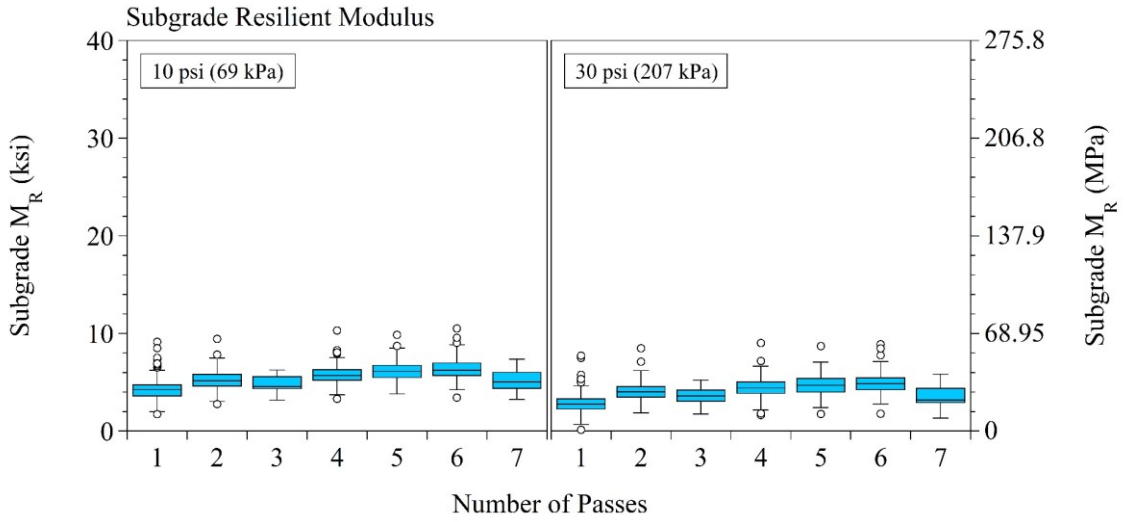

Base+Subbase Resilient Modulus
10 psi (69 kPa)
30 psi (207 kPa)
Base+Subbase M_R (ksi)
Base+Subbase M_R (MPa)
0
10
20
30
40
0
68.95
137.9
206.8
275.8
1 2 3 4 5 6 7 1 2 3 4 5 6 7
Number of Passes


Subgrade Resilient Modulus
10 psi (69 kPa)
30 psi (207 kPa)
Subgrade M_R (ksi)
Subgrade M_R (MPa)
0
10
20
30
40
0
68.95
137.9
206.8
275.8
1 2 3 4 5 6 7 1 2 3 4 5 6 7
Number of Passes

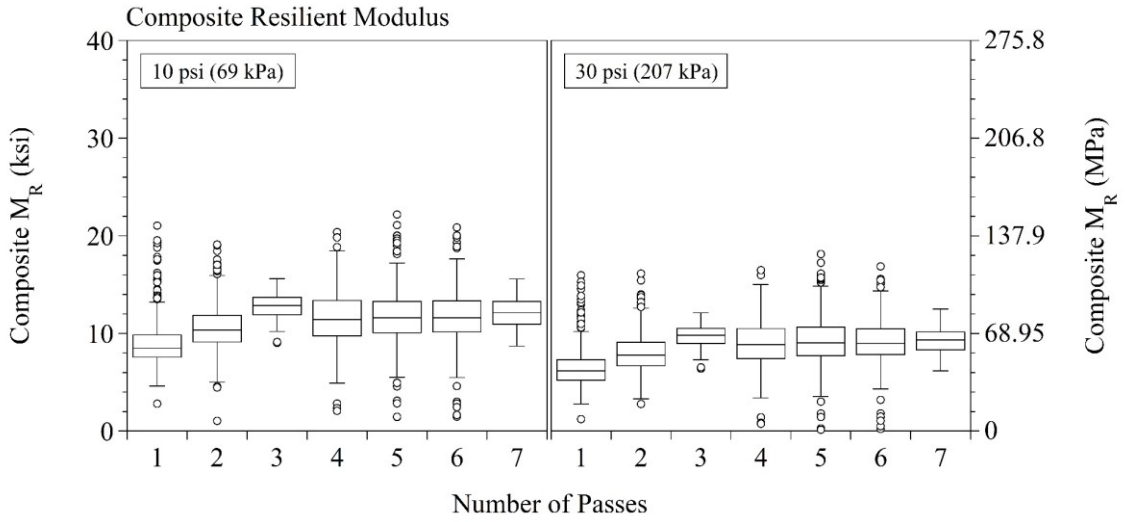
Cell 528:

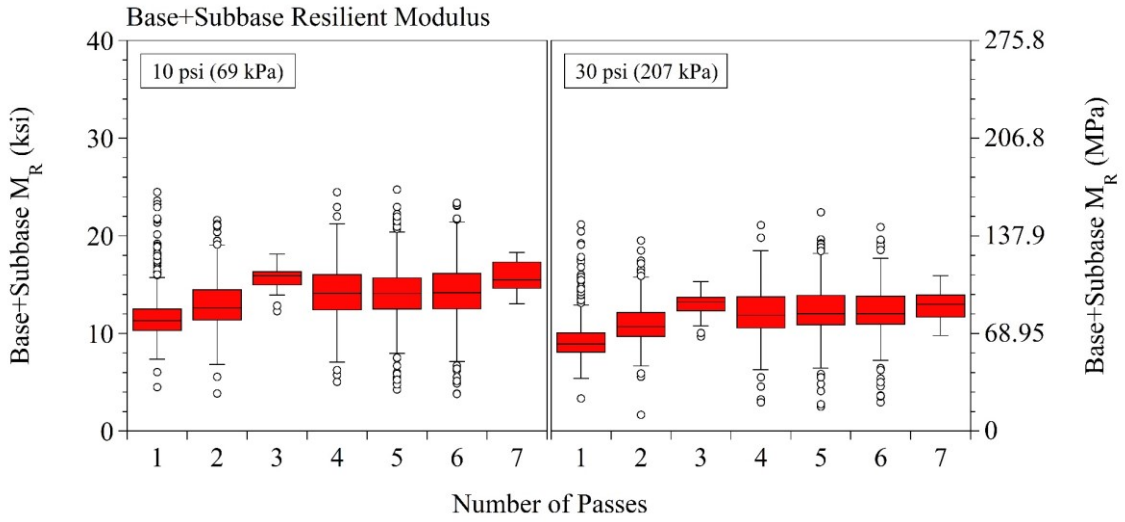

Composite Resilient Modulus
10 psi (69 kPa)
30 psi (207 kPa)
Composite M_R (ksi)
Composite M_R (MPa)
0
10
20
30
40
68.95
137.9
206.8
275.8
1 2 3 4 5 6 7 1 2 3 4 5 6 7
Number of Passes

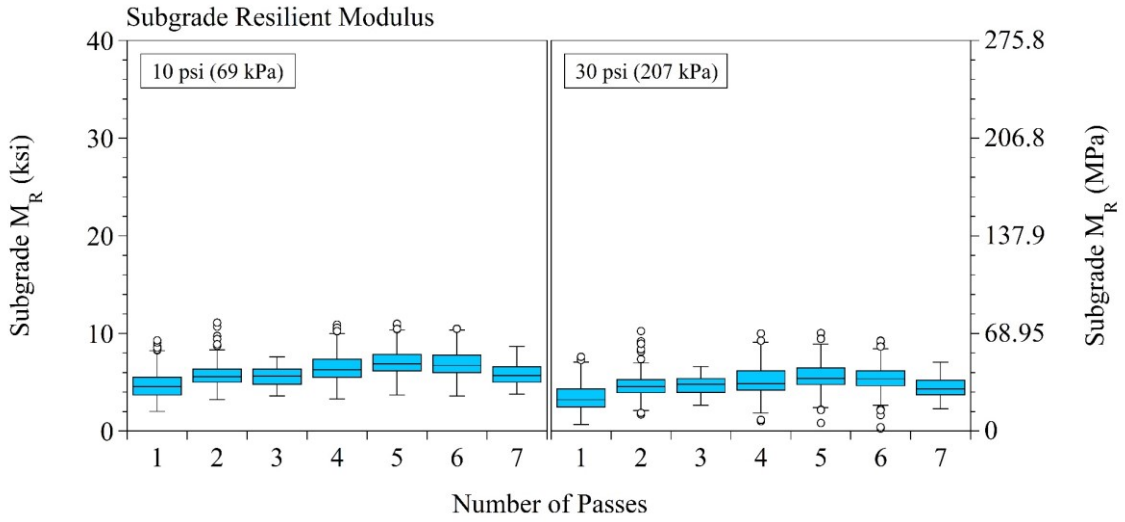

Base+Subbase Resilient Modulus
10 psi (69 kPa)
30 psi (207 kPa)
Base+Subbase M_R (ksi)
Base+Subbase M_R (MPa)
0
10
20
30
40
68.95
137.9
206.8
275.8
1 2 3 4 5 6 7 1 2 3 4 5 6 7
Number of Passes


Subgrade Resilient Modulus
10 psi (69 kPa)
30 psi (207 kPa)
Subgrade M_R (ksi)
Subgrade M_R (MPa)
0
10
20
30
40
68.95
137.9
206.8
275.8
1 2 3 4 5 6 7 1 2 3 4 5 6 7
Number of Passes

Cell 628:


Composite Resilient Modulus
10 psi (69 kPa)
30 psi (207 kPa)
Composite M_R (ksi)
Composite M_R (MPa)
0
10
20
30
40
0
68.95
137.9
206.8
275.8
1 2 3 4 5 6 7 1 2 3 4 5 6 7
Number of Passes


Base+Subbase Resilient Modulus
10 psi (69 kPa)
30 psi (207 kPa)
Base+Subbase M_R (ksi)
Base+Subbase M_R (MPa)
0
10
20
30
40
0
68.95
137.9
206.8
275.8
1 2 3 4 5 6 7 1 2 3 4 5 6 7
Number of Passes

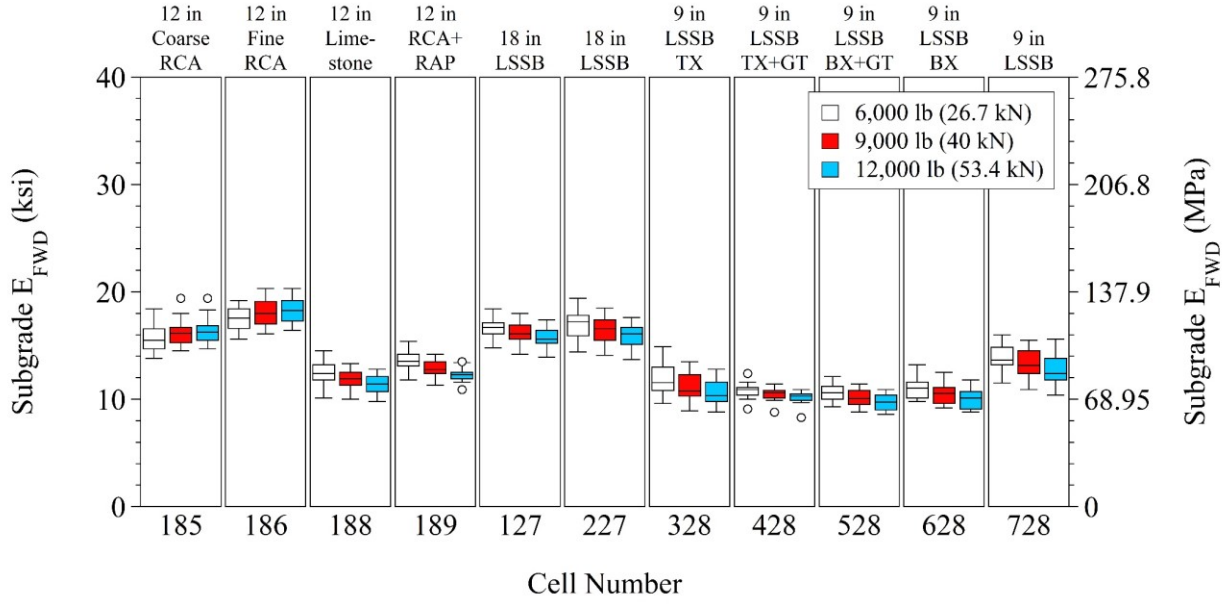

Subgrade Resilient Modulus
10 psi (69 kPa)
30 psi (207 kPa)
Subgrade M_R (ksi)
Subgrade M_R (MPa)
0
10
20
30
40
0
68.95
137.9
206.8
275.8
1 2 3 4 5 6 7 1 2 3 4 5 6 7
Number of Passes

APPENDIX L
FALLING WEIGHT DEFLECTOMETER (FWD) TESTING EQUIPMENT

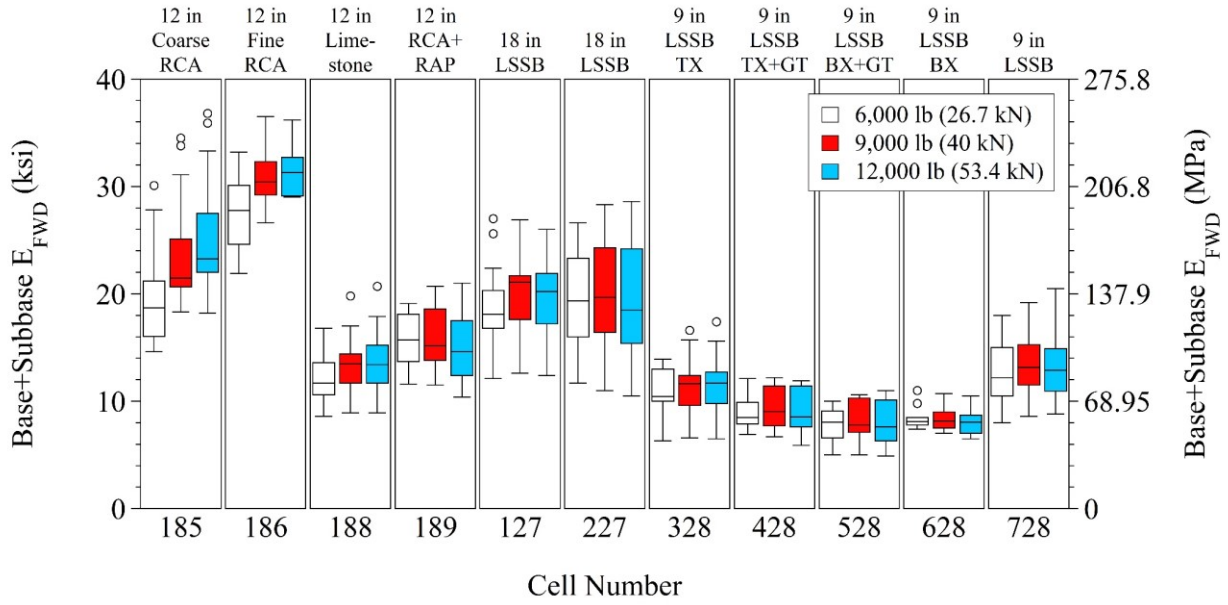
Trailer-mounted Dynatest Model 8002 FWD device:

APPENDIX M
FALLING WEIGHT DEFLECTOMETER (FWD) TEST RESULTS OF CELLS AFTER PAVING

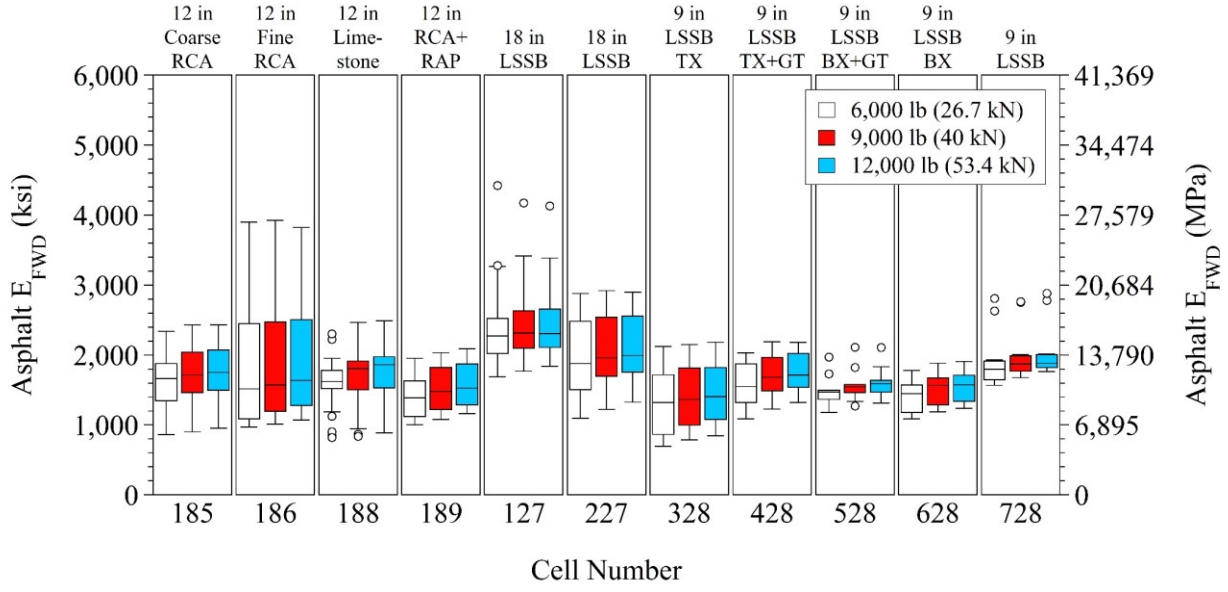
Subgrade E_{FWD} - After Paving



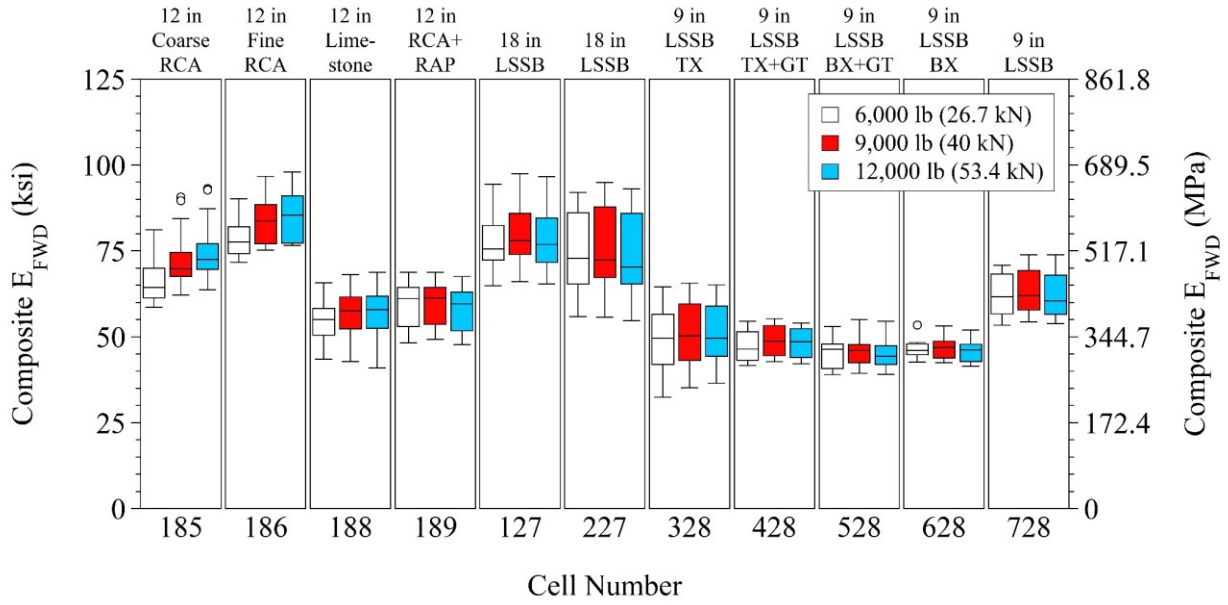
Base+Subbase E_{FWD} - After Paving



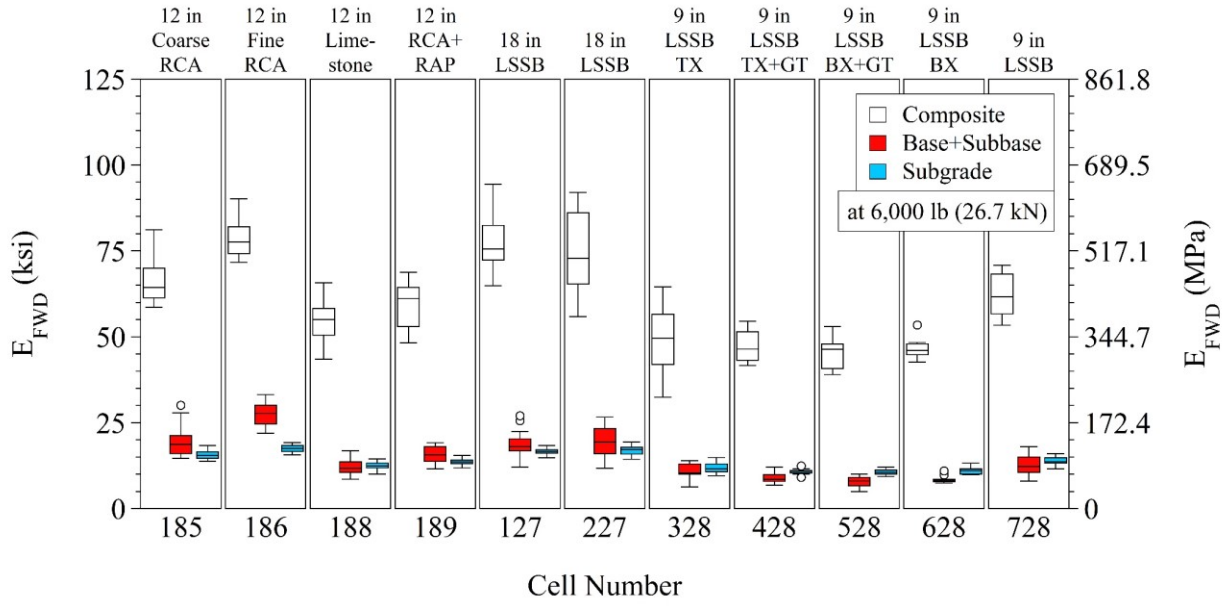
Asphalt E_{FWD} - After Paving



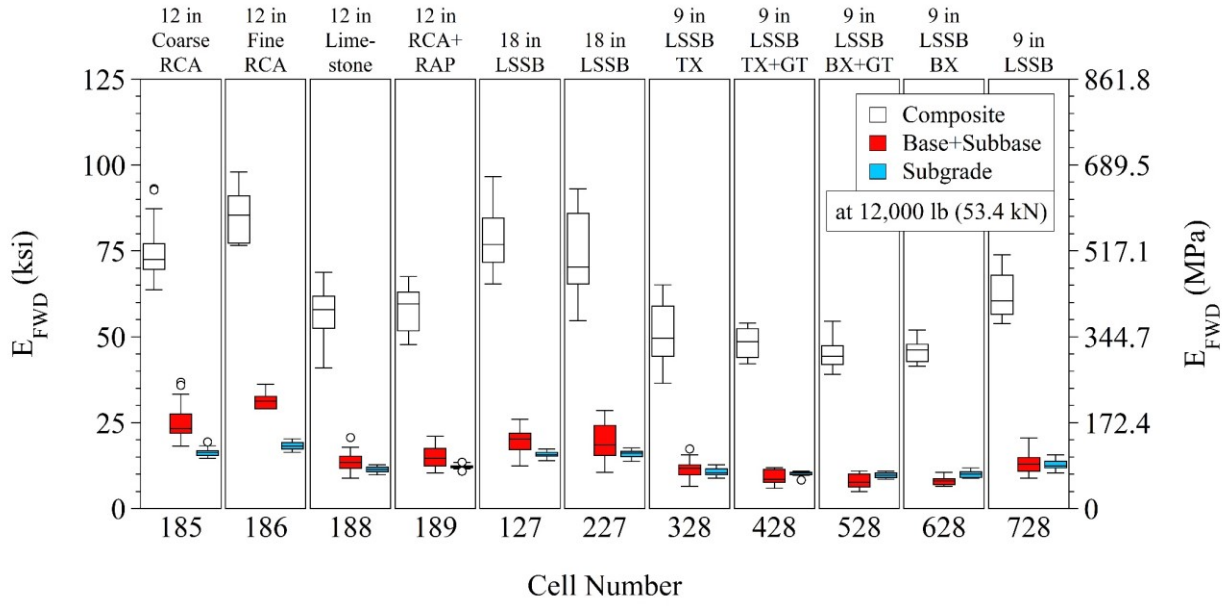
Composite E_{FWD} - After Paving



E_{FWD} at 6,000 lb (26.7 kN) - After paving

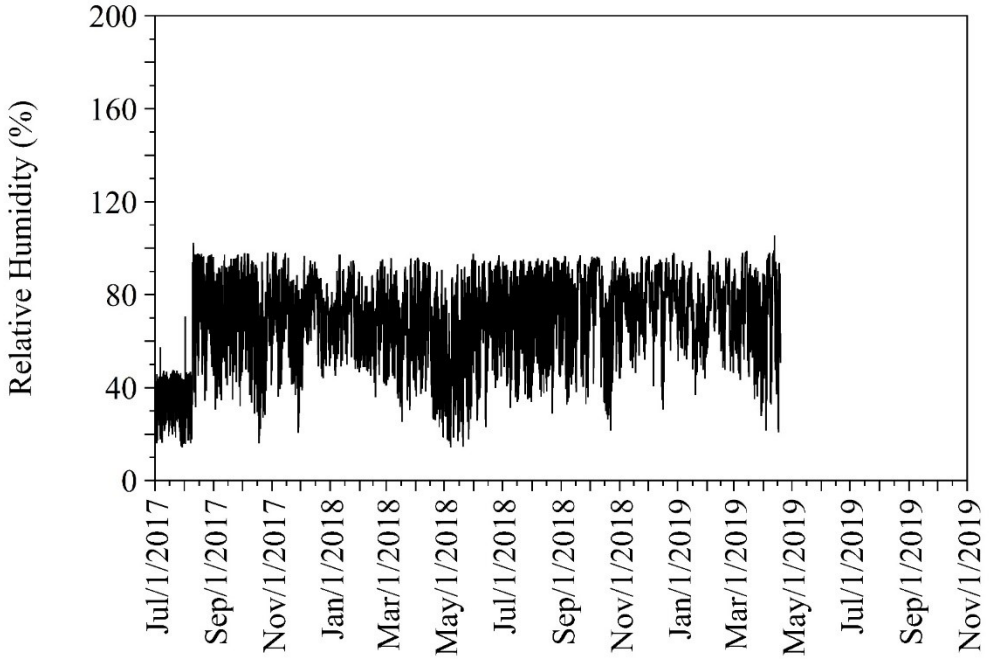


E_{FWD} at 12,000 lb (53.4 kN) - After paving

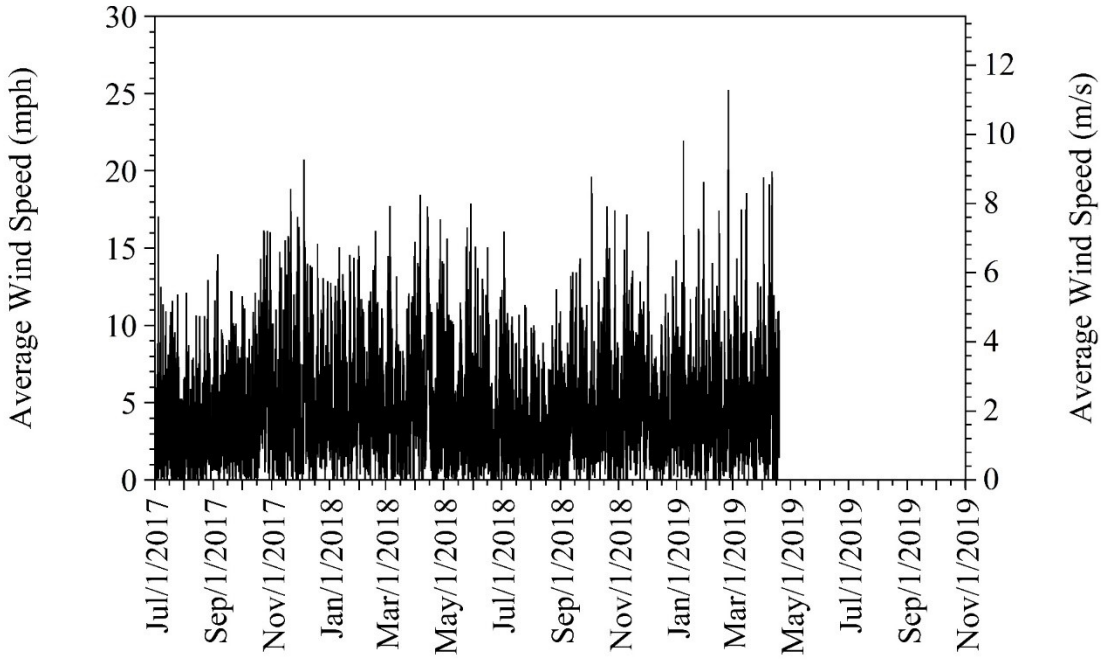


APPENDIX N
RELATIVE HUMIDITY AND AVERAGE WIND SPEED DATA IN THE LONG-TERM

Relative humidity (results are the average of the data collected from the two weather stations):



Average wind speed (results are the average of the data collected from the two weather stations):



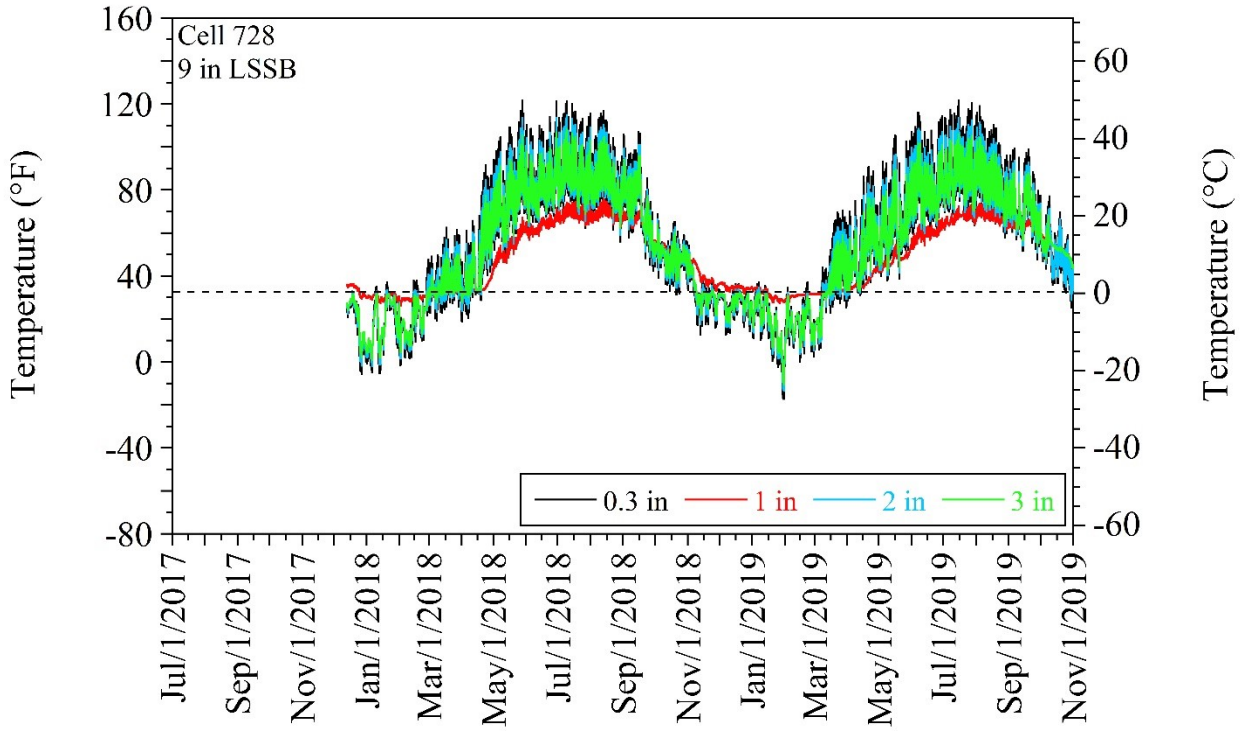
APPENDIX O
LOCATIONS OF EMBEDDED SENSORS

Cell Number	Cell Description	Sensor	Number	Station	Offset (ft)	Depth from Surface (in)
185	12 in Coarse RCA	Thermocouple (TC)	1	16538.51	-6.4	2.8
			2	16538.51	-6.4	3.8
			3	16538.51	-6.4	9.3
			4	16538.51	-6.4	14.8
			5	16538.51	-6.4	15.8
			6	16538.51	-6.4	18.3
			7	16538.51	-6.4	19.3
			8	16538.51	-6.4	23.8
			9	16538.51	-6.4	35.8
			10	16538.51	-6.4	47.8
			11	16538.51	-6.4	59.8
			12	16538.51	-6.4	71.8
		Moisture Probe (EC)	1	16538.81	-5.8	5
			2	16538.81	-5.8	14
			3	16538.81	-5.8	17
			4	16538.81	-5.8	20.5
186	12 in Fine RCA	Thermocouple (TC)	1	16678.52	-6.3	3
			2	16678.52	-6.3	4
			3	16678.52	-6.3	9.5
			4	16678.52	-6.3	15
			5	16678.52	-6.3	16
			6	16678.52	-6.3	18.5
			7	16678.52	-6.3	19.5
			8	16678.52	-6.3	24
			9	16678.52	-6.3	36
			10	16678.52	-6.3	48
			11	16678.52	-6.3	60
			12	16678.52	-6.3	72
		Moisture Probe (EC)	1	16678.91	-5.6	5
			2	16678.91	-5.6	14
			3	16678.91	-5.6	17
			4	16678.91	-5.6	20.5

Cell Number	Cell Description	Sensor	Number	Station	Offset (ft)	Depth from Surface (in)
188	12 in Limestone	Thermocouple (TC)	1	17111.5	-5.5	3
			2	17111.5	-5.5	4
			3	17111.5	-5.5	9.5
			4	17111.5	-5.5	15
			5	17111.5	-5.5	16
			6	17111.5	-5.5	18.5
			7	17111.5	-5.5	19.5
			8	17111.5	-5.5	24
			9	17111.5	-5.5	36
			10	17111.5	-5.5	48
			11	17111.5	-5.5	60
			12	17111.5	-5.5	72
		Moisture Probe (EC)	1	17111.8	-4.8	5
			2	17111.8	-4.8	14
			3	17111.8	-4.8	17
			4	17111.8	-4.8	20.5
189	12 in RCA+RAP	Thermocouple (TC)	1	17306.1	-5.3	3
			2	17306.1	-5.3	4
			3	17306.1	-5.3	9.5
			4	17306.1	-5.3	15
			5	17306.1	-5.3	16
			6	17306.1	-5.3	18.5
			7	17306.1	-5.3	19.5
			8	17306.1	-5.3	24
			9	17306.1	-5.3	36
			10	17306.1	-5.3	48
			11	17306.1	-5.3	60
			12	17306.1	-5.3	72
		Moisture Probe (EC)	1	17306.2	-4.7	5
			2	17306.2	-4.7	14
			3	17306.2	-4.7	17
			4	17306.2	-4.7	20.5

Cell Number	Cell Description	Sensor	Number	Station	Offset (ft)	Depth from Surface (in)
127	18 in LSSB	Thermocouple (TC)	1	17569	-11.5	3
			2	17569	-11.5	4
			3	17569	-11.5	6.5
			4	17569	-11.5	9
			5	17569	-11.5	10
			6	17569	-11.5	12
			7	17569	-11.5	18
			8	17569	-11.5	24
			9	17569	-11.5	36
			10	17569	-11.5	48
			11	17569	-11.5	60
			12	17569	-11.5	72
		Moisture Probe (EC)	1	17569	-11	6.5
			2	17569	-11	29
			3	17569	-11	36
728	9 in LSSB	Thermocouple (TC)	1	18544.1	-11.6	3
			2	18544.1	-11.6	4
			3	18544.1	-11.6	6.5
			4	18544.1	-11.6	9
			5	18544.1	-11.6	10
			6	18544.1	-11.6	14
			7	18544.1	-11.6	18.5
			8	18544.1	-11.6	24
			9	18544.1	-11.6	36
			10	18544.1	-11.6	48
			11	18544.1	-11.6	60
			12	18544.1	-11.6	72
			13	18544.1	-11.9	0.3
			14	18544.1	-11.9	1
			15	18544.1	-11.9	2
			16	18544.1	-11.9	3
		Moisture Probe (EC)	1	18544	-11	8.5
			2	18544	-11	19.5
			3	18544	-11	24
			4	18544	-11	36

APPENDIX P
CHANGE IN TEMPERATURE OF ASPHALT LAYER IN CELL 728 (9-IN LSSB)


Cell 728
9 in LSSB
Temperature (°F)
Temperature (°C)
160
120
80
40
0
-40
-80
60
40
20
0
-20
-40
-60
0.3 in
1 in
2 in
3 in
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

APPENDIX Q
CALIBRATION EQUATIONS TO ESTIMATE VOLUMETRIC WATER CONTENT (VWC) AND DEGREE OF SATURATION (DOS) VALUES

Calibration equations:

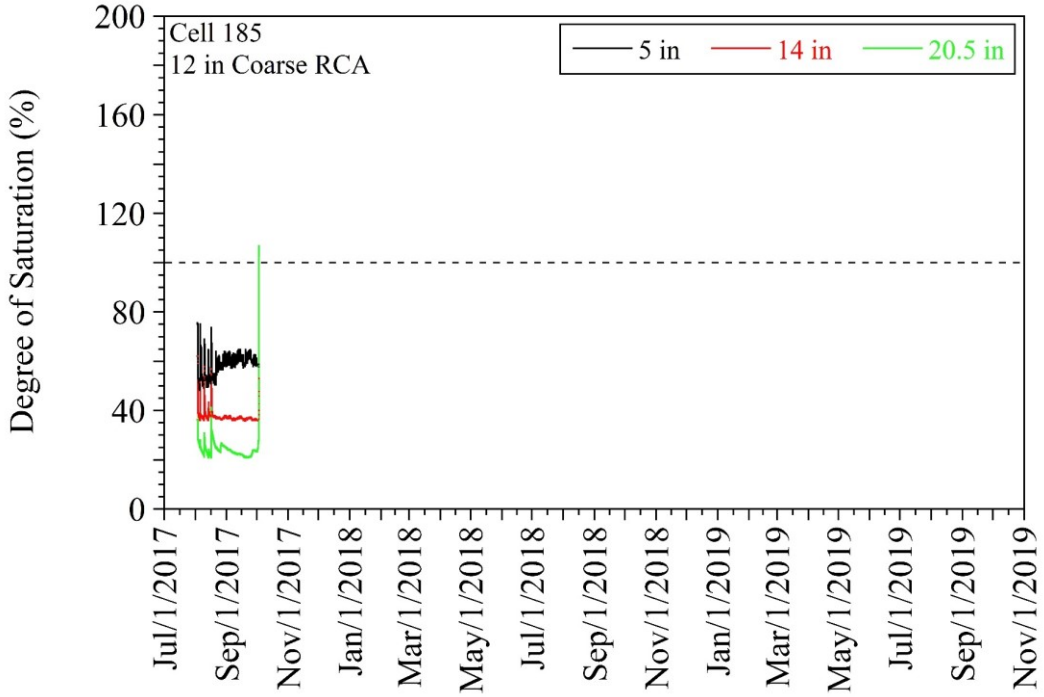
Cell/Instrument	Layer	Calibration Equation
185-186		
EC 1	RCA (-5”)	-0.0000004*RAW^2+0.0007*RAW-0.0409
EC 2	RCA (-14”)	-0.0000004*RAW^2+0.0007*RAW-0.0409
EC 3	S. Granular (-17”)	0.0005*RAW-0.0908
EC 4	Sand (-20.5”)	0.0004*RAW-0.078
188		
EC 1	Cl-6 Limestone (-5”)	0.0003*RAW-0.0437
EC 2	Cl-6 Limestone (-14)	0.0003*RAW-0.0437
EC 3	S. Granular (-17”)	0.0005*RAW-0.0908
EC 4	Clay (-20.5”)	0.0003*RAW-0.0021
189		
EC 1	Cl-6 Recycled (-5”)	0.0006*RAW-0.1358
EC 2	Cl-6 Recycled (-14”)	0.0006*RAW-0.1358
EC 3	S. Granular (-17”)	0.0005*RAW-0.0908
EC 4	Clay (-20.5”)	0.0003*RAW-0.0021
127		
EC 1	Cl-6 (-6.5”)	0.0006*RAW-0.1358
EC 2	Clay (-29”)	0.0003*RAW-0.0021
EC 3	Clay (-36”)	0.0003*RAW-0.0021
728		
EC 1	Cl-5Q (-8.5”)	-0.0000004*RAW^2+0.0007*RAW-0.0409
EC 2	Clay (-19”)	0.0003*RAW-0.0021
EC 3	Clay (-24”)	0.0003*RAW-0.0021
EC 4	Clay (-36”)	0.0003*RAW-0.0021

Degree of Saturation (DOS) Values

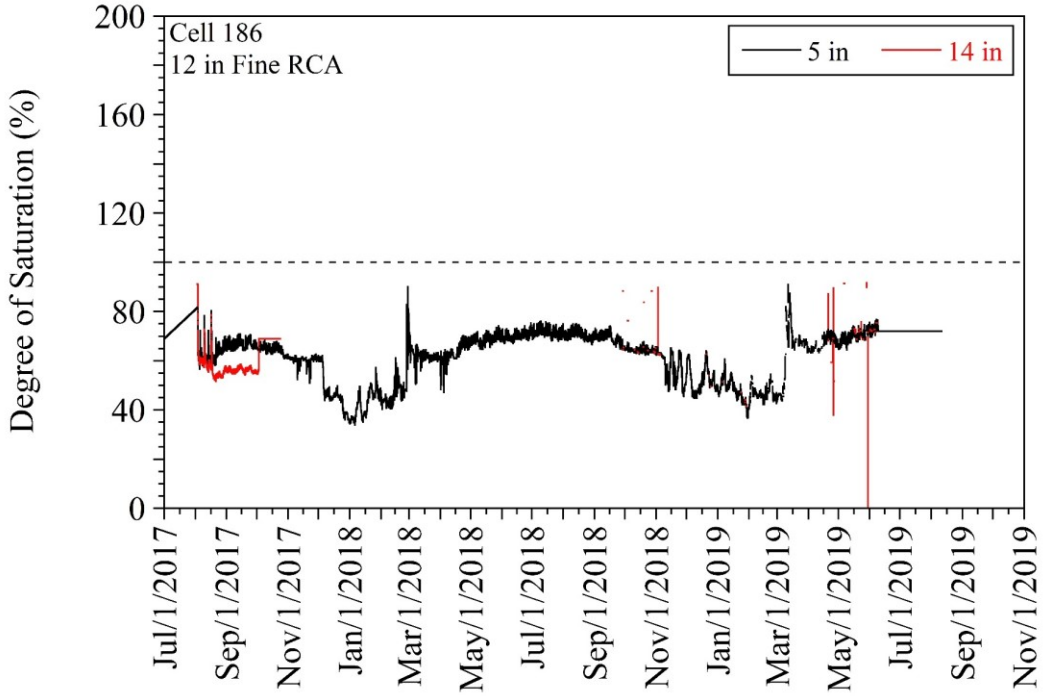
The following equation was used to calculate the degree of saturation (DOS). The median dry unit weight (γ_{dry}) values of the materials were determined from the nuclear density gauge (NDG) measurements taken from the outside lanes of the test cells during construction. The specific gravity (G_s) values of the materials were taken from laboratory test results. To calculate the moisture content (gravimetric) of the materials (ω), the VWC values were divided by γ_{dry} (γ_{water} = 1 g/cm^3). Overall, it was concluded that slight increases in the DOS values were observed due to precipitation in the rainy periods.

$$DOS\ (\%) = \frac{\gamma_{dry} * G_s * \omega}{\gamma_{water} * G_s - \gamma_{dry}} * 100$$

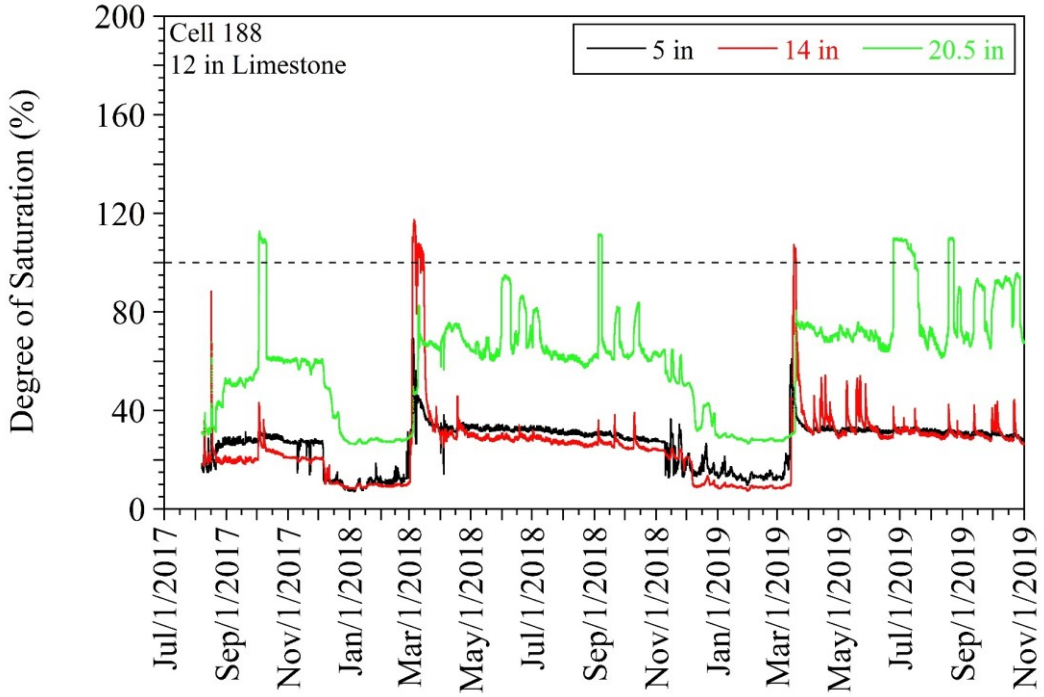
Cell 185 (12-in Coarse RCA)



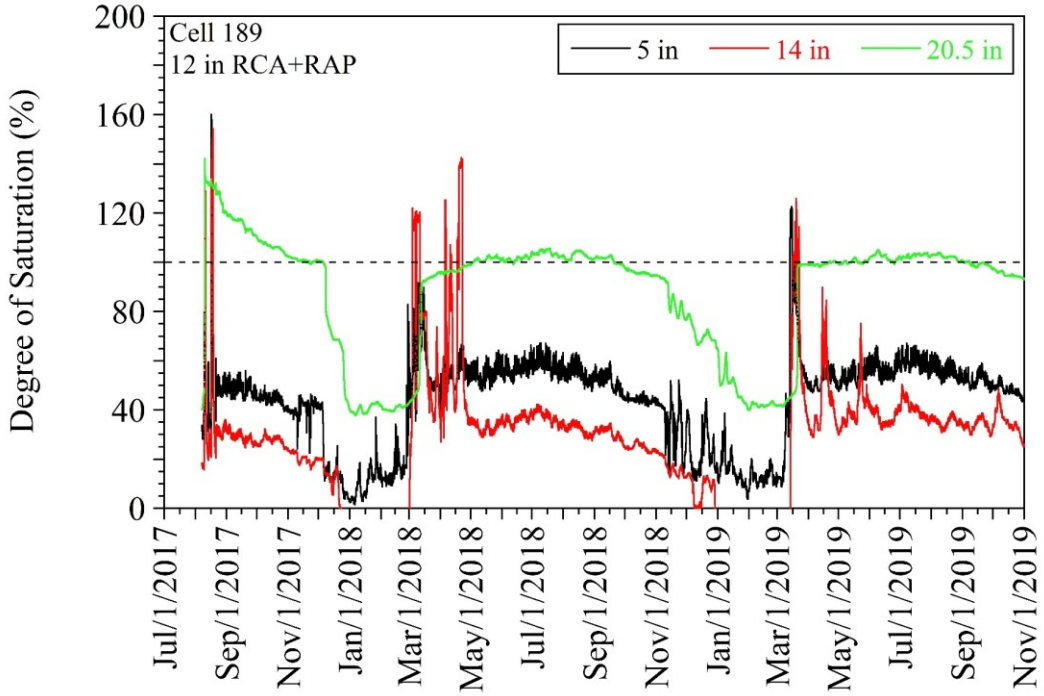
Cell 186 (12-in Fine RCA)



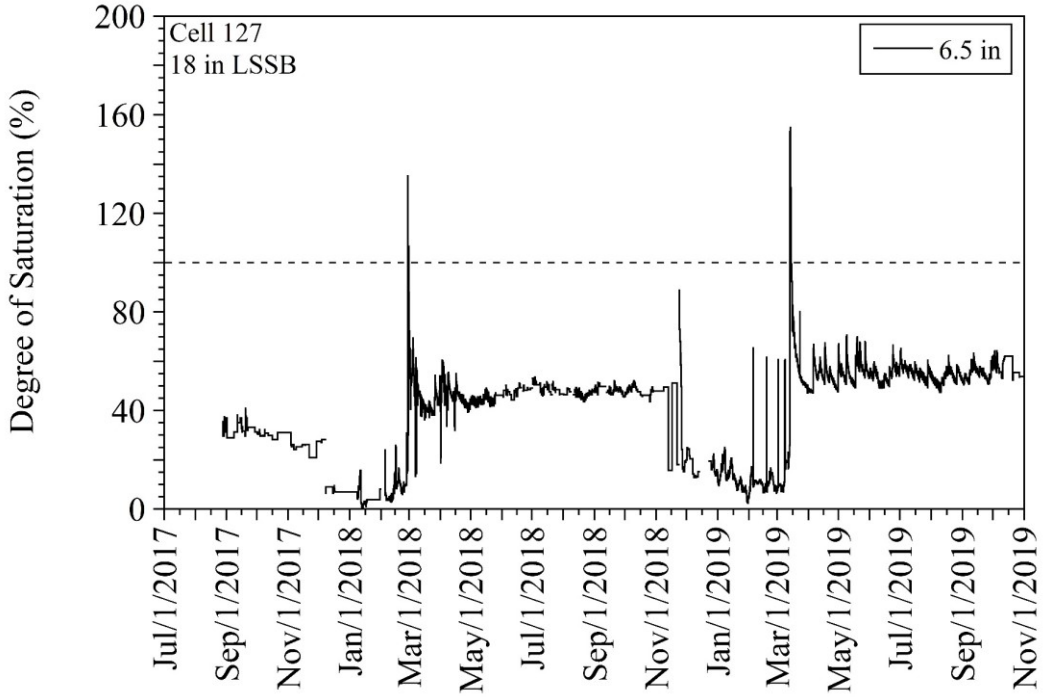
Cell 188 (12-in Limestone)



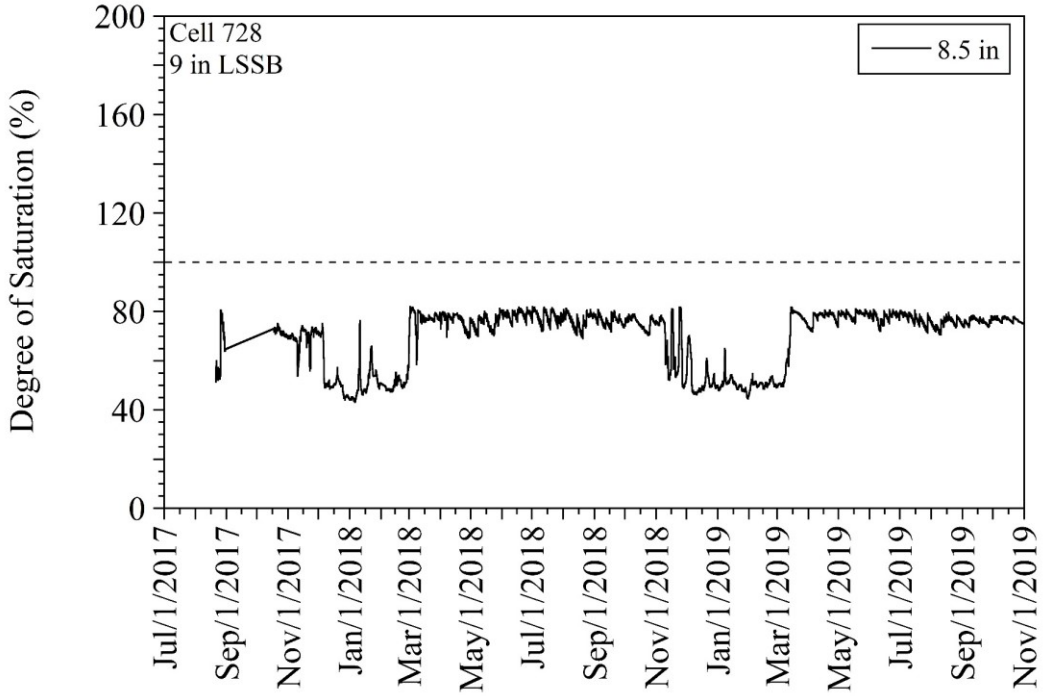
Cell 189 (12-in RCA+RAP)



Cell 127 (18-in LSSB)

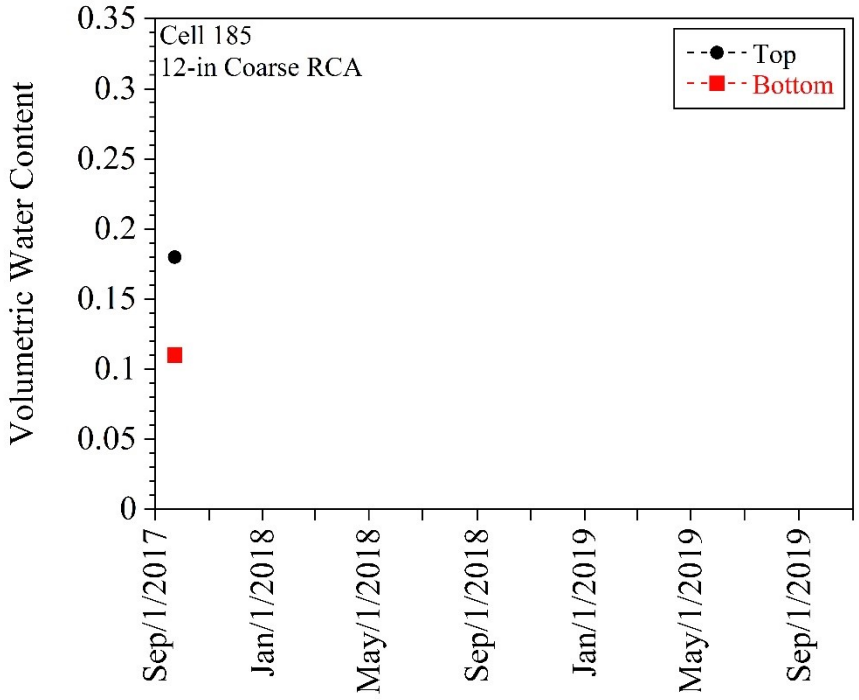


Cell 728 (9-in LSSB)

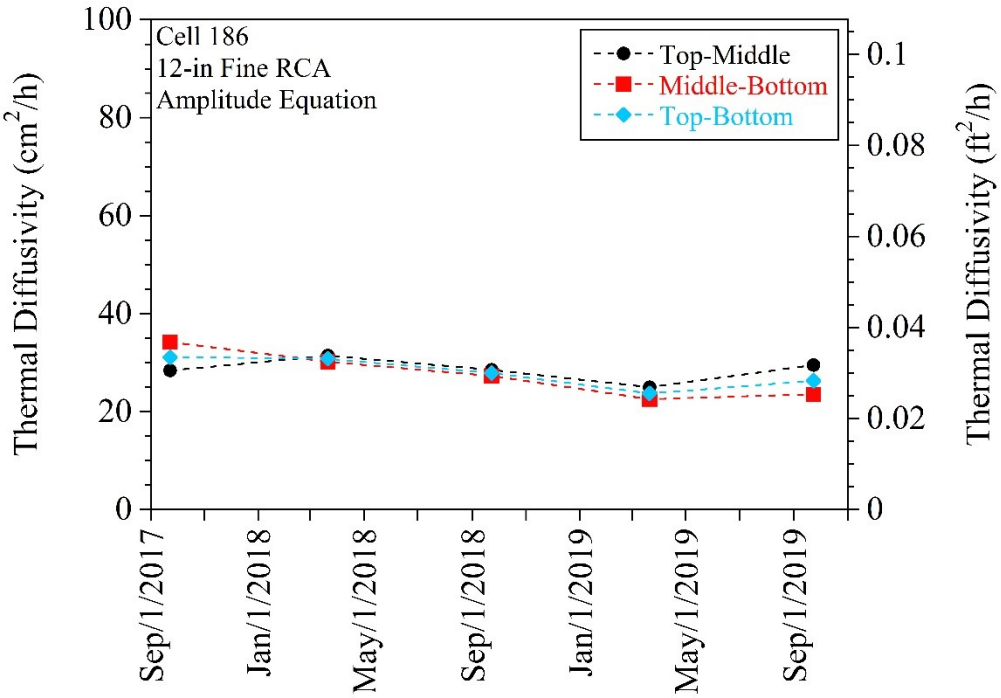


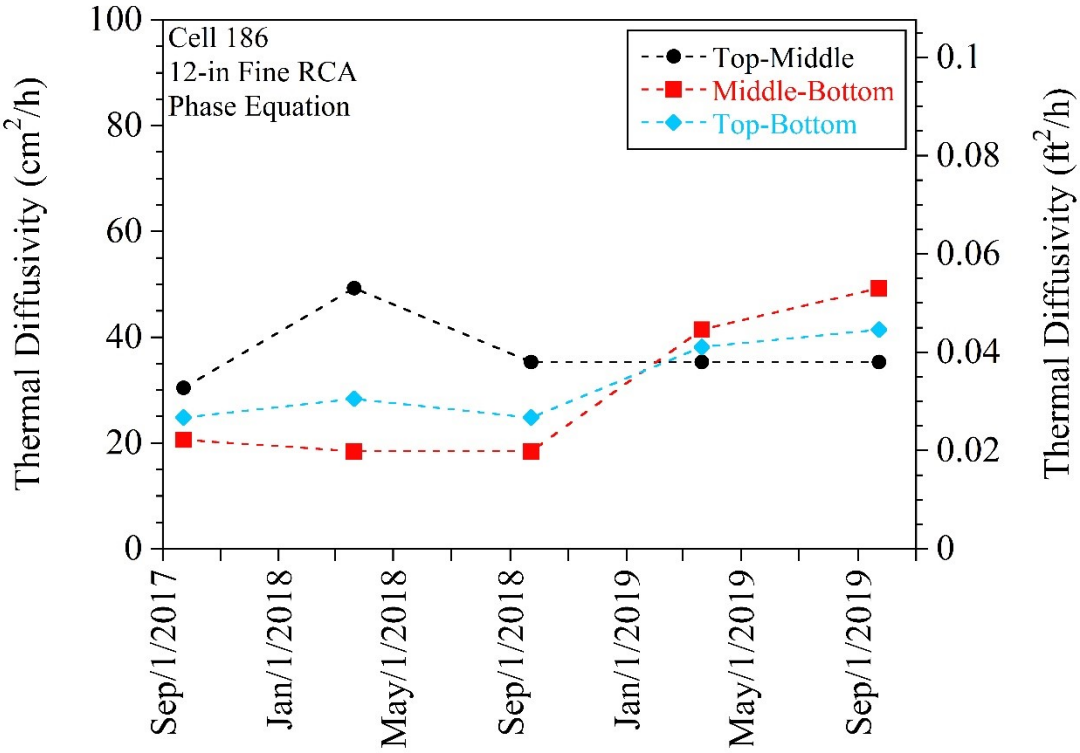
APPENDIX R
THERMAL DIFFUSIVITY (α) AND VOLUMETRIC WATER CONTENT (VWC) VALUES DETERMINED FOR 12-IN COARSE RCA (CELL 185), FINE RCA (CELL 186), LIMESTONE (CELL 188), AND RCA+RAP (CELL 189) BASE LAYERS

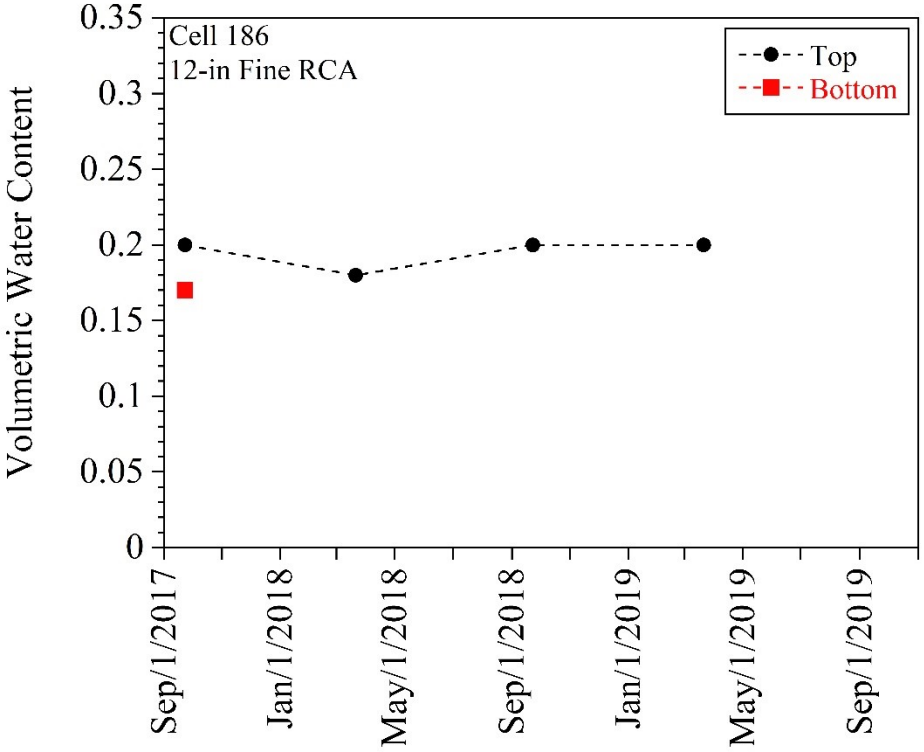
For 12-in Coarse RCA (Cell 185):



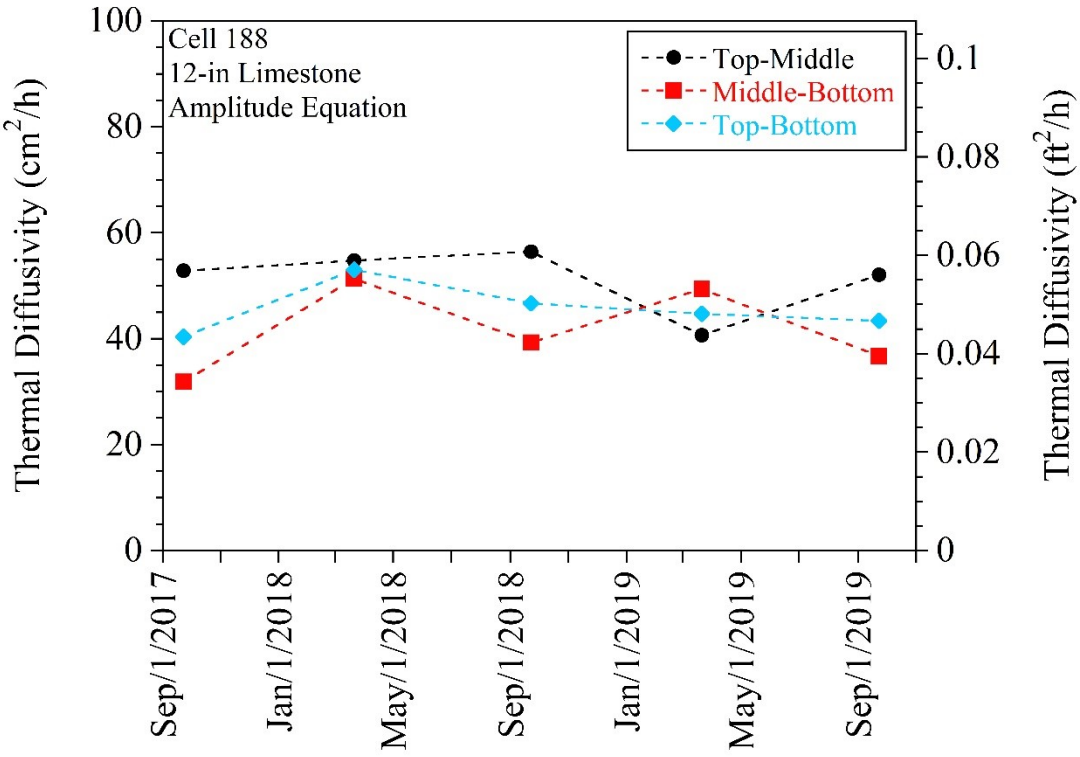
For 12-in Fine RCA (Cell 186):

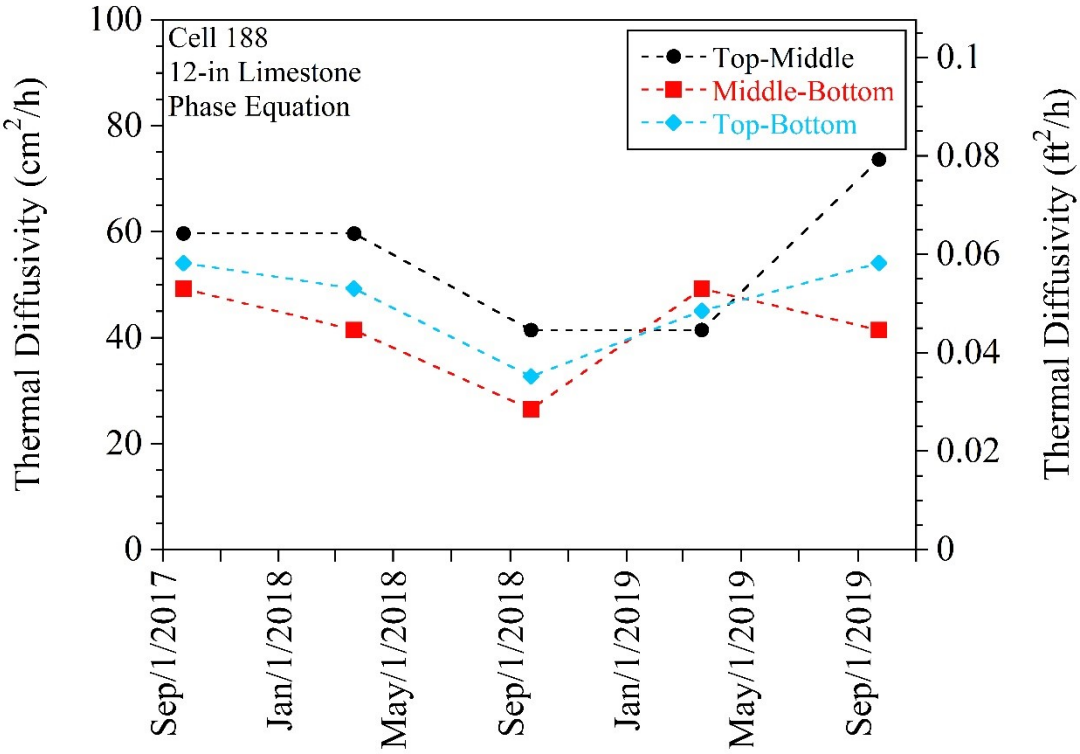


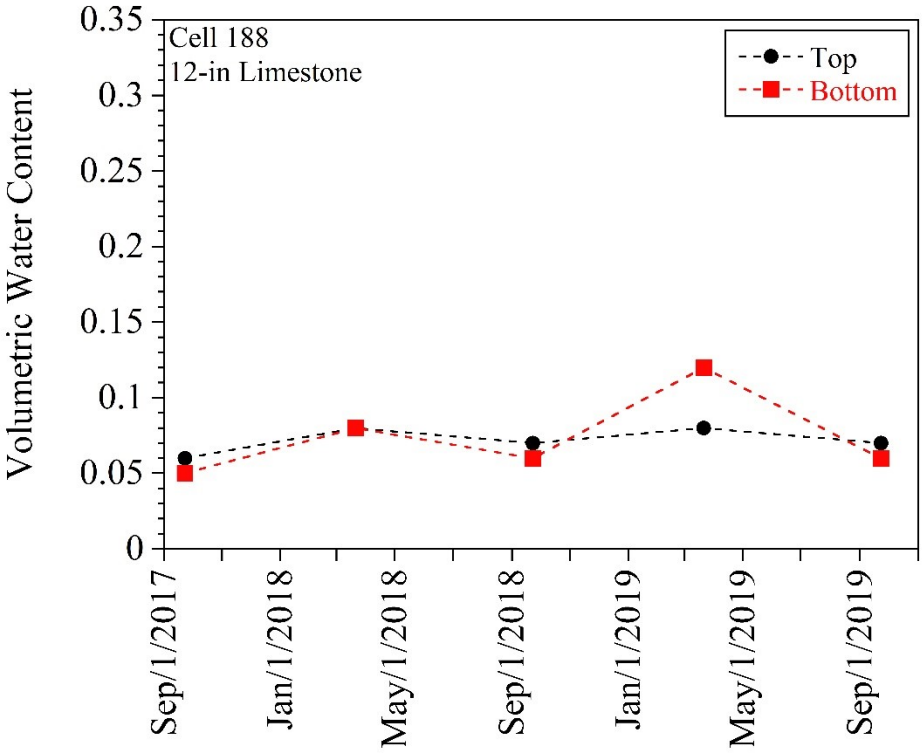

Cell 186
12-in Fine RCA
Phase Equation
Top-Middle
Middle-Bottom
Top-Bottom
Thermal Diffusivity (cm²/h)
Thermal Diffusivity (ft²/h)
0
20
40
60
80
100
0
0.02
0.04
0.06
0.08
0.1
Sep/1/2017
Jan/1/2018
May/1/2018
Sep/1/2018
Jan/1/2019
May/1/2019
Sep/1/2019


Cell 186
12-in Fine RCA
Top
Bottom
Volumetric Water Content
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Sep/1/2017
Jan/1/2018
May/1/2018
Sep/1/2018
Jan/1/2019
May/1/2019
Sep/1/2019

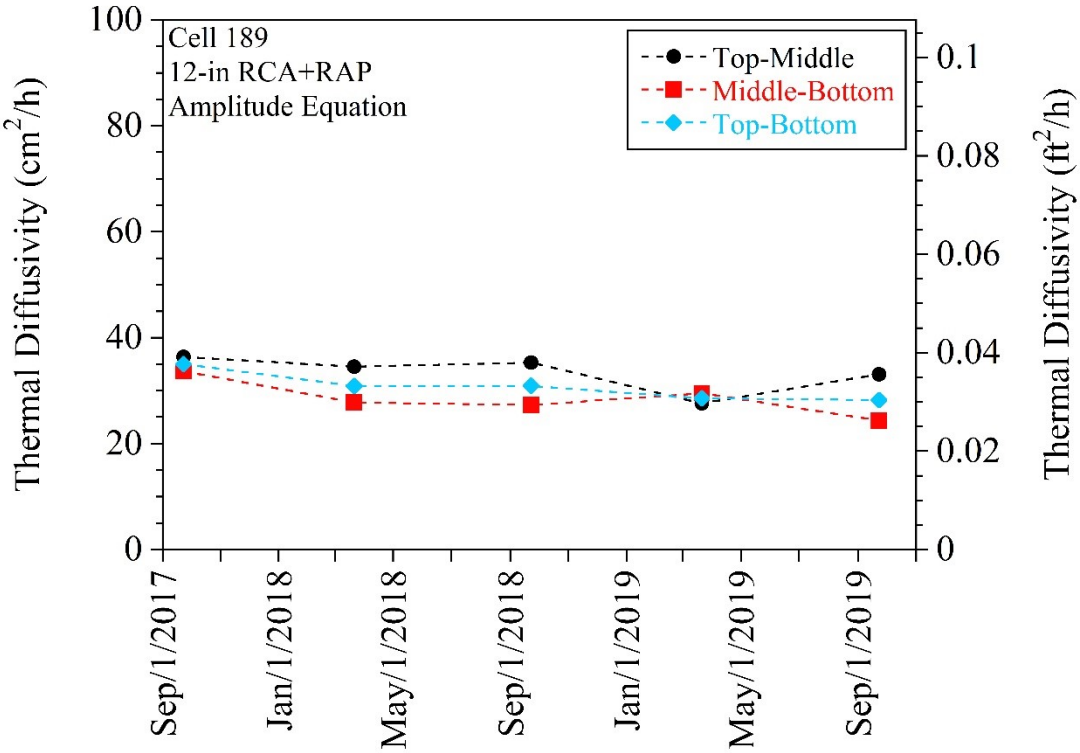
For 12-in Limestone (Cell 188):

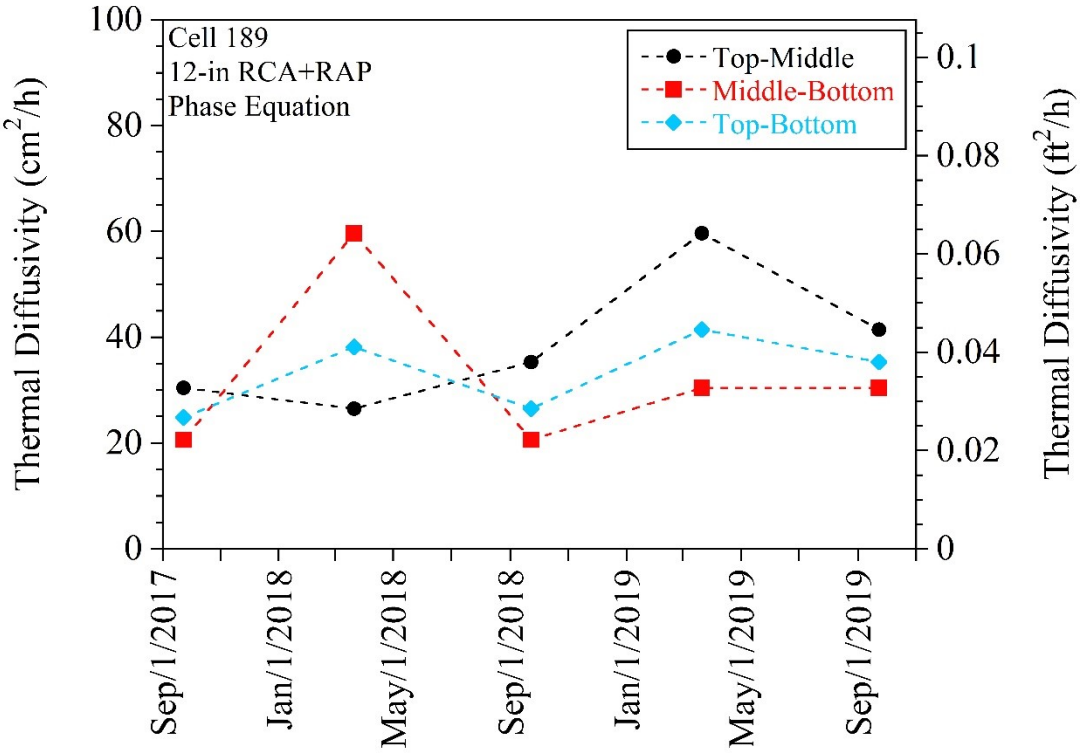


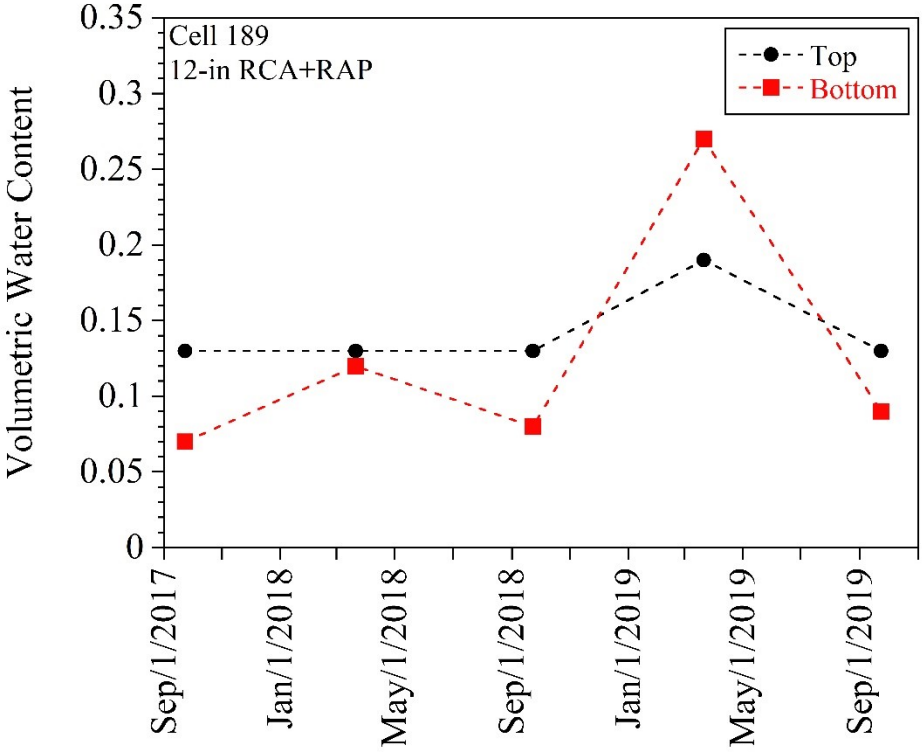




For 12-in RCA+RAP (Cell 189):

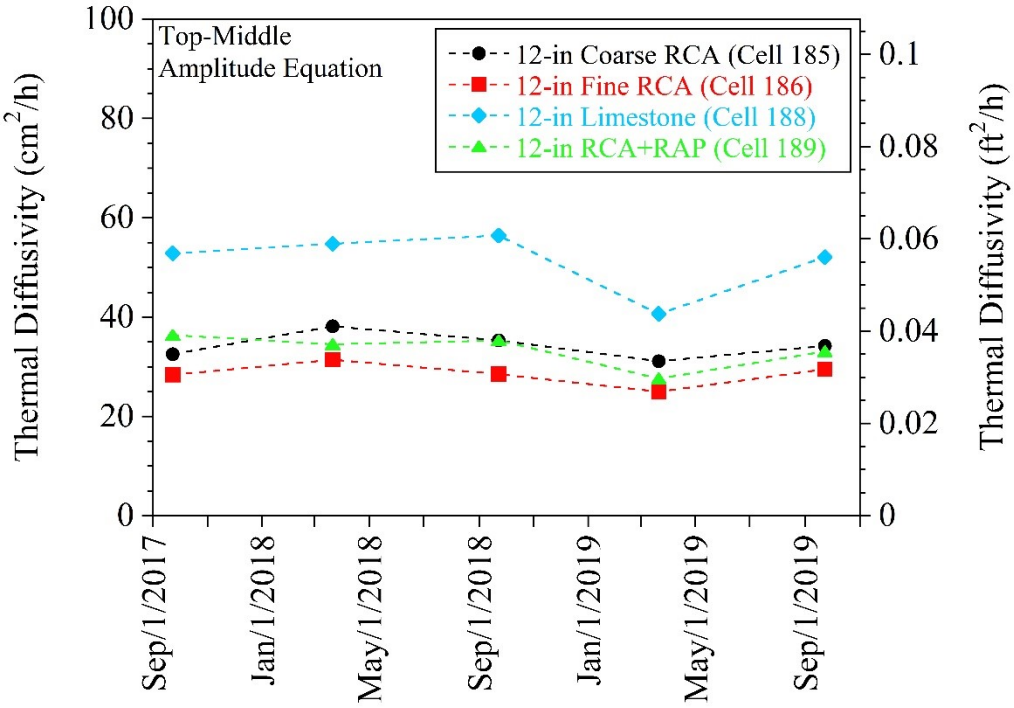



Cell 189
12-in RCA+RAP
Phase Equation
Top-Middle
Middle-Bottom
Top-Bottom
Thermal Diffusivity (cm²/h)
Thermal Diffusivity (ft²/h)
100
80
60
40
20
0
0.1
0.08
0.06
0.04
0.02
0
Sep/1/2017
Jan/1/2018
May/1/2018
Sep/1/2018
Jan/1/2019
May/1/2019
Sep/1/2019

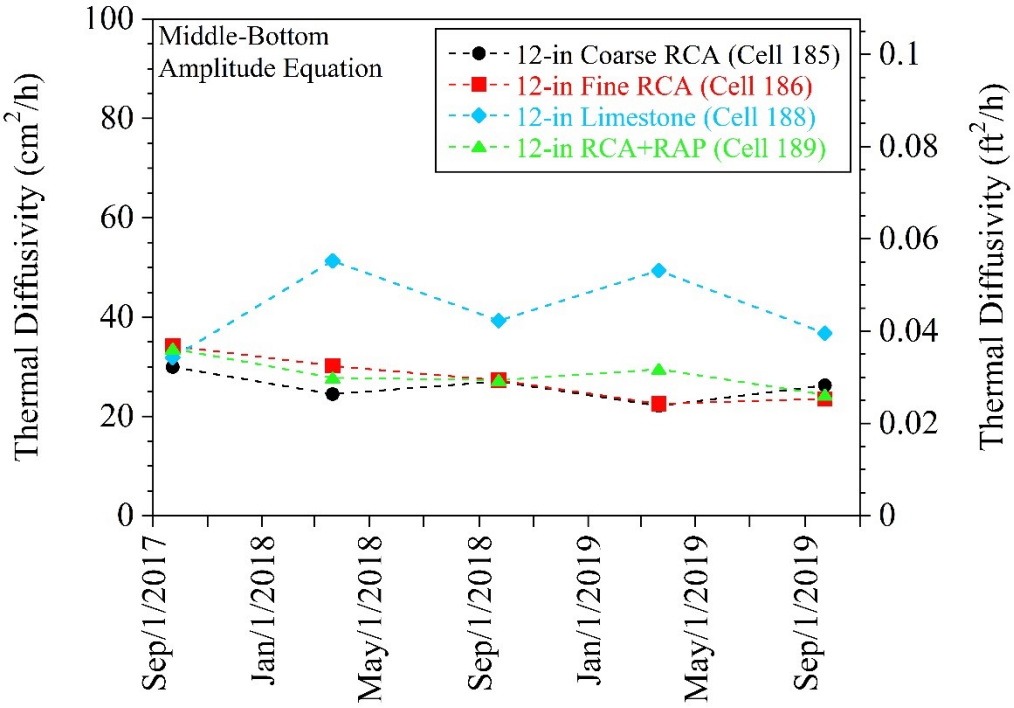

Cell 189
12-in RCA+RAP
Top
Bottom
Volumetric Water Content
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Sep/1/2017
Jan/1/2018
May/1/2018
Sep/1/2018
Jan/1/2019
May/1/2019
Sep/1/2019

APPENDIX S
COMPARISONS BETWEEN TOP-MIDDLE AND MIDDLE- BOTTOM THERMOCOUPLES (TCS) IN 12-IN AGGREGATE BASE LAYERS

For top-middle TC sensors:

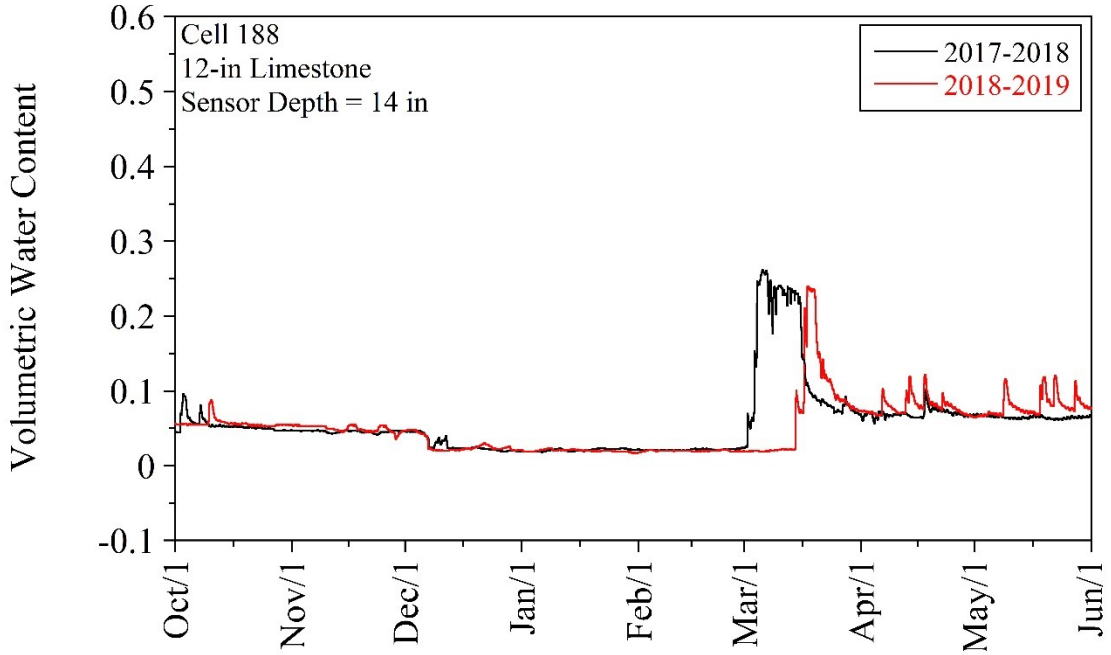


For middle-bottom TC sensors:

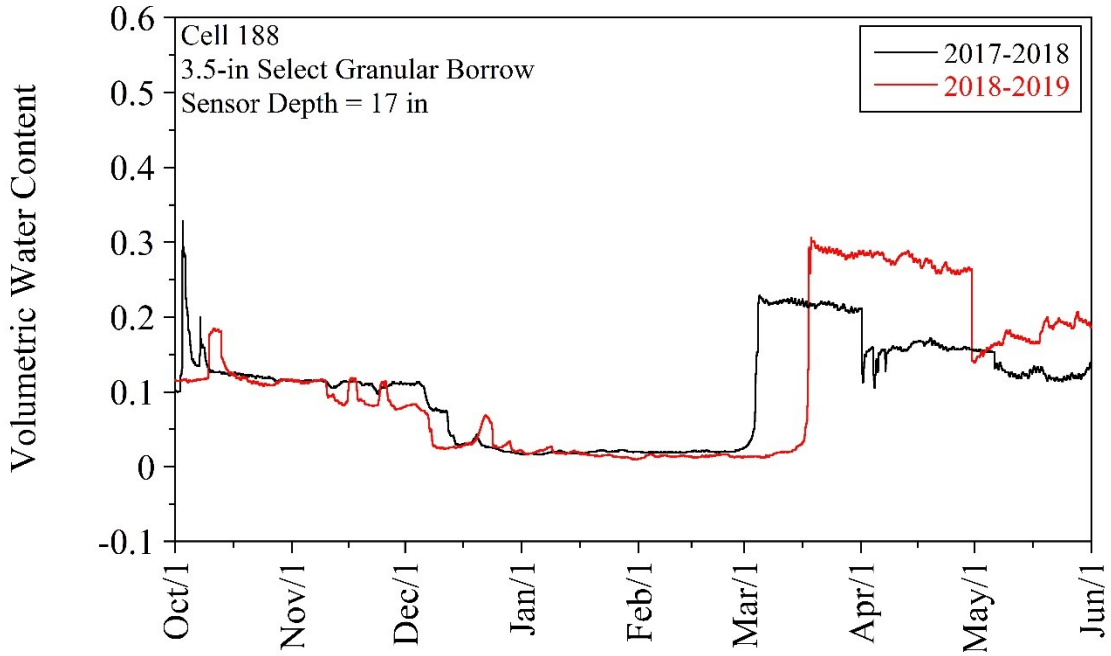


APPENDIX T
COMPARISONS BETWEEN VOLUMETRIC WATER CONTENT (VWC) VALUES IN FIRST (2017-2018) AND SECOND (2018-2019) FREEZING AND THAWING PERIODS

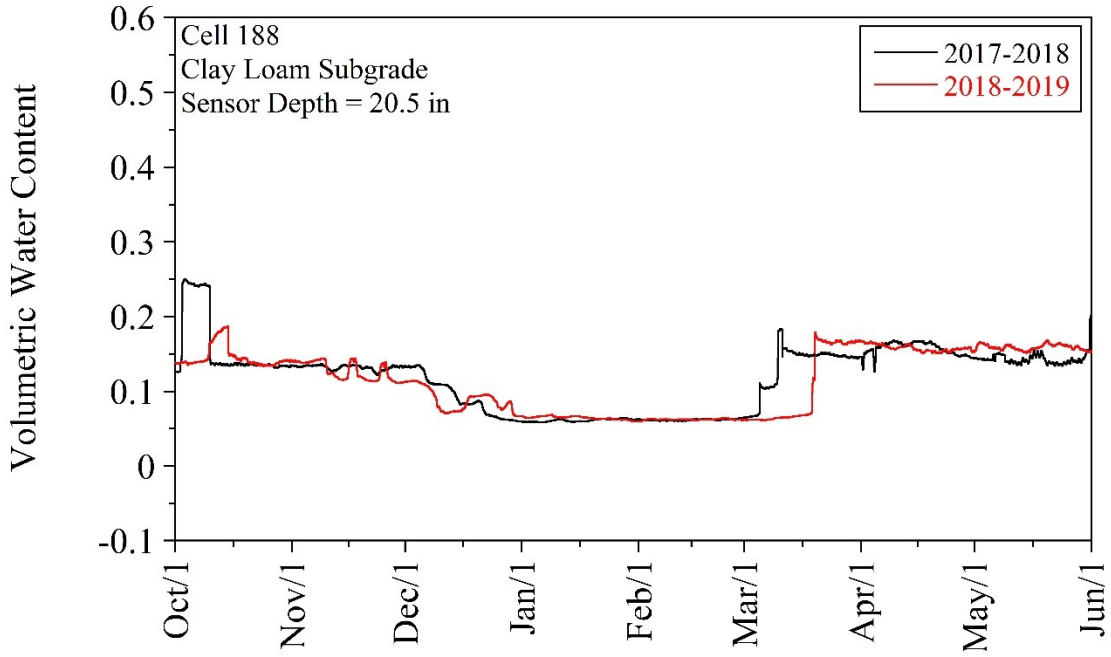
For Cell 188:



(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)

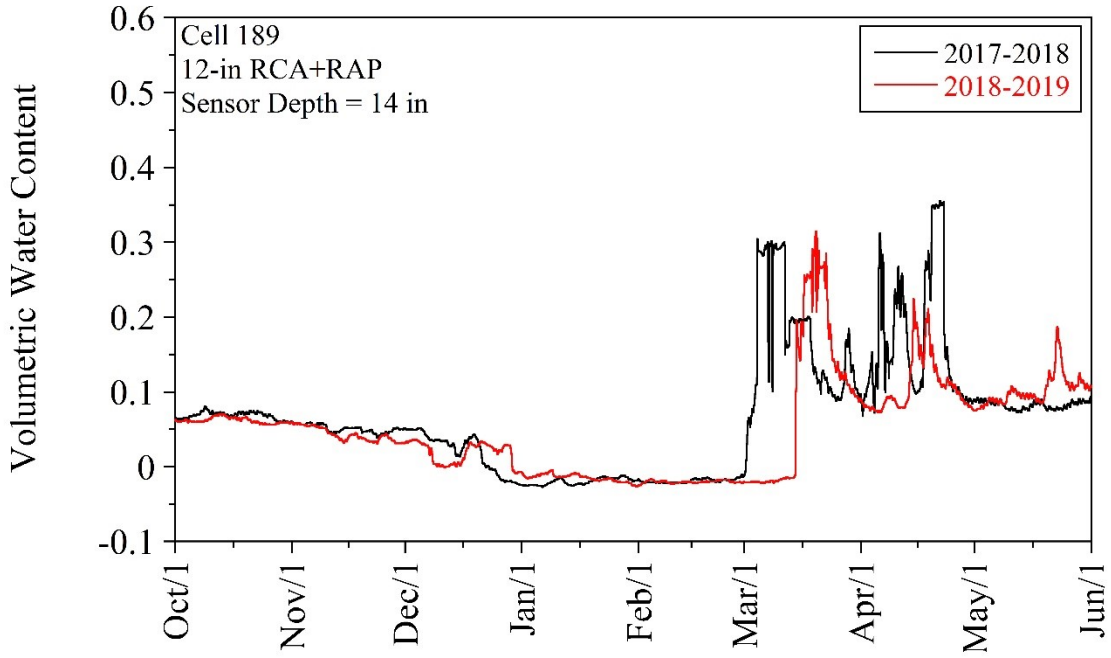


(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)

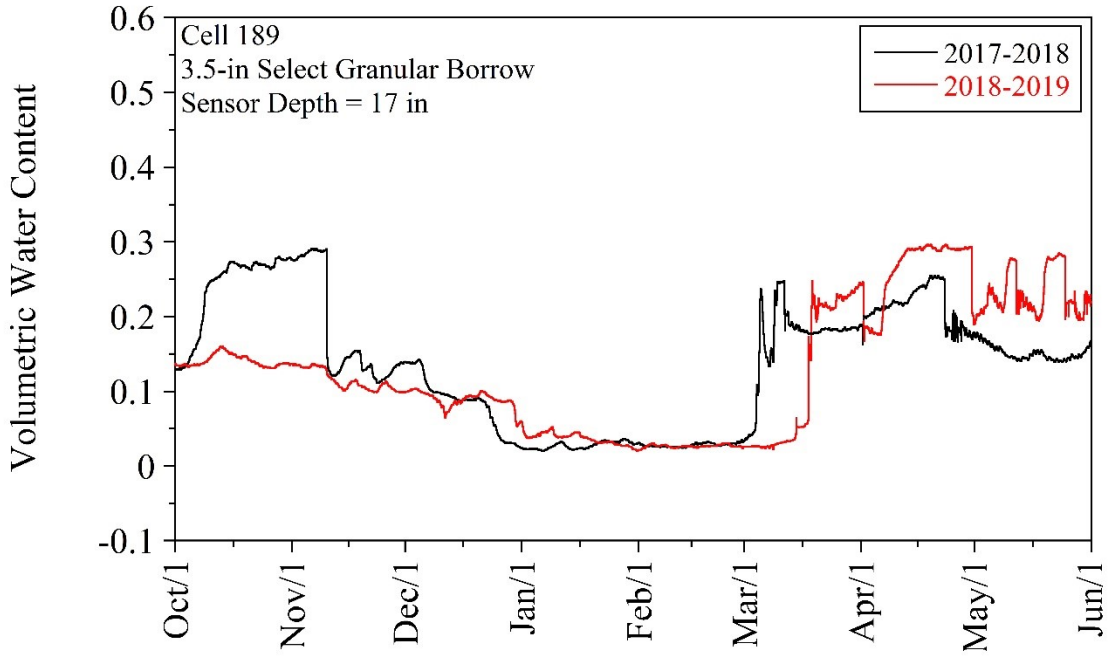


(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)

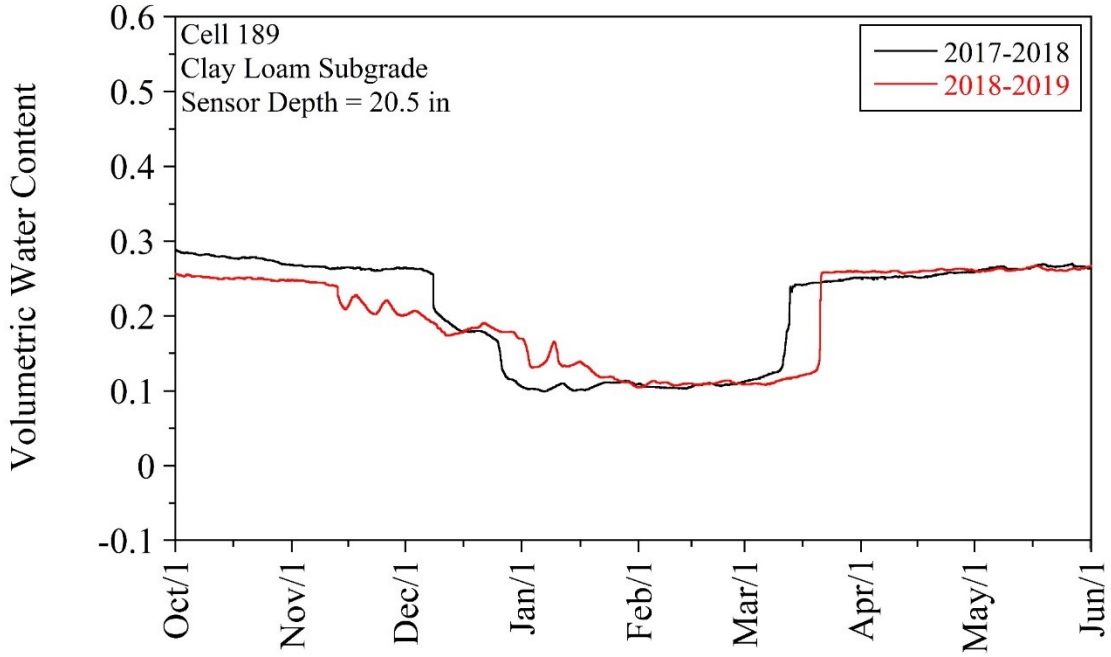
For Cell 189:



(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)

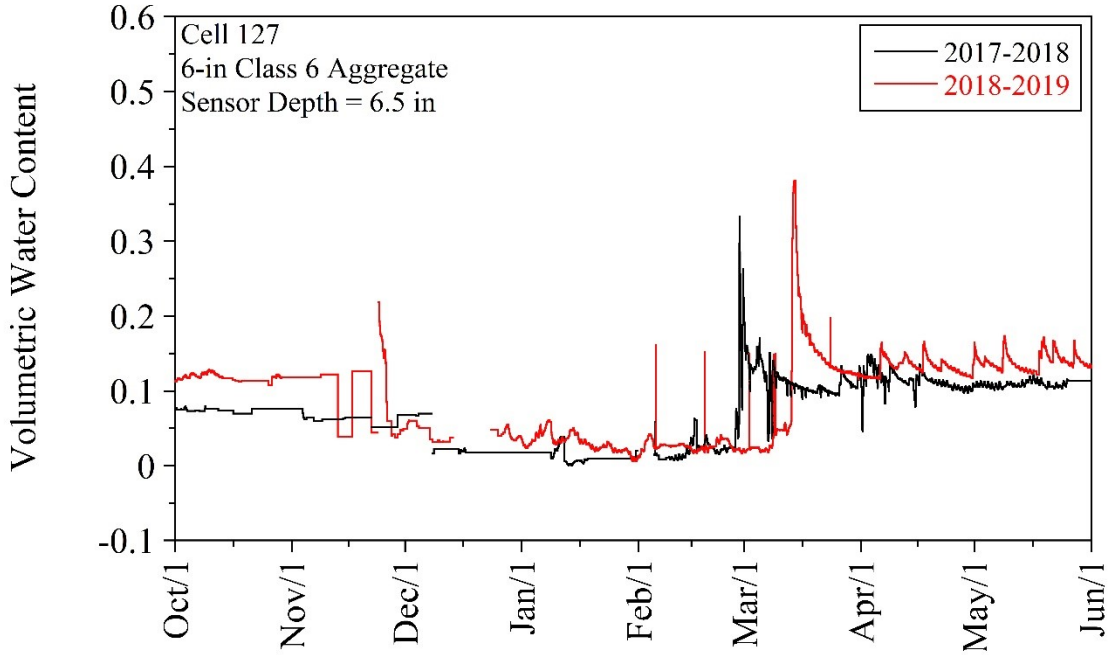


(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)

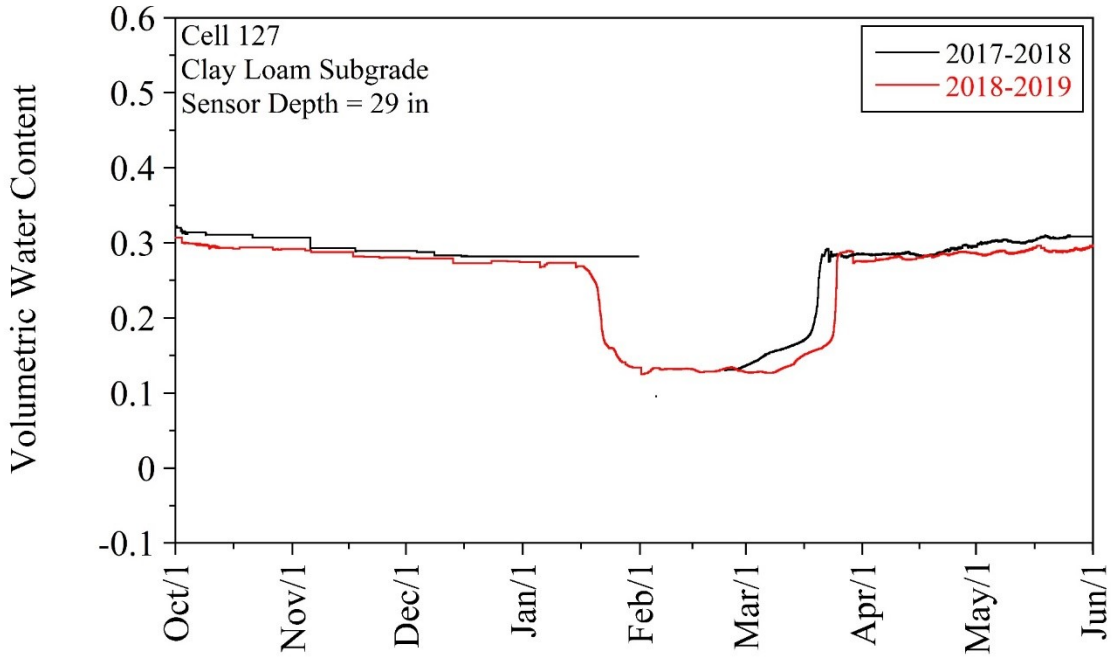


(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)

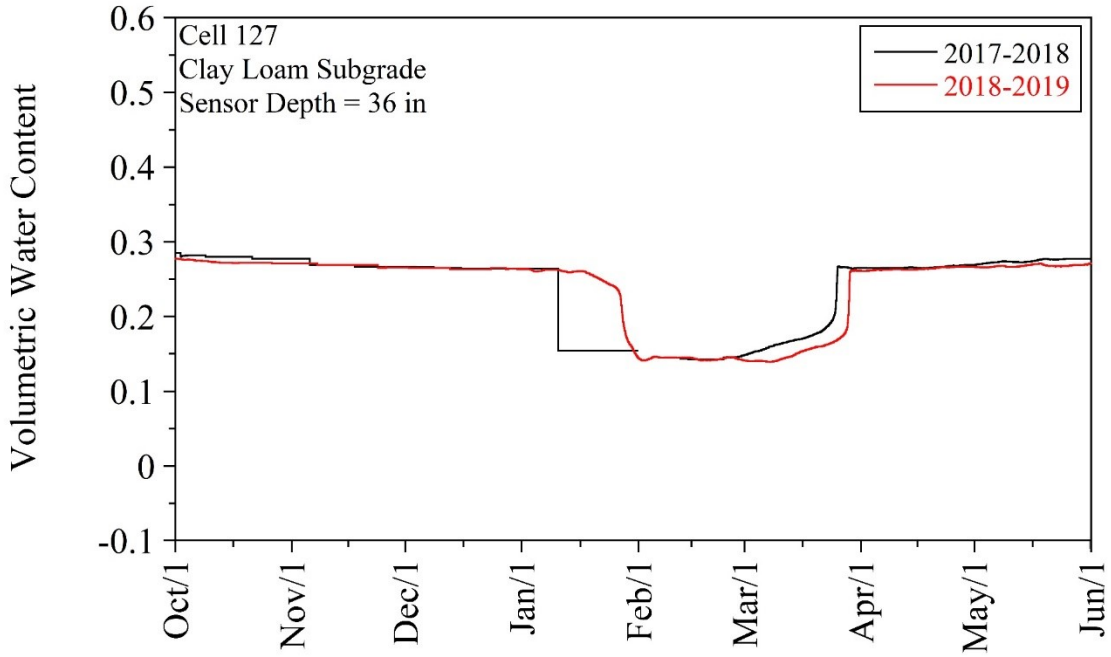
For Cell 127:



(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)

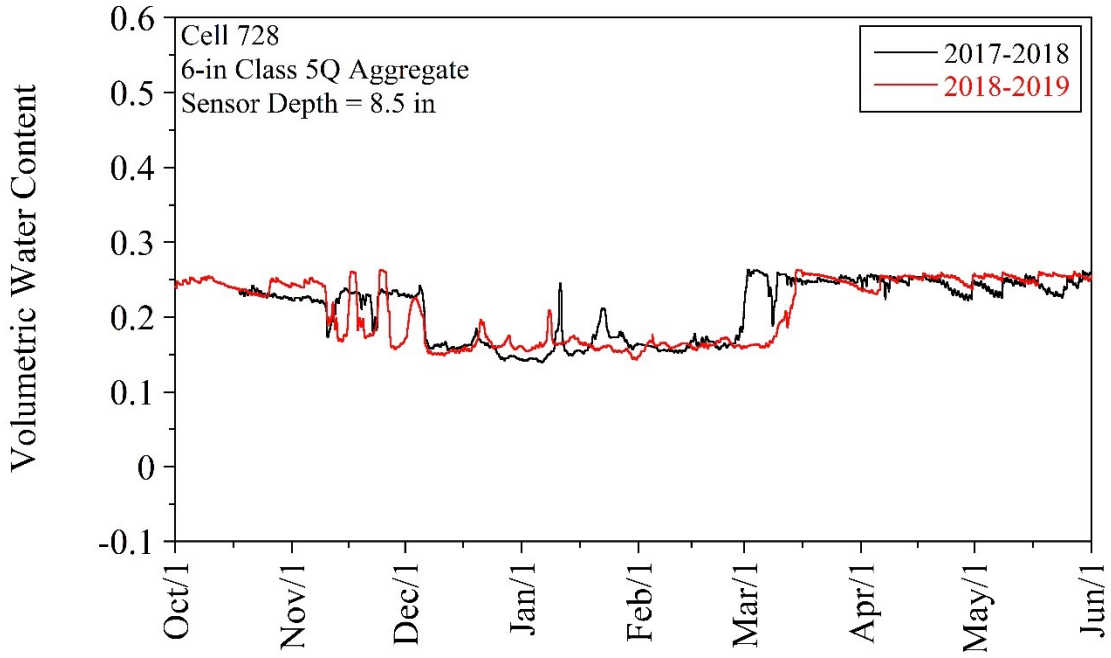


(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)

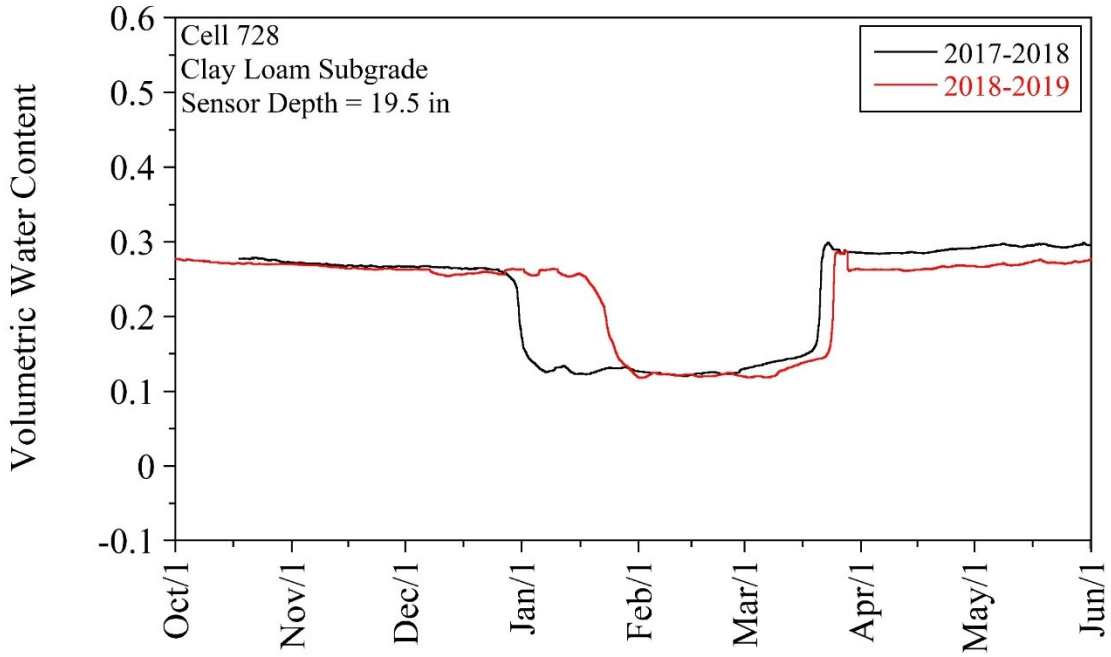


(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)

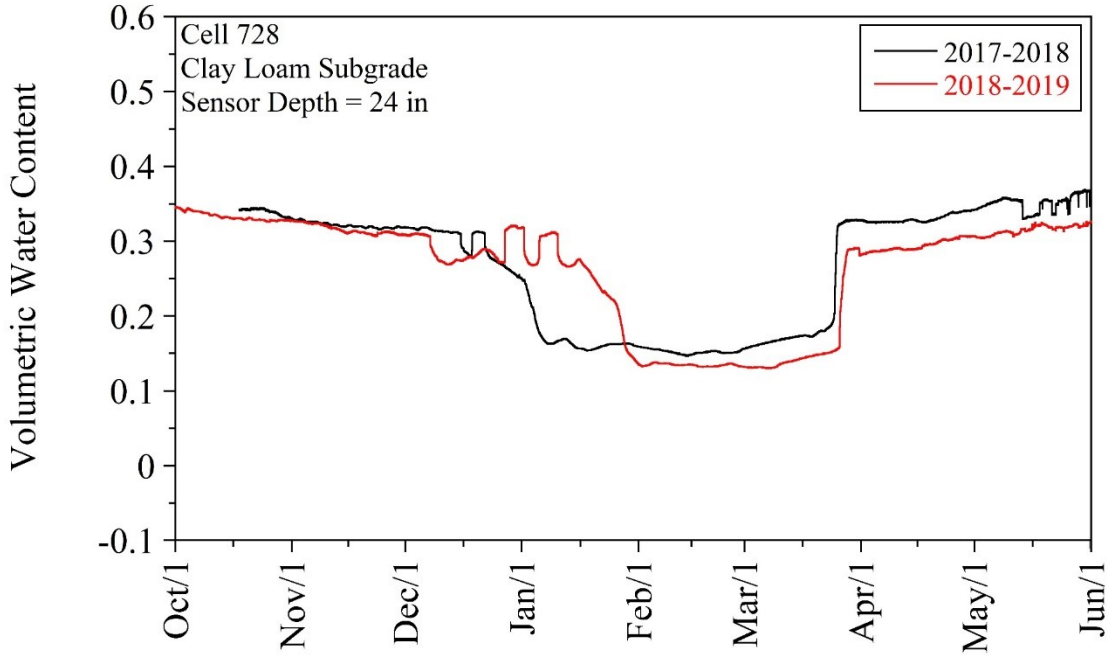
For Cell 728:



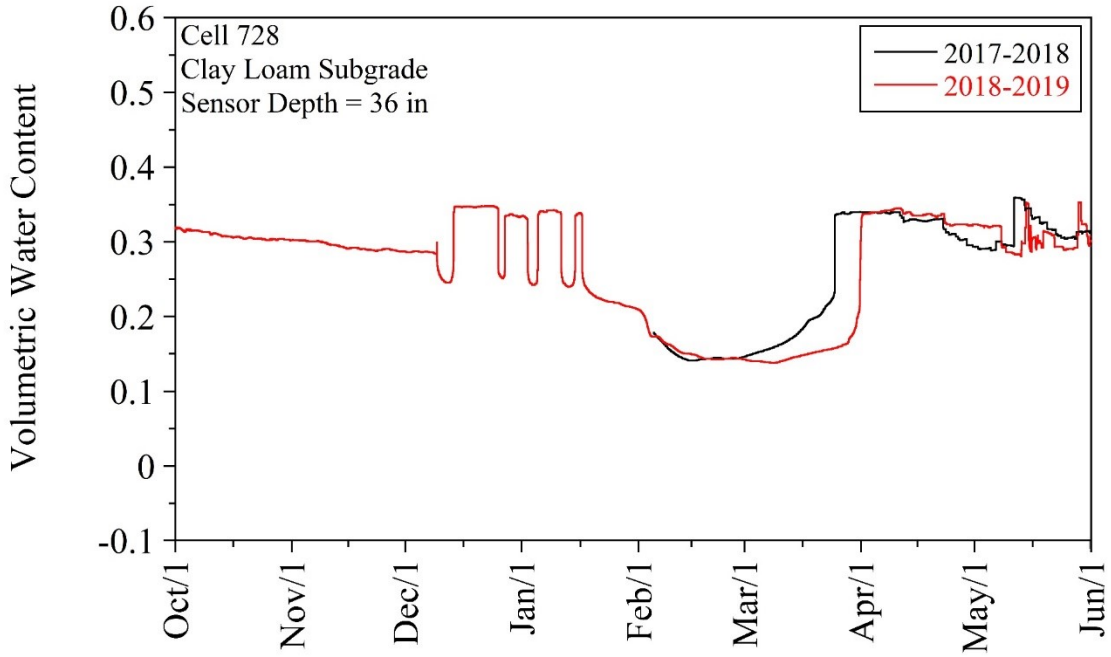
(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)



(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)



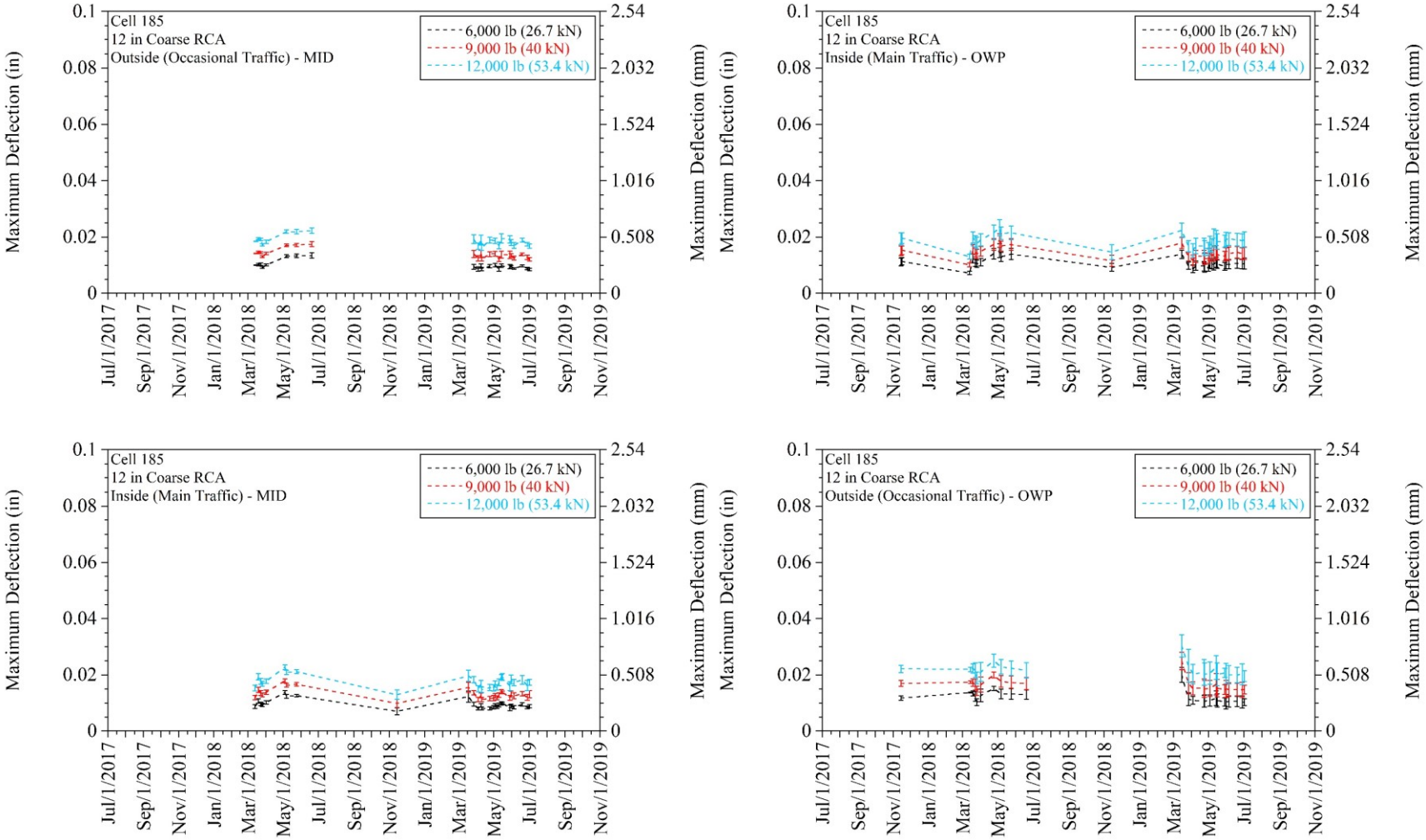
(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)



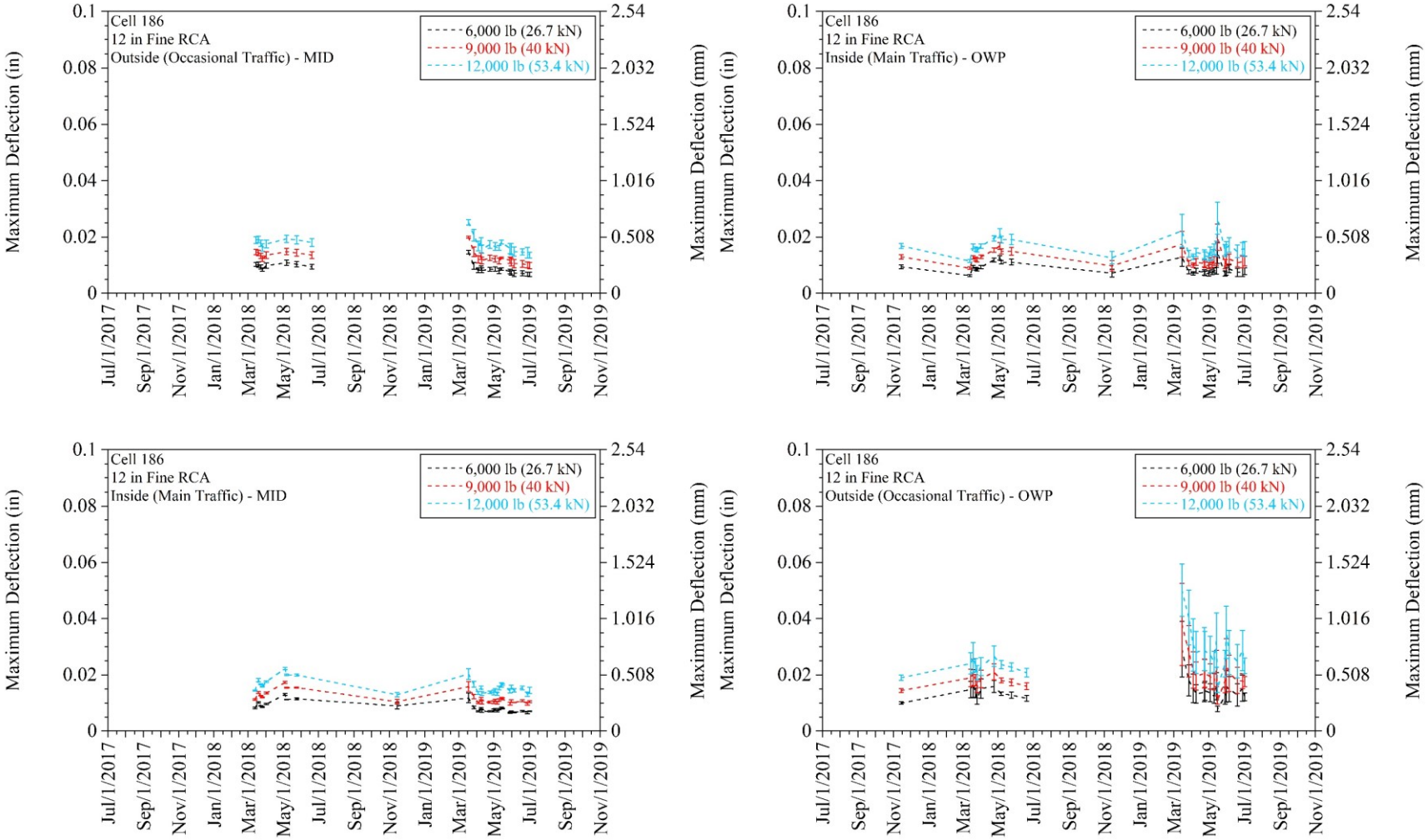
(the dates on the x-axis represent the time periods for both 2017-2018 and 2018-2019 years)

APPENDIX U
MAXIMUM DEFLECTION VALUES AT 6,000 LB (26.7 KN), 9,000 LB (40 KN), AND 12,000 LB (53.4 KN) FOR EACH CELL

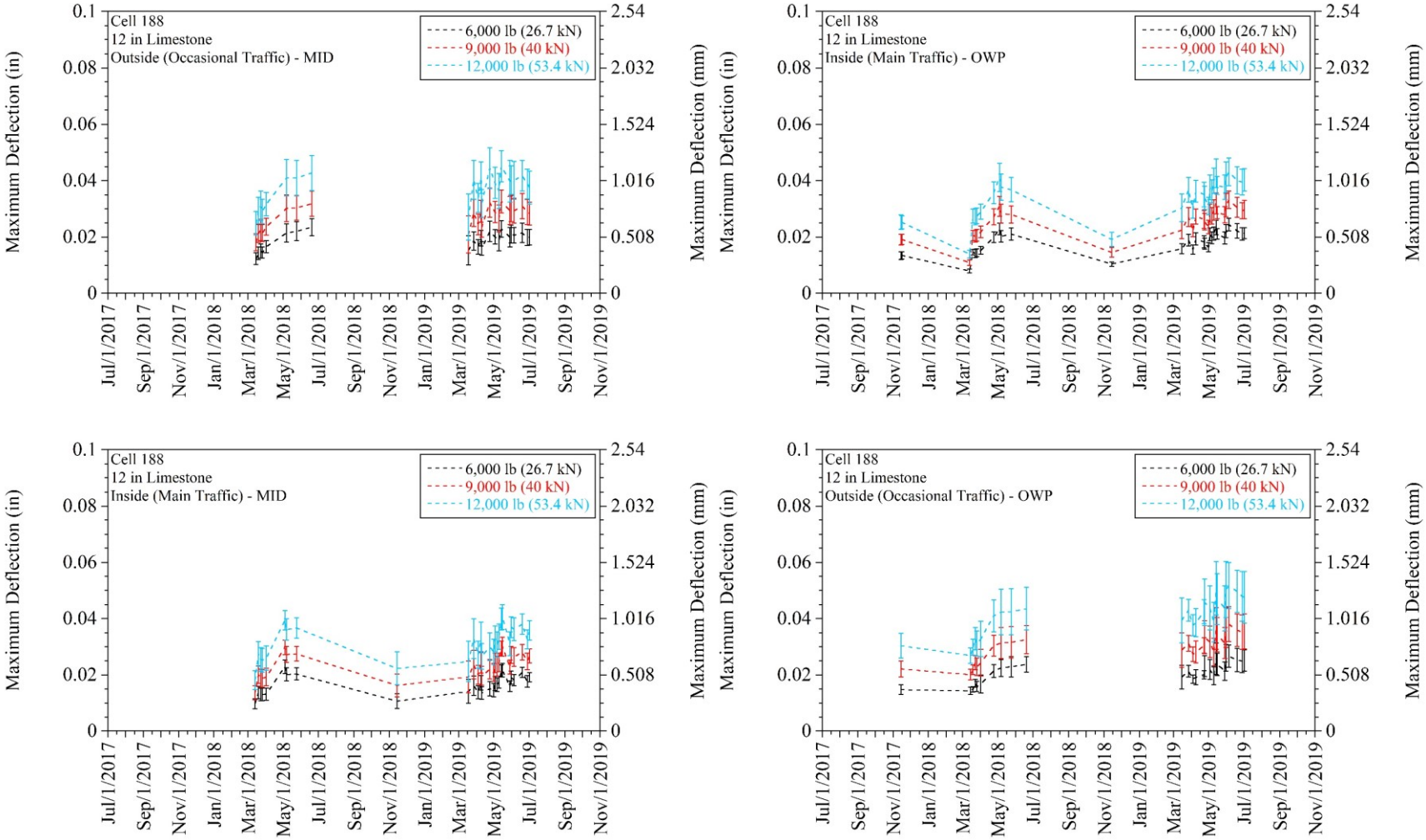
Cell 185 (12-in Coarse RCA) - maximum deflection (error bars represent one standard deviation of the data):



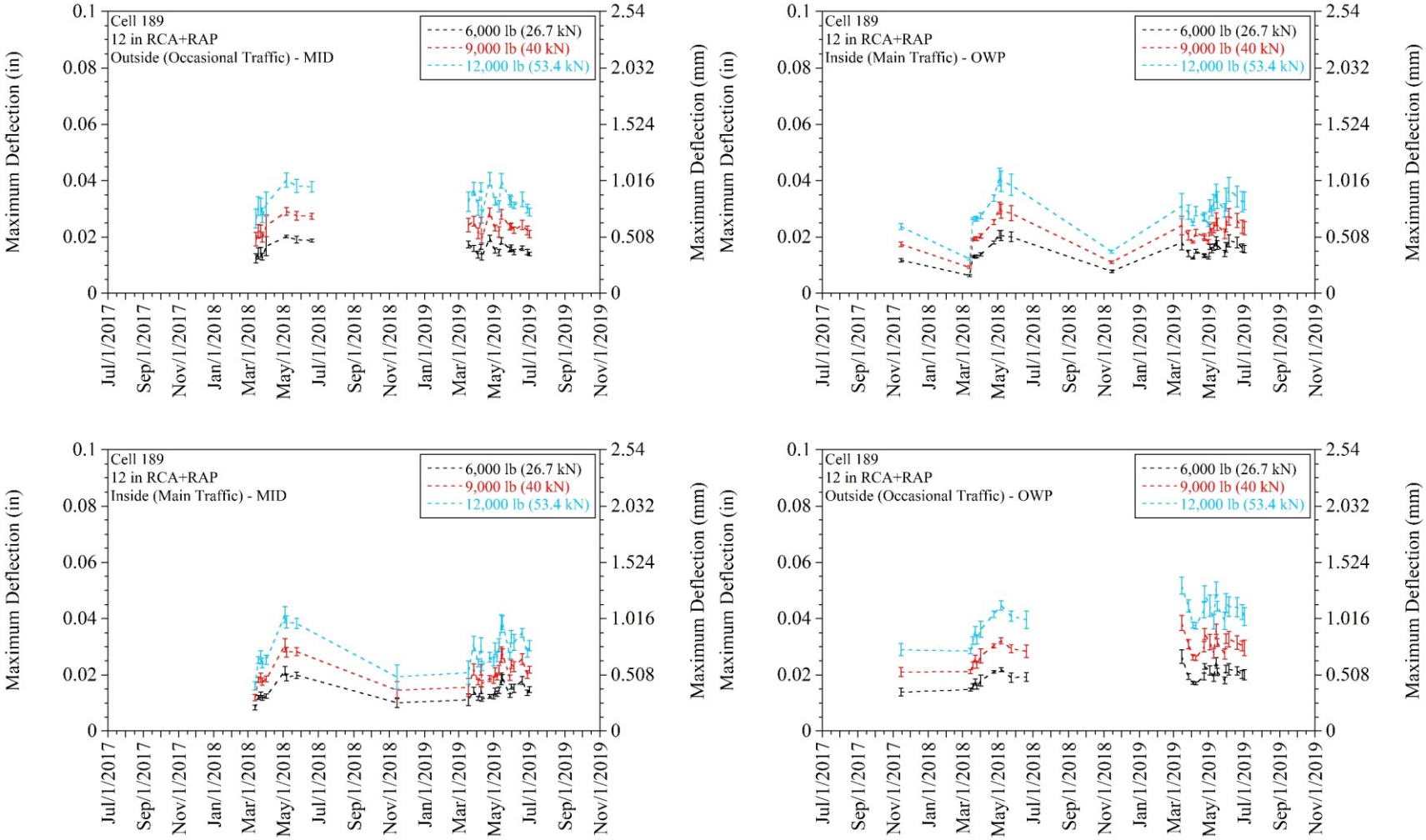
Cell 186 (12-in Fine RCA) - maximum deflection (error bars represent one standard deviation of the data):



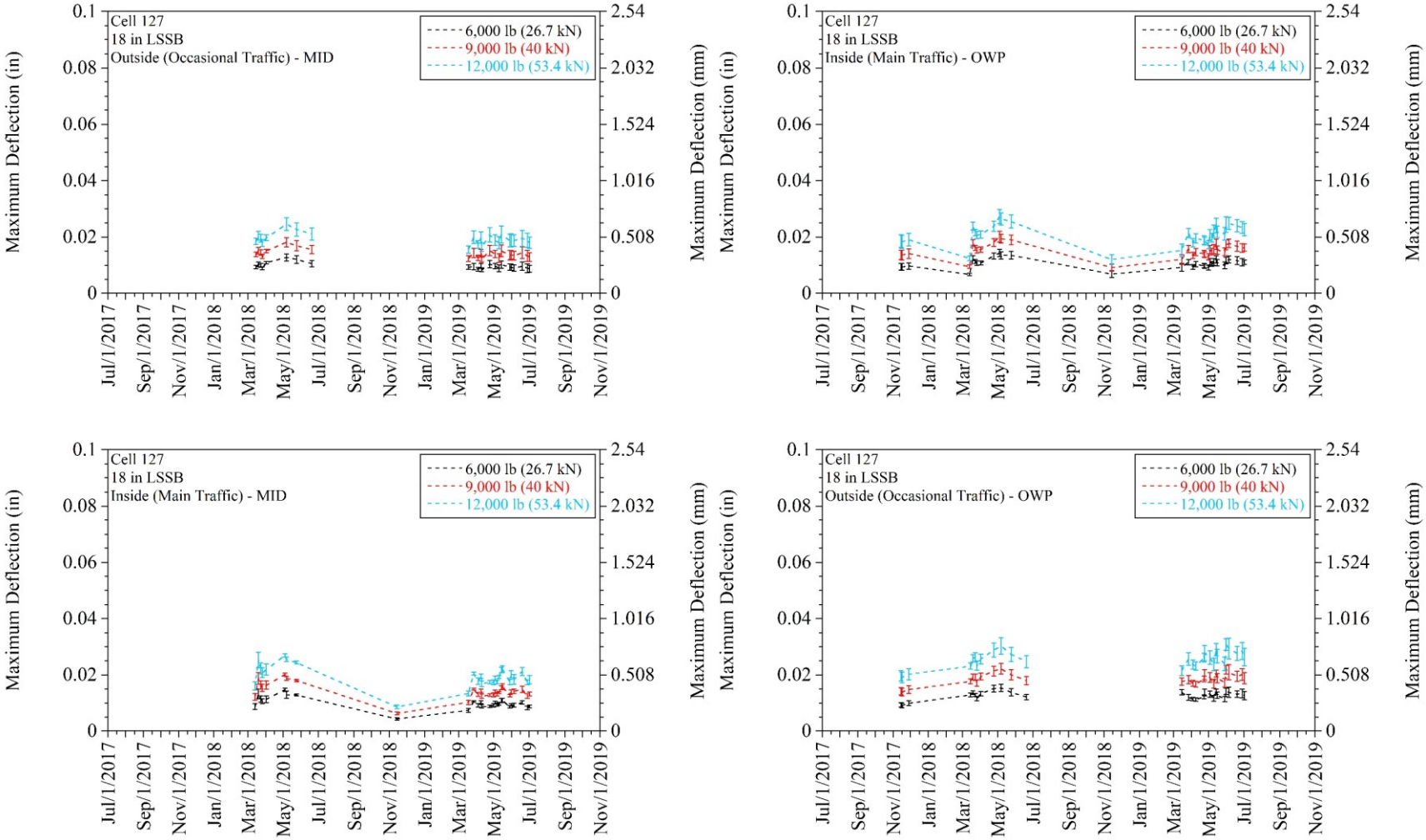
Cell 188 (12-in Limestone) - maximum deflection (error bars represent one standard deviation of the data):



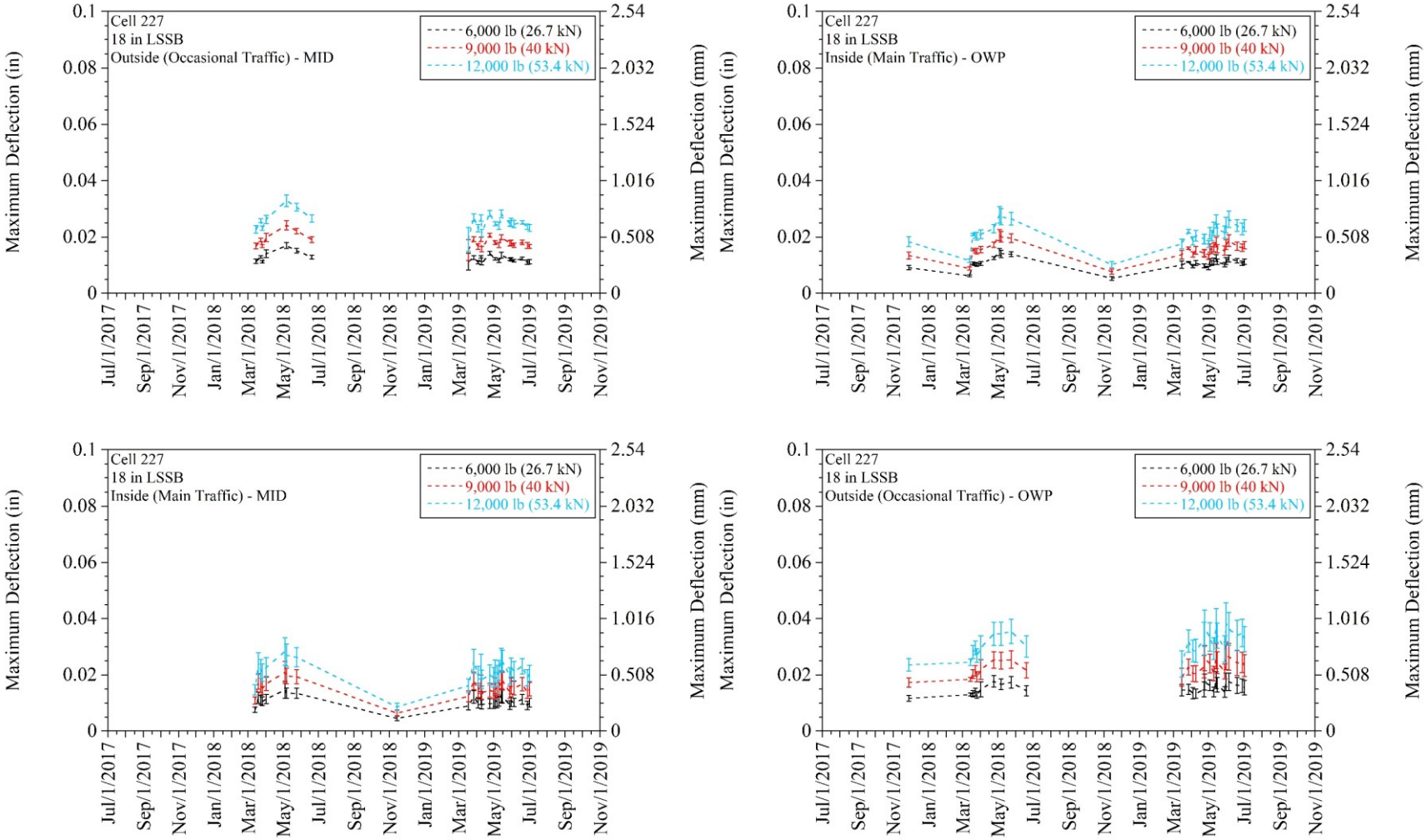
Cell 189 (12-in RCA+RAP) - maximum deflection (error bars represent one standard deviation of the data):



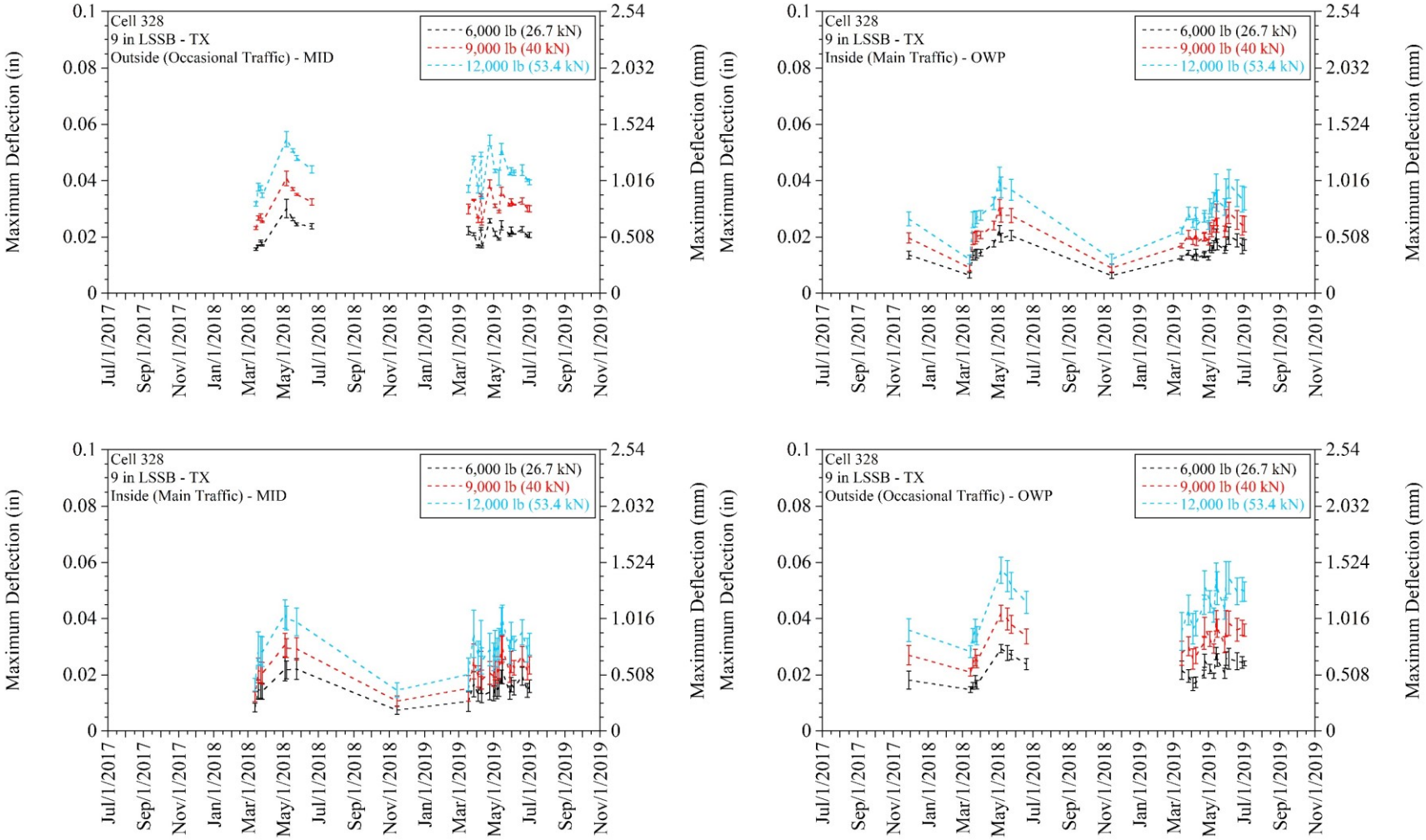
Cell 127 (18-in LSSB) - maximum deflection (error bars represent one standard deviation of the data):



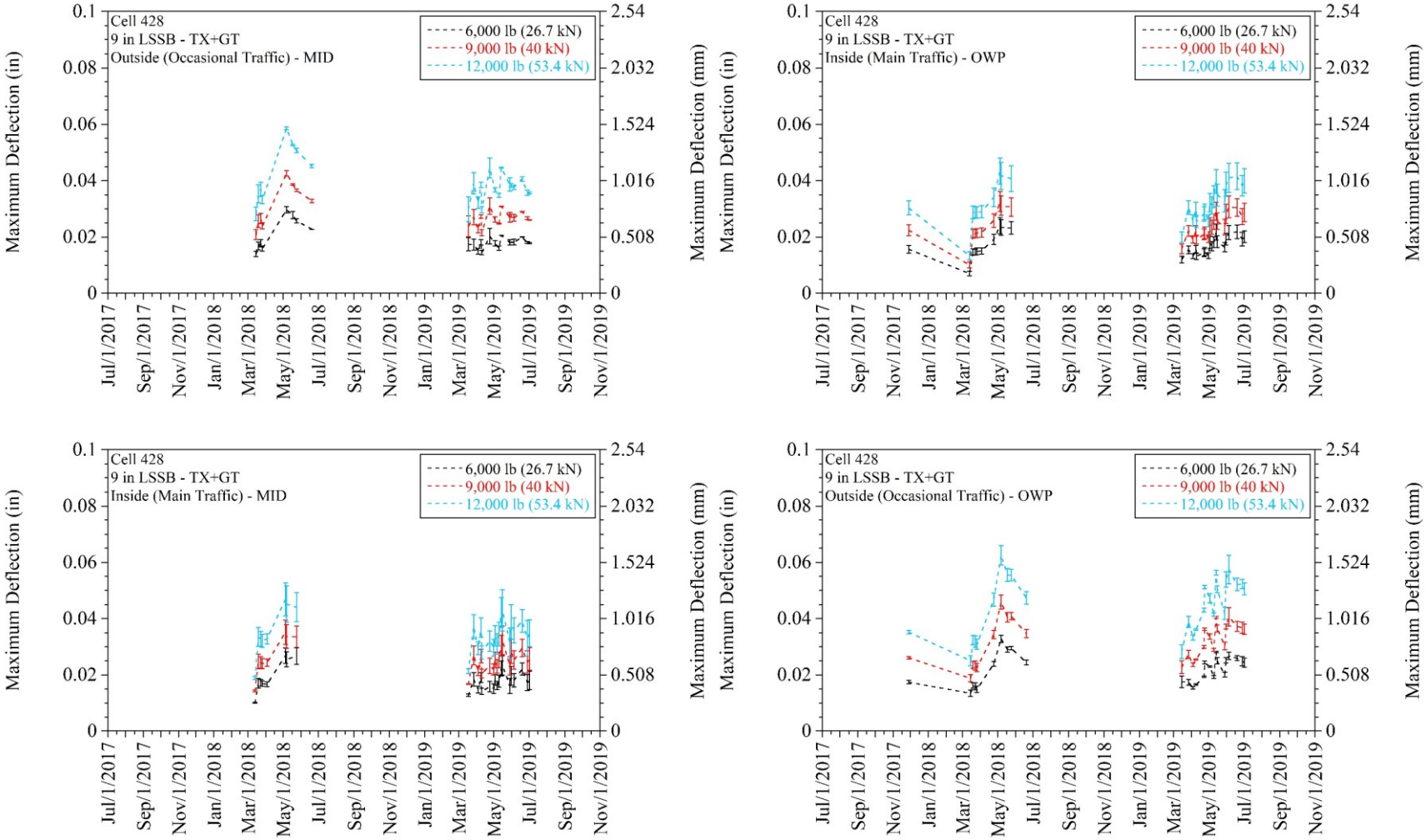
Cell 227 (18-in LSSB) - maximum deflection (error bars represent one standard deviation of the data):



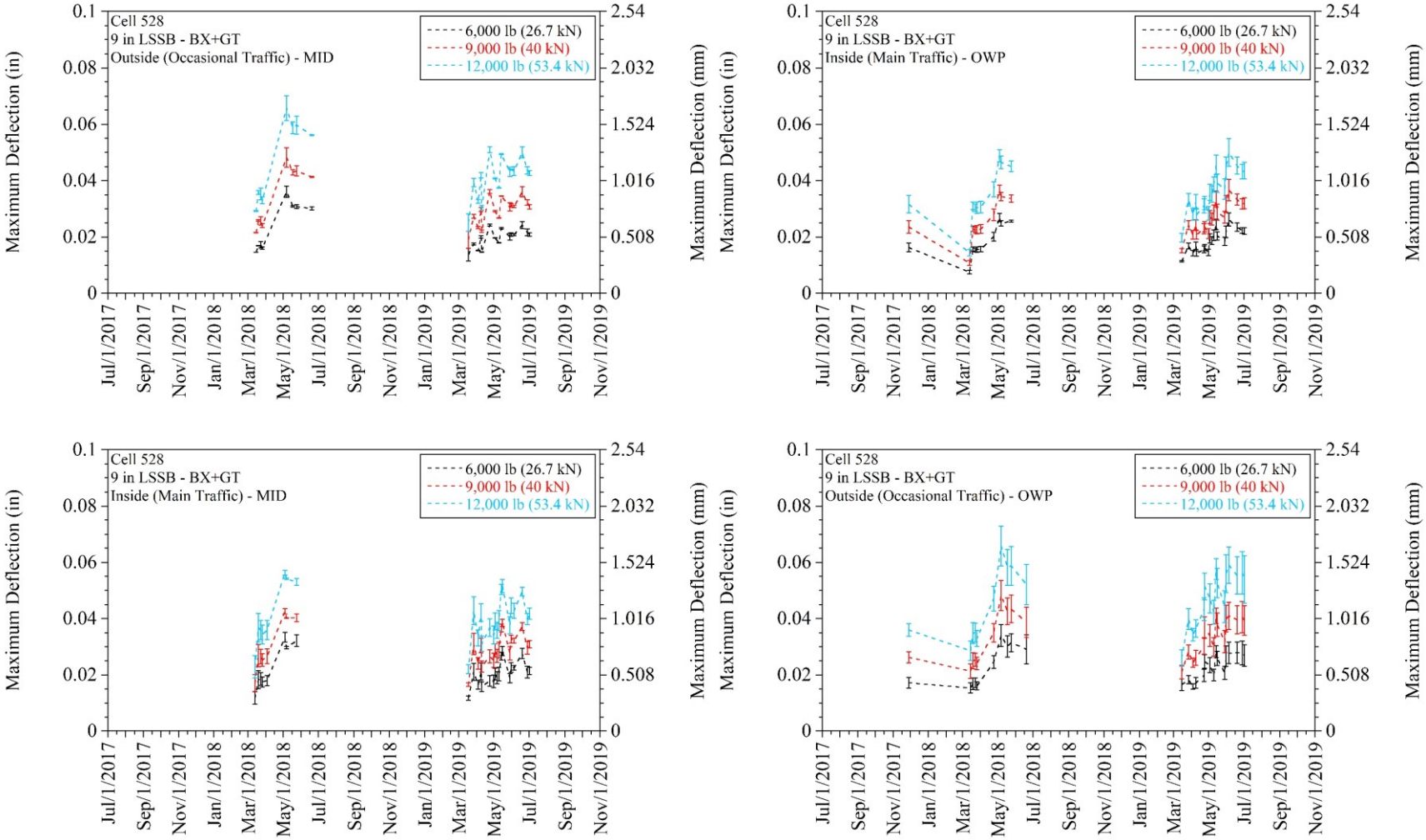
Cell 328 (9-in LSSB - TX) - maximum deflection (error bars represent one standard deviation of the data):



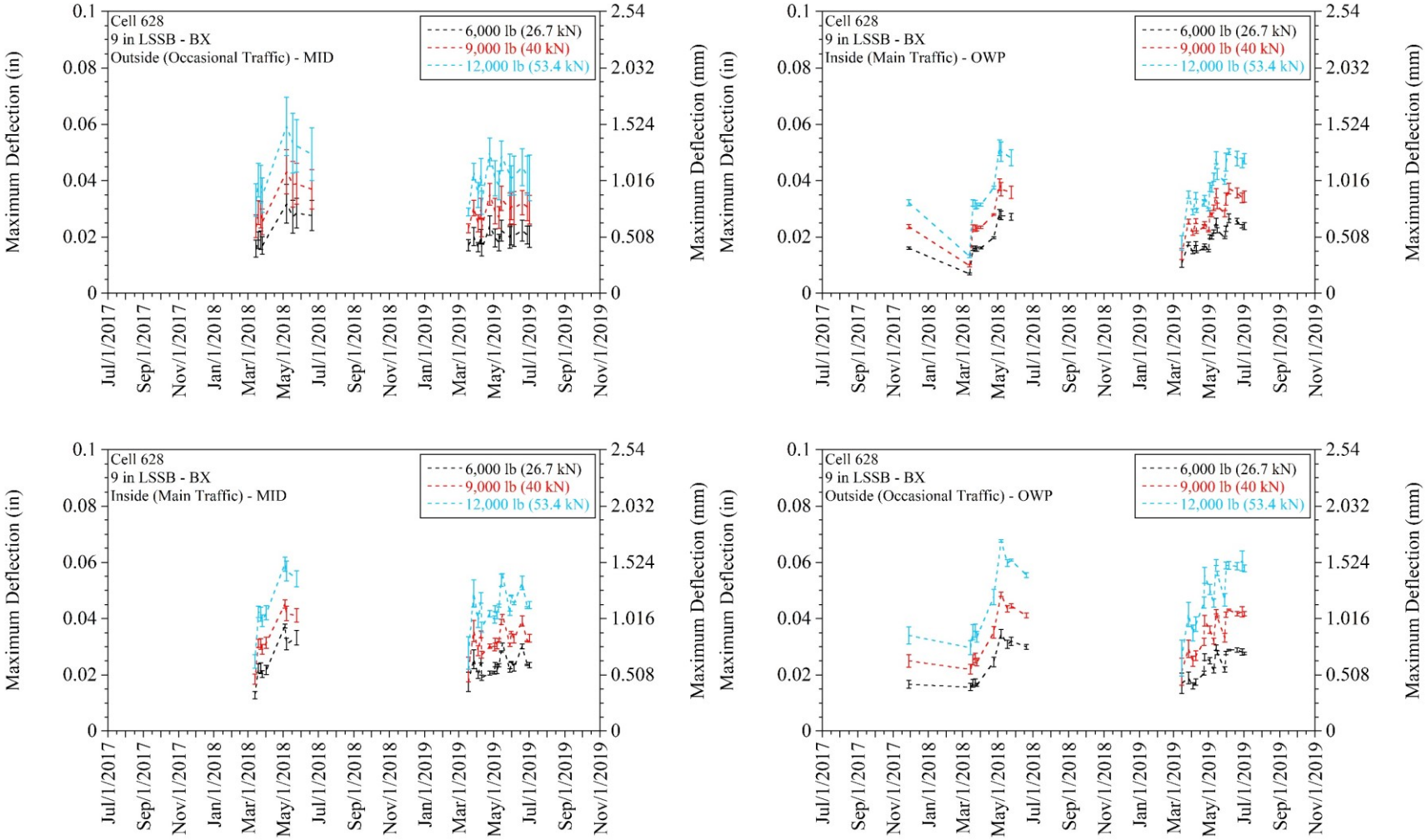
Cell 428 (9-in LSSB - TX+GT) - maximum deflection (error bars represent one standard deviation of the data):



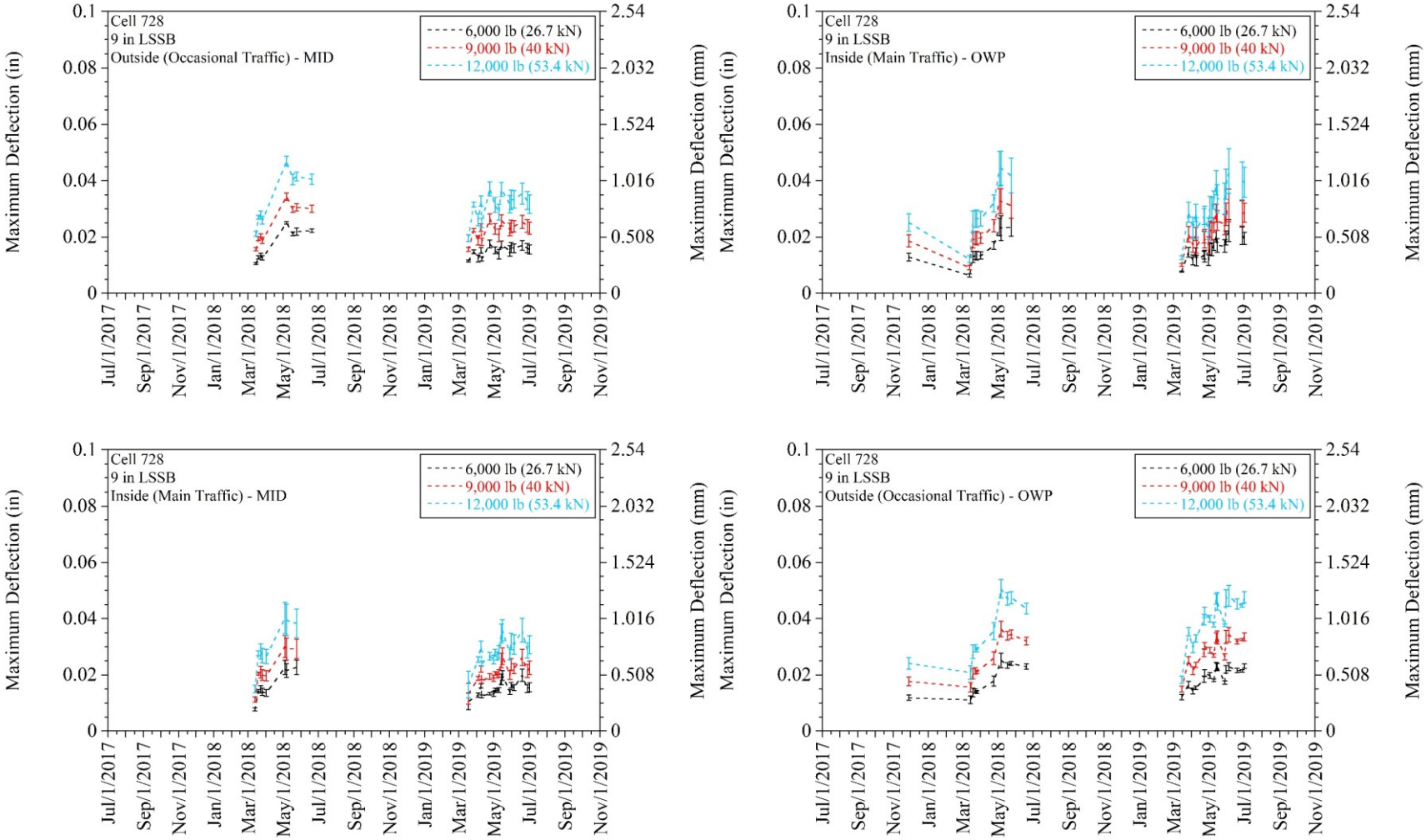
Cell 528 (9-in LSSB - BX+GT) - maximum deflection (error bars represent one standard deviation of the data):



Cell 628 (9-in LSSB - BX) - maximum deflection (error bars represent one standard deviation of the data):

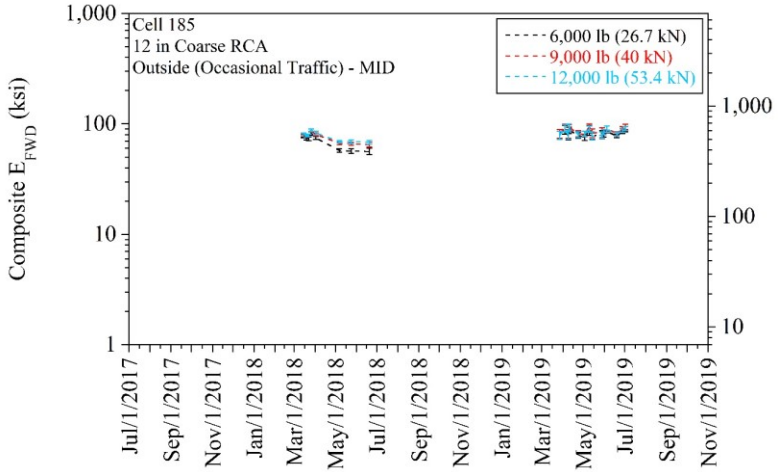


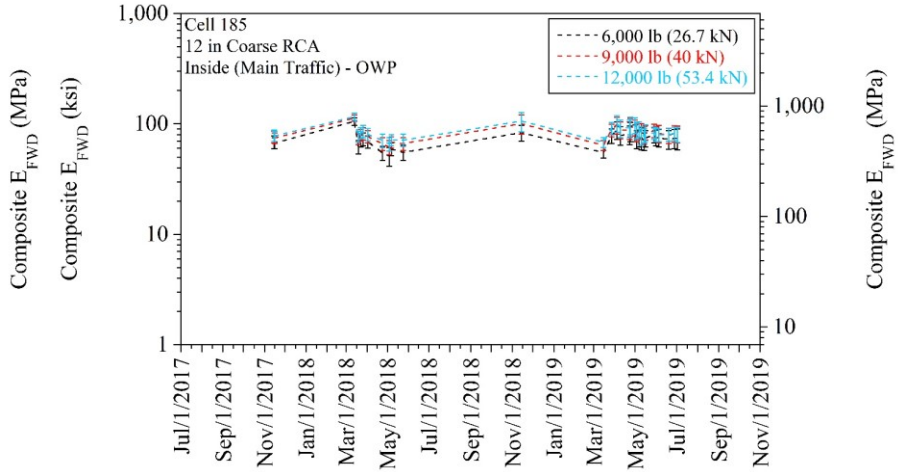
Cell 728 (9-in LSSB) - maximum deflection (error bars represent one standard deviation of the data):

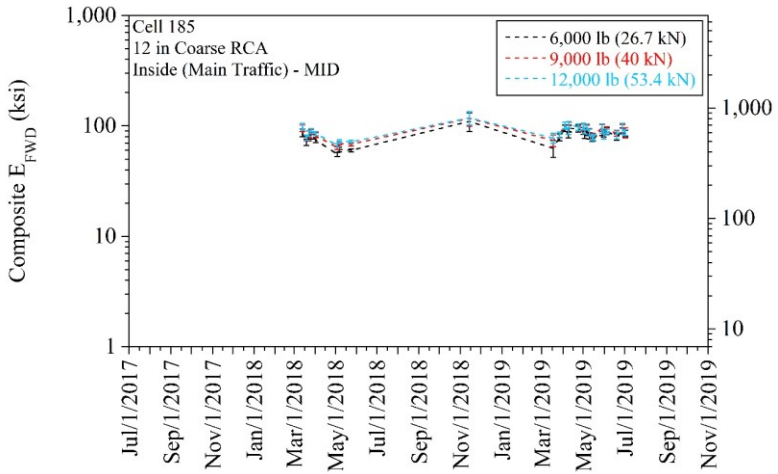


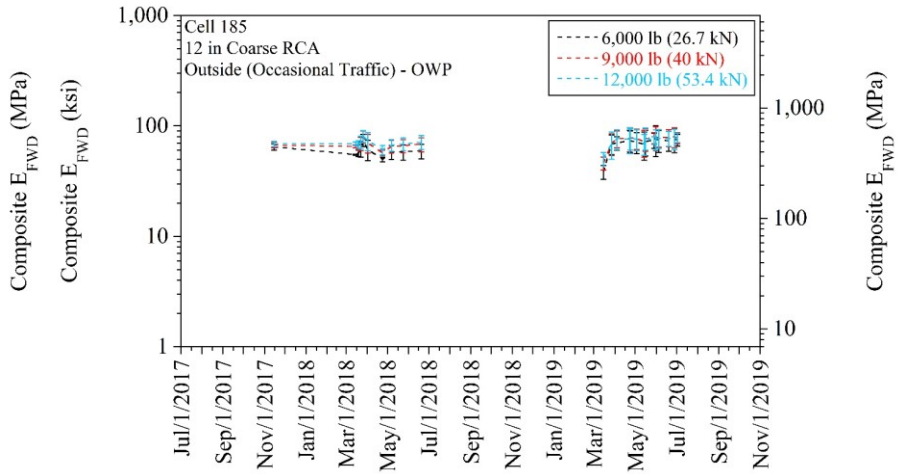
APPENDIX V
COMPOSITE FALLING WEIGHT DEFLECTOMETER (FWD) ELASTIC MODULUS (E_{FWD}) VALUES AT 6,000 LB (26.7 KN), 9,000 LB (40 KN), AND 12,000 LB (53.4 KN) FOR EACH CELL

Cell 185 (12-in Coarse RCA) - composite E_{FWD} (error bars represent one standard deviation of the data):

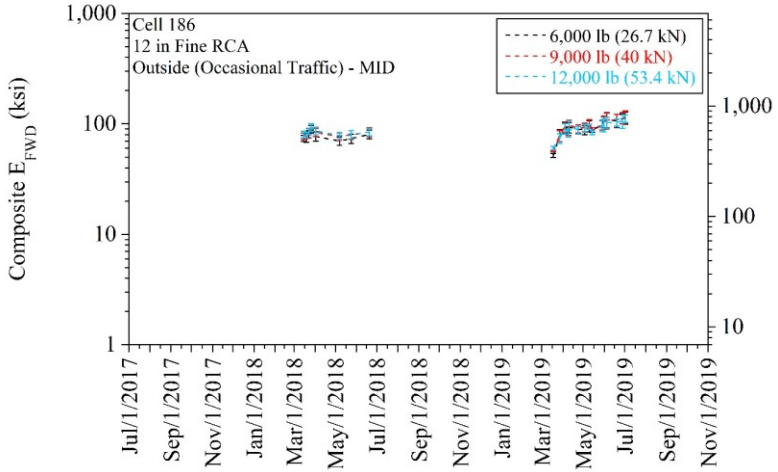


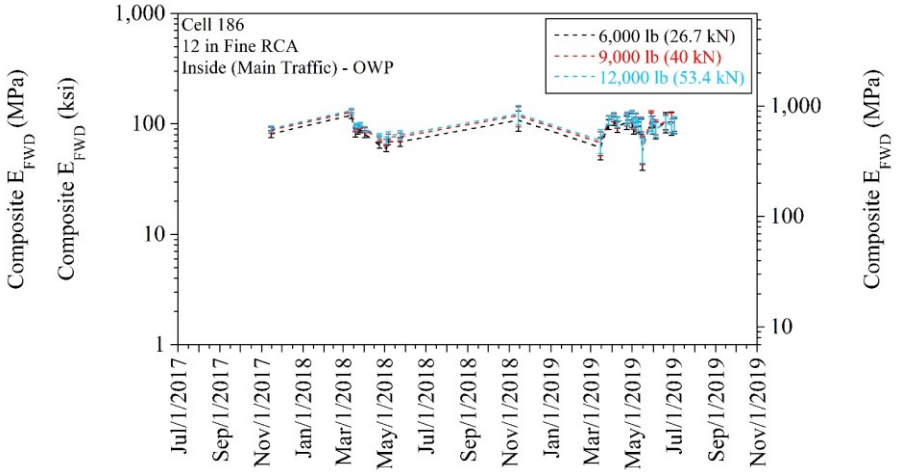


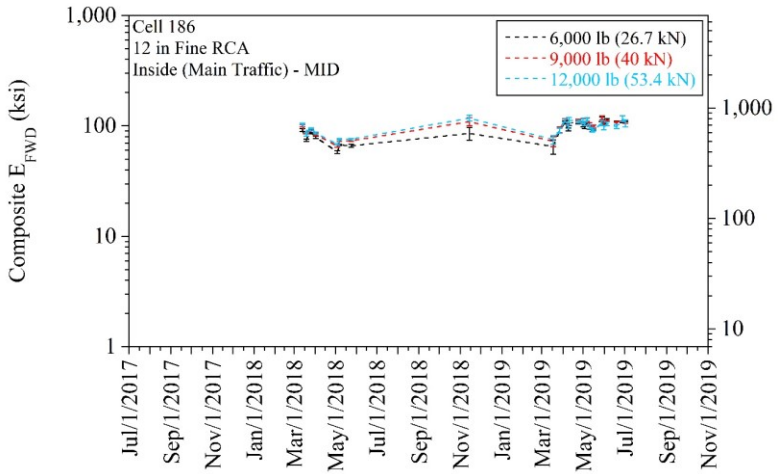


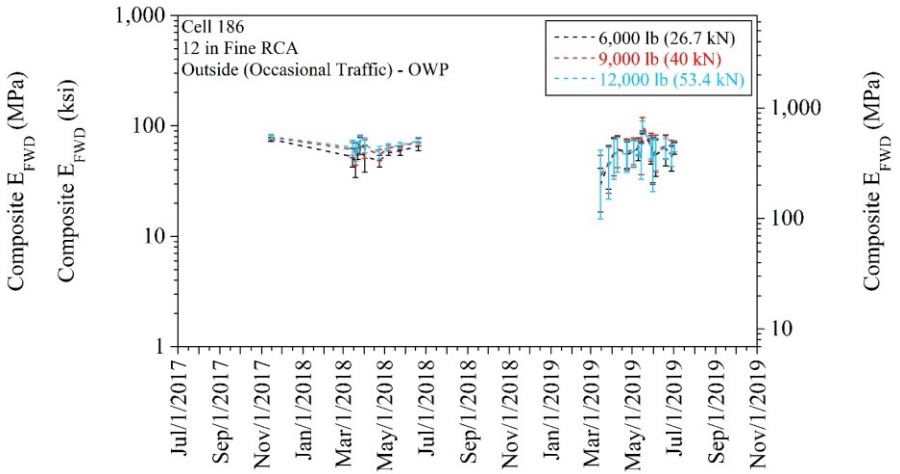


Cell 186 (12-in Fine RCA) - composite E_{FWD} (error bars represent one standard deviation of the data):

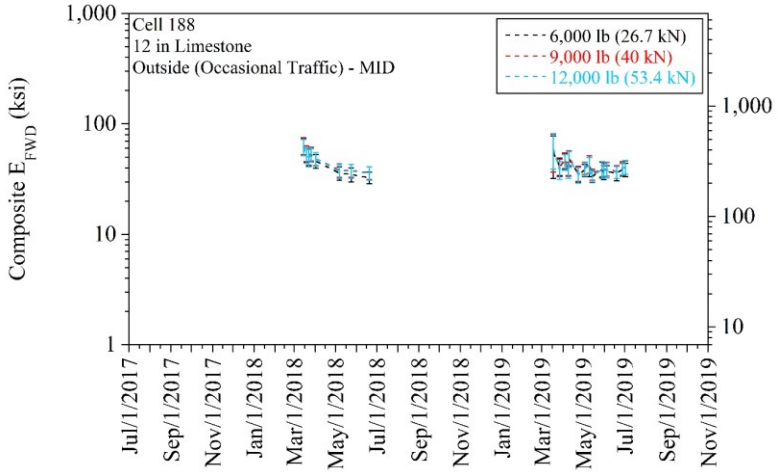


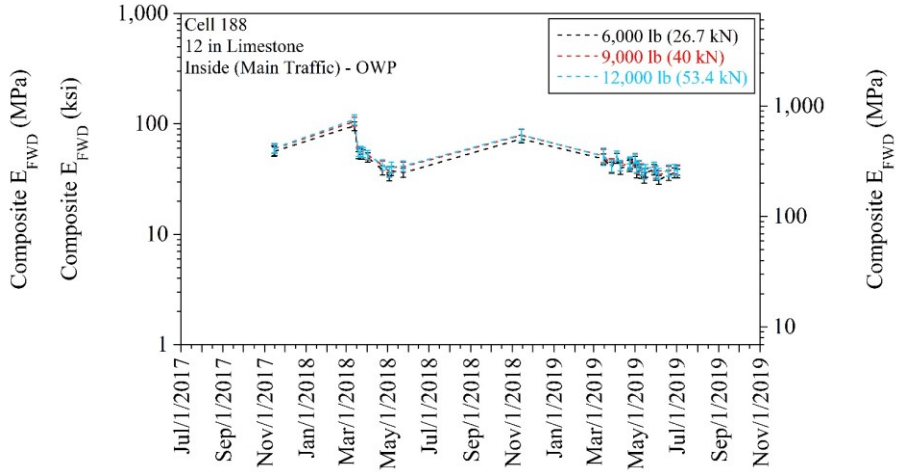


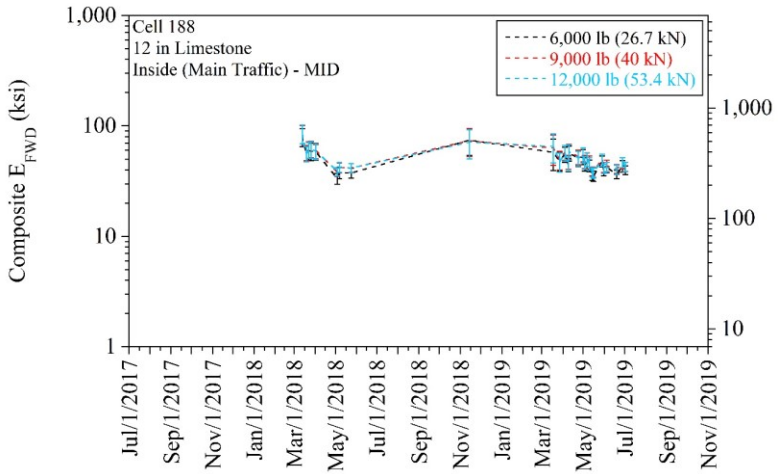


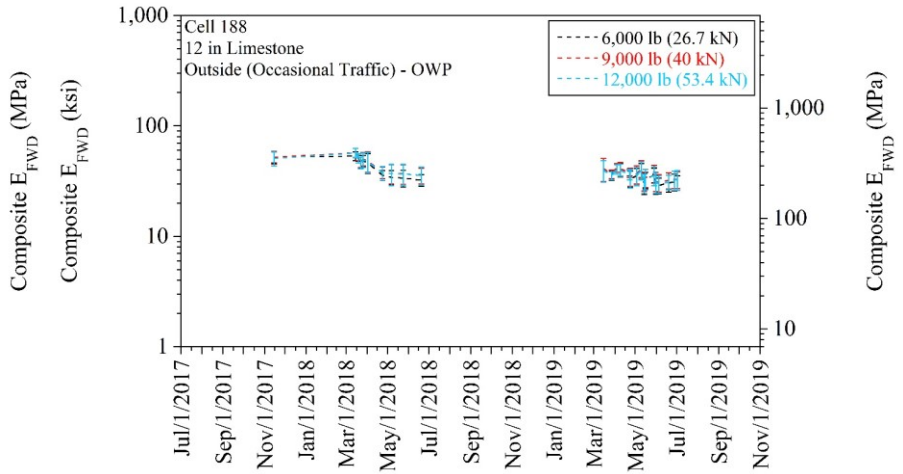


Cell 188 (12-in Limestone) - composite E_{FWD} (error bars represent one standard deviation of the data):

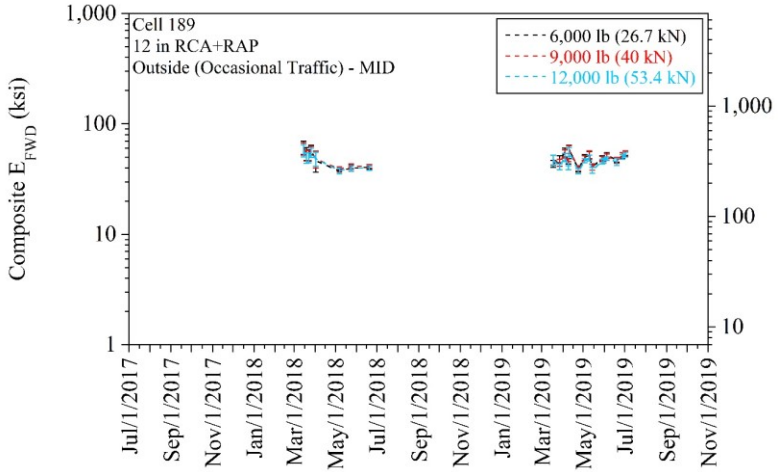


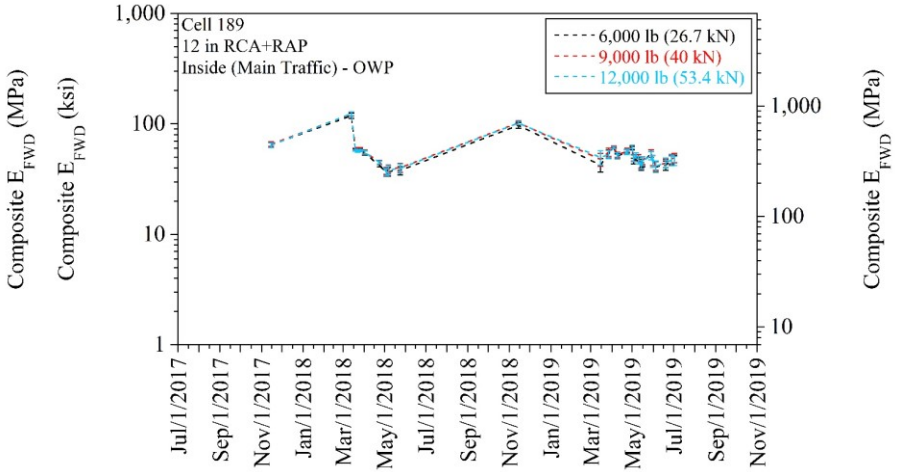


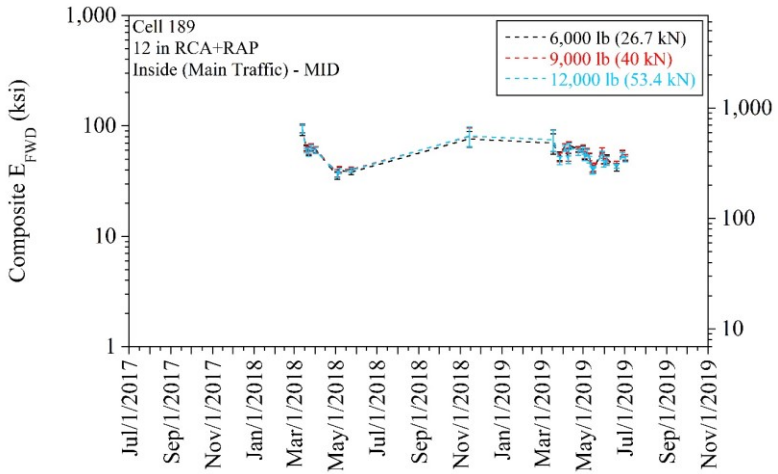


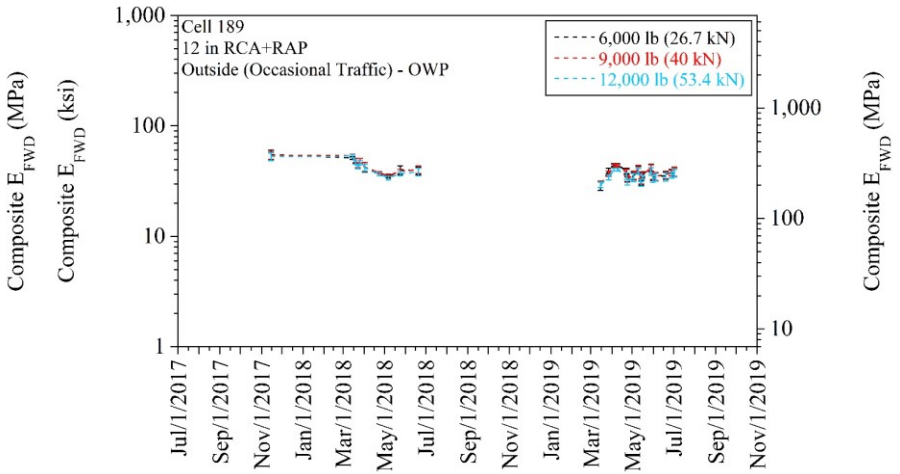


Cell 189 (12-in RCA+RAP) - composite E_{FWD} (error bars represent one standard deviation of the data):

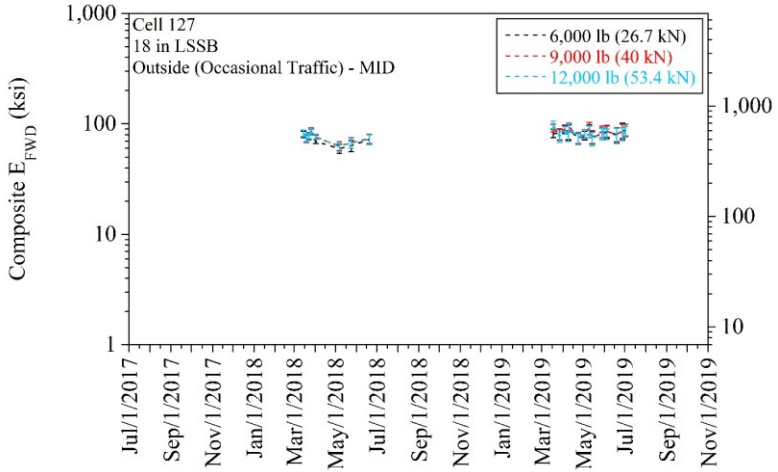


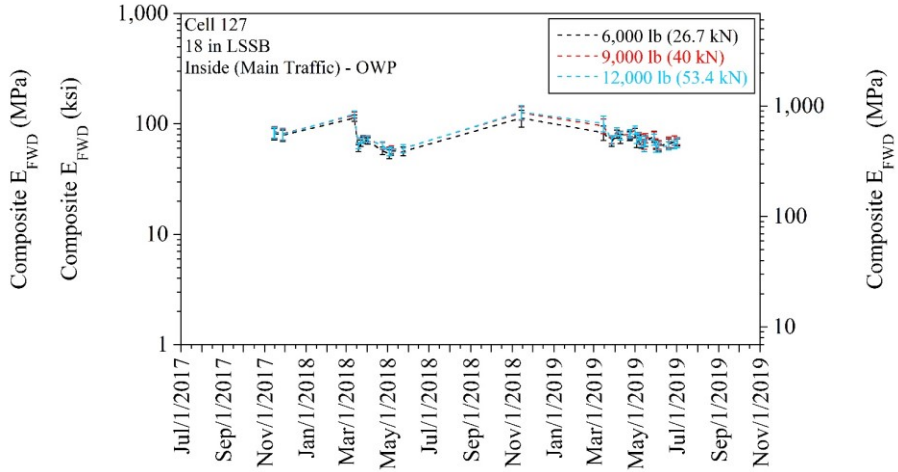


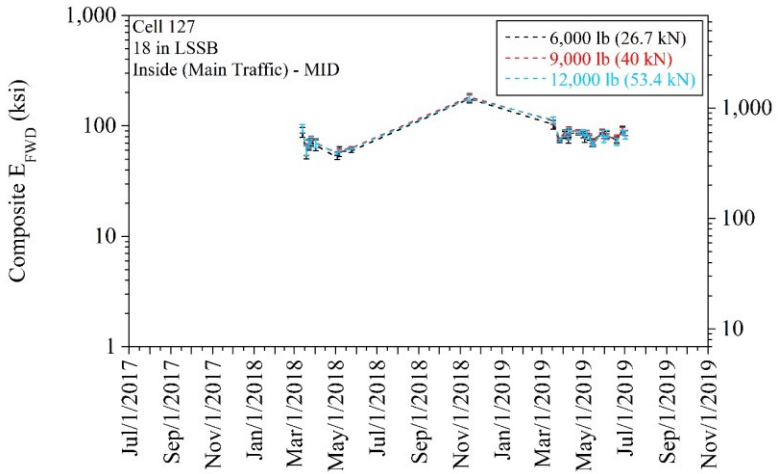


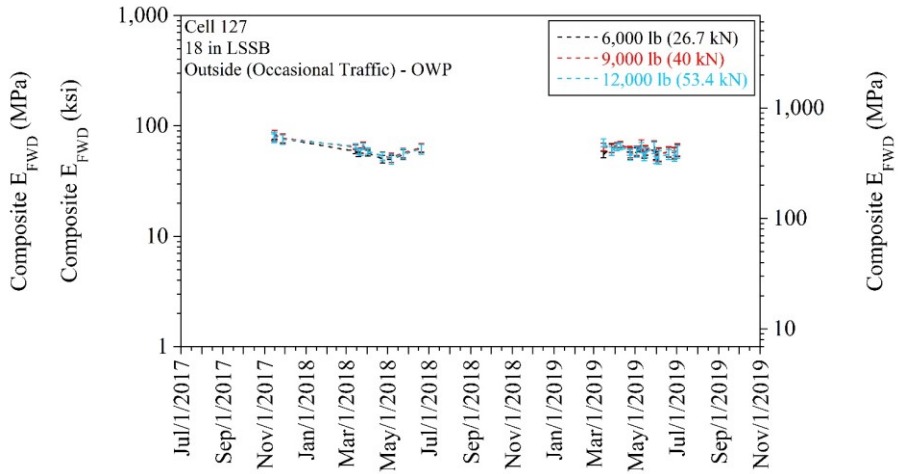


Cell 127 (18-in LSSB) - composite E_{FWD} (error bars represent one standard deviation of the data):

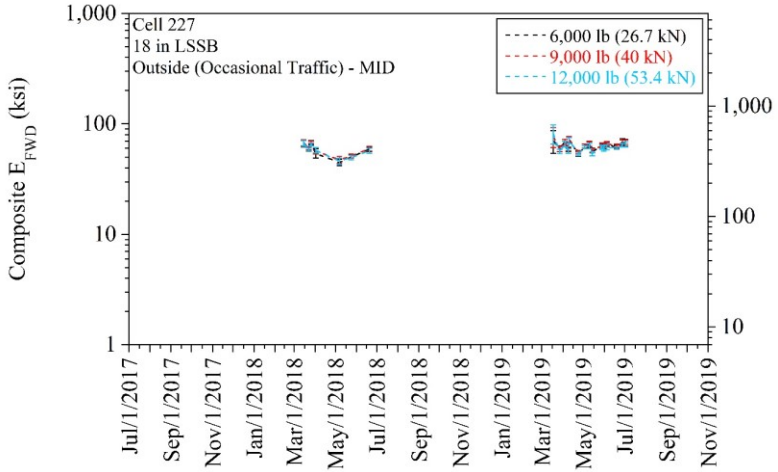


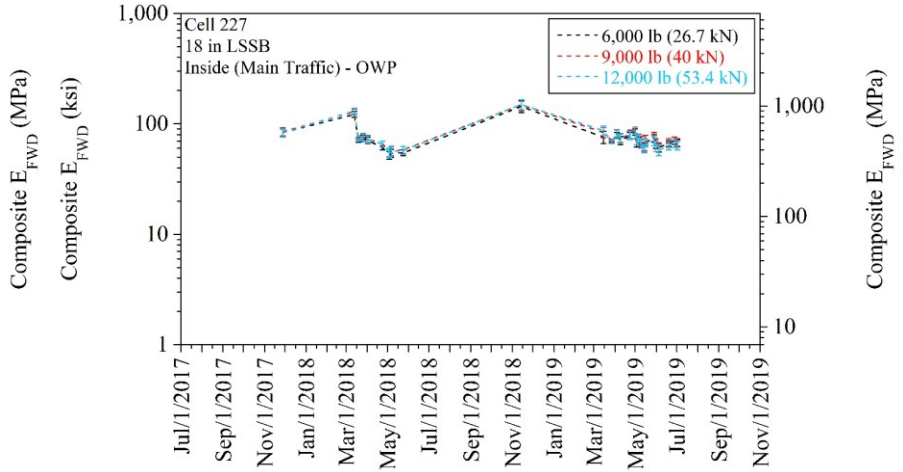


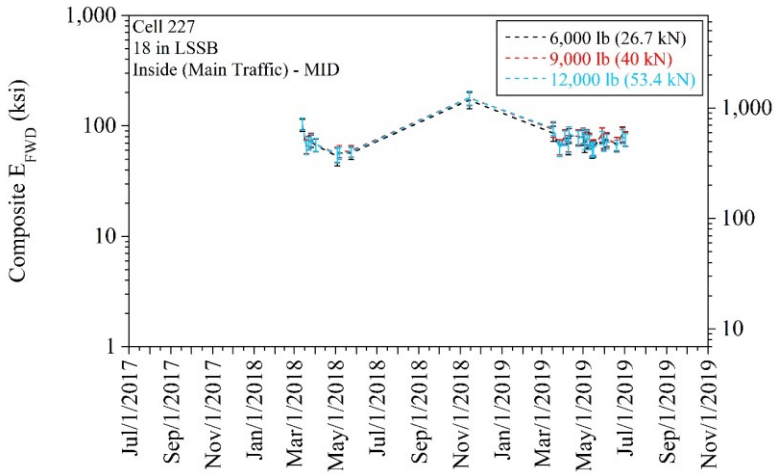


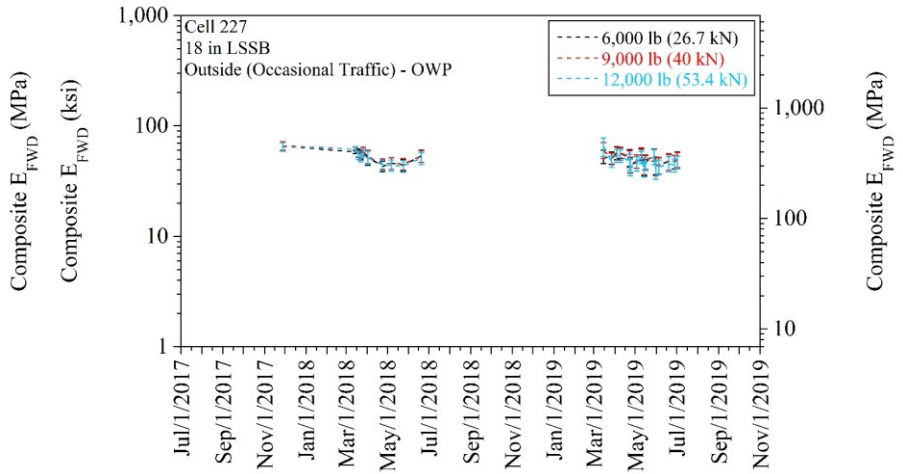


Cell 227 (18-in LSSB) - composite E_{FWD} (error bars represent one standard deviation of the data):

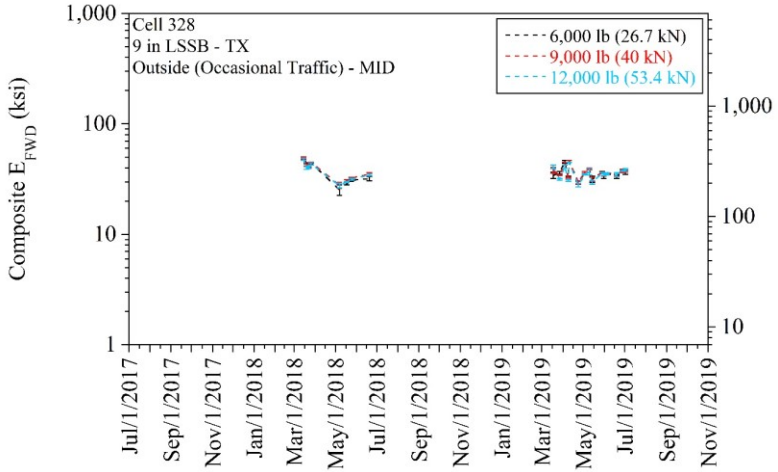


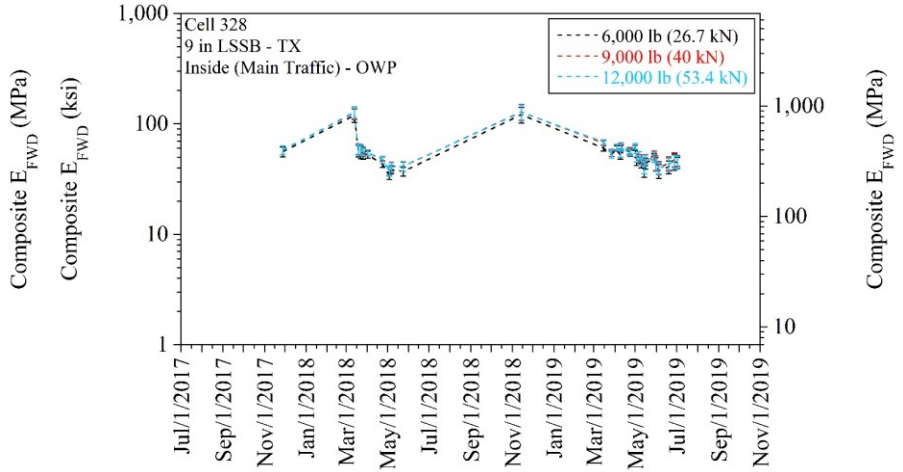


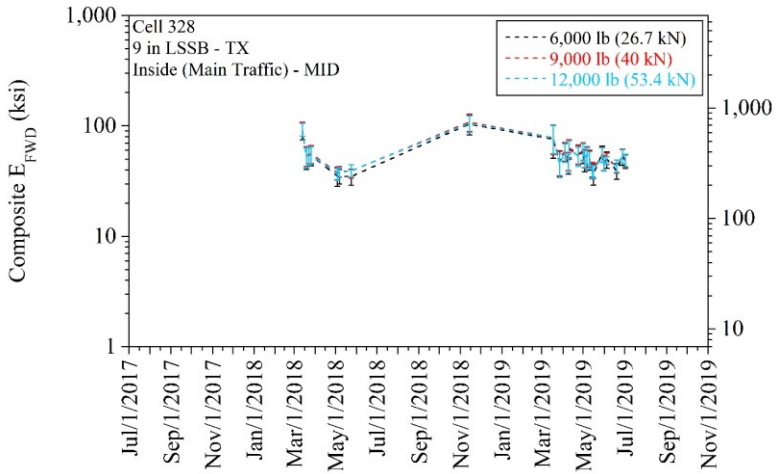


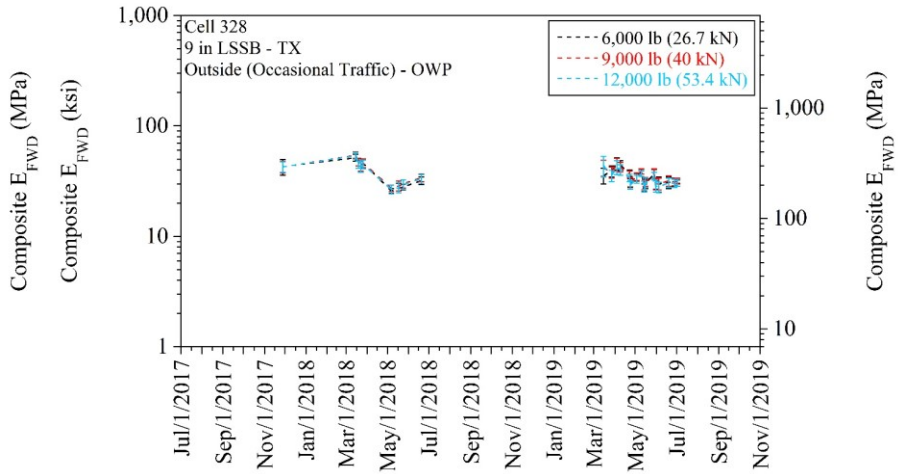


Cell 328 (9-in LSSB - TX) - composite E_{FWD} (error bars represent one standard deviation of the data):

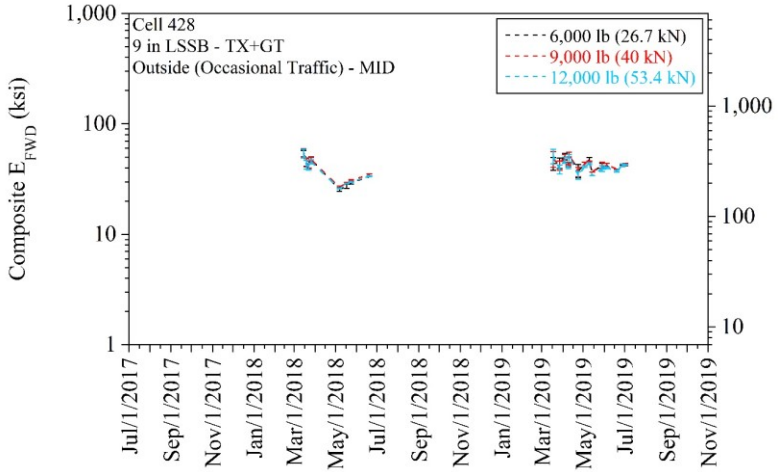


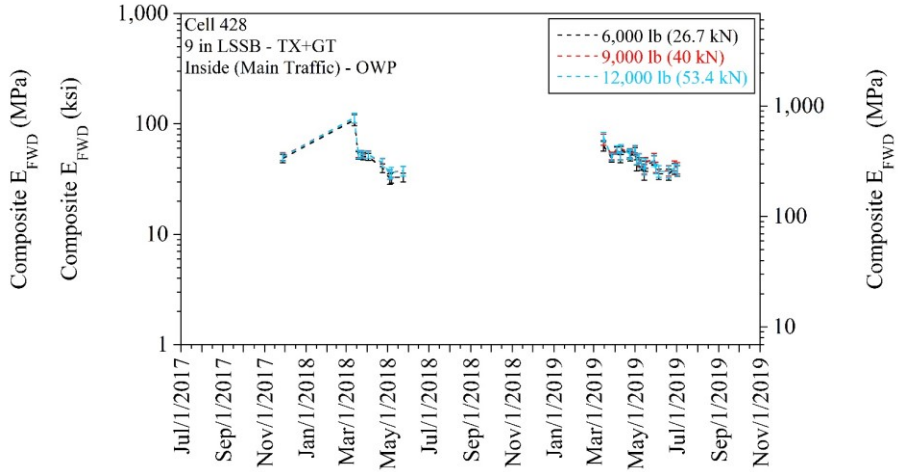


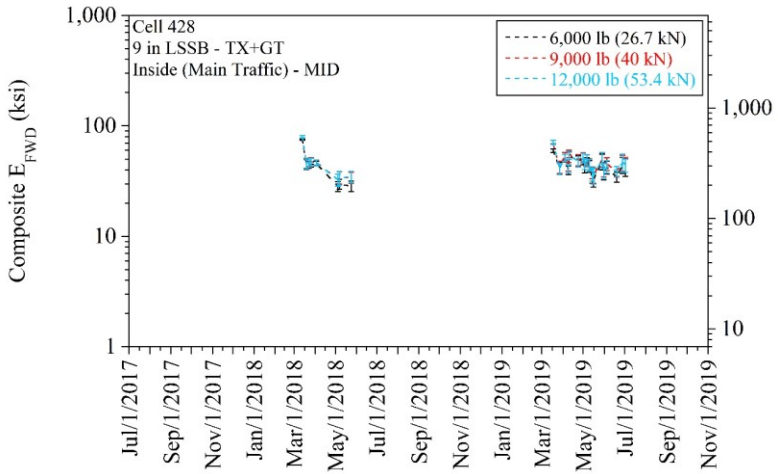


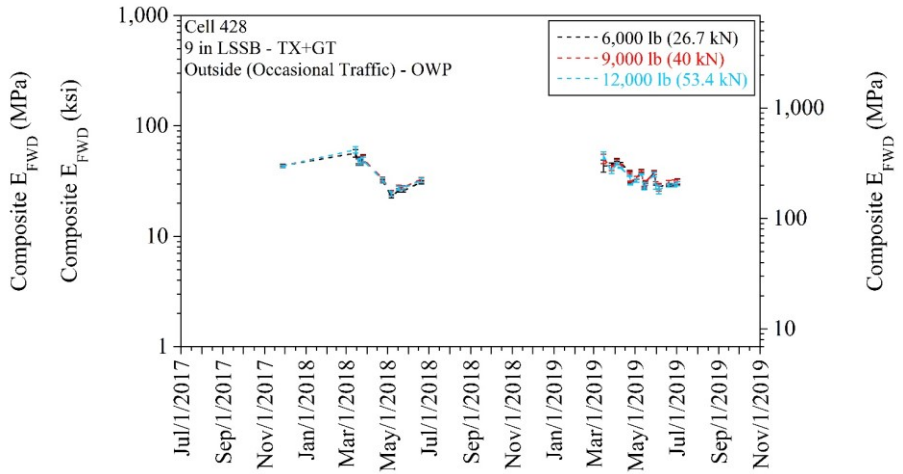


Cell 428 (9-in LSSB - TX+GT) - composite E_{FWD} (error bars represent one standard deviation of the data):

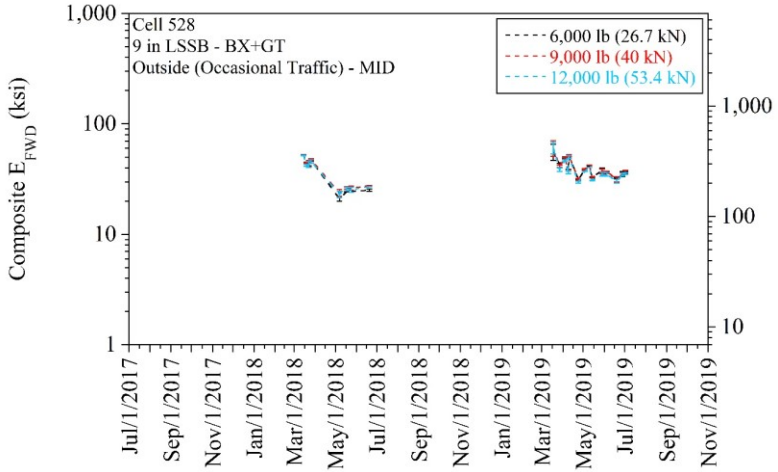


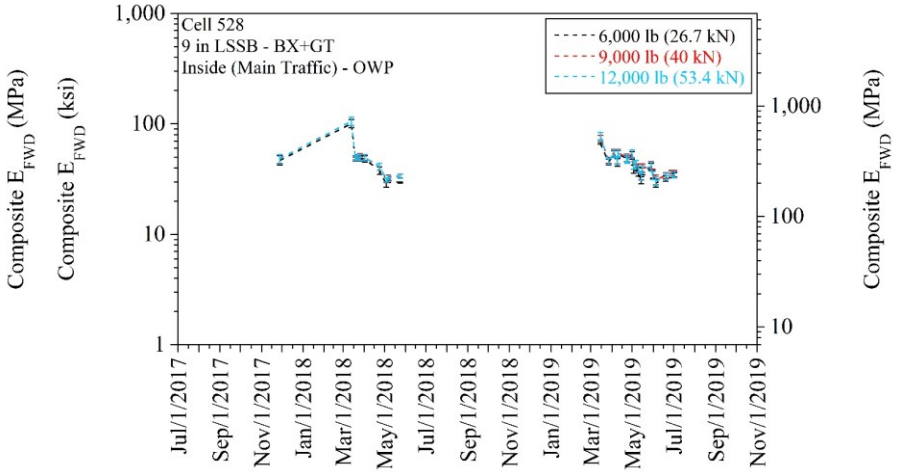


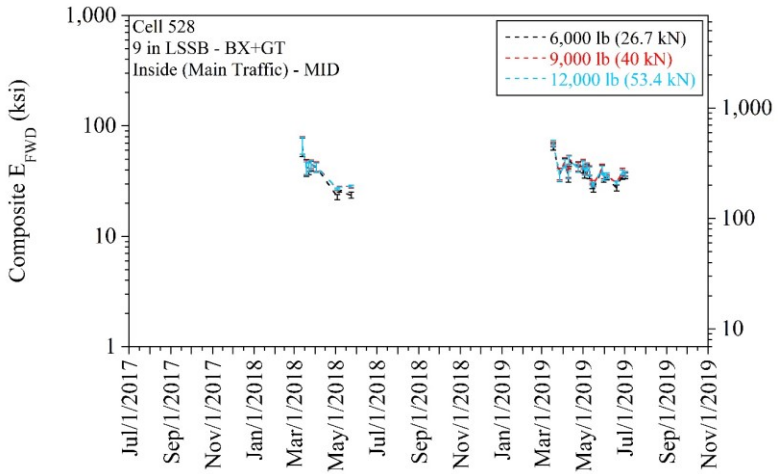


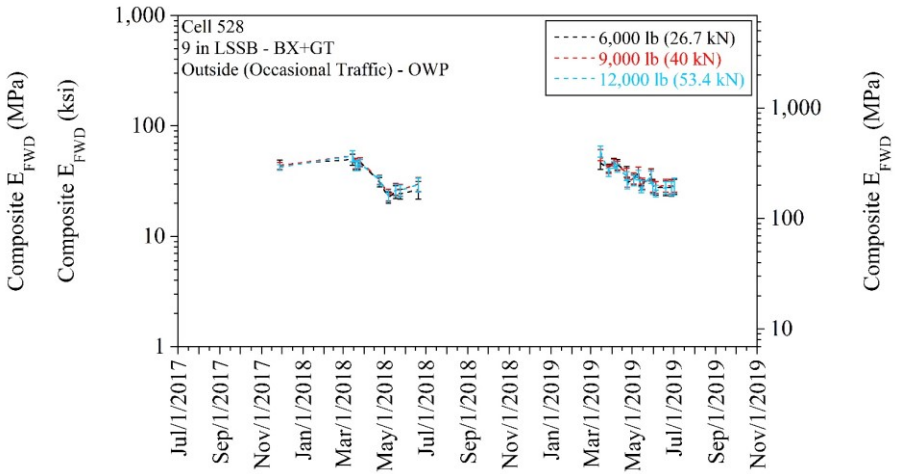


Cell 528 (9-in LSSB - BX+GT) - composite E_{FWD} (error bars represent one standard deviation of the data):

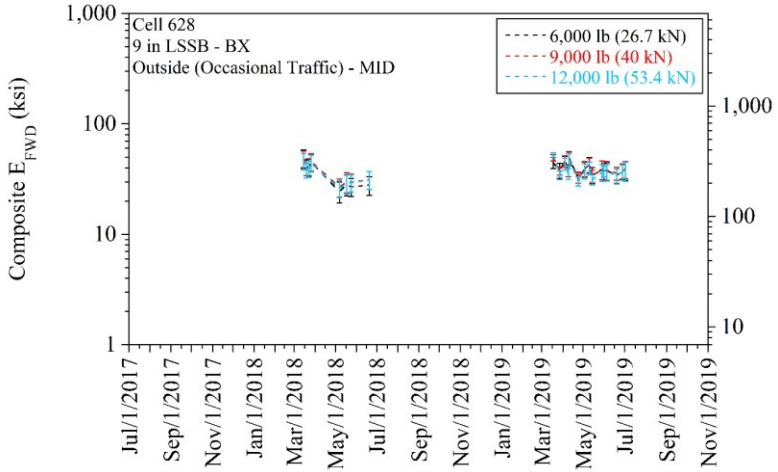


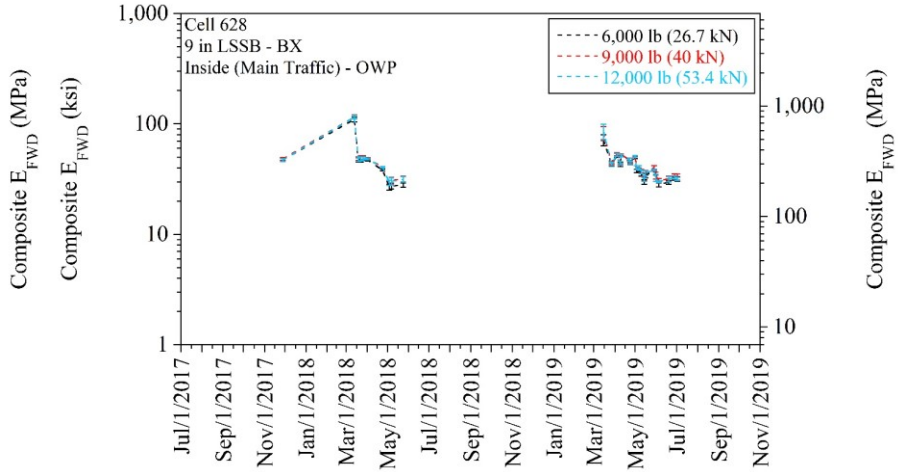


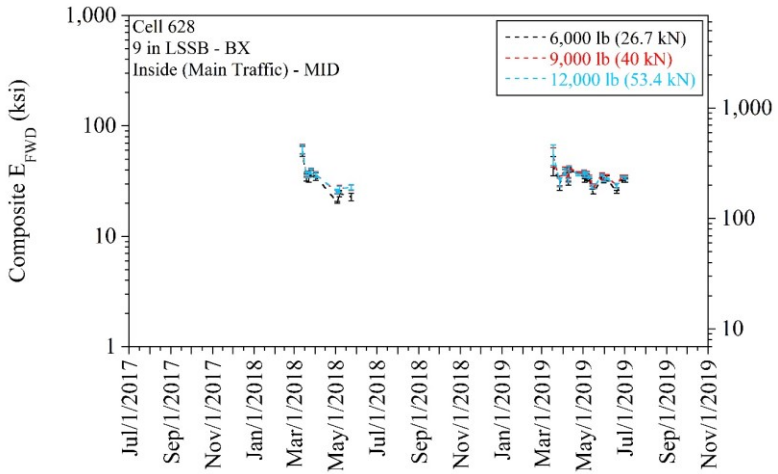


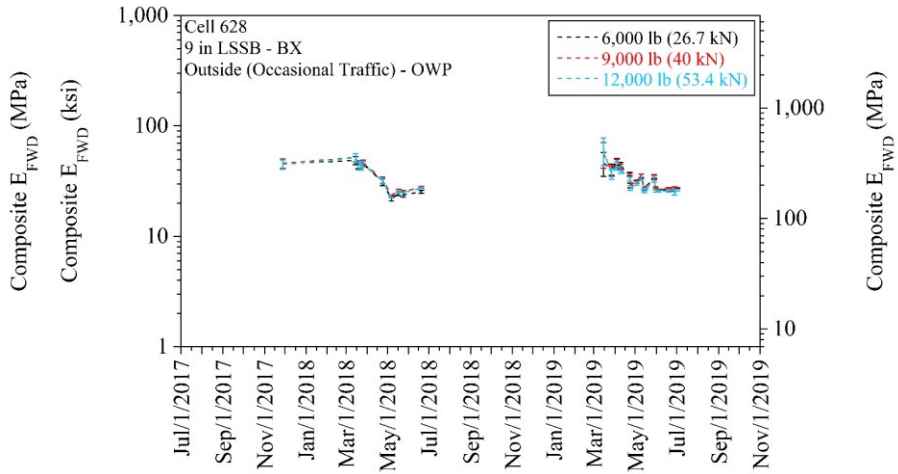


Cell 628 (9-in LSSB - BX) - composite E_{FWD} (error bars represent one standard deviation of the data):

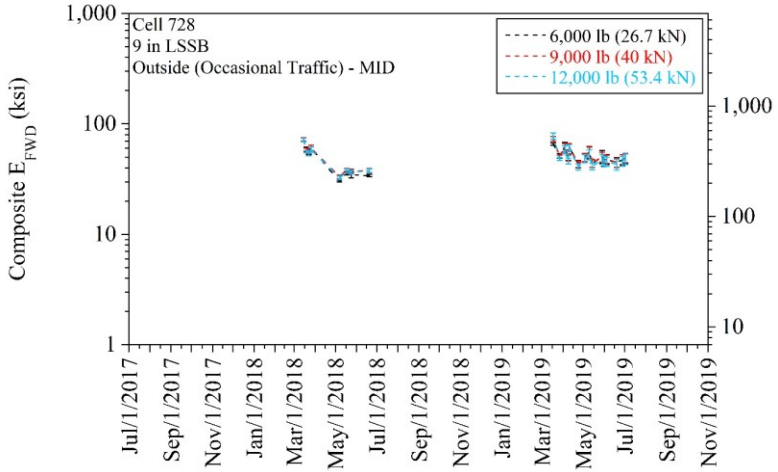


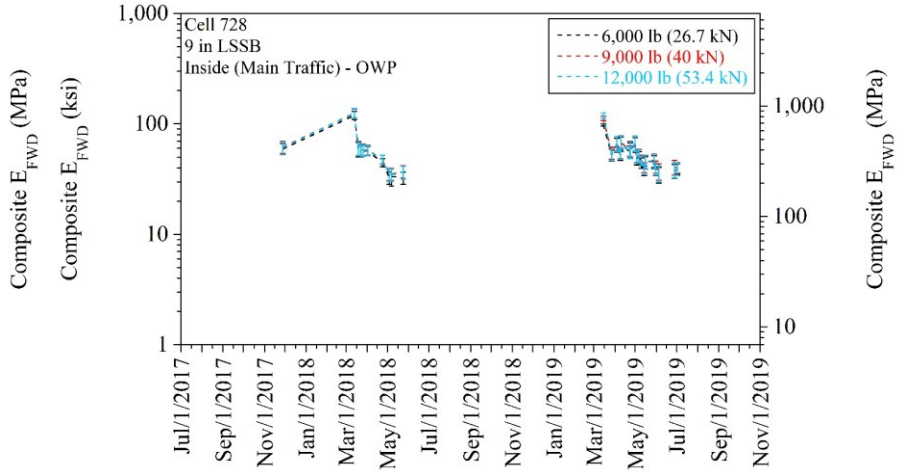


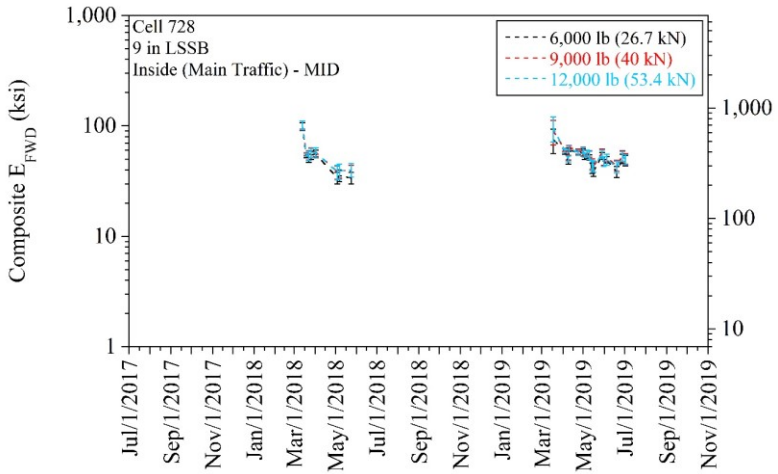


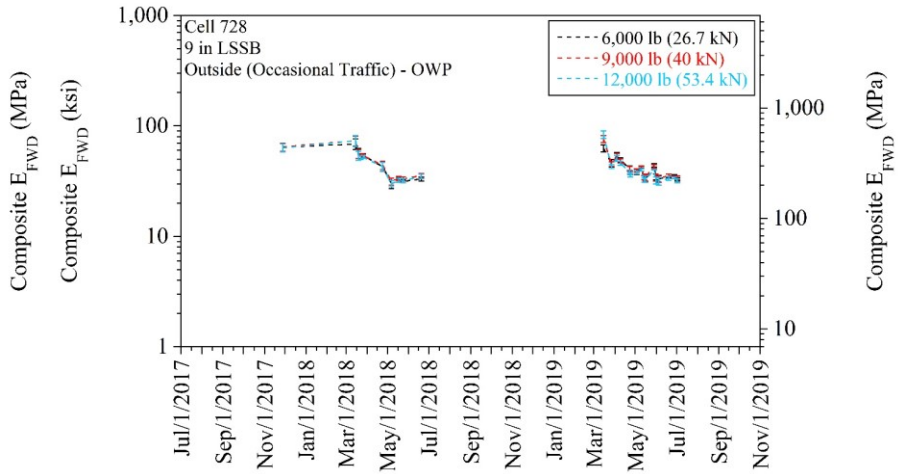


Cell 728 (9-in LSSB) - composite E_{FWD} (error bars represent one standard deviation of the data):



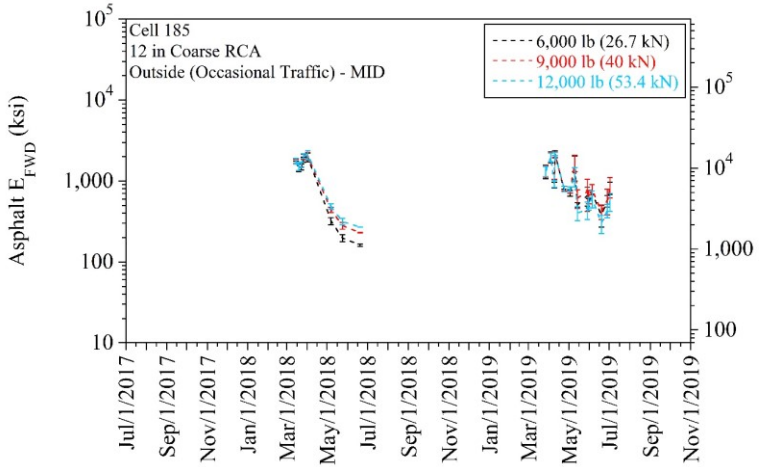


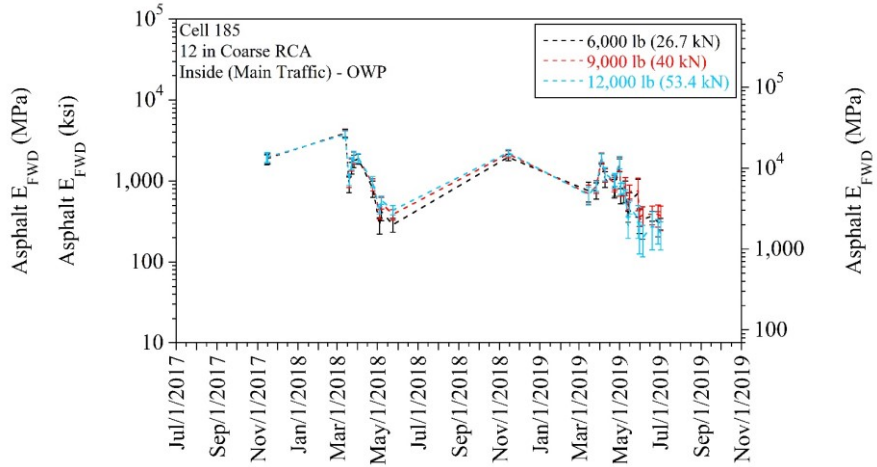


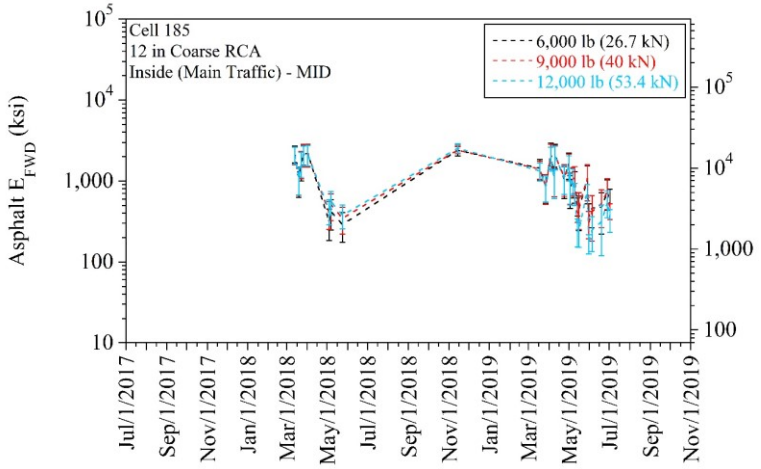


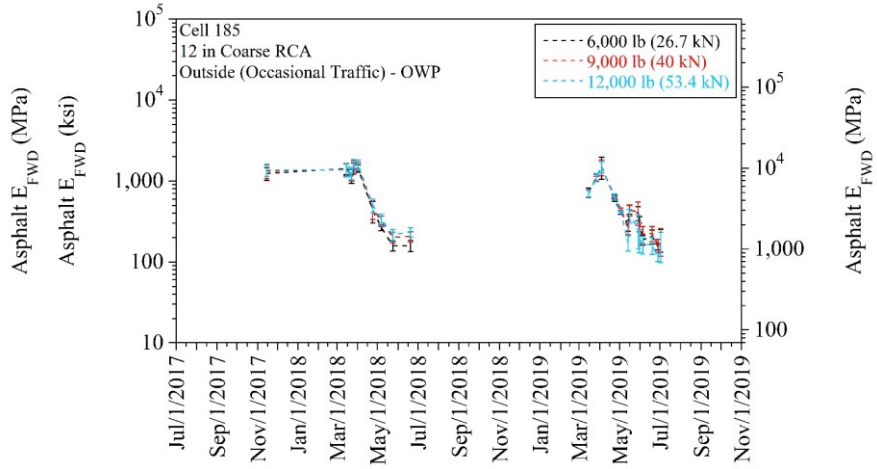
APPENDIX W
ASPHALT FALLING WEIGHT DEFLECTOMETER (FWD) ELASTIC MODULUS (E_{FWD}) AT 6,000 LB (26.7 KN), 9,000 LB (40 KN), AND 12,000 LB (53.4 KN) FOR EACH CELL

Cell 185 (12-in Coarse RCA) - asphalt E_{FWD} (error bars represent one standard deviation of the data):

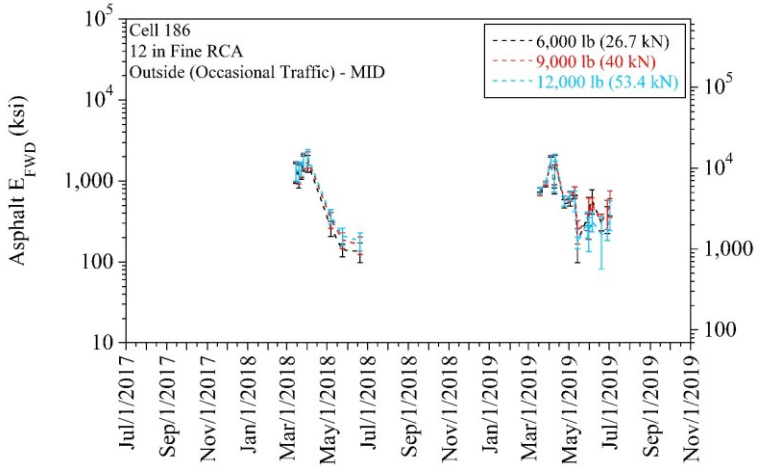


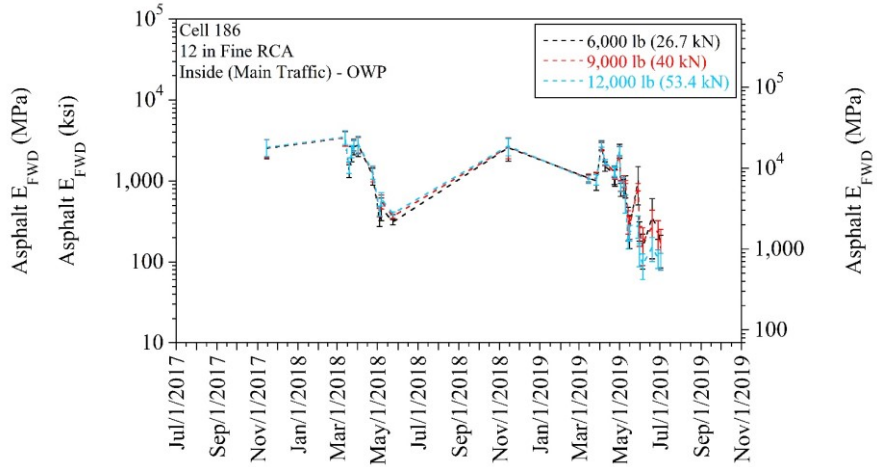


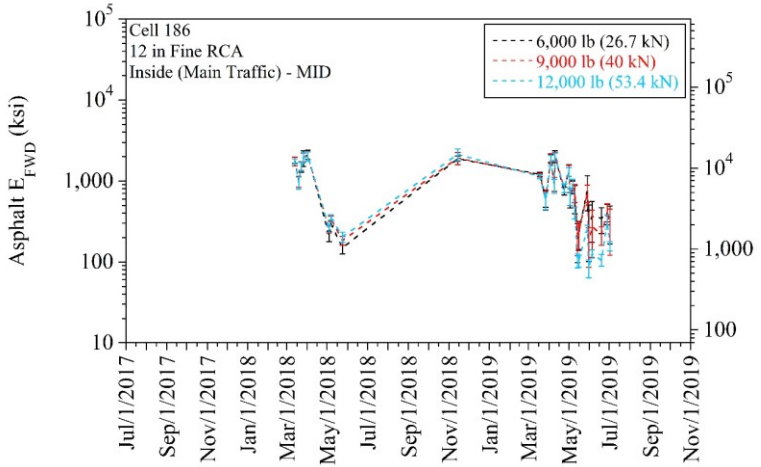


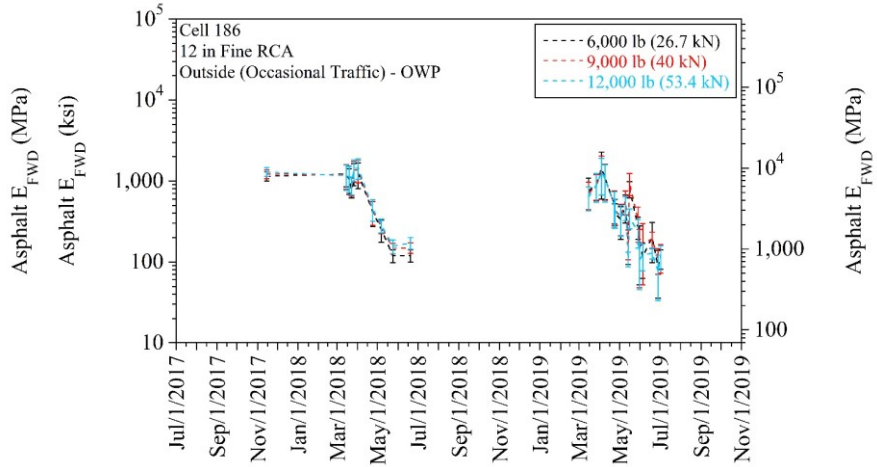


Cell 186 (12-in Fine RCA) - asphalt E_{FWD} (error bars represent one standard deviation of the data):

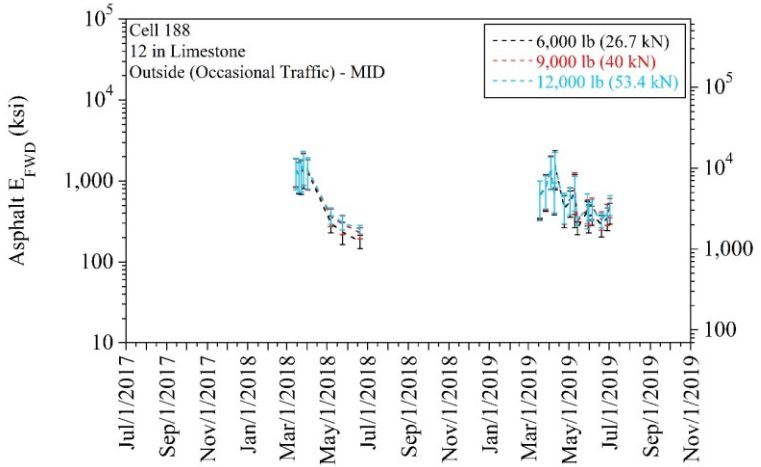


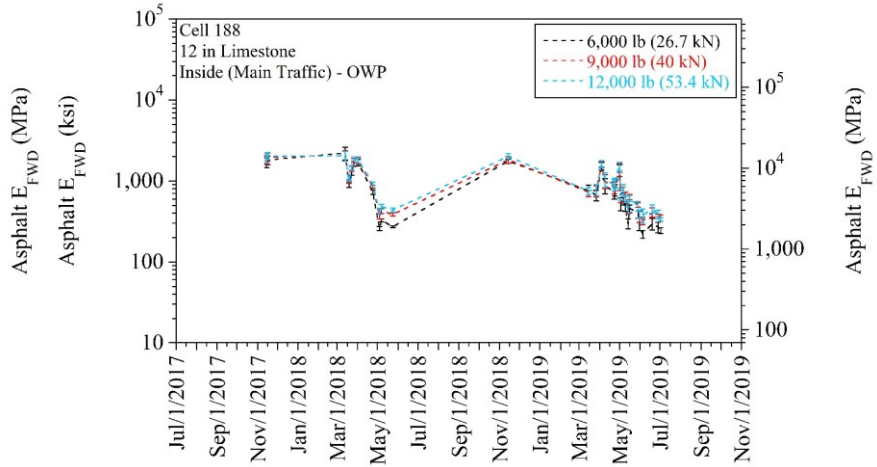


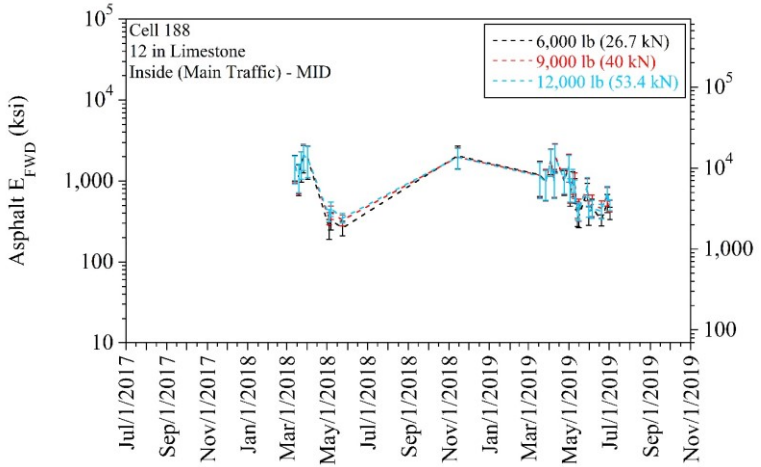


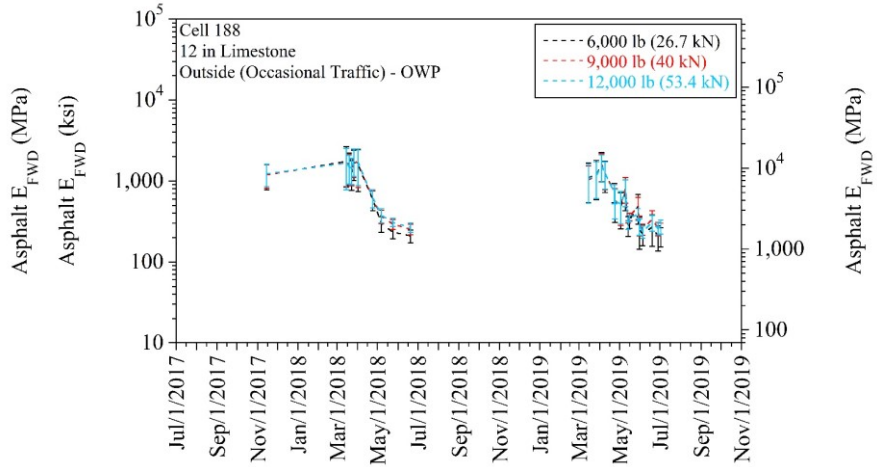


Cell 188 (12-in Limestone) - asphalt E_{FWD} (error bars represent one standard deviation of the data):

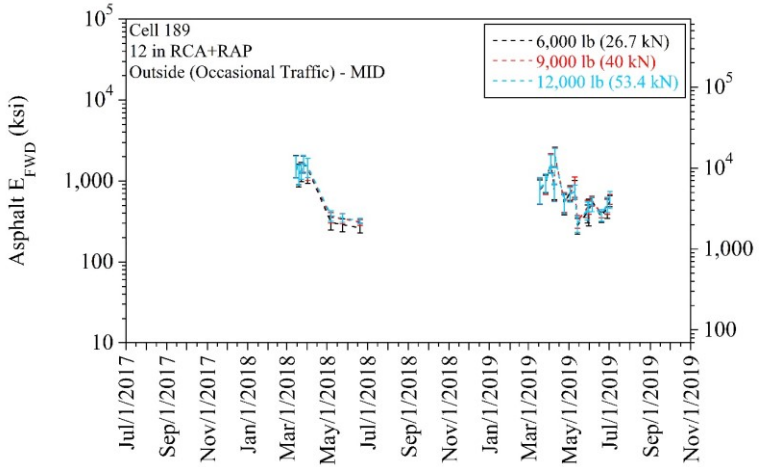


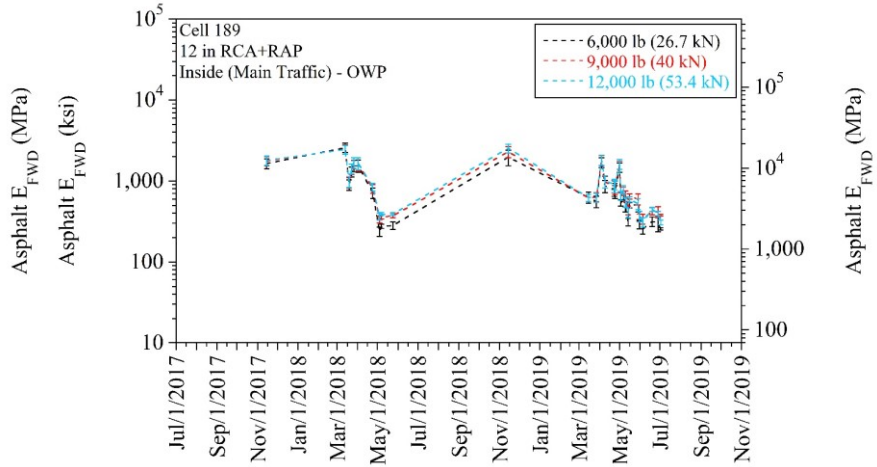


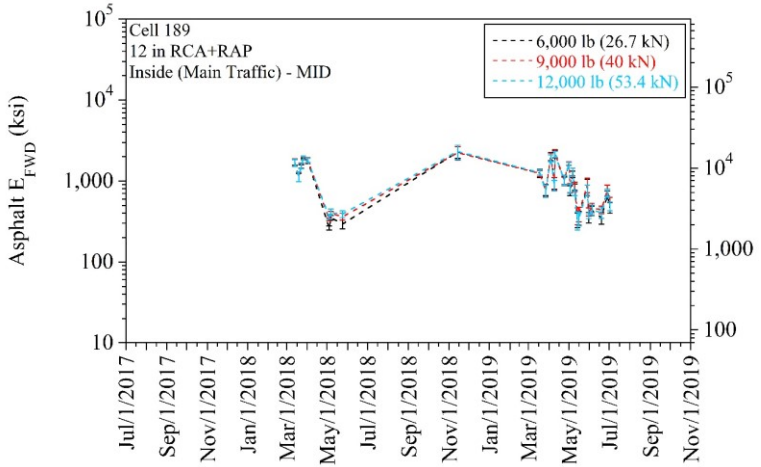


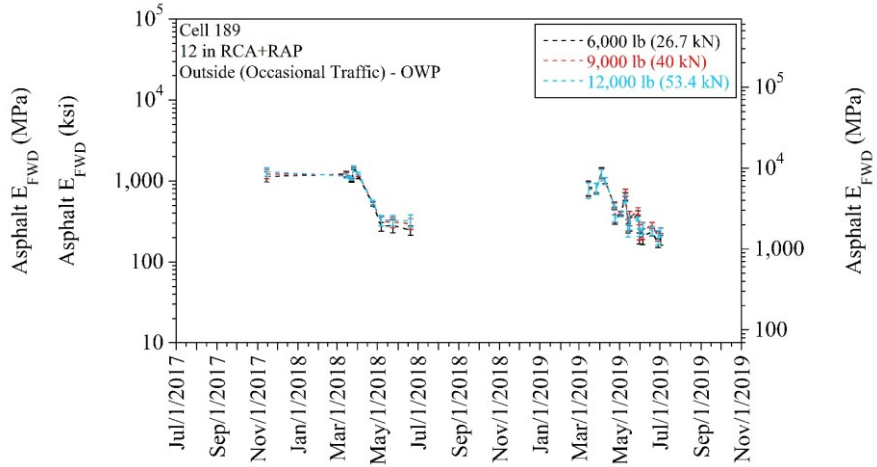


Cell 189 (12-in RCA+RAP) - asphalt E_{FWD} (error bars represent one standard deviation of the data):

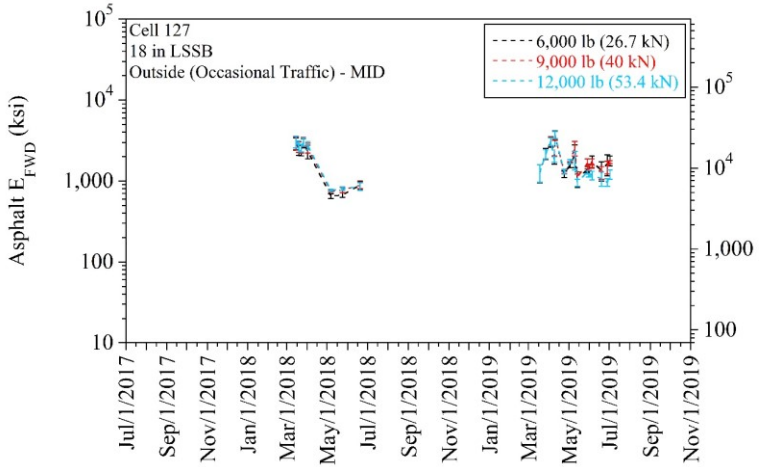


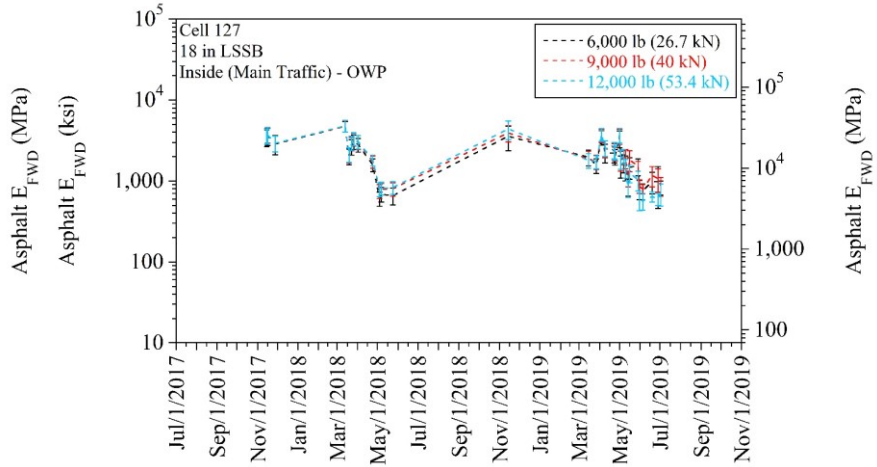


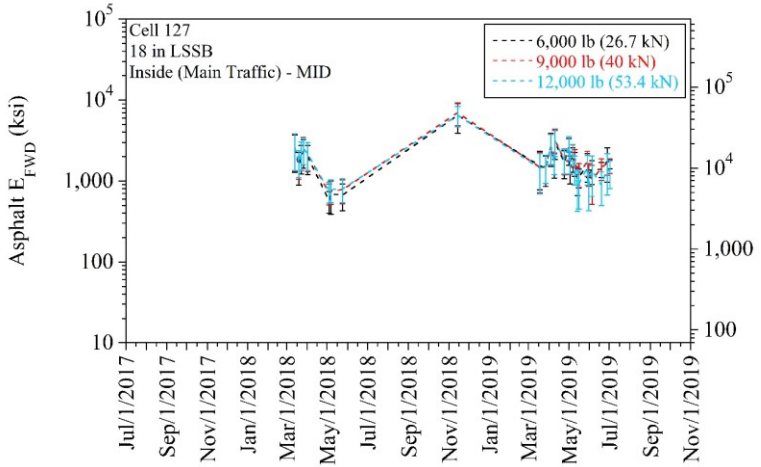


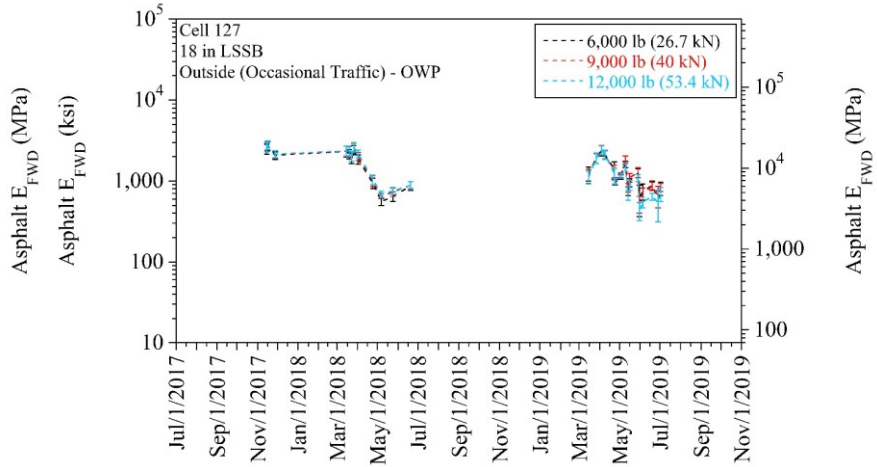


Cell 127 (18-in LSSB) - asphalt E_{FWD} (error bars represent one standard deviation of the data):

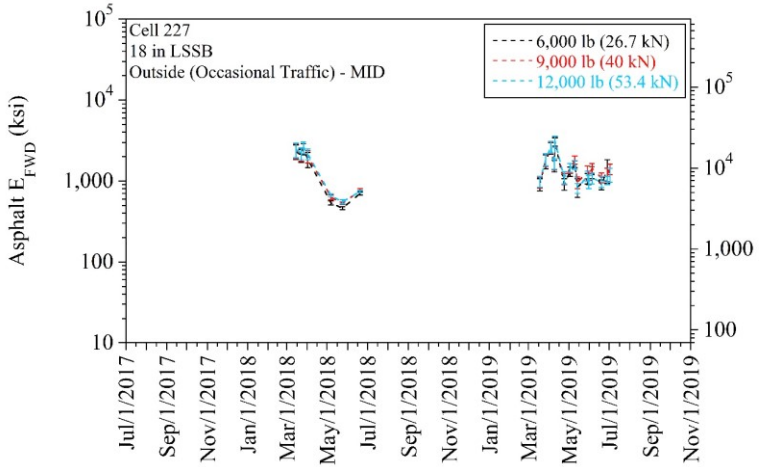


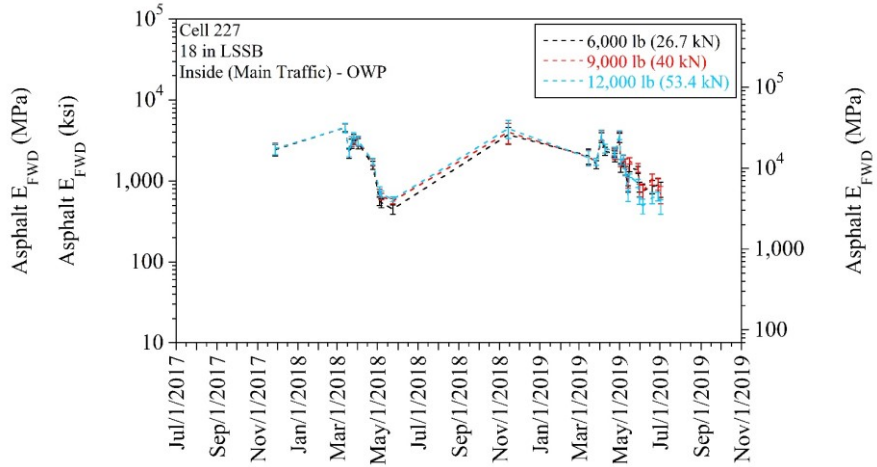


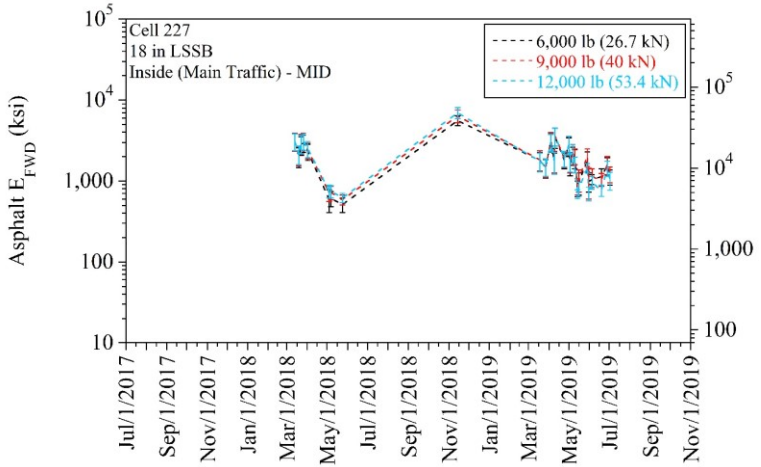


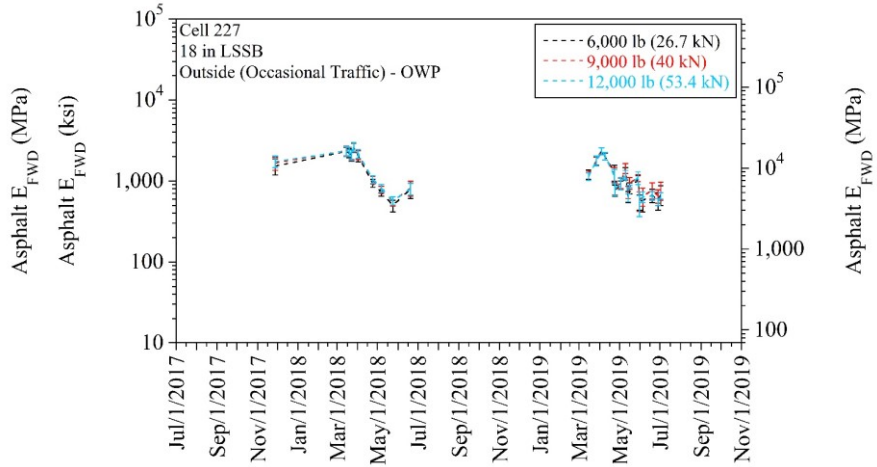


Cell 227 (18-in LSSB) - asphalt E_{FWD} (error bars represent one standard deviation of the data):

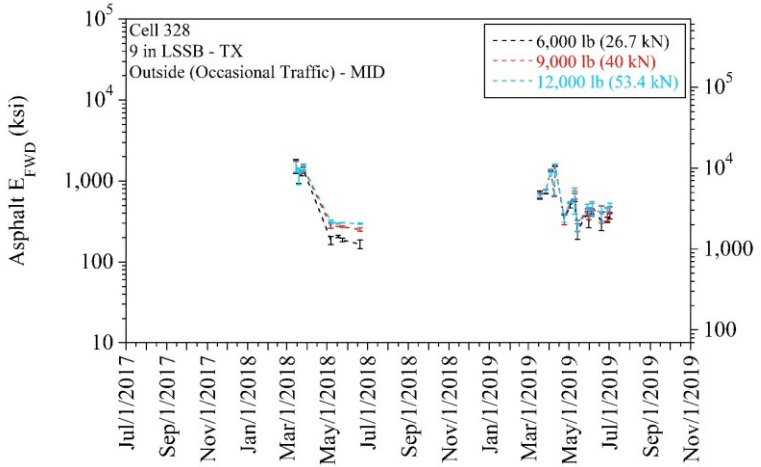


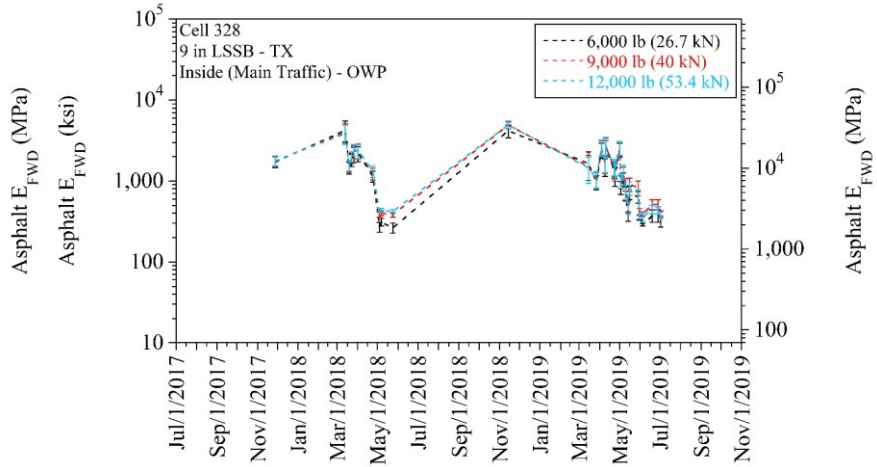


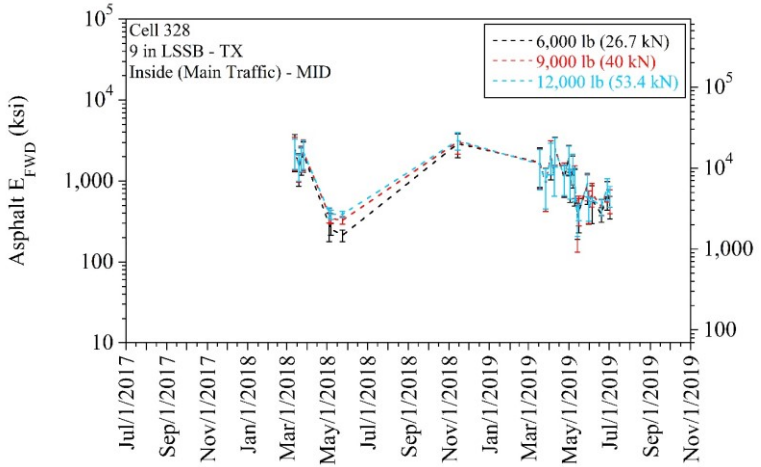


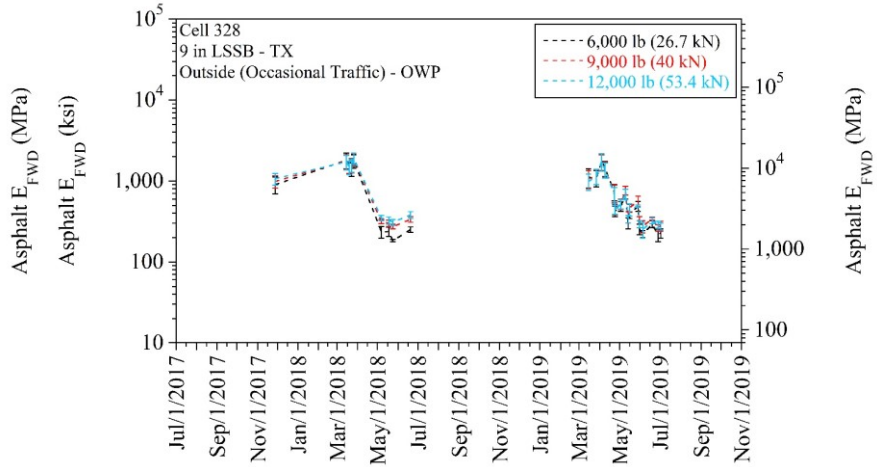


Cell 328 (9-in LSSB - TX) - asphalt E_{FWD} (error bars represent one standard deviation of the data):

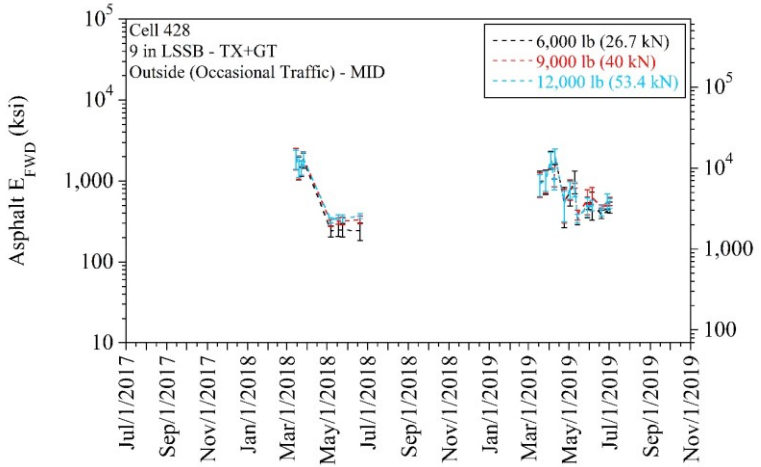


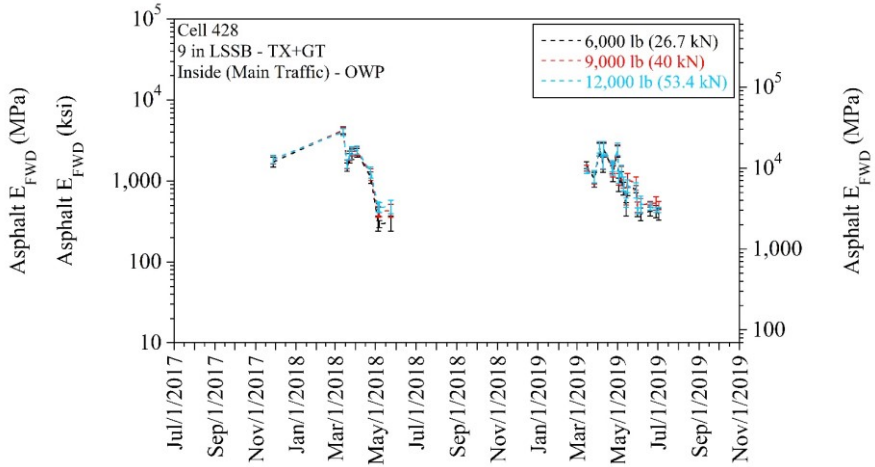


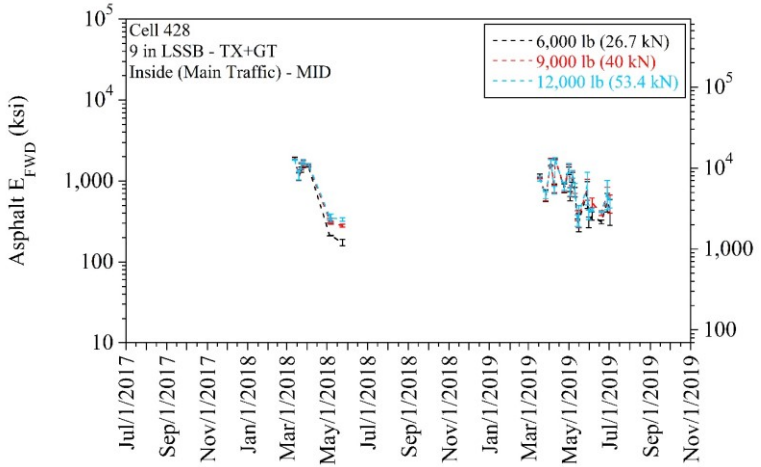


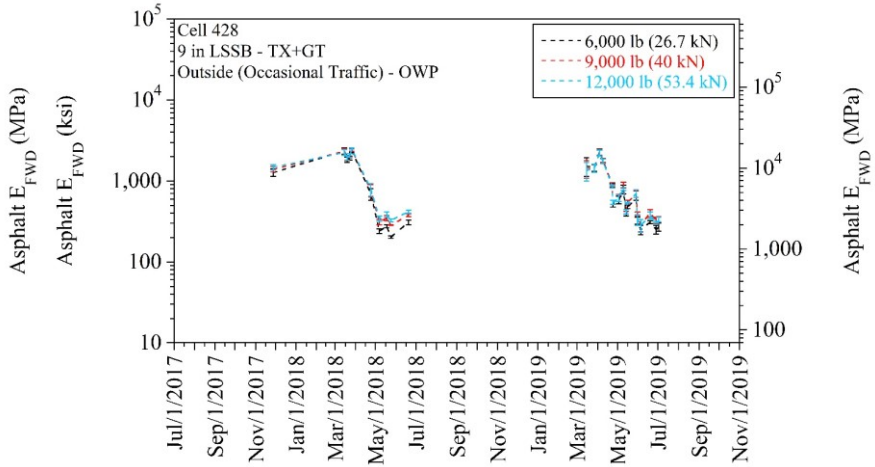


Cell 428 (9-in LSSB - TX+GT) - asphalt E_{FWD} (error bars represent one standard deviation of the data):

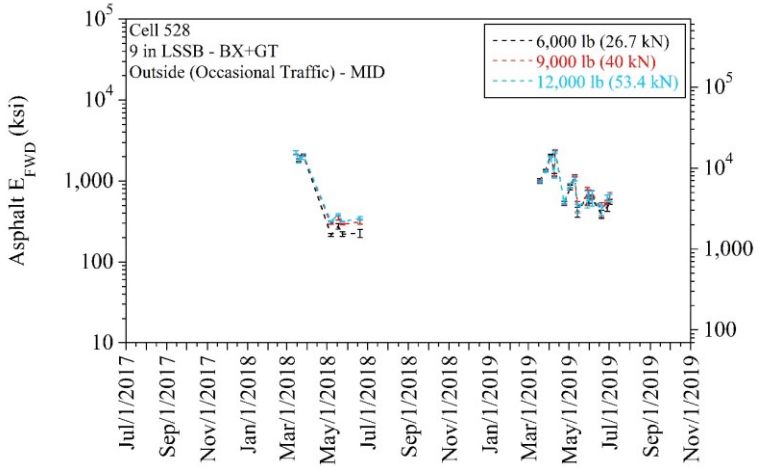


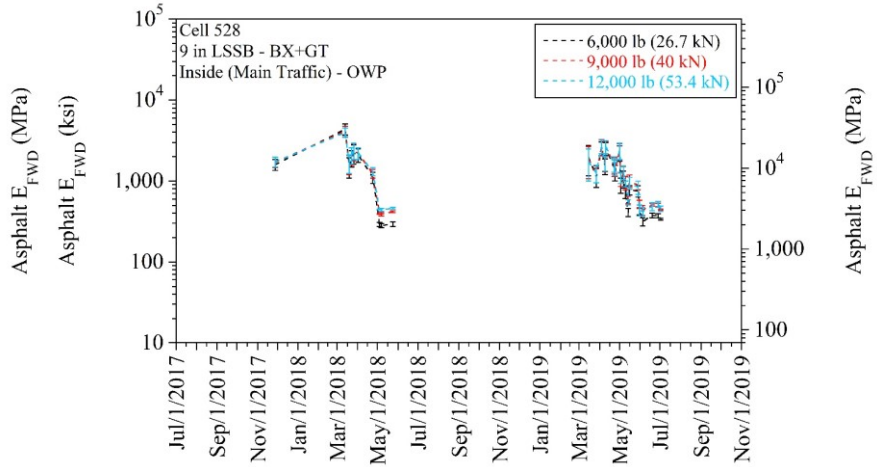


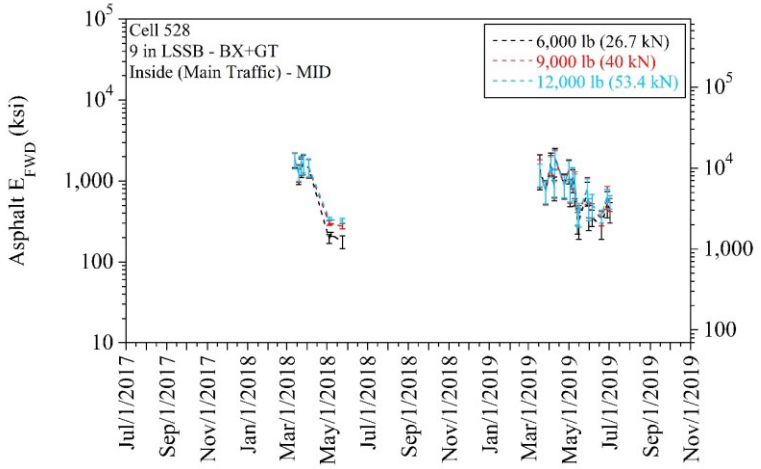


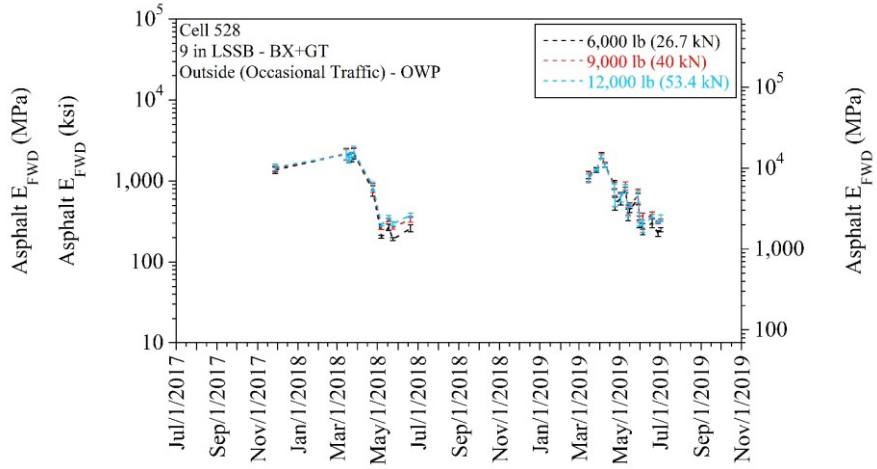


Cell 528 (9-in LSSB - BX+GT) - asphalt E_{FWD} (error bars represent one standard deviation of the data):

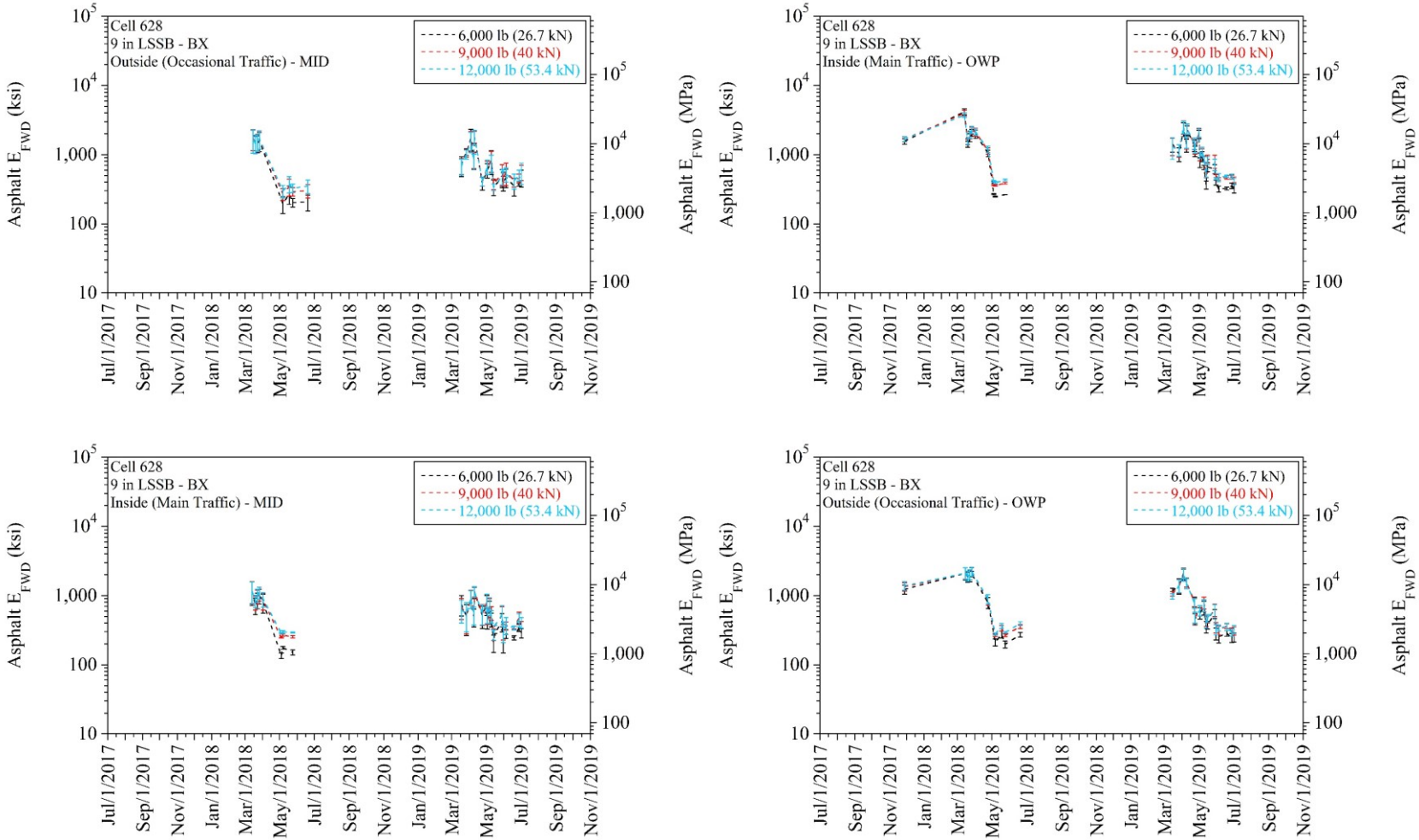




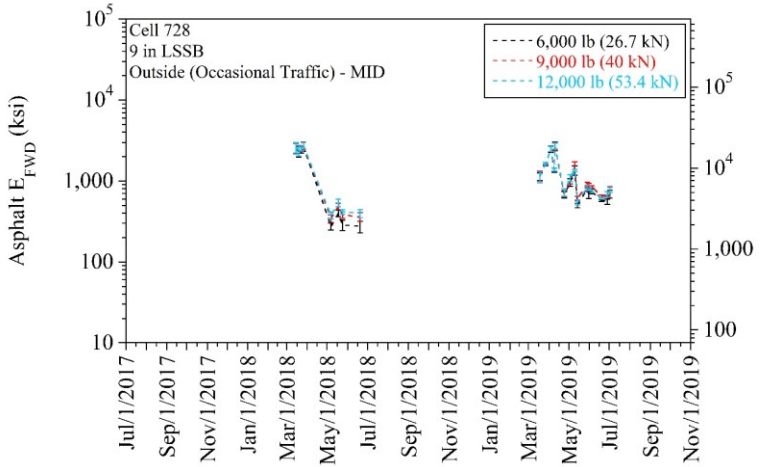


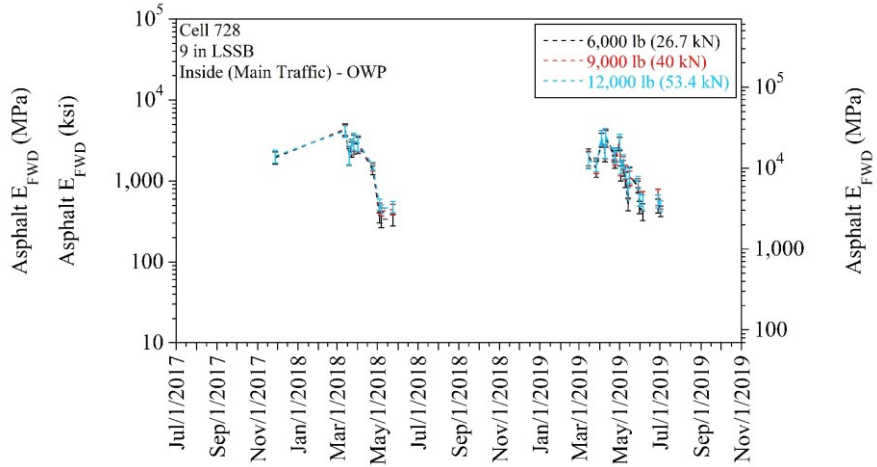


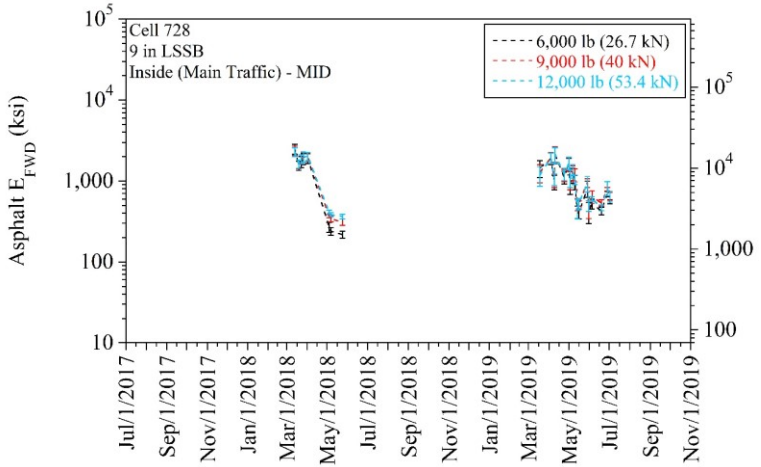
Cell 628 (9-in LSSB - BX) - asphalt E_{FWD} (error bars represent one standard deviation of the data):

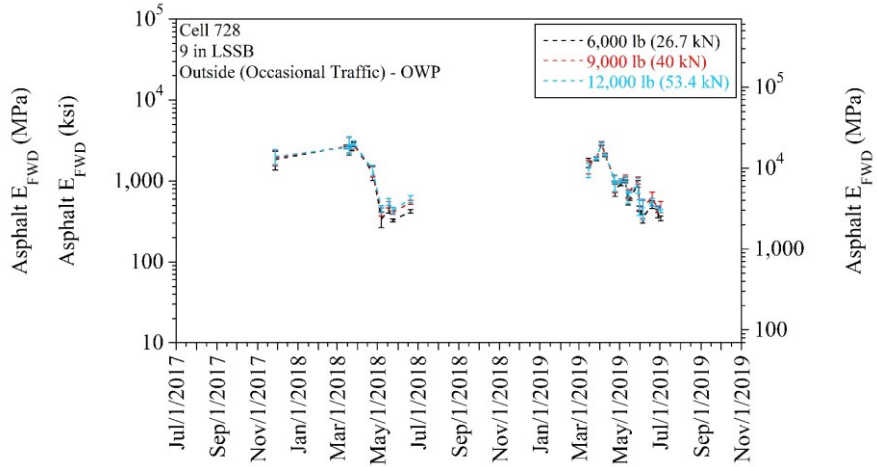


Cell 728 (9-in LSSB) - asphalt E_{FWD} (error bars represent one standard deviation of the data):



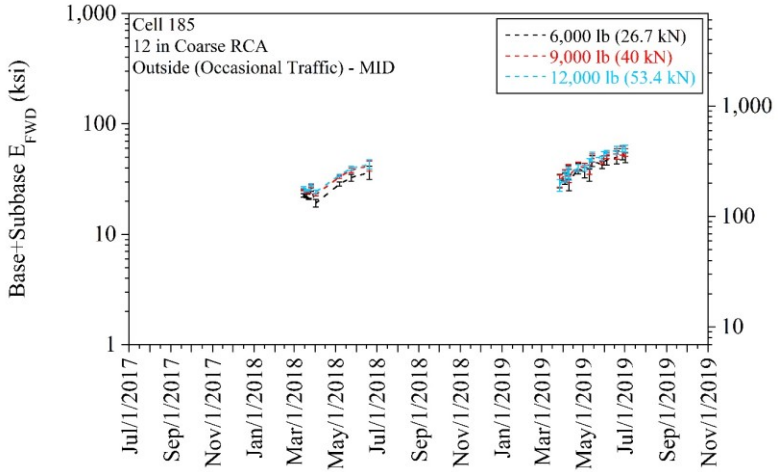


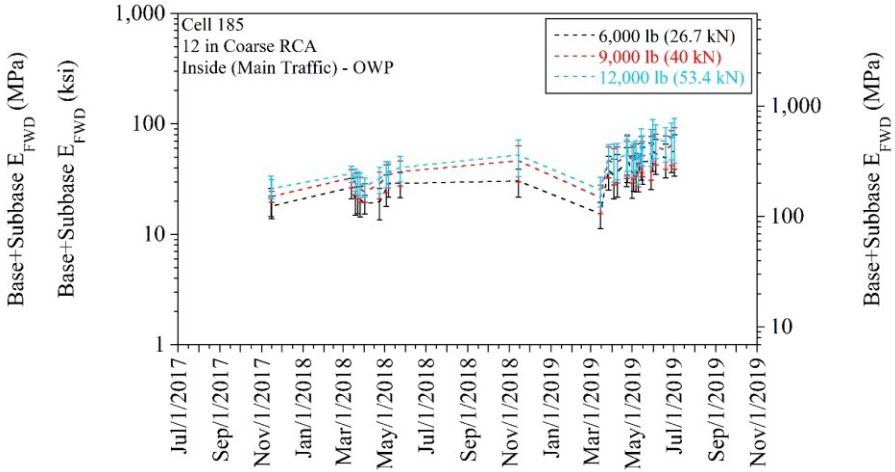


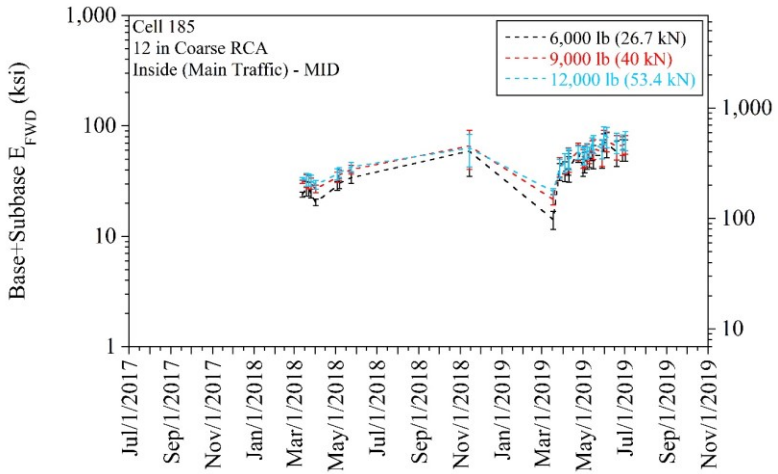


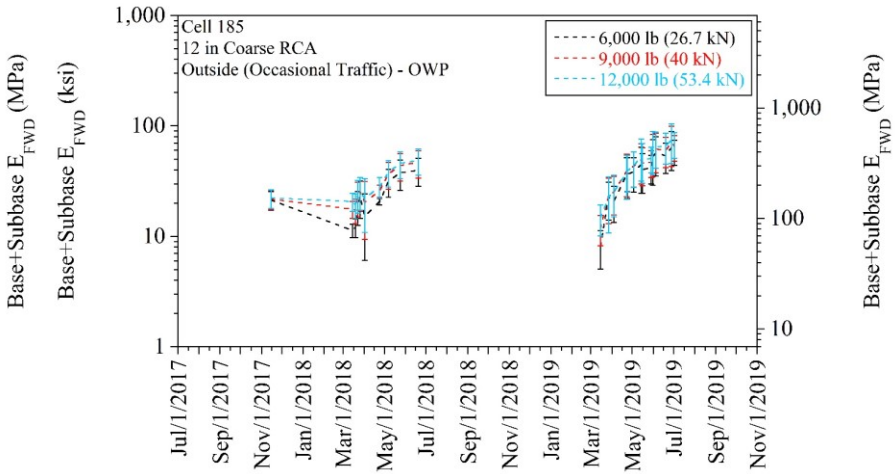
APPENDIX X
BASE+SUBBASE FALLING WEIGHT DEFLECTOMETER (FWD) ELASTIC MODULUS (E_{FWD}) AT 6,000 LB (26.7 KN), 9,000 LB (40 KN), AND 12,000 LB (53.4 KN) FOR EACH CELL

Cell 185 (12-in Coarse RCA) - base+subbase E_{FWD} (error bars represent one standard deviation of the data):

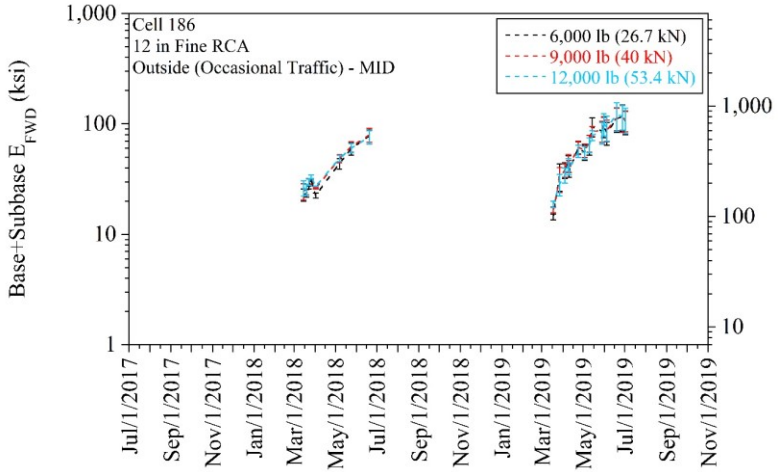


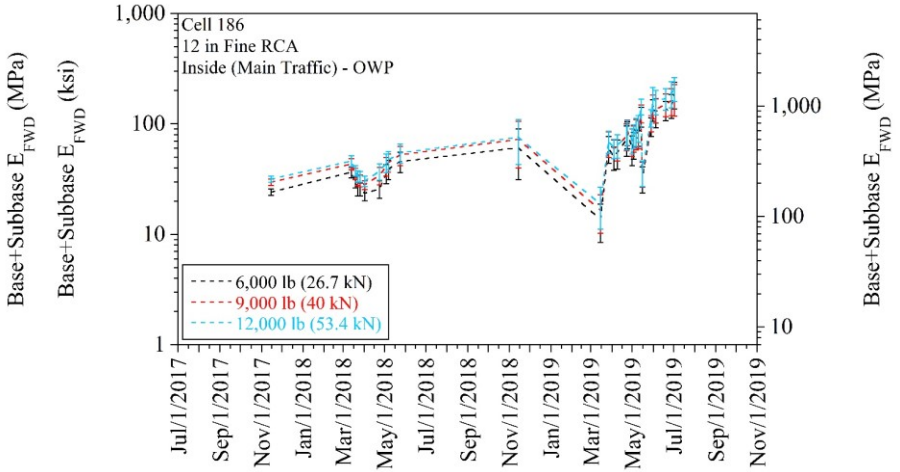


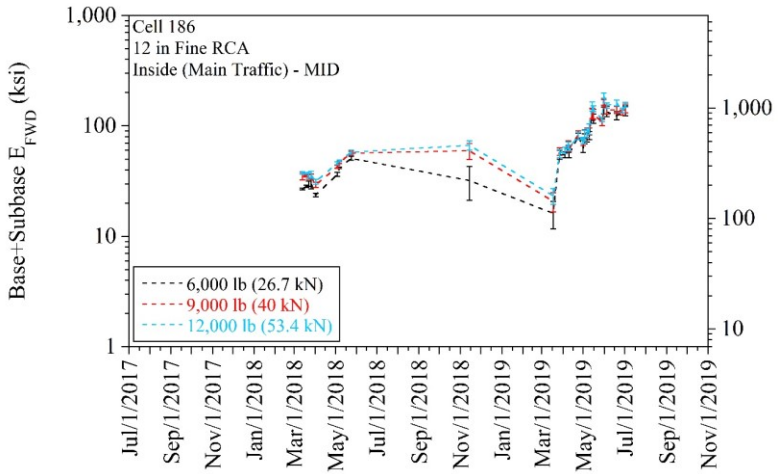


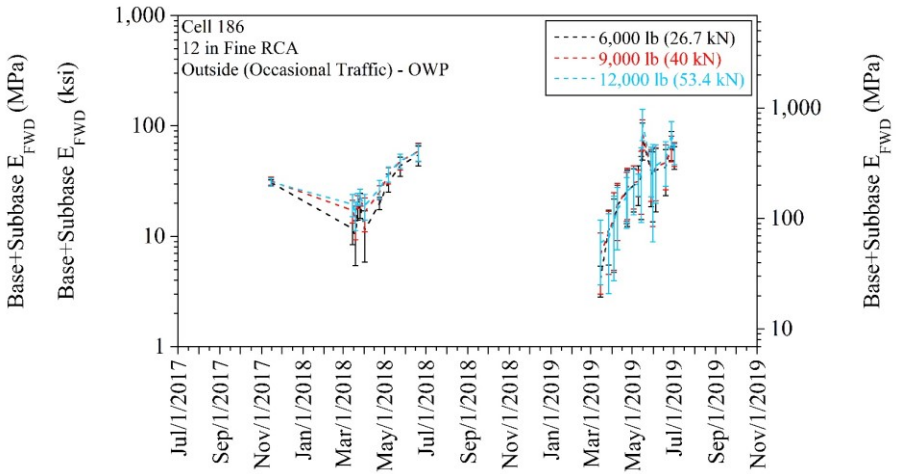


Cell 186 (12-in Fine RCA) - base+subbase E_{FWD} (error bars represent one standard deviation of the data):

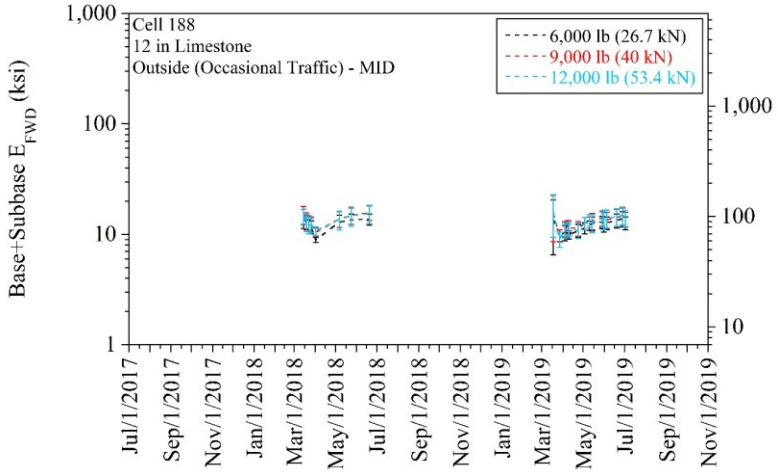


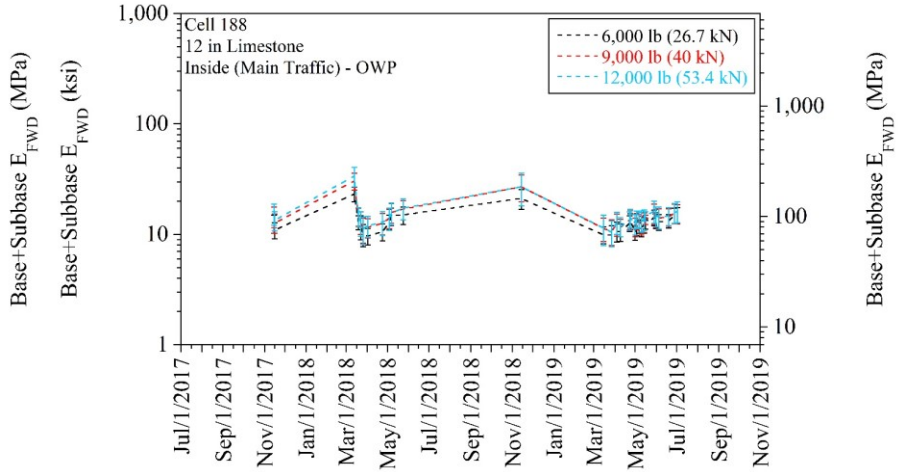


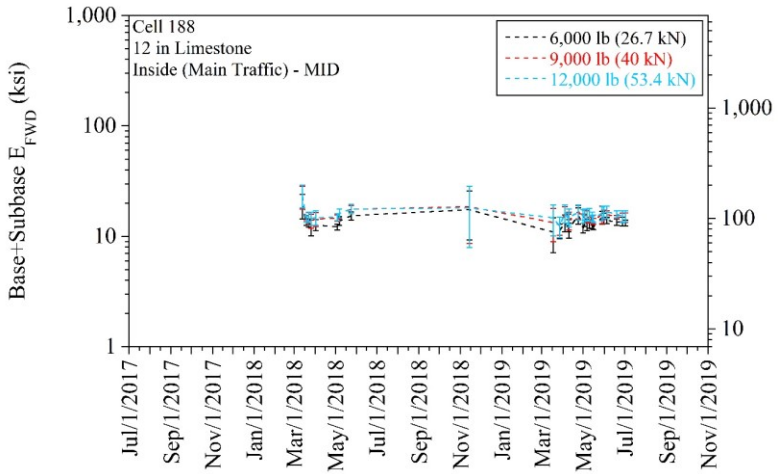


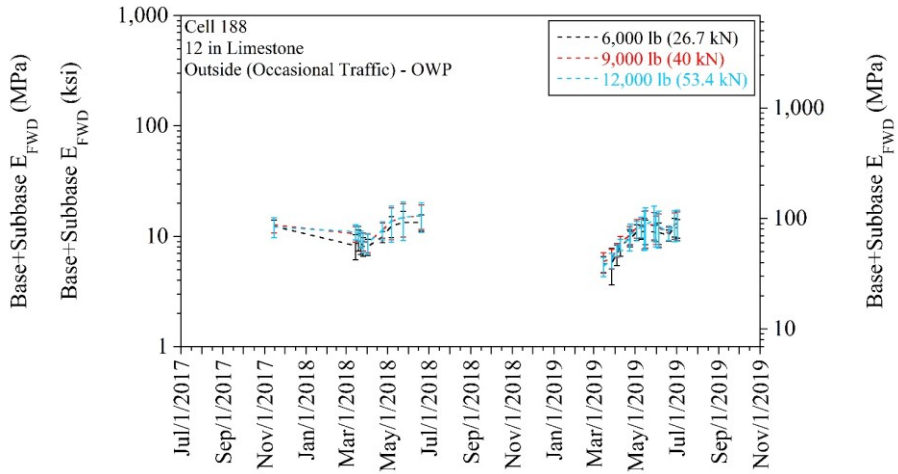


Cell 188 (12-in Limestone) - base+subbase E_{FWD} (error bars represent one standard deviation of the data):

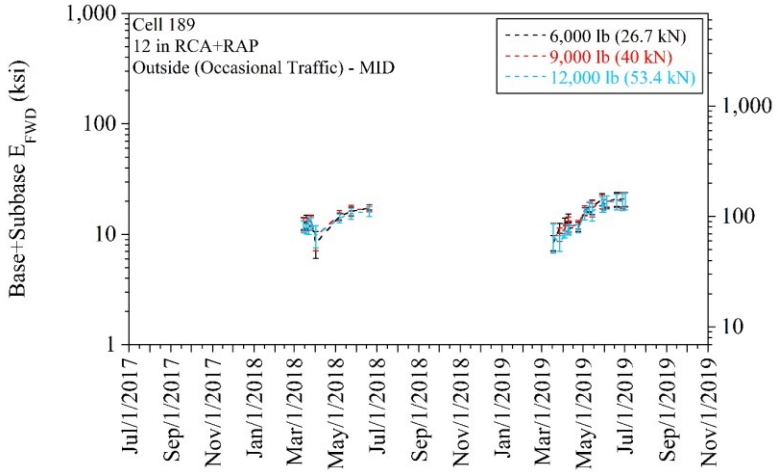


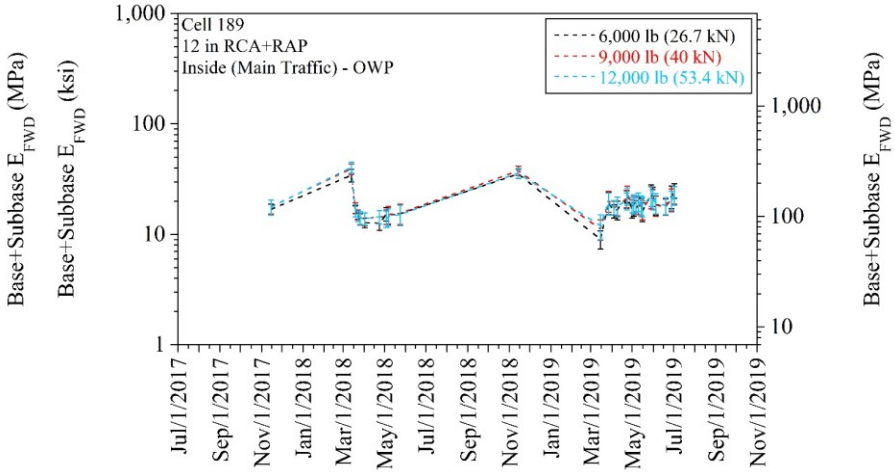


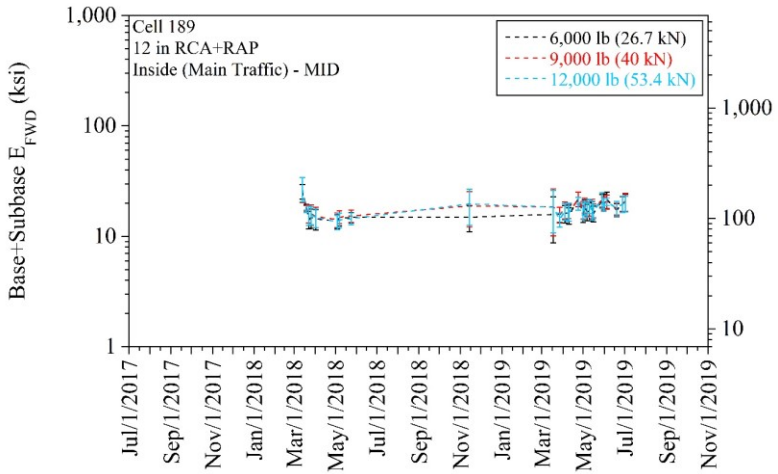


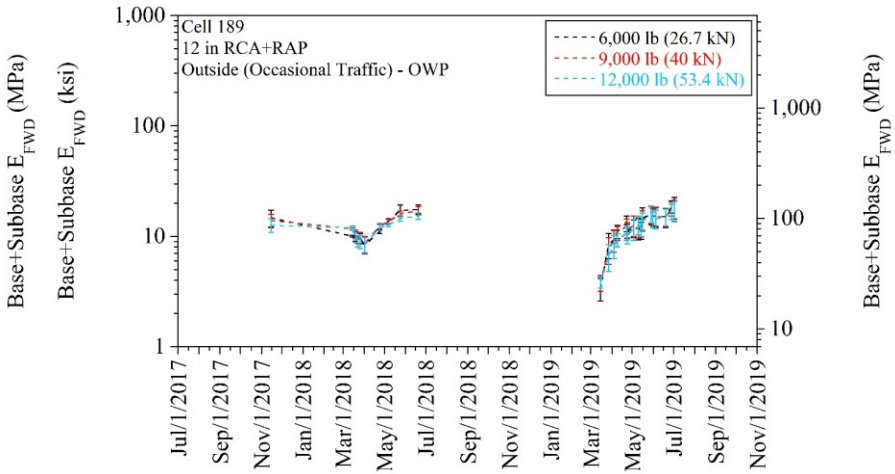


Cell 189 (12-in RCA+RAP) - base+subbase E_{FWD} (error bars represent one standard deviation of the data):

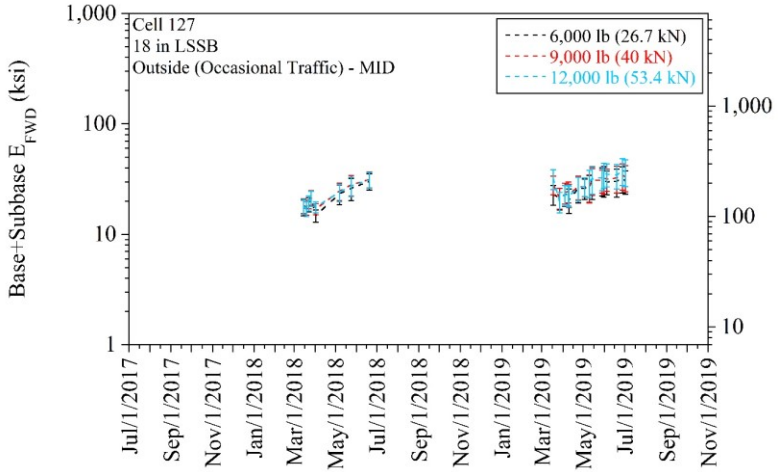


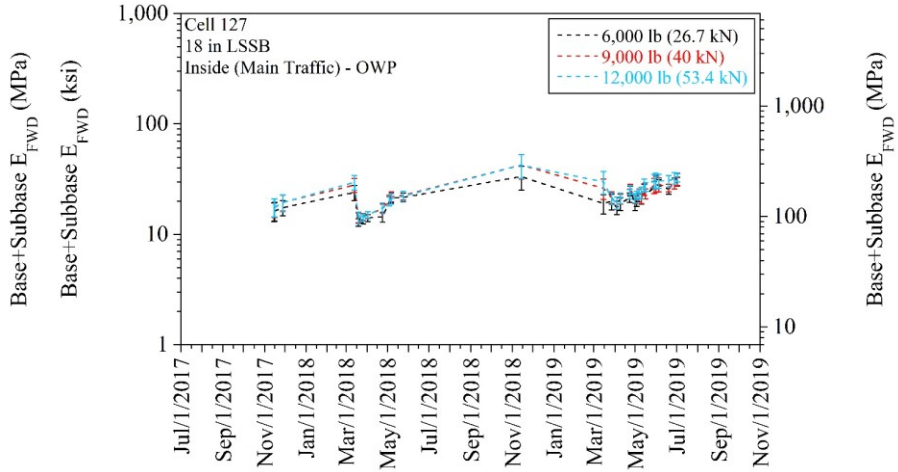


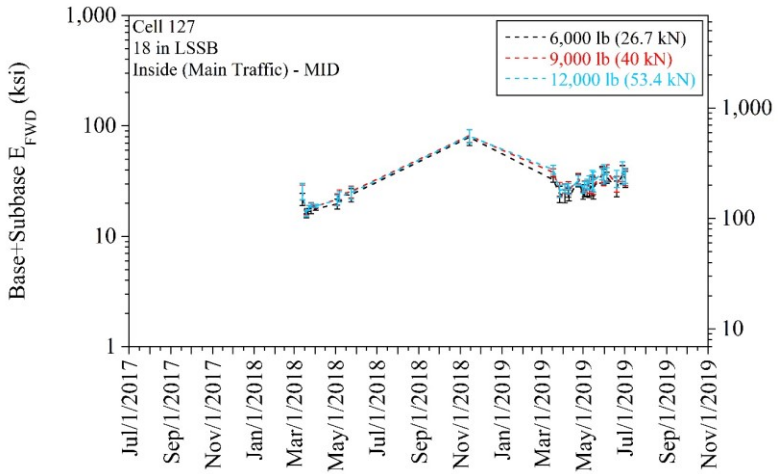


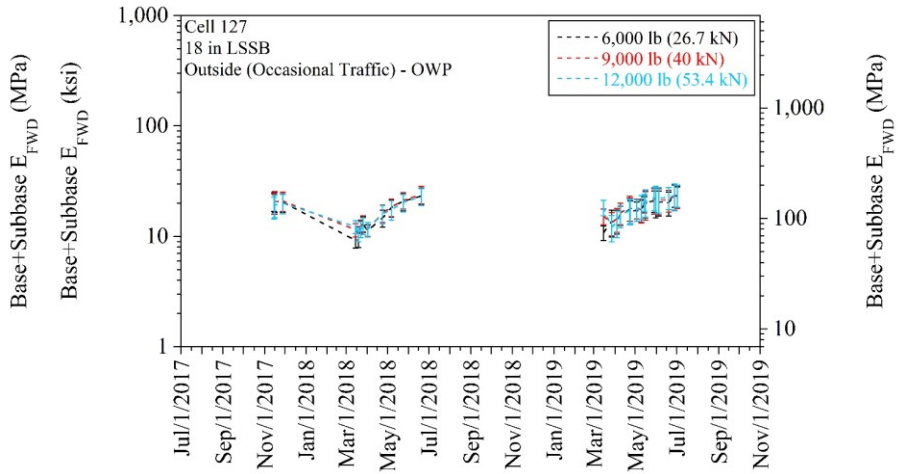


Cell 127 (18-in LSSB) - base+subbase E_{FWD} (error bars represent one standard deviation of the data):

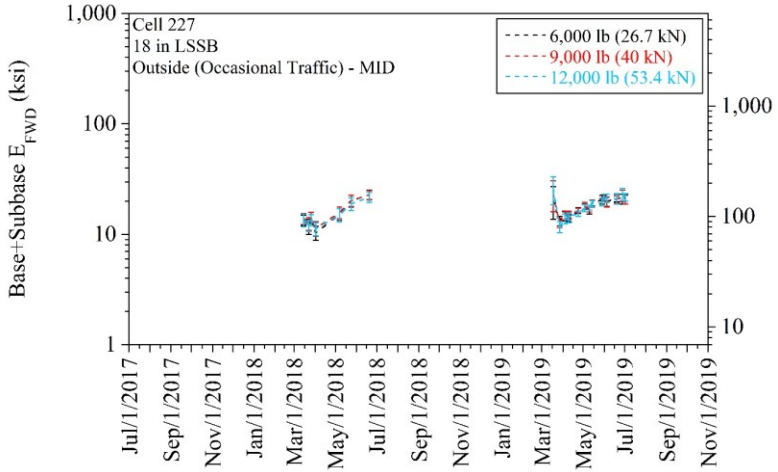


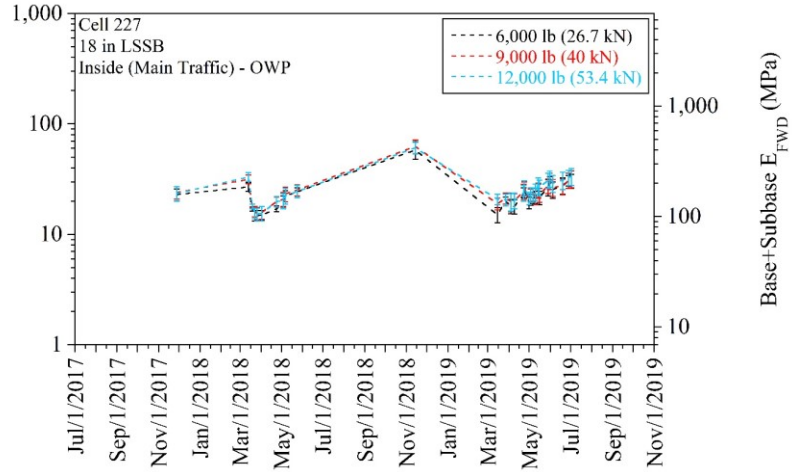


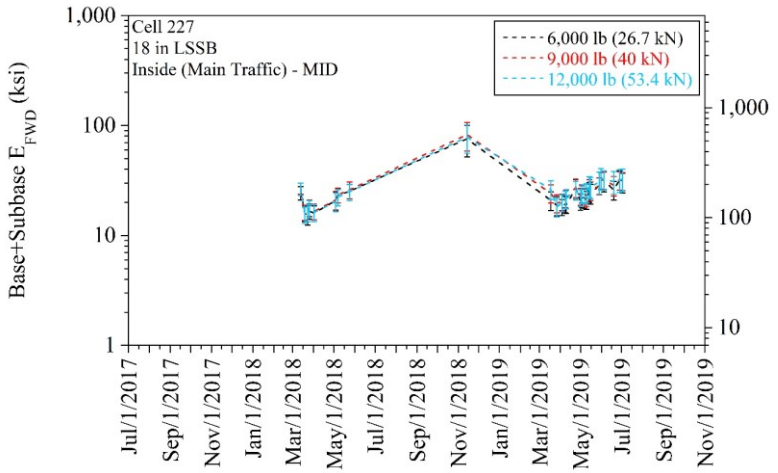


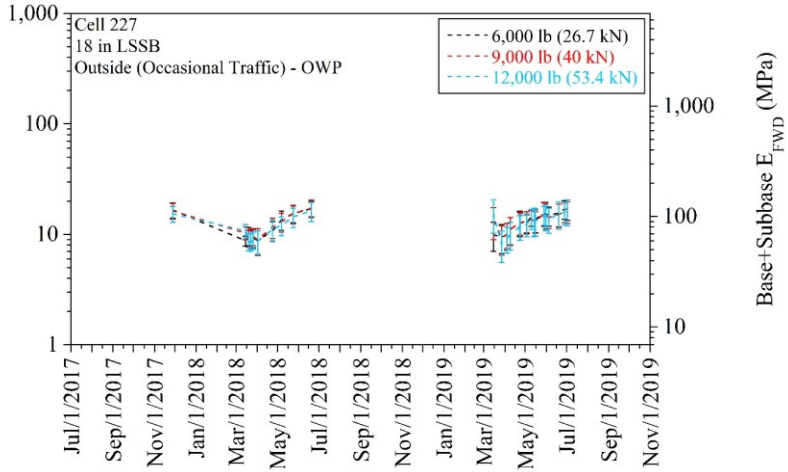


Cell 227 (18-in LSSB) - base+subbase E_{FWD} (error bars represent one standard deviation of the data):

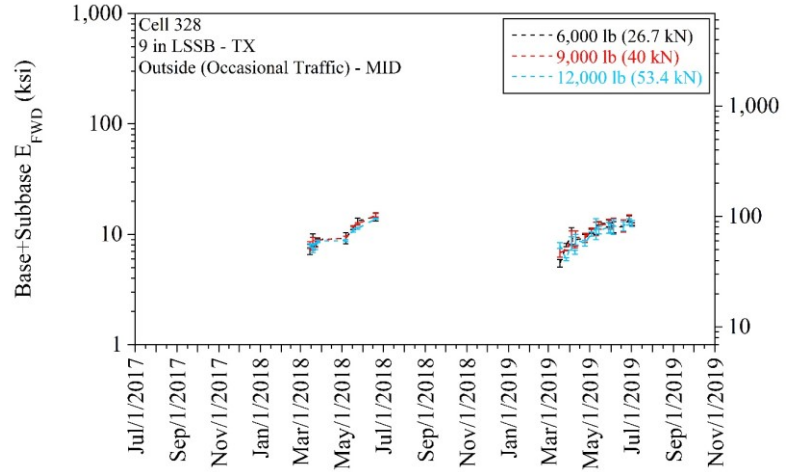


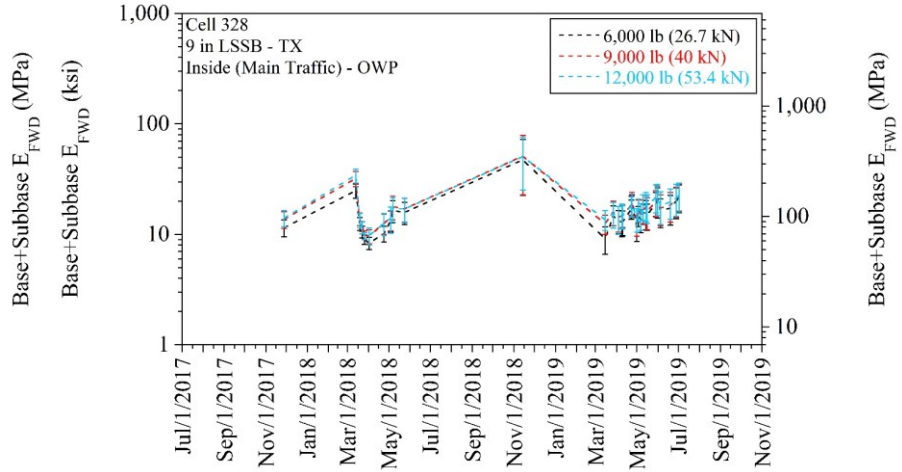


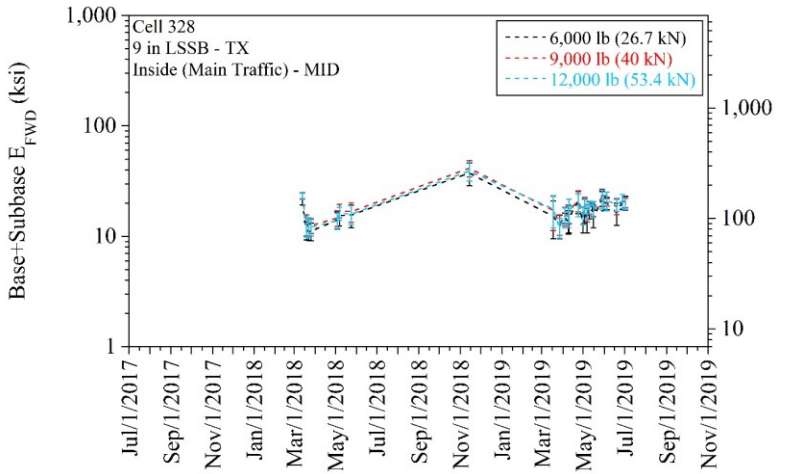


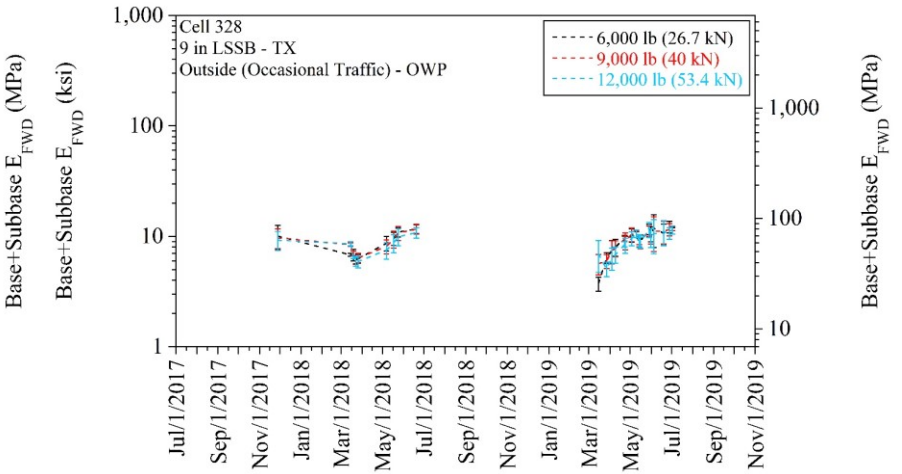


Cell 328 (9-in LSSB - TX) - base+subbase E_{FWD} (error bars represent one standard deviation of the data):

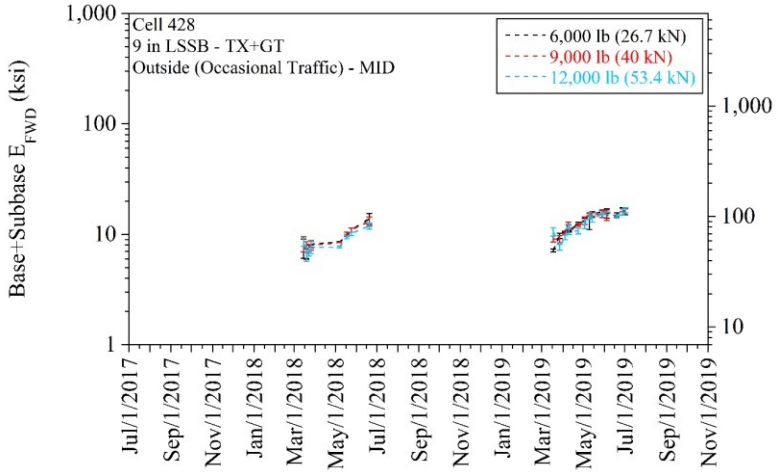


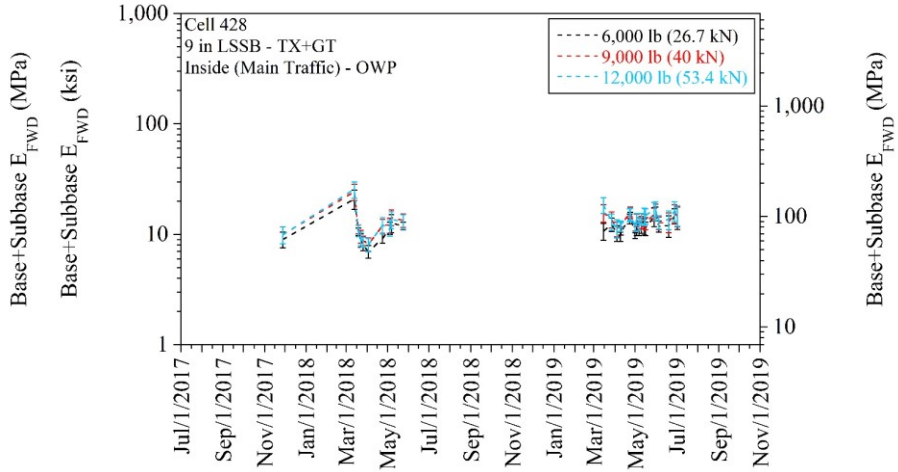


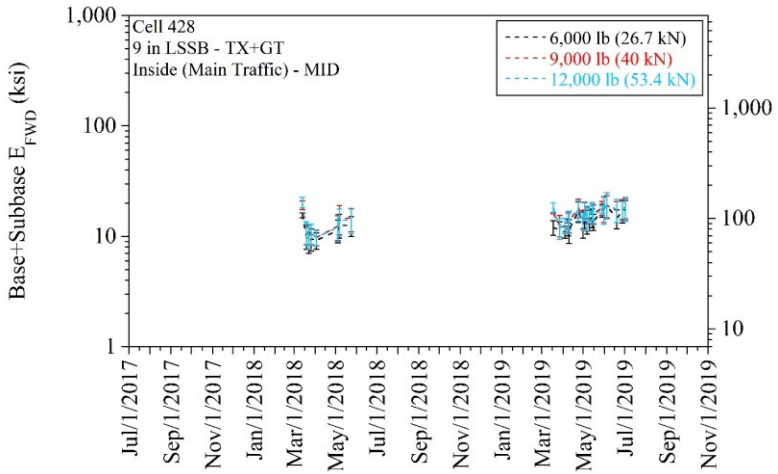


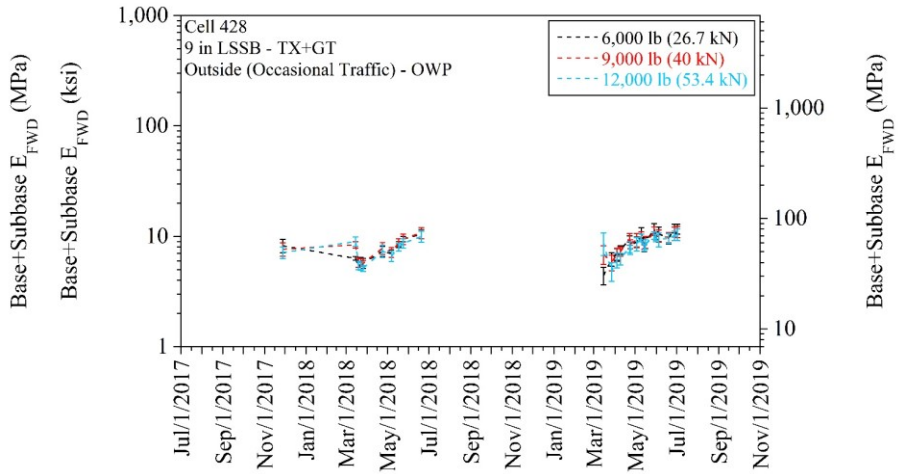


Cell 428 (9-in LSSB - TX+GT) - base+subbase E_{FWD} (error bars represent one standard deviation of the data):

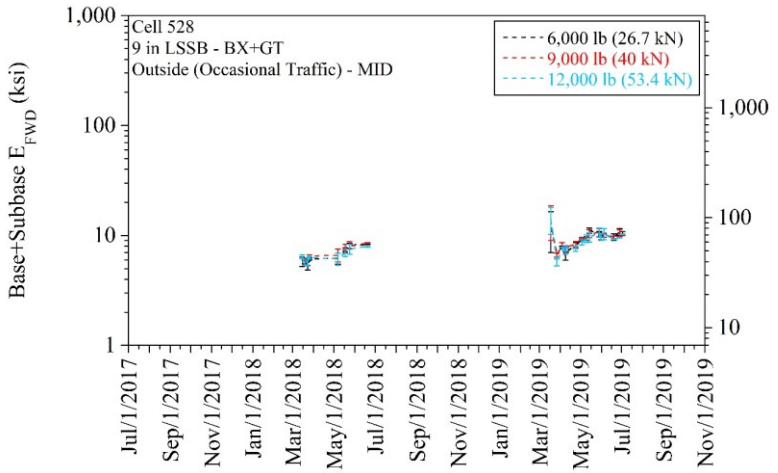


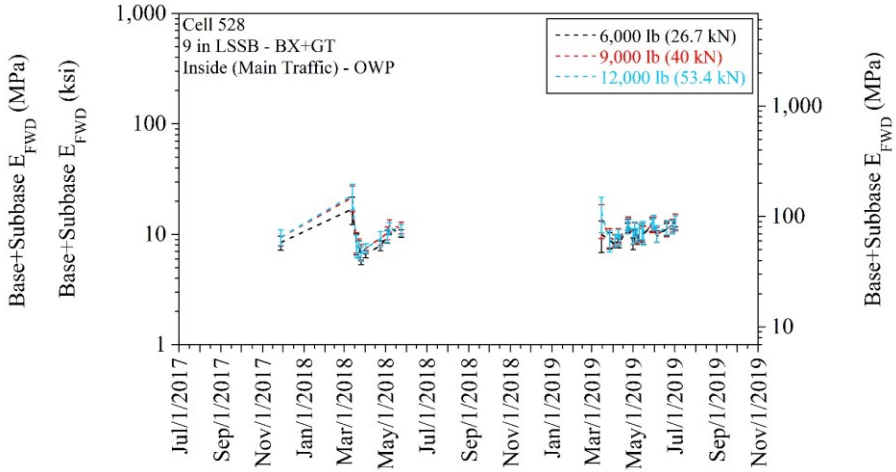


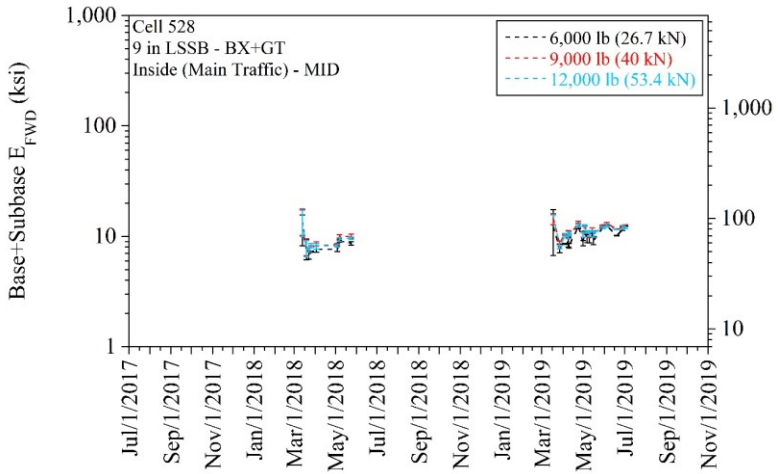


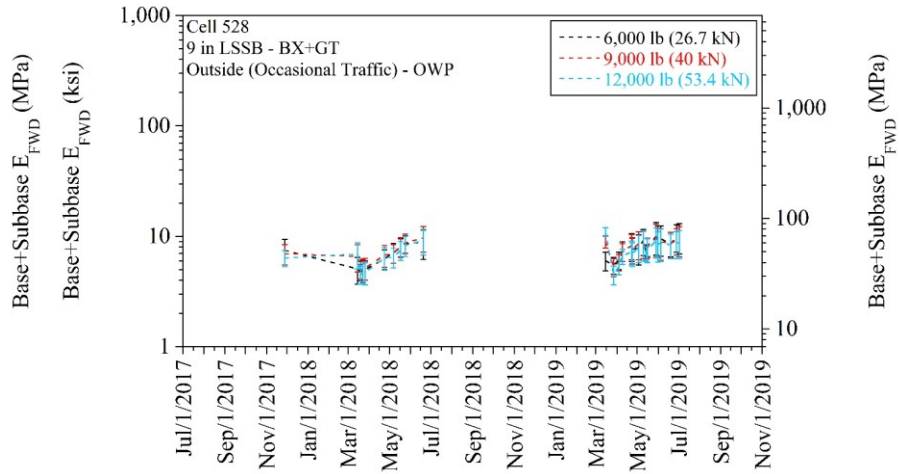


Cell 528 (9-in LSSB - BX+GT) - base+subbase E_{FWD} (error bars represent one standard deviation of the data):

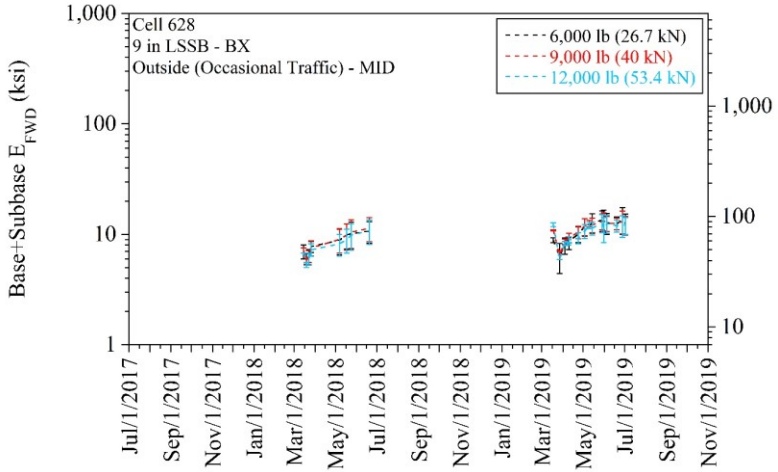


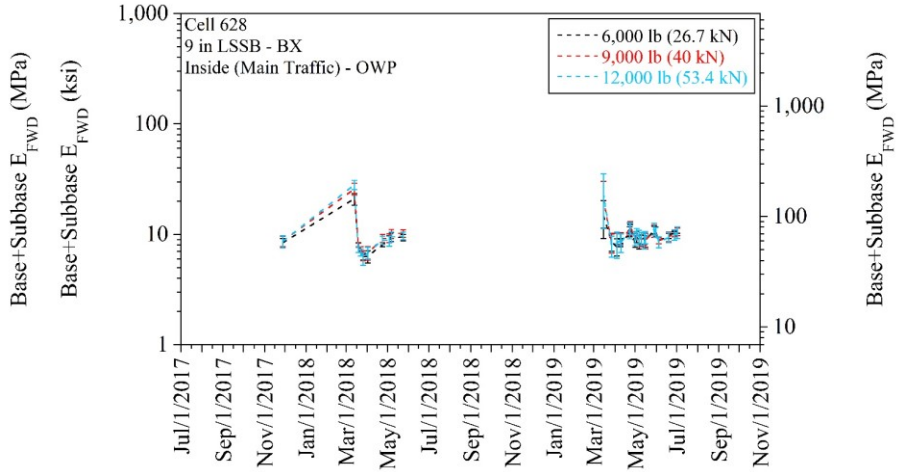


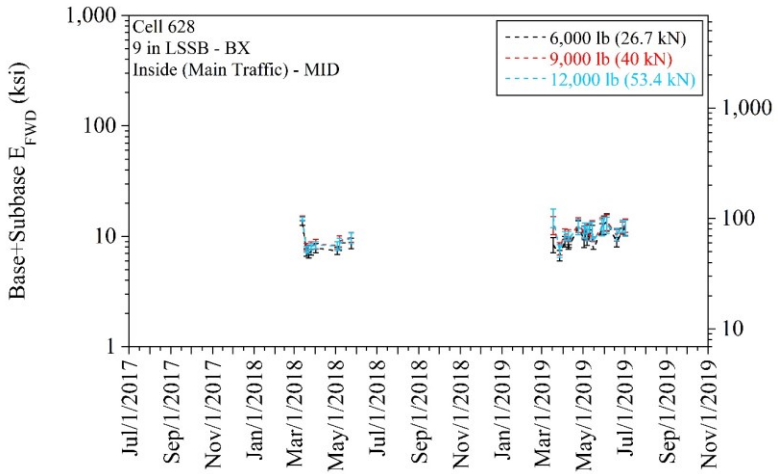


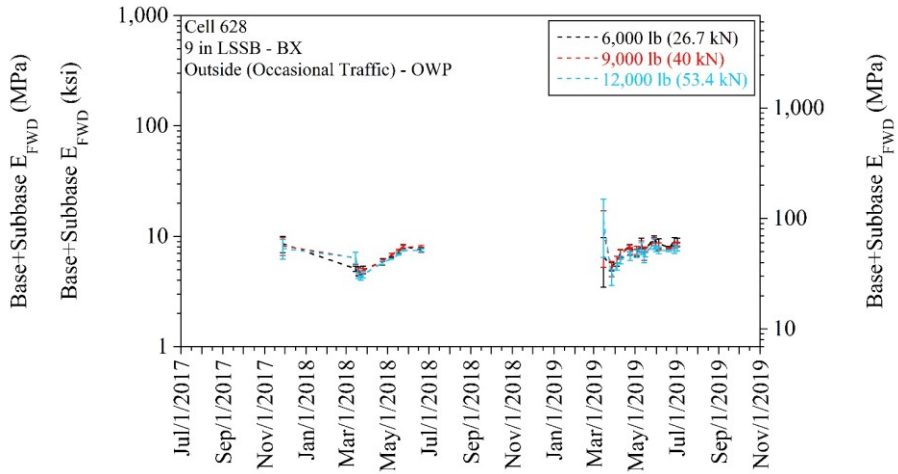


Cell 628 (9-in LSSB - BX) - base+subbase E_{FWD} (error bars represent one standard deviation of the data):

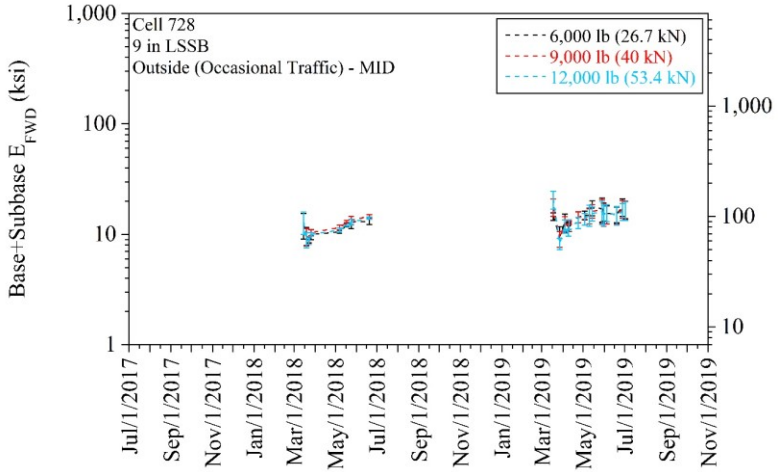


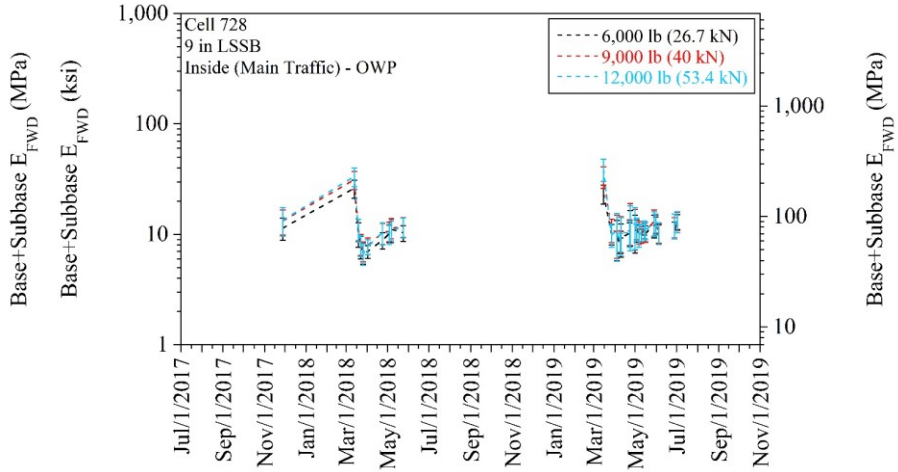


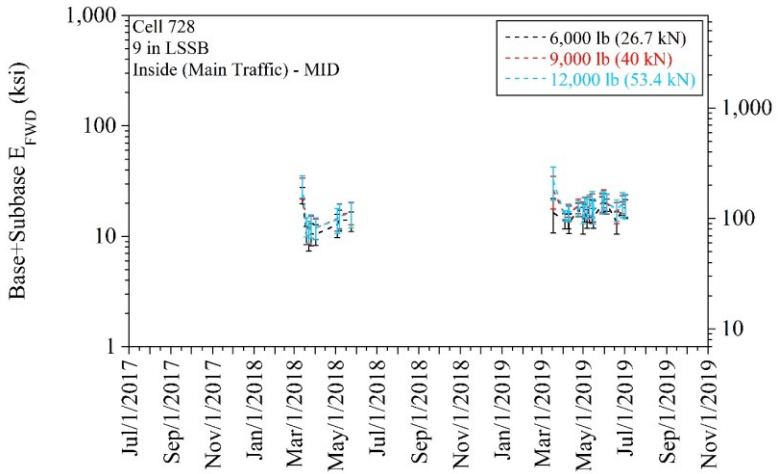


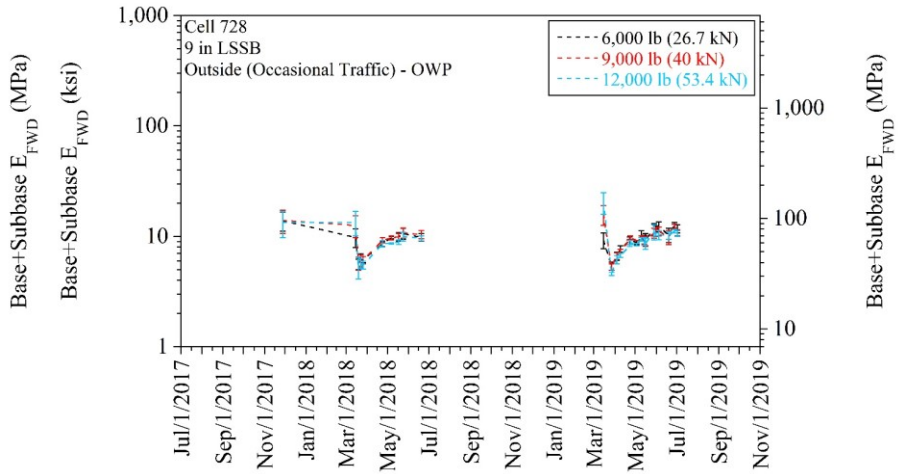


Cell 728 (9-in LSSB) - base+subbase E_{FWD} (error bars represent one standard deviation of the data):



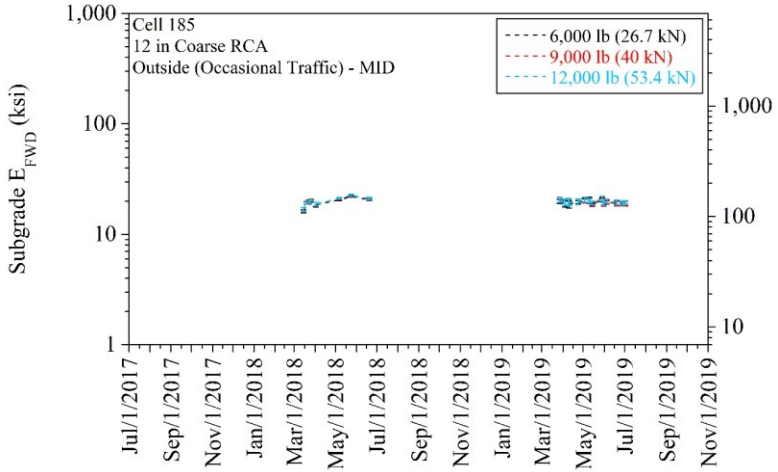


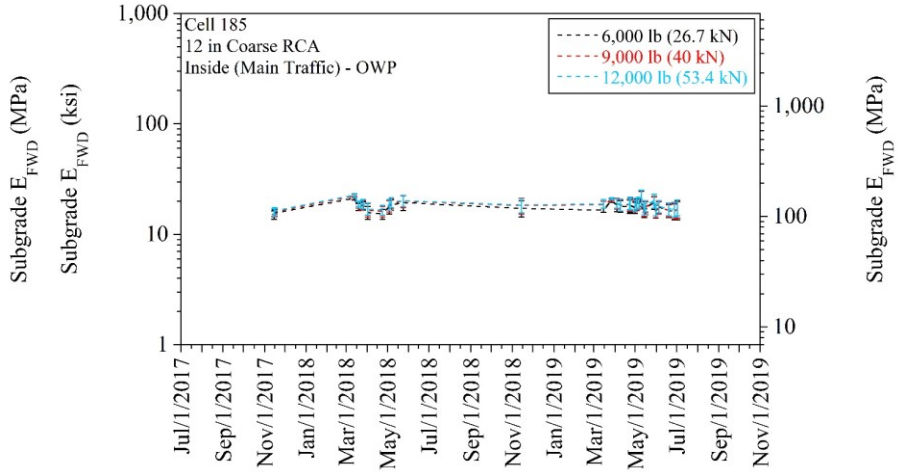


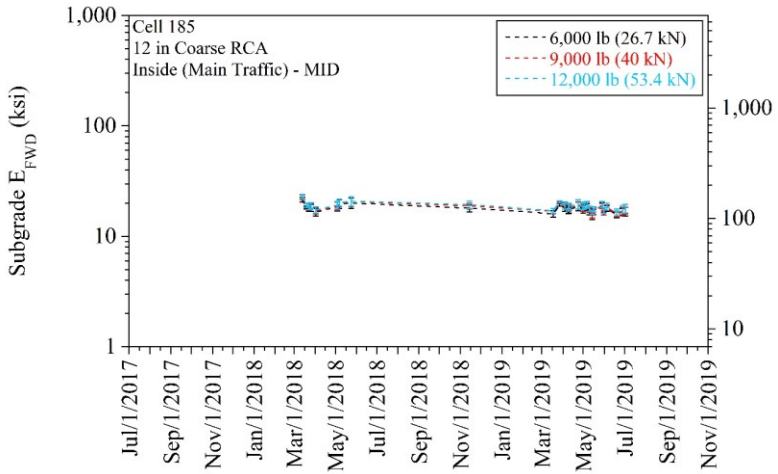


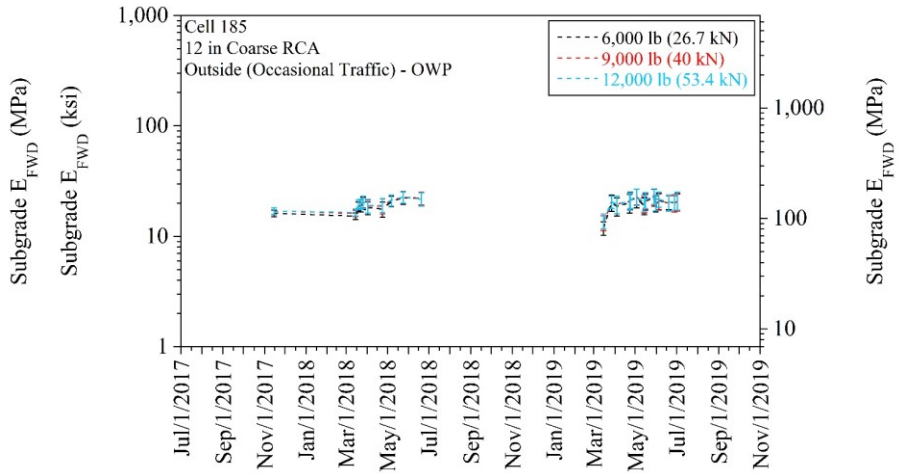
APPENDIX Y
SUBGRADE FALLING WEIGHT DEFLECTOMETER (FWD) ELASTIC MODULUS (E_{FWD}) AT 6,000 LB (26.7 KN), 9,000 LB (40 KN), AND 12,000 LB (53.4 KN) FOR EACH CELL

Cell 185 (12-in Coarse RCA) - subgrade E_{FWD} (error bars represent one standard deviation of the data):

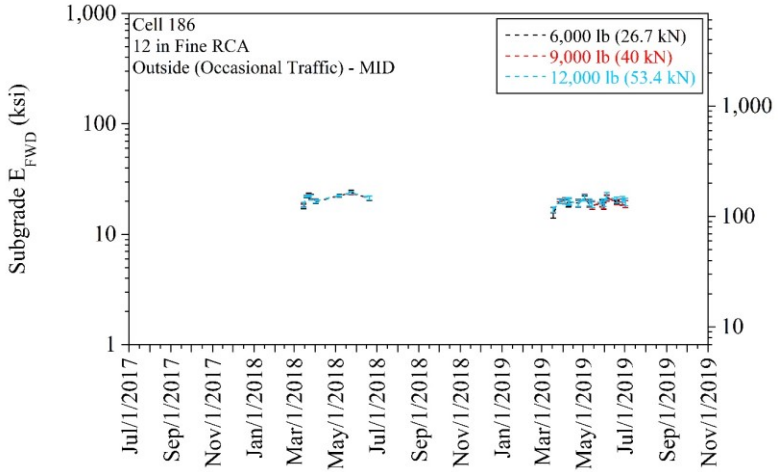


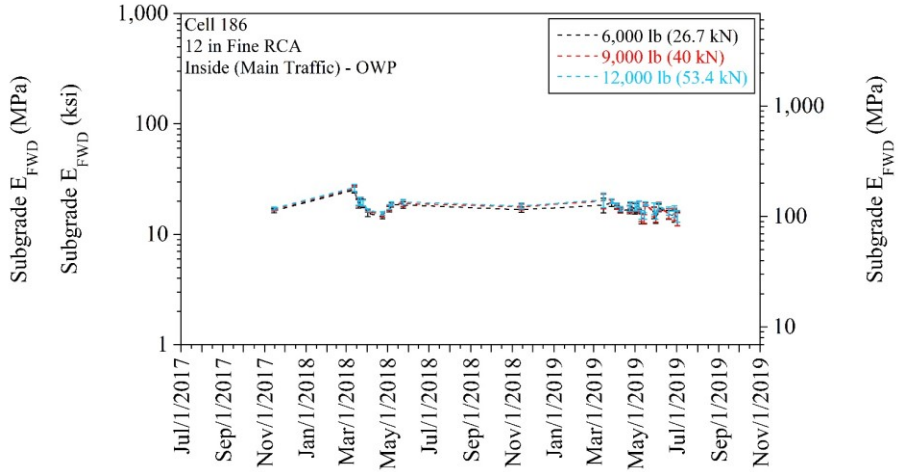


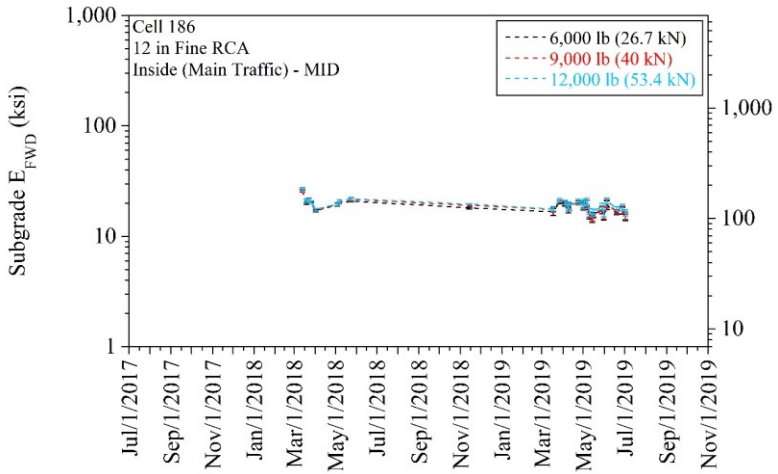


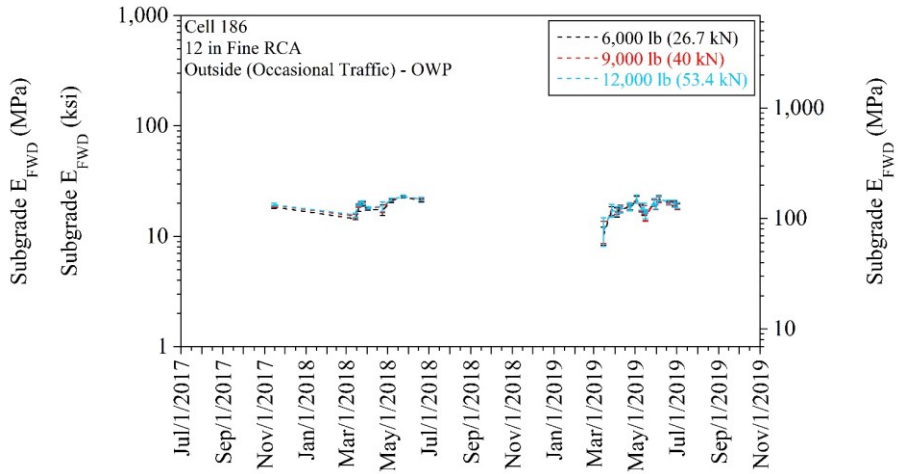


Cell 186 (12-in Fine RCA) - subgrade E_{FWD} (error bars represent one standard deviation of the data):

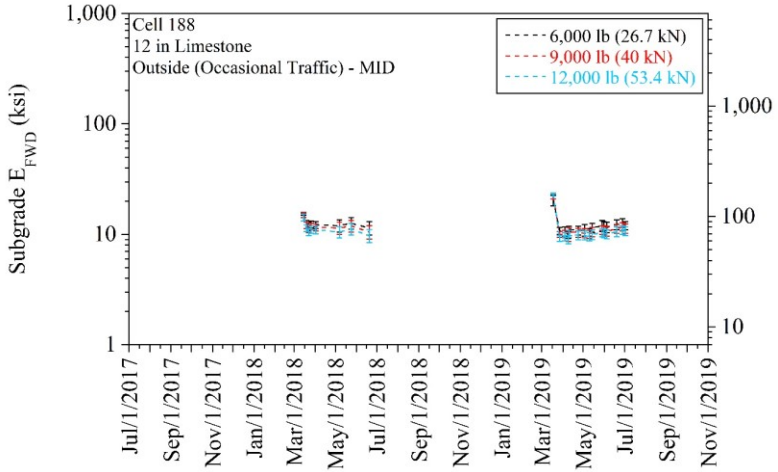


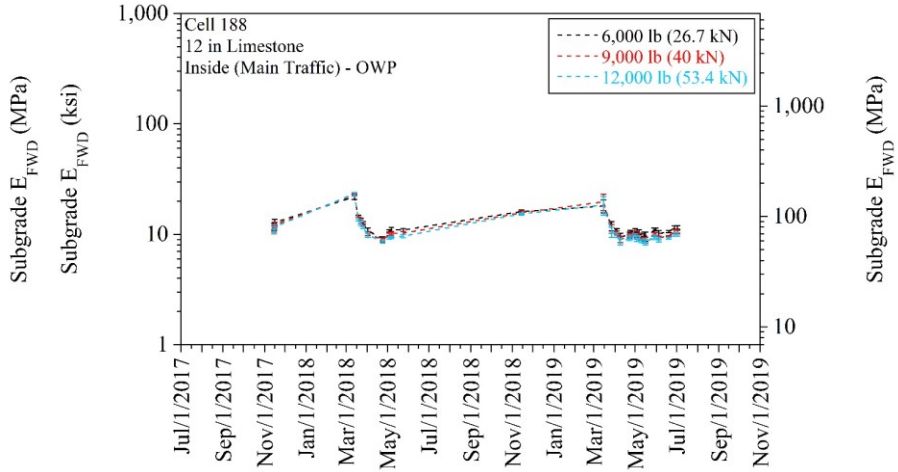


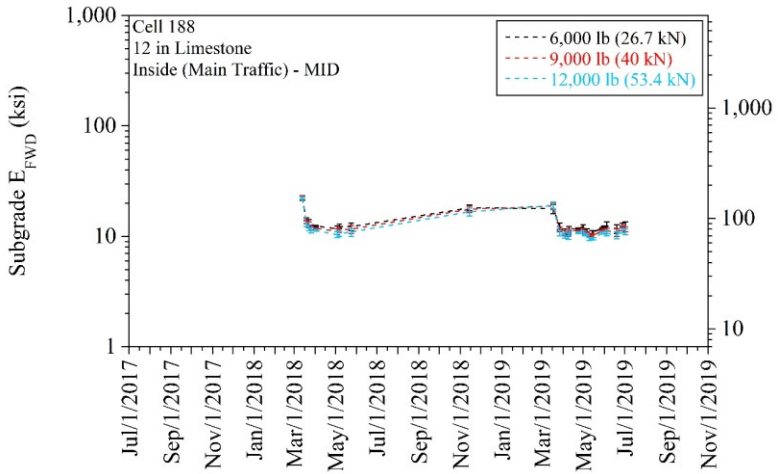


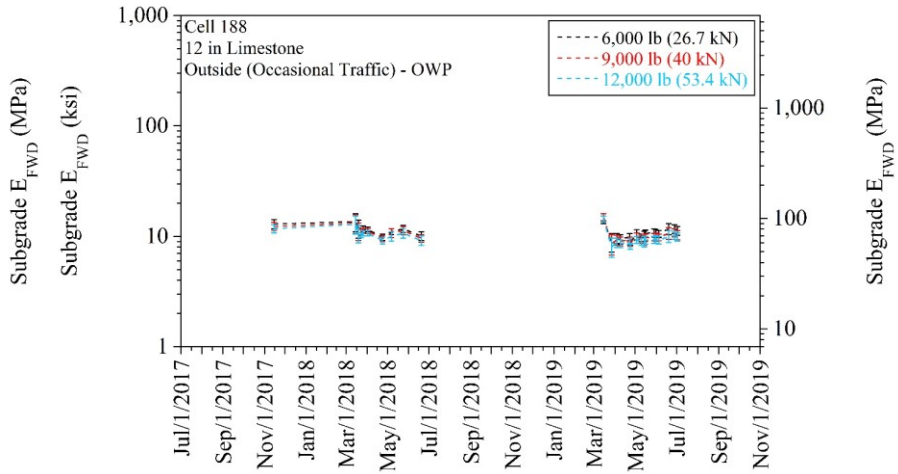


Cell 188 (12-in Limestone) - subgrade E_{FWD} (error bars represent one standard deviation of the data):

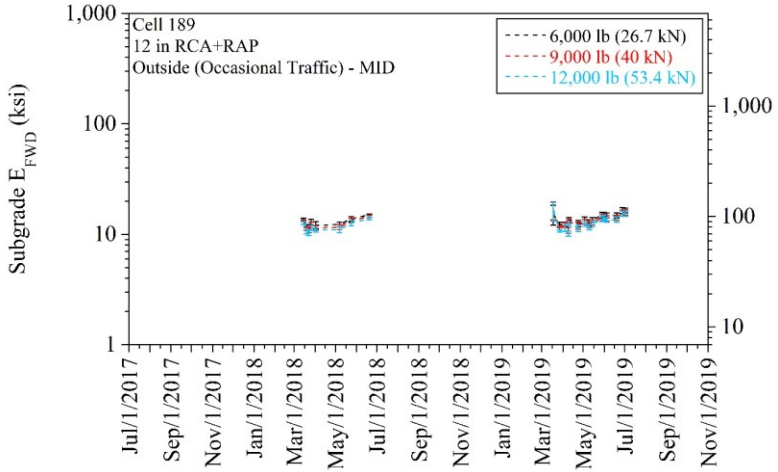


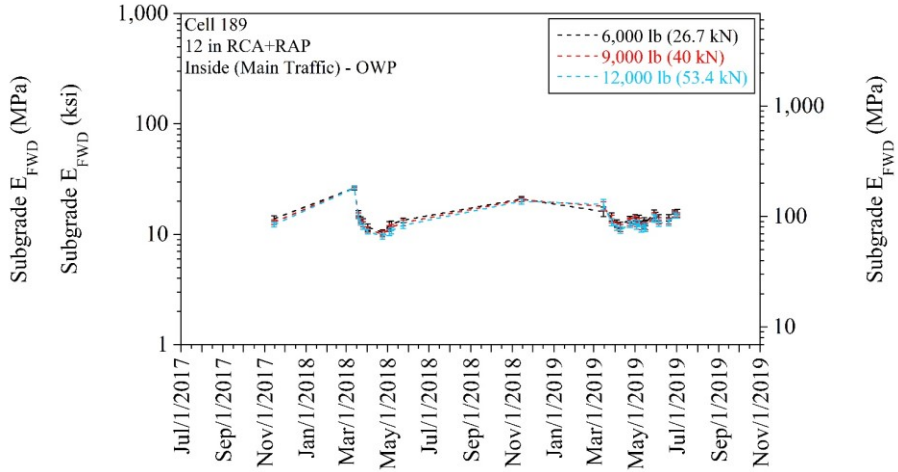


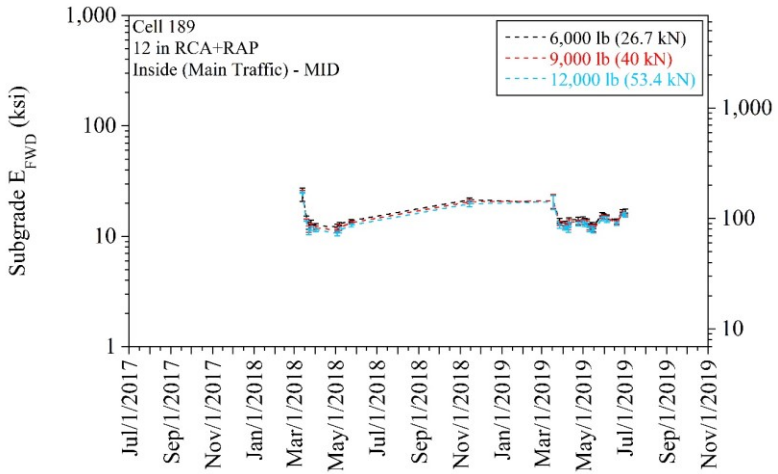


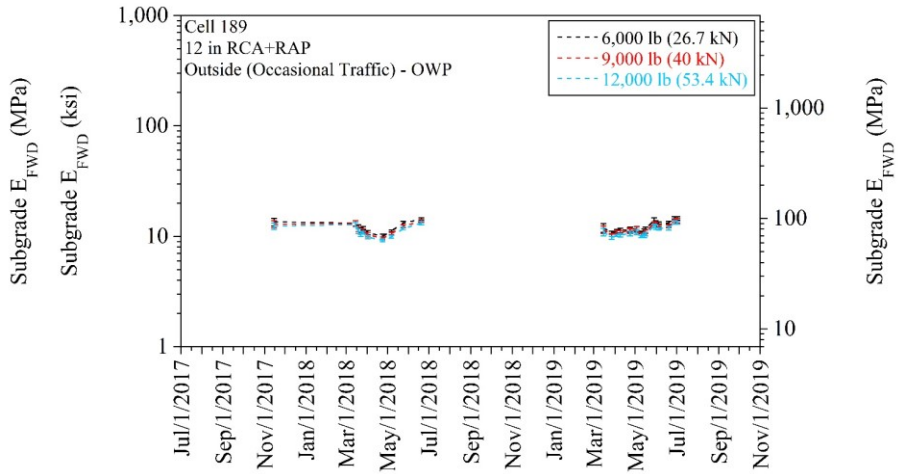


Cell 189 (12-in RCA+RAP) - subgrade E_{FWD} (error bars represent one standard deviation of the data):

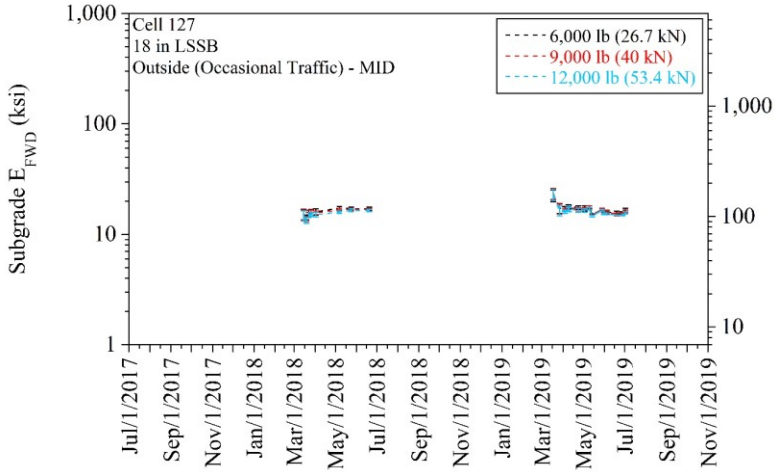


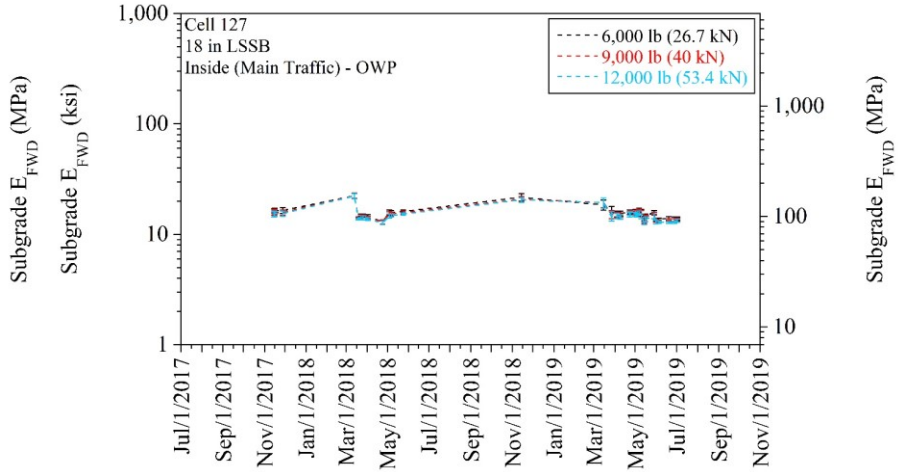


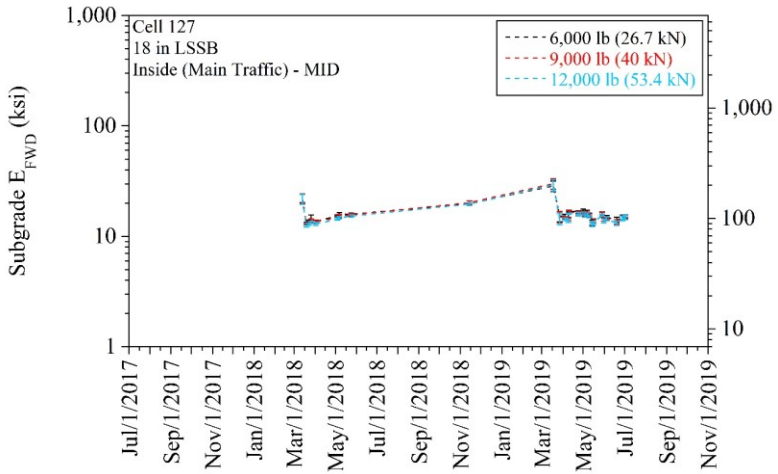


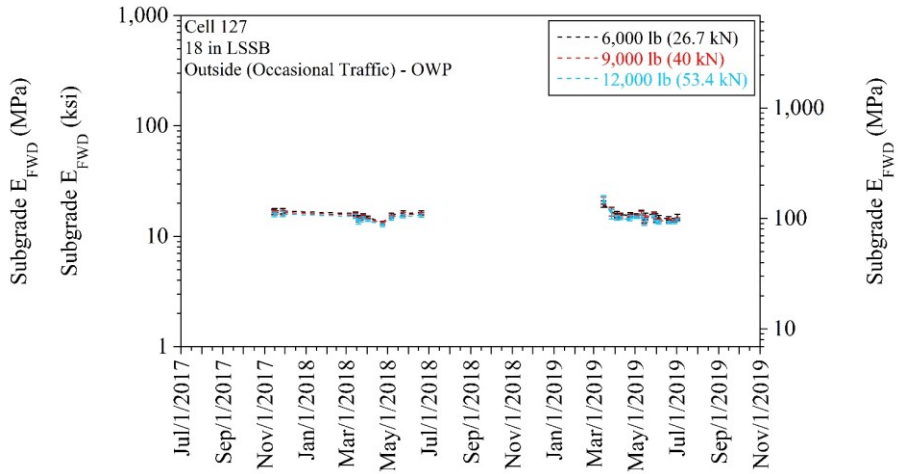


Cell 127 (18-in LSSB) - subgrade E_{FWD} (error bars represent one standard deviation of the data):

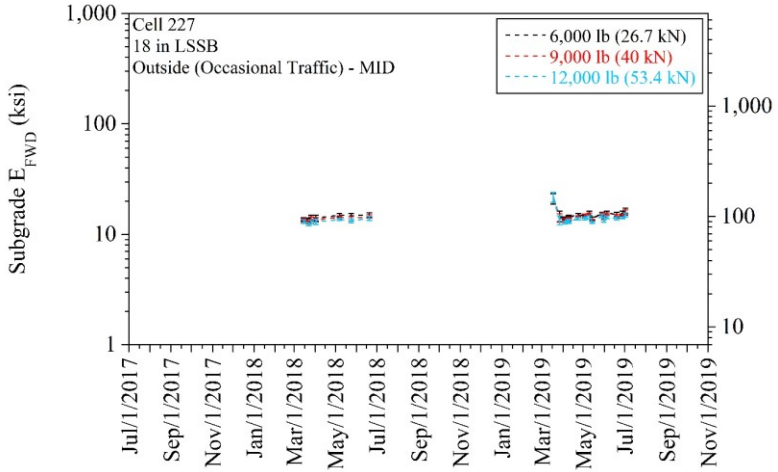


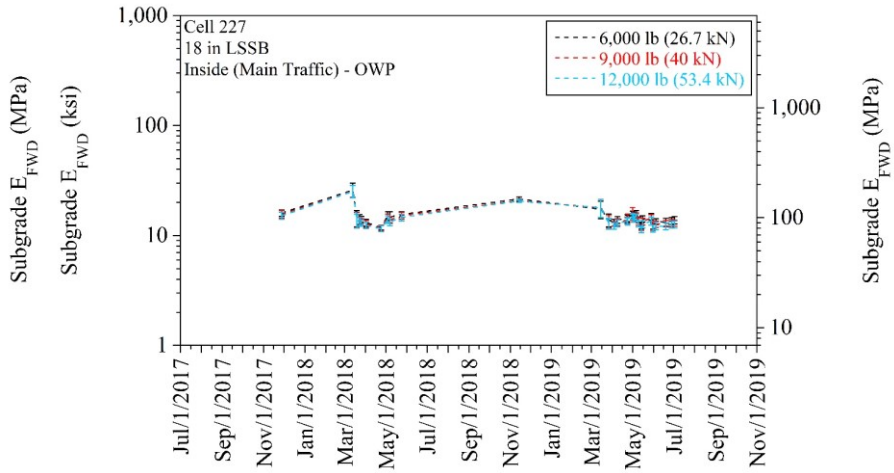


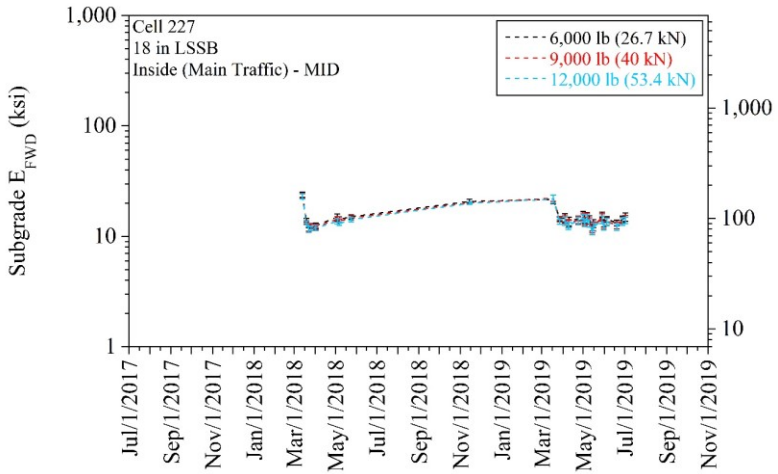


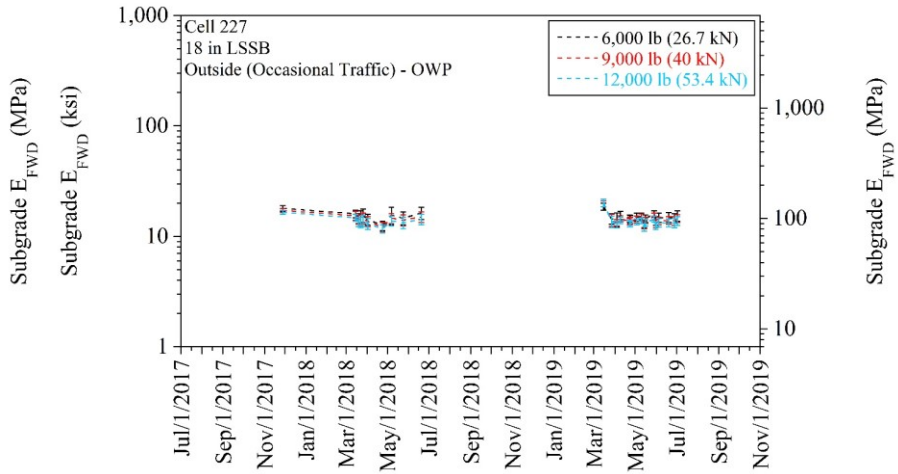


Cell 227 (18-in LSSB) - subgrade E_{FWD} (error bars represent one standard deviation of the data):

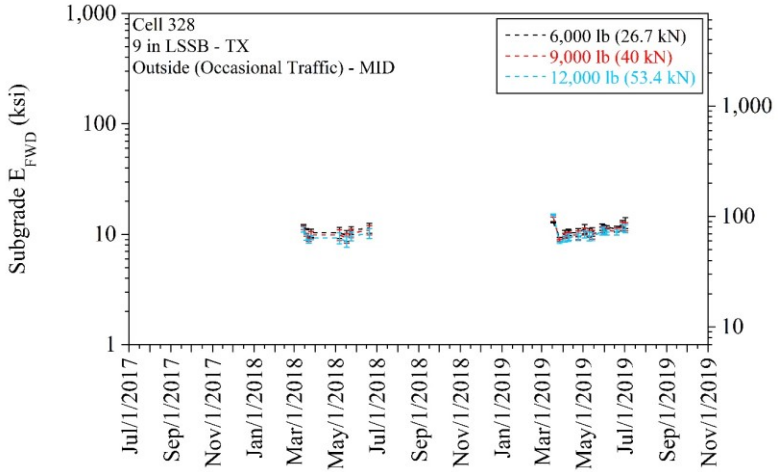


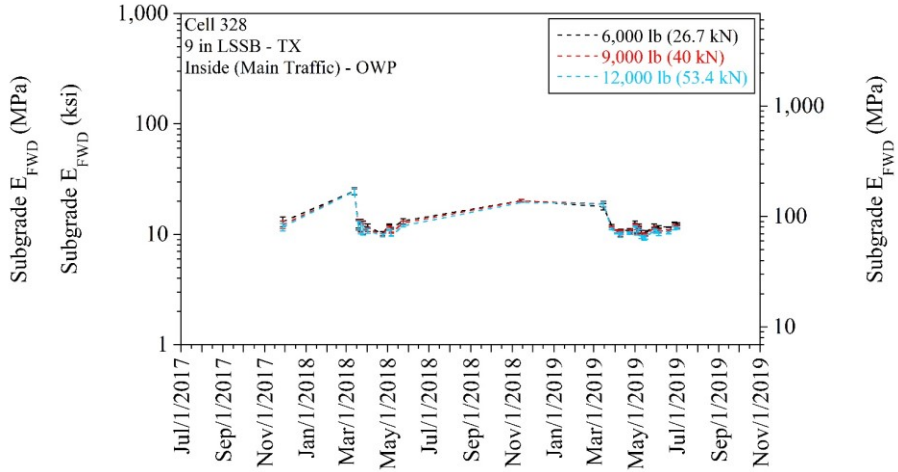


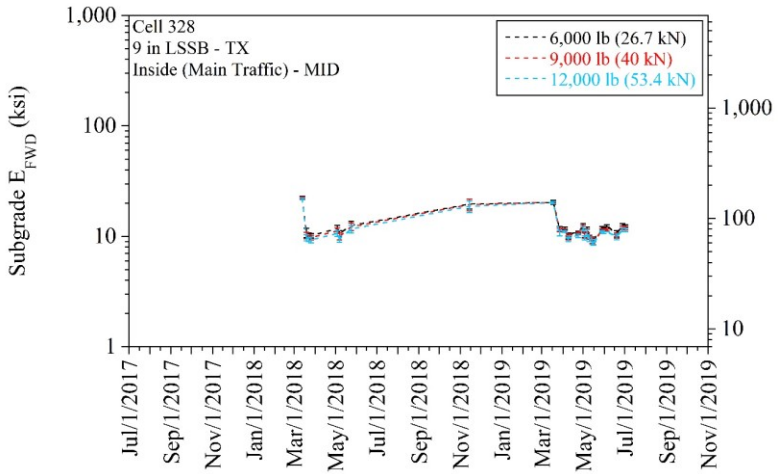


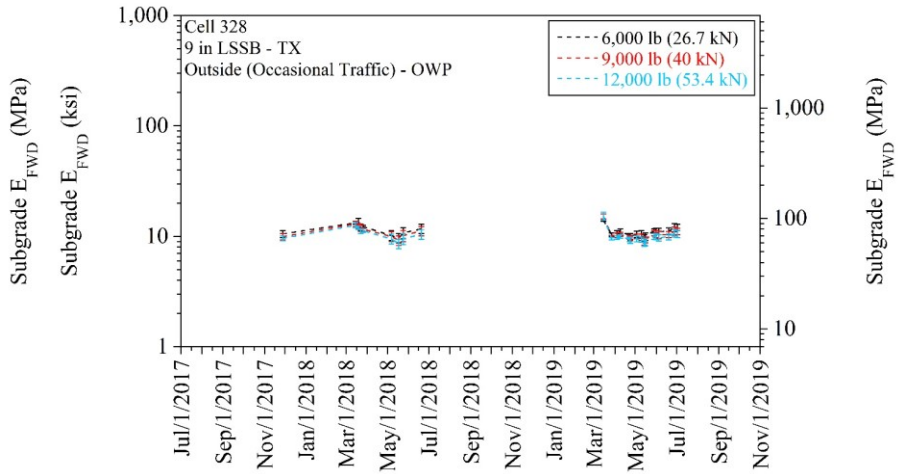


Cell 328 (9-in LSSB - TX) - subgrade E_{FWD} (error bars represent one standard deviation of the data):

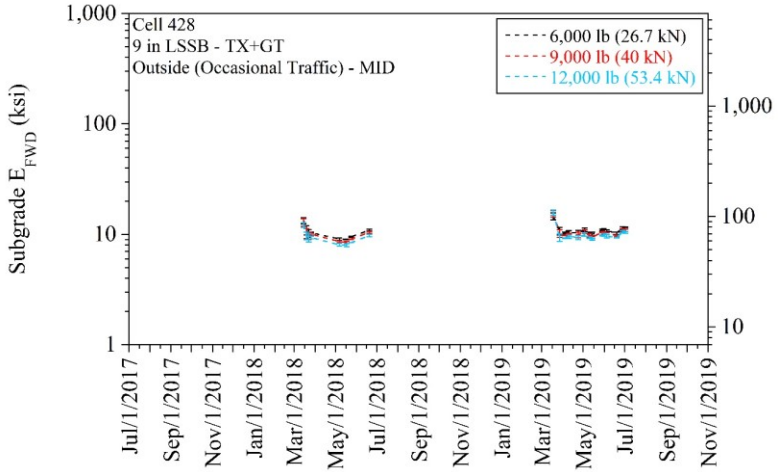


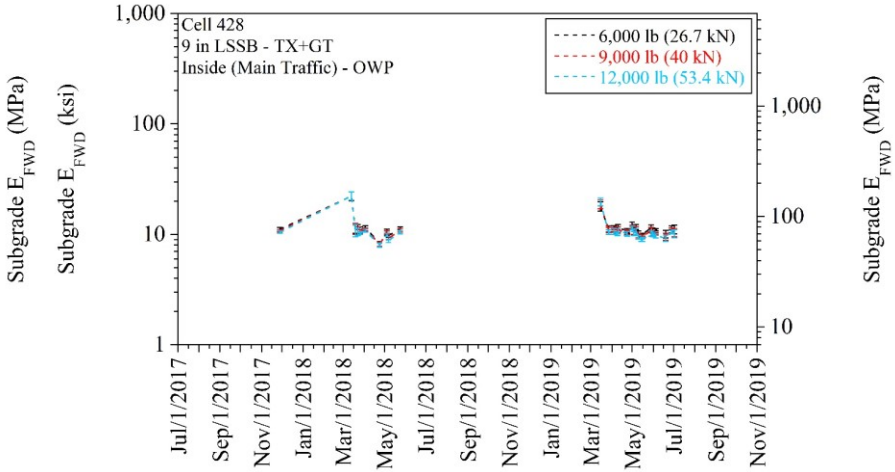


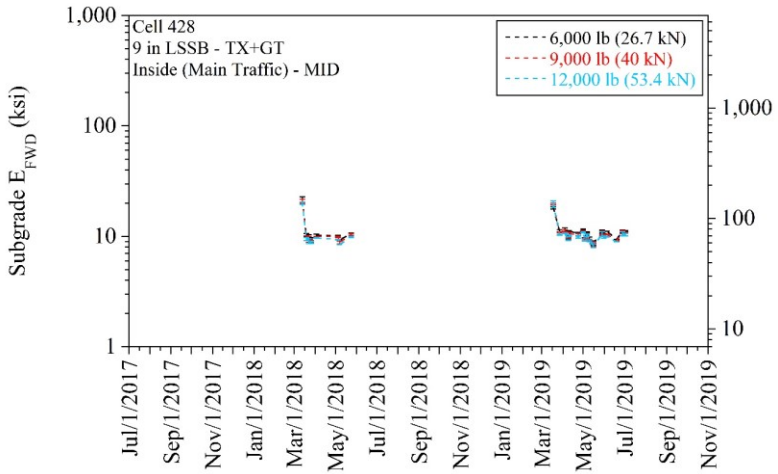


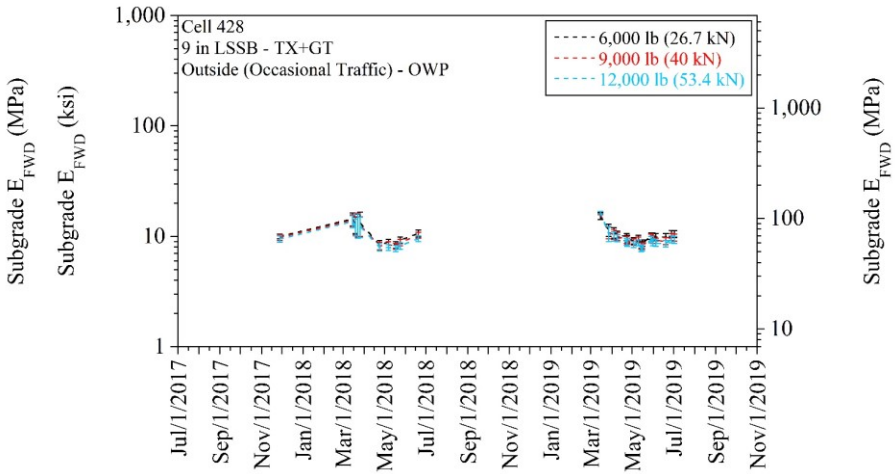


Cell 428 (9-in LSSB - TX+GT) - subgrade E_{FWD} (error bars represent one standard deviation of the data):

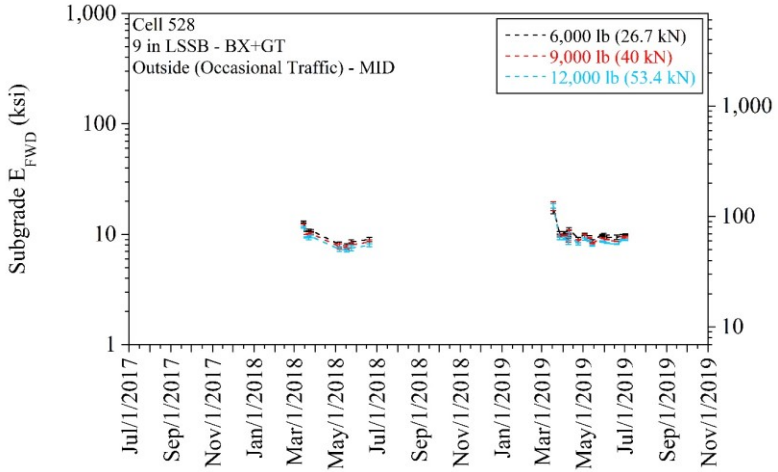


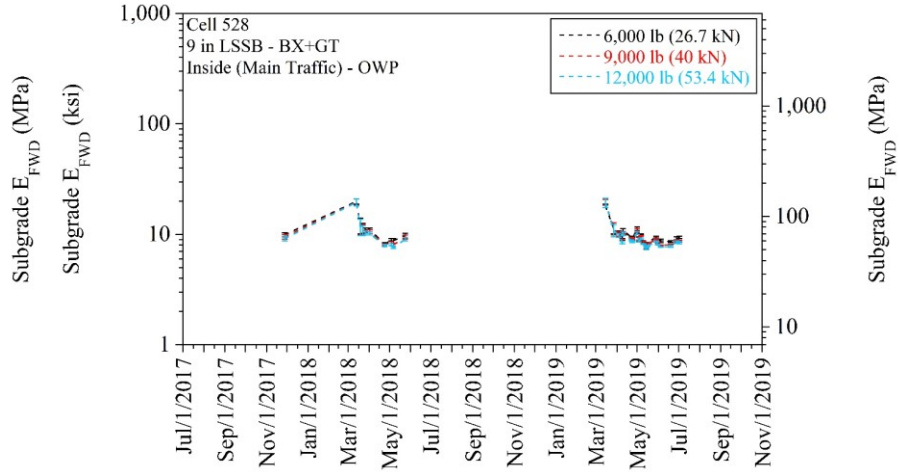


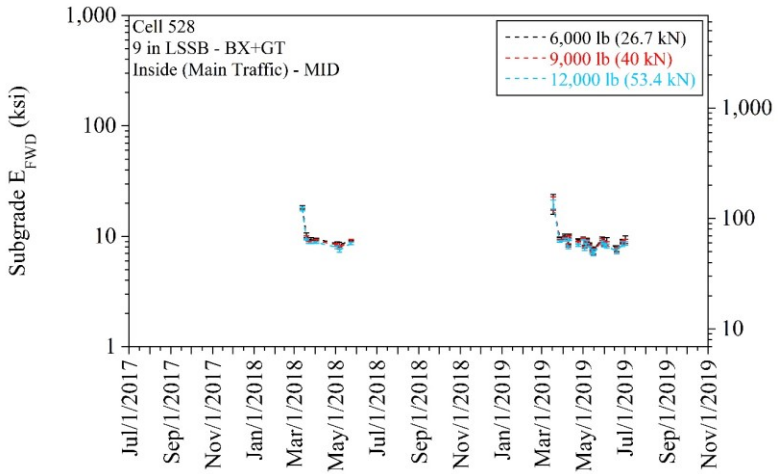


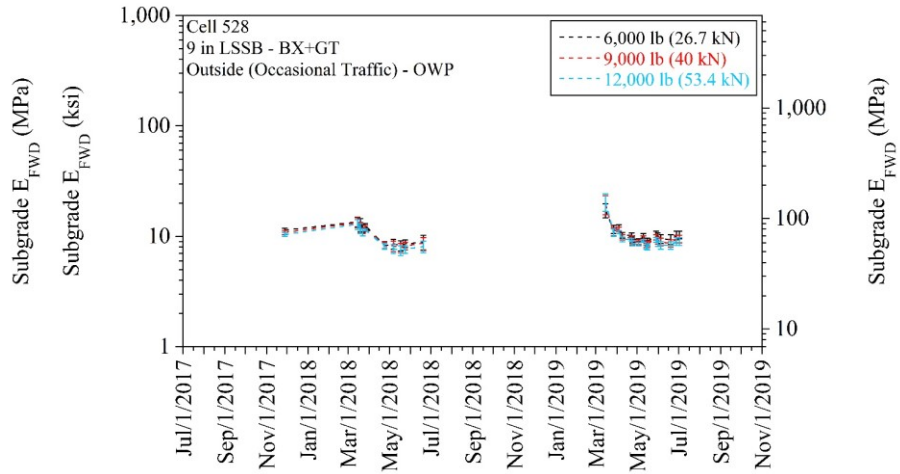


Cell 528 (9-in LSSB - BX+GT) - subgrade E_{FWD} (error bars represent one standard deviation of the data):

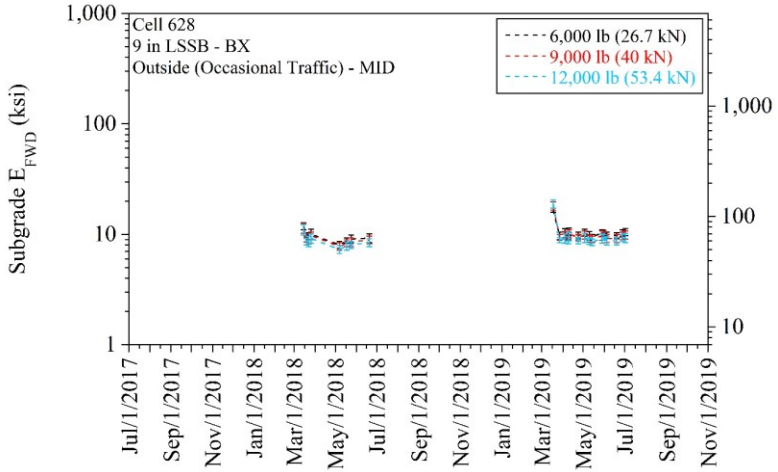


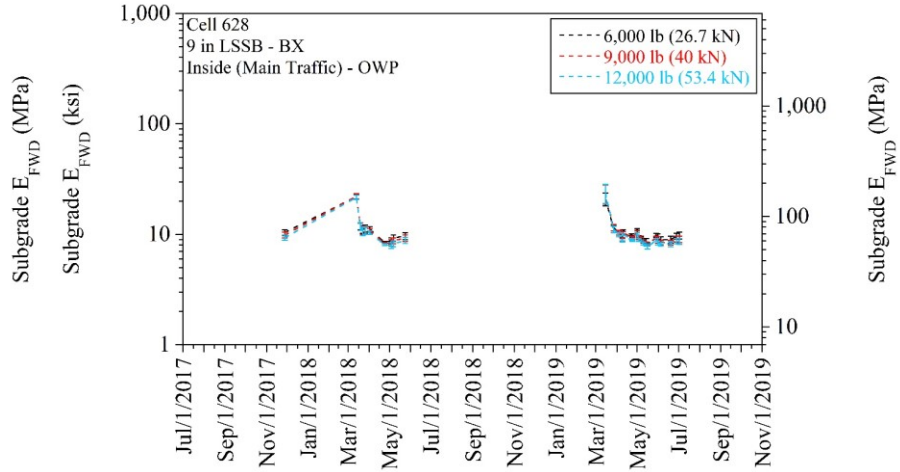


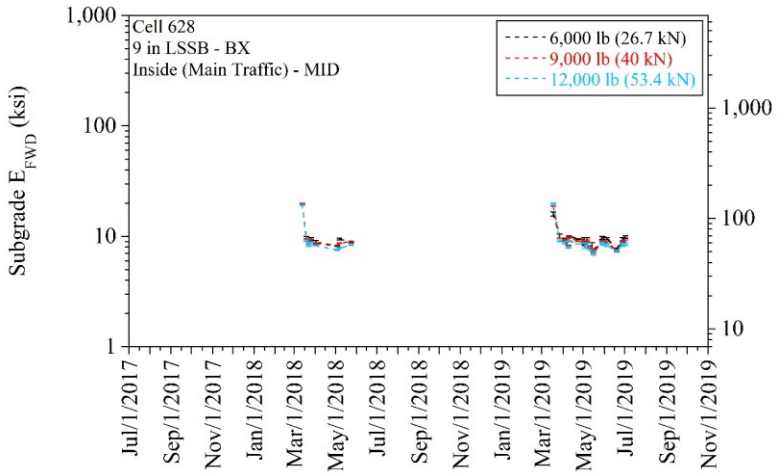


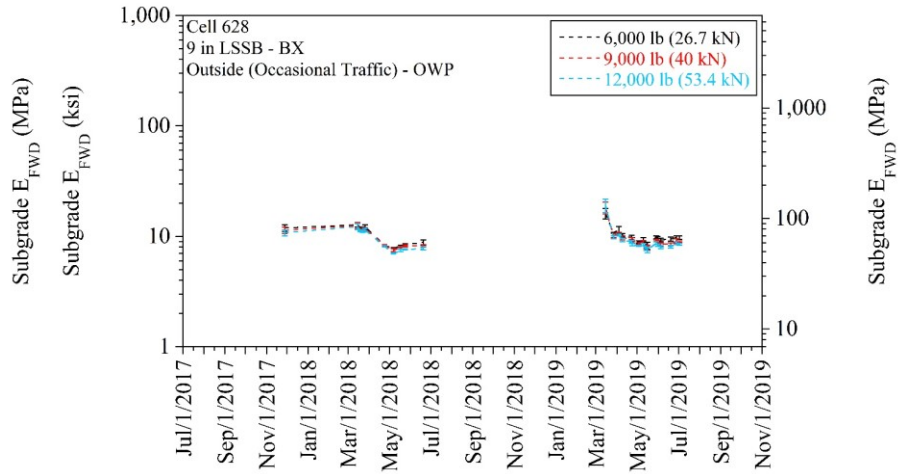


Cell 628 (9-in LSSB - BX) - subgrade E_{FWD} (error bars represent one standard deviation of the data):

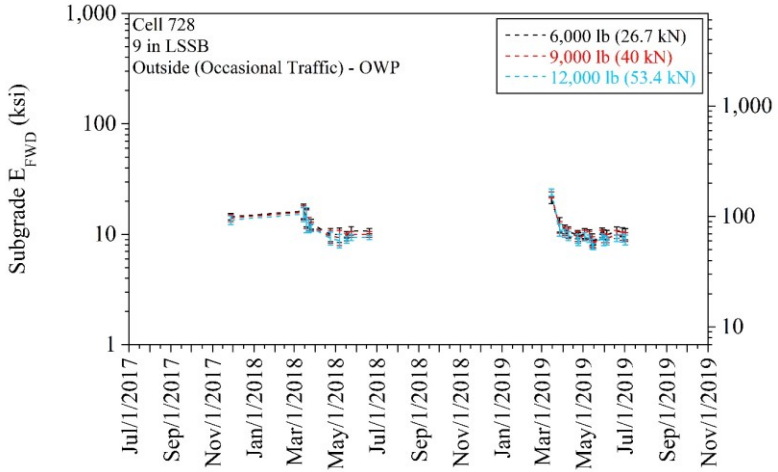


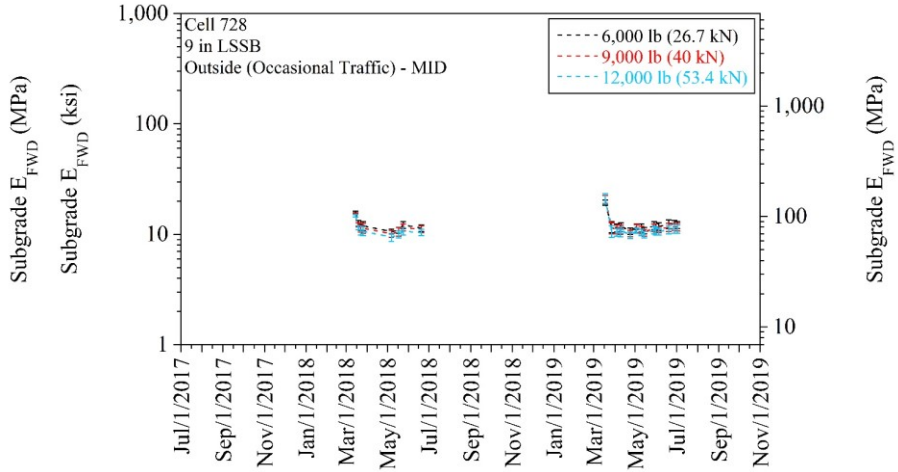


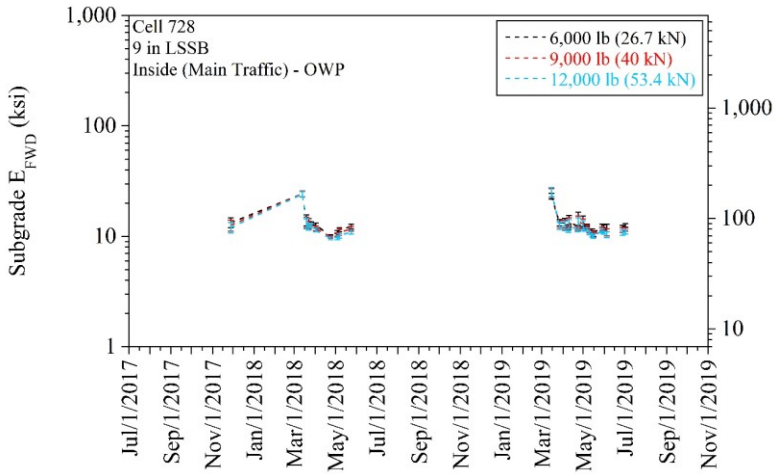


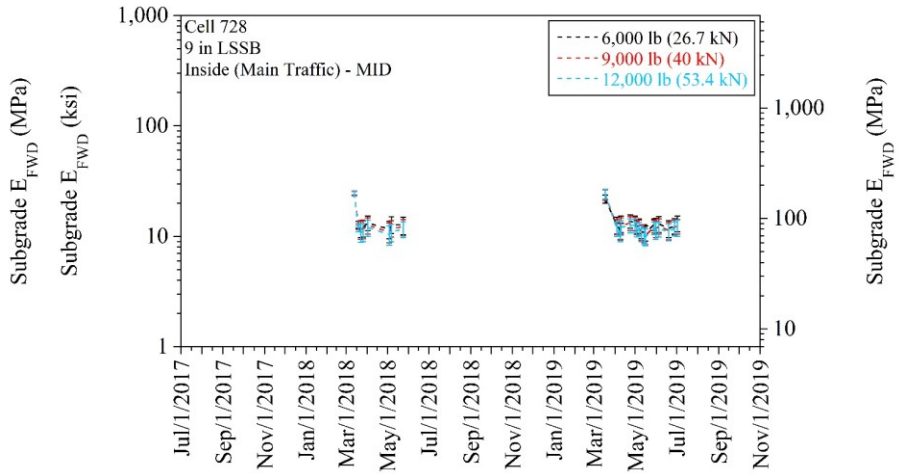


Cell 728 (9-in LSSB) - subgrade E_{FWD} (error bars represent one standard deviation of the data):



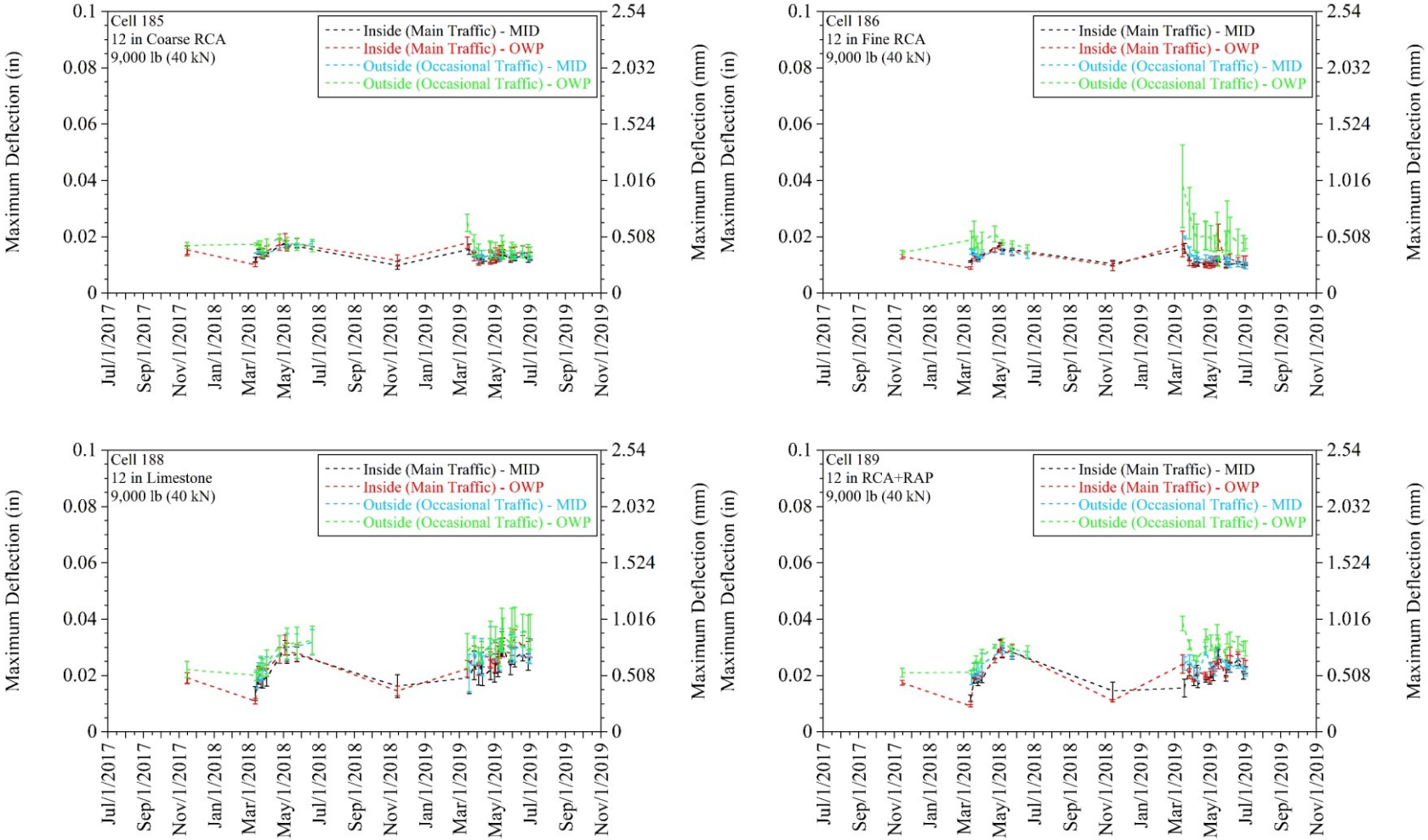


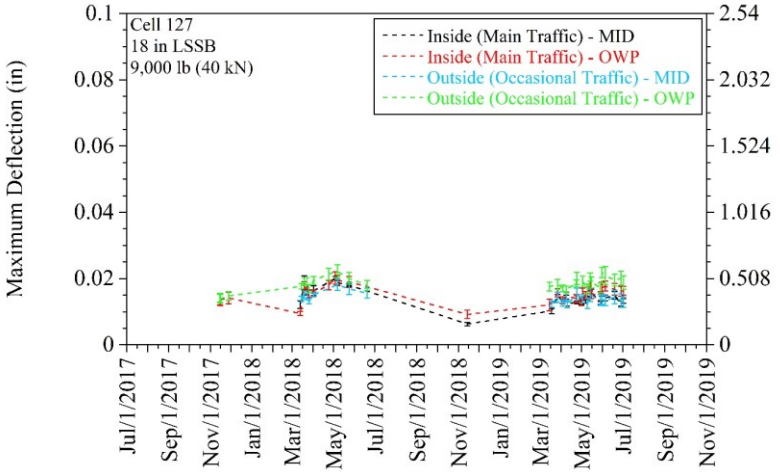


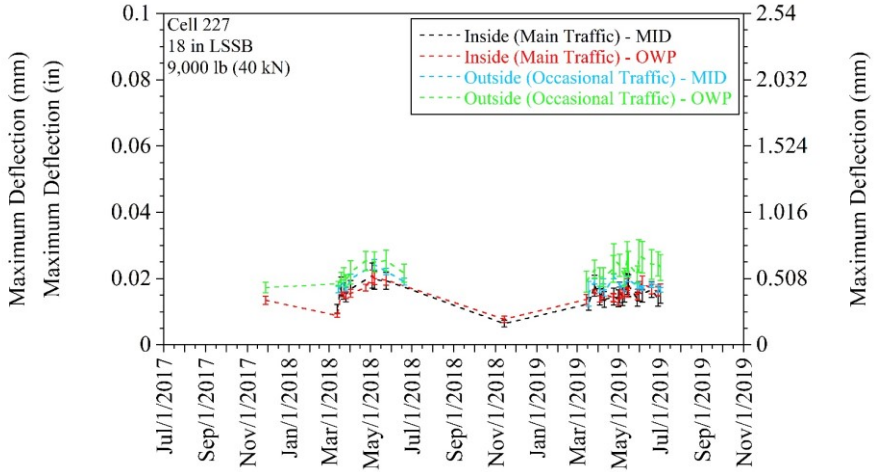


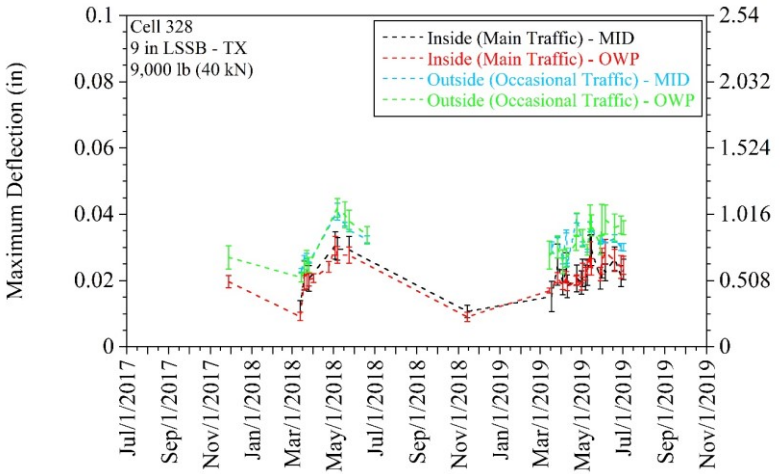
APPENDIX Z
MAXIMUM DEFLECTIONS FOR DIFFERENT TEST LOCATIONS AT 9,000 LB (40 KN) FOR EACH CELL

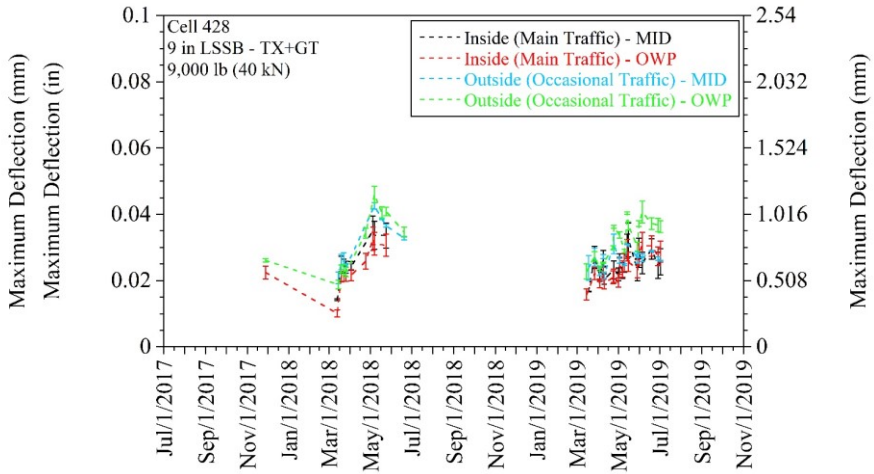
(error bars represent one standard deviation of the data)

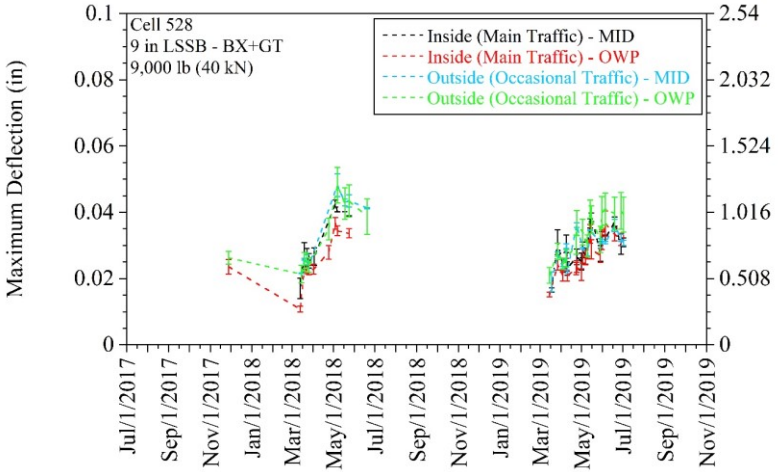


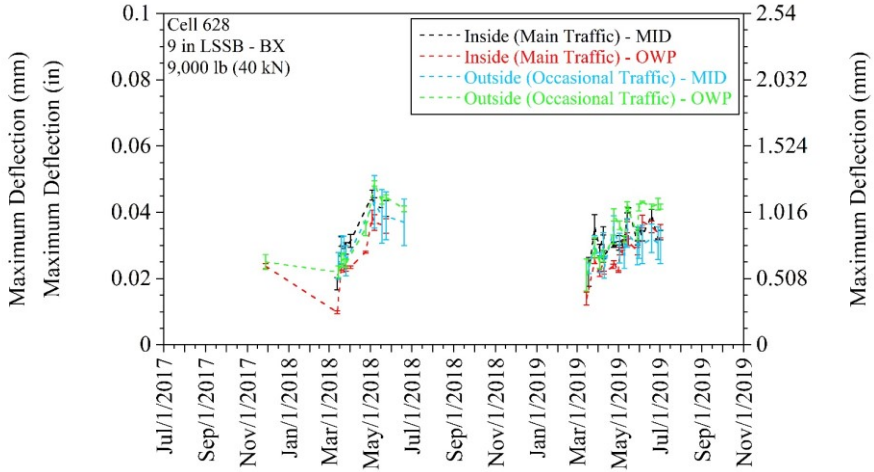

Cell 127
18 in LSSB
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Maximum Deflection (in)
Maximum Deflection (mm)
0.1
0.08
0.06
0.04
0.02
0
2.54
2.032
1.524
1.016
0.508
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

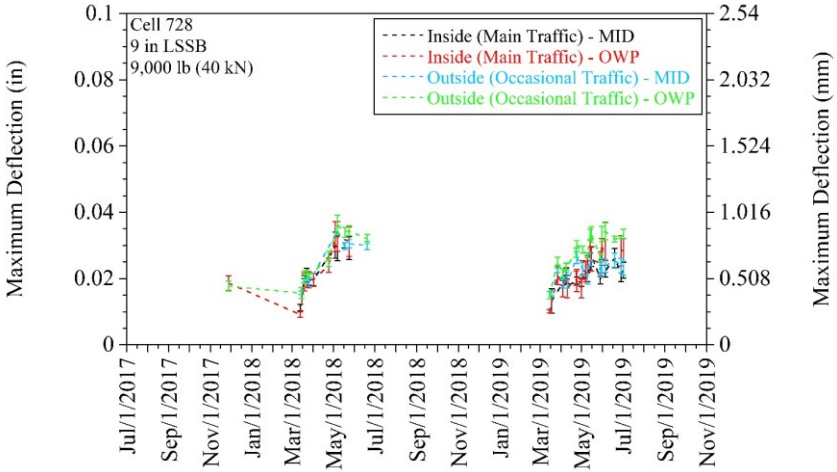

Cell 227
18 in LSSB
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Maximum Deflection (in)
Maximum Deflection (mm)
0.1
0.08
0.06
0.04
0.02
0
2.54
2.032
1.524
1.016
0.508
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 328
9 in LSSB - TX
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Maximum Deflection (in)
Maximum Deflection (mm)
0.1
0.08
0.06
0.04
0.02
0
2.54
2.032
1.524
1.016
0.508
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 428
9 in LSSB - TX+GT
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Maximum Deflection (in)
Maximum Deflection (mm)
0.1
0.08
0.06
0.04
0.02
0
2.54
2.032
1.524
1.016
0.508
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

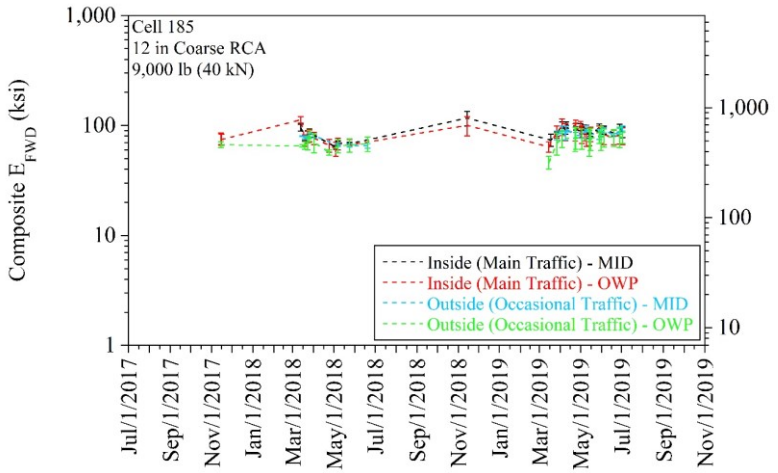

Cell 528
9 in LSSB - BX+GT
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Maximum Deflection (in)
Maximum Deflection (mm)
0.1
0.08
0.06
0.04
0.02
0
2.54
2.032
1.524
1.016
0.508
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

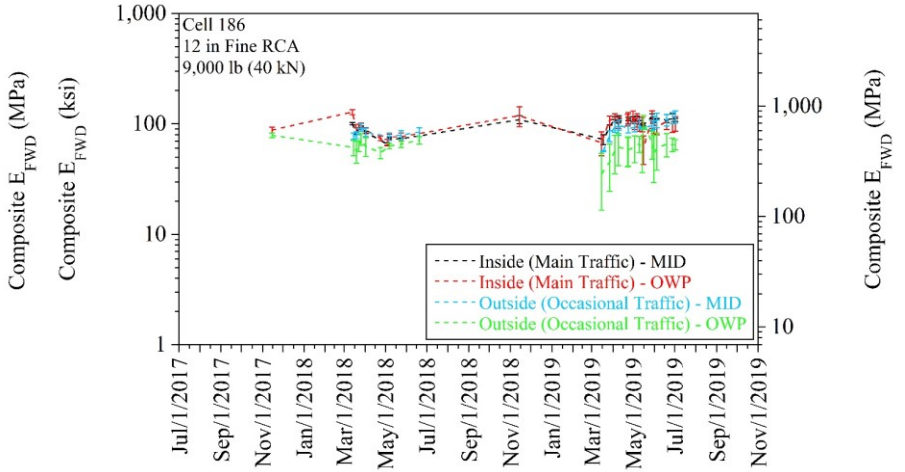

Cell 628
9 in LSSB - BX
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Maximum Deflection (in)
Maximum Deflection (mm)
0.1
0.08
0.06
0.04
0.02
0
2.54
2.032
1.524
1.016
0.508
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

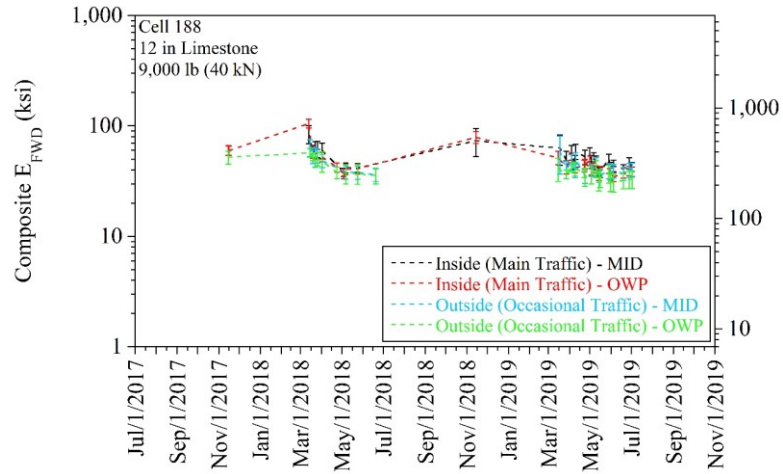

Cell 728
9 in LSSB
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Maximum Deflection (in)
Maximum Deflection (mm)
0.1
0.08
0.06
0.04
0.02
0
2.54
2.032
1.524
1.016
0.508
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

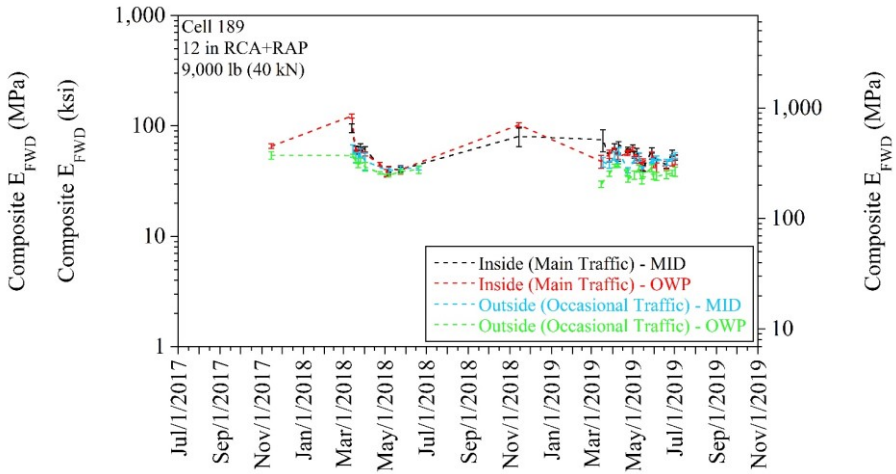
APPENDIX AA
COMPOSITE FALLING WEIGHT DEFLECTOMETER (FWD) ELASTIC MODULUS (E_{FWD}) FOR DIFFERENT TEST LOCATIONS AT 9,000 LB (40 KN) FOR EACH CELL

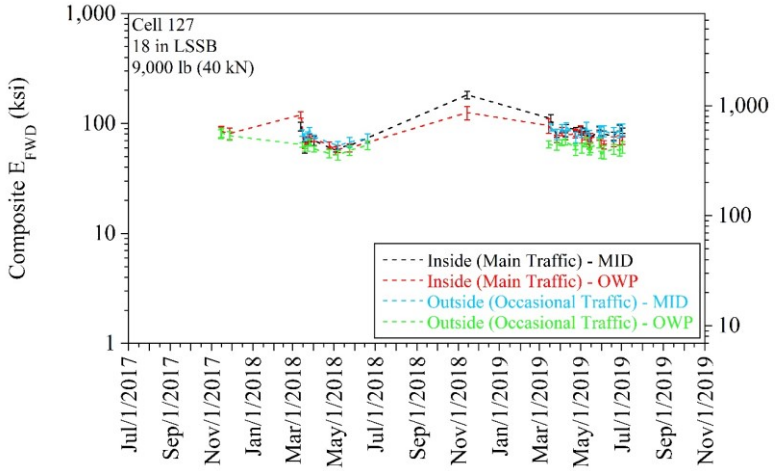
(error bars represent one standard deviation of the data)

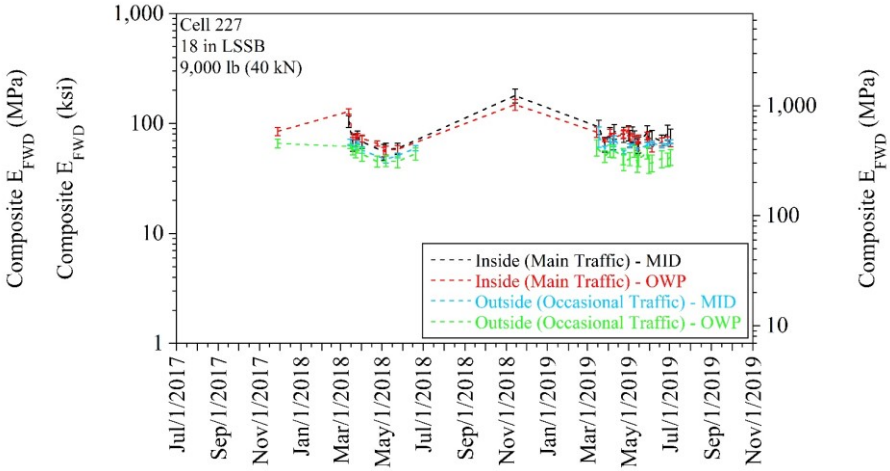


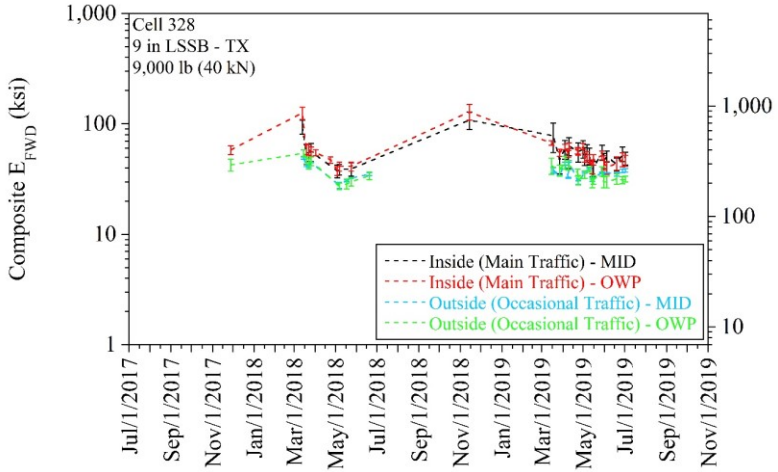


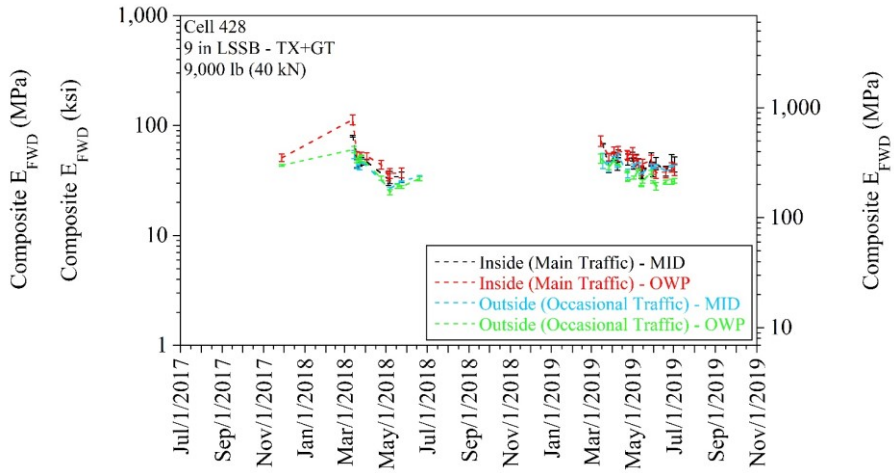


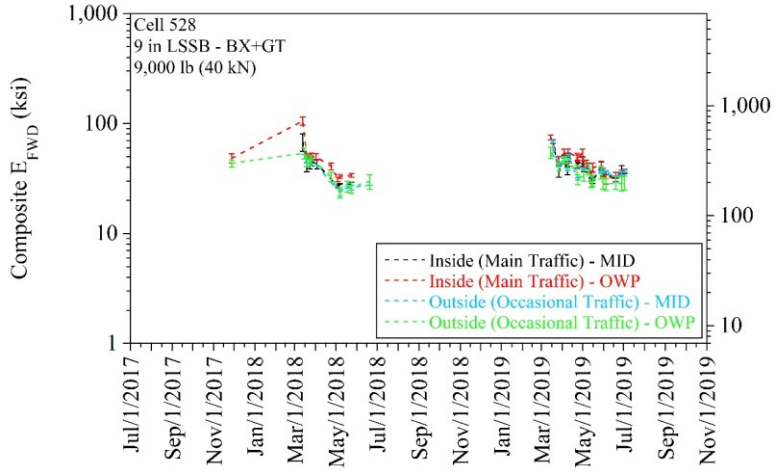


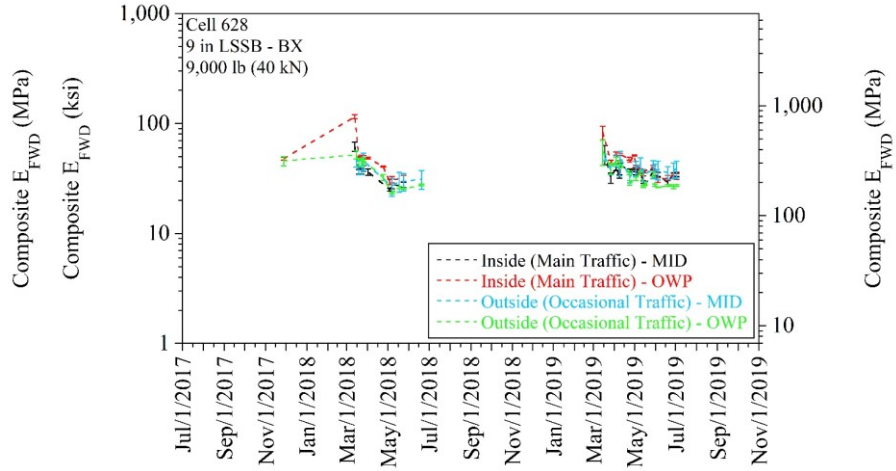

Cell 127
18 in LSSB
9,000 lb (40 kN)
Composite E_{FWD} (ksi)
Composite E_{FWD} (MPa)
1,000
100
10
1
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

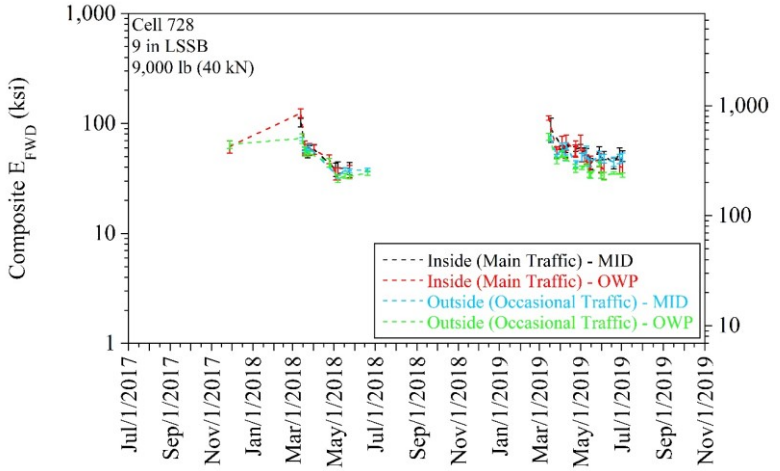

Cell 227
18 in LSSB
9,000 lb (40 kN)
Composite E_{FWD} (ksi)
Composite E_{FWD} (MPa)
1,000
100
10
1
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 328
9 in LSSB - TX
9,000 lb (40 kN)
Composite E_{FWD} (ksi)
Composite E_{FWD} (MPa)
1,000
100
10
1
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 428
9 in LSSB - TX+GT
9,000 lb (40 kN)
Composite E_{FWD} (ksi)
Composite E_{FWD} (MPa)
1,000
100
10
1
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

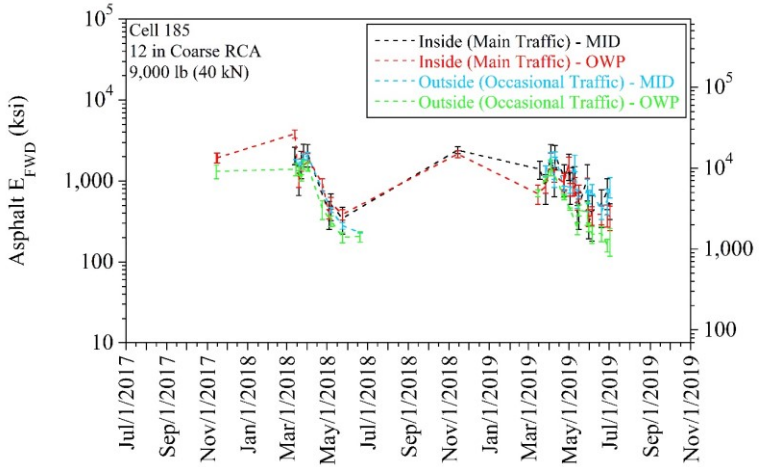

Cell 528
9 in LSSB - BX+GT
9,000 lb (40 kN)
Composite E_{FWD} (ksi)
Composite E_{FWD} (MPa)
1,000
100
10
1
1,000
100
10
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

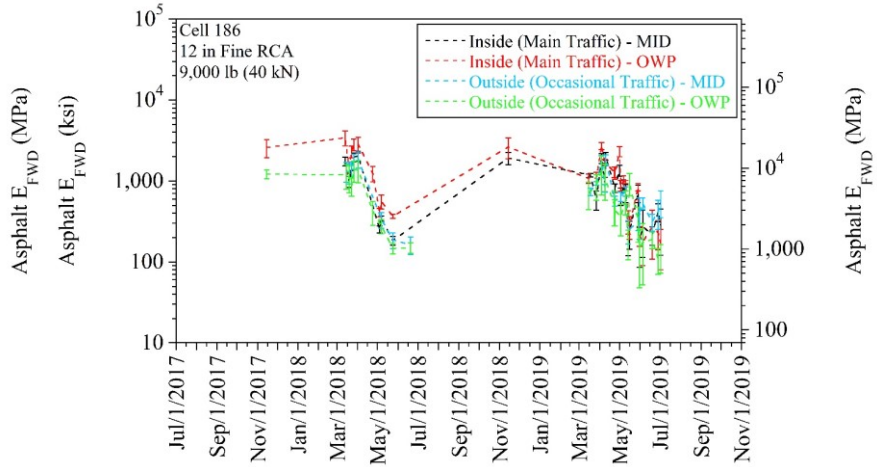

Cell 628
9 in LSSB - BX
9,000 lb (40 kN)
Composite E_{FWD} (ksi)
Composite E_{FWD} (MPa)
1,000
100
10
1
1,000
100
10
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

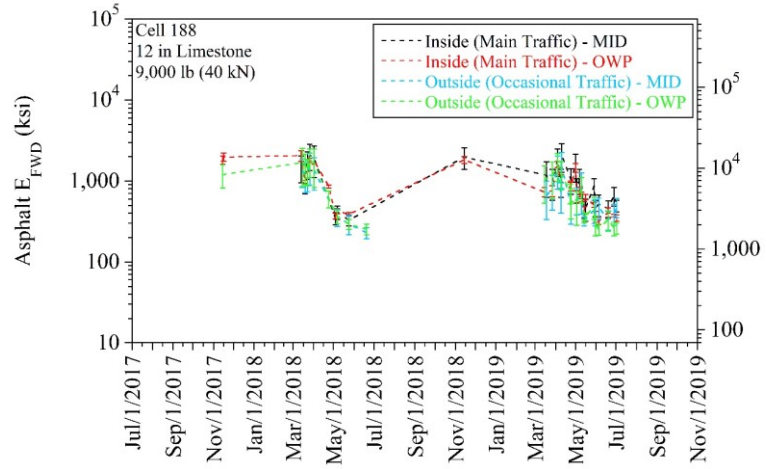

Cell 728
9 in LSSB
9,000 lb (40 kN)
Composite E_{FWD} (ksi)
Composite E_{FWD} (MPa)
1,000
100
10
1
1,000
100
10
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

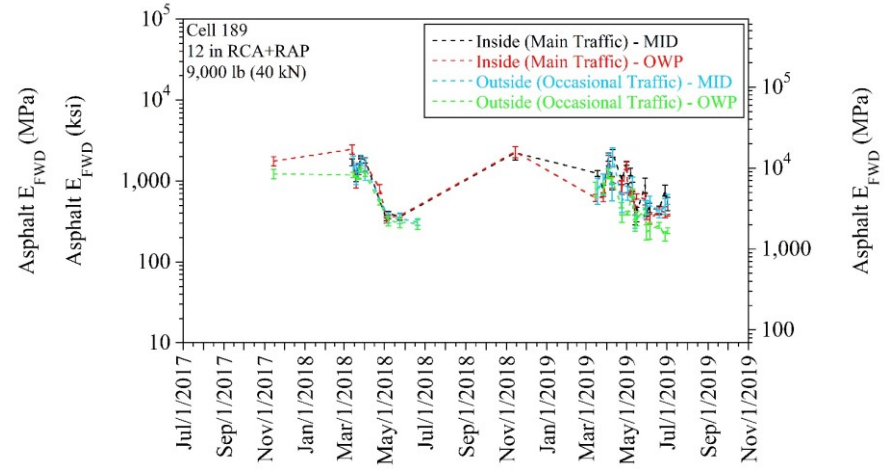
APPENDIX AB
ASPHALT FALLING WEIGHT DEFLECTOMETER (FWD) ELASTIC MODULUS (E_{FWD}) FOR DIFFERENT TEST LOCATIONS AT 9,000 LB (40 KN) FOR EACH CELL

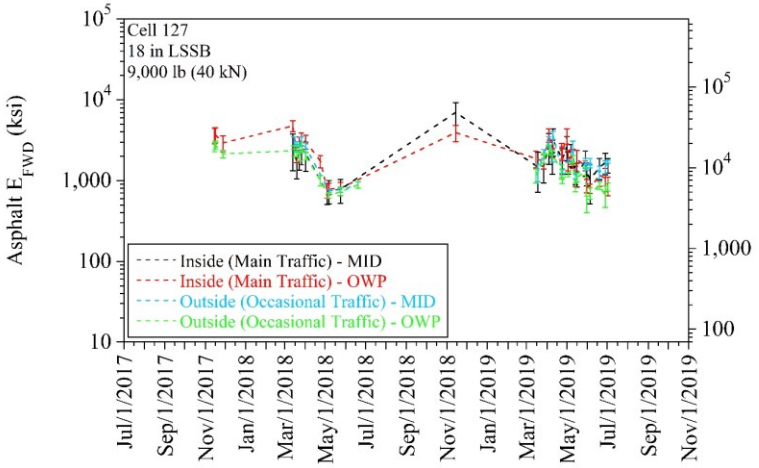
(error bars represent one standard deviation of the data)

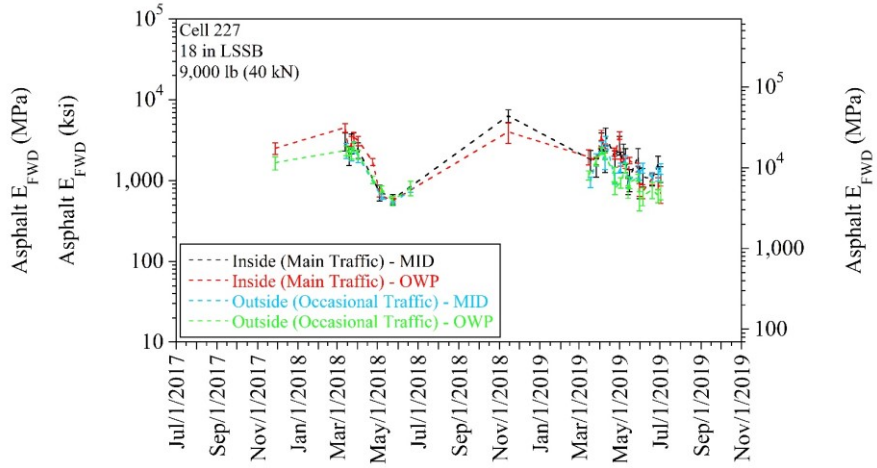


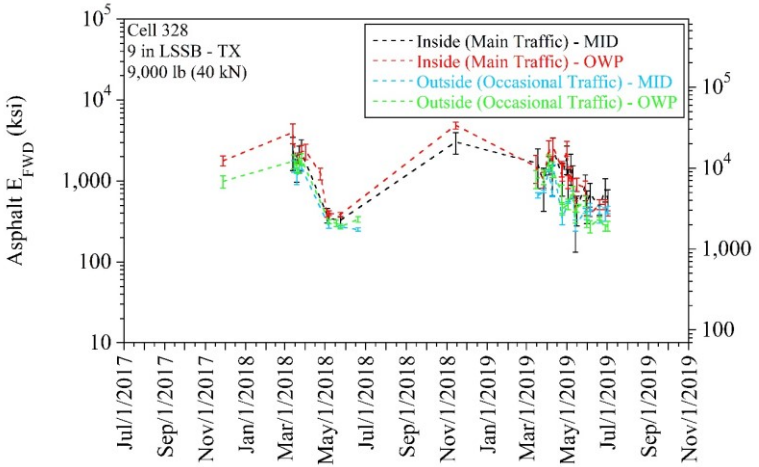


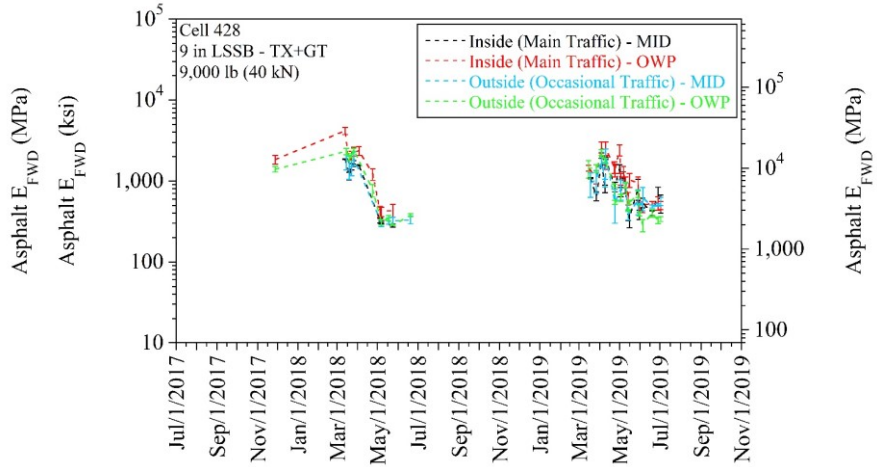


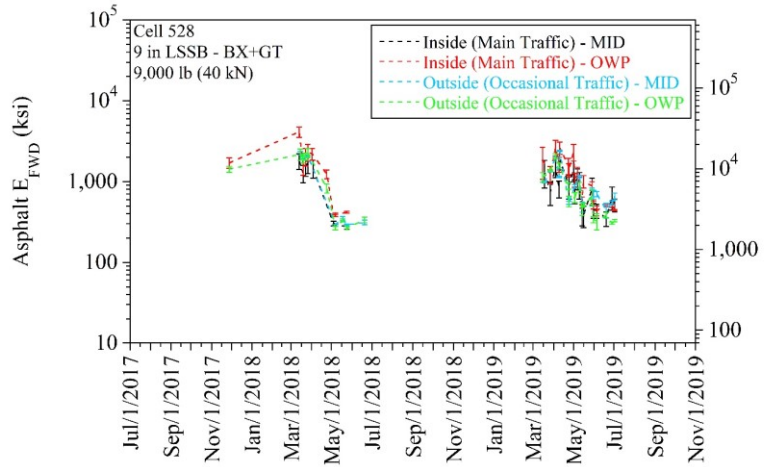


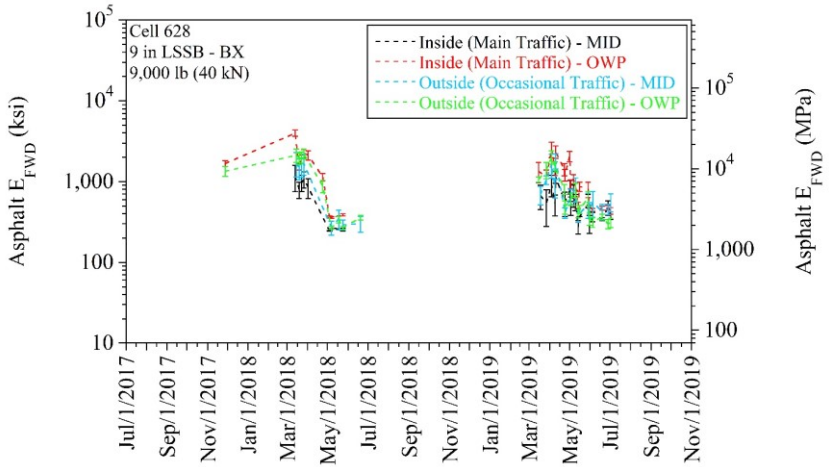

Cell 127
18 in LSSB
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Asphalt E_{FWD} (ksi)
Asphalt E_{FWD} (MPa)

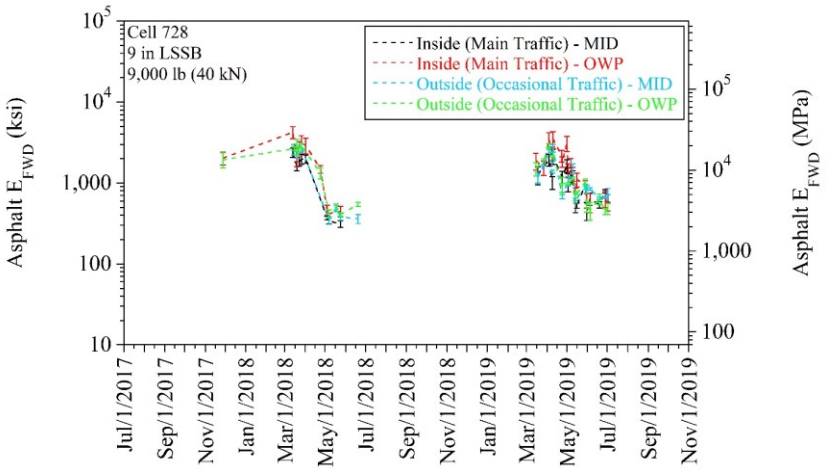

Cell 227
18 in LSSB
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Asphalt E_{FWD} (ksi)
Asphalt E_{FWD} (MPa)


Cell 328
9 in LSSB - TX
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Asphalt E_{FWD} (ksi)
Asphalt E_{FWD} (MPa)


Cell 428
9 in LSSB - TX+GT
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Asphalt E_{FWD} (ksi)
Asphalt E_{FWD} (MPa)

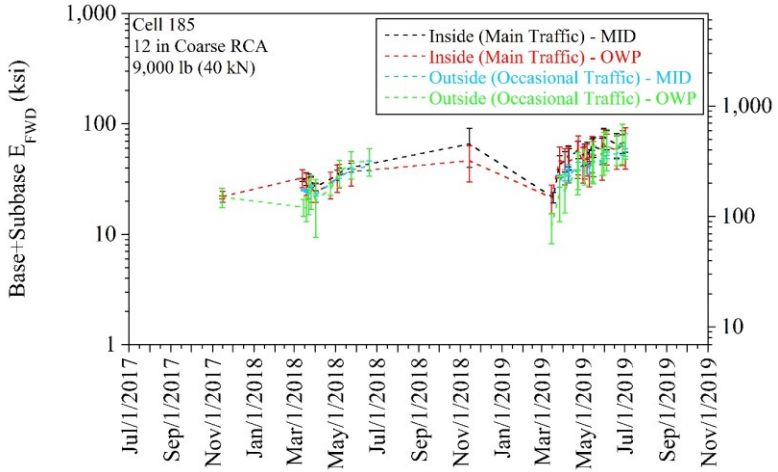

Cell 528
9 in LSSB - BX+GT
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Asphalt E_FWD (ksi)
Asphalt E_FWD (MPa)
10^5
10^4
1,000
100
10
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

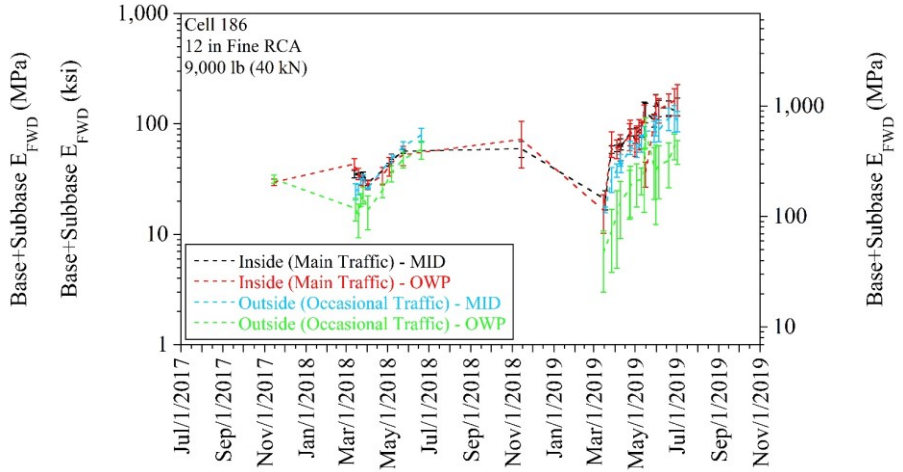

Cell 628
9 in LSSB - BX
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Asphalt E_FWD (ksi)
Asphalt E_FWD (MPa)
10^5
10^4
1,000
100
10
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

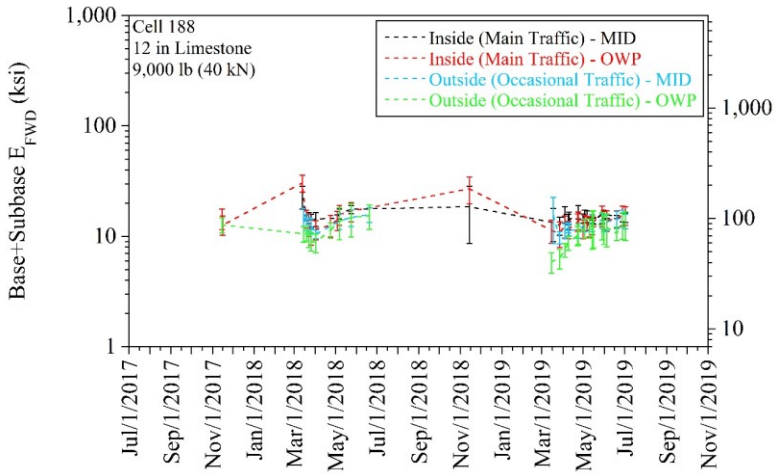

Cell 728
9 in LSSB
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Asphalt E_FWD (ksi)
Asphalt E_FWD (MPa)
10^5
10^4
1,000
100
10
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

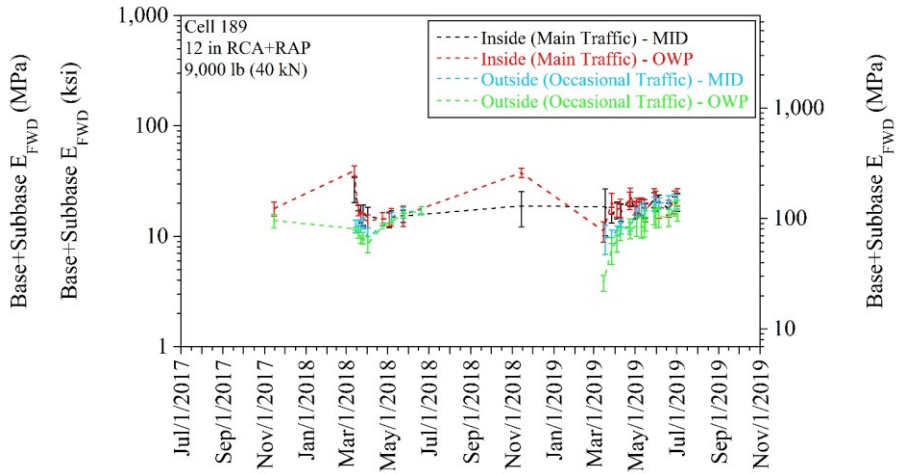
APPENDIX AC
BASE+SUBBASE FALLING WEIGHT DEFLECTOMETER (FWD) ELASTIC MODULUS (E_{FWD}) FOR DIFFERENT TEST LOCATIONS AT 9,000 LB (40 KN) FOR EACH CELL

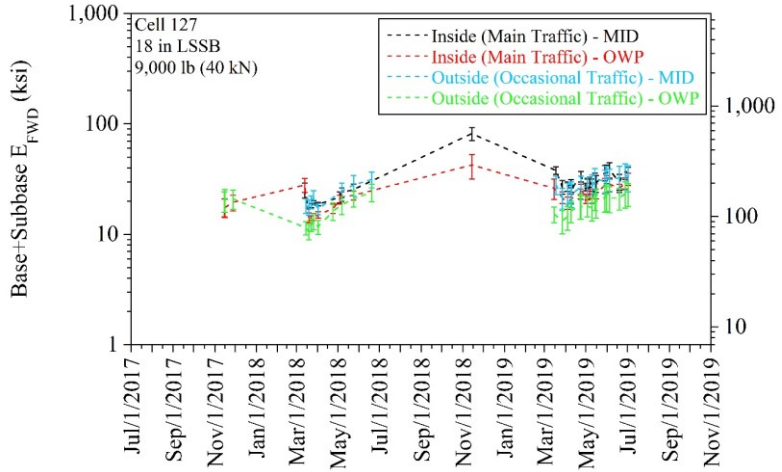
(error bars represent one standard deviation of the data)

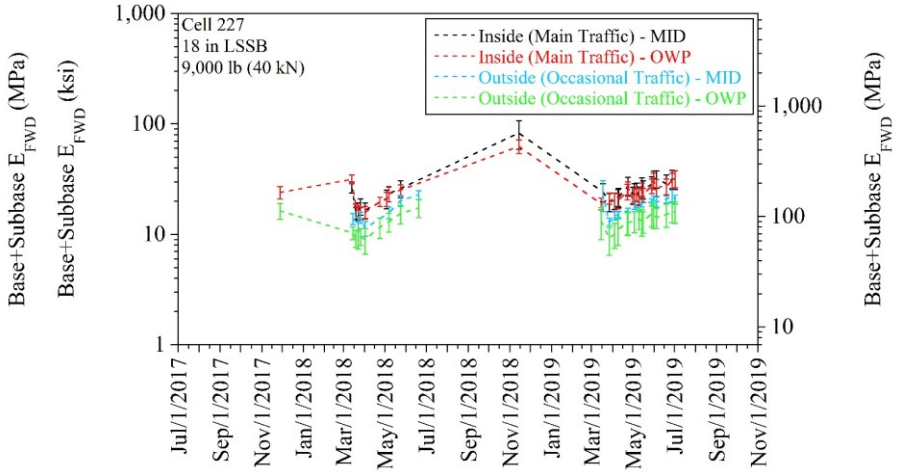


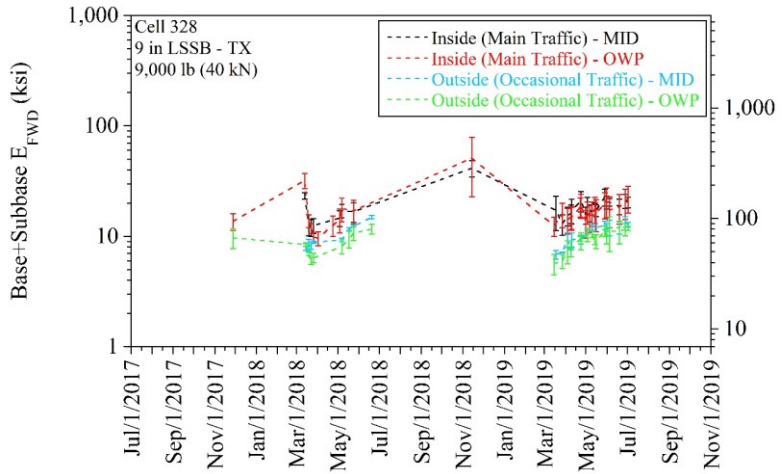


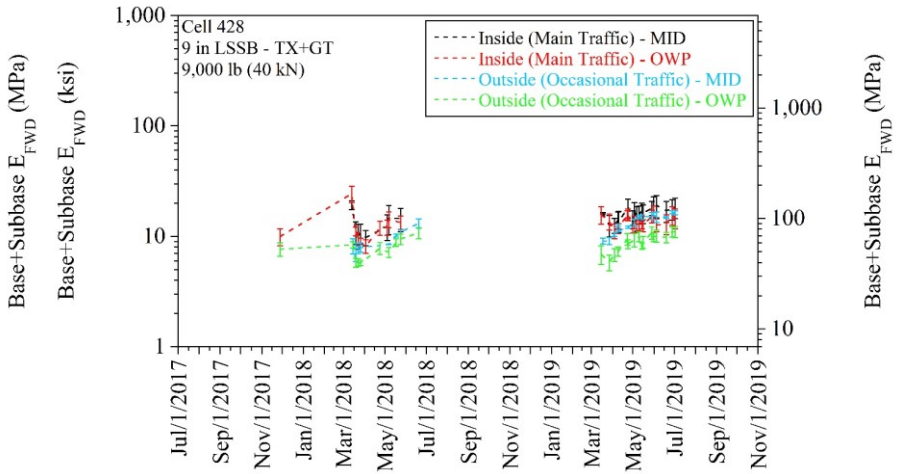


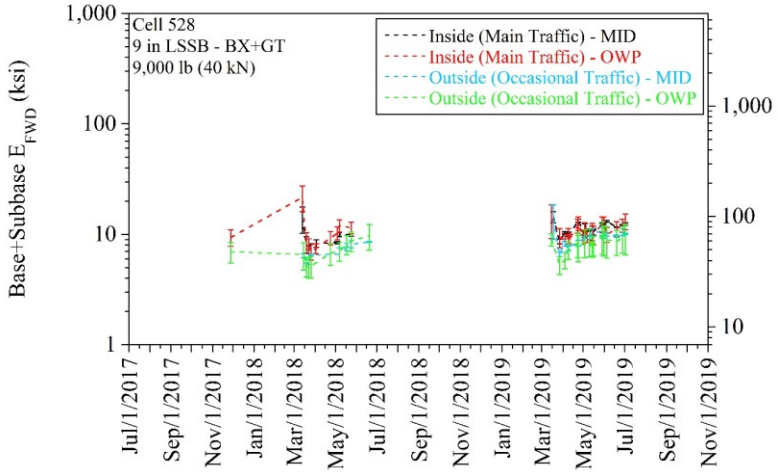


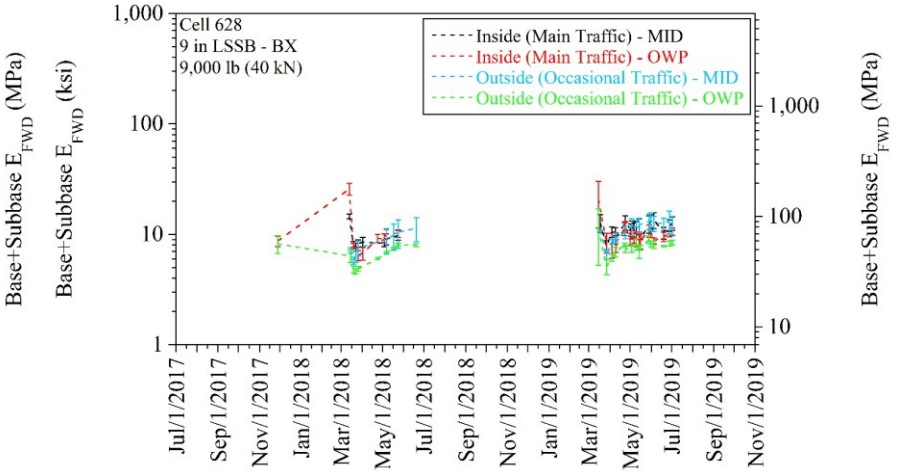

Cell 127
18 in LSSB
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Base+Subbase E_FWD (ksi)
Base+Subbase E_FWD (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

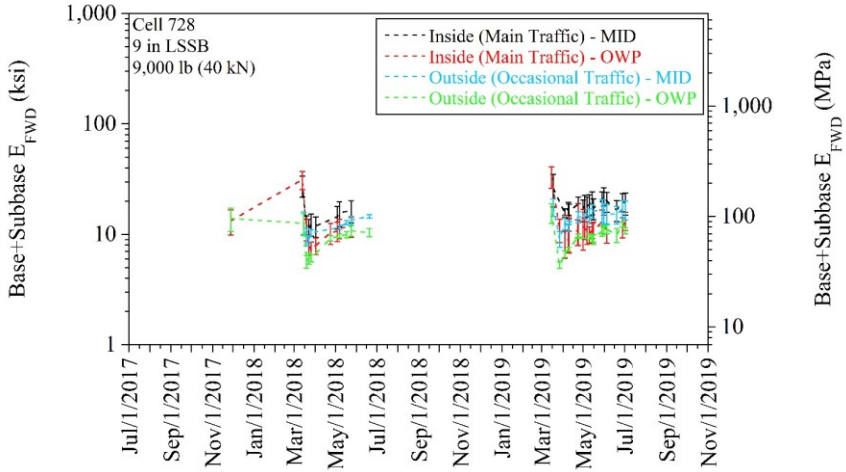

Cell 227
18 in LSSB
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Base+Subbase E_FWD (ksi)
Base+Subbase E_FWD (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 328
9 in LSSB - TX
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Base+Subbase E_FWD (ksi)
Base+Subbase E_FWD (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 428
9 in LSSB - TX+GT
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Base+Subbase E_FWD (ksi)
Base+Subbase E_FWD (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

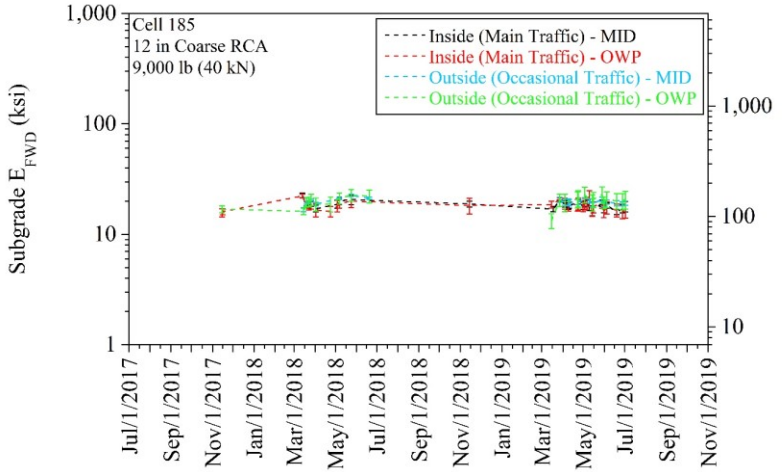

Cell 528
9 in LSSB - BX+GT
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Base+Subbase E_FWD (ksi)
Base+Subbase E_FWD (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

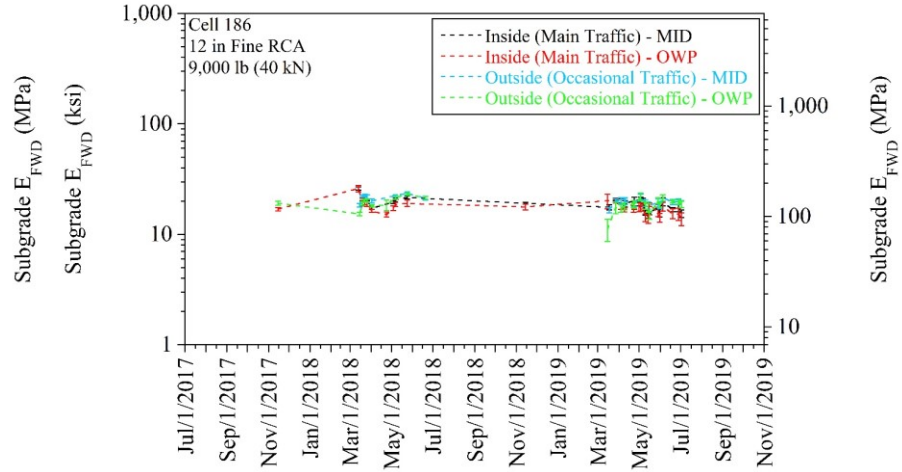

Cell 628
9 in LSSB - BX
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Base+Subbase E_FWD (ksi)
Base+Subbase E_FWD (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

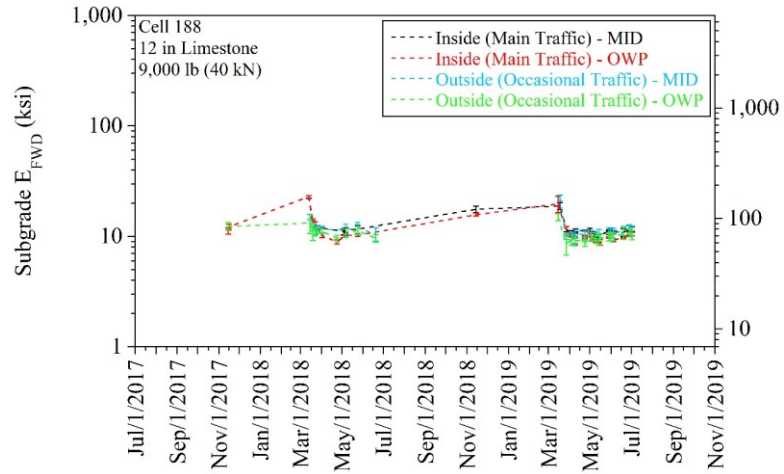

Cell 728
9 in LSSB
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Base+Subbase E_FWD (ksi)
Base+Subbase E_FWD (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

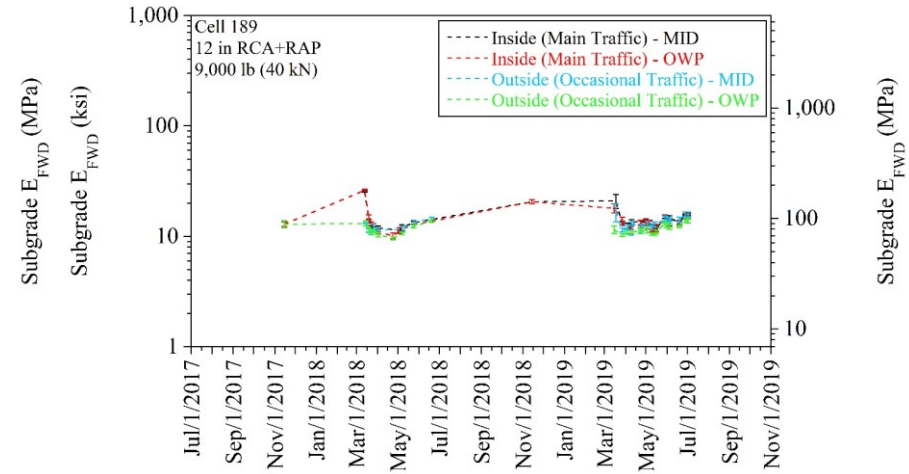
APPENDIX AD
SUBGRADE FALLING WEIGHT DEFLECTOMETER (FWD) ELASTIC MODULUS (E_{FWD}) FOR DIFFERENT TEST LOCATIONS AT 9,000 LB (40 KN) FOR EACH CELL

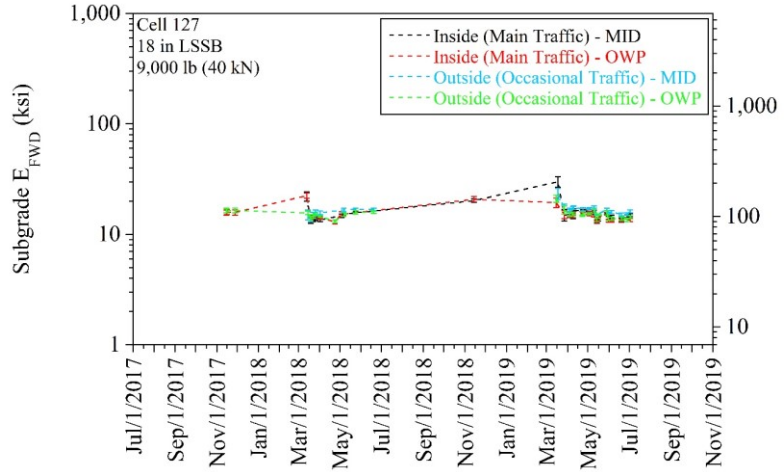
(error bars represent one standard deviation of the data)

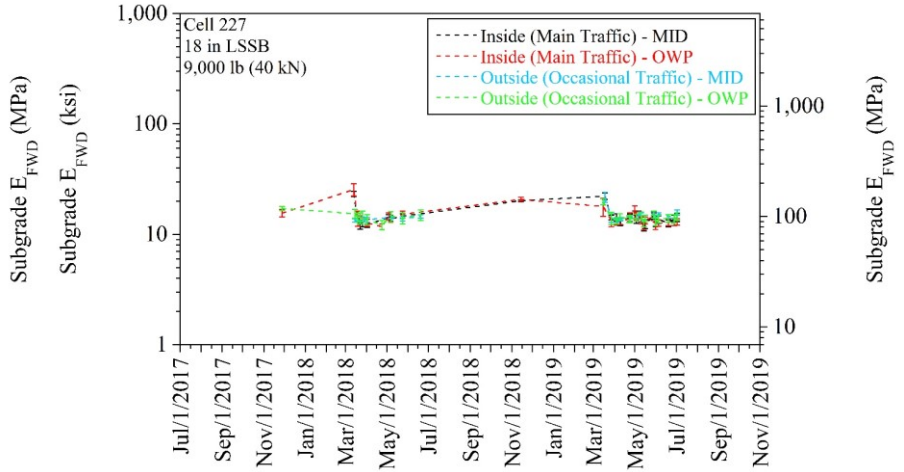


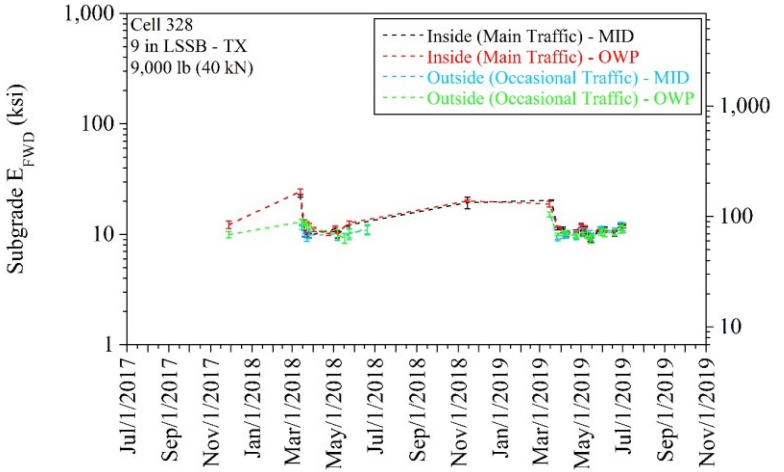


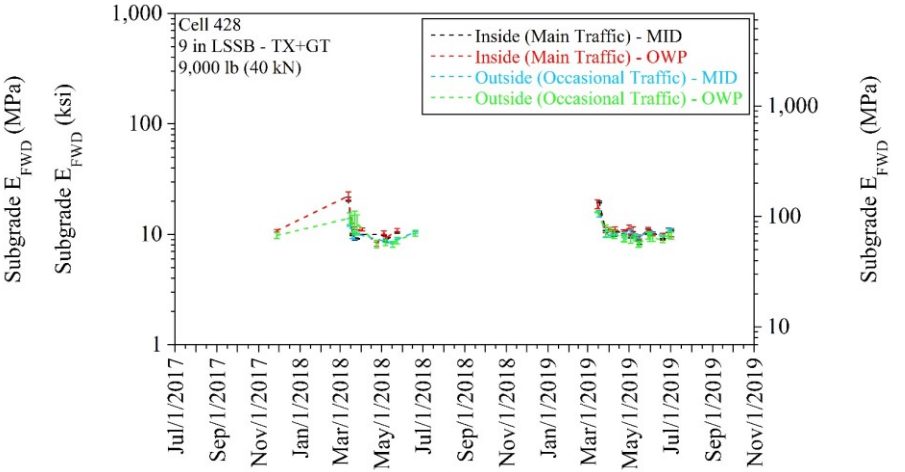


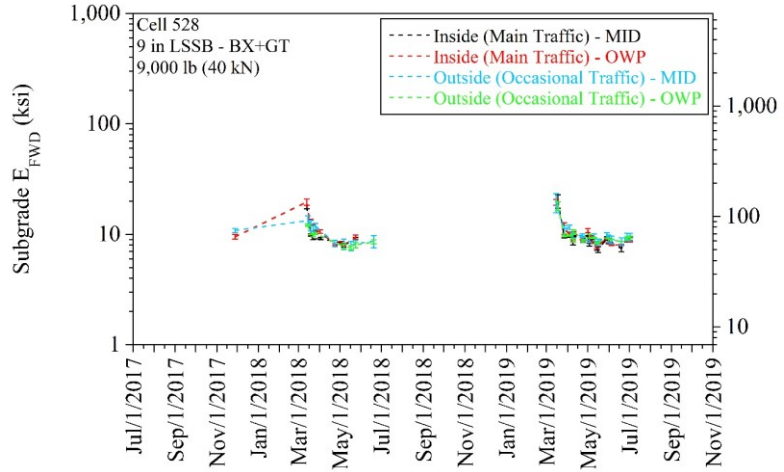


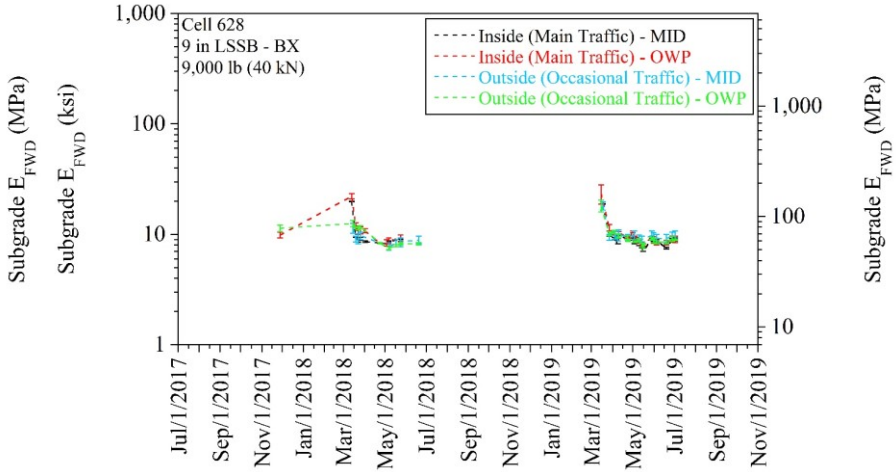

Cell 127
18 in LSSB
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Subgrade E_{FWD} (ksi)
Subgrade E_{FWD} (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

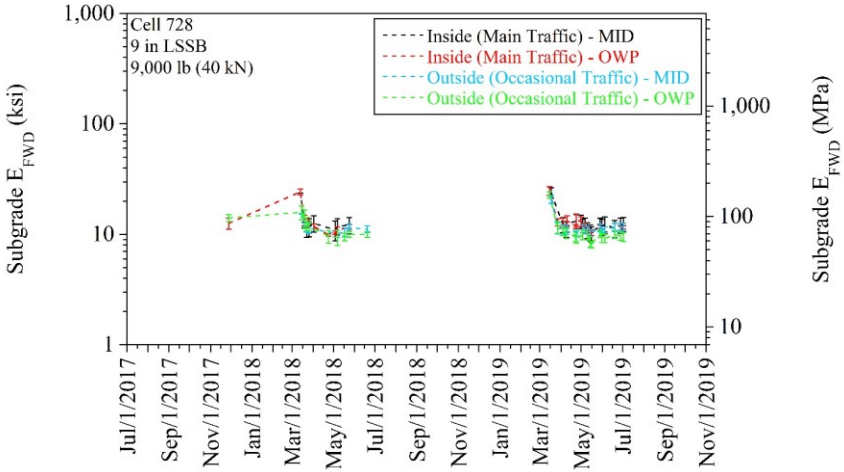

Cell 227
18 in LSSB
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Subgrade E_{FWD} (ksi)
Subgrade E_{FWD} (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 328
9 in LSSB - TX
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Subgrade E_{FWD} (ksi)
Subgrade E_{FWD} (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 428
9 in LSSB - TX+GT
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Subgrade E_{FWD} (ksi)
Subgrade E_{FWD} (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 528
9 in LSSB - BX+GT
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Subgrade E_{FWD} (ksi)
Subgrade E_{FWD} (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 628
9 in LSSB - BX
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Subgrade E_{FWD} (ksi)
Subgrade E_{FWD} (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 728
9 in LSSB
9,000 lb (40 kN)
Inside (Main Traffic) - MID
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - MID
Outside (Occasional Traffic) - OWP
Subgrade E_{FWD} (ksi)
Subgrade E_{FWD} (MPa)
1,000
100
10
1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

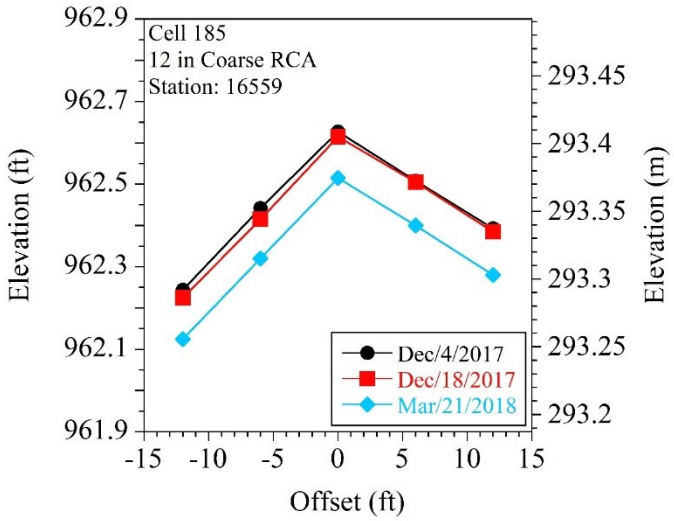
APPENDIX AE
VOLUMETRIC WATER CONTENT (VWC) VALUES DETERMINED FOR SECOND THAWING PERIOD

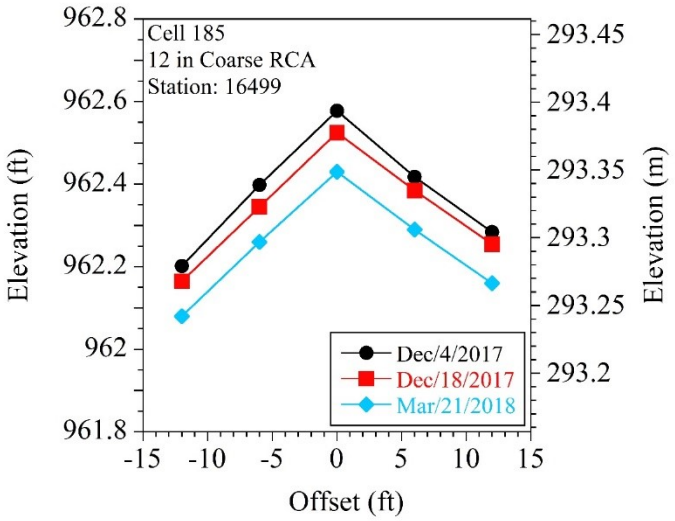
The thawing period in 2019 was evaluated in three stages: (1) frozen (average VWC for one day in fully-frozen condition - right before the thawing starts), (2) during thawing (the peak VWC between fully-frozen and thawed conditions), and (3) after thawing (average VWC for one day after the peak VWC during thawing).

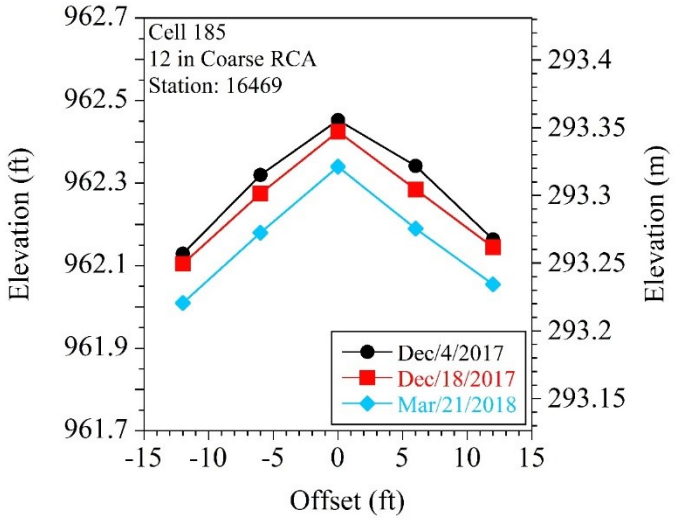
Cell	Depth (in)	Material	VWC - Thawing Period in 2019		
			Frozen	During Thawing	After Thawing
185	5	Coarse RCA	NA	NA	NA
	14	Coarse RCA	NA	NA	NA
	17	Select Granular Borrow	NA	NA	NA
	20.5	Sand Subgrade	NA	NA	NA
186	5	Fine RCA	0.0616	0.2107	0.1147
	14	Fine RCA	NA	NA	NA
	17	Select Granular Borrow	NA	NA	NA
	20.5	Sand Subgrade	NA	NA	NA
188	5	Limestone	0.0056	0.2126	0.0842
	14	Limestone	-0.011	0.416	0.0788
	17	Select Granular Borrow	0.0207	0.3042	0.2872
	20.5	Clay Loam Subgrade	0.0681	0.1719	0.1632
189	5	RCA+RAP	0.0206	0.2954	0.1196
	14	RCA+RAP	NA	0.3026	0.065
	17	Select Granular Borrow	0.0347	0.2467	0.2117
	20.5	Clay Loam Subgrade	0.1092	0.2553	0.2589
127	6.5	Class 6 Aggregate	0.017	0.3698	0.1094
	29	Clay Loam Subgrade	0.1272	0.2874	0.2778
	36	Clay Loam Subgrade	0.1398	0.2583	0.2634
728	8.5	Class 5Q Aggregate	0.0853	0.2146	0.1726
	19.5	Clay Loam Subgrade	0.1191	0.285	0.2631
	24	Clay Loam Subgrade	0.1305	0.2886	0.2865
	36	Clay Loam Subgrade	0.1425	0.3375	0.324

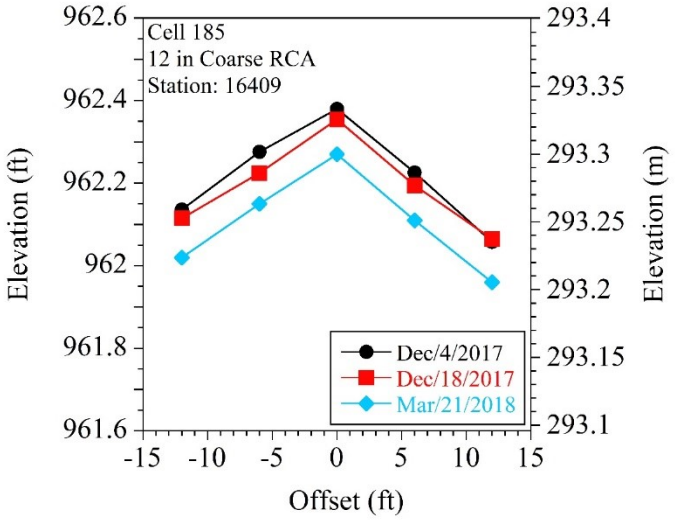
APPENDIX AF
ELEVATION PROFILE FOR EACH TEST CELL

Cell 185 (12-in Coarse RCA):

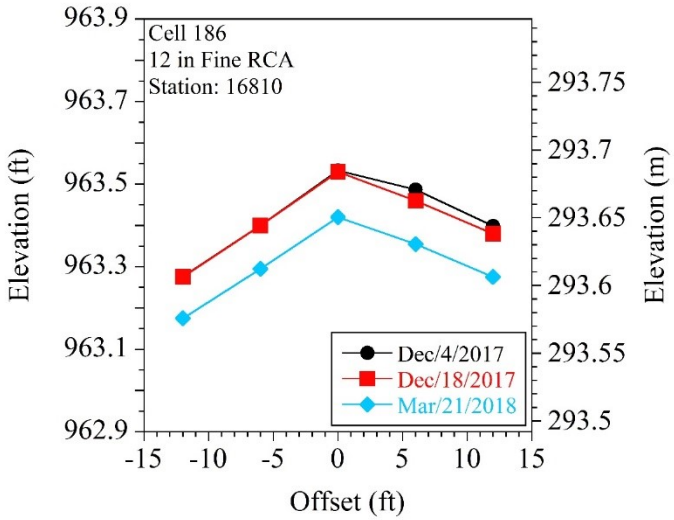


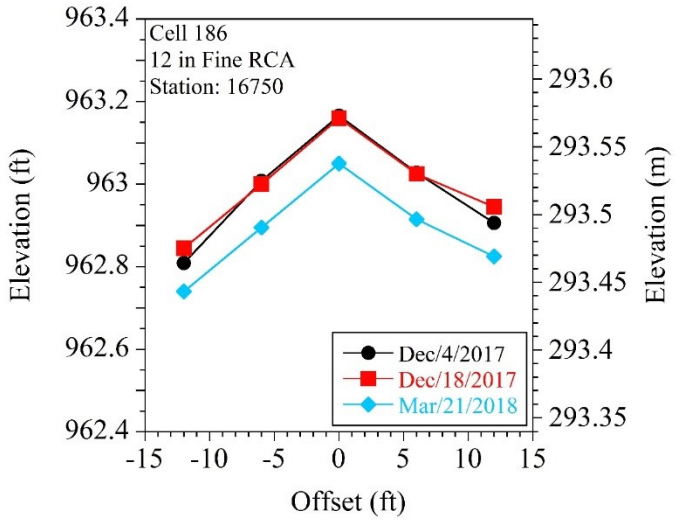


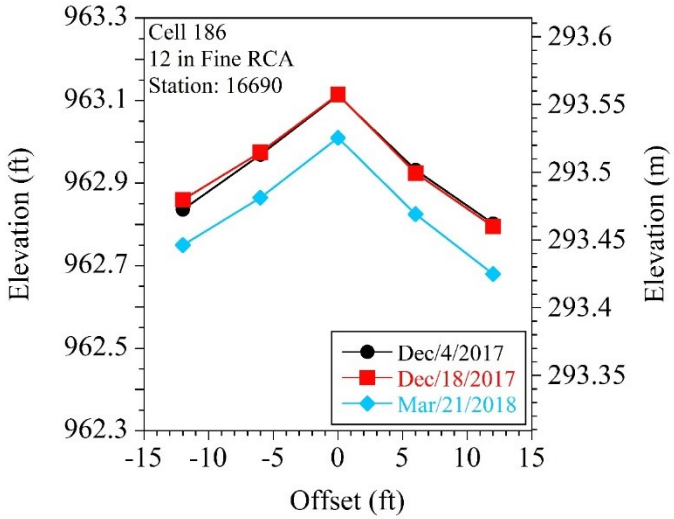


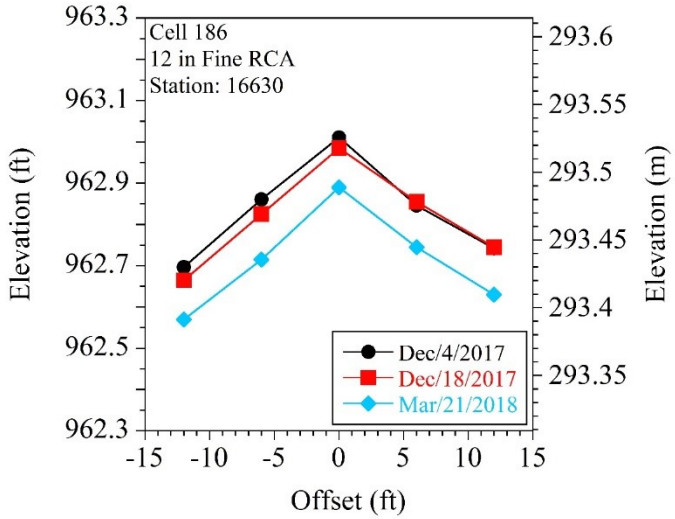


Cell 186 (12-in Fine RCA):

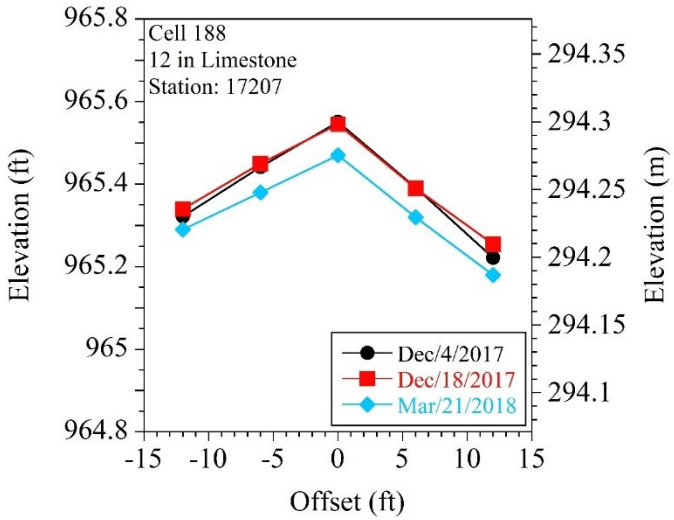


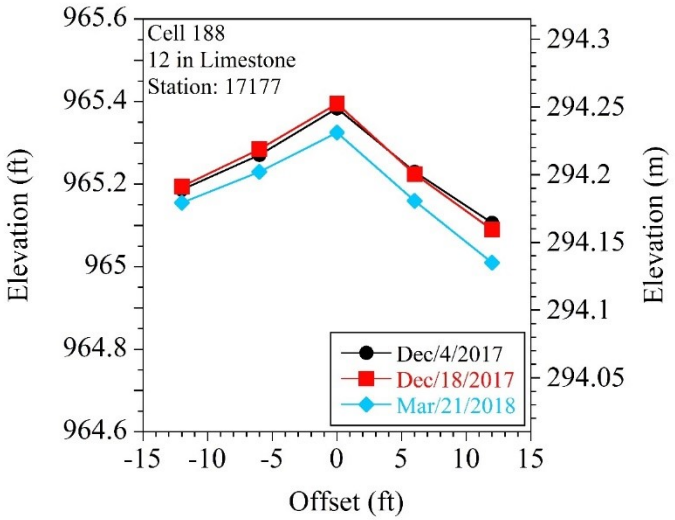


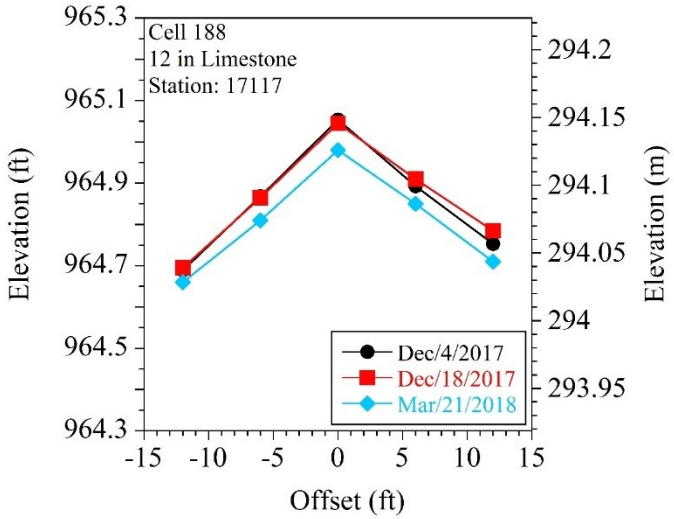


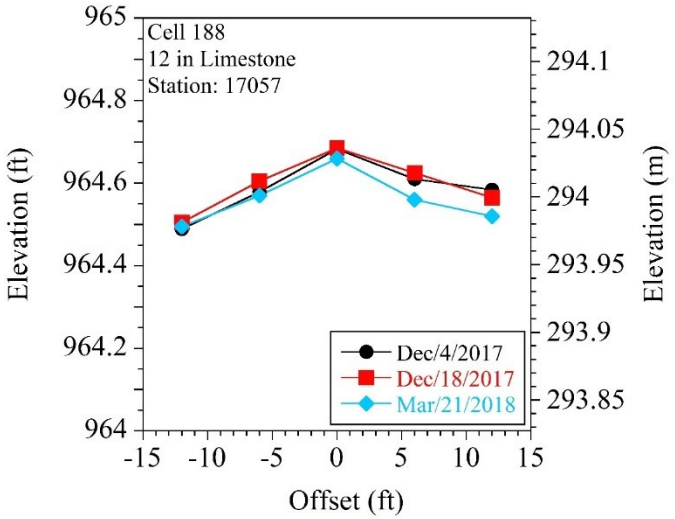


Cell 188 (12-in Limestone):

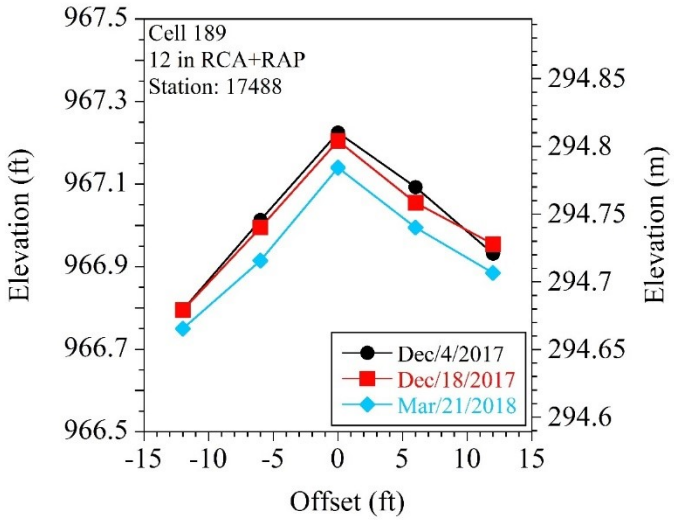


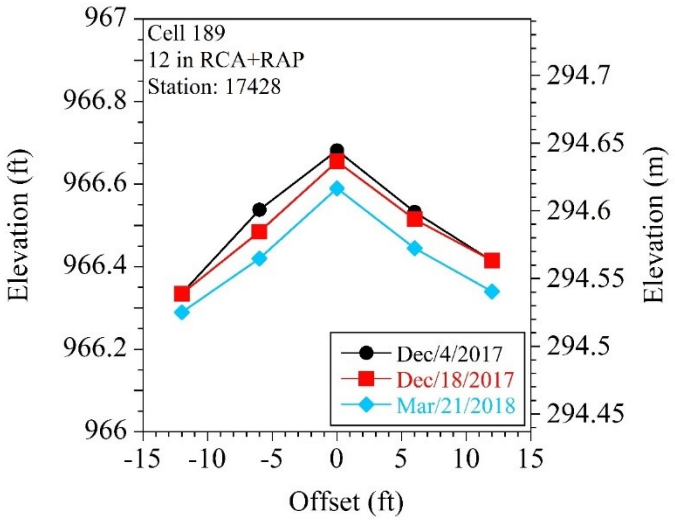


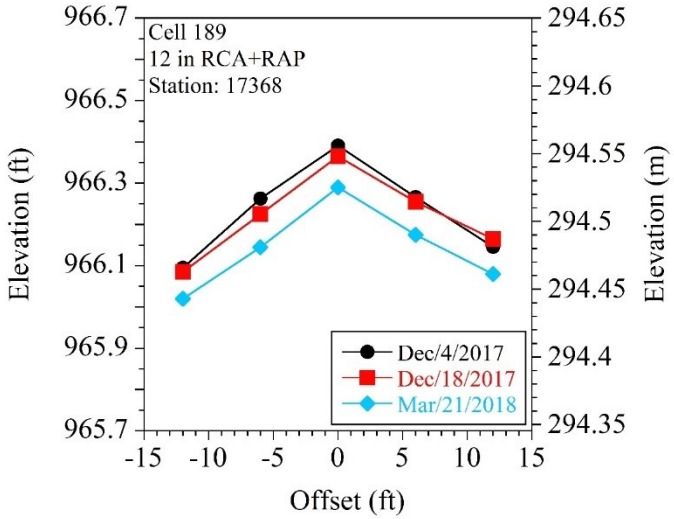


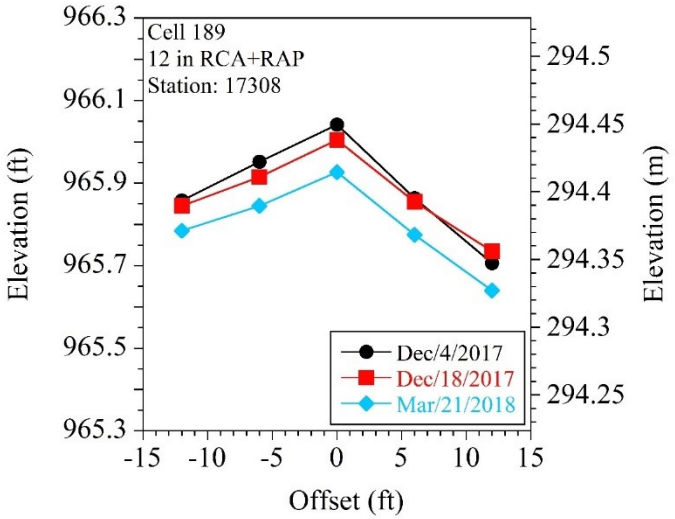


Cell 189 (12-in RCA+RAP):

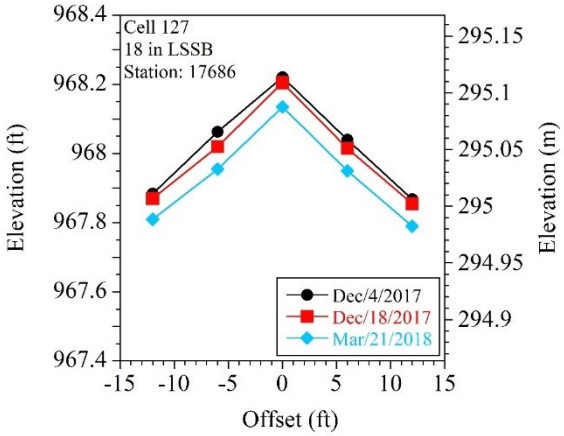


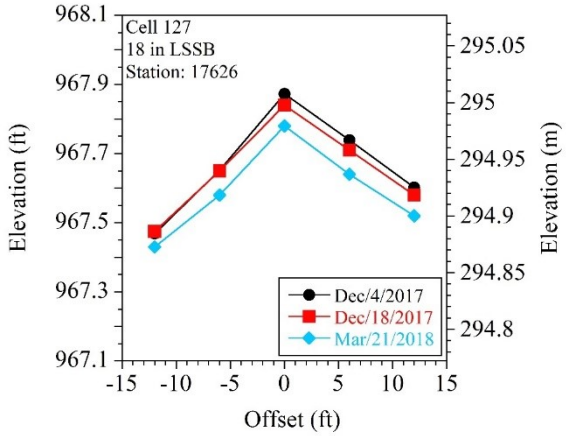


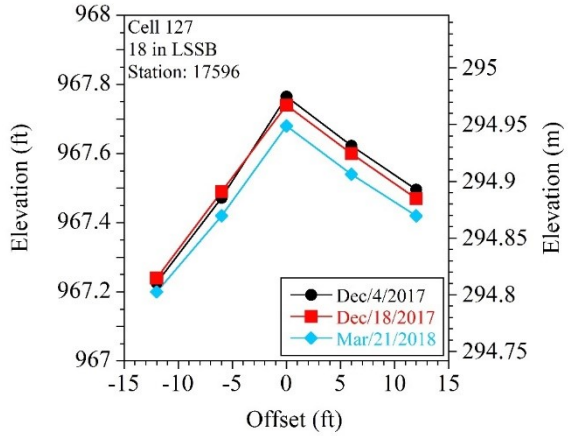


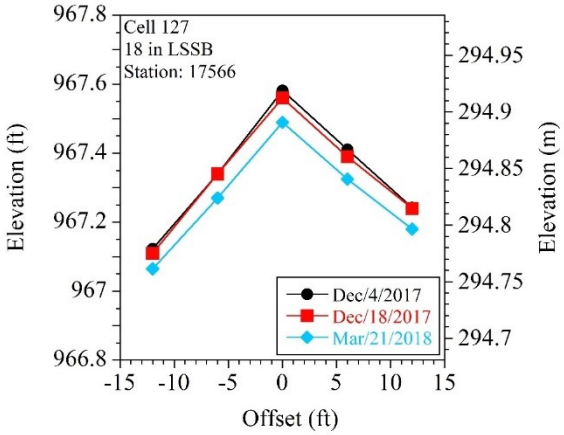


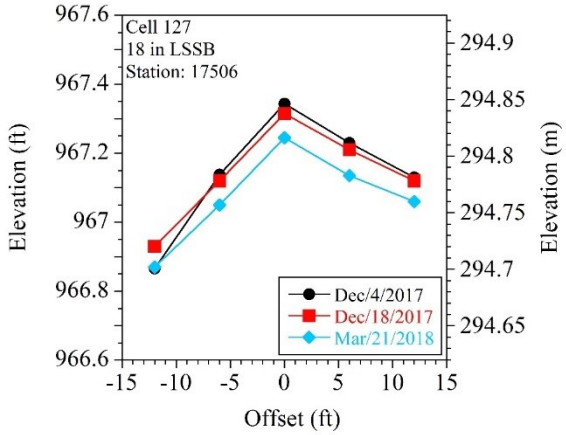
Cell 127 (18-in LSSB):

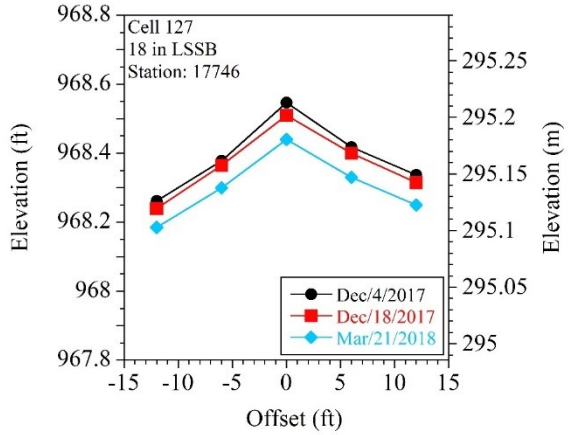




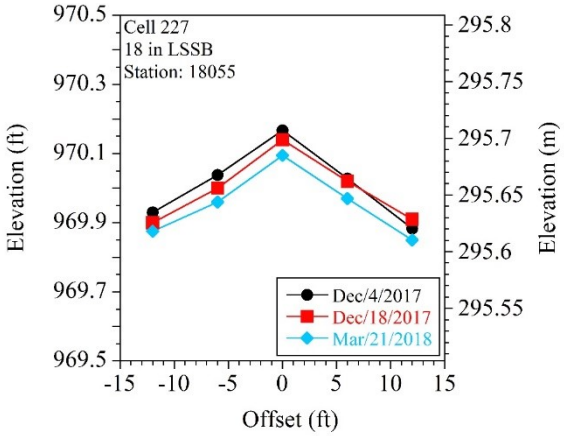


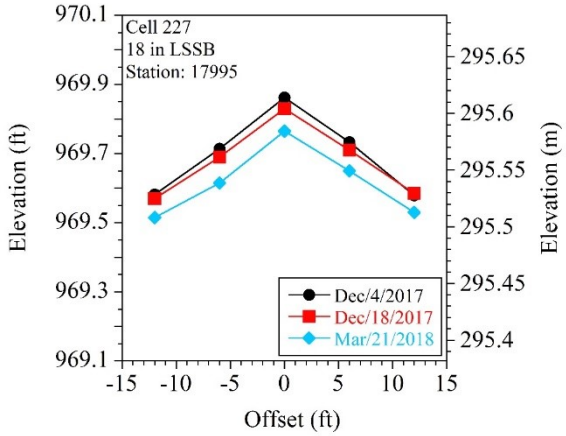


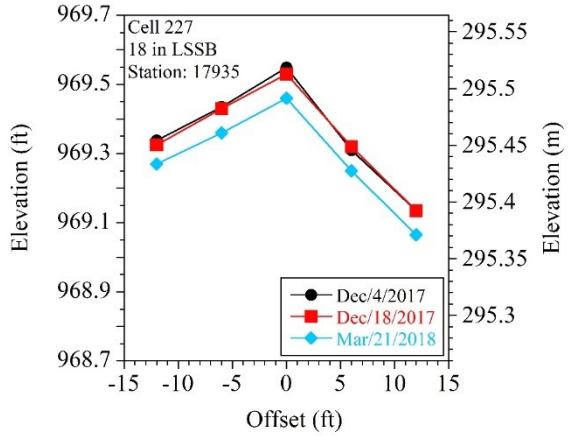


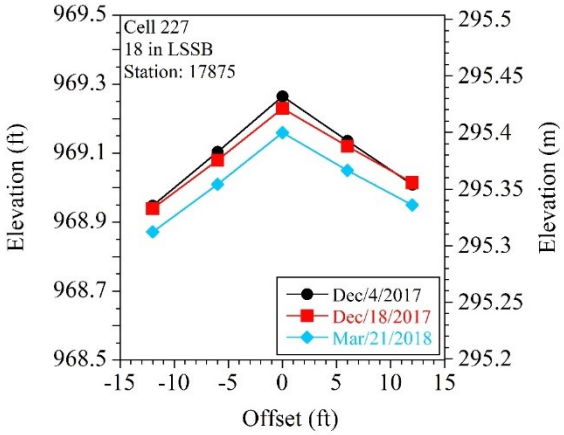


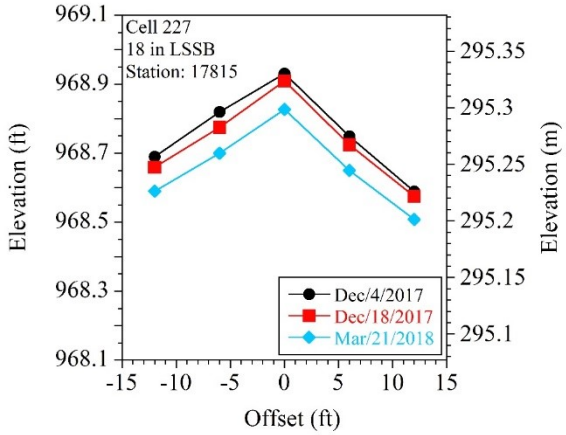
Cell 227 (18-in LSSB):



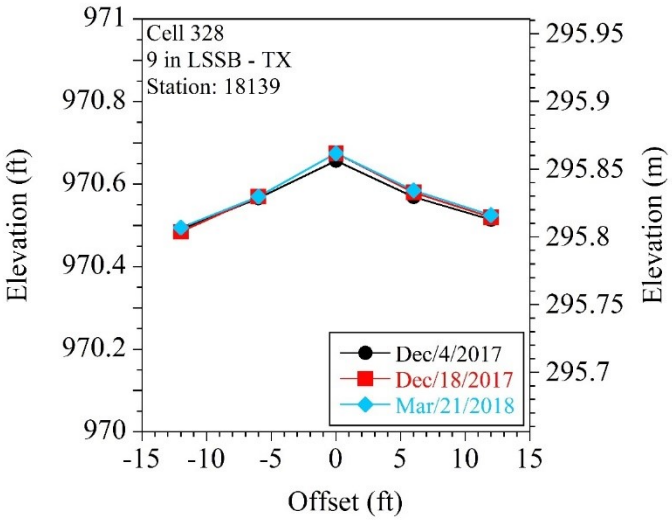


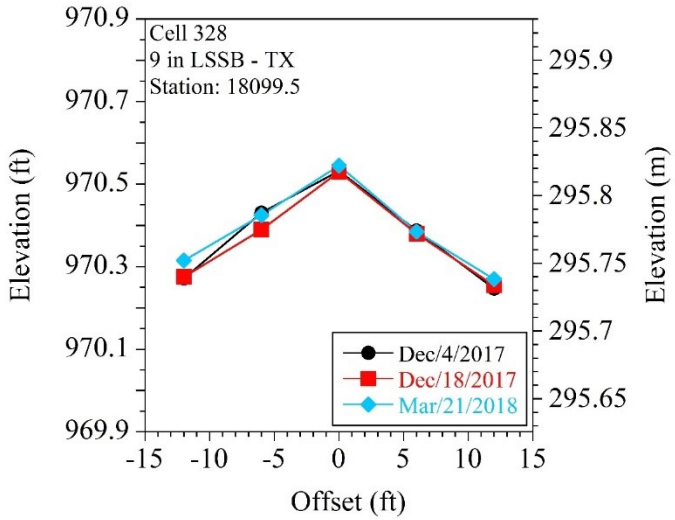




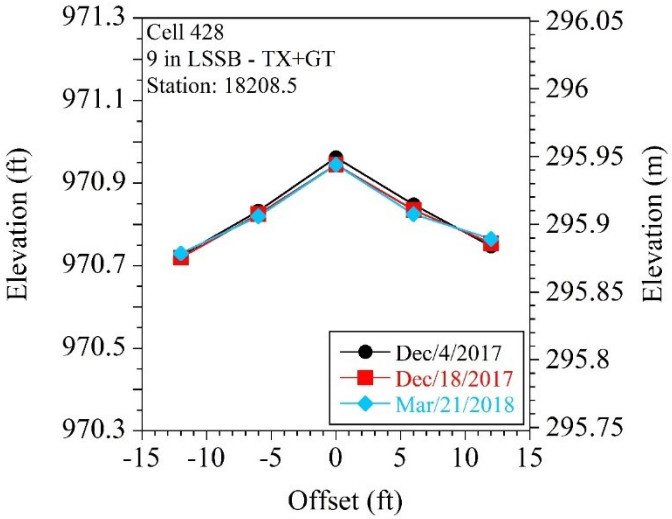


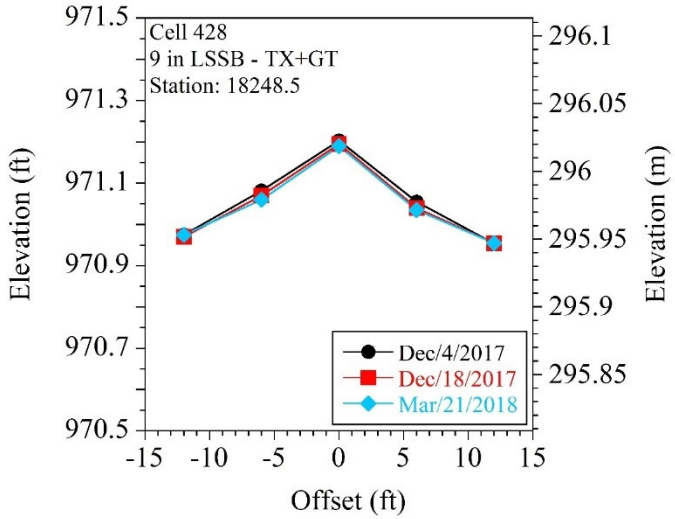
Cell 328 (9-in LSSB - TX):



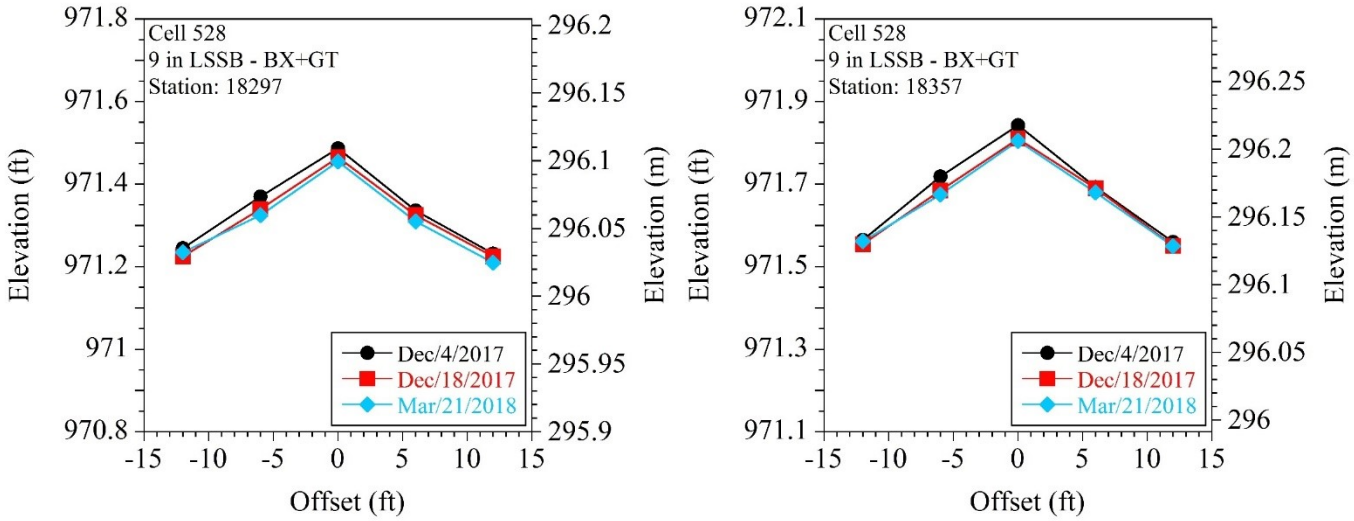


Cell 428 (9-in LSSB - TX+GT):

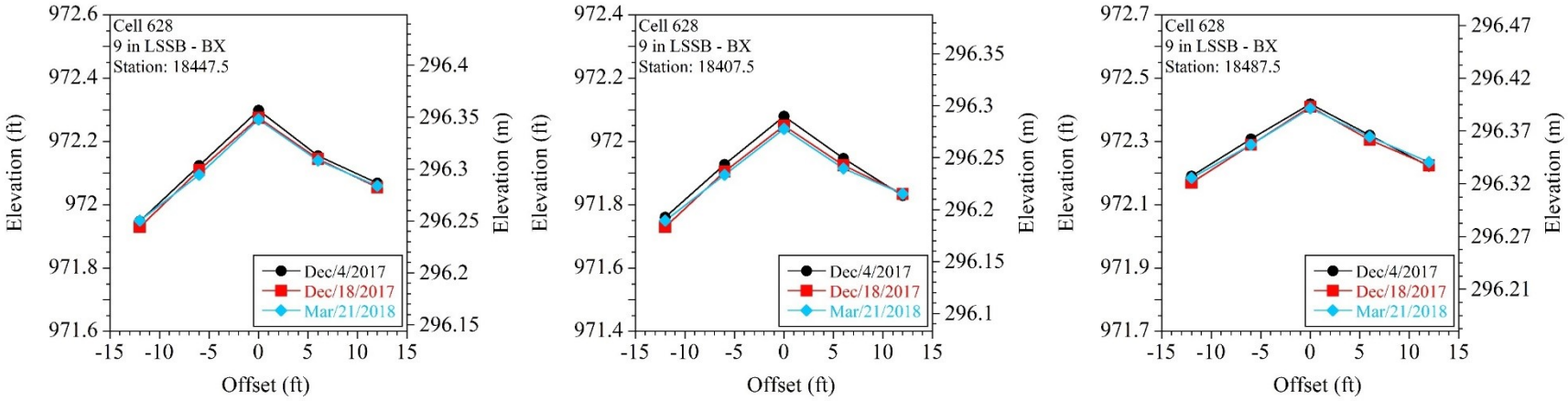




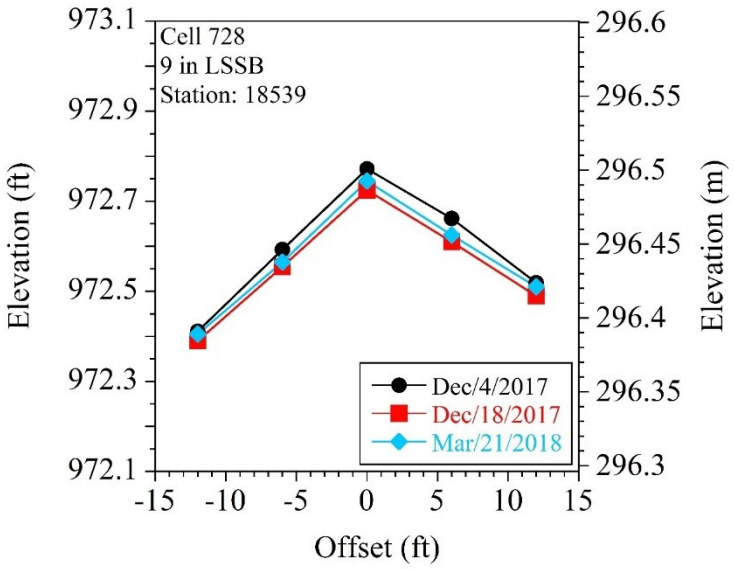
Cell 528 (9-in LSSB - BX+GT):

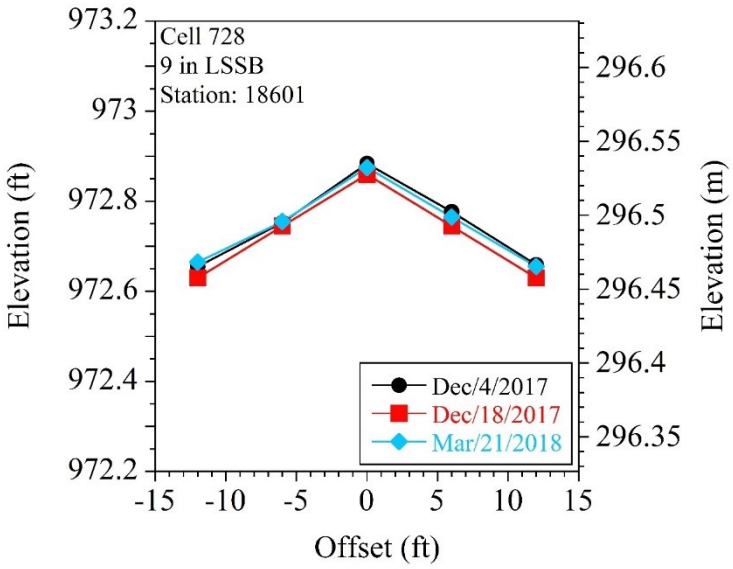


Cell 628 (9-in LSSB - BX):

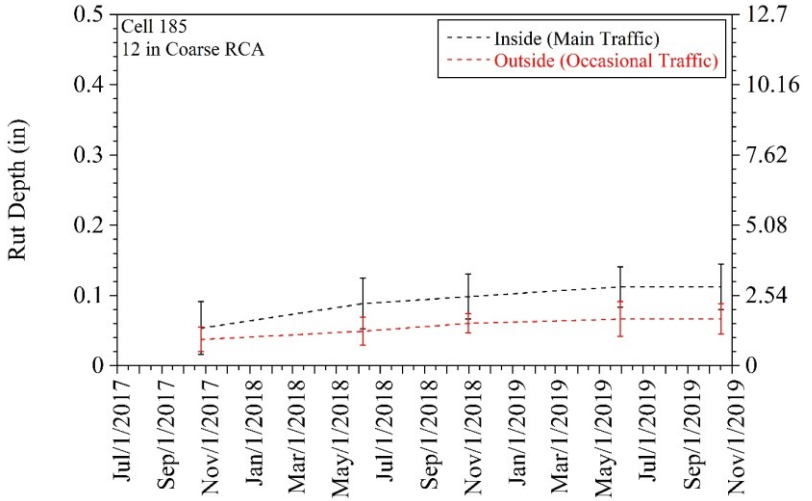


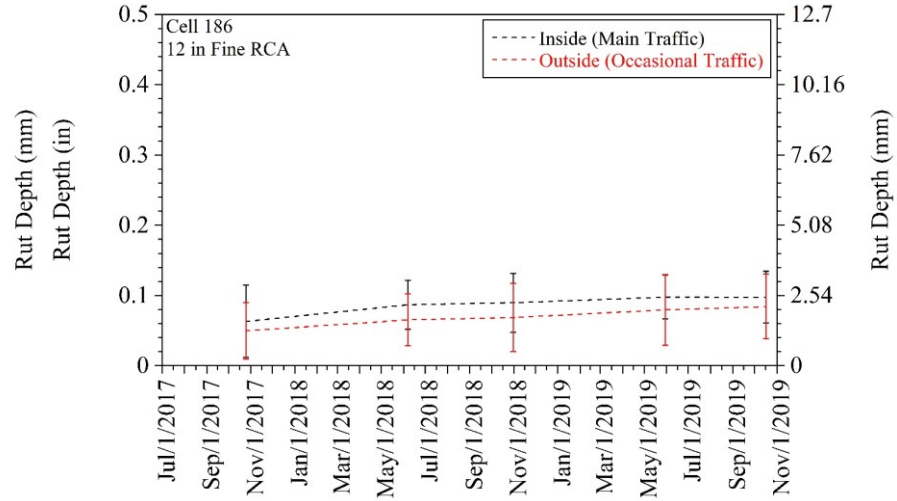
Cell 728 (9-in LSSB):

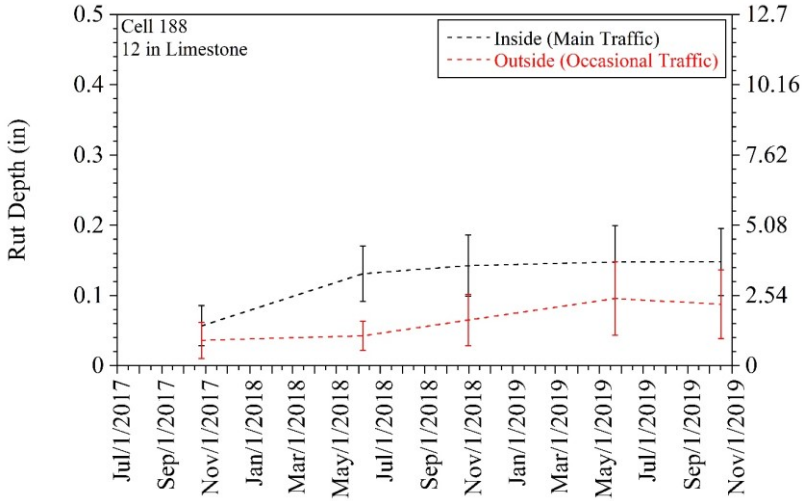


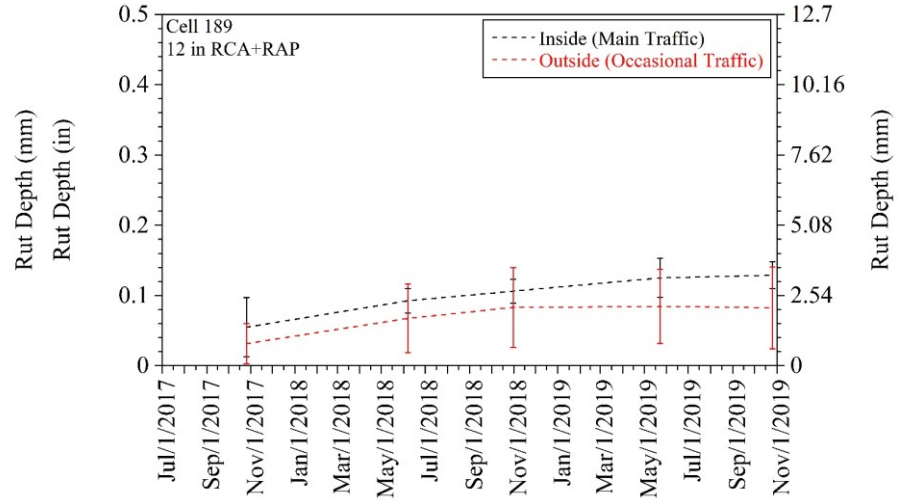


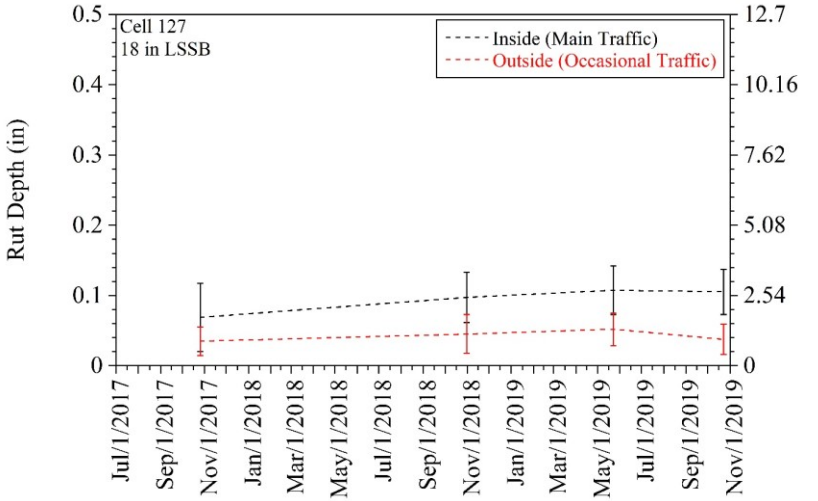
APPENDIX AG
RUT DEPTH MEASUREMENTS FOR EACH CELL

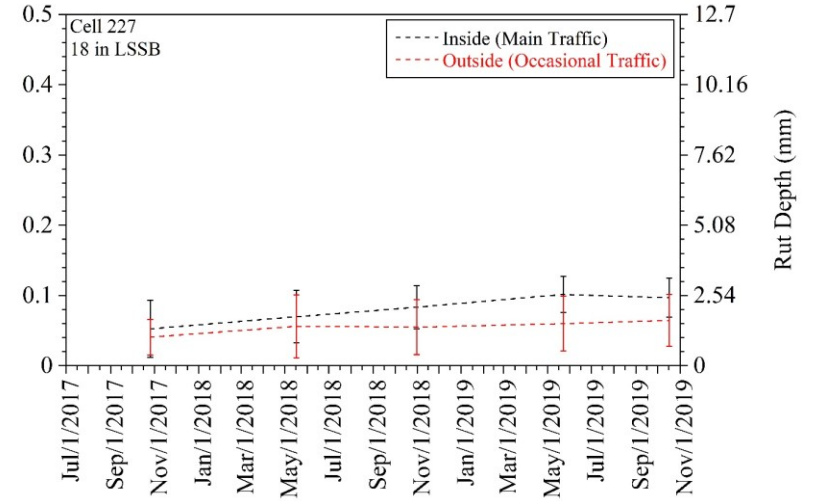

Cell 185
12 in Coarse RCA
Inside (Main Traffic)
Outside (Occasional Traffic)
Rut Depth (in)
Rut Depth (mm)
0.5
0.4
0.3
0.2
0.1
0
12.7
10.16
7.62
5.08
2.54
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

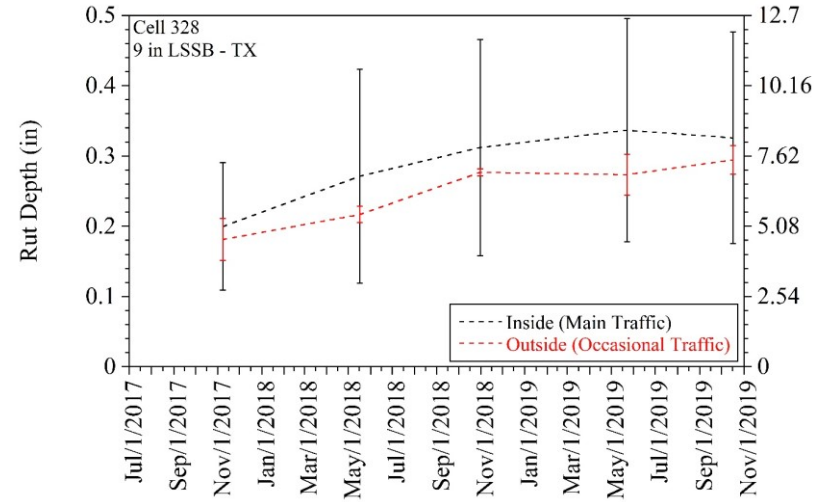

Cell 186
12 in Fine RCA
Inside (Main Traffic)
Outside (Occasional Traffic)
Rut Depth (in)
Rut Depth (mm)
0.5
0.4
0.3
0.2
0.1
0
12.7
10.16
7.62
5.08
2.54
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

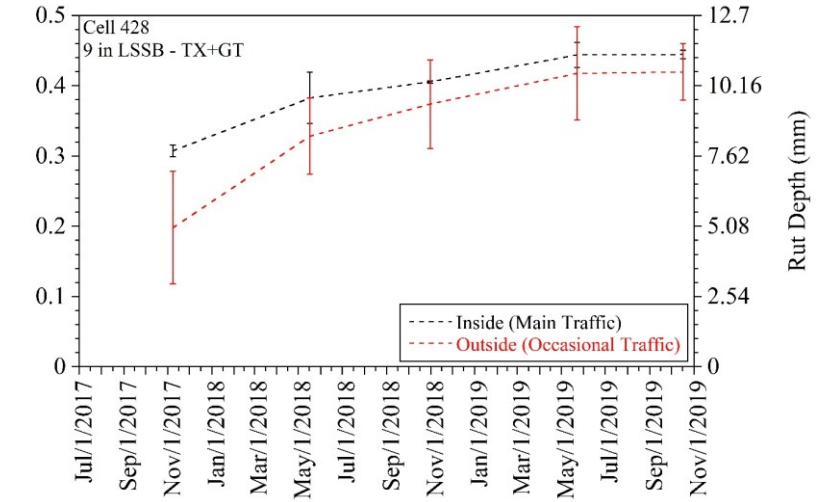

Cell 188
12 in Limestone
Inside (Main Traffic)
Outside (Occasional Traffic)
Rut Depth (in)
Rut Depth (mm)
0.5
0.4
0.3
0.2
0.1
0
12.7
10.16
7.62
5.08
2.54
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

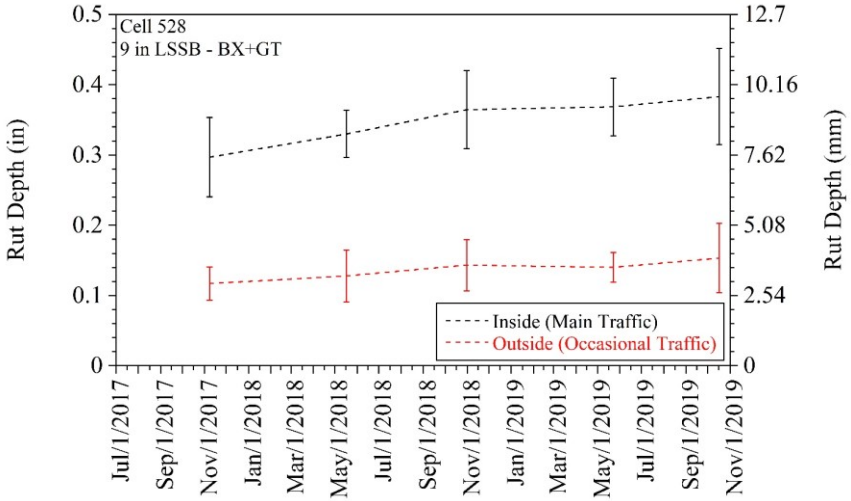

Cell 189
12 in RCA+RAP
Inside (Main Traffic)
Outside (Occasional Traffic)
Rut Depth (in)
Rut Depth (mm)
0.5
0.4
0.3
0.2
0.1
0
12.7
10.16
7.62
5.08
2.54
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

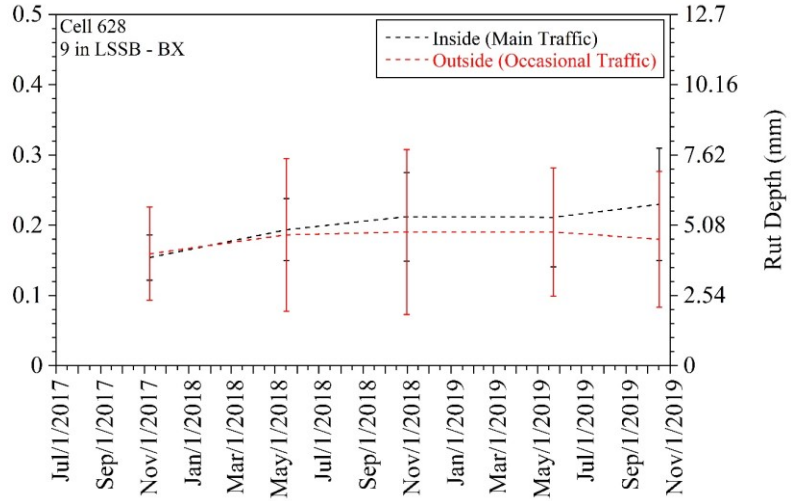

Cell 127
18 in LSSB
Inside (Main Traffic)
Outside (Occasional Traffic)
Rut Depth (in)
Rut Depth (mm)
0.5
0.4
0.3
0.2
0.1
0
12.7
10.16
7.62
5.08
2.54
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

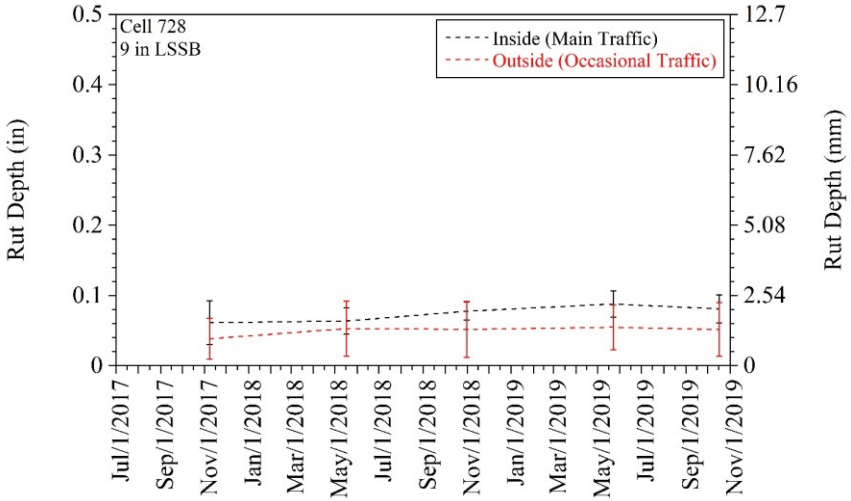

Cell 227
18 in LSSB
Inside (Main Traffic)
Outside (Occasional Traffic)
Rut Depth (in)
Rut Depth (mm)
0.5
0.4
0.3
0.2
0.1
0
12.7
10.16
7.62
5.08
2.54
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 328
9 in LSSB - TX
Inside (Main Traffic)
Outside (Occasional Traffic)
Rut Depth (in)
Rut Depth (mm)
0.5
0.4
0.3
0.2
0.1
0
12.7
10.16
7.62
5.08
2.54
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

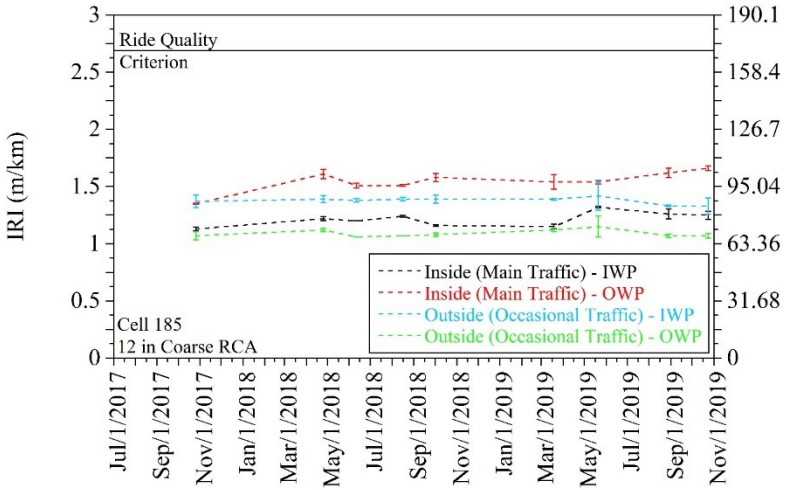

Cell 428
9 in LSSB - TX+GT
Inside (Main Traffic)
Outside (Occasional Traffic)
Rut Depth (in)
Rut Depth (mm)
0.5
0.4
0.3
0.2
0.1
0
12.7
10.16
7.62
5.08
2.54
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

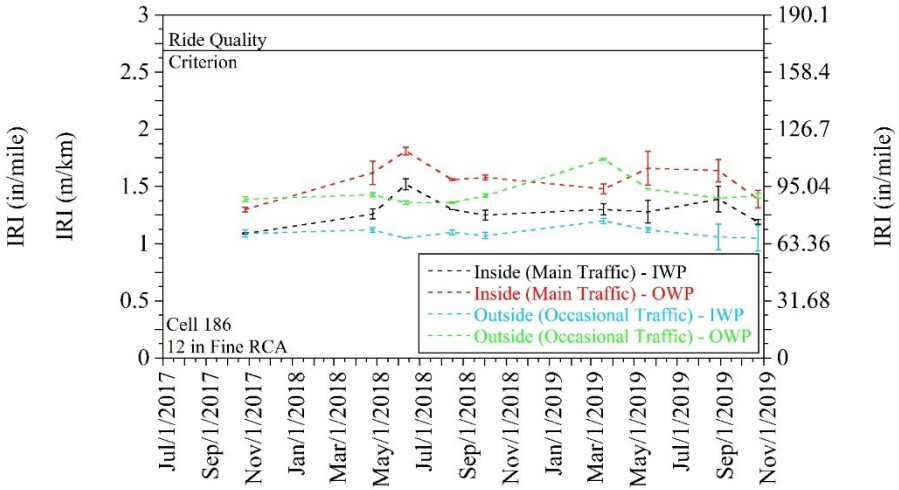

Cell 528
9 in LSSB - BX+GT
Inside (Main Traffic)
Outside (Occasional Traffic)
Rut Depth (in)
Rut Depth (mm)
0.5
0.4
0.3
0.2
0.1
0
12.7
10.16
7.62
5.08
2.54
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

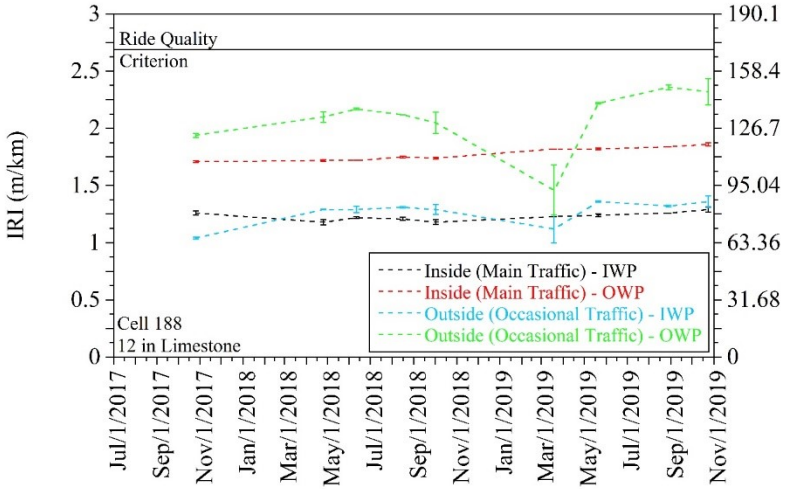

Cell 628
9 in LSSB - BX
Inside (Main Traffic)
Outside (Occasional Traffic)
Rut Depth (in)
Rut Depth (mm)
0.5
0.4
0.3
0.2
0.1
0
12.7
10.16
7.62
5.08
2.54
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

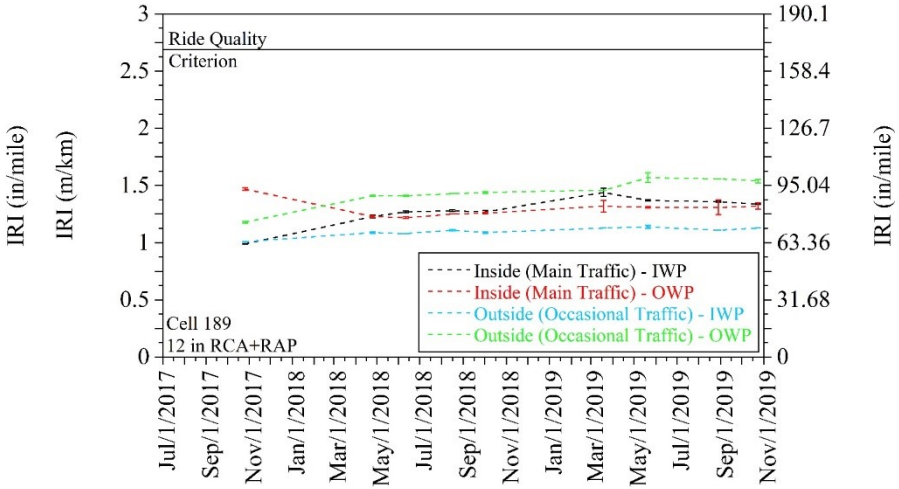

Cell 728
9 in LSSB
Inside (Main Traffic)
Outside (Occasional Traffic)
Rut Depth (in)
Rut Depth (mm)
0.5
0.4
0.3
0.2
0.1
0
12.7
10.16
7.62
5.08
2.54
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

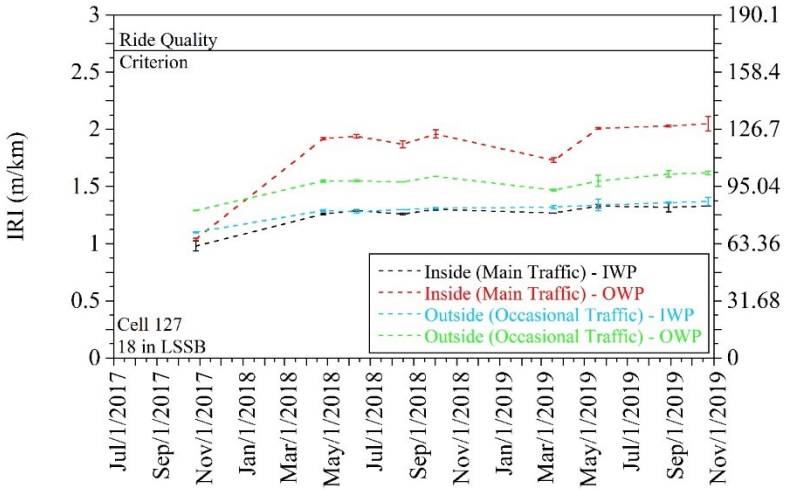
APPENDIX AH
INTERNATIONAL ROUGHNESS INDEX (IRI) TEST RESULTS FOR EACH CELL

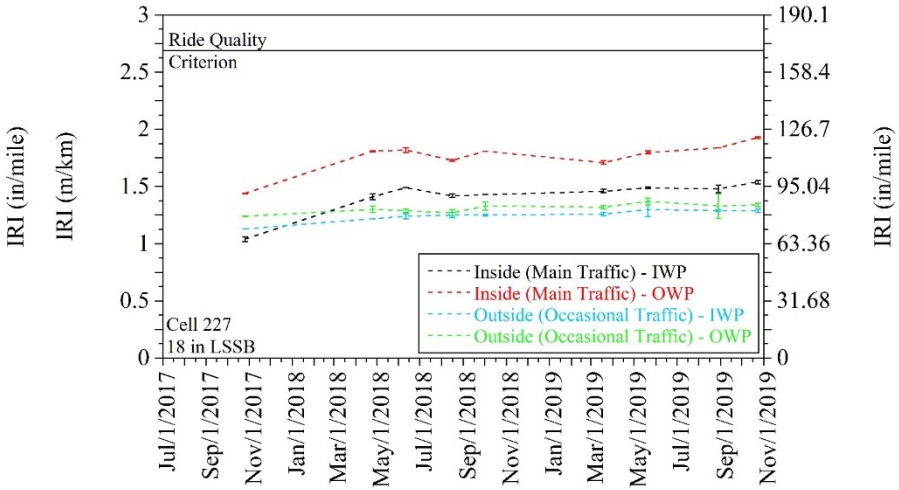

Ride Quality
Criterion
Cell 185
12 in Coarse RCA
Inside (Main Traffic) - IWP
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - IWP
Outside (Occasional Traffic) - OWP
IRI (m/km)
IRI (in/mile)
3
2.5
2
1.5
1
0.5
0
190.1
158.4
126.7
95.04
63.36
31.68
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

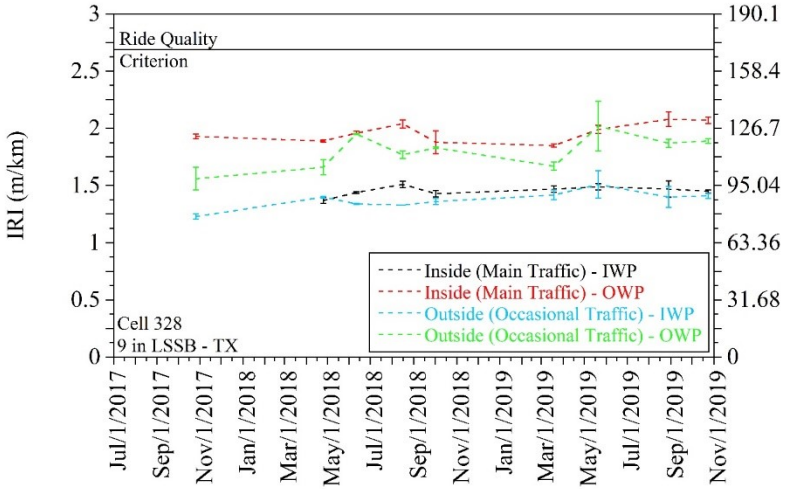

Ride Quality
Criterion
Cell 186
12 in Fine RCA
Inside (Main Traffic) - IWP
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - IWP
Outside (Occasional Traffic) - OWP
IRI (m/km)
IRI (in/mile)
3
2.5
2
1.5
1
0.5
0
190.1
158.4
126.7
95.04
63.36
31.68
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

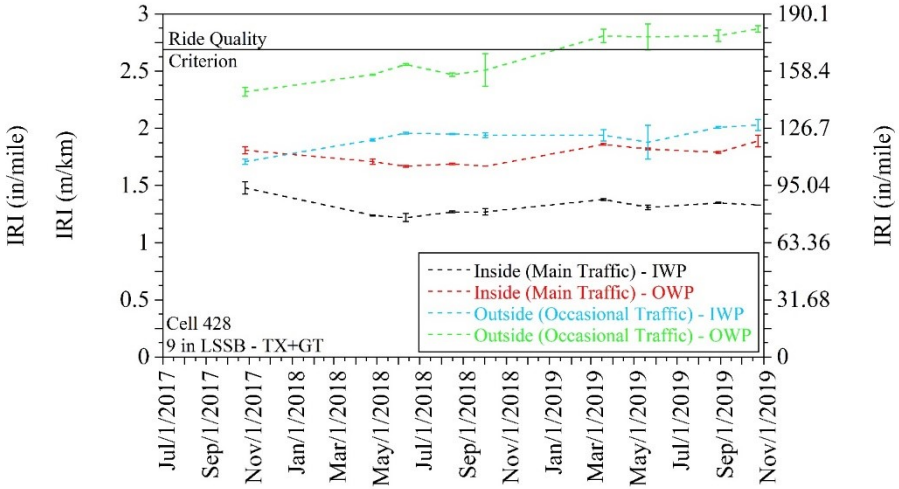

Ride Quality
Criterion
Cell 188
12 in Limestone
Inside (Main Traffic) - IWP
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - IWP
Outside (Occasional Traffic) - OWP
IRI (m/km)
IRI (in/mile)
3
2.5
2
1.5
1
0.5
0
190.1
158.4
126.7
95.04
63.36
31.68
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

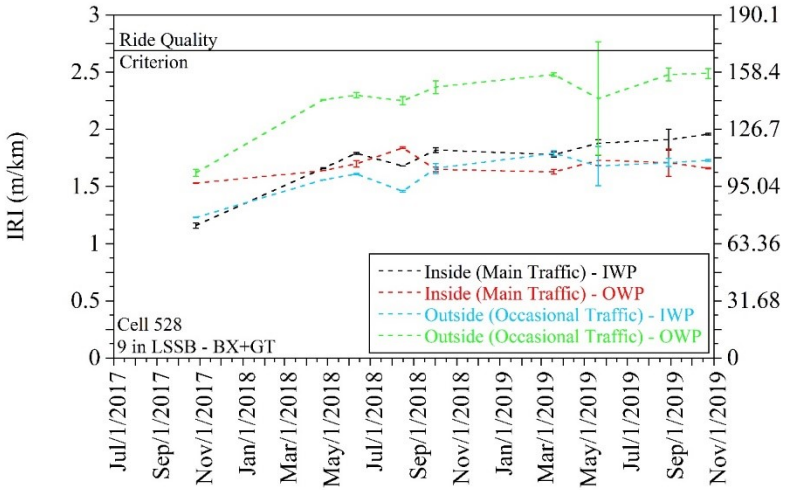

Ride Quality
Criterion
Cell 189
12 in RCA+RAP
Inside (Main Traffic) - IWP
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - IWP
Outside (Occasional Traffic) - OWP
IRI (m/km)
IRI (in/mile)
3
2.5
2
1.5
1
0.5
0
190.1
158.4
126.7
95.04
63.36
31.68
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

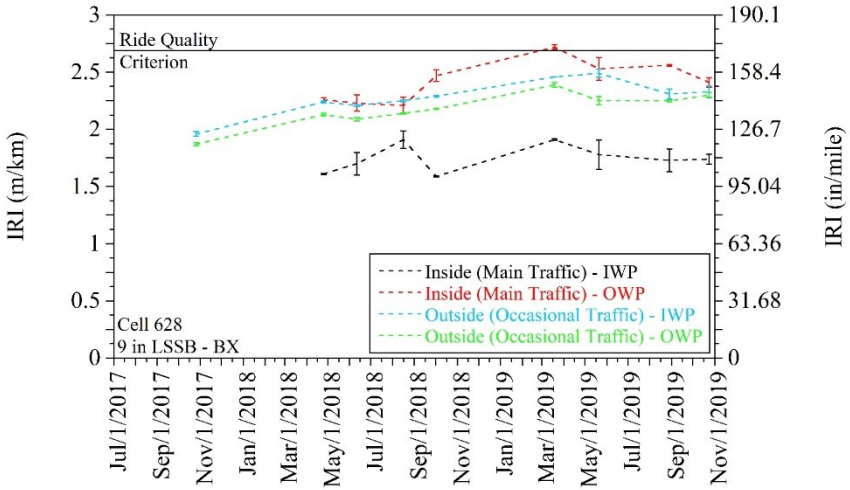

Ride Quality
Criterion
Cell 127
18 in LSSB
Inside (Main Traffic) - IWP
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - IWP
Outside (Occasional Traffic) - OWP
IRI (m/km)
IRI (in/mile)
3
2.5
2
1.5
1
0.5
0
190.1
158.4
126.7
95.04
63.36
31.68
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

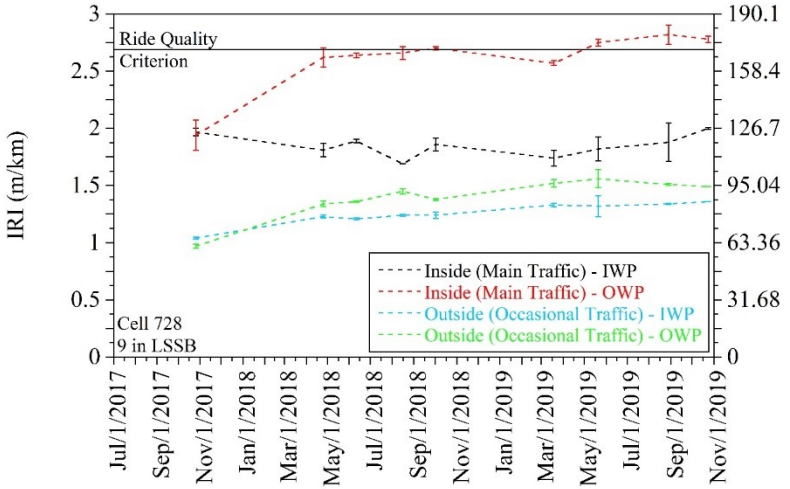

Ride Quality
Criterion
Cell 227
18 in LSSB
Inside (Main Traffic) - IWP
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - IWP
Outside (Occasional Traffic) - OWP
IRI (m/km)
IRI (in/mile)
3
2.5
2
1.5
1
0.5
0
190.1
158.4
126.7
95.04
63.36
31.68
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Ride Quality
Criterion
Cell 328
9 in LSSB - TX
Inside (Main Traffic) - IWP
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - IWP
Outside (Occasional Traffic) - OWP
IRI (m/km)
IRI (in/mile)
3
2.5
2
1.5
1
0.5
0
190.1
158.4
126.7
95.04
63.36
31.68
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

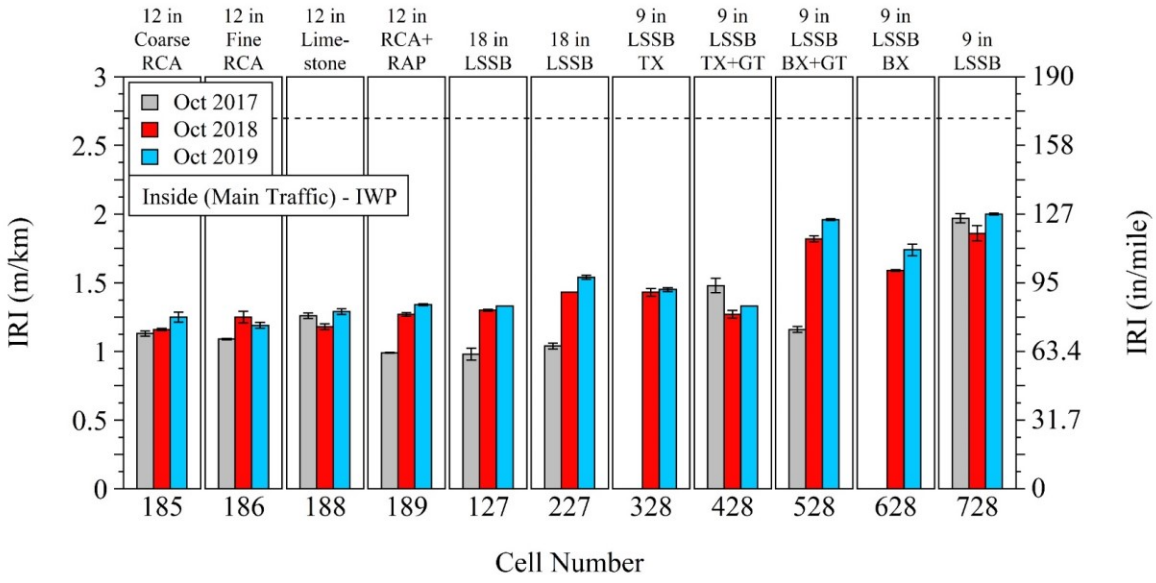

Ride Quality
Criterion
Cell 428
9 in LSSB - TX+GT
Inside (Main Traffic) - IWP
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - IWP
Outside (Occasional Traffic) - OWP
IRI (m/km)
IRI (in/mile)
3
2.5
2
1.5
1
0.5
0
190.1
158.4
126.7
95.04
63.36
31.68
0
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Ride Quality
Criterion
Cell 528
9 in LSSB - BX+GT
Inside (Main Traffic) - IWP
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - IWP
Outside (Occasional Traffic) - OWP
IRI (m/km)
IRI (in/mile)
0
0.5
1
1.5
2
2.5
3
31.68
63.36
95.04
126.7
158.4
190.1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Ride Quality
Criterion
Cell 628
9 in LSSB - BX
Inside (Main Traffic) - IWP
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - IWP
Outside (Occasional Traffic) - OWP
IRI (m/km)
IRI (in/mile)
0
0.5
1
1.5
2
2.5
3
31.68
63.36
95.04
126.7
158.4
190.1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Ride Quality
Criterion
Cell 728
9 in LSSB
Inside (Main Traffic) - IWP
Inside (Main Traffic) - OWP
Outside (Occasional Traffic) - IWP
Outside (Occasional Traffic) - OWP
IRI (m/km)
IRI (in/mile)
0
0.5
1
1.5
2
2.5
3
31.68
63.36
95.04
126.7
158.4
190.1
Jul/1/2017
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

APPENDIX AI
INTERNATIONAL ROUGHNESS INDEX (IRI) IN INSIDE LANE (MAIN TRAFFIC) - IWP OF TEST CELLS


12 in Coarse RCA
12 in Fine RCA
12 in Lime-stone
12 in RCA+ RAP
18 in LSSB
18 in LSSB
9 in LSSB TX
9 in LSSB TX+GT
9 in LSSB BX+GT
9 in LSSB BX
9 in LSSB
Oct 2017
Oct 2018
Oct 2019
Inside (Main Traffic) - IWP
IRI (m/km)
IRI (in/mile)
0
0.5
1
1.5
2
2.5
3
0
31.7
63.4
95
127
158
190
185
186
188
189
127
227
328
428
528
628
728
Cell Number

APPENDIX AJ
RAVELING IN TEST CELLS

Raveling pictures taken from the distress identification manual for the LTTP (Miller and Bellinger 2014):

Loss of fine aggregate

Loss of fine and some coarse aggregate

Loss of coarse aggregate

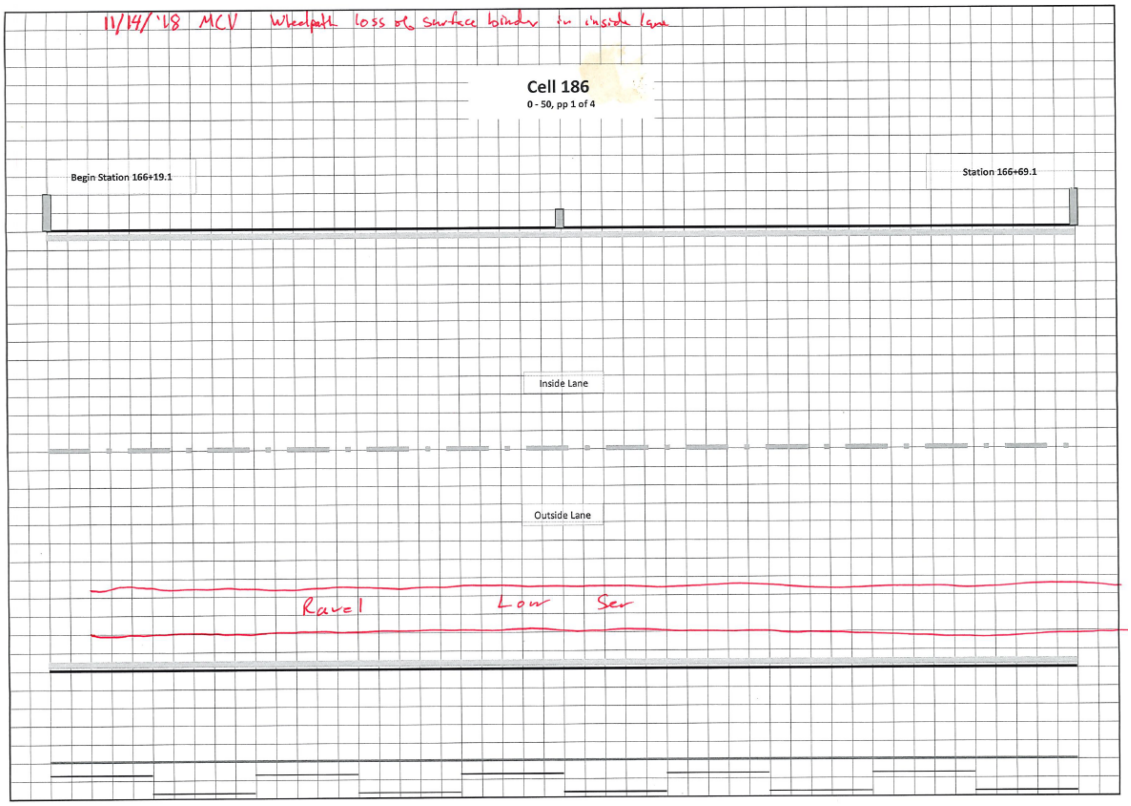


Illustration of raveling on the distress survey maps

Cell Number	Cell Description	Lane	Date	Raveling - Low Severity (Area)	Raveling - Moderate Severity (Area)
185	12-in Coarse RCA	Inside	11/14/2018	0	6
			3/26/2019	0	6
			12/4/2019	0	6
186	12-in Fine RCA	Inside	11/14/2018	0	0
			3/26/2019	0	0
			12/4/2019	0	0
188	12-in Limestone	Inside	11/14/2018	44	0
			3/26/2019	44	0
			12/4/2019	44	0
189	12-in RCA+RAP	Inside	11/14/2018	5	0
			3/26/2019	5	0
			12/4/2019	5	0
127	18-in LSSB	Inside	11/14/2018	1	0
			3/26/2019	1	0
			12/4/2019	1	0
227	18-in LSSB	Inside	11/14/2018	123	0
			3/26/2019	123	0
			12/4/2019	123	0
328	9-in LSSB - TX	Inside	12/17/2018	0	0
			4/7/2019	0	0
			12/4/2019	0	0
428	9-in LSSB - TX+GT	Inside	12/17/2018	0	0
			4/7/2019	0	0
			12/4/2019	0	0
528	9-in LSSB - BX+GT	Inside	12/17/2018	0	0
			4/7/2019	0	0
			12/4/2019	0	0
628	9-in LSSB - BX	Inside	12/17/2018	0	0
			4/7/2019	0	0
			12/4/2019	0	0
728	9-in LSSB	Inside	12/17/2018	0	0
			4/7/2019	0	0
			12/4/2019	0	0

Cell Number	Cell Description	Lane	Date	Raveling - Low Severity (Area)	Raveling - Moderate Severity (Area)
185	12-in Coarse RCA	Outside	11/14/2018	0	12
			3/26/2019	0	12
			12/4/2019	0	12
186	12-in Fine RCA	Outside	11/14/2018	0	0
			3/26/2019	0	0
			12/4/2019	0	0
188	12-in Limestone	Outside	11/14/2018	30	0
			3/26/2019	30	0
			12/4/2019	30	0
189	12-in RCA+RAP	Outside	11/14/2018	0	0
			3/26/2019	0	0
			12/4/2019	0	0
127	18-in LSSB	Outside	11/14/2018	0	0
			3/26/2019	0	0
			12/4/2019	0	0
227	18-in LSSB	Outside	11/14/2018	27	0
			3/26/2019	30	0
			12/4/2019	30	0
328	9-in LSSB - TX	Outside	12/17/2018	0	0
			4/7/2019	0	0
			12/4/2019	0	0
428	9-in LSSB - TX+GT	Outside	12/17/2018	0	0
			4/7/2019	0	0
			12/4/2019	0	0
528	9-in LSSB - BX+GT	Outside	12/17/2018	0	0
			4/7/2019	0	0
			12/4/2019	0	0
628	9-in LSSB - BX	Outside	12/17/2018	0	0
			4/7/2019	0	0
			12/4/2019	0	0
728	9-in LSSB	Outside	12/17/2018	0	0
			4/7/2019	0	0
			12/4/2019	0	0

APPENDIX AK
LABORATORY TEST RESULTS OF BASE LAYER AGGREGATES USED IN FORWARD STEPWISE REGRESSION ANALYSES

Gradation characteristics:

Material	Gravel (%)	Sand (%)	Gravel-to-Sand Ratio	Fines (%)	D_{10} (mm)	D_{30} (mm)	D_{50} (mm)	D_{60} (mm)	C_u	C_c
Coarse RCA	61.7	34.9	1.77	3.4	0.36	2.79	8.45	12.37	34.49	1.75
Fine RCA	38.3	54.6	0.7	7.1	0.13	0.82	2.98	4.49	33.93	1.12
Limestone	52.3	32.6	1.6	15.1	0.04	0.78	5.39	8.19	211.31	1.91
RCA+RAP	41	50.4	0.81	8.6	0.1	0.71	3.15	5.05	49.41	0.98
Class 6 Agg.	35.1	58.6	0.6	6.3	0.16	0.61	2.12	3.88	23.82	0.6
Class 5Q Agg.	65.9	30.9	2.13	3.2	0.4	3.75	10.05	13.49	33.69	2.6

Fines = silt and clay; D_{10} = effective particle size; D_{30} = particle size at which 30% of the particles are finer; D_{50} = median particle diameter; D_{60} = particle size at which 60% of the particles are finer; C_u = coefficient of uniformity; C_c = coefficient of curvature

Atterberg limits:

Material	LL	PL	PI
Coarse RCA	NA	NA	NP
Fine RCA	32.7	NA	NP
Limestone	17.9	NA	NP
RCA+RAP	27.4	NA	NP
Class 6 Agg.	27.4	NA	NP
Class 5Q Agg.	NA	NA	NP

LL = liquid limit; PL = plastic limit; PI = plasticity index; NA = not available; NP = non-plastic

Oven-dry (OD) specific gravity (G_s):

Material	Coarse OD G_s	Fine OD G_s	Combined OD G_s
Coarse RCA	2.4	2	2.25
Fine RCA	2.45	1.99	2.17
Limestone	2.65	2.68	2.66
RCA+RAP	2.47	2.15	2.28
Class 6 Agg.	2.45	2.3	2.35
Class 5Q Agg.	2.39	2.07	2.28

OD = oven-dry; G_s = specific gravity

Saturated-surface-dry (SSD) specific gravity (G_s):

Material	Coarse SSD G_s	Fine SSD G_s	Combined SSD G_s
Coarse RCA	2.49	2.24	2.4
Fine RCA	2.54	2.23	2.35
Limestone	2.7	2.72	2.71
RCA+RAP	2.54	2.26	2.38
Class 6 Agg.	2.52	2.4	2.44
Class 5Q Agg.	2.5	2.27	2.42

SSD = saturated-surface-dry; G_s = specific gravity

Apparent specific gravity (G_s):

Material	Coarse Apparent G_s	Fine Apparent G_s	Combined Apparent G_s
Coarse RCA	2.65	2.61	2.64
Fine RCA	2.7	2.6	2.64
Limestone	2.79	2.8	2.79
RCA+RAP	2.67	2.42	2.52
Class 6 Agg.	2.64	2.55	2.58
Class 5Q Agg.	2.68	2.59	2.65

G_s = specific gravity

Absorption:

Material	Coarse Absorption (%)	Fine Absorption (%)	Combined Absorption (%)
Coarse RCA	4.05	11.68	6.97
Fine RCA	3.7	11.73	8.65
Limestone	1.91	1.51	1.72
RCA+RAP	3.09	5.22	4.34
Class 6 Agg.	3	4.32	3.86
Class 5Q Agg.	4.62	9.62	6.32

Proctor compaction parameters, void ratio (e), and porosity (n)

Material	Uncorrected MDU (kN/m^3)	Uncorrected OMC (%)	Corrected MDU (kN/m^3)	Corrected OMC (%)	e	n
Coarse RCA	19.31	11.3	20.19	9.48	0.28	0.22
Fine RCA	19.1	11.1	19.12	11.07	0.35	0.26
Limestone	22.34	6.2	22.49	6.28	0.22	0.18
RCA+RAP	19.73	10	19.76	9.97	0.25	0.2
Class 6 Agg.	20.14	8.3	20.19	8.26	0.25	0.2
Class 5Q Agg.	19.26	11	20.11	9.63	0.29	0.23

MDU = maximum dry unit weight; OMC = optimum moisture content; e = void ratio [based on corrected MDU and apparent specific gravity (G_s)]; n = porosity [n = e/(1+e)]

Asphalt binder and residual mortar contents:

Material	Asphalt Binder Content by Ignition (%)	Asphalt Binder Content by Extraction (%)	Residual Mortar Content (%)
Coarse RCA	2.02	0.1	33.4
Fine RCA	2.98	0.38	29.6
Limestone	1.61	0.35	1.3
RCA+RAP	3.18	1.58	20.1
Class 6 Agg.	3.17	1.77	25.6
Class 5Q Agg.	2.15	0.28	37.1

Width-to-length ratio sphericity:

Material	Median Sphericity	$PLS_{0.9}$ (%)	$PLS_{0.7}$ (%)	$PLS_{0.5}$ (%)	$PLS_{0.3}$ (%)	$PLS_{0.1}$ (%)
Coarse RCA	0.769729034	88	28	1	0	0
Fine RCA	0.758298649	90	32	2.5	0	0
Limestone	0.775580109	88	26	1	0	0
RCA+RAP	0.763247555	90.5	30	2	0	0
Class 6 Agg.	0.759657917	90	32	2	0	0
Class 5Q Agg.	0.756547947	90.5	33	2	0	0

$PLS_{0.9}$ = percent less spherical than 0.9; $PLS_{0.7}$ = percent less spherical than 0.7; $PLS_{0.5}$ = percent less spherical than 0.5; $PLS_{0.3}$ = percent less spherical than 0.3; $PLS_{0.1}$ = percent less spherical than 0.1

Roundness:

Material	Median Roundness	$PLR_{0.9}$ (%)	$PLR_{0.7}$ (%)	$PLR_{0.5}$ (%)	$PLR_{0.3}$ (%)	$PLR_{0.1}$ (%)
Coarse RCA	0.660245895	99.5	64	11	0.5	0
Fine RCA	0.657135606	99.5	66	9.5	0	0
Limestone	0.649245381	99.5	67.5	10	0	0
RCA+RAP	0.663714975	100	63.5	8.5	0	0
Class 6 Agg.	0.663310677	99	63.5	10	0	0
Class 5Q Agg.	0.641065776	100	70	12.5	0	0

$PLR_{0.9}$ = percent less rounded than 0.9; $PLR_{0.7}$ = percent less rounded than 0.7; $PLR_{0.5}$ = percent less rounded than 0.5; $PLR_{0.3}$ = percent less rounded than 0.3; $PLR_{0.1}$ = percent less rounded than 0.1

Relative breakage (B_r):

Material	B_r After 100 Gyrations	B_r After 300 Gyrations	B_r After 500 Gyrations
Coarse RCA	0.03407	0.03801	0.06440
Fine RCA	0.02577	0.03413	0.05325
Limestone	0.01421	0.01848	0.02582
RCA+RAP	0.02146	0.02436	0.02777
Class 6 Agg.	0.02677	0.02942	0.03870
Class 5Q Agg.	0.04644	0.06259	0.07820

B_r = relative breakage

Saturated hydraulic conductivity (K_{sat}) and soil-water characteristic curve (SWCC) parameters:

Material	K_{sat} (cm/sec)	Residual VWC	Saturated VWC	Air-Entry Pressure (kPa)
Coarse RCA	2.67E-04	0	0.2804	2.5
Fine RCA	4.85E-04	0	0.2887	6
Limestone	4.86E-05	0.0406	0.2366	2
RCA+RAP	2.06E-04	0.0048	0.2764	2
Class 6 Agg.	1.91E-04	0.0502	0.2607	3
Class 5Q Agg.	2.91E-04	0.0318	0.317	1.75

K_{sat} = saturated hydraulic conductivity; VWC = volumetric water content

Resilient modulus (M_R):

Material	**SM_R (MPa)**	**k_1**	**k_2**	**k_3**
Coarse RCA	124.99	913	0.44	-0.07
Fine RCA	122.46	882	0.45	-0.06
Limestone	96.02	762	0.32	-0.05
RCA+RAP	113.68	803	0.51	-0.12
Class 6 Agg.	NA	NA	NA	NA
Class 5Q Agg.	NA	NA	NA	NA

SMR = summary M_R; k_1, k_2, and k_3 = MEPDG M_R model fitting parameters; NA = not available

APPENDIX AL
ALTERNATIVE MODELS TO ESTIMATE UNCORRECTED OPTIMUM MOISTURE CONTENT (OMC) AND MAXIMUM DRY UNIT WEIGHT (MDU) VALUES OF AGGREGATE BASE LAYERS

For uncorrected optimum moisture content (OMC):

Equation	R^2	Adj. R^2	Std. Error
-13.7918*Combined OD G_s - 0.1033*Sand (%) - 0.1434*D_{50} (mm) + 47.0832	1	1	0
-13.7114*Combined OD G_s - 0.0854*Sand (%) - 0.2107*D_{30} (mm) + 45.6781	1	1	0.02
-13.5679*Combined OD G_s - 0.0760*Sand (%) - 1.3958*D_{10} (mm) + 44.8785	1	1	0.04
-13.7779*Combined OD G_s - 0.1166*Sand (%) - 0.0477*Gravel (%) + 49.2062	1	1	0.02
-13.7779*Combined OD G_s - 0.0689*Sand (%) + 0.0477*Fines (%) + 44.4357	1	1	0.05
-10.2402*Fine SSD G_s - 0.6206*Asphalt Binder Content by Extraction (%) + 0.2358*C_c + 33.8534	1	1	0.05
0.3288*Fine Absorption (%) - 9.1184*Fine Apparent G_s + 0.3155*C_c - 0.4603*Asphalt Binder Content by Extraction (%) + 30.7698	1	1	0.05
-12.6425*Combined OD G_s - 0.0632*Sand (%) + 41.8871	1	1	0
-7.6245*Fine OD G_s + 0.4420*C_c + 25.7617	1	1	0.14
-11.8099*Fine SSD G_s - 0.9615*Asphalt Binder Content by Ignition (%) + 39.8574	1	0.99	0.18
-19.6912*Combined SSD G_s - 1.7824*Asphalt Binder Content by Ignition (%) + 62.3518	0.99	0.98	0.29
-13.6173*Combined OD G_s - 1.2124*Asphalt Binder Content by Ignition (%) + 44.4507	0.99	0.97	0.32
-10.9676*Combined OD G_s + 0.1602*D_{60} (mm) + 33.9536	0.98	0.97	0.35
-10.8351*Combined OD G_s + 0.2065*D_{50} (mm) + 33.8059	0.98	0.97	0.35
-11.7264*Combined OD G_s + 0.9328*C_c + 35.5972	0.98	0.97	0.35
-17.0353*Combined SSD G_s - 0.0793*Sand (%) + 54.8267	0.98	0.97	0.36
-15.6546*Combined SSD G_s + 1.2149*C_c + 46.1668	0.97	0.95	0.45
-14.0096*Combined SSD G_s + 0.2540*D_{50} (mm) + 42.5928	0.97	0.94	0.49
-10.9123*Combined OD G_s + 35.0921	0.96	0.92	0.56
0.7431*Combined Absorption (%) + 5.7034	0.87	0.84	0.81
-13.6175*Combined SSD G_s + 42.9932	0.83	0.79	0.93

G_s = specific gravity; SSD = saturated-surface-dry; OD = oven-dry; C_c = coefficient of curvature

For uncorrected maximum dry unit weight (MDU):

Equation	R^2	Adj. R^2	Std. Error
6.3812*Combined SSD G_s - 0.4756*Coarse Absorption (%) + 5.9683	1	1	0.07
5.4082*Combined OD G_s - 0.3449*Coarse Absorption (%) + 8.5401	1	0.99	0.09
6.5823*Combined OD G_s - 0.1496*D_{30} (mm) + 4.8677	1	0.99	0.1
4.9439*Combined OD G_s - 0.0304*Residual Mortar Content (%) + 9.1974	1	0.99	0.11
4.5928*Fine SSD G_s - 0.0280*Residual Mortar Content (%) + 9.8594	1	0.99	0.11
5.4125*Combined OD G_s + 0.0730*Fines (%) + 6.8279	0.99	0.99	0.12
5.6446*Combined SSD G_s - 0.0401*Residual Mortar Content (%) + 7.1398	0.99	0.98	0.16
9.5737*Combined SSD G_s - 0.3991*C_c - 2.8669	0.99	0.98	0.17
9.0361*Combined SSD G_s - 0.0852*D_{50} (mm) - 1.6901	0.99	0.98	0.17
7.9065*Combined SSD G_s - 2.0737*D_{10} (mm) + 1.0323	0.99	0.98	0.18
9.0976*Combined SSD G_s - 0.0648*D_{60} (mm) - 1.7844	0.99	0.98	0.19
-0.2085*Fine Absorption (%) + 6.9277*Combined Apparent G_s + 3.2383	0.97	0.96	0.25
-1.3568*Coarse Absorption (%) + 0.8841*Gravel-to-Sand Ratio + 23.4612	0.97	0.95	0.26
-1.3618*Coarse Absorption (%) + 0.7804*C_c + 23.4353	0.97	0.95	0.27
6.9110*Combined OD G_s + 3.8658	0.97	0.96	0.23
-1.5319*Coarse Absorption (%) + 0.1977*D_{50} (mm) + 24.1188	0.97	0.94	0.29
-0.3613*Combined Absorption (%) + 4.5591*Fine Apparent G_s + 10.0660	0.96	0.93	0.33
-1.0944*Coarse Absorption (%) - 0.7557*Asphalt Binder Content by Ignition (%) + 25.5955	0.96	0.93	0.33
-1.4842*Coarse Absorption (%) + 0.1448*D_{60} (mm) + 23.8709	0.96	0.93	0.33
-0.3588*Combined Absorption (%) + 6.1792*Combined Apparent G_s + 5.5866	0.96	0.92	0.33
-0.3175*Combined Absorption (%) + 11.6006*Coarse Apparent G_s - 9.5334	0.96	0.93	0.33
-1.4232*Coarse Absorption (%) + 0.0446*Gravel (%) + 22.6210	0.96	0.93	0.33
8.9049*Combined SSD G_s - 1.8244	0.94	0.92	0.34
-0.4286*Combined Absorption (%) + 22.2548	0.77	0.71	0.65

G_s = specific gravity; SSD = saturated-surface-dry; OD = oven-dry; C_c = coefficient of curvature

APPENDIX AM
ALTERNATIVE MODELS TO ESTIMATE CORRECTED OPTIMUM MOISTURE CONTENT (OMC) AND MAXIMUM DRY UNIT WEIGHT (MDU) VALUES OF AGGREGATE BASE LAYERS

For corrected optimum moisture content (OMC):

Equation	**R^2**	**Adj. R^2**	**Std. Error**
0.9066*Uncorrected OMC (%) - 0.3036*D_{60} (mm) + 0.8947*C_c + 1.4338	1	1	0.11
0.8501*Uncorrected OMC (%) - 0.1533*D_{60} (mm) + 2.1258	0.97	0.96	0.34
1.0244*Uncorrected OMC (%) - 5.5904*D_{10} (mm) + 0.3445	0.97	0.95	0.37
0.8580*Uncorrected OMC (%) - 0.1930*D_{50} (mm) + 1.8711	0.97	0.94	0.4
0.8252*Uncorrected OMC (%) - 0.0470*Gravel (%) + 3.4571	0.97	0.94	0.4
0.9422*Uncorrected OMC (%) - 0.5206*D_{30} (mm) + 0.8448	0.96	0.94	0.41
-11.7635*Combined SSD G_s + 37.9200	0.88	0.85	0.64
0.7499*Uncorrected OMC (%) + 1.8796	0.84	0.8	0.74

OMC = optimum moisture content; C_c = coefficient of curvature; SSD = saturated-surface-dry; G_s = specific gravity

For corrected maximum dry unit weight (MDU):

Equation	R^2	Adj. R^2	Std. Error
1.3991*Uncorrected MDU (kN/m^3) + 0.8096*D_{50} - 3.4342*Gravel-to-Sand Ratio - 7.6185	1	1	0.04
-0.4399*Uncorrected OMC (%) - 1.2115*Asphalt Binder Content by Ignition (%) - 2.1556*Fine Apparent G_s + 33.1997	1	1	0.05
0.9264*Uncorrected MDU (kN/m^3) + 0.0938*D_{60} (mm) + 1.0596	1	0.99	0.1
1.1356*Uncorrected MDU (kN/m^3) + 3.3492*D_{10} (mm) - 3.0446	0.99	0.99	0.13
0.9375*Uncorrected MDU (kN/m^3) + 0.1195*D_{50} (mm) + 0.9394	0.99	0.99	0.14
0.8999*Uncorrected MDU (kN/m^3) + 0.0297*Gravel (%) + 0.8753	0.99	0.99	0.14
1.0342*Uncorrected MDU (kN/m^3) + 0.3132*D_{30} (mm) - 0.8455	0.99	0.98	0.14
0.8580*Uncorrected MDU (kN/m^3) + 0.5861*Gravel-to-Sand Ratio + 2.4342	0.99	0.98	0.16
-0.3939*Uncorrected OMC (%) - 0.9332*Asphalt Binder Content by Ignition (%) + 26.4608	0.99	0.98	0.17
-0.4655*Uncorrected OMC (%) - 0.0494*Sand (%) + 26.9591	0.99	0.98	0.18
0.8015*Uncorrected MDU (kN/m^3) - 0.0310*Sand (%) + 5.6495	0.98	0.97	0.2
0.7185*Uncorrected MDU (kN/m^3) - 0.6171*Asphalt Binder Content by Ignition (%) + 7.5096	0.98	0.97	0.2
3.6328*Fine OD G_s - 0.0368*Sand (%) + 13.9284	0.98	0.96	0.22
5.0802*Fine SSD G_s - 0.0290*Sand (%) + 9.6254	0.98	0.96	0.23
4.2779*Fine OD G_s + 0.1074*D_{60} (mm) + 10.0510	0.98	0.96	0.23
5.7675*Fine SSD G_s + 0.0815*D_{60} (mm) + 6.0954	0.98	0.96	0.23
1.4339*Uncorrected MDU (kN/m^3) + 0.7989*Coarse Absorption (%) - 11.0475	0.98	0.96	0.23
-0.5524*Uncorrected OMC (%) + 0.0475*Gravel (%) + 23.3136	0.97	0.96	0.24
3.9122*Fine OD G_s + 0.6678*Gravel-to-Sand Ratio + 10.8568	0.97	0.95	0.26
4.3220*Fine OD G_s + 0.1350*D_{50} (mm) + 10.0800	0.97	0.95	0.26
-0.5099*Uncorrected OMC (%) + 0.9094*Gravel-to-Sand Ratio + 24.0760	0.97	0.94	0.27
-0.5817*Uncorrected OMC (%) + 0.1881*D_{50} (mm) + 24.9159	0.96	0.93	0.31
0.8848*Uncorrected MDU (kN/m^3) + 2.6339	0.88	0.85	0.44
-0.4764*Uncorrected OMC (%) + 24.9076	0.71	0.63	0.69

MDU = maximum dry unit weight; OMC = optimum moisture content; G_s = specific gravity; SSD = saturated-surface-dry

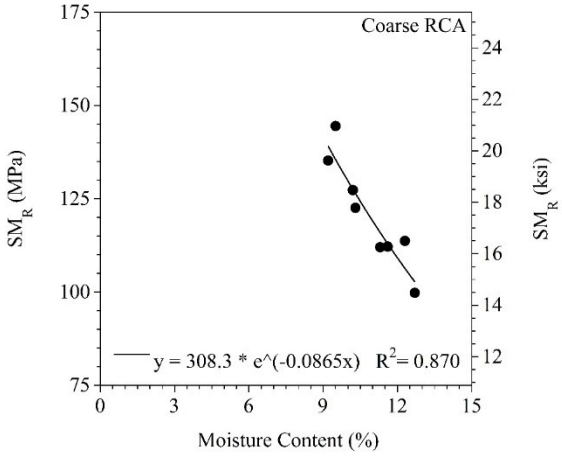
APPENDIX AN
ALTERNATIVE MODELS TO ESTIMATE SATURATED HYDRAULIC CONDUCTIVITY (K_{SAT}) VALUES OF AGGREGATE BASE LAYERS

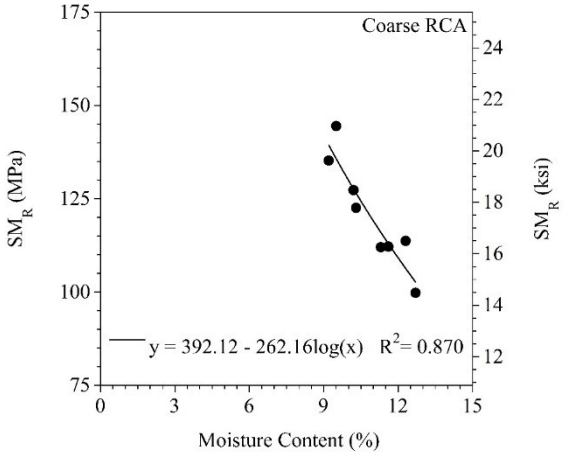
Equation	R^2	Adj. R^2	Std. Error
0.001581*Corrected MDU (kN/m^3) - 0.012708*Combined Apparent G_s + 0.046235*n - 0.008281	1	1	4.23E-06
0.002988*e - 0.000185*Combined Apparent G_s - 8.53E-05	1	1	7.14E-06
0.002735*e - 0.000165*Combined SSD G_s - 9.97E-05	1	1	9.99E-06

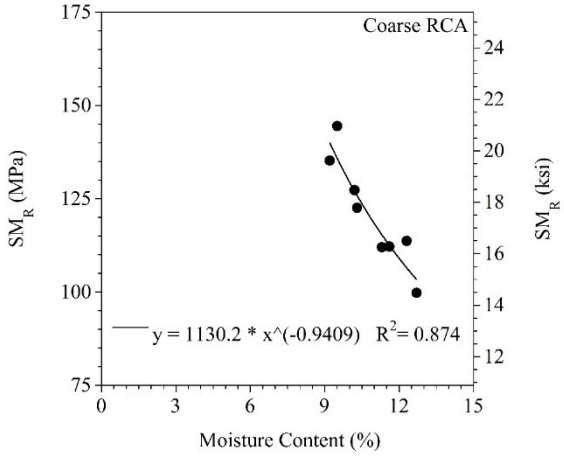
MDU = maximum dry unit weight; G_s = specific gravity; e = void ratio [based on corrected MDU and apparent specific gravity (G_s)]; n = porosity [n = e/(1+e)]; SSD = saturated-surface-dry

APPENDIX AO
SUMMARY RESILIENT MODULUS (SM_R) VS. MOISTURE CONTENT

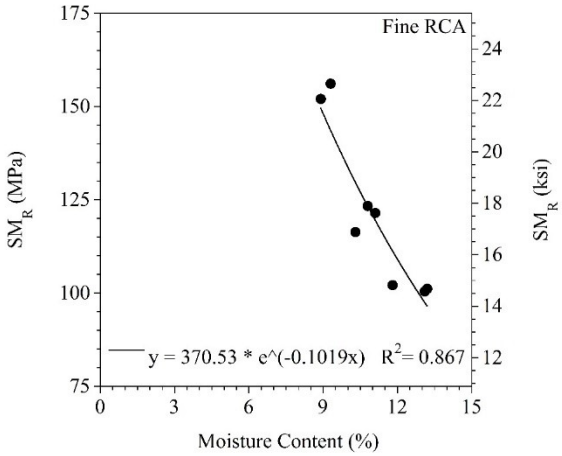
For Coarse RCA:

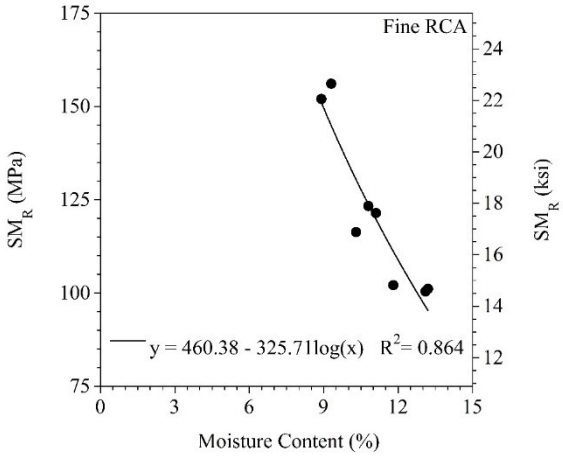


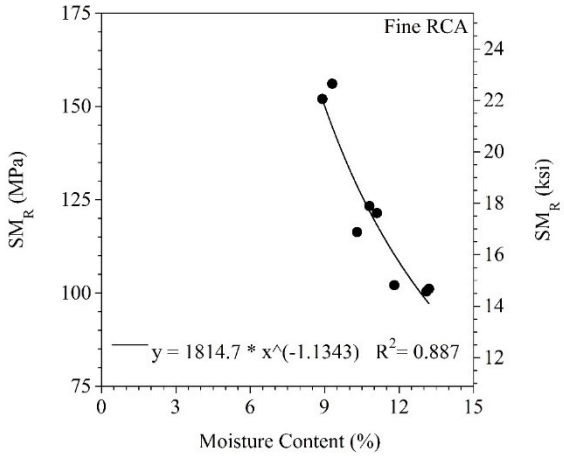




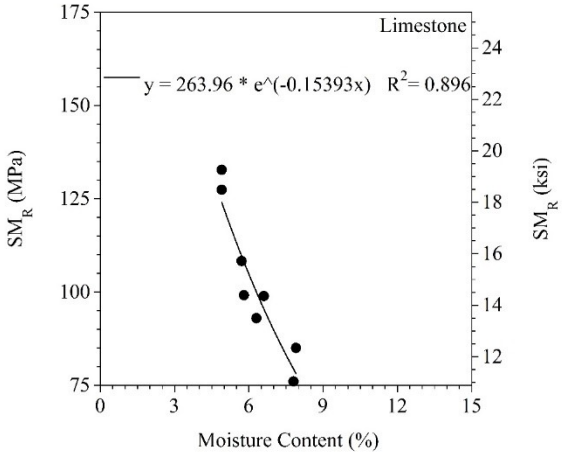
For Fine RCA:

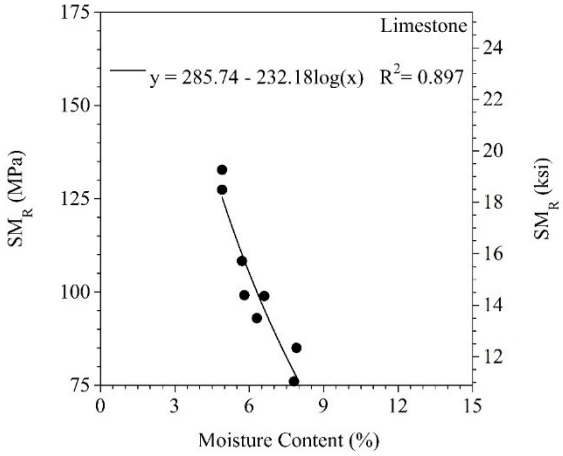


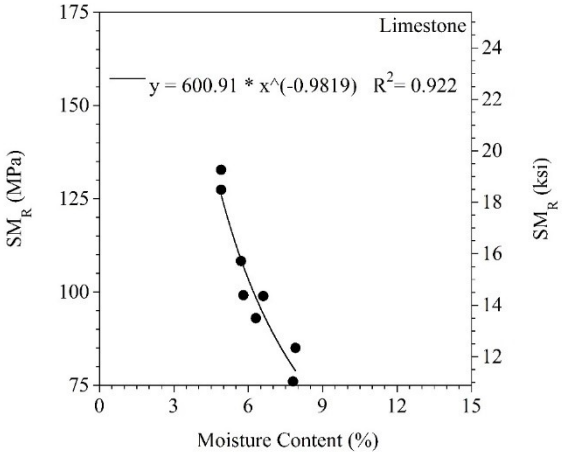




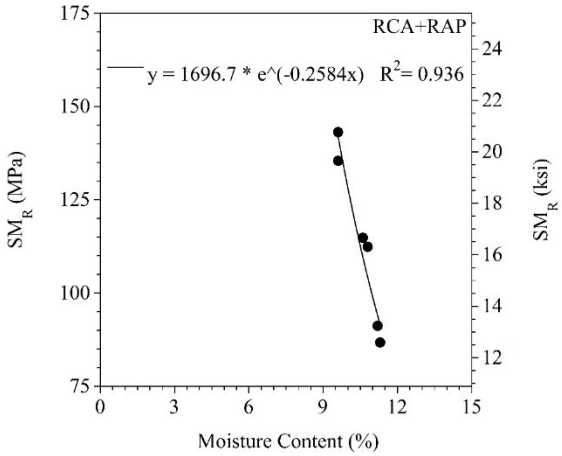
For Limestone:

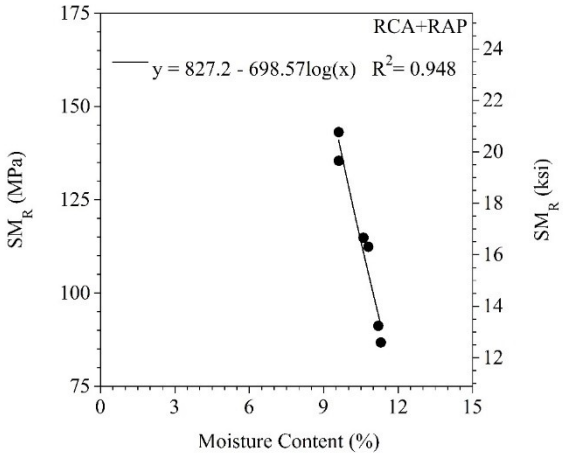


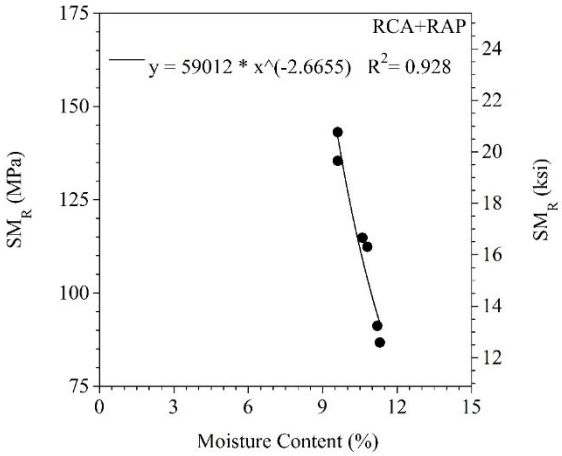




For RCA+RAP:

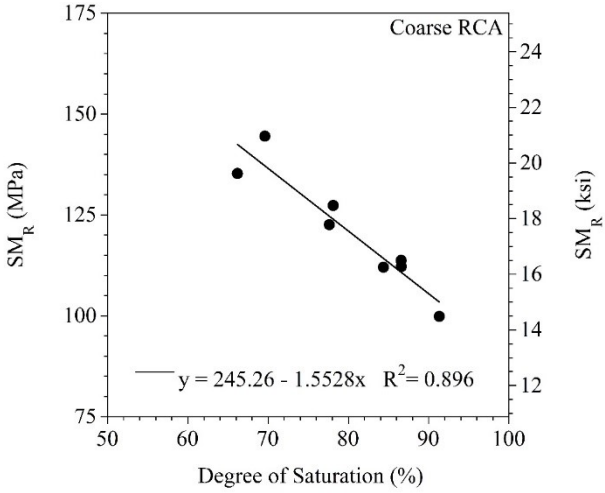


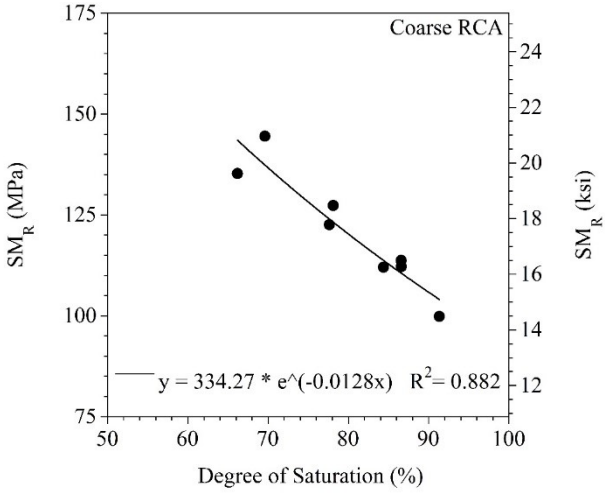


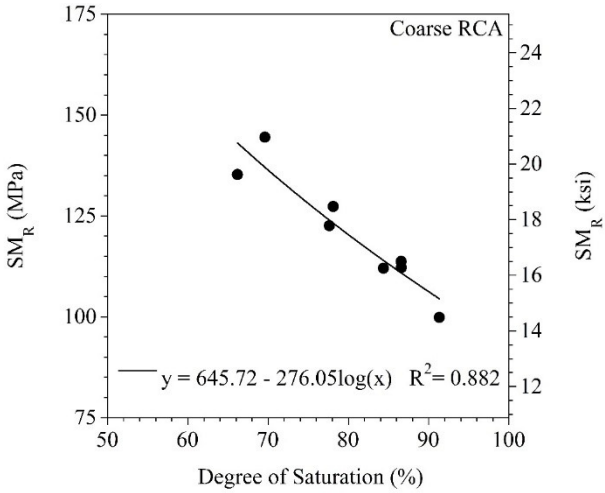


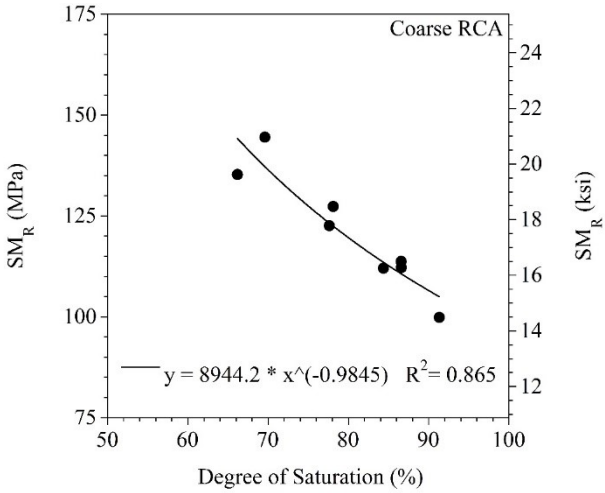
APPENDIX AP
SUMMARY RESILIENT MODULUS (SM_R) VS. DEGREE OF SATURATION (DOS)

For Coarse RCA:

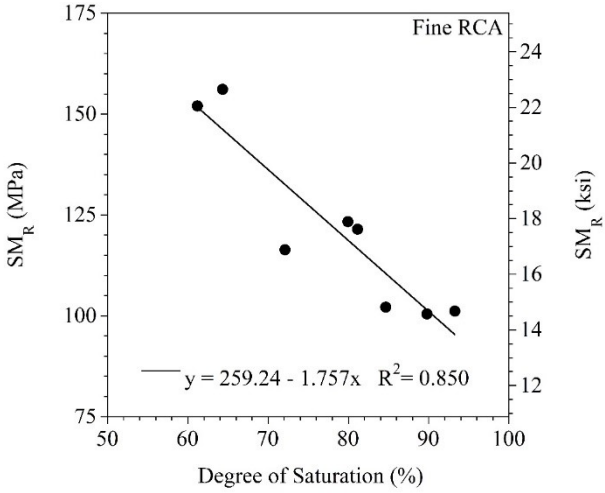


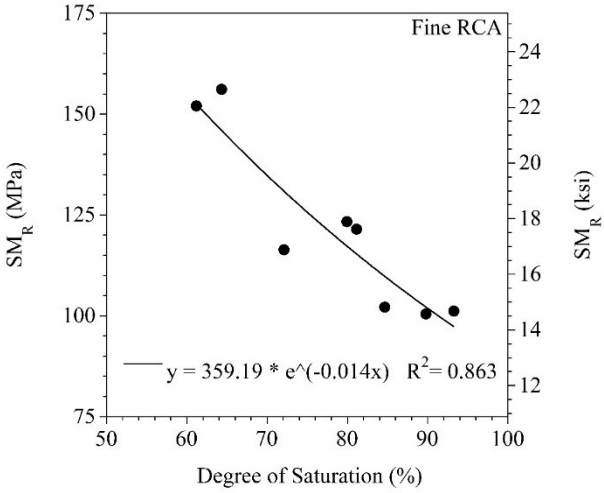


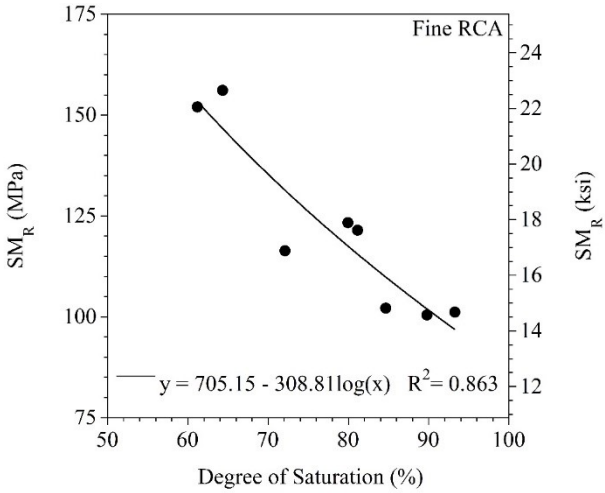


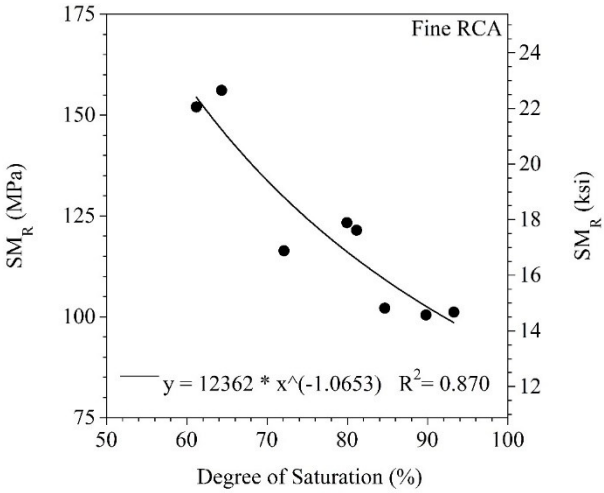


For Fine RCA:

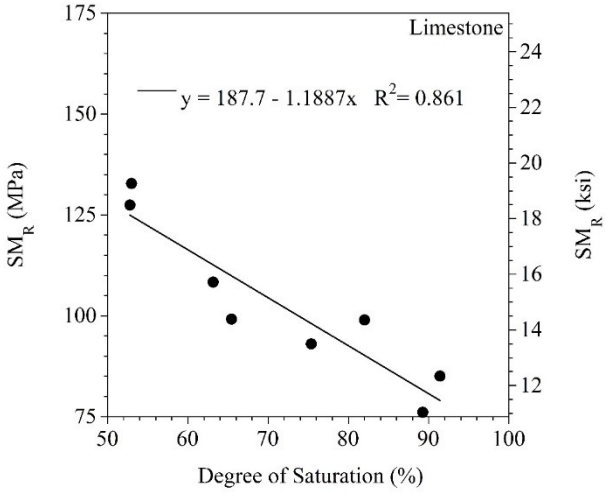

Fine RCA
y = 259.24 - 1.757x R²= 0.850
SMR (MPa)
SMR (ksi)
Degree of Saturation (%)

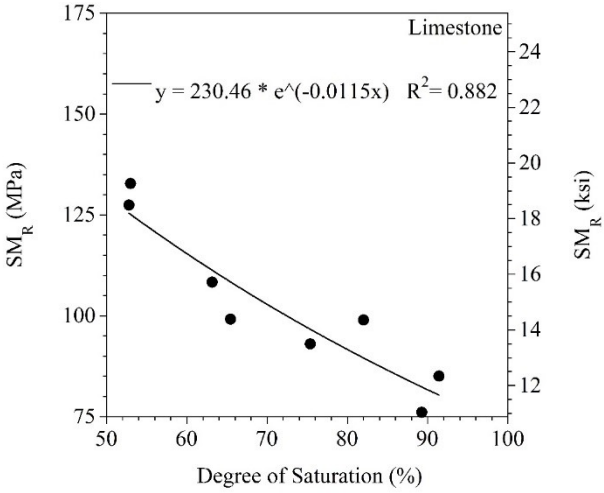

Fine RCA
y = 359.19 * e^(-0.014x) R²= 0.863
SMR (MPa)
SMR (ksi)
Degree of Saturation (%)

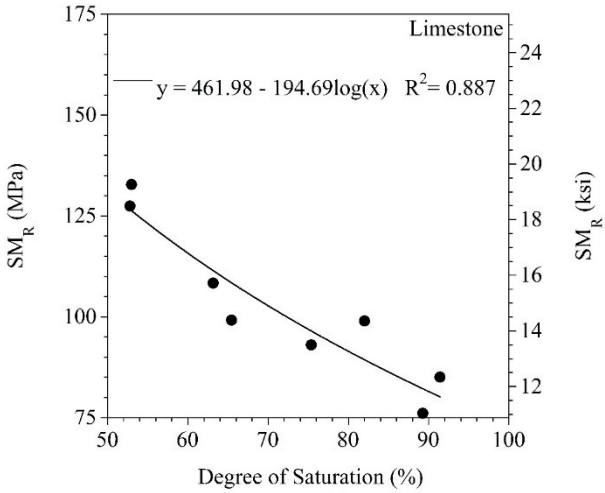

Fine RCA
y = 705.15 - 308.81log(x) R²= 0.863
SMR (MPa)
SMR (ksi)
Degree of Saturation (%)

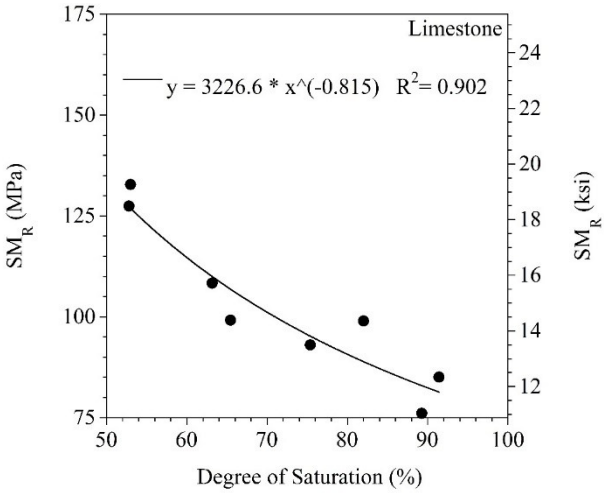

Fine RCA
y = 12362 * x^(-1.0653) R²= 0.870
SMR (MPa)
SMR (ksi)
Degree of Saturation (%)

For Limestone:

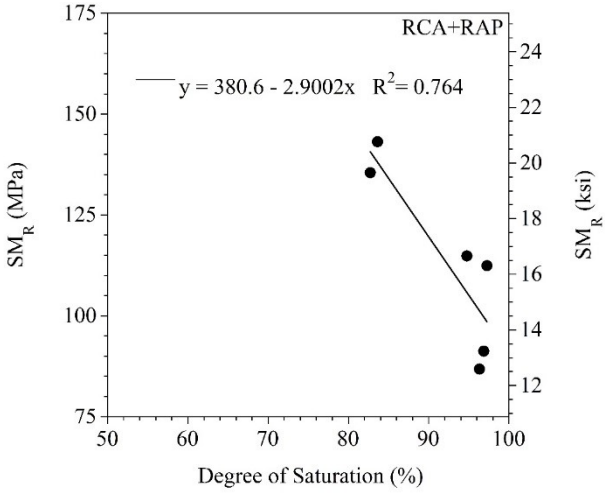


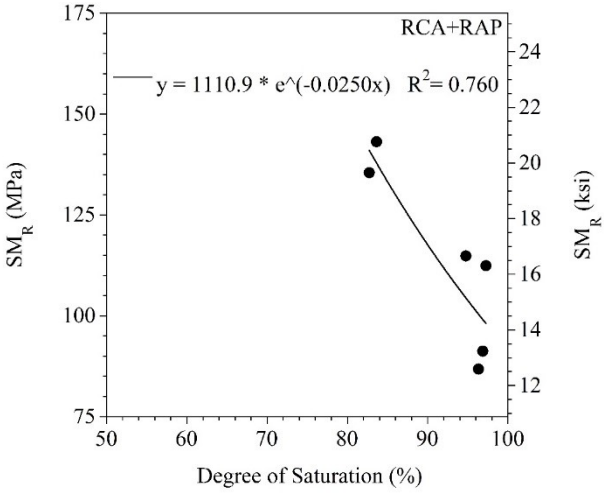


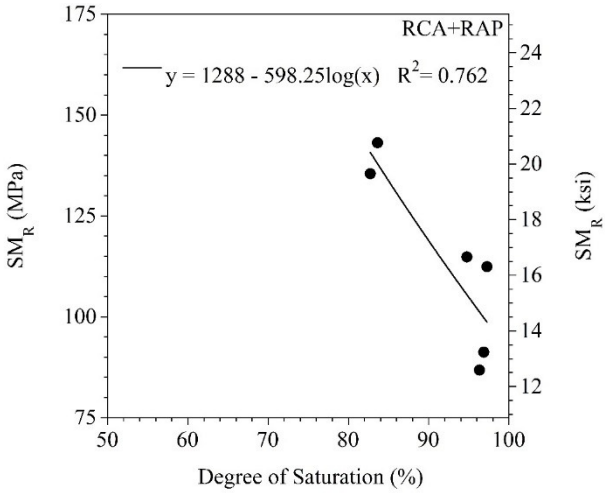


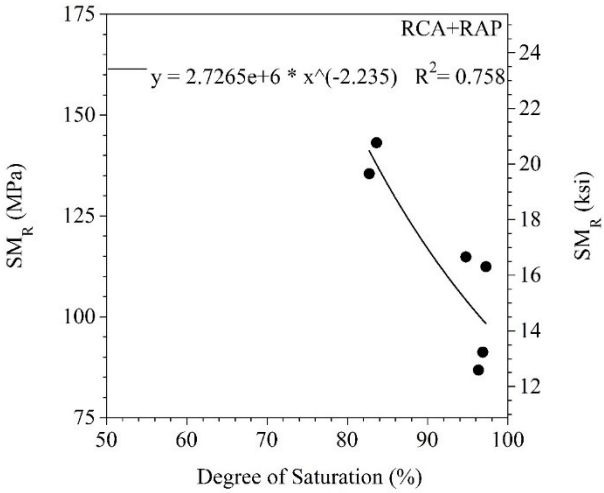


For RCA+RAP:


RCA+RAP
y = 380.6 - 2.9002x R2= 0.764
SMR (MPa)
SMR (ksi)
Degree of Saturation (%)

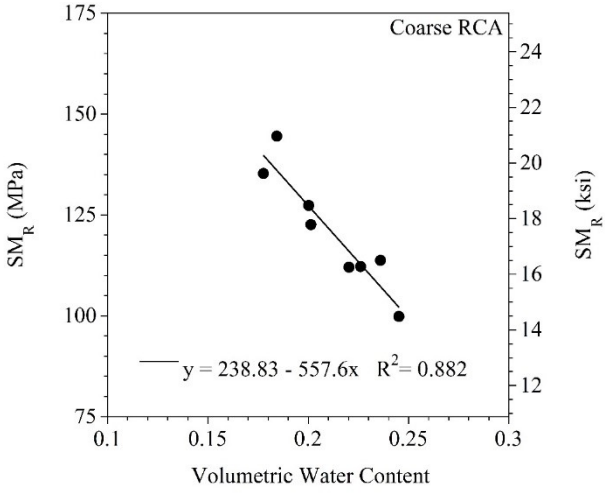

RCA+RAP
y = 1110.9 * e^(-0.0250x) R2= 0.760
SMR (MPa)
SMR (ksi)
Degree of Saturation (%)

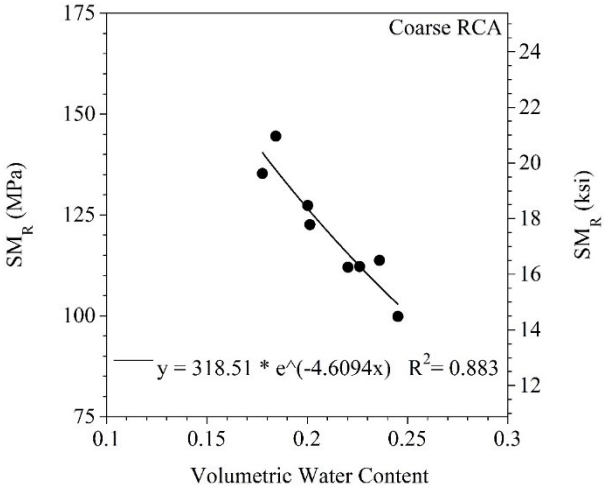

RCA+RAP
y = 1288 - 598.25log(x) R2= 0.762
SMR (MPa)
SMR (ksi)
Degree of Saturation (%)

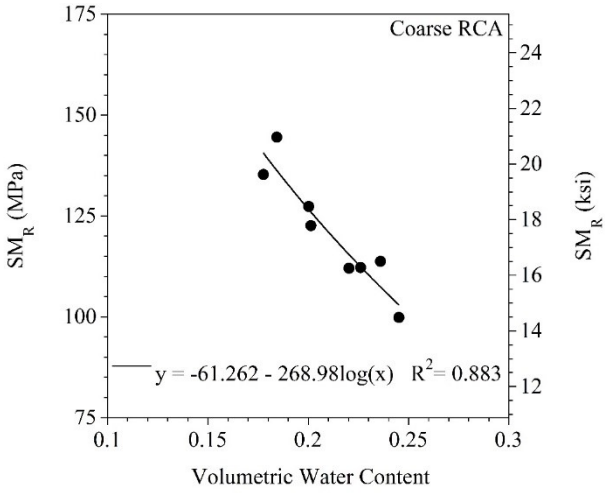

RCA+RAP
y = 2.7265e+6 * x^(-2.235) R2= 0.758
SMR (MPa)
SMR (ksi)
Degree of Saturation (%)

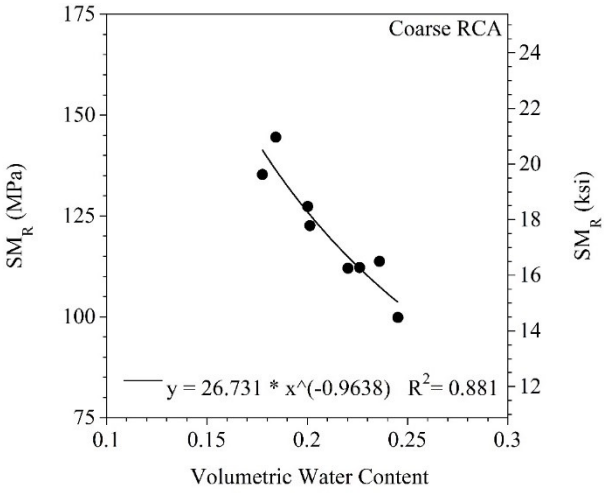
APPENDIX AQ
SUMMARY RESILIENT MODULUS (SM_R) VS. VOLUMETRIC WATER CONTENT (VWC)

For Coarse RCA:

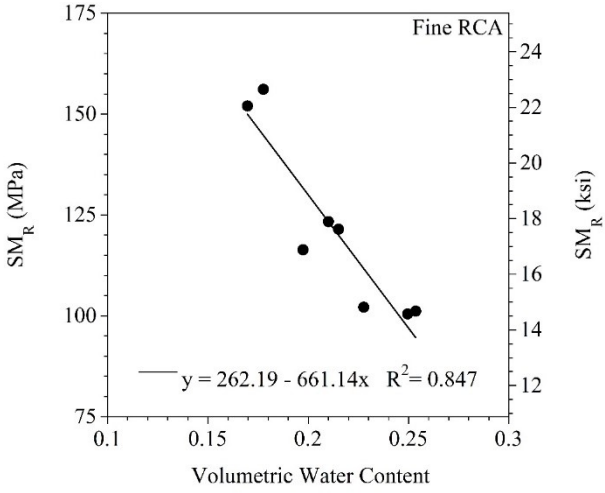


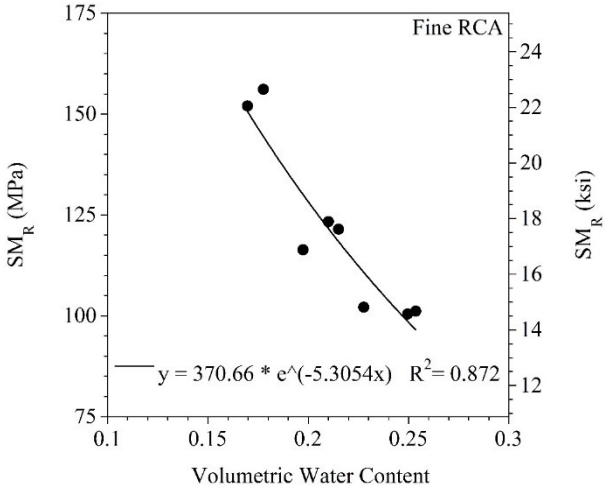


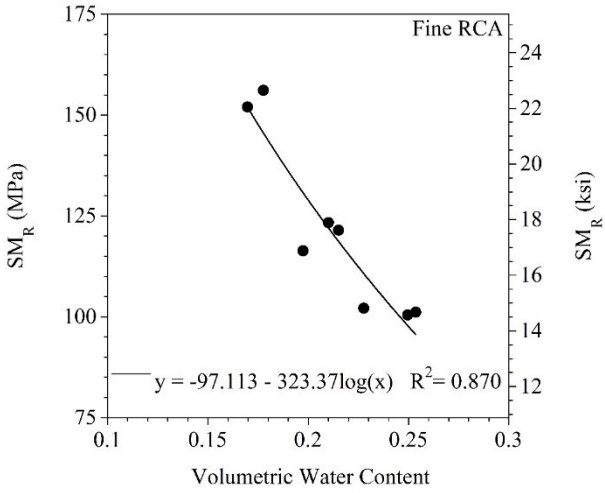


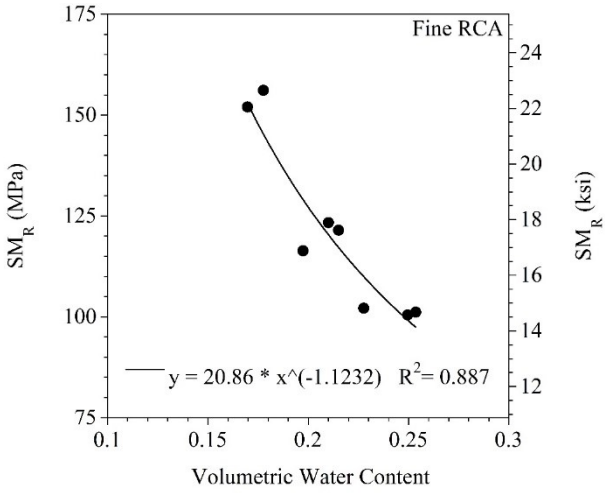


Fine RCA:

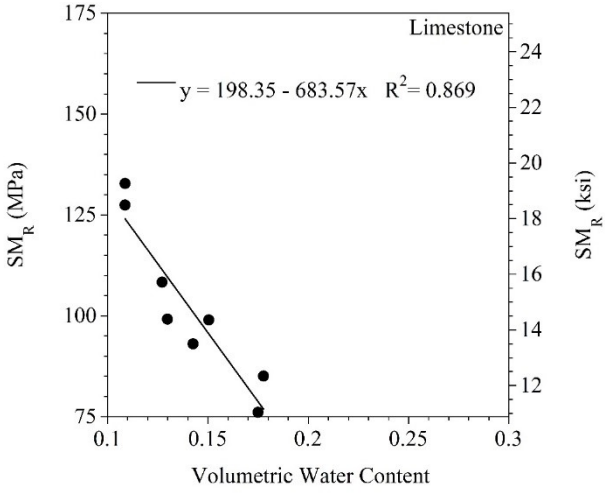

Fine RCA
SM_R (MPa)
SM_R (ksi)
Volumetric Water Content
y = 262.19 - 661.14x R^2= 0.847

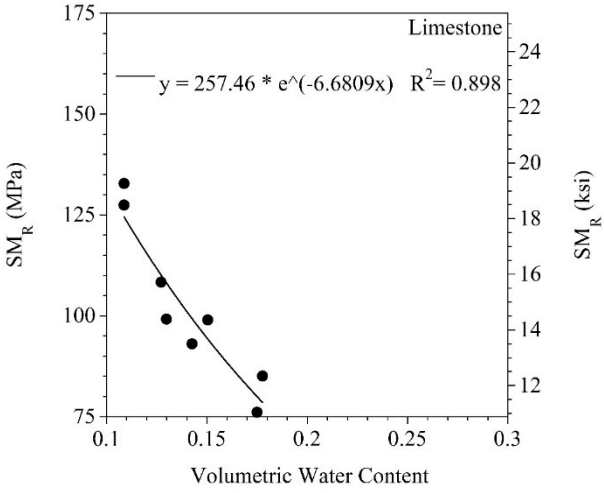

Fine RCA
SM_R (MPa)
SM_R (ksi)
Volumetric Water Content
y = 370.66 * e^(-5.3054x) R^2= 0.872

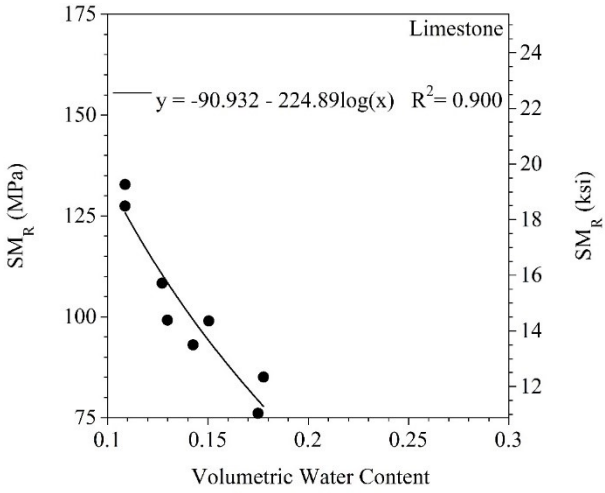

Fine RCA
SM_R (MPa)
SM_R (ksi)
Volumetric Water Content
y = -97.113 - 323.37log(x) R^2= 0.870

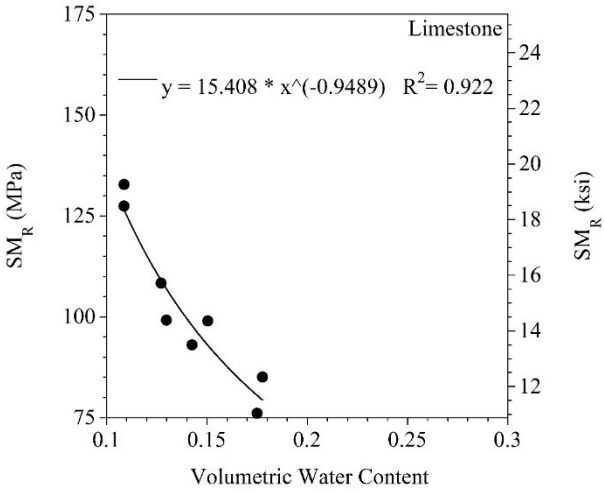

Fine RCA
SM_R (MPa)
SM_R (ksi)
Volumetric Water Content
y = 20.86 * x^(-1.1232) R^2= 0.887

For Limestone:

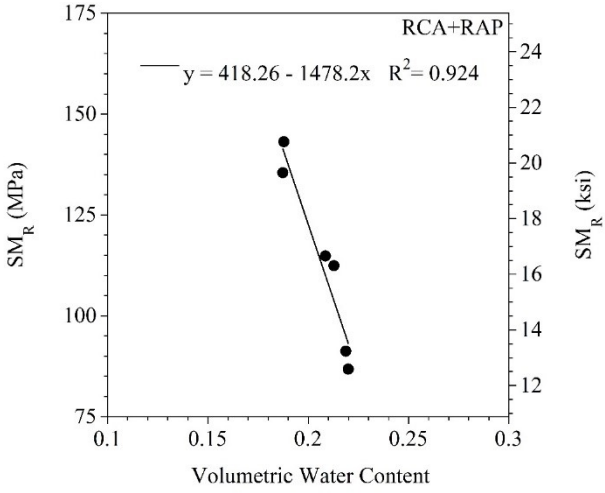


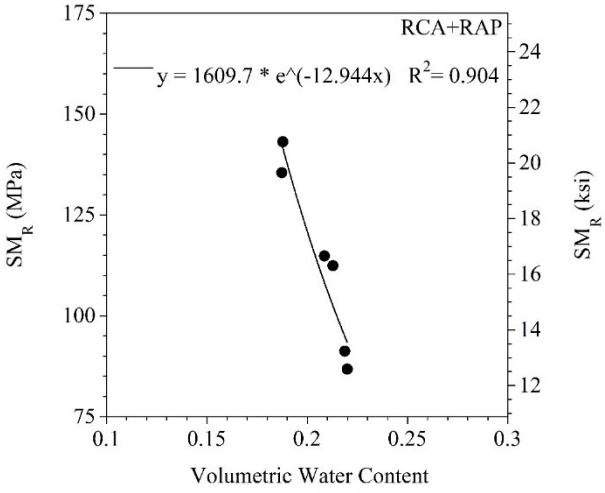


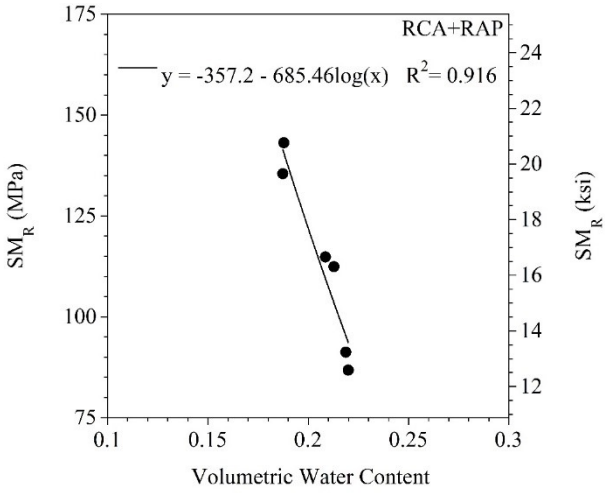


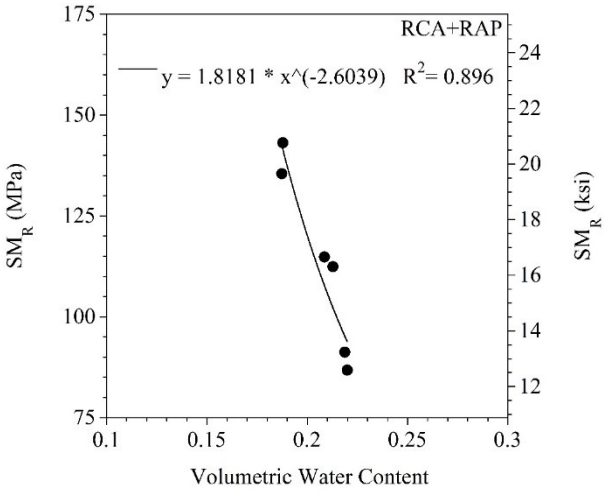


For RCA+RAP:


RCA+RAP
y = 418.26 - 1478.2x R²= 0.924
SMR (MPa)
SMR (ksi)
Volumetric Water Content

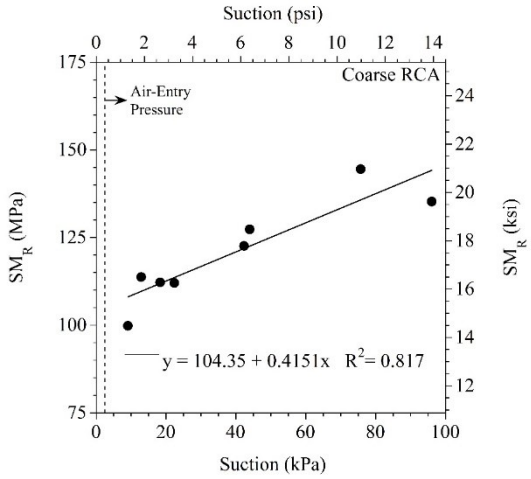

RCA+RAP
y = 1609.7 * e^(-12.944x) R²= 0.904
SMR (MPa)
SMR (ksi)
Volumetric Water Content

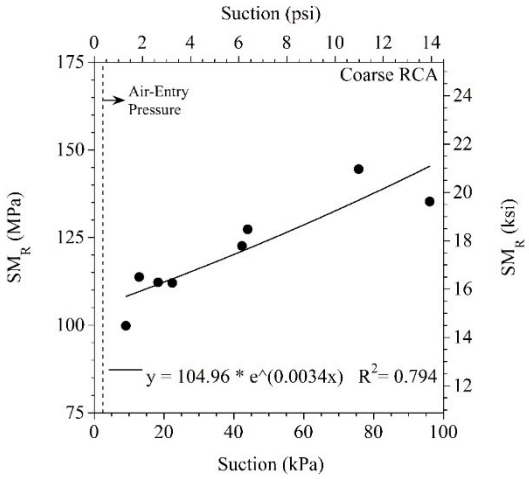

RCA+RAP
y = -357.2 - 685.46log(x) R²= 0.916
SMR (MPa)
SMR (ksi)
Volumetric Water Content

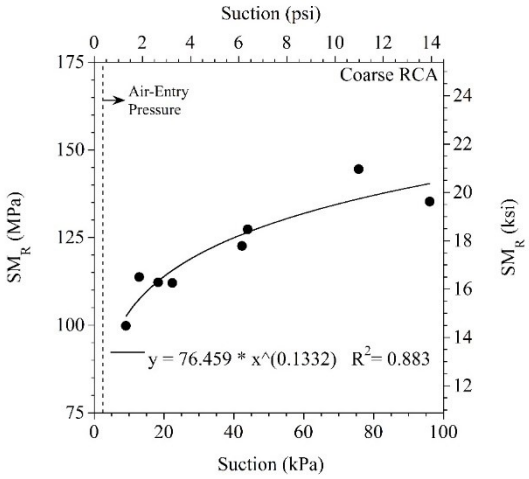

RCA+RAP
y = 1.8181 * x^(-2.6039) R²= 0.896
SMR (MPa)
SMR (ksi)
Volumetric Water Content

APPENDIX AR
SUMMARY RESILIENT MODULUS (SM_R) VS. MATRIC SUCTION

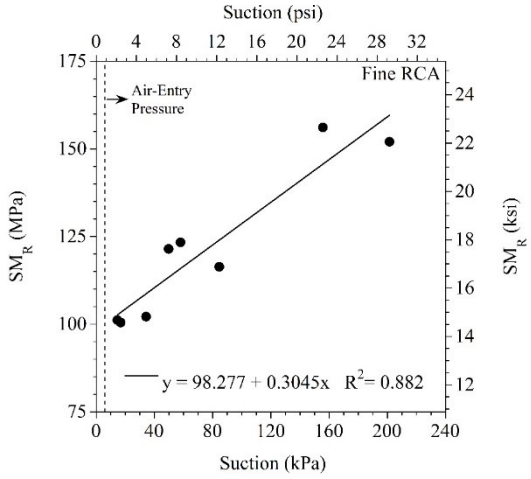
For Coarse RCA:

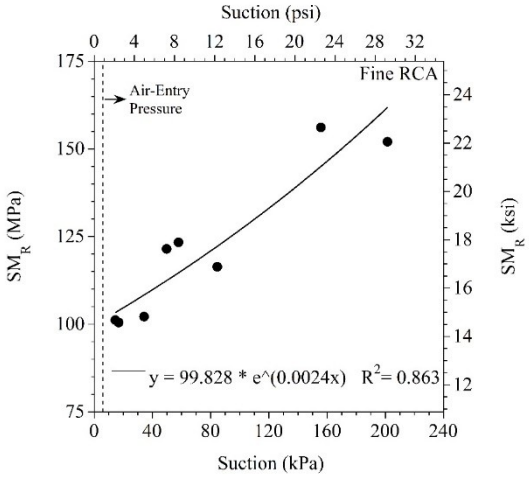


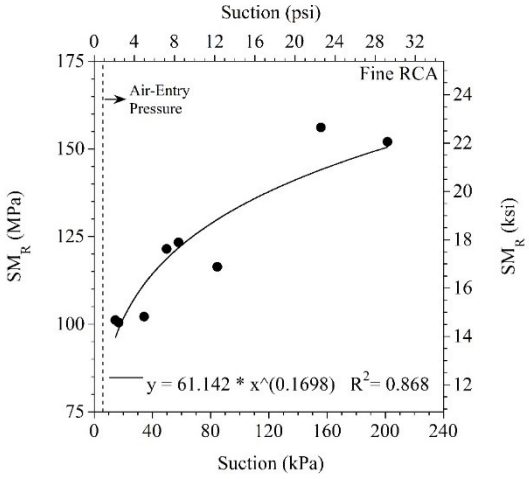




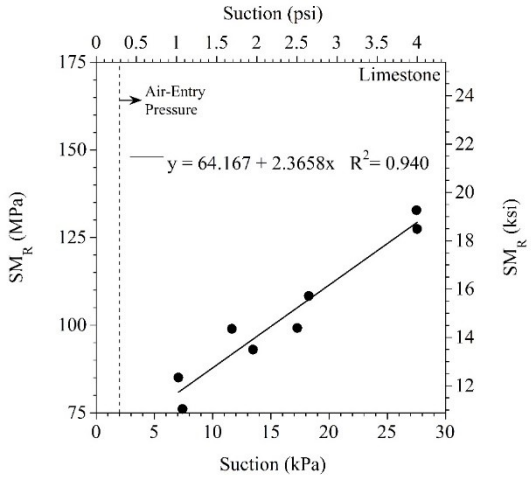
For Fine RCA:

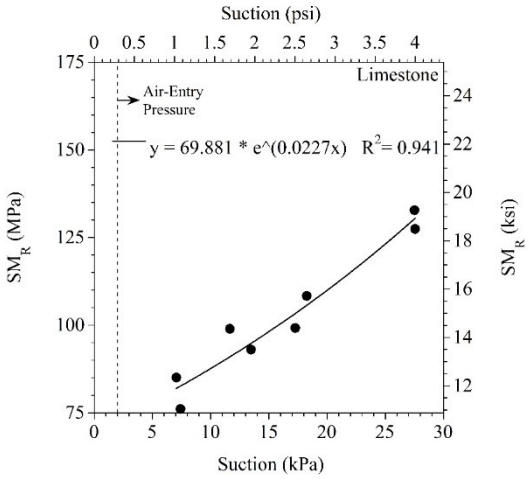


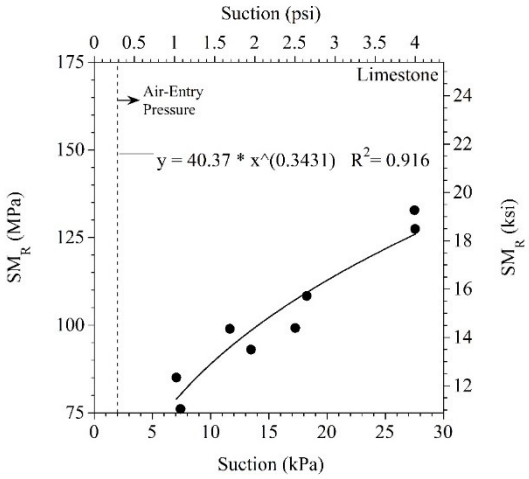




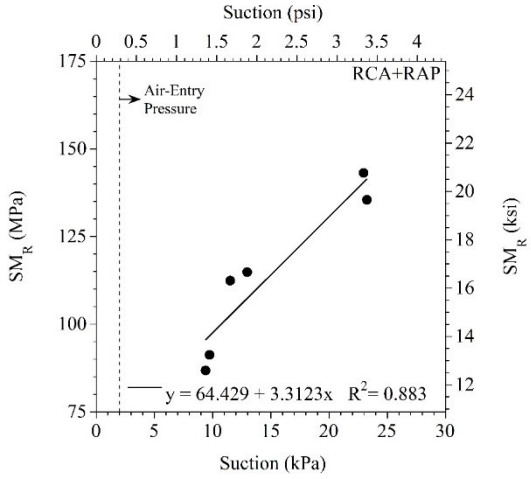
For Limestone:

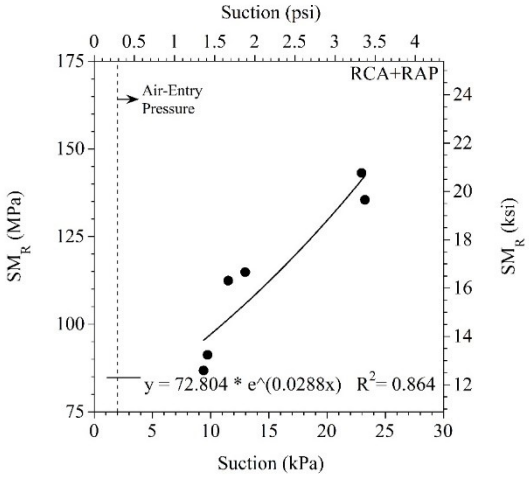


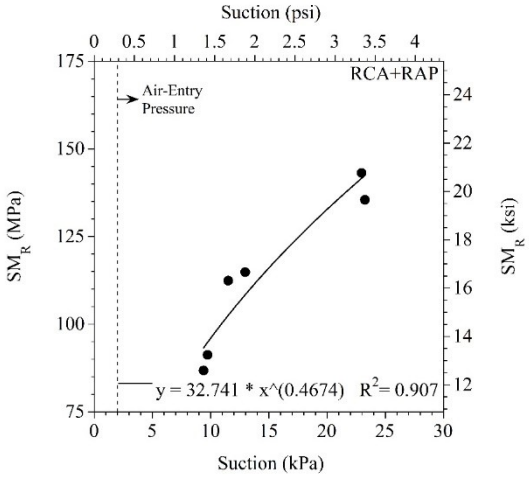




For RCA+RAP:







APPENDIX AS
ALTERNATIVE MODELS TO ESTIMATE SUMMARY RESILIENT MODULUS (SM_R) AT OPTIMUM MOISTURE CONTENT (OMC)

Equation	R^2	Adj. R^2	Std. Error
-8.5917*Uncorrected MDU (kN/m^3) + 3.0558*$PLR_{0.5}$ (%) + 257.3496	1	1	0.25
-209.7556*Coarse SSD G_s + 3.7592*$PLR_{0.7}$ (%) + 407.9011	1	1	0.48
-68.7070*Combined OD G_s - 3.6657* $PLS_{0.9}$ (%) + 601.7242	1	1	0.45
-56.4223*Combined OD G_s + 246.2814	0.91	0.86	4.89

MDU = maximum dry unit weight; SSD = saturated-surface-dry; OD = oven-dry; G_s = specific gravity; $PLR_{0.5}$ = percent less rounded than 0.5; $PLR_{0.7}$ = percent less rounded than 0.7; $PLS_{0.9}$ = percent less spherical than 0.9

APPENDIX AT
REASSESSMENT OF MODELS PROVIDED IN EDIL ET AL. (2012)

Index properties, compaction characteristics, and summary resilient modulus (SRM) values based on power function [Equation (AT1)] for the materials used in Edil et al. (2012) are shown in Table AT1, Table AT2, and Table AT3, respectively. The empirical correlations reported by Edil (2012) were reevaluated.

Table AT1. Index properties of the materials (Edil et al. 2012)

Material	States	D_{10} (mm)	D_{30} (mm)	D_{50} (mm)	D_{60} (mm)	C_u	C_c	G_s	Absorption (%)	Asphalt Content /Mortar Content (%)	Impurities (%)	Gravel (%)	Sand (%)	Fines (%)	USCS	AASHTO
Class 5 Aggregate	MN	0.1	0.4	1.0	1.7	21	1.4	2.57	_	_	0.25	22.9	67.6	9.5	GW-GM	A-1-b
Blend	MN	0.2	0.6	1.5	2.8	13	0.5	_	_	_	0.36	32.7	63.8	3.4	SP	A-1-b
RCA	MN	0.1	0.4	1.0	1.7	21	1.4	2.39	5.0	55	0.87	31.8	64.9	3.3	SW	A-1-a
	MI	0.4	4.1	9.7	12.3	35	3.9	2.37	5.4	_	0.35	68.5	28.3	3.2	GP	A-1-a
	CO	0.1	0.6	2.8	4.9	66	1.1	2.28	5.8	47	0.26	40.9	46.3	12.8	SC	A-1-b
	CA	0.3	1.7	4.8	6.8	22	1.4	2.32	5.0	37	0.26	50.6	47.1	2.3	GW	A-1-a
	TX	0.4	6.5	13.3	16.3	38	6.0	2.27	5.5	45	0.86	76.3	21.6	2.1	GW	A-1-a
	OH	0.2	1.2	3.4	5.3	34	1.7	2.24	6.5	65	0.16	43.2	49.5	7.3	SW-SM	A-1-a
	NJ	0.2	0.5	2.0	5.1	28	0.3	2.31	5.4	_	1.67	41.2	54.6	4.3	SP	A-1-b
RAP	MN	0.3	0.7	1.6	2.3	7	0.7	2.41	1.8	7.1	0.06	26.3	71.2	2.5	SP	A-1-a
	CO	0.4	0.9	2.2	3.3	9	0.7	2.23	3.0	5.9	0.09	31.7	67.7	0.7	SP	A-1-a
	CA	0.3	1.3	3.0	4.2	13	1.2	2.56	2.0	5.7	0.33	36.8	61.4	1.8	SW	A-1-a
	TX	0.7	2.5	5.4	7.9	11	1.1	2.34	1.3	4.7	0.05	41.0	44.9	1.0	SW	A-1-a
	OH	0.5	1.6	2.9	3.8	7	1.3	2.43	0.6	6.2	0.06	32.1	66.2	1.7	SW	A-1-a
	NJ	1.0	2.8	4.9	5.9	6	1.3	2.37	2.1	5.2	0.48	50.9	48.4	0.7	GW	A-1-a
	WI	0.6	1.4	2.7	3.6	6	0.9	2.37	1.5	6.2	0.08	30.9	68.5	0.5	SP	A-1-b
RPM	NJ	0.5	2.1	5.8	8.7	18	1.0	2.35	2.6	4.3	0.04	55.7	43.6	0.6	GW	A-1-b
	MI	0.4	1.7	4.6	6.5	17	1.1	2.39	1.7	5.3	0.13	49.3	50.4	0.4	SW	A-1-b

D_{10} = effective size; D_{30} = particle size for 30% finer; D_{50} = median particle size; D_{60} = particle size for 60% finer; C_u = coefficient of uniformity; C_c = coefficient of curvature; G_s = specific gravity; USCS = unified soil classification system; AASHTO: the American Association of State Highway and Transportation Officials

Note 1: Asphalt content determined for RAP/RPM and mortar content determined for available RCA. RPM was a recycled pavement material that included HMA and base layer aggregate and possibly some subgrade soil like in full-depth reclamation.

Note 2: Particle size analysis conducted following ASTM D 422, G_s determined by ASTM D 854, Absorption of coarse aggregate were determined by ASTM C127-07, USCS classification determined by ASTM D 2487, AASHTO classification determined by ASTM D 3282, asphalt content determined by ASTM D 6307

Note 3: Blend consists of 50% RCA (MN) and 50% Class 5 aggregate obtained at MNROAD field site

Table AT2. Maximum dry unit weight and optimum water content of the materials (Edil et al. (2012)

Specimens	States	Optimum Water Content W_{opt} (%)	Maximum Dry Unit Weight γ_{dmax} (kN/m^3)
Class 5 Aggregate	MN	8.9	20.1
Blend*	MN	8	21.3
RCA	MN	11.2	19.5
	MI	8.7	20.8
	CO	11.9	18.9
	CA	10.4	19.9
	TX	9.2	19.7
	OH	11.8	19.4
	NJ	9.5	19.8
RAP	MN	6.7	20.8
	CO	5.7	20.7
	CA	6.1	20.7
	TX	8	20.3
	OH	8.8	19.8
	NJ	6.5	20.4
	WI	7.3	20
RPM	MI	5.2	21.5
	NJ	6.3	20.6

Note: Blend consists of 50% RCA (MN) and 50% Class 5 aggregate obtained at MNROAD field site

Table AT3. Summary resilient modulus (SRM), power function model fitting parameters k_1 and k_2, and plastic strain [based on Equation (AT1)] (Edil et al. 2012)

Material	States	External			Internal			Plastic Strain (%)	SRM_{INT}/ SRM_{EXT}
		k_1	k_2	SRM (MPa)	k_1	k_2	SRM(MPa)		
Class 5 Aggregate	MN	14.9	0.43	152	43.2	0.47	525	1.60	3.5
Blend*	MN	18.2	0.43	182	50.2	0.49	675	1.05	3.7
RCA	MN	18.5	0.44	189	38.3	0.54	680	0.63	3.6
	MI	14.3	0.46	171	40.7	0.54	715	0.80	4.2
	CO	17.4	0.43	175	41.5	0.49	580	0.73	3.3
	CA	15.2	0.46	178	33.0	0.54	627	0.70	3.5
	TX	9.1	0.54	164	17.6	0.64	549	0.83	3.3
	OH	12.6	0.48	163	27.7	0.56	554	0.57	3.4
	NJ	22.0	0.42	208	49.6	0.50	735	0.55	3.5
RAP	MN	23.0	0.39	180	26.3	0.61	674	1.35	3.7
	CO	25.6	0.37	184	75.0	0.41	673	1.47	3.7
	CA	12.3	0.49	173	36.4	0.53	627	1.16	3.6
	TX	21.6	0.42	198	52.4	0.52	776	1.38	3.9
	OH	15.6	0.48	197	42.7	0.52	699	1.32	3.6
	NJ	23.5	0.41	209	54.6	0.48	715	2.13	3.4
	WI	29.5	0.41	266	65.0	0.51	968	0.89	3.6
RPM	MI	14.7	0.46	168	43.5	0.50	631	1.49	3.8
	NJ	26.3	0.43	264	61.6	0.52	989	1.26	3.8

Note: Plastic strains were determined for base materials from M_R testing by using the measured permanent deformations from the internal LVDTs with the power function model. Plastic strains were calculated as the sum of the plastic strains for each loading sequence during resilient modulus test by excluding the plastic strains in the conditioning phase (Sequence 1).

The power function model proposed by Moossazedh and Witczak (1981):

$$M_R = k_1\theta^{k_2} \quad \text{(AT1)}$$

where M_R is the resilient modulus, θ is the bulk stress, and k_1 and k_2 are empirical fitting parameters.

In Edil et al. (2012), based on the index properties (Table AT1) and compaction characteristics (Table AT2) of the materials, the forward stepwise regression technique was performed by using multiple linear regressions to develop correlations (models) to predict the compaction characteristics of RCA and RAP based on their gradation characteristics (Table AT4). A significance level of 0.05 [or alpha (α) = 0.05], which gives 95% confidence, was used to determine whether the model is statistically significant. In Edil et al. (2012), it was stated that all the independent variables used in the models shown in Table AT4 had p-values smaller than 0.05, which showed the statistical significance of those variables. As can be seen in Table AT4, for both RCA and RAP materials, W_{opt} was a function of C_u and absorption. In addition, γ_{dmax} was a function of W_{opt}.

Table AT4. Equations to estimate optimum moisture content (W_{opt}) and maximum dry unit weight (γ_{dmax}) of the materials (Edil et al. 2012)

Materials	Compaction Characteristics	Correlation Equations	R^2
RCA	W_{opt} (%)	-0.064 *Cu + 0.763 *$Absorption(\%)$ + 7.75	0.65
	γ_{dmax} (kN/m^3)	-0.374 *$W_{opt}(\%)$ + 23.6	0.83
RAP	W_{opt} (%)	-0.0626 *Cu - 1.349 *$Absorption(\%)$ + 9.84	0.92
	γ_{dmax} (kN/m^3)	-0.289* W_{opt} (%) + 22.42	0.83

W_{opt} = optimum moisture content; γ_{dmax} = maximum dry unit weight; C_u = coefficient of uniformity

An effort was made to reassess the equations given in Table AT4 using the data generated in Edil et a. (2012). First, the actual (based on the laboratory test results) and estimated (based on the equations given in Table AT4) W_{opt} and γ_{dmax} values were compared. Figure AT1 shows the actual W_{opt} vs. predicted W_{opt} for RCA and RAP. Figure AT2 shows the actual γ_{dmax} vs. predicted γ_{dmax} for RCA and RAP. Based on Figure AT1 and Figure AT2, it was observed that while the models for W_{opt} of RAP and γ_{dmax} of RCA and RAP were somewhat successful, the W_{opt} model of RCA was not satisfactory.

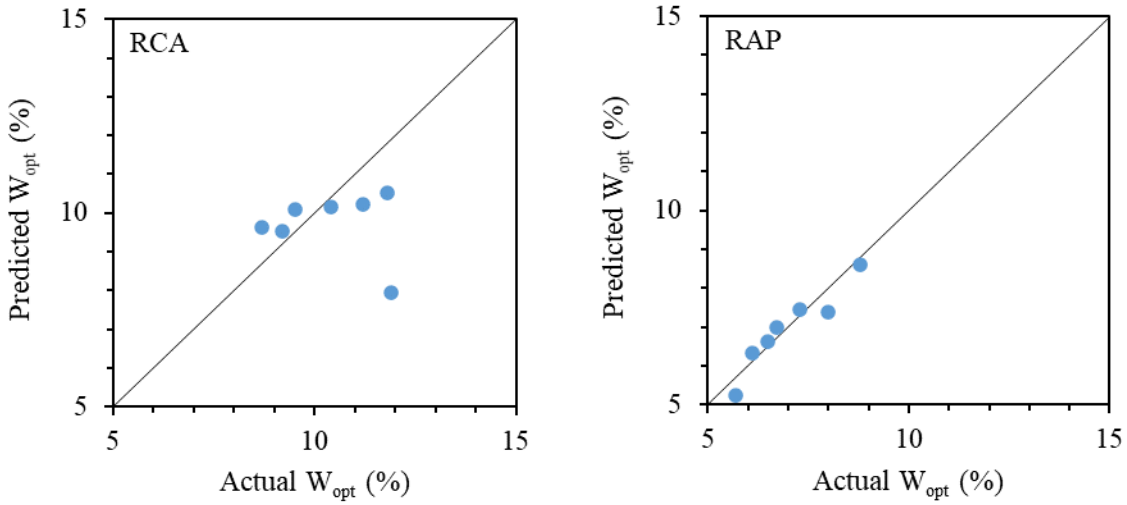


Figure AT1. Actual W_{opt} vs. predicted W_{opt} for RCA (left) and RAP (right)

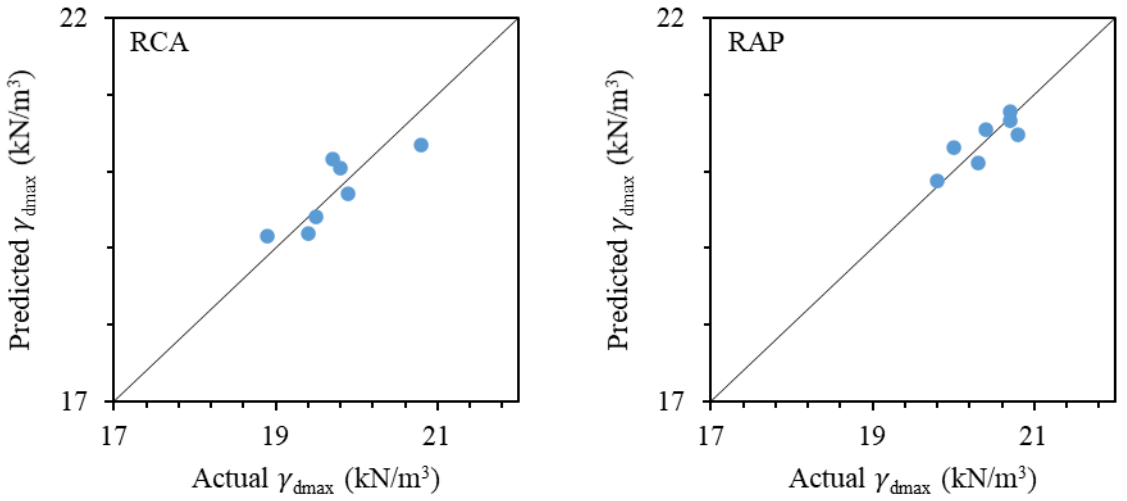


Figure AT2. Actual γ_{dmax} vs. predicted γ_{dmax} for RCA (left) and RAP (right)

The data generated by Edil et al (2012) were used to develop models that were the most convenient with statistical significance. To do so, forward stepwise regression technique, described previously, was used by considering all the parameters shown in Table AT1 and Table AT2, and new models were established.

Table AT5 summarizes the new equations to estimate W_{opt}. According to Table AT4, W_{opt} was a function of C_u and absorption for both RCA and RAP materials. However, as can be seen from Table AT5, there was no equation that contained both C_u and absorption parameters. For RCA, neither C_u nor absorption was statistically significant (Table AT5). For RAP, while absorption was statistically significant, C_u was insignificant. The combination of G_s and absorption was found to be statistically significant for RAP materials. In addition to separate regression analyses for RCA and RAP materials, these materials were combined with each other and with class 5 aggregate to establish more models (Table AT5).

Table AT6 summarizes the new equations to estimate γ_{dmax}. According to Table AT4, γ_{dmax} was a function of W_{opt} for both RCA and RAP. As can be seen from Table AT6, both equations shown in Table AT4 were statistically significant. In Table AT4, the R^2 values of both models were reported as 0.83. However, after reassessing the reported equations, it was found that multiple R values, which were 0.83, were reported instead of R^2 values. According to Table AT6, the correct R^2 values were 0.690 and 0.694 for RCA and RAP, respectively. In addition to separate regression analyses for RCA and RAP materials, these materials were combined with each other and with class 5 aggregate to establish more models (Table AT6).

Table AT5. New equations to estimate optimum moisture content (W_{opt}) (%) of the materials

Material	Equation	R^2	Adj. R^2	Std. Error
RCA	-8.2941*D_{10} (mm) + 12.4000	0.67	0.6	0.81
RAP	-1.3891*Absorption (%) + 9.4552	0.9	0.88	0.38
	-1.5831*Absorption (%) - 3.5587*G_s + 18.2910	0.99	0.98	0.16
RCA and RAP	0.7619*Absorption (%) + 5.9300	0.55	0.52	1.45
	0.0889*C_u + 6.7750	0.54	0.5	1.48
	0.4642*Fines (%) + 7.2345	0.54	0.5	1.48
	#0.0769*Mortar Content (%) + 7.0368	0.81	0.79	1.04
RCA, RAP, and Class 5	#0.0725*Mortar Content (%) + 7.2647	0.76	0.73	1.12
	#0.0598*Mortar Content (%) + 0.1864*Fines (%) + 6.8460	0.84	0.81	0.94
RCA and Class 5	#0.0482*Mortar Content (%) - 0.3237*D_{30} (mm) + 9.1488	0.92	0.86	0.49
	#0.0472*Mortar Content (%) - 0.4115*C_c + 9.5007	0.93	0.88	0.44

#RCA-MI and RCA-NJ materials were removed because their mortar contents were not reported

Table AT6. New equations to estimate maximum dry unit weight (γ_{dmax}) (kN/m^3) of the materials

Material	Equation	R^2	Adj. R^2	Std. Error
RCA	-0.3743*W_{opt} (%) + 23.6015	0.69	0.63	0.35
	3.4559*D_{10} (mm) + 18.8750	0.57	0.49	0.42
RAP	-0.2900*W_{opt} (%) + 22.4195	0.69	0.63	0.23
	0.4714*Absorption (%) + 0.2977*Fines (%) + 19.1788	0.90	0.85	0.15
RCA and RAP	-0.2413*W_{opt} (%) + 22.1494	0.74	0.72	0.31
	#-0.0179*Mortar Content (%) + 20.3795	0.64	0.61	0.37
RCA, RAP, and Class 5	-0.2410*W_{opt} (%) + 22.1531	0.74	0.72	0.30
	#-0.0172*Mortar Content (%) + 20.3453	0.62	0.59	0.36
RCA and Class 5	-0.3557*W_{opt} (%) + 23.3907	0.70	0.65	0.33

#RCA-MI and RCA-NJ materials were removed because their mortar contents were not reported

In Edil et al. (2012), based on the index properties (Table AT1), compaction characteristics (Table AT2), and SRM values (based on power function) of the materials, the forward stepwise regression technique was performed by using multiple linear regressions to develop correlations (models) to predict the SRM values (based on power function) (Table AT3). A significance level of 0.05 [or alpha (α) = 0.05], which

gives 95% confidence, was used to determine whether the model is statistically significant. In Edil et al. (2012), it was stated that all the independent variables used in the models shown in Table AT7 had p-values smaller than 0.05, which showed the statistical significance of those variables.

Table AT7. Equations to estimate the summary resilient modulus (SRM) of the materials determined by the power function model (Edil et al. 2012)

Materials	Summary Resilient Modulus (SRM) (Mpa)	Correlation Equations	R^2
RCA	SMR_{EXT}	$171.646-(3.482*D_{30}) + (22.378*\text{Impurities \%})$	0.89
	SMR_{INT}	$14683.478 - (36.764*D_{30}) - (72.719*W_{opt})$	0.89
RAP	SMR_{EXT}	$(117.493 * D_{30}) + (19.472 *\gamma_{dmax} + (27.128 * \text{Asphalt Content(\%)}) - (18.510 * \text{Absorption(\%)}) -427.329$	0.99
	SMR_{INT}	$(-2268.783)-(285.884*\text{Fines \%})+(628.742*\text{Asphalt content (\%)})+ (201.107*D_{60})-(483.158*G_s)-(58.243*\text{Absorption (\%)})$	0.99

D_{30} = particle size for 30% finer; W_{opt} = optimum moisture content; γ_{dmax} = maximum dry unit weight; G_s = specific gravity

An effort was made to reassess the equations given in Table AT7. First, the actual (based on the laboratory test results) and estimated (based on the equations given in Table AT7) SM_R values were compared. Figure AT3 shows the actual SRM based on external linear variable differential transformer (LVDT) (SRM_{EXT}) vs. predicted SRM_{EXT} for RCA and RAP. Figure AT4 shows the actual SRM based on internal linear LVDT (SRM_{INT}) vs. predicted SRM_{INT} for RCA and RAP. Based on Figure AT3 and Figure AT4, it was observed that while the models for RCA were somewhat successful, the models for RAP was not satisfactory.

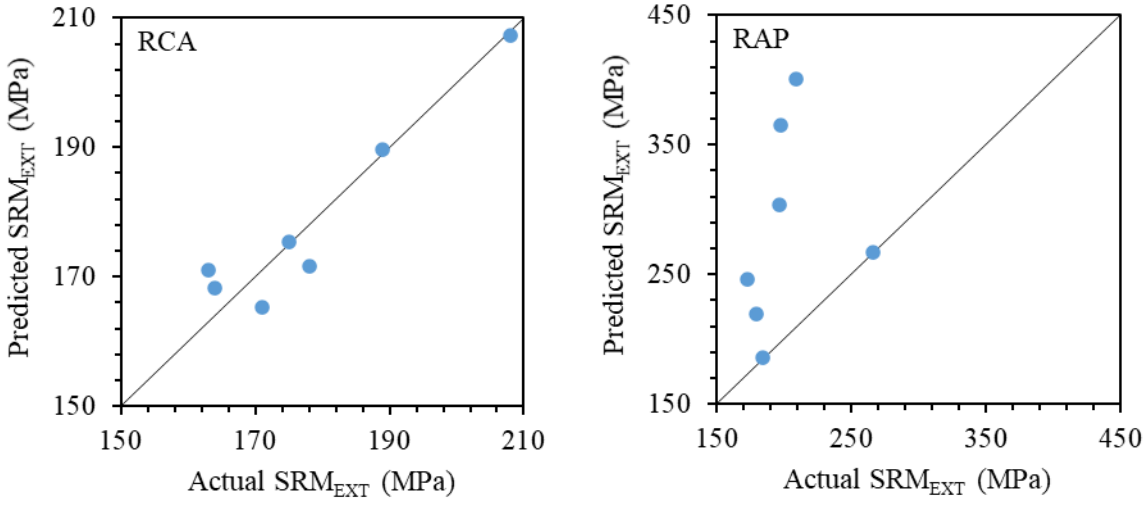


Figure AT3. Actual SRM_{EXT} vs. predicted SRM_{EXT} for RCA (left) and RAP (right)

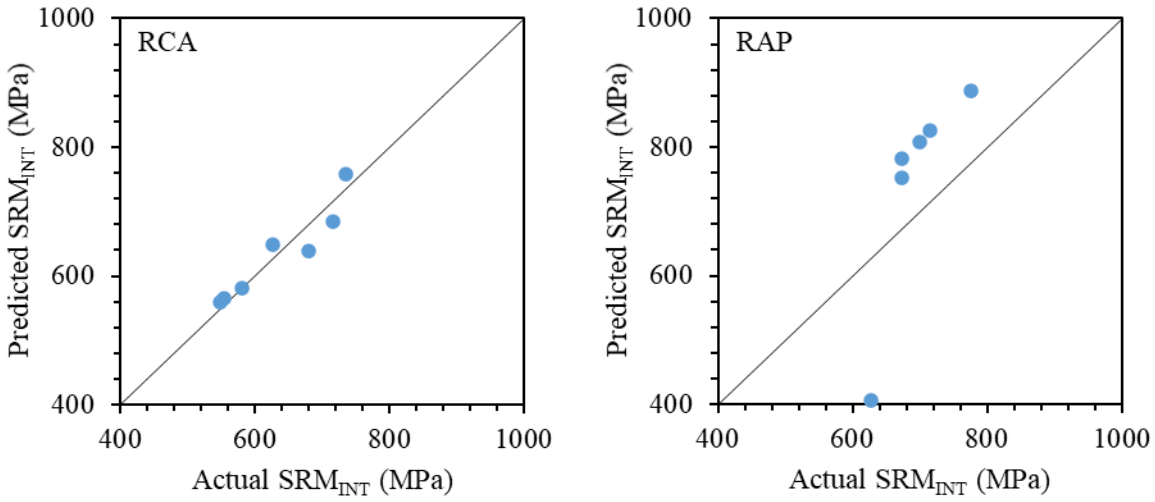


Figure AT4. Actual SRM_{INT} vs. predicted SRM_{INT} for RCA (left) and RAP (right)

The data generated by Edil et al (2012) were used to develop models that are the most convenient with statistical significance. The forward stepwise regression method was performed by using multiple linear regressions to develop correlations (models) to predict the SRM values (based on power function) (Table AT3).

Table AT8 summarizes the new equations to estimate SRM_{EXT}. According to Table AT7, the SRM_{EXT} of RCA materials was a function of D_{30} and impurities. As can be seen from Table AT8, both D_{30} and impurities were statistically significant for SRM_{EXT} of RCA. In addition, Table AT8 shows that not only D_{30} but also C_c can be used in combination with impurities to estimate SRM_{EXT} of RCA. While Table AT7 shows a complex equation to estimate SRM_{EXT} of RAP, reassessment of the laboratory data revealed that none of those parameters was statistically significant. Therefore, no statistically significant equation could be found for SRM_{EXT} of RAP. In addition to the separate regression analyses for RCA and RAP materials, these materials were combined with each other and with class 5 aggregate to establish more models. Among the combinations, only the combination of RCA and class 5 aggregate provided an equation (Table AT8).

Table AT9 summarizes the new equations to estimate SRM_{INT}. According to Table AT7, the SRM_{INT} of RCA materials was a function of D_{30} and W_{opt}. As can be seen from Table AT9, both D_{30} and W_{opt} were statistically significant for SRM_{INT} of RCA. In addition, Table AT9 shows that G_s can also be used to estimate SRM_{INT} of RCA. While Table AT7 shows a complex equation to estimate SRM_{INT} of RAP, reassessment of the laboratory data revealed that none of those parameters had a statistical significance. Thus, any equation, which are statistically significant, could not be found for SRM_{INT} of RAP. In addition to the separate regression analyses for RCA and RAP materials, these materials were combined with each other and with class 5 aggregate to establish more models. However, no statistically significant equations could be found for the combinations (Table AT9).

Table AT8. New equations to estimate SRM_{EXT} (MPa) of the materials

Material	Equation	R^2	Adj. R^2	Std. Error
RCA	23.0770*Impurities (%) + 163.6812	0.63	0.55	10.58
	21.0281*Impurities (%) - 4.3410*C_c + 174.7761	0.92	0.88	5.5
	22.0836*Impurities (%) - 3.5436*D_{30} (mm) + 171.9035	0.89	0.84	6.31
RAP	No Equation			
RCA and RAP	No Equation			
RCA, RAP, and Class 5	No Equation			
RCA and Class 5	28.1646*Impurities (%) + 159.6937	0.62	0.55	11.6

C_c = coefficient of curvature

Table AT9. New equations to estimate SRM_{INT} (MPa) of the materials

Material	Equation	R^2	Adj. R^2	Std. Error
RCA	1091.5850*G_s - 1888.8350	0.59	0.5	54.10
	-36.8275*D_{30} (mm) - 72.9428*W_{opt} (%) + 1470.7646	0.89	0.83	31.37
RAP	No Equation			
RCA and RAP	No Equation			
RCA, RAP, and Class 5	No Equation			
RCA and Class 5	No Equation			

G_s = specific gravity; W_{opt} = optimum moisture content

APPENDIX AU
FIELD TEST RESULTS (DURING CONSTRUCTION) USED IN FORWARD STEPWISE REGRESSION ANALYSES

Cell Number	Median NDG Moisture Content (%)	Median NDG Dry Unit Weight (kN/m^3)	Median Relative OMC (%)	Median Relative MDU (%)	Median DCPI (mm/blow)	Median CBR (%)	Median E_{LWD} (MPa)	Median E_{FWD} (MPa)	Median IC M_R at 69 kPa (MPa)	Median IC M_R at 207 kPa (MPa)
185	6.86	18.65	72.33	92.34	7.58	30.24	98.06	165.47	265.04	305.98
186	7.5	18.27	67.71	95.59	7.49	30.62	99.52	222.01	278.43	311.51
188	4.43	21.28	70.53	94.62	8.46	27.01	84.85	102.04	171.48	166.4
189	6.57	18.53	65.91	93.79	9.87	22.57	71.88	77.91	144.05	134.81
127	5.49	18.99	66.46	94.07	9	24.92	79.52	102.04	216.39	208.48
227	5.62	19.2	68.1	95.08	7	33.03	82.79	108.25	153.74	146.92
328	7.7	17.86	79.99	88.79	9.5	23.54	64.03	43.44	120.51	97.87
428	7.89	17.82	81.94	88.6	9	24.92	46.7	31.37	105.7	81.65
528	6.2	17.01	64.38	84.58	10.5	21.03	25.68	23.79	85.02	66.87
628	8.03	18.15	83.4	90.25	10.5	21.03	47.49	35.85	106.88	89.65
728	8.5	17.36	88.28	86.31	11	19.91	59.88	60.67	115.96	109.82

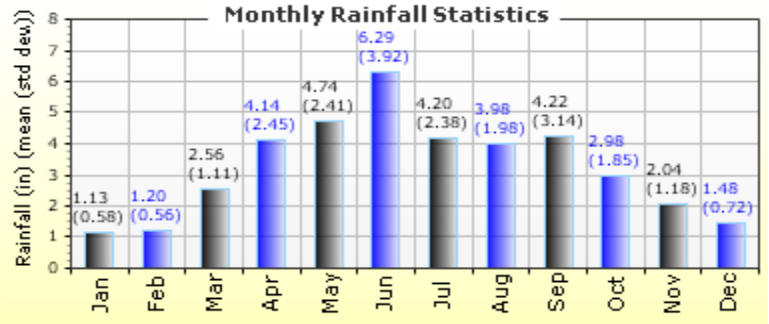
NDG = nuclear density gauge; OMC = optimum moisture content; MDU = maximum dry unit weight; DCPI = dynamic cone penetration (DCP) index; CBR = field California bearing ratio; E_{LWD} = light weight deflectometer (LWD) elastic modulus; E_{FWD} = falling weight deflectometer (FWD) elastic modulus; IC M_R = intelligent compaction resilient modulus

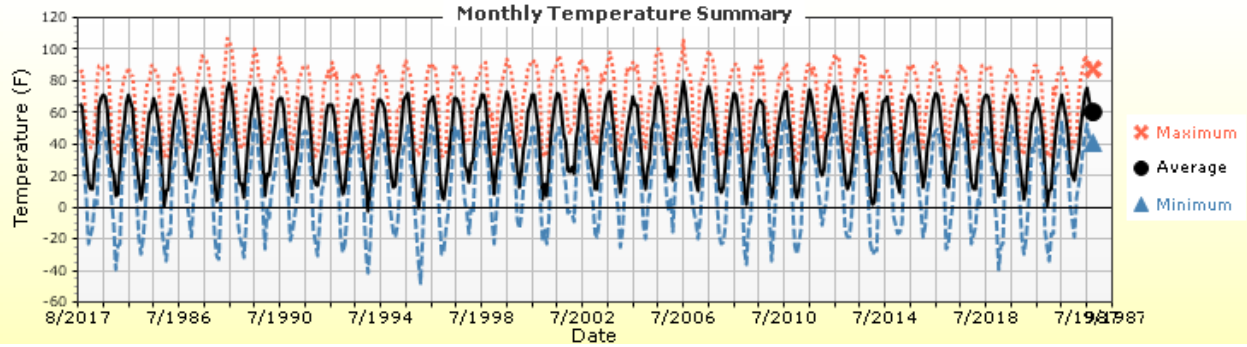
APPENDIX AV
ALTERNATIVE MODELS TO ESTIMATE INTELLIGENT COMPACTION (IC) RESILIENT MODULUS (M_R) AT 207 KPA (30 PSI)

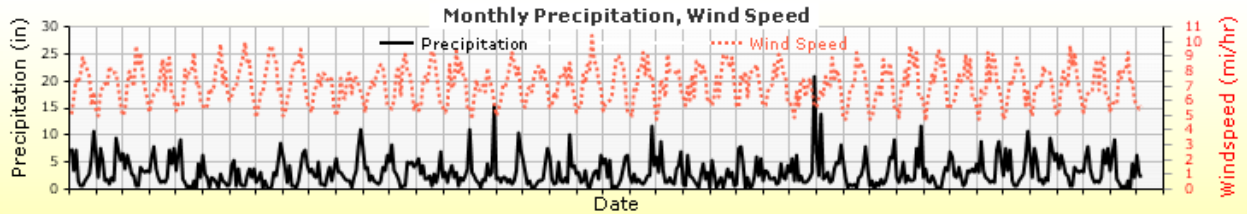
Equation	R^2	Adj. R^2	Std. Error
3.0066*Median E_{LWD} (MPa) + 30.0589*Combined Absorption (%) - 31.5527*Median NDG Moisture Content (%) - 3.6529	0.94	0.91	25.65
3.1960*Median E_{LWD} (MPa) + 16.8517*Fine Absorption (%) - 31.3564*Median NDG Moisture Content (%) + 15.5679	0.94	0.91	26.01
1.8399*Median E_{LWD} (MPa) + 26.0419*Fine Absorption (%) - 86.9710*Coarse Absorption (%) + 154.2450	0.93	0.9	27.54
3.2263*Median E_{LWD} (MPa) + 10.2064*Fine Absorption (%) - 2.8517*Median Relative OMC (%) + 62.4653	0.93	0.9	27.68
3.4006*Median E_{LWD} (MPa) + 14.0113*Combined Absorption (%) - 156.4348	0.87	0.83	34.92
3.4875*Median E_{LWD} (MPa) + 7.8616*Fine Absorption (%) - 146.8084	0.87	0.83	35.04

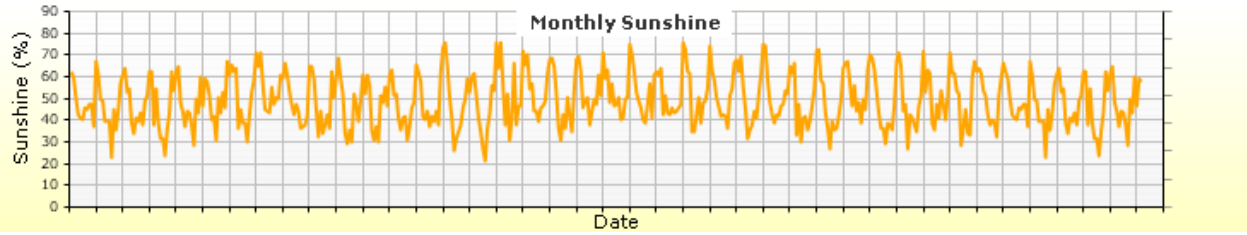
E_{LWD} = light weight deflectometer (LWD) elastic modulus; OMC = optimum moisture content; NDG = nuclear density gauge

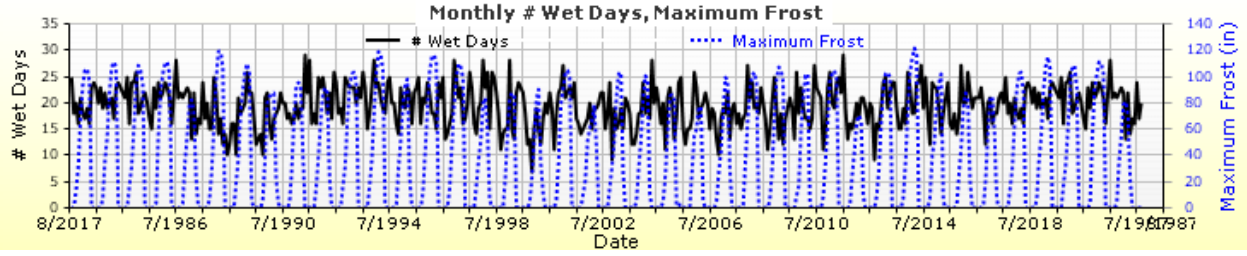
APPENDIX AW
MONTHLY RAINFALL STATISTICS, MONTHLY CLIMATE SUMMARY, AND HOURLY AIR TEMPERATURE DISTRIBUTION BY MONTH FOR MINNESOTA ROAD RESEARCH PROJECT (MNROAD) LOW VOLUME ROAD (LVR) TEST FACILITY


Monthly Rainfall Statistics
Rainfall (in) (mean (std dev))
1.13 (0.58)
1.20 (0.56)
2.56 (1.11)
4.14 (2.45)
4.74 (2.41)
6.29 (3.92)
4.20 (2.38)
3.98 (1.98)
4.22 (3.14)
2.98 (1.85)
2.04 (1.18)
1.48 (0.72)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

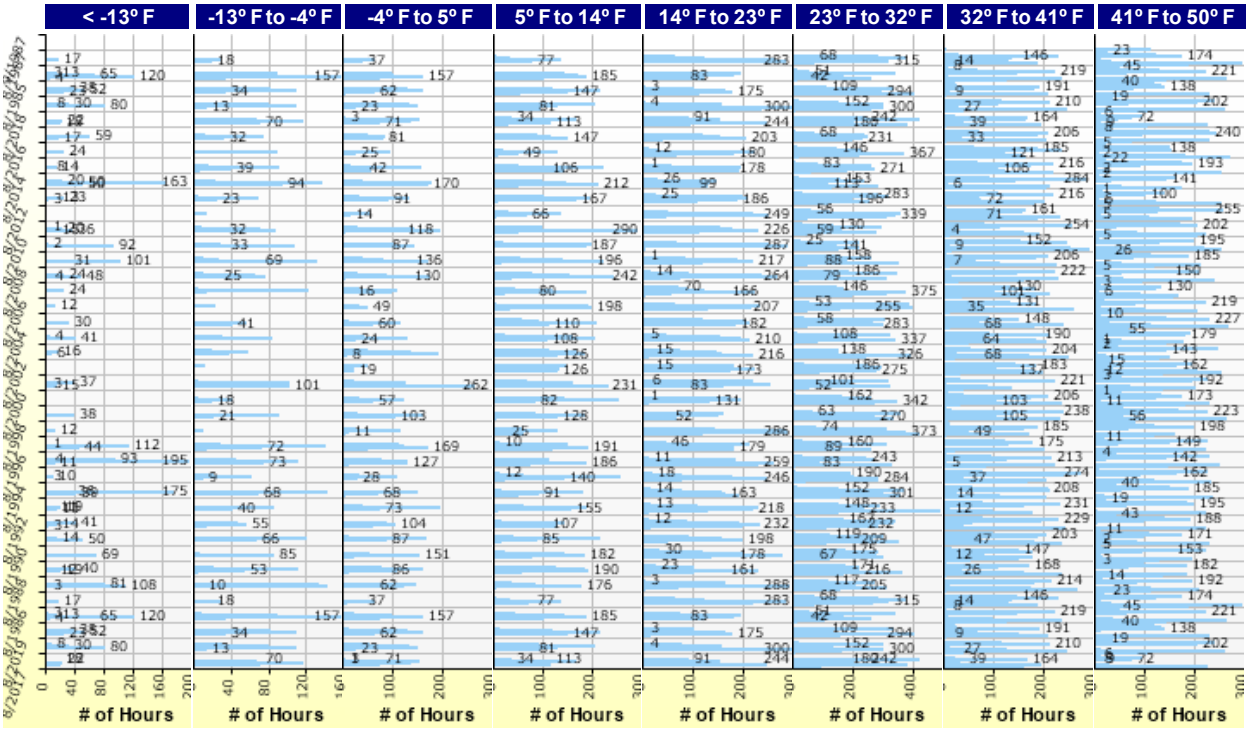

Monthly Temperature Summary
Temperature (F)
Maximum
Average
Minimum
8/2017
7/1986
7/1990
7/1994
7/1998
7/2002
7/2006
7/2010
7/2014
7/2018
Date

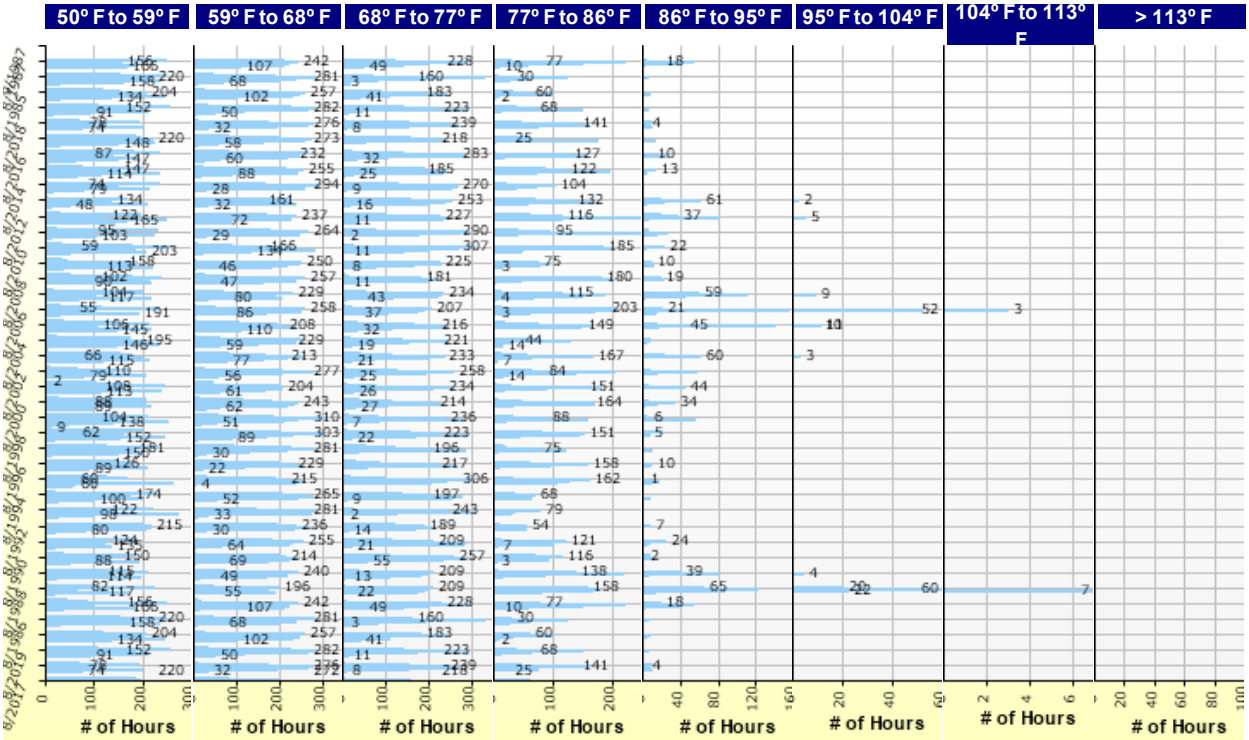

Monthly Precipitation, Wind Speed
Precipitation
Wind Speed
Precipitation (in)
Windspeed (mi/hr)
Date


Monthly Sunshine
Sunshine (%)
Date

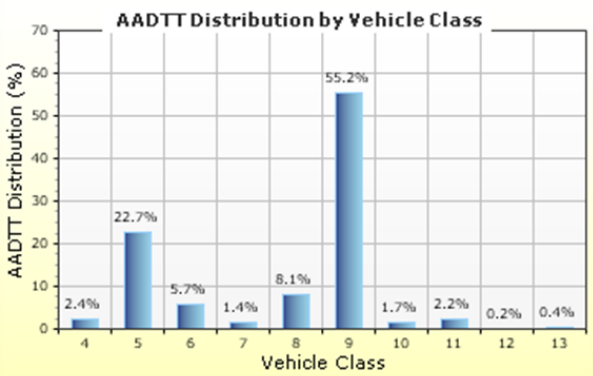

Monthly # Wet Days, Maximum Frost
Wet Days
Maximum Frost
Maximum Frost (in)
8/2017
7/1986
7/1990
7/1994
7/1998
7/2002
7/2006
7/2010
7/2014
7/2018
Date

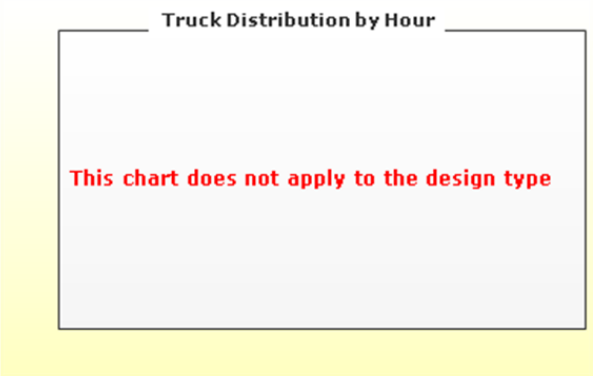
Hourly Air Temperature Distribution by Month:

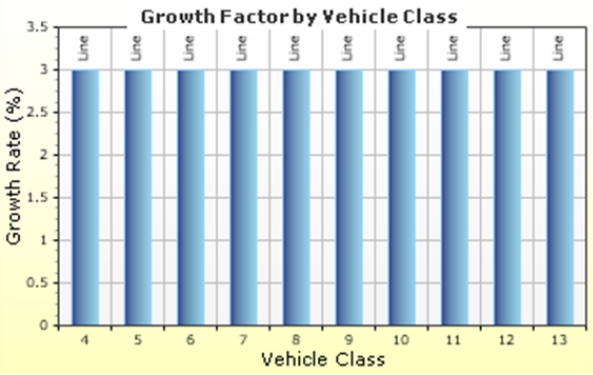


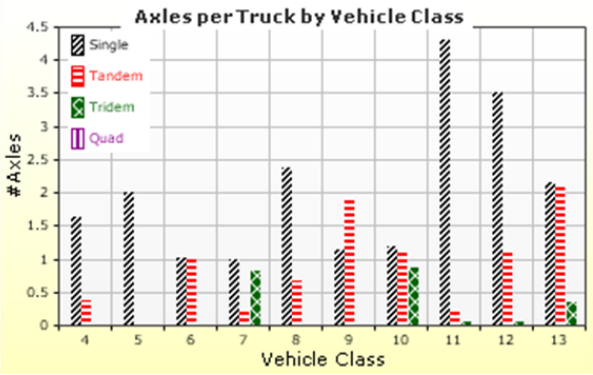


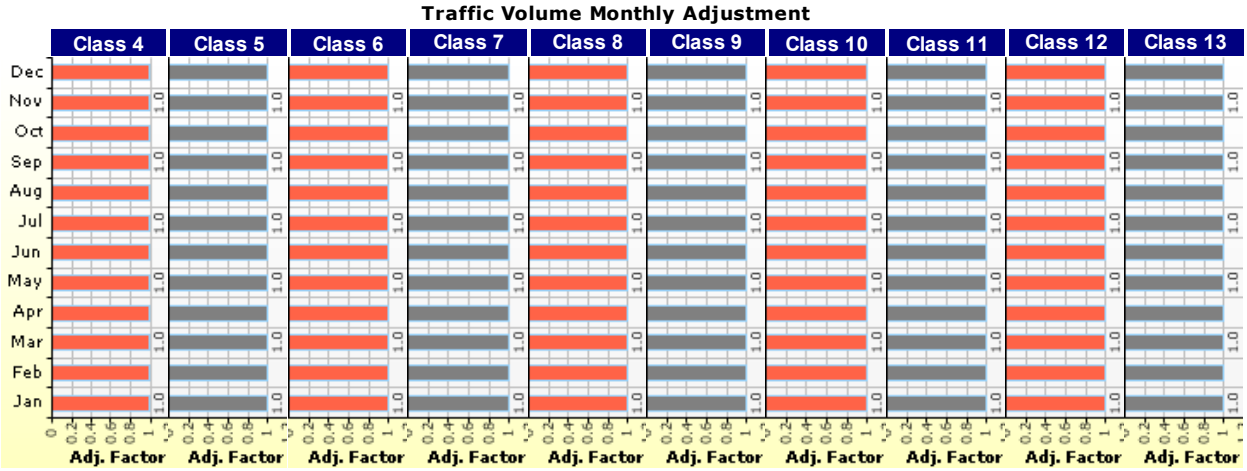
APPENDIX AX
GRAPHICAL AND TABULAR REPRESENTATIONS OF TRAFFIC INPUTS AND AXLE CONFIGURATION


AADTT Distribution by Vehicle Class
AADTT Distribution (%)
Vehicle Class
2.4%
22.7%
5.7%
1.4%
8.1%
55.2%
1.7%
2.2%
0.2%
0.4%


Truck Distribution by Hour
This chart does not apply to the design type


Growth Factor by Vehicle Class
Growth Rate (%)
Vehicle Class
Line


Axles per Truck by Vehicle Class
#Axles
Vehicle Class
Single
Tandem
Tridem
Quad


Traffic Volume Monthly Adjustment
Class 4
Class 5
Class 6
Class 7
Class 8
Class 9
Class 10
Class 11
Class 12
Class 13
Dec
Nov
Oct
Sep
Aug
Jul
Jun
May
Apr
Mar
Feb
Jan
Adj. Factor

Volume Monthly Adjustment Factors

Level 3: Default MAF

Month	Vehicle Class									
	4	5	6	7	8	9	10	11	12	13
January	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
February	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
March	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
April	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
May	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
June	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
July	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
August	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
September	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
October	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
November	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
December	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Distributions by Vehicle Class

Vehicle Class	AADTT Distribution (%) (Level 3)	Growth Factor	
		Rate (%)	Function
Class 4	2.4%	3%	Linear
Class 5	22.7%	3%	Linear
Class 6	5.7%	3%	Linear
Class 7	1.4%	3%	Linear
Class 8	8.1%	3%	Linear
Class 9	55.2%	3%	Linear
Class 10	1.7%	3%	Linear
Class 11	2.2%	3%	Linear
Class 12	0.2%	3%	Linear
Class 13	0.4%	3%	Linear

Axle Configuration

Traffic Wander	
Mean wheel location (in)	18.0
Traffic wander standard deviation (in)	10.0
Design lane width (ft)	12.0

Axle Configuration	
Average axle width (ft)	8.5
Dual tire spacing (in)	12.0
Tire pressure (psi)	120.0

Average Axle Spacing	
Tandem axle spacing (in)	51.6
Tridem axle spacing (in)	49.2
Quad axle spacing (in)	49.2

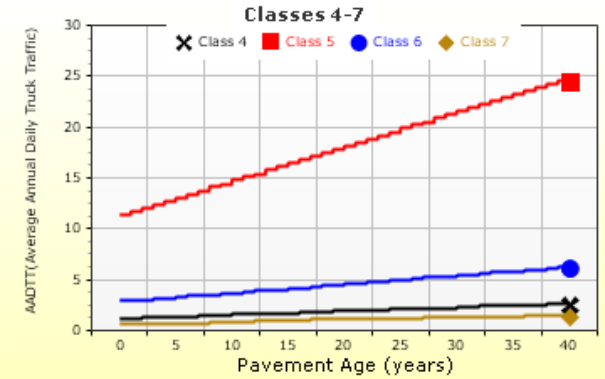
Wheelbase does not apply

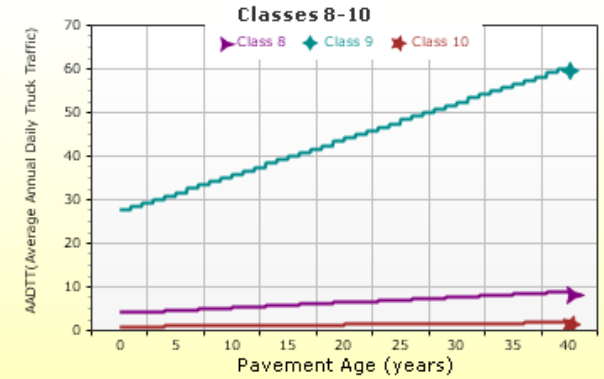
Number of Axles per Truck

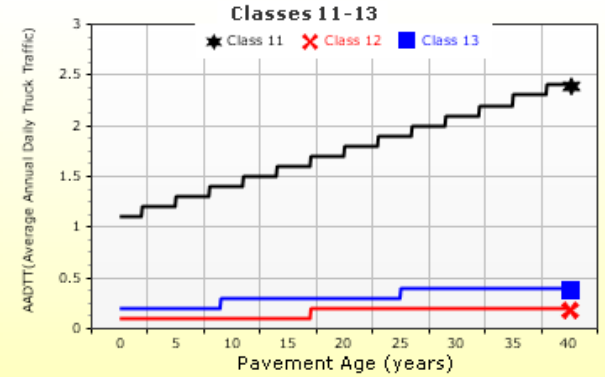
Vehicle Class	Single Axle	Tandem Axle	Tridem Axle	Quad Axle
Class 4	1.62	0.39	0	0
Class 5	2	0	0	0
Class 6	1.02	0.99	0	0
Class 7	1	0.26	0.83	0
Class 8	2.38	0.67	0	0
Class 9	1.13	1.93	0	0
Class 10	1.19	1.09	0.89	0
Class 11	4.29	0.26	0.06	0
Class 12	3.52	1.14	0.06	0
Class 13	2.15	2.13	0.35	0

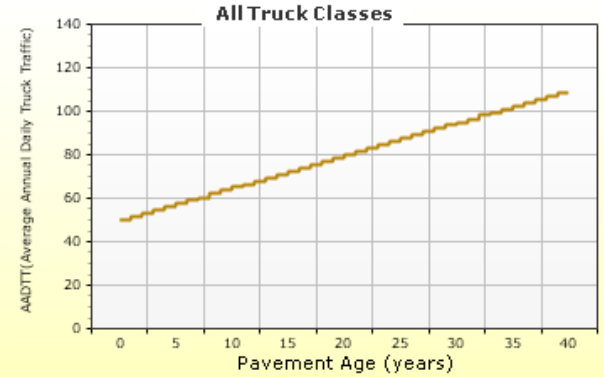
AADTT (Average Annual Daily Truck Traffic) Growth

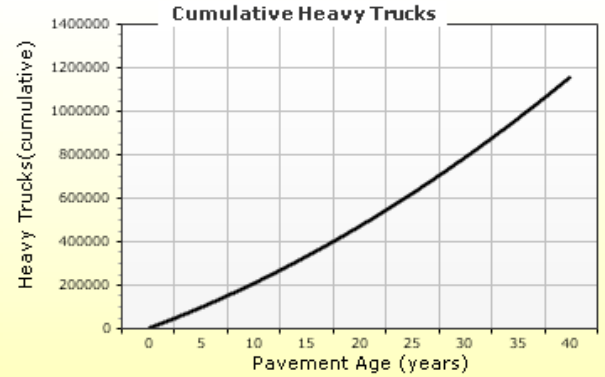
*** Traffic cap is not enforced**











APPENDIX AY
ASPHALT LAYER PARAMETERS (LEVEL 3) IN PAVEMENT ME

HMA Design Properties

Use Multilayer Rutting Model	False
Using G* based model (not nationally calibrated)	False
Is NCHRP 1-37A HMA Rutting Model Coefficients	True
Endurance Limit	-
Use Reflective Cracking	True

Structure - ICM Properties	
AC surface shortwave absorptivity	0.85

Layer Name	**Layer Type**	**Interface Friction**
Layer 1 Flexible : Default asphalt concrete	Flexible (1)	1.00
Layer 2 Non-stabilized Base : A-1-a	Non-stabilized Base (4)	1.00
Layer 3 Non-stabilized Base : A-1-b	Non-stabilized Base (4)	1.00
Layer 4 Subgrade : A-1-b	Subgrade (5)	-

Master Curve Plot

Delta	2.8417502
Alpha	3.870018
Beta	-0.6501216
Gamma	0.313351
c	1.255882
SSE	0
Se/Sy	0

log(Reduce	E* (psi)	14 oF	40 oF	70 oF	100 oF	130 oF
-6.0271108	2682441.7	2682441.7				
-5.6291708	2477445	2477445				
-4.6291708	1949019.2	1949019.2				
-4.3281408	1790705.9	1790705.9				
-3.597245	1419160.5		1419160.5			
-3.1993049	1229267.8		1229267.8			
-2.1993049	809542.6		809542.6			
-1.8982749	702304.56		702304.56			
-1.39794	545336.95			545336.95		
-1	439474.08			439474.08		
0	242381.01			242381.01		
0.30103	200015.76			200015.76		
0.3203962	197523.86				197523.86	
0.7183362	152018.74				152018.74	
1.7183362	76682.67				76682.67	
2.0193662	62165.031				62165.031	
1.6808806	78707.012					78707.012
2.0788206	59637.836					59637.836
3.0788206	29842.823					29842.823
3.3798506	24350.865					24350.865

Shift Factor Plot

c	1.255882

Temp (F)	Shift	14 oF	40 oF	70 oF	100 oF	130 oF
14	4.6291708	4.6291708				
40	2.1993049		2.1993049			
70	0			0		
100	-1.7183362				-1.7183362	
130	-3.0788206					-3.0788206

Temperature Viscosity

Ao	10.035
VTSo	-3.35

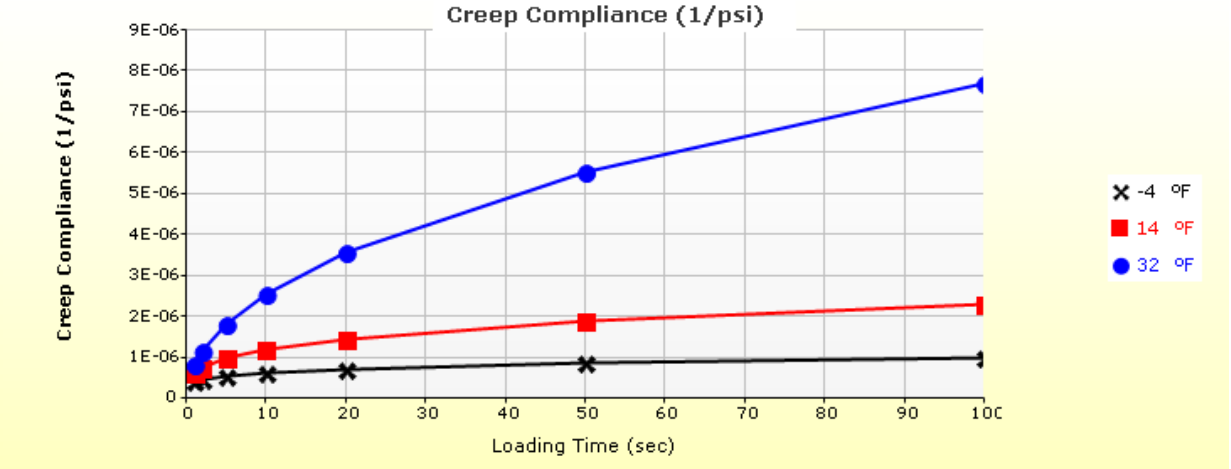
Log Temp	Log(Viscosity (cp))
2.6987093	9.87014833
2.72403	8.118944837
2.7479553	6.750714198
2.7706311	5.667424222

Thermal Cracking

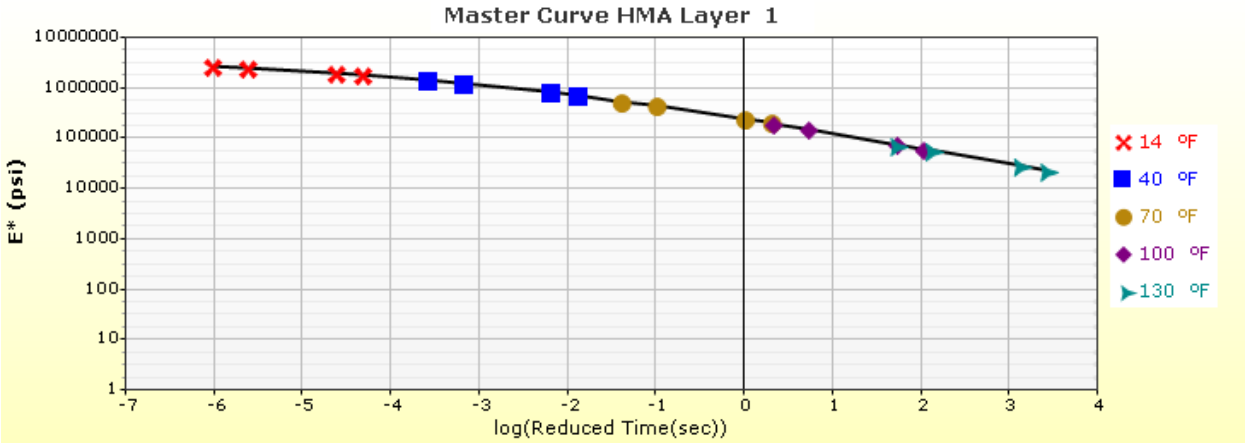
Thermal Contraction	
Is thermal contraction calculated?	True
Mix coefficient of thermal contraction (in/in/ºF)	-
Aggregate coefficient of thermal contraction (in/in/ºF)	5.0e-006
Voids in Mineral Aggregate (%)	18.6

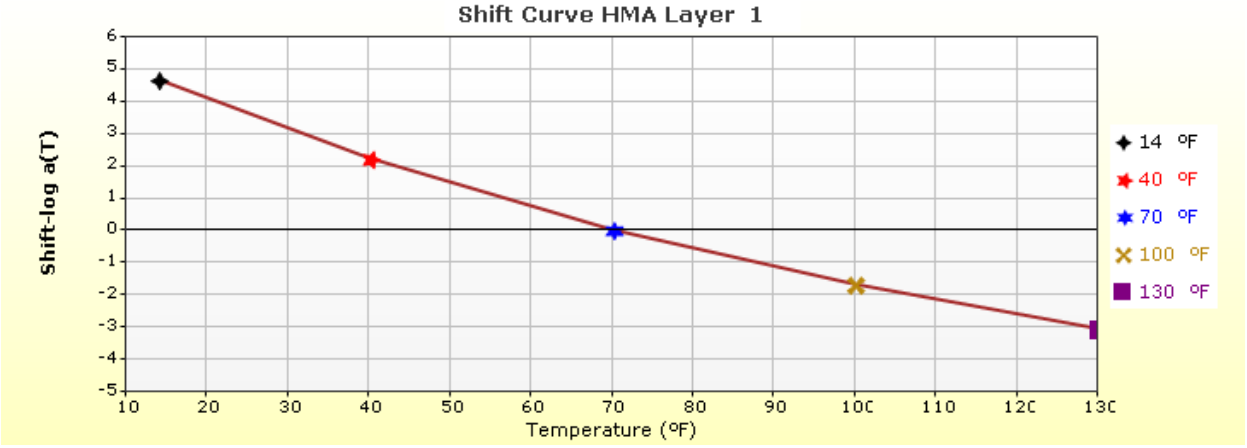
Indirect Tensile Strength (Input Level: 3)	
Test Temperature (ºF)	Indirect Tensilte Strength (psi)
14.0	473.35

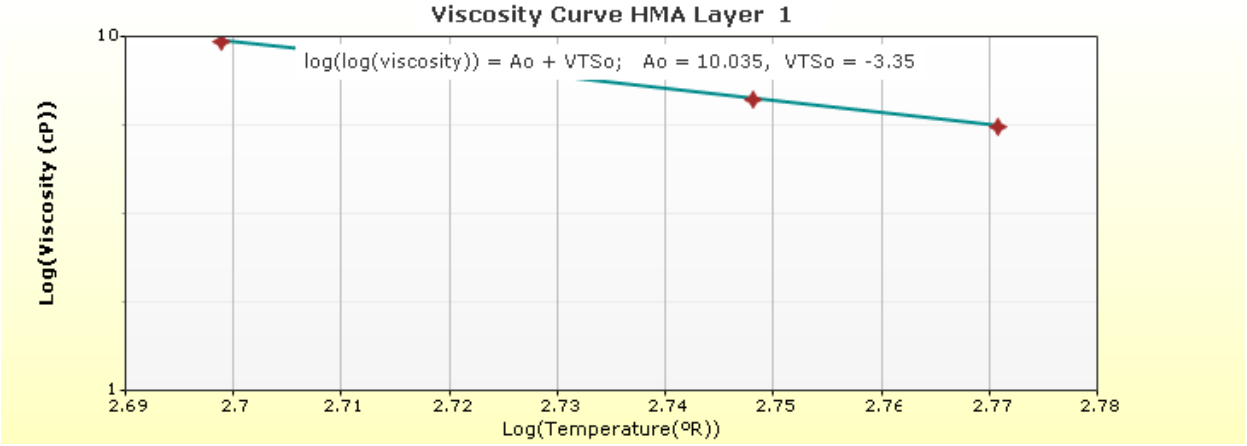
Creep Compliance (1/psi) (Input Level: 3)			
Loading time (sec)	-4 ºF	14 ºF	32 ºF
1	4.14e-007	6.27e-007	8.50e-007
2	4.72e-007	7.63e-007	1.19e-006
5	5.62e-007	9.89e-007	1.84e-006
10	6.42e-007	1.20e-006	2.56e-006
20	7.32e-007	1.46e-006	3.57e-006
50	8.71e-007	1.90e-006	5.55e-006
100	9.94e-007	2.31e-006	7.73e-006



HMA Layer 1: Layer 1 Flexible : Default asphalt concrete







Layer 1 Flexible : Default asphalt concrete

Asphalt		
Thickness (in)	3.5	
Unit weight (pcf)	150.0	
Poisson's ratio	Is Calculated?	False
	Ratio	0.30
	Parameter A	-
	Parameter B	-

Asphalt Dynamic Modulus (Input Level: 3)

Gradation	Percent Passing
3/4-inch sieve	100
3/8-inch sieve	77
No.4 sieve	60
No.200 sieve	6

Asphalt Binder

Parameter	Value
Grade	Superpave Performance Grade
Binder Type	58-34
A	10.035
VTS	-3.35

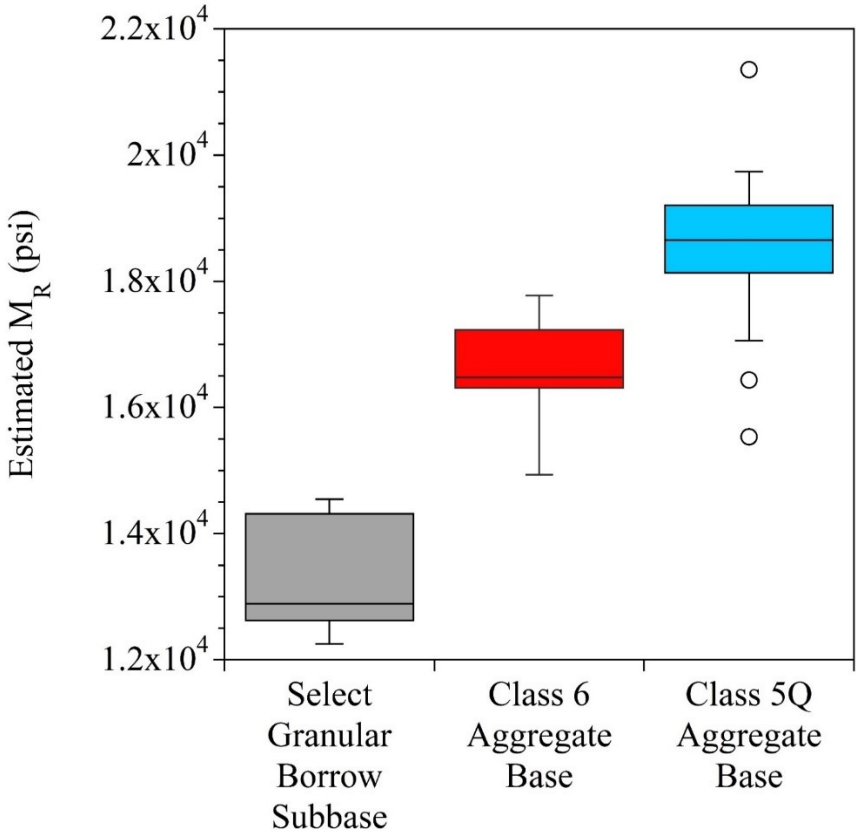
General Info

Name	Value
Reference temperature (ºF)	70
Effective binder content (%)	11.6
Air voids (%)	7
Thermal conductivity (BTU/hr-ft-ºF)	0.67
Heat capacity (BTU/lb-ºF)	0.23

Identifiers

Field	Value
Display name/identifier	Default asphalt concrete
Description of object	
Author	
Date Created	10/30/2010 12:00:00 AM
Approver	
Date approved	10/30/2010 12:00:00 AM
State	
District	
County	
Highway	
Direction of Travel	
From station (miles)	
To station (miles)	
Province	
User defined field 1	
User defined field 2	
User defined field 3	
Revision Number	0

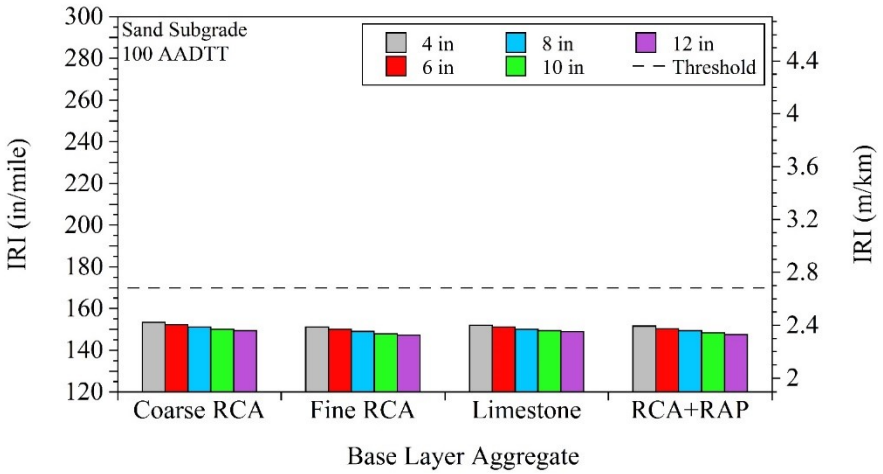
APPENDIX AZ
ESTIMATION OF SUMMARY RESILIENT MODULUS (SM_R) FOR SELECT GRANULAR BORROW, CLASS 6 AGGREGATE, AND CLASS 5Q AGGREGATE

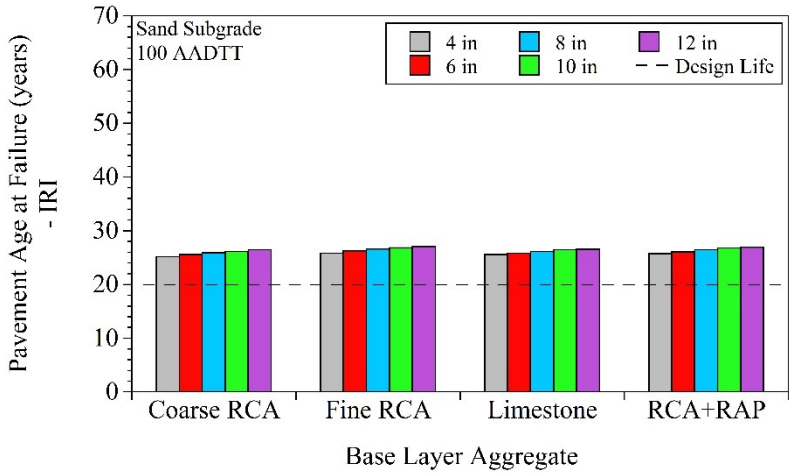


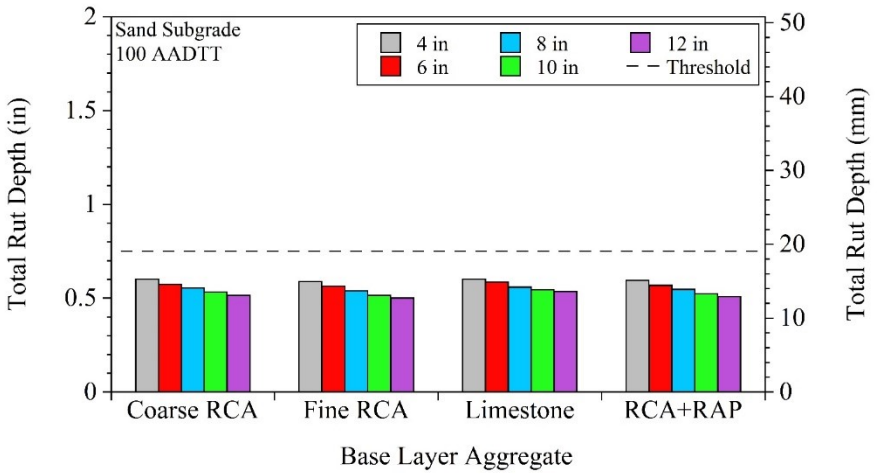
Median SM_R values:
Select Granular Borrow subbase = 12,888 psi
Class 6 Aggregate base = 16,478.9 psi
Class 5Q Aggregate base = 18,651.1 psi

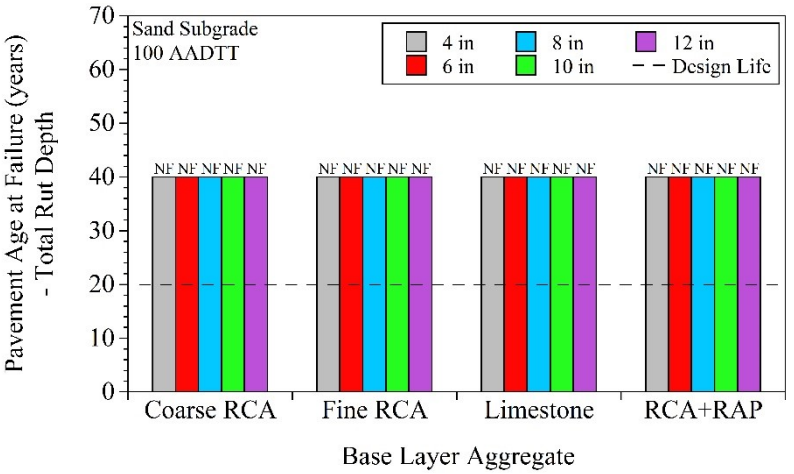
APPENDIX BA
EFFECT OF AGGREGATE BASE LAYER THICKNESS ON PAVEMENT PERFORMANCE PREDICTIONS

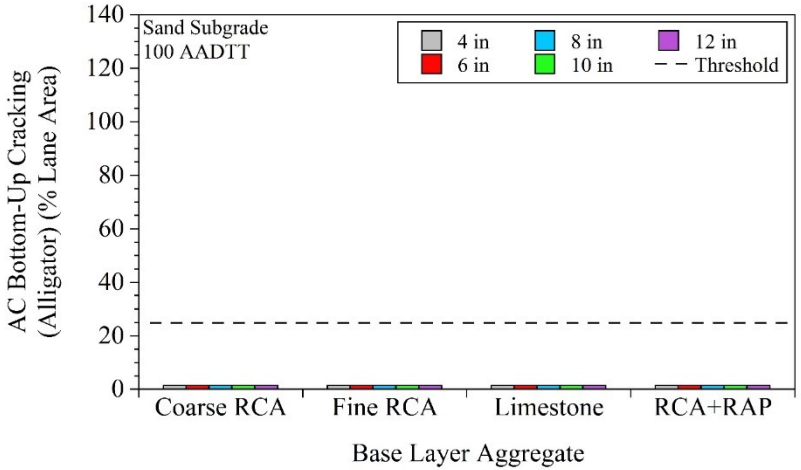
For pavement models that contained Sand Subgrade - 100 AADTT:

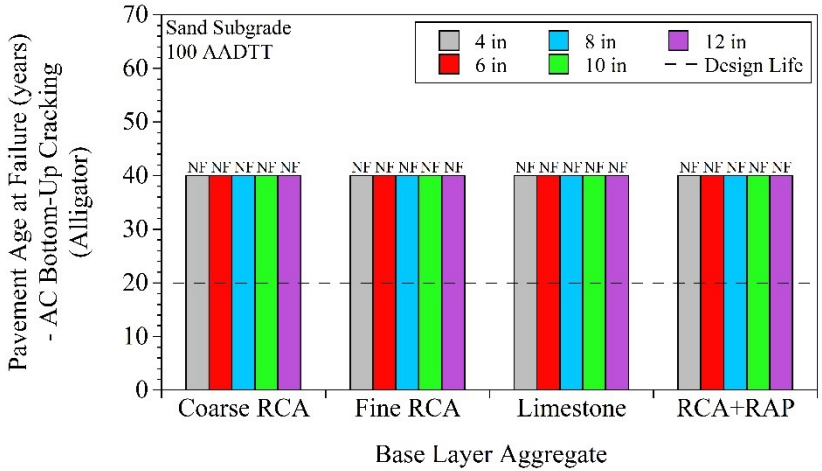


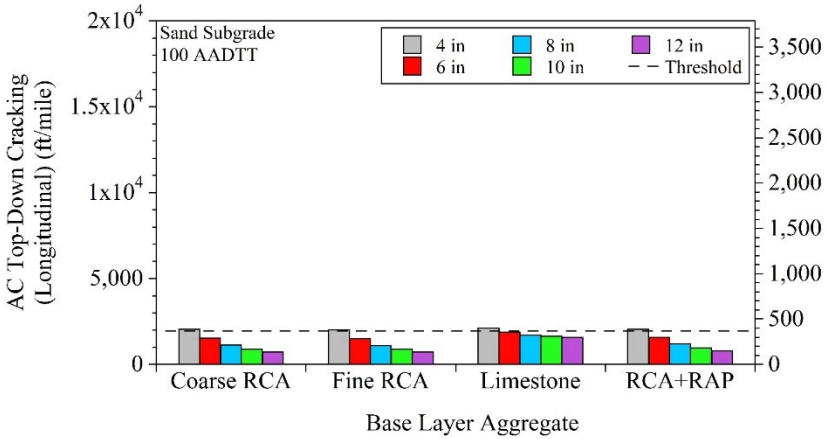


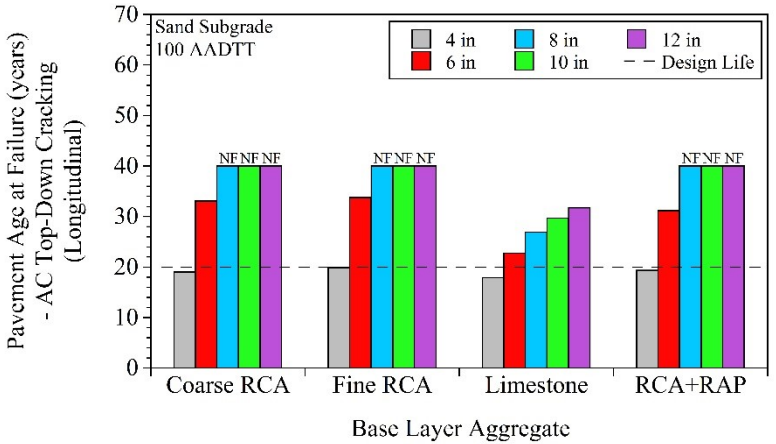




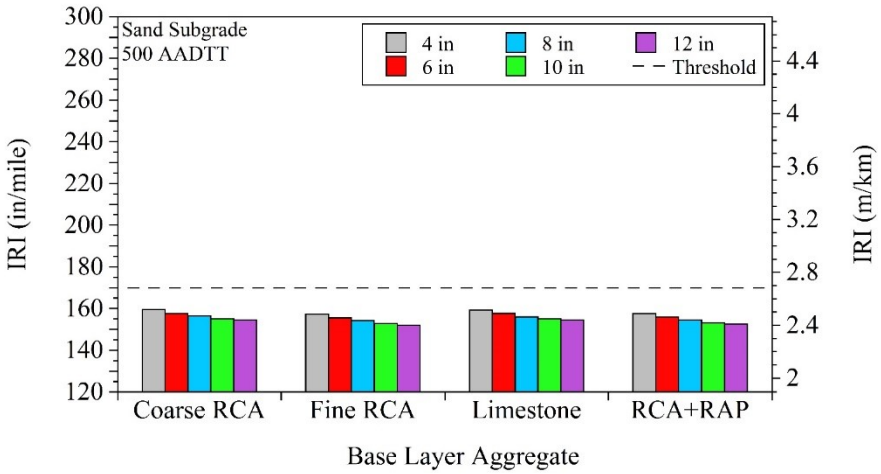

Sand Subgrade
100 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

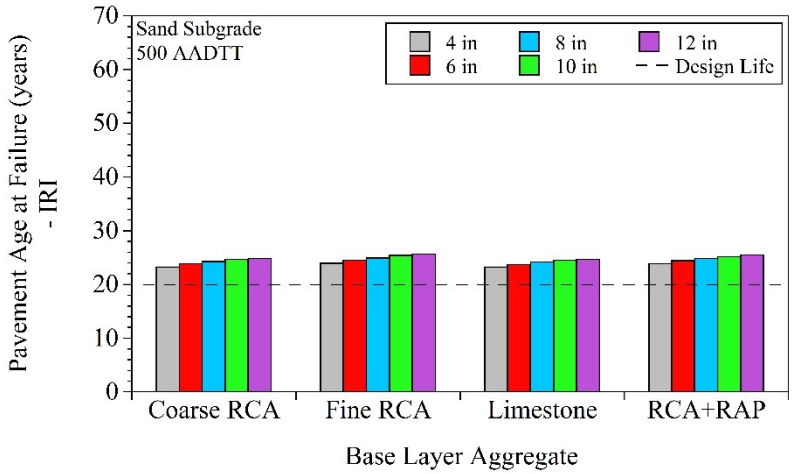

Sand Subgrade
100 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
NF NF NF NF NF
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

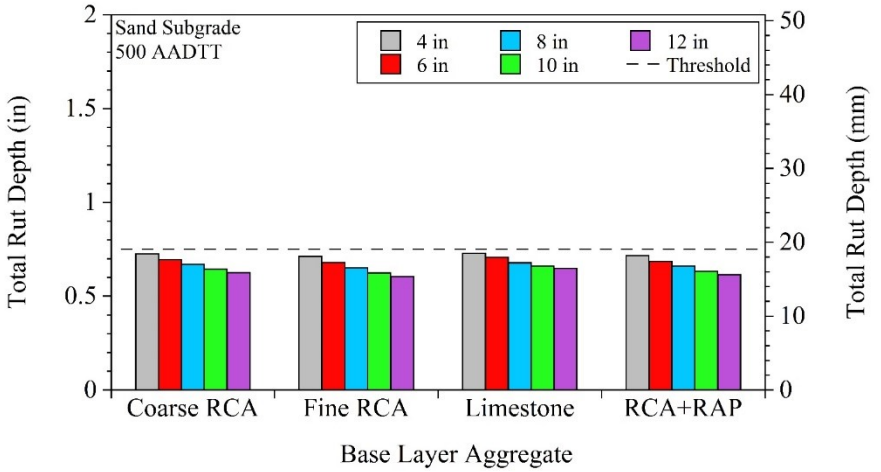

Sand Subgrade
100 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Top-Down Cracking
(Longitudinal) (ft/mile)
0
5,000
1x10^4
1.5x10^4
2x10^4
AC Top-Down Cracking
(Longitudinal) (m/km)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

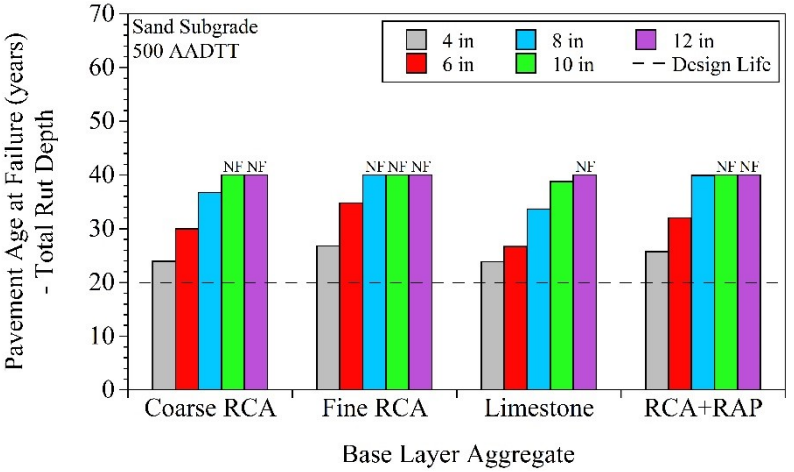

Sand Subgrade
100 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Top-Down Cracking
(Longitudinal)
0
10
20
30
40
50
60
70
NF NF NF
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

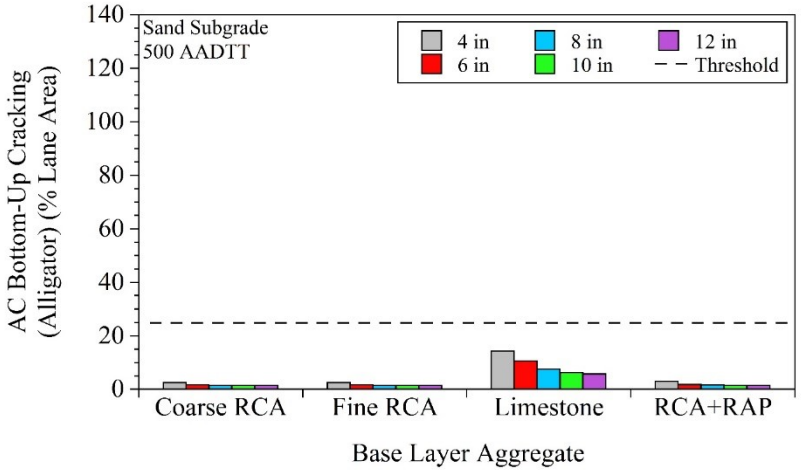
For pavements that contained Sand Subgrade - 500 AADTT:

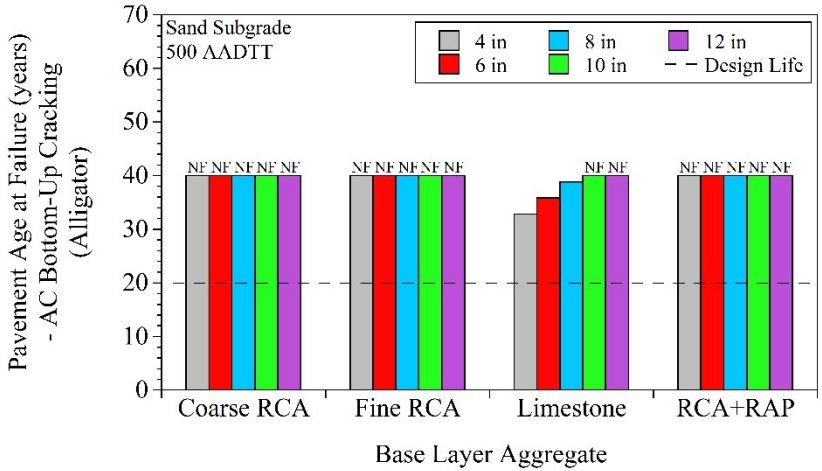


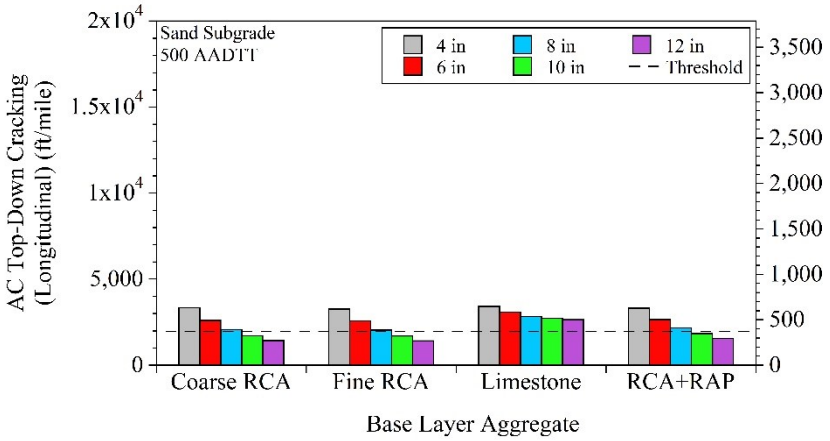


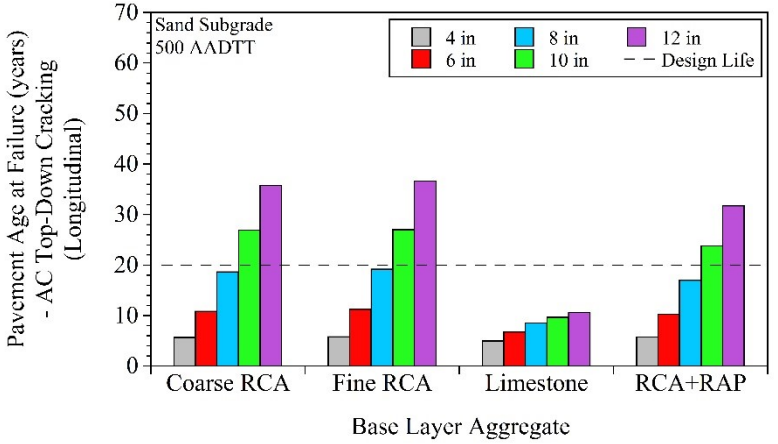




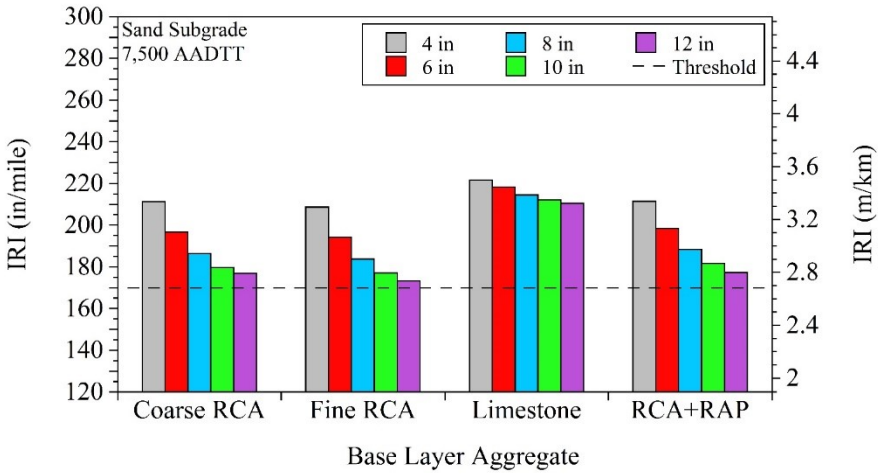

Sand Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
140
120
100
80
60
40
20
0
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

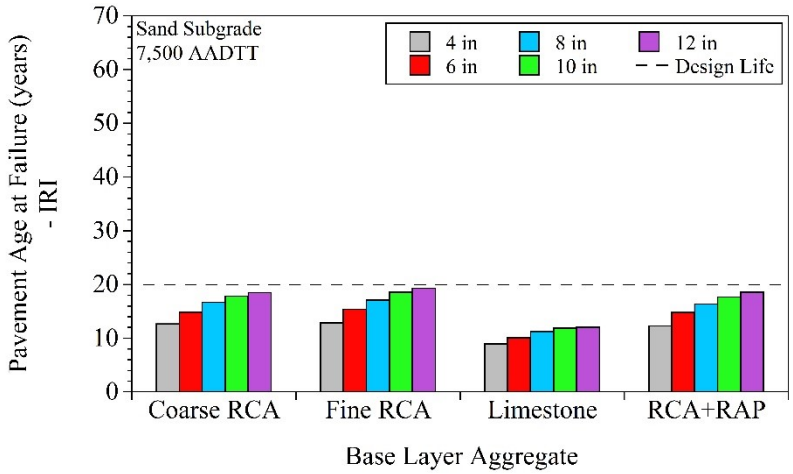

Sand Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
70
60
50
40
30
20
10
0
NF NF NF NF NF
NF NF NF NF NF
NF NF
NF NF NF NF NF
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

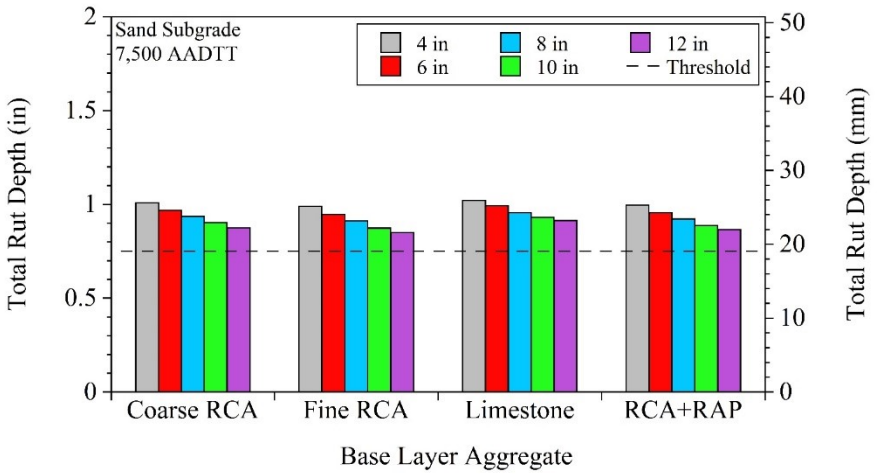

Sand Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Top-Down Cracking
(Longitudinal) (ft/mile)
2x10^4
1.5x10^4
1x10^4
5,000
0
3,500
3,000
2,500
2,000
1,500
1,000
500
0
AC Top-Down Cracking
(Longitudinal) (m/km)
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

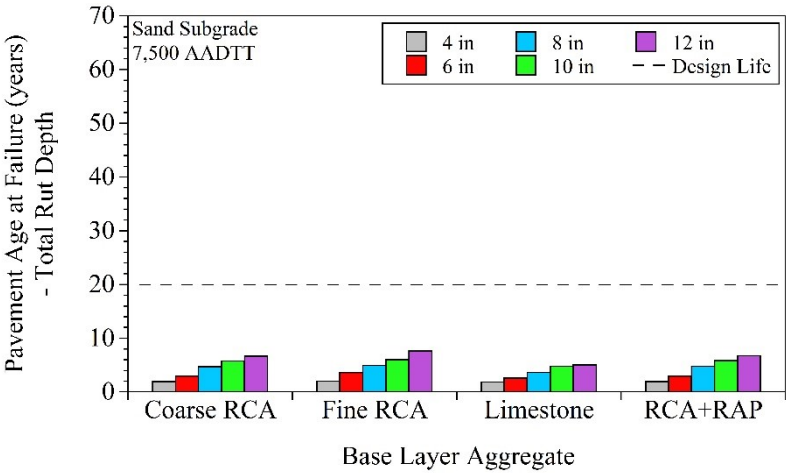

Sand Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Top-Down Cracking
(Longitudinal)
70
60
50
40
30
20
10
0
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

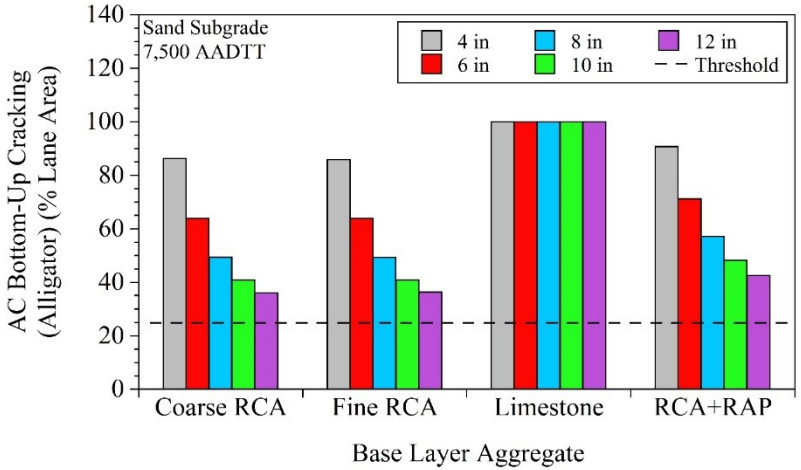
For pavements that contained Sand Subgrade - 7,500 AADTT:

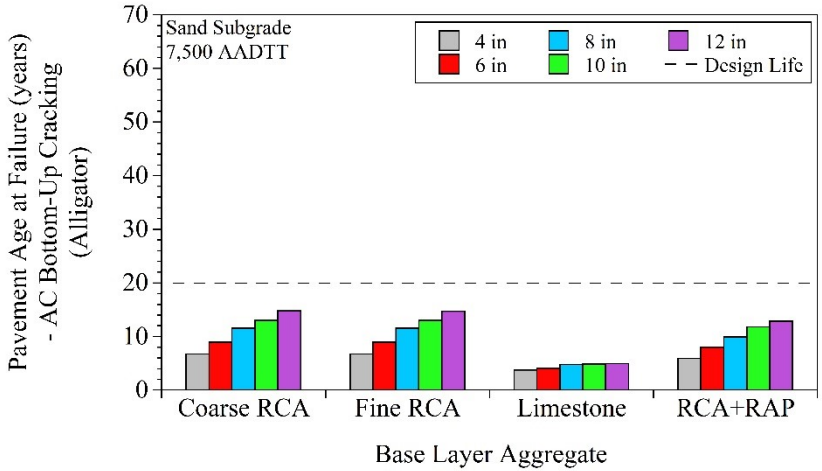


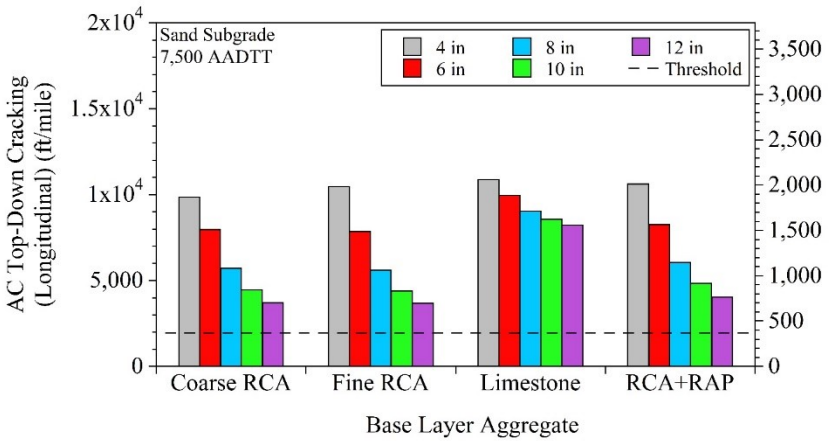


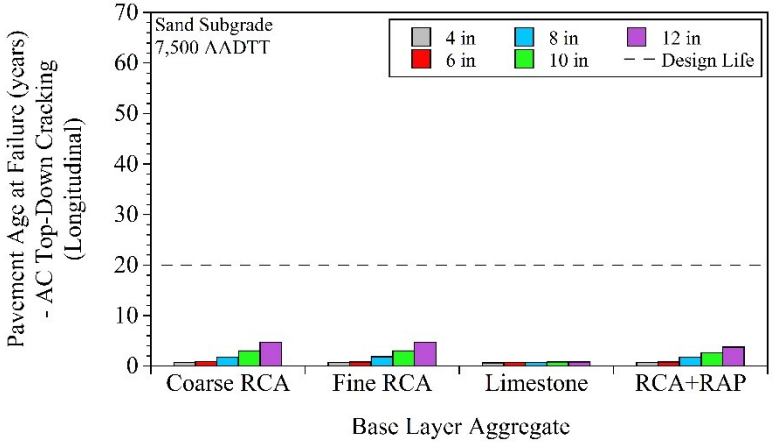




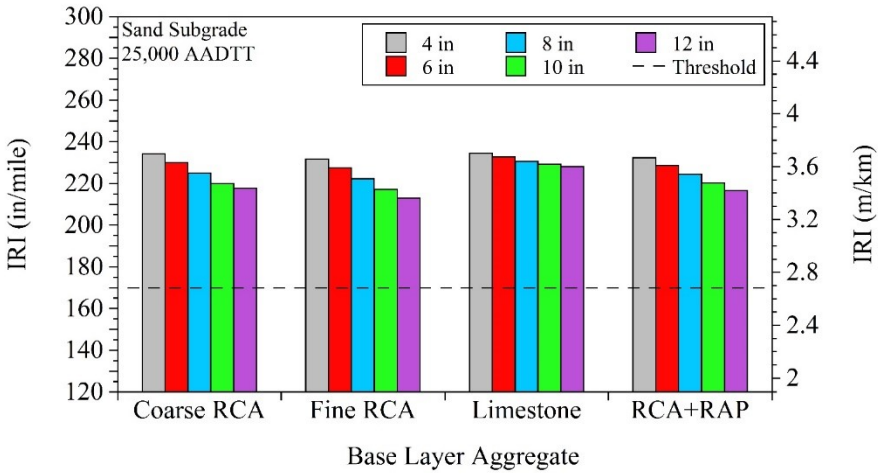

Sand Subgrade
7,500 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
140
120
100
80
60
40
20
0
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

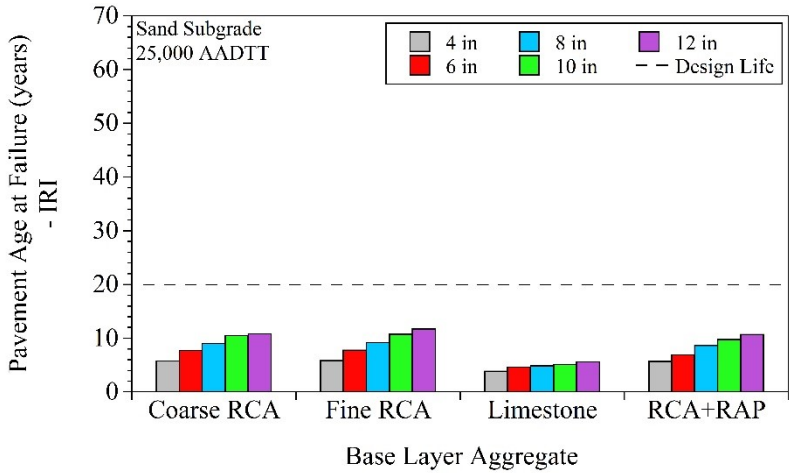

Sand Subgrade
7,500 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
70
60
50
40
30
20
10
0
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

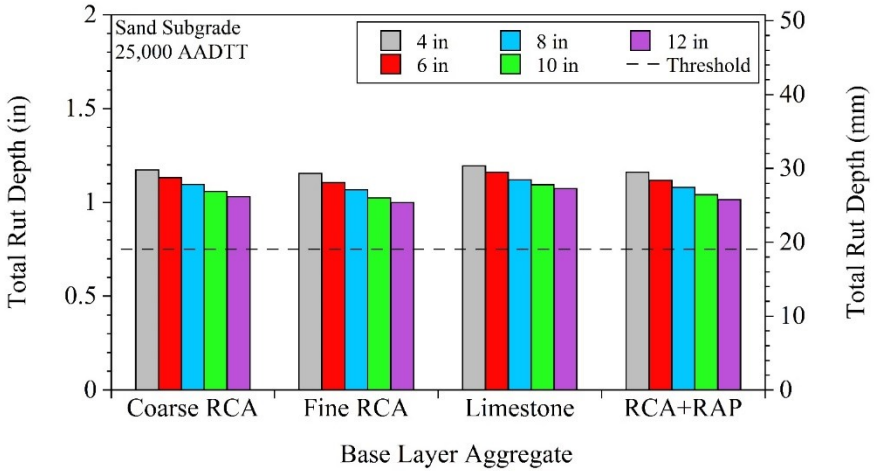

Sand Subgrade
7,500 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Top-Down Cracking
(Longitudinal) (ft/mile)
2x10^4
1.5x10^4
1x10^4
5,000
0
3,500
3,000
2,500
2,000
1,500
1,000
500
0
AC Top-Down Cracking
(Longitudinal) (m/km)
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

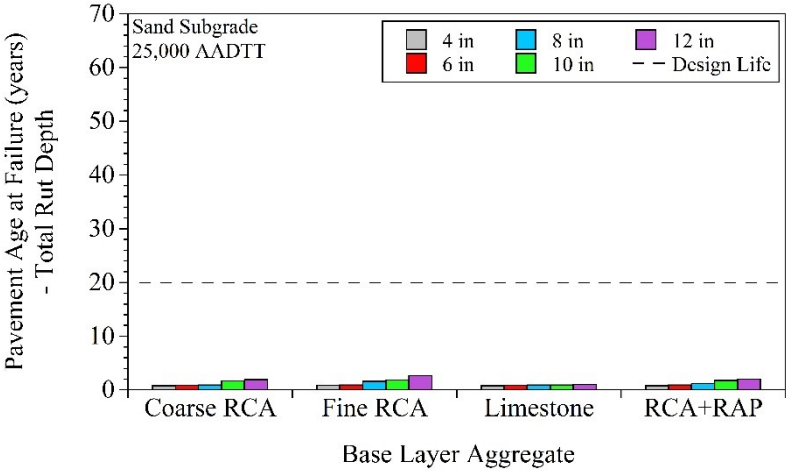

Sand Subgrade
7,500 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Top-Down Cracking
(Longitudinal)
70
60
50
40
30
20
10
0
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

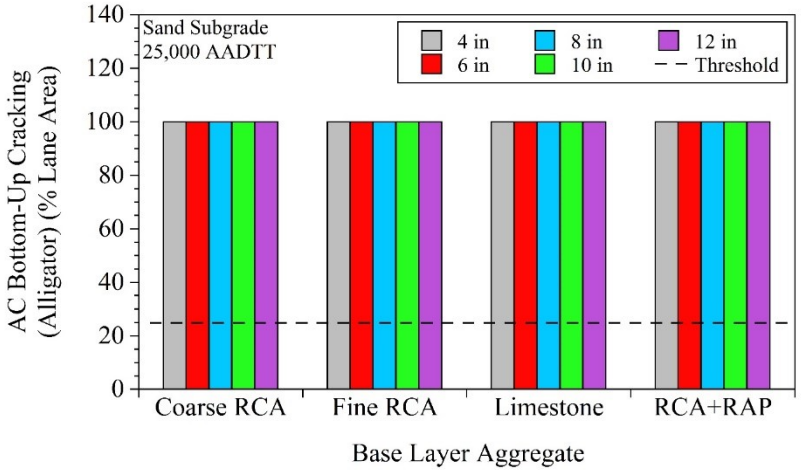
For pavements that contained Sand Subgrade - 25,000 AADTT:

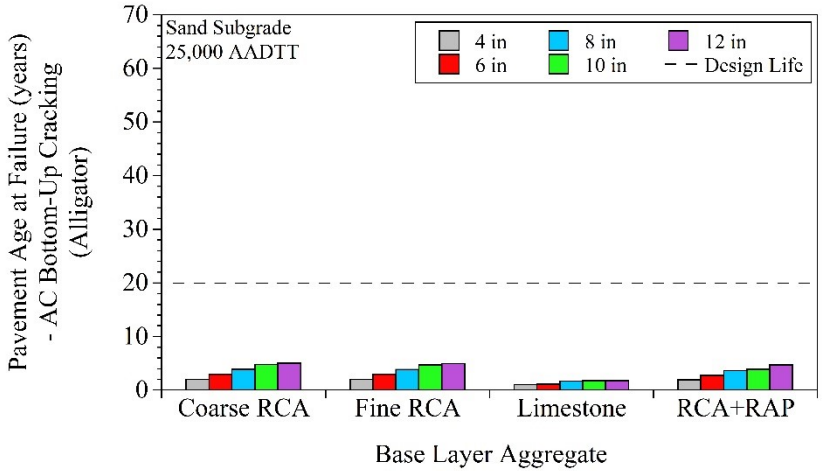


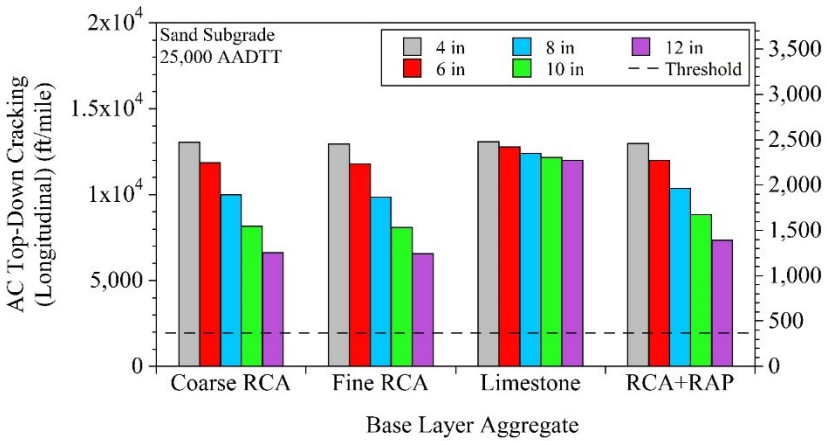


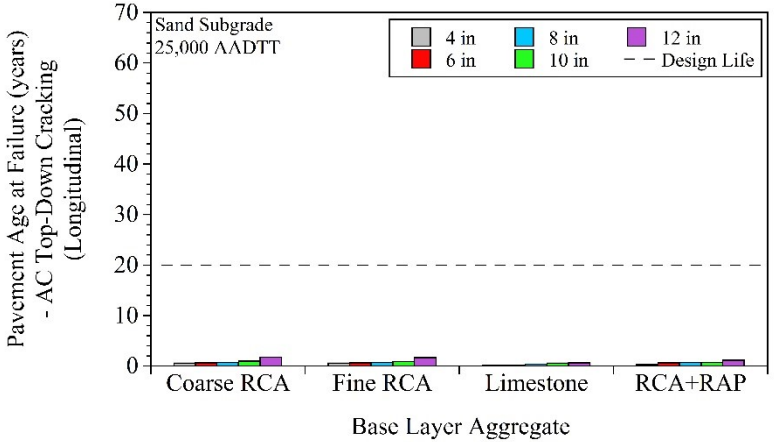




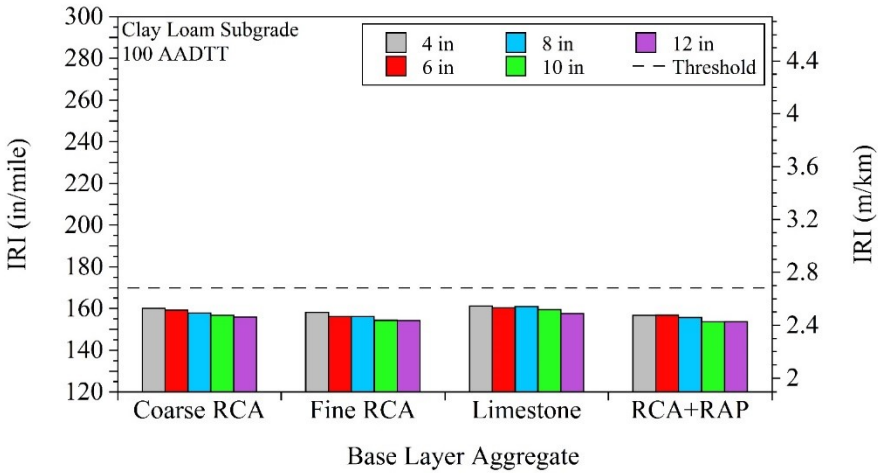

Sand Subgrade
25,000 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
140
120
100
80
60
40
20
0
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

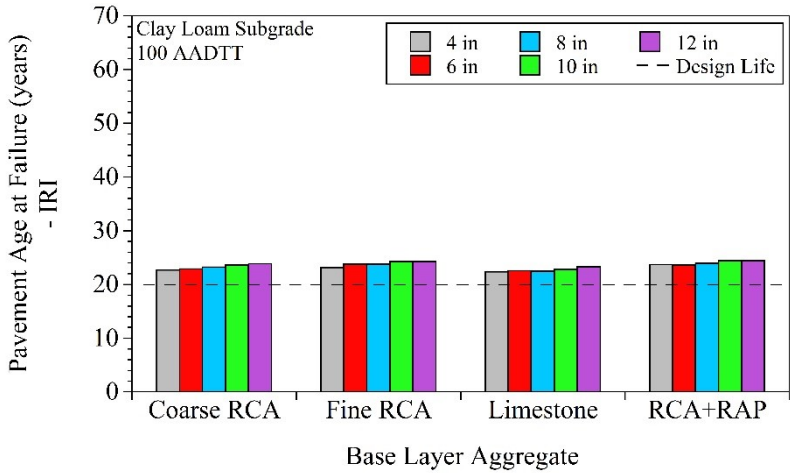

Sand Subgrade
25,000 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
70
60
50
40
30
20
10
0
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

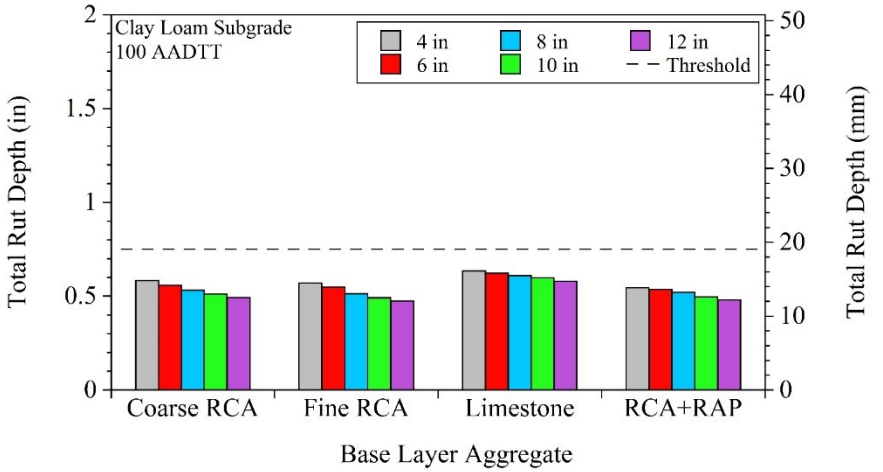

Sand Subgrade
25,000 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Top-Down Cracking
(Longitudinal) (ft/mile)
2x10^4
1.5x10^4
1x10^4
5,000
0
3,500
3,000
2,500
2,000
1,500
1,000
500
0
AC Top-Down Cracking
(Longitudinal) (m/km)
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

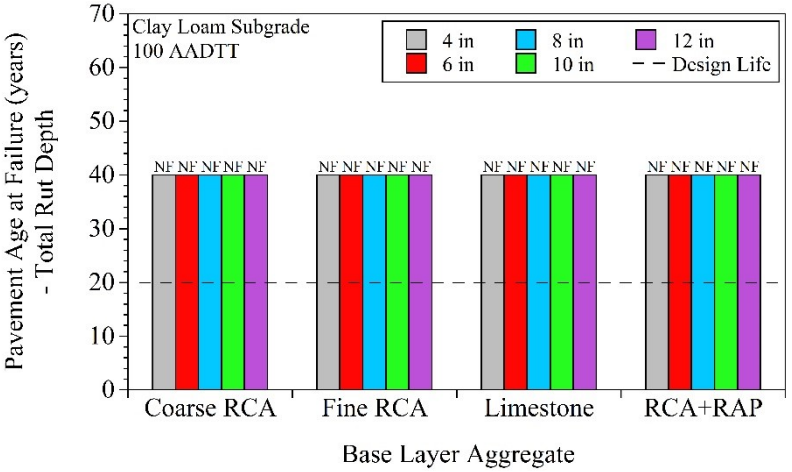

Sand Subgrade
25,000 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Top-Down Cracking
(Longitudinal)
70
60
50
40
30
20
10
0
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

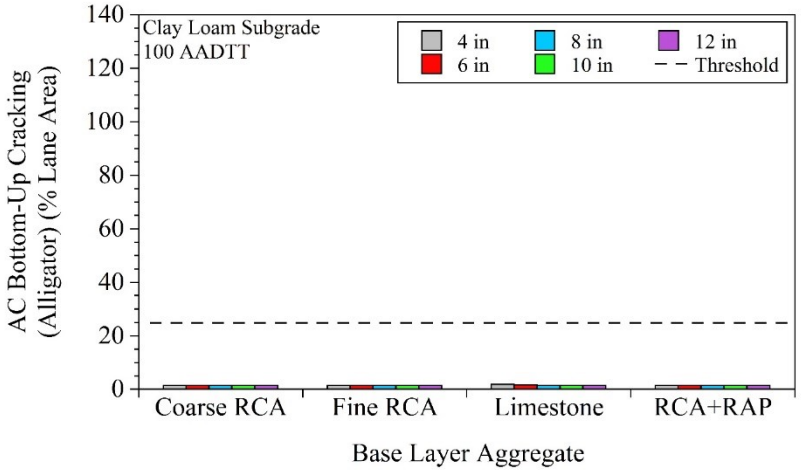
For pavements that contained Clay Loam subgrade - 100 AADTT:

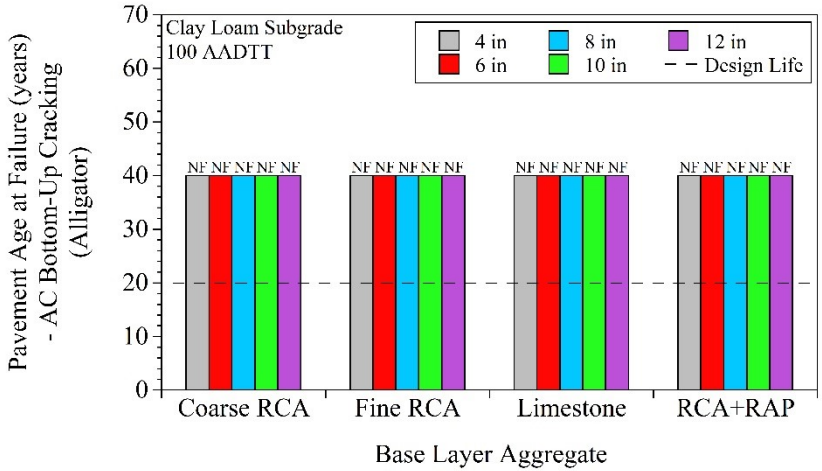




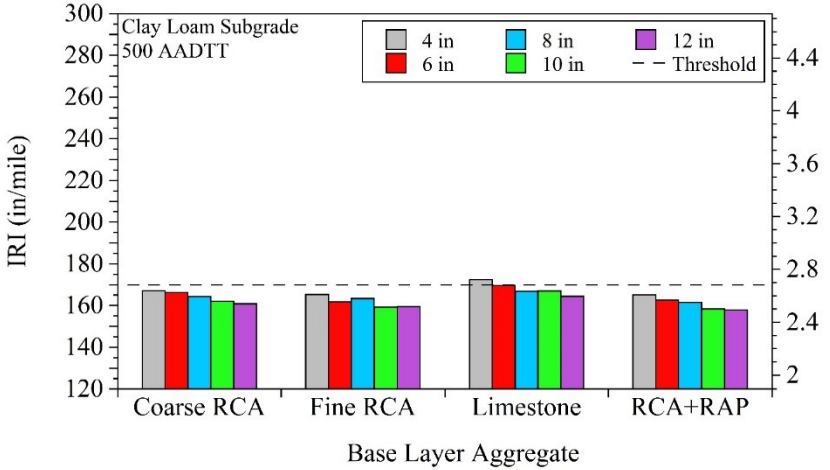


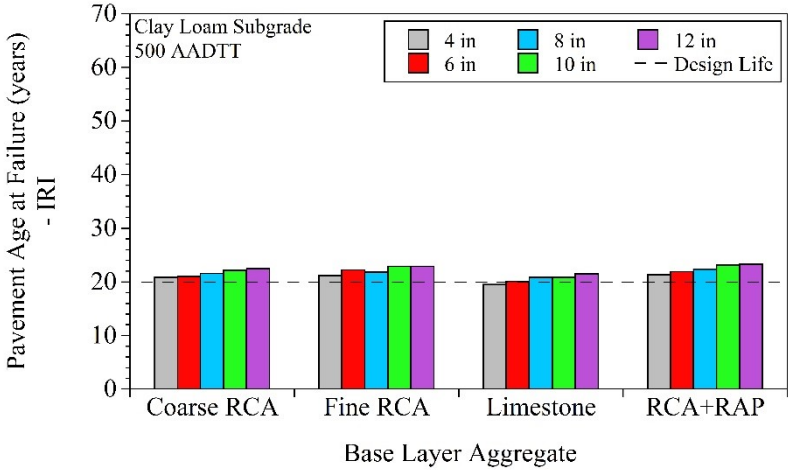


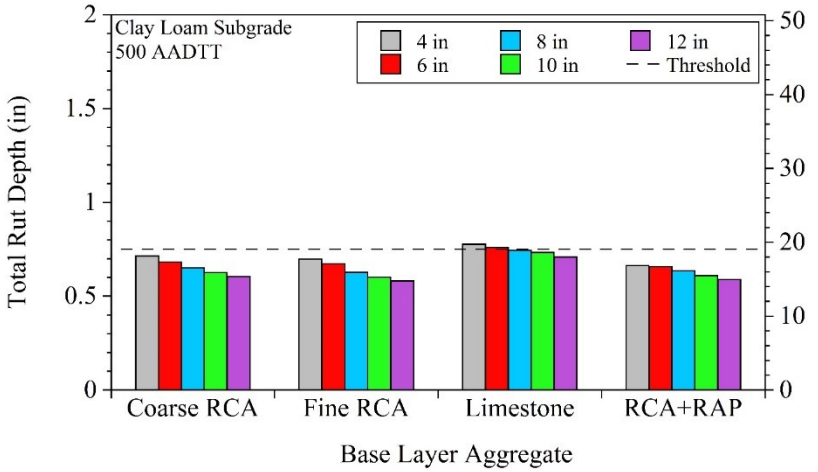


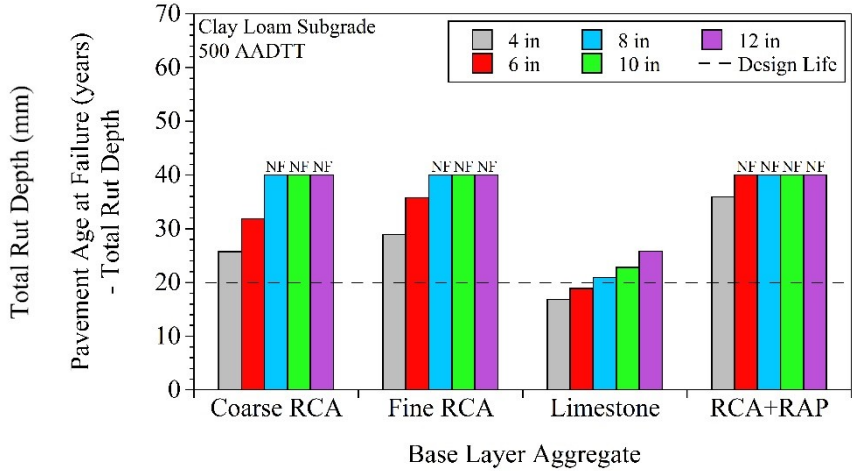


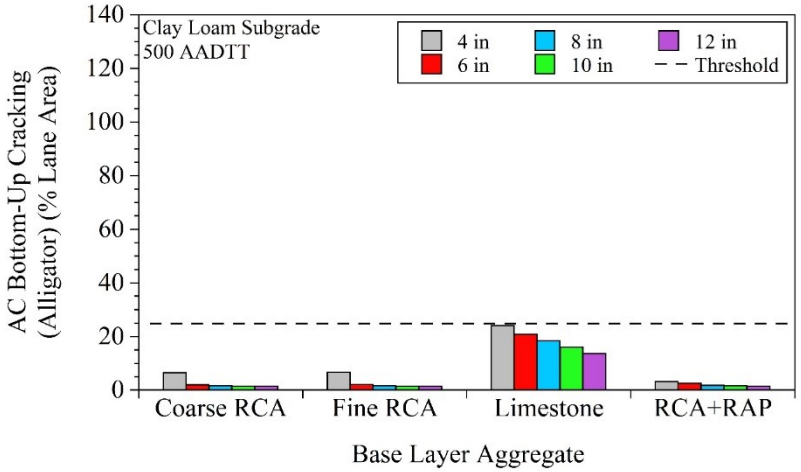
For pavements that contained Clay Loam subgrade - 500 AADTT:

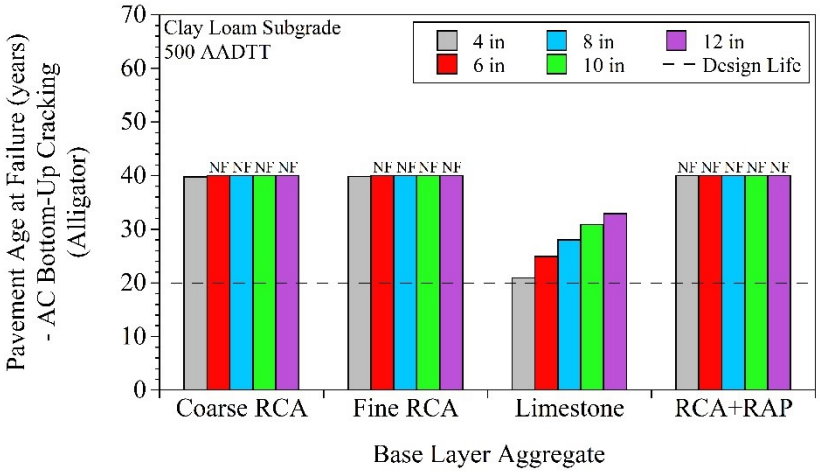




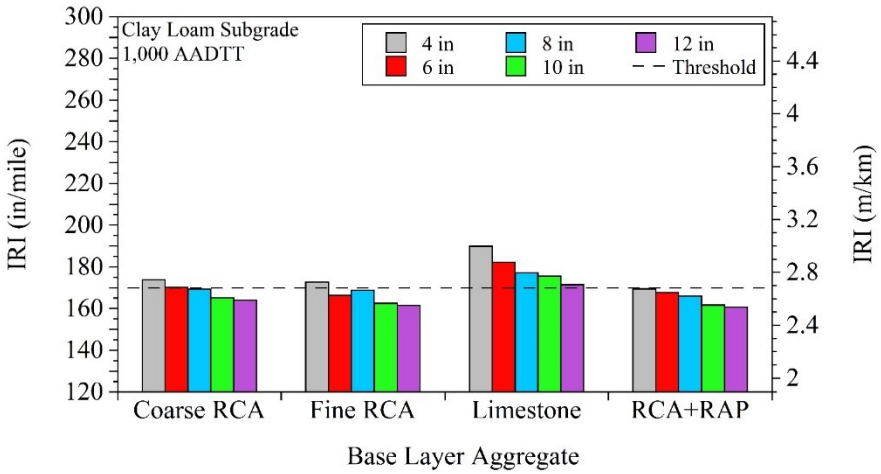

Clay Loam Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

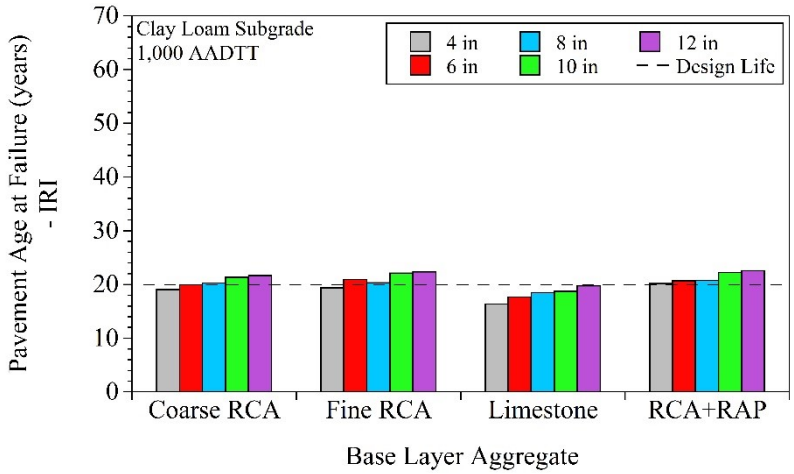

Clay Loam Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
NF NF NF
NF NF NF
NF NF NF NF
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

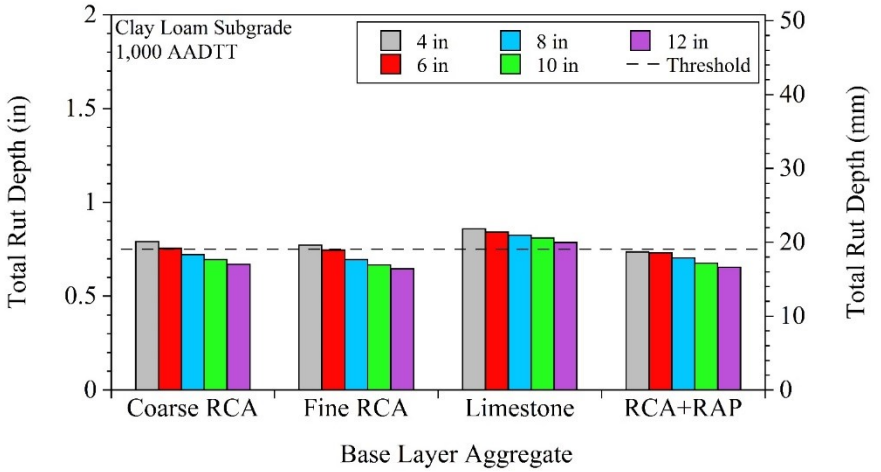

Clay Loam Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

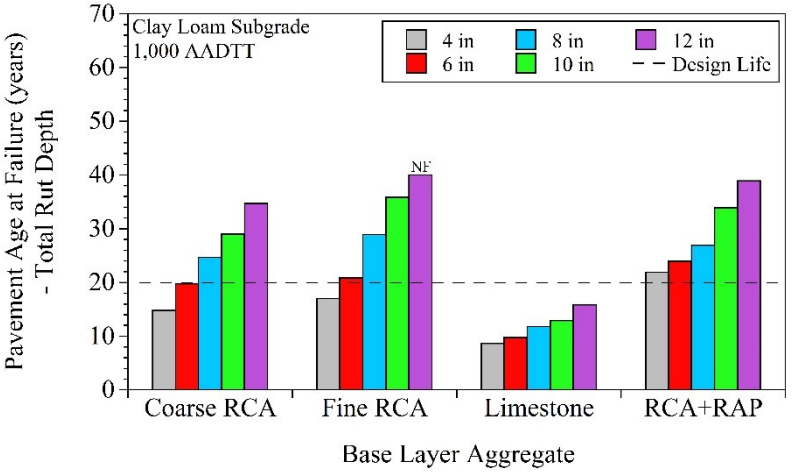

Clay Loam Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
NF NF NF NF
NF NF NF NF
NF NF NF NF NF
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

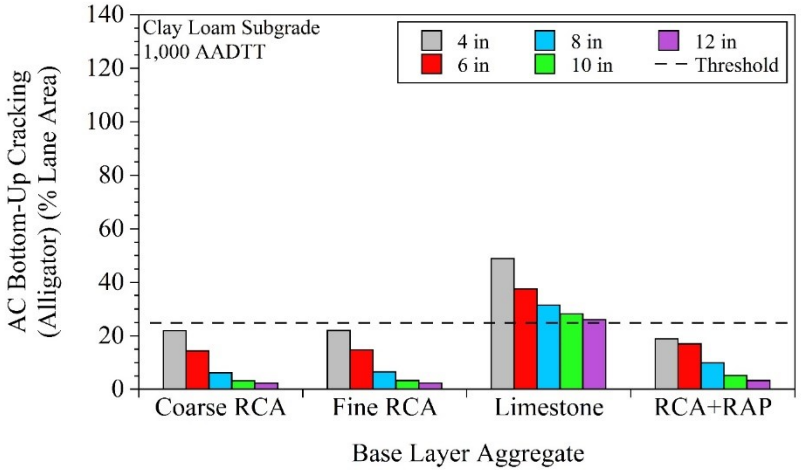
For pavements that contained Clay Loam subgrade - 1,000 AADTT:

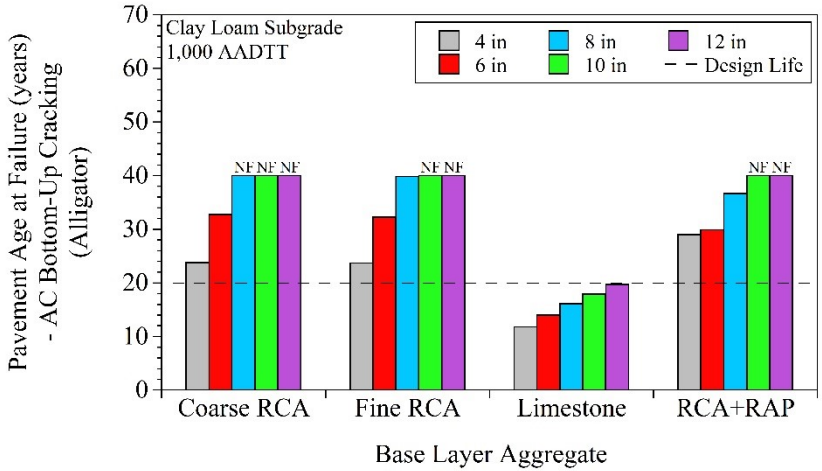




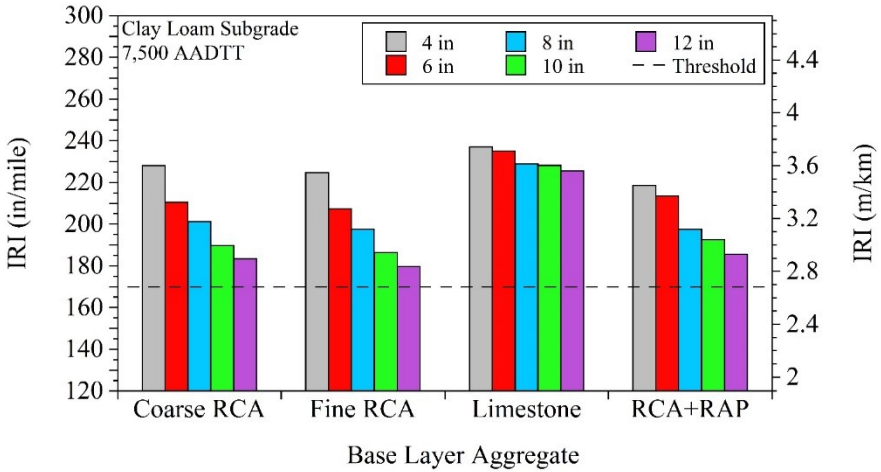


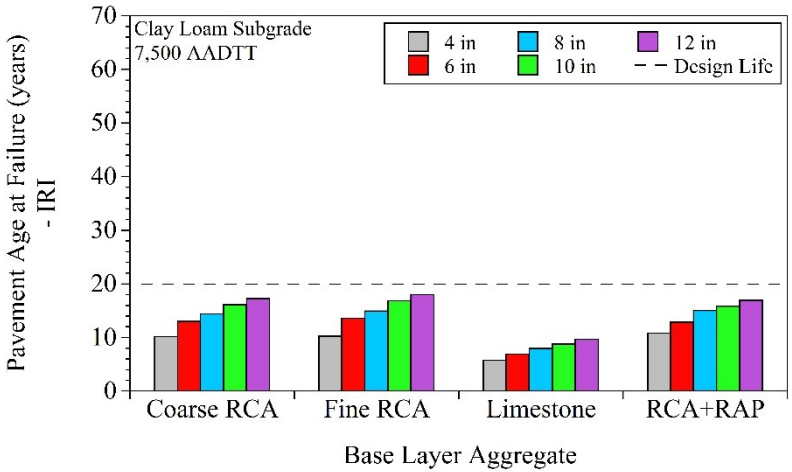


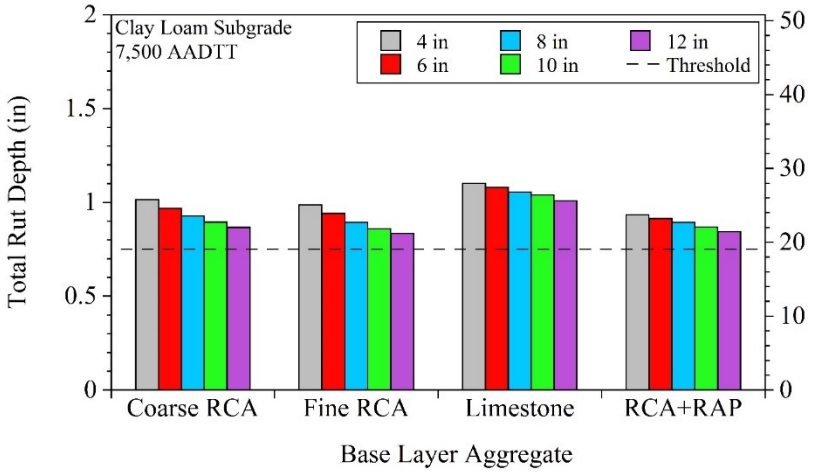


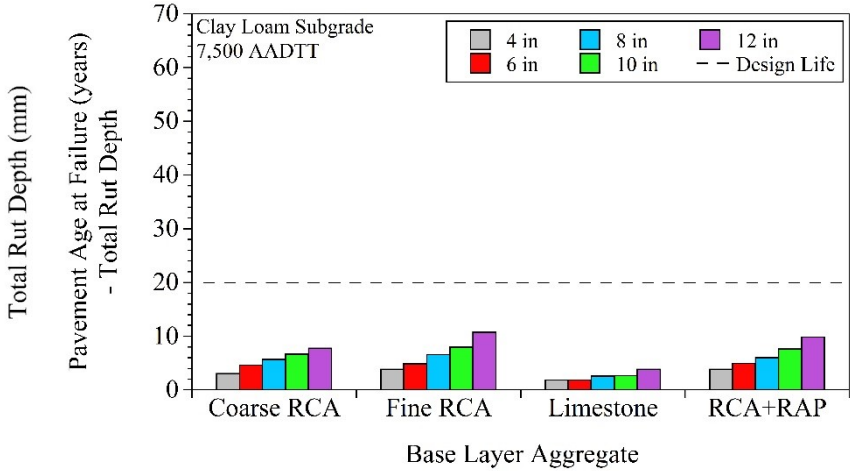


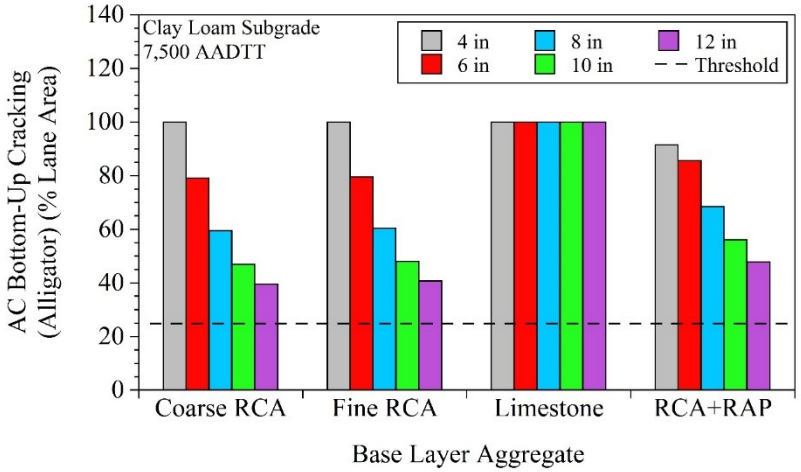
For pavements that contained Clay Loam subgrade - 7,500 AADTT:

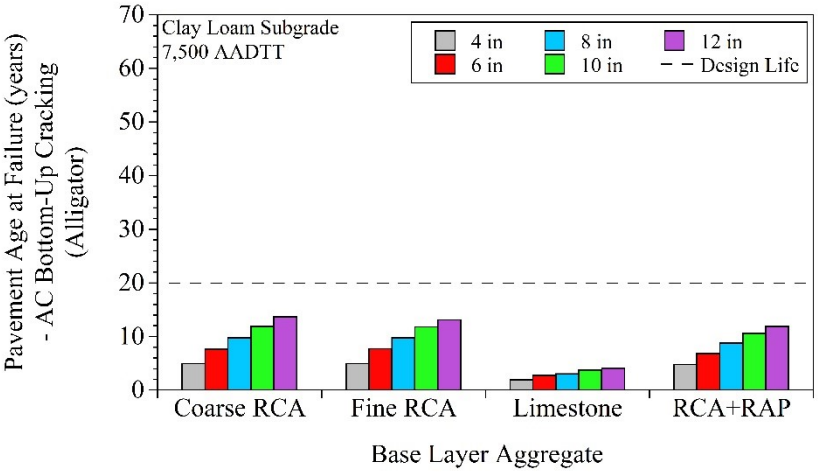




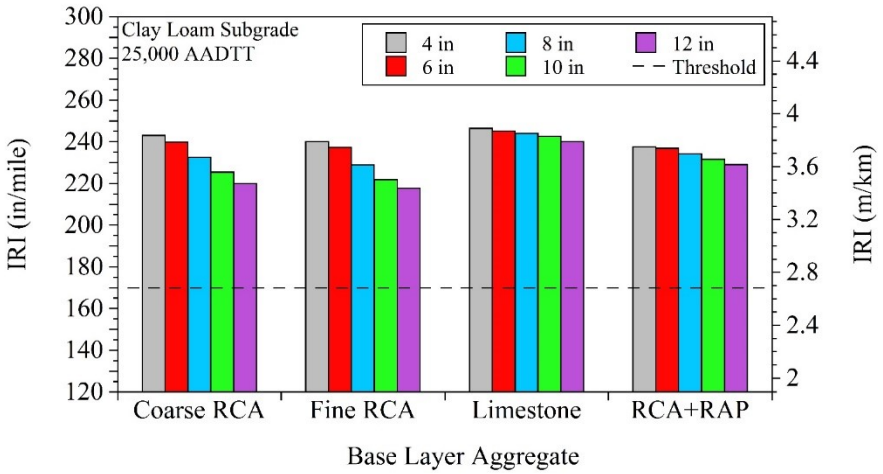

Clay Loam Subgrade
7,500 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

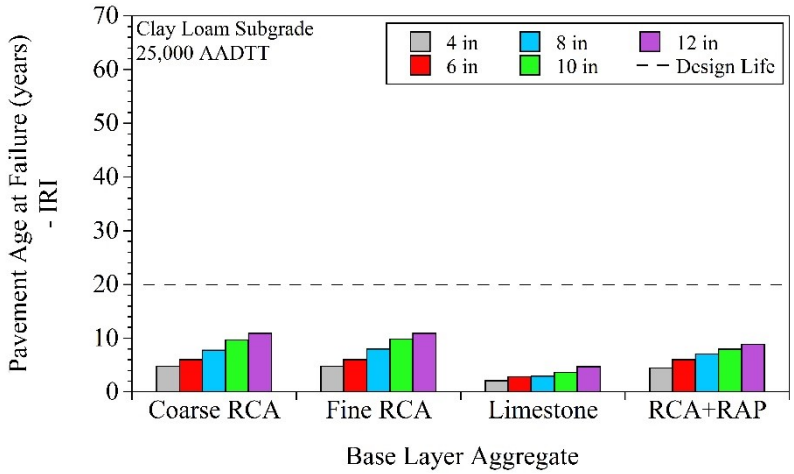

Clay Loam Subgrade
7,500 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

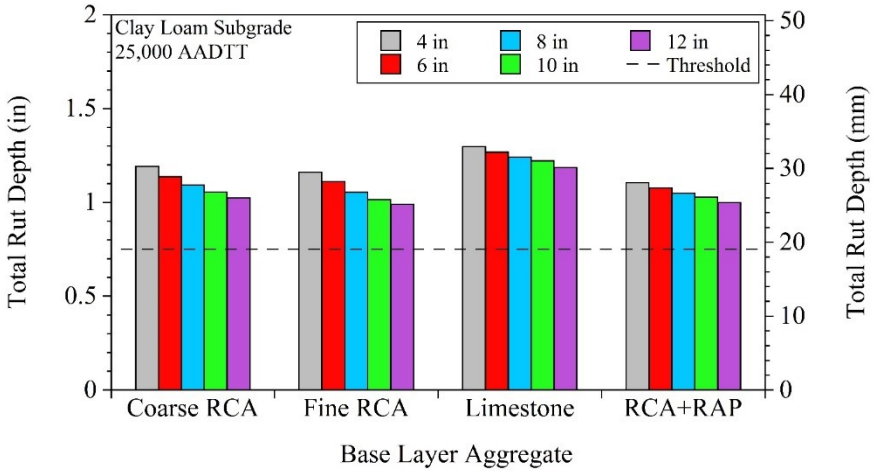

Clay Loam Subgrade
7,500 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

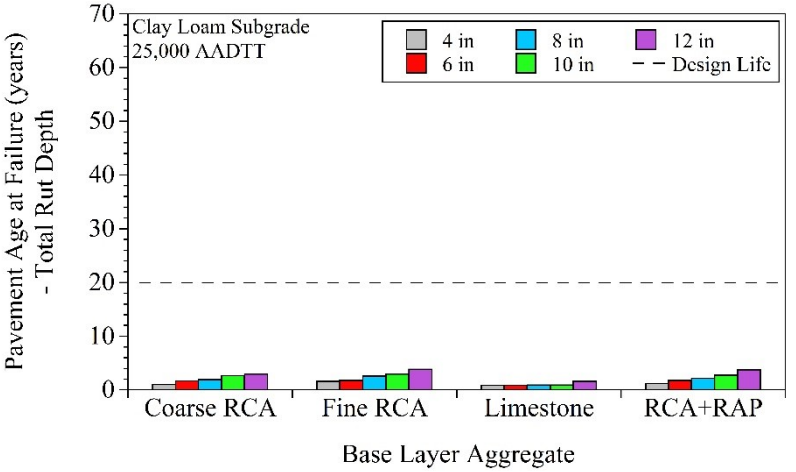

Clay Loam Subgrade
7,500 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

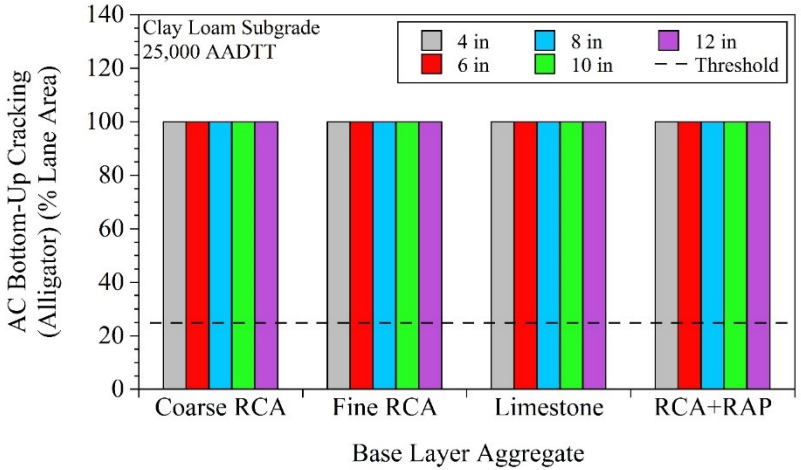
For pavements that contained Clay Loam subgrade - 25,000 AADTT:

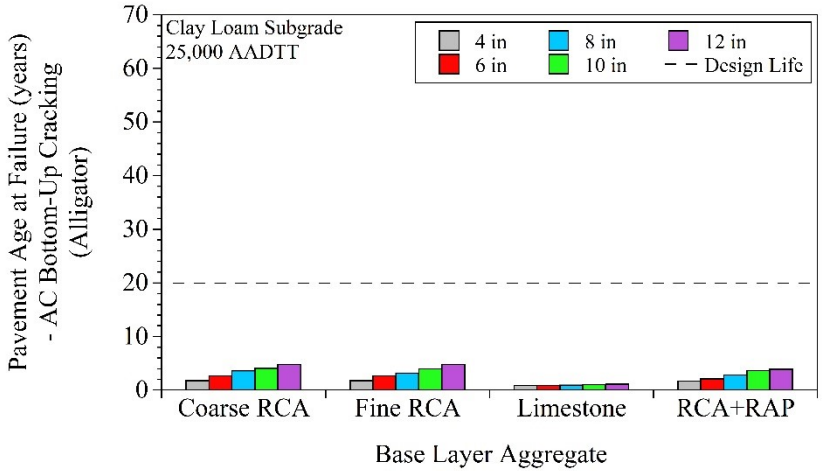






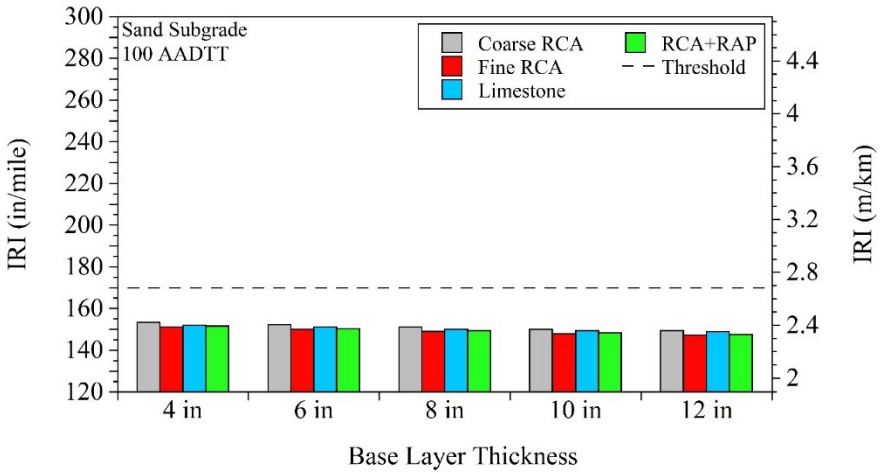


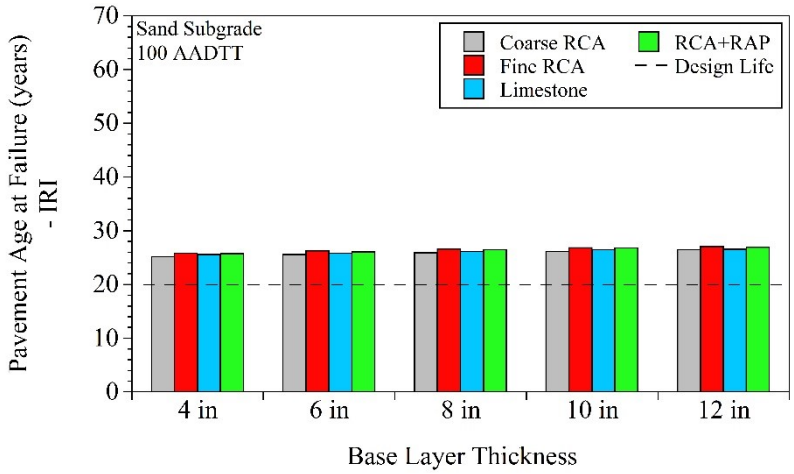

Clay Loam Subgrade
25,000 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

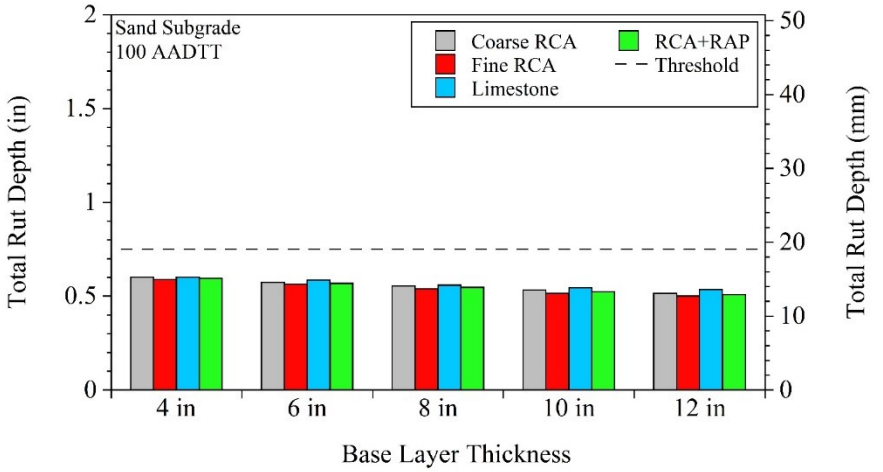

Clay Loam Subgrade
25,000 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

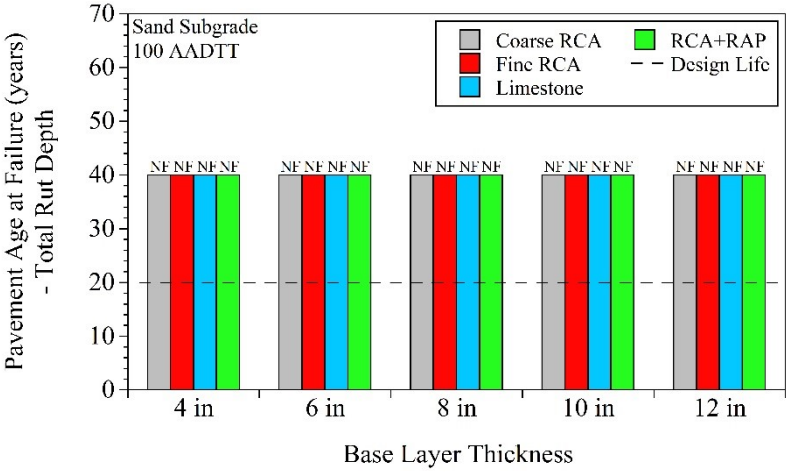
APPENDIX BB
EFFECT OF BASE LAYER AGGREGATE TYPE ON PAVEMENT PERFORMANCE PREDICTIONS

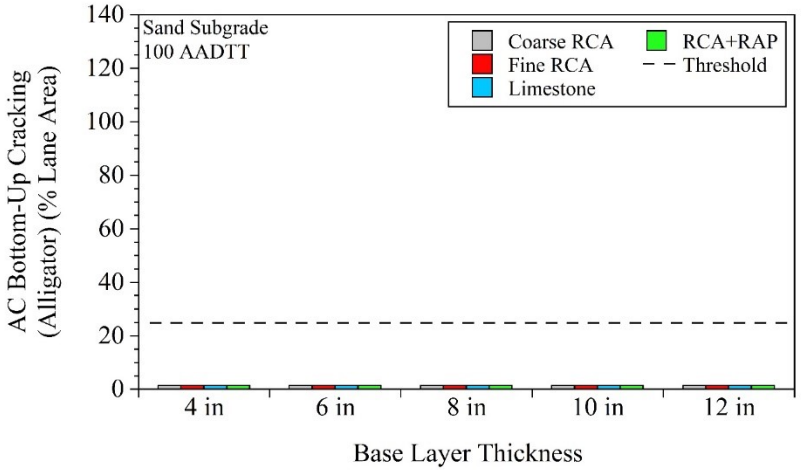
For pavements that contained Sand Subgrade - 100 AADTT:

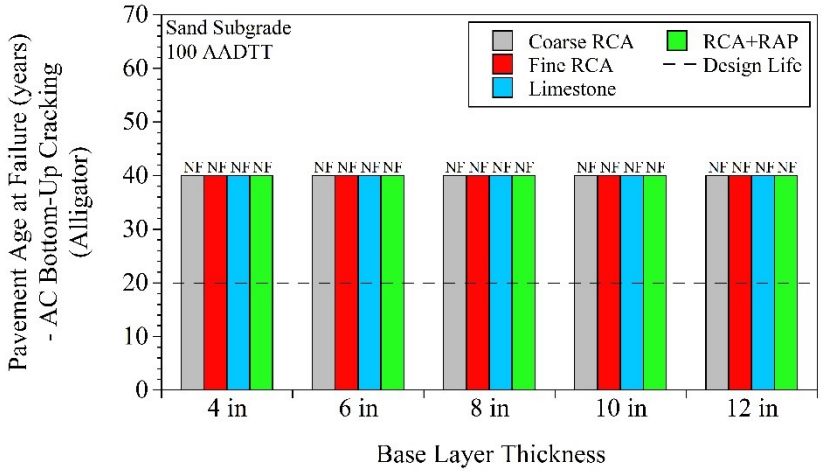


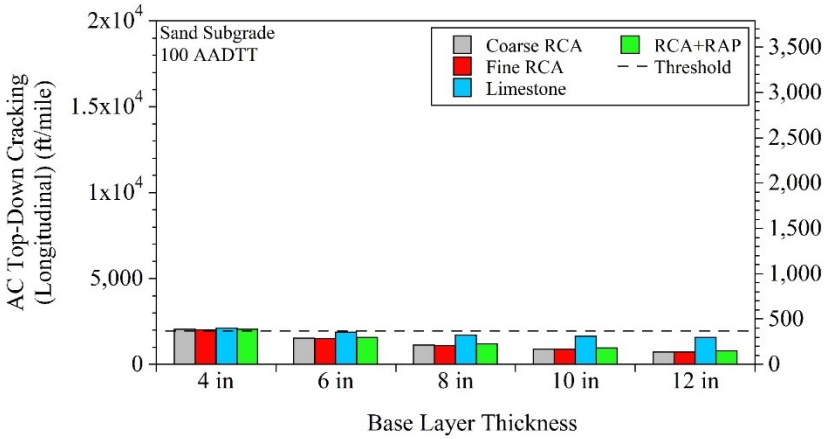


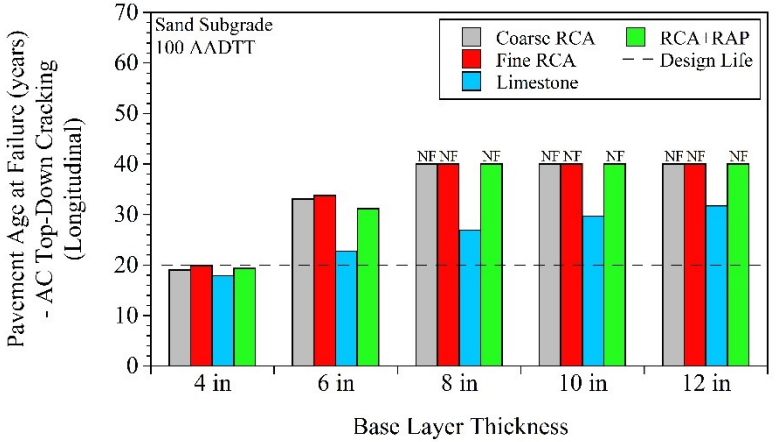




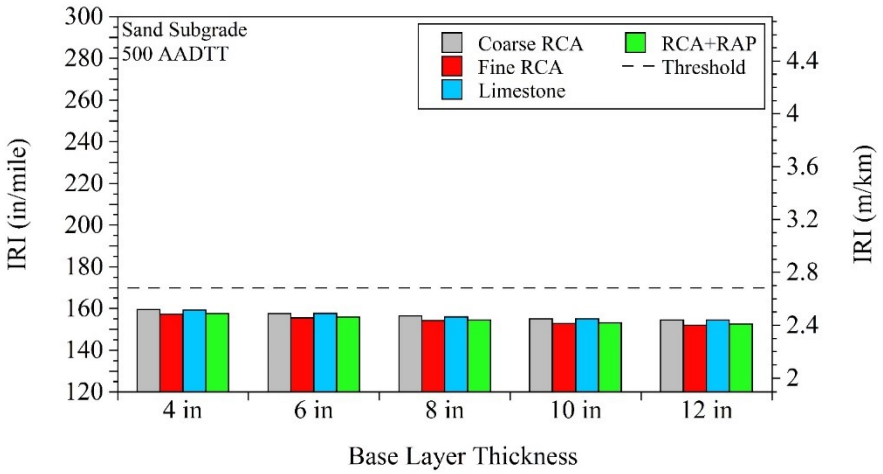

Sand Subgrade
100 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

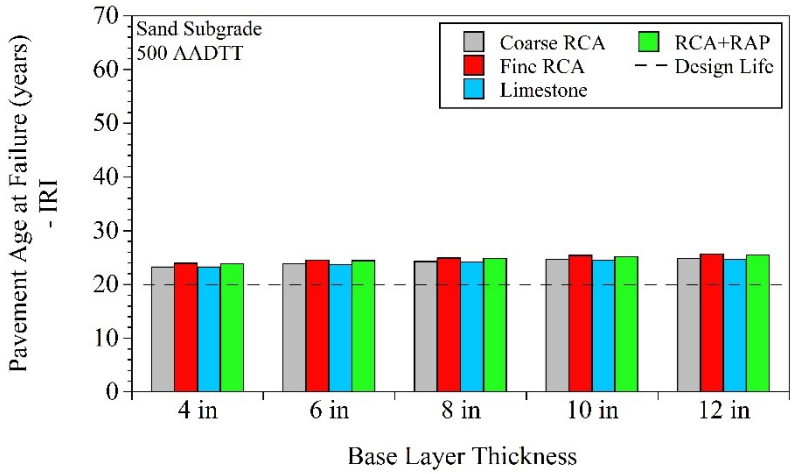

Sand Subgrade
100 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
NF NF NF NF
0
10
20
30
40
50
60
70
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

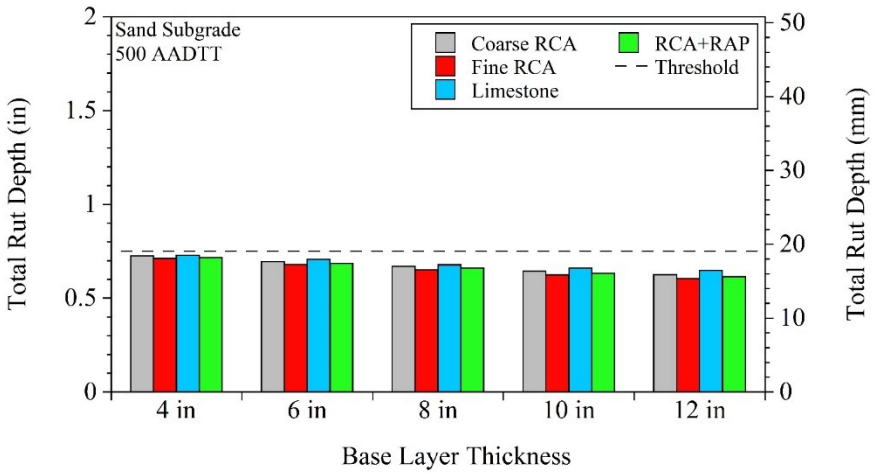

Sand Subgrade
100 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
AC Top-Down Cracking
(Longitudinal) (ft/mile)
0
5,000
1x10^4
1.5x10^4
2x10^4
AC Top-Down Cracking
(Longitudinal) (m/km)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

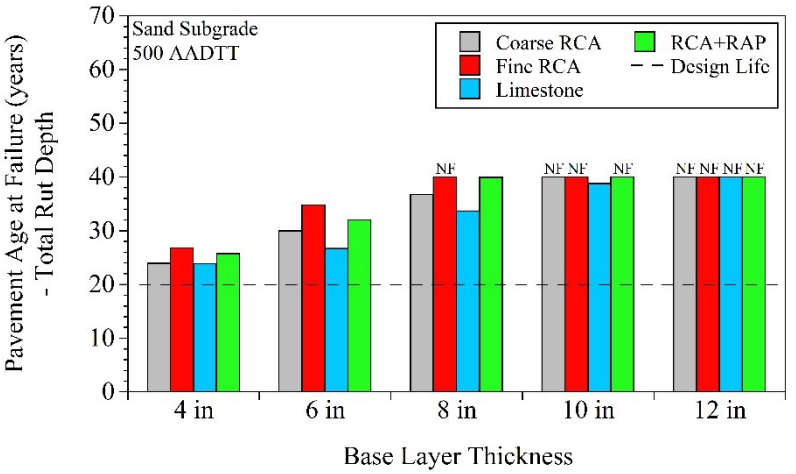

Sand Subgrade
100 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- AC Top-Down Cracking
(Longitudinal)
NF NF NF
0
10
20
30
40
50
60
70
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

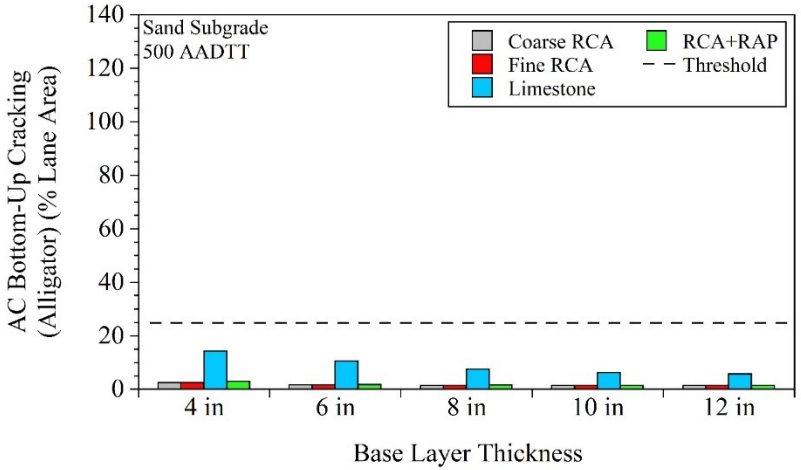
For pavements that contained Sand Subgrade - 500 AADTT:

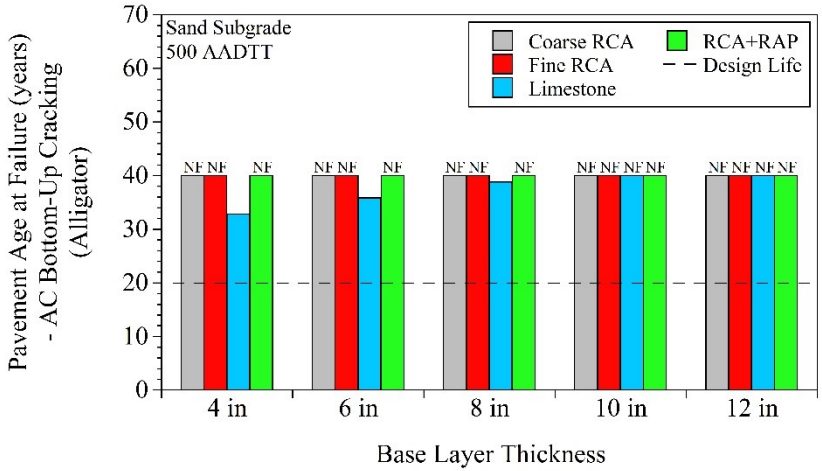


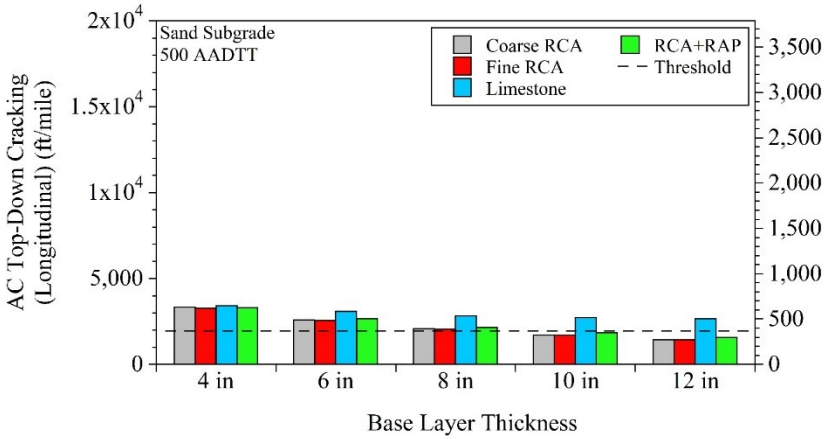


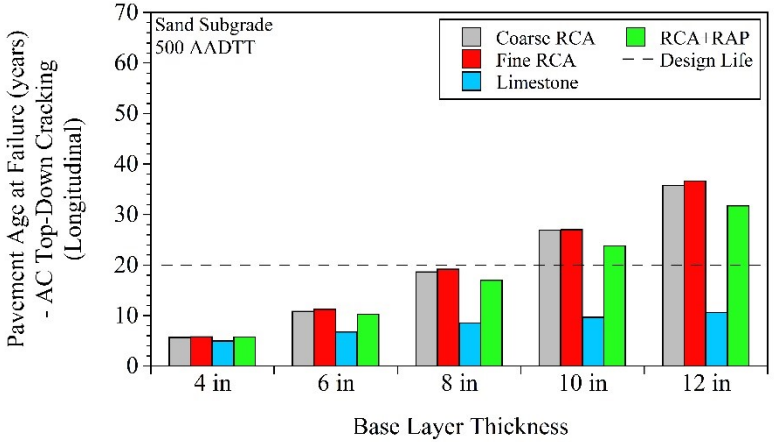




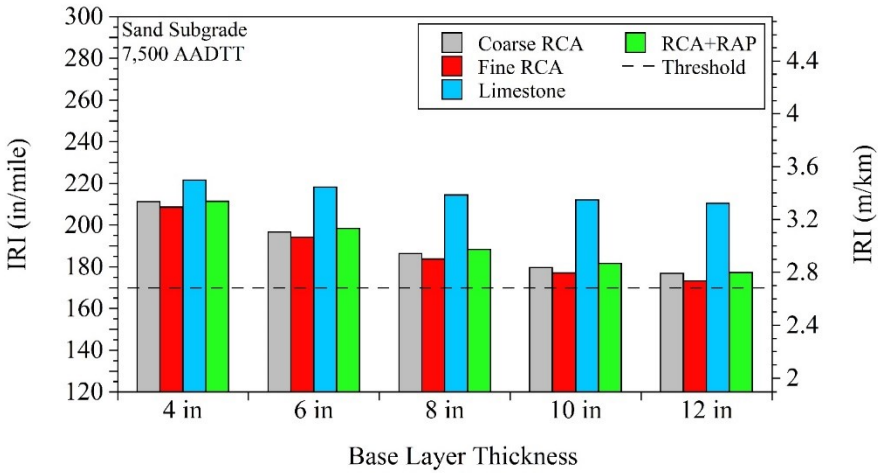

Sand Subgrade
500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

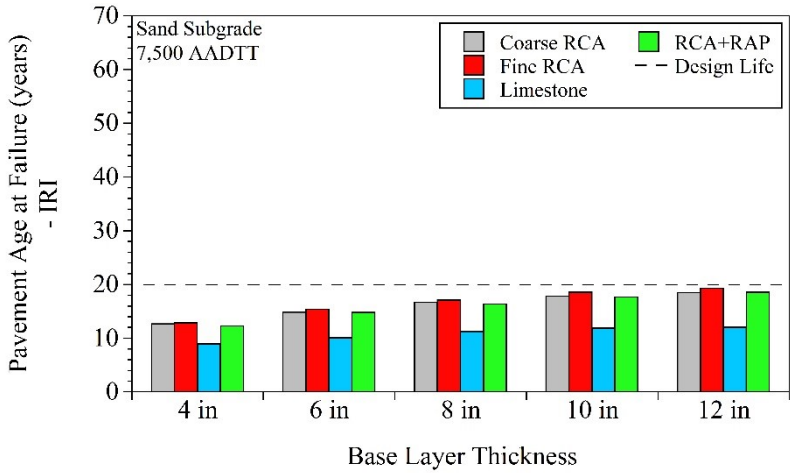

Sand Subgrade
500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
NF
0
10
20
30
40
50
60
70
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

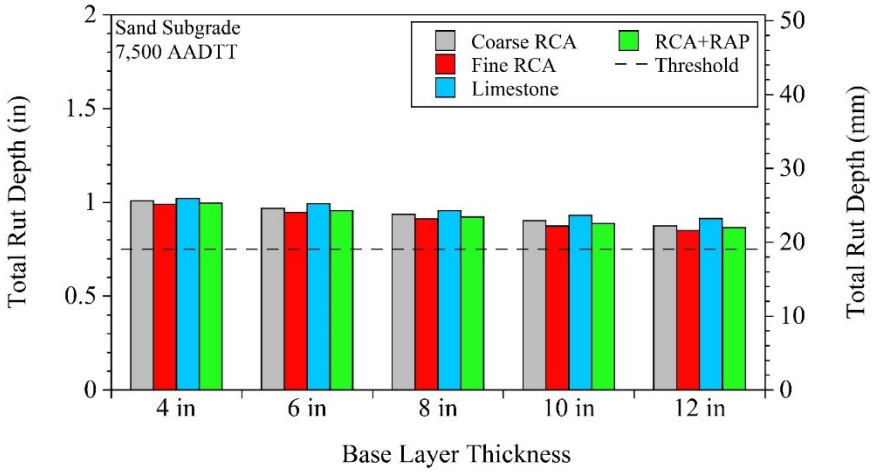

Sand Subgrade
500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
AC Top-Down Cracking
(Longitudinal) (ft/mile)
0
5,000
1x10^4
1.5x10^4
2x10^4
AC Top-Down Cracking
(Longitudinal) (m/km)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

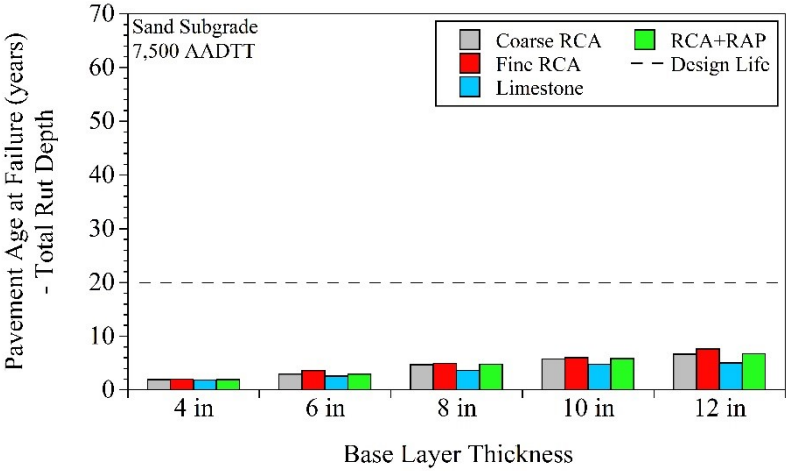

Sand Subgrade
500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- AC Top-Down Cracking
(Longitudinal)
0
10
20
30
40
50
60
70
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

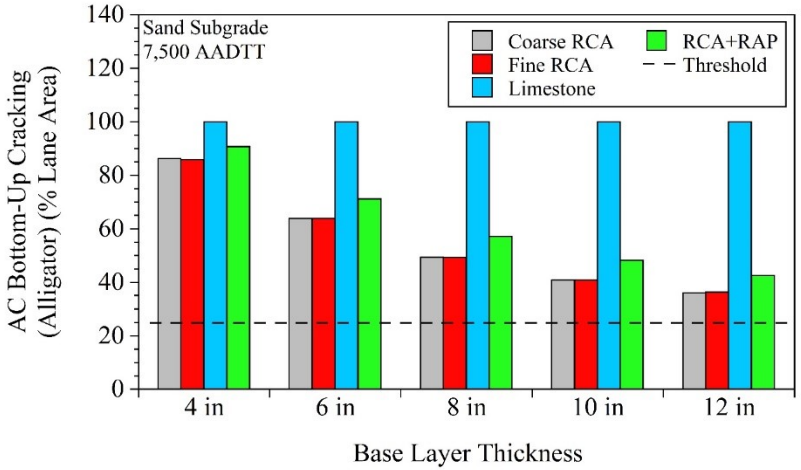
For pavements that contained Sand Subgrade - 7,500 AADTT:

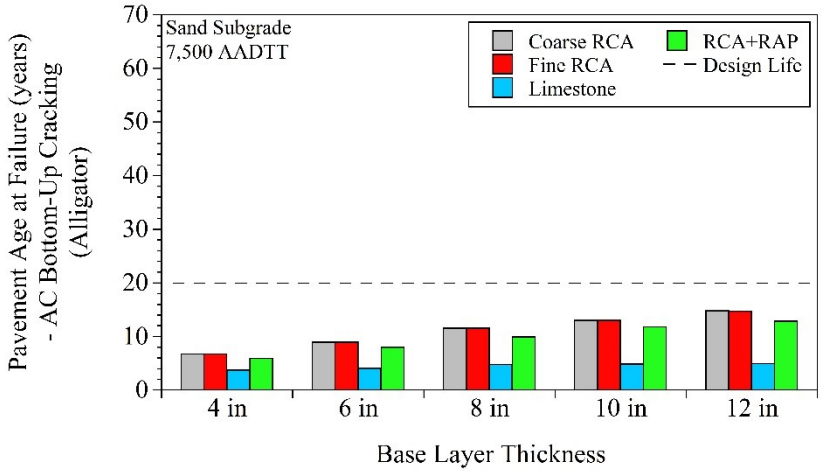


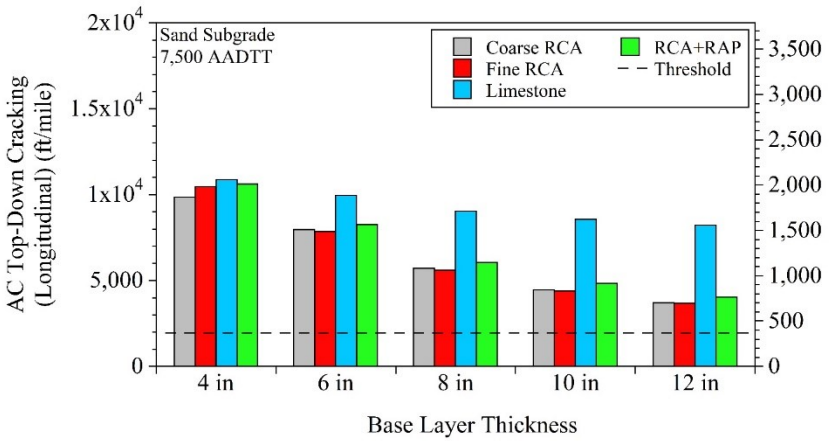


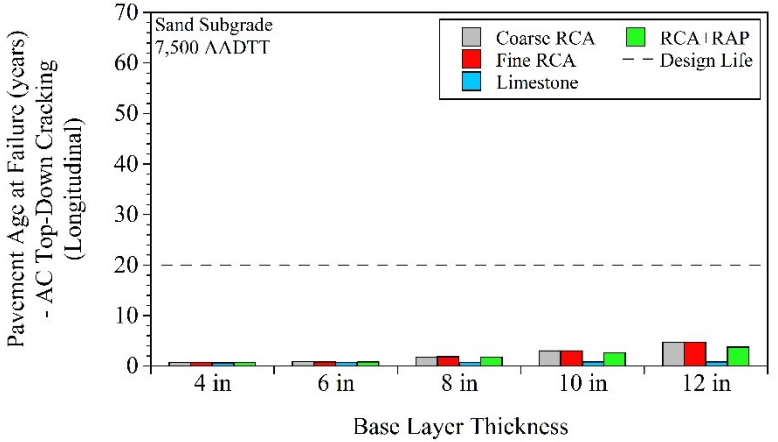




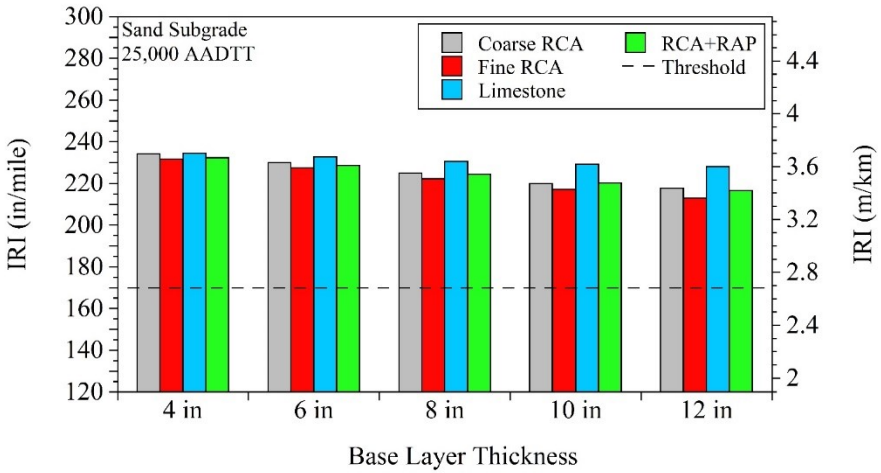

Sand Subgrade
7,500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

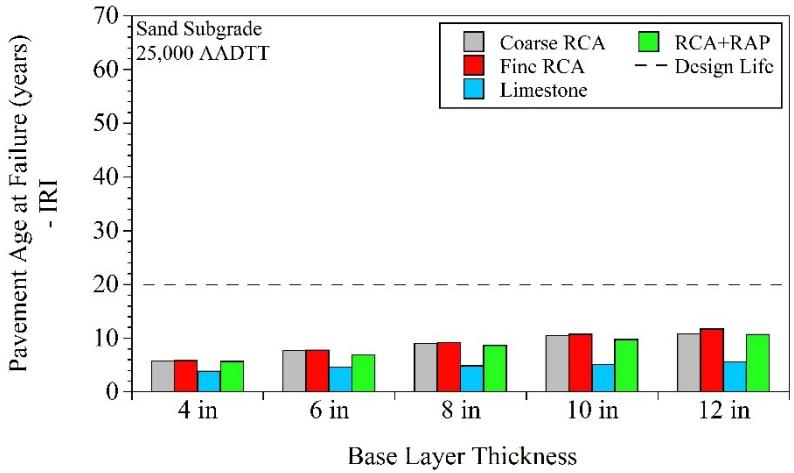

Sand Subgrade
7,500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

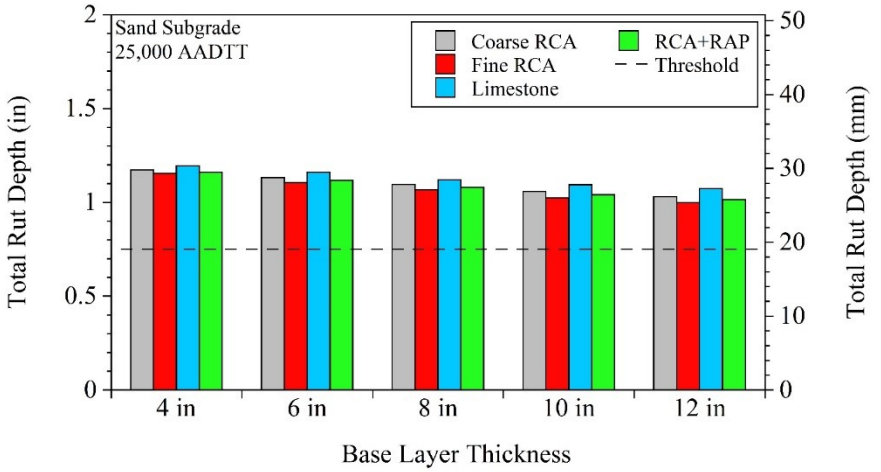

Sand Subgrade
7,500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
AC Top-Down Cracking
(Longitudinal) (ft/mile)
0
5,000
1x10^4
1.5x10^4
2x10^4
AC Top-Down Cracking
(Longitudinal) (m/km)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

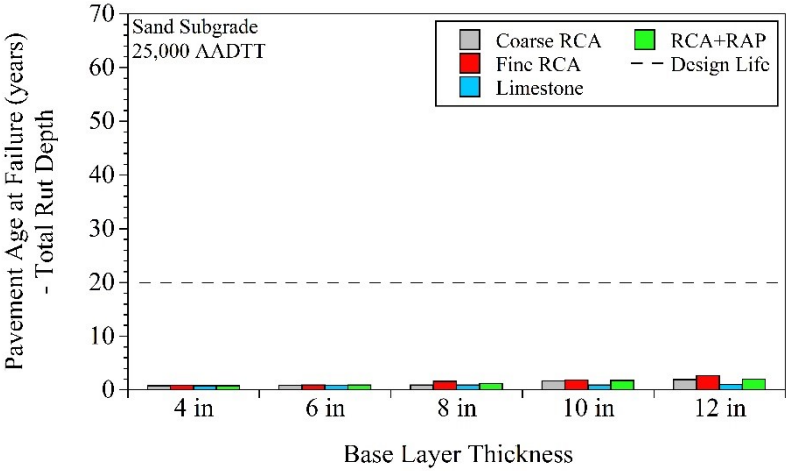

Sand Subgrade
7,500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- AC Top-Down Cracking
(Longitudinal)
0
10
20
30
40
50
60
70
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

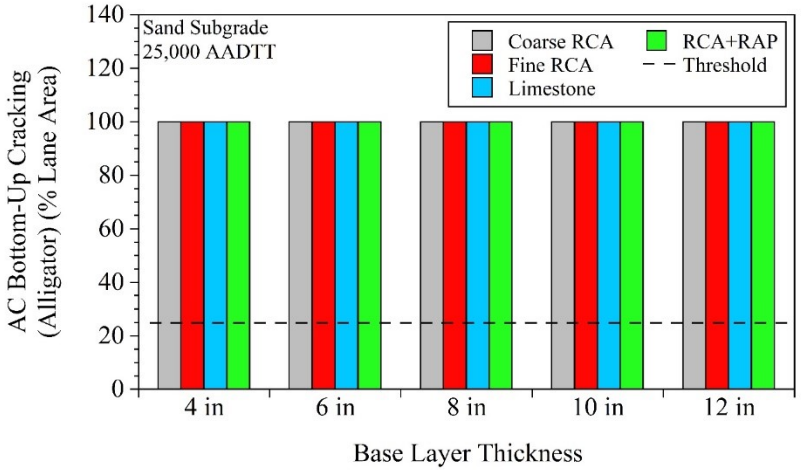
For pavements that contained Sand Subgrade - 25,000 AADTT:

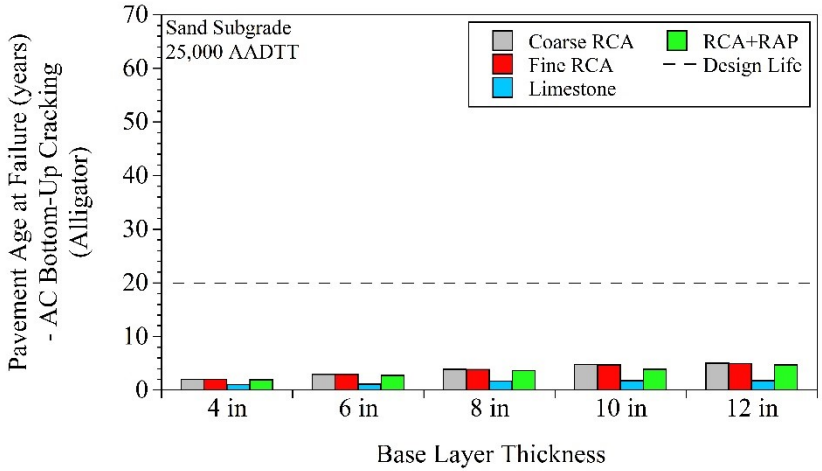


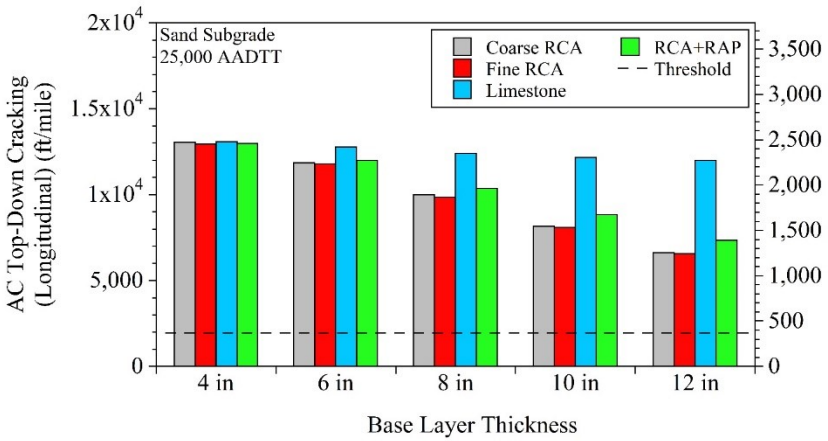


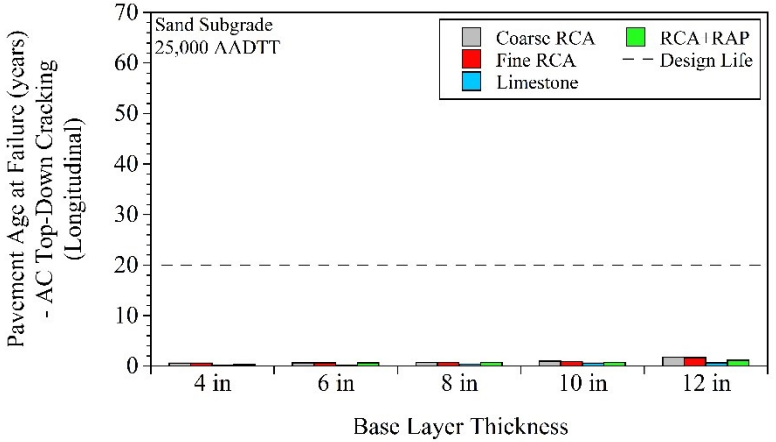




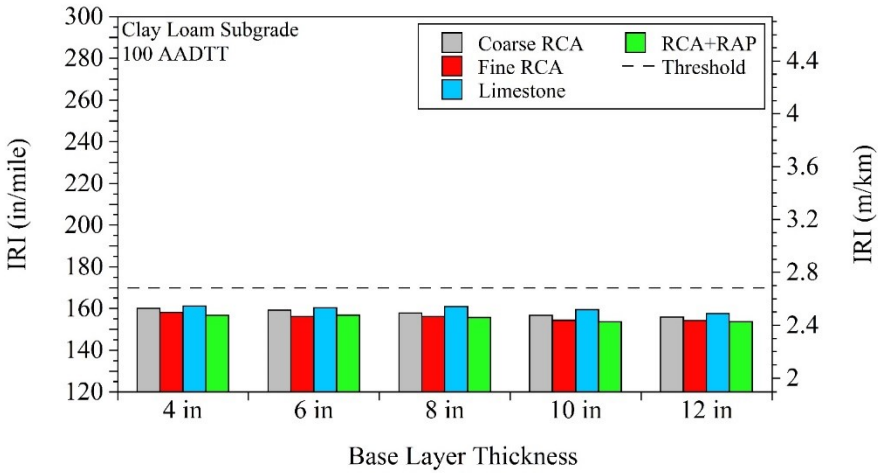

Sand Subgrade
25,000 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

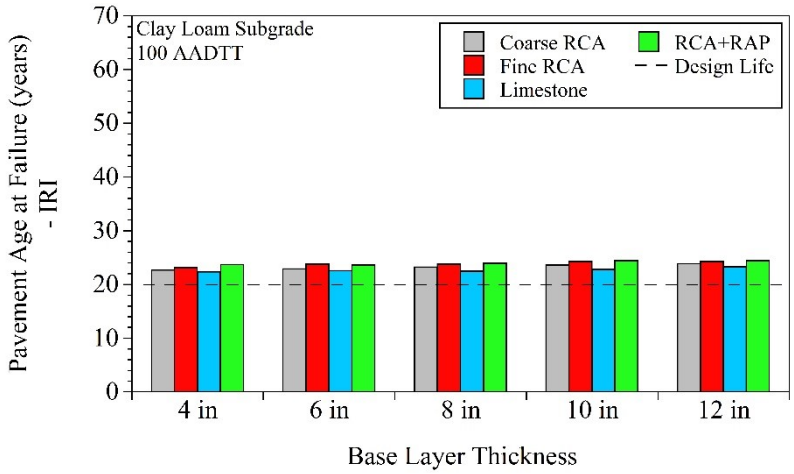

Sand Subgrade
25,000 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

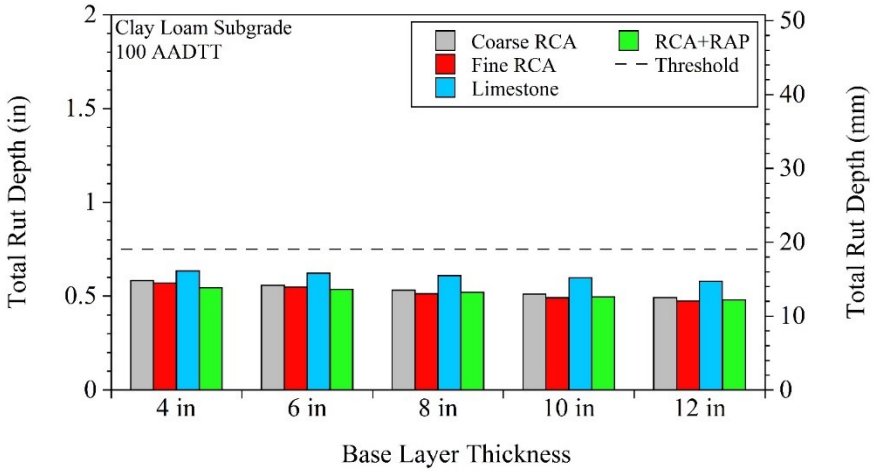

Sand Subgrade
25,000 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
AC Top-Down Cracking
(Longitudinal) (ft/mile)
0
5,000
1x10^4
1.5x10^4
2x10^4
AC Top-Down Cracking
(Longitudinal) (m/km)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

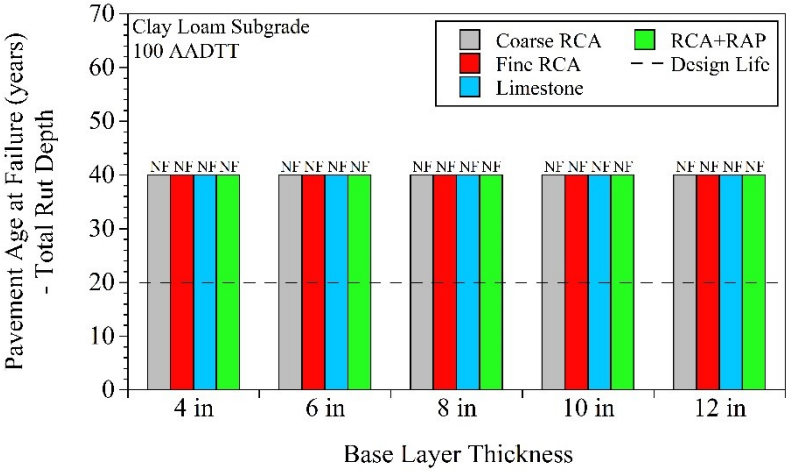

Sand Subgrade
25,000 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- AC Top-Down Cracking
(Longitudinal)
0
10
20
30
40
50
60
70
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

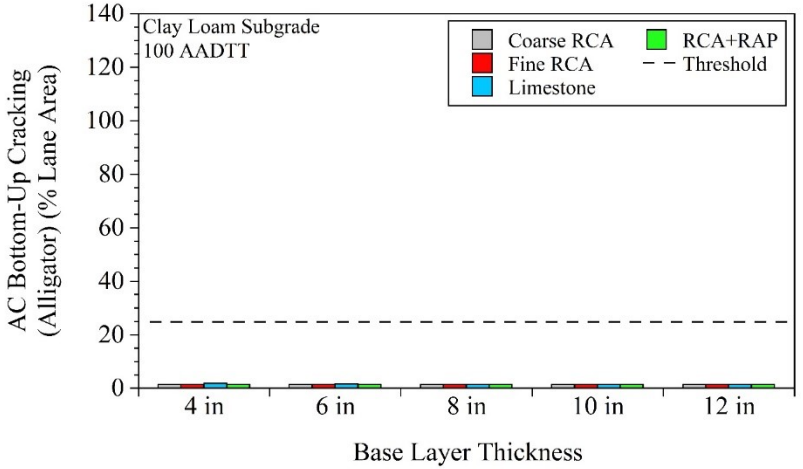
For pavements that contained Clay Loam subgrade - 100 AADTT:

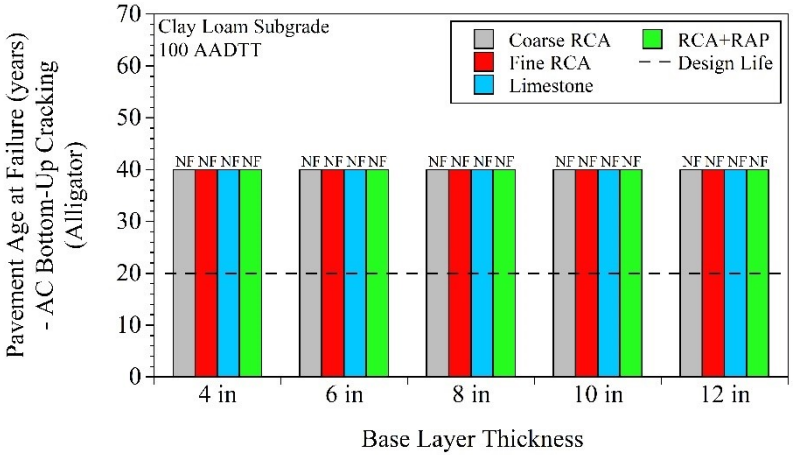




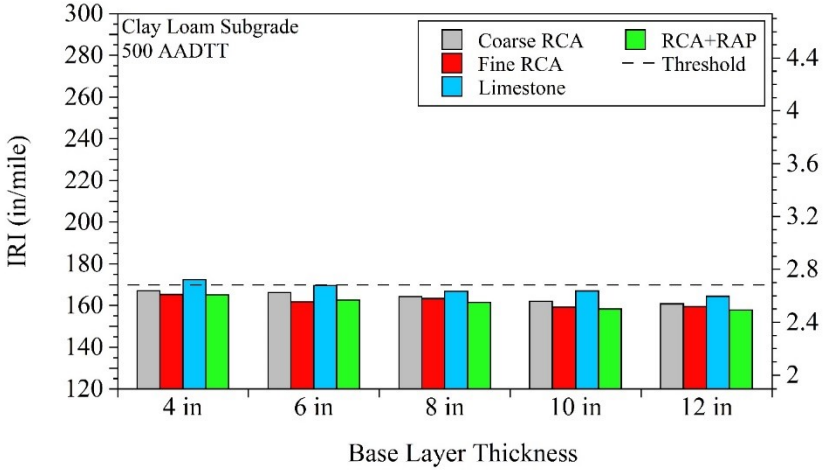


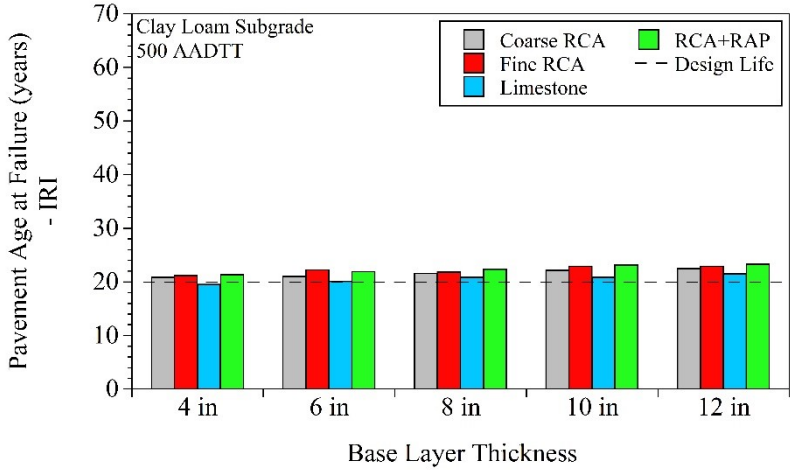


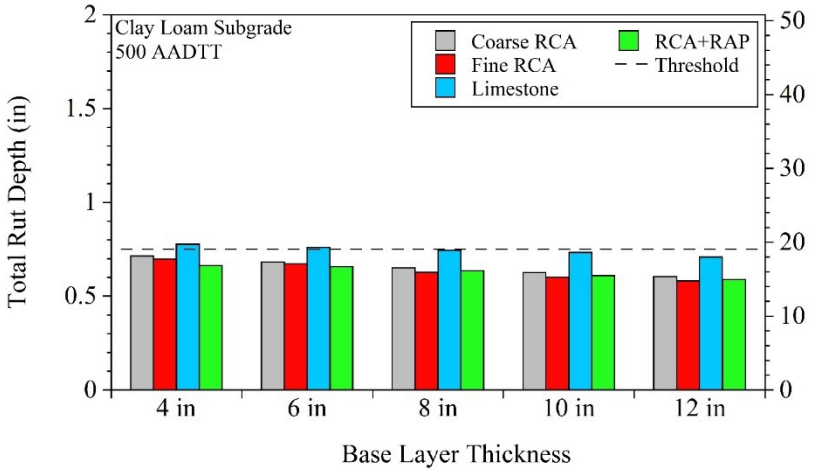


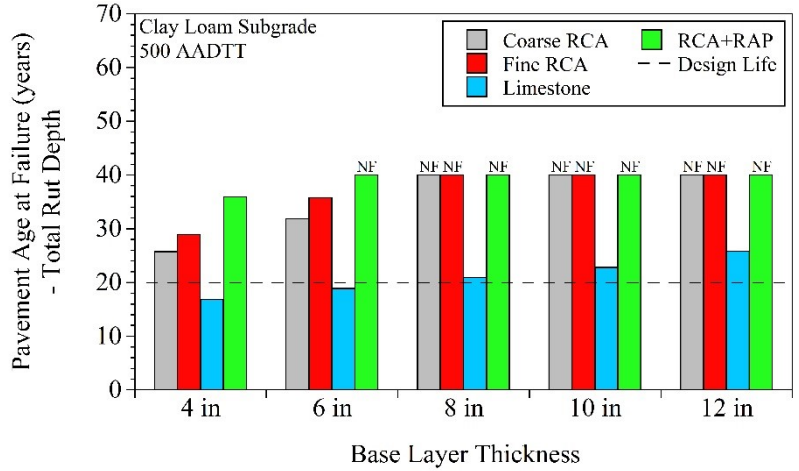


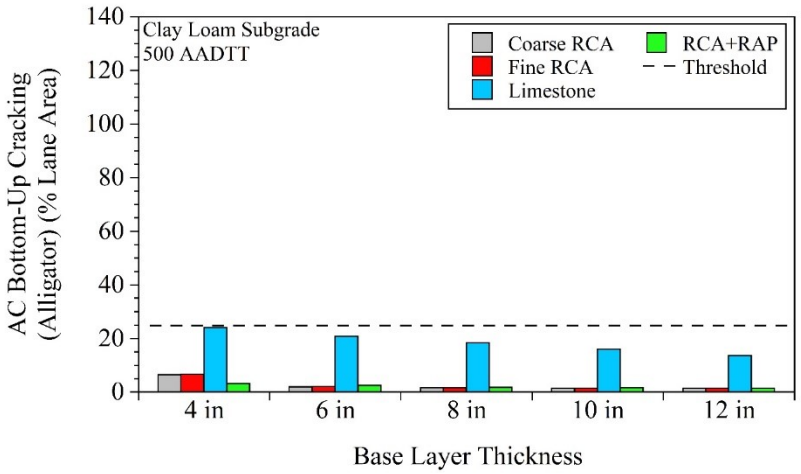
For pavements that contained Clay Loam subgrade - 500 AADTT:

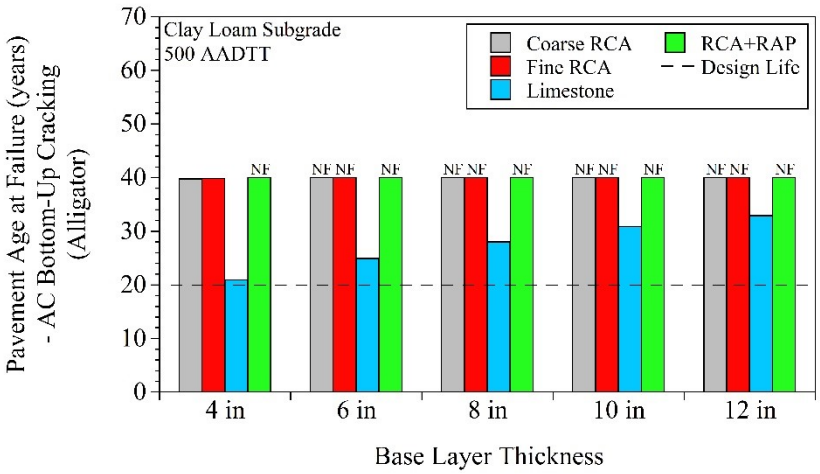




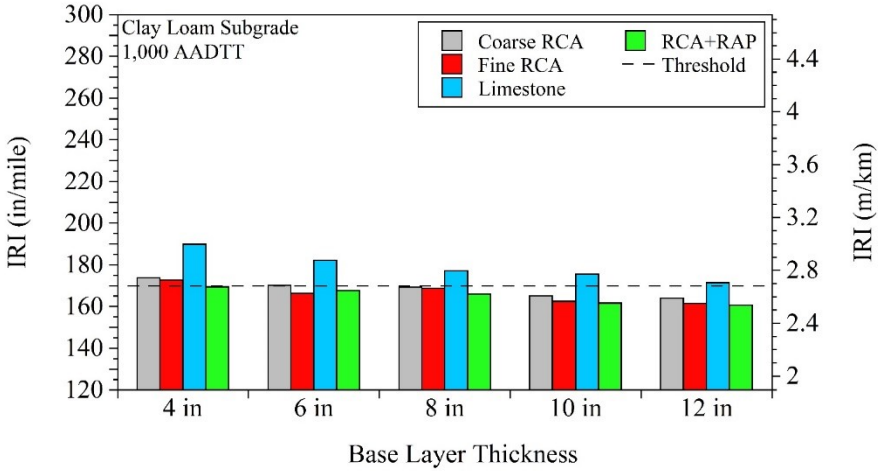

Clay Loam Subgrade
500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
Base Layer Thickness
4 in
6 in
8 in
10 in
12 in

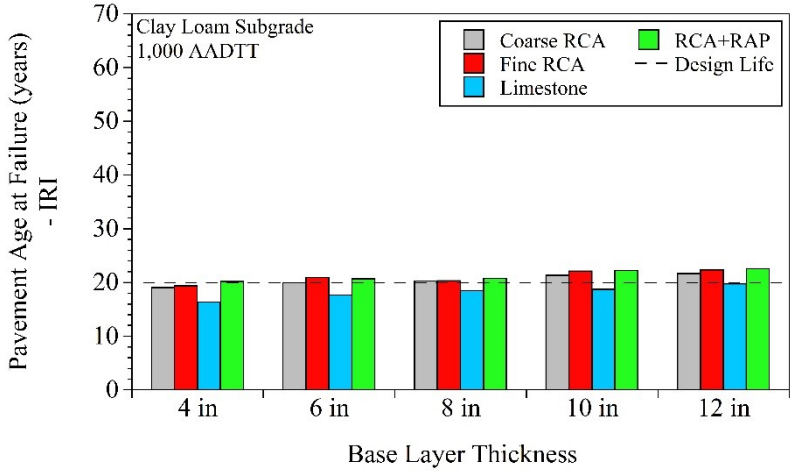

Clay Loam Subgrade
500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
NF
Base Layer Thickness
4 in
6 in
8 in
10 in
12 in

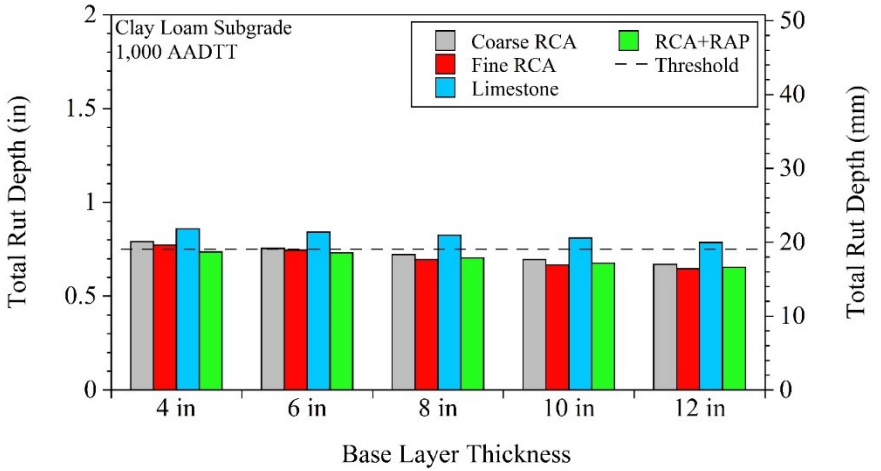

Clay Loam Subgrade
500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
Base Layer Thickness
4 in
6 in
8 in
10 in
12 in

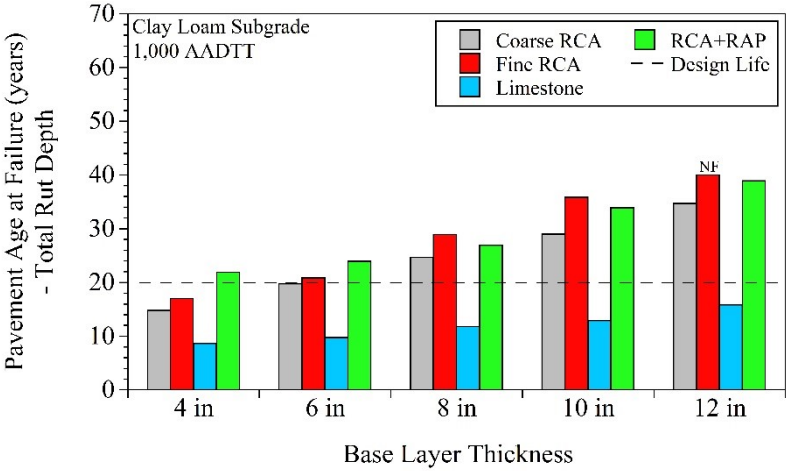

Clay Loam Subgrade
500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
NF
Base Layer Thickness
4 in
6 in
8 in
10 in
12 in

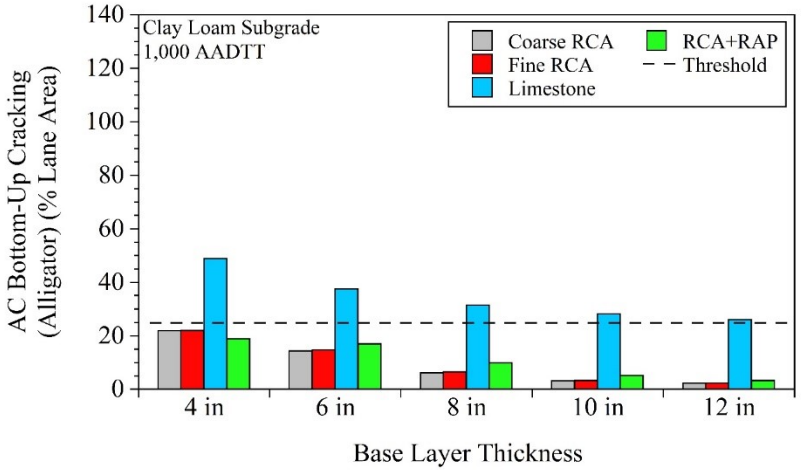
For pavements that contained Clay Loam subgrade - 1,000 AADTT:

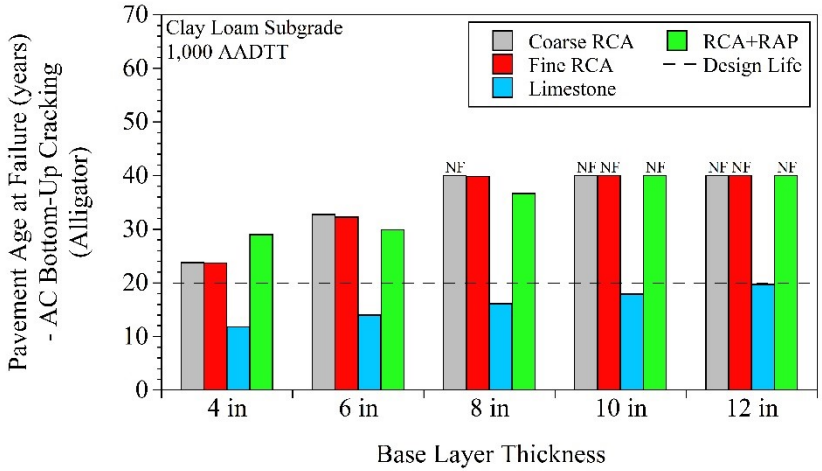




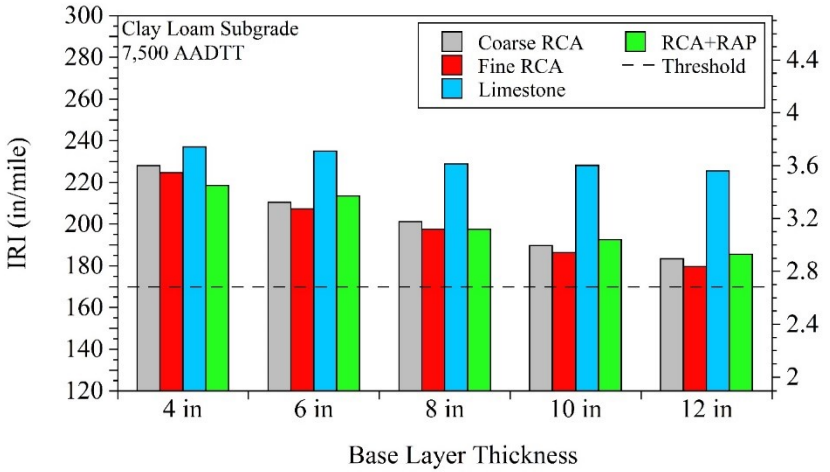


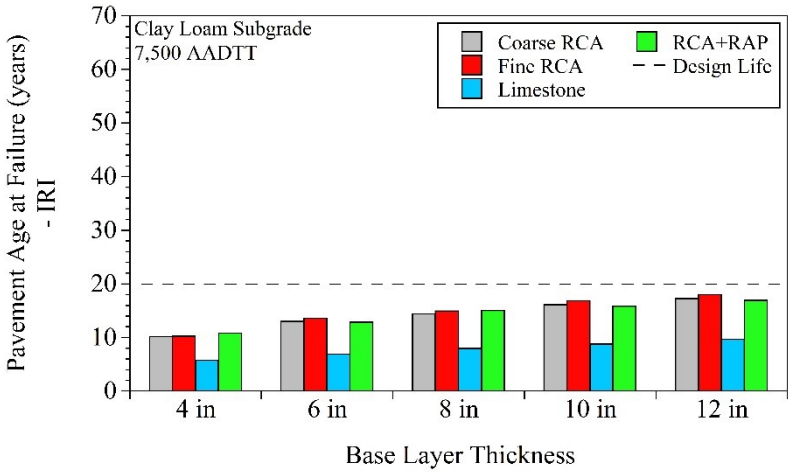


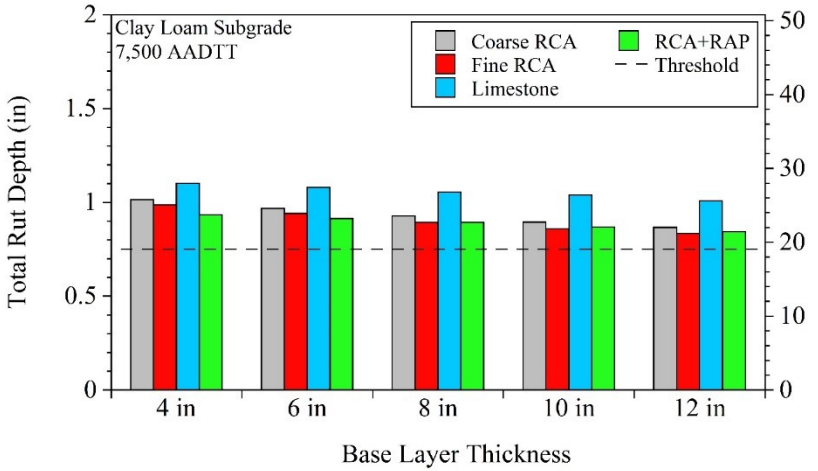


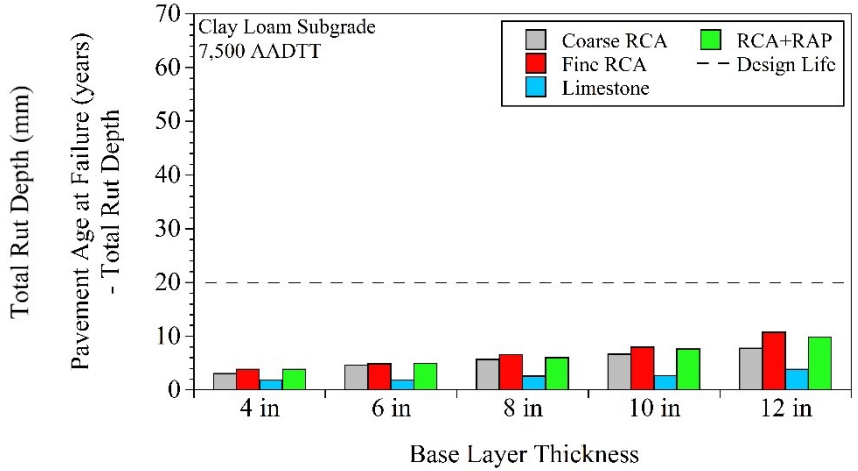


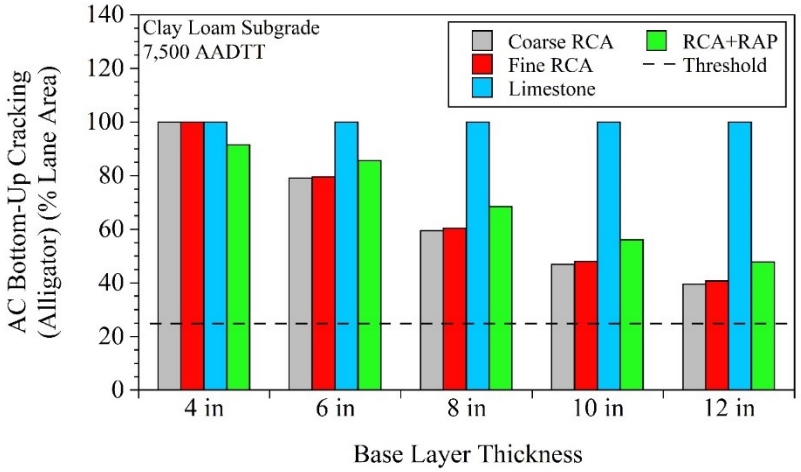
For pavements that contained Clay Loam subgrade - 7,500 AADTT:

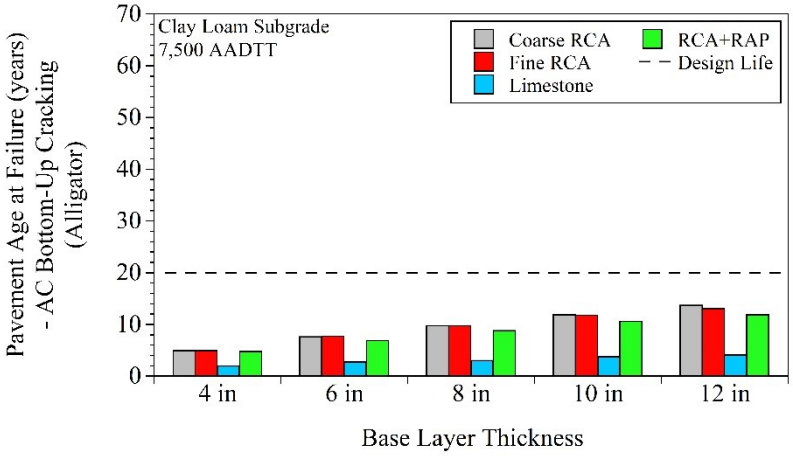




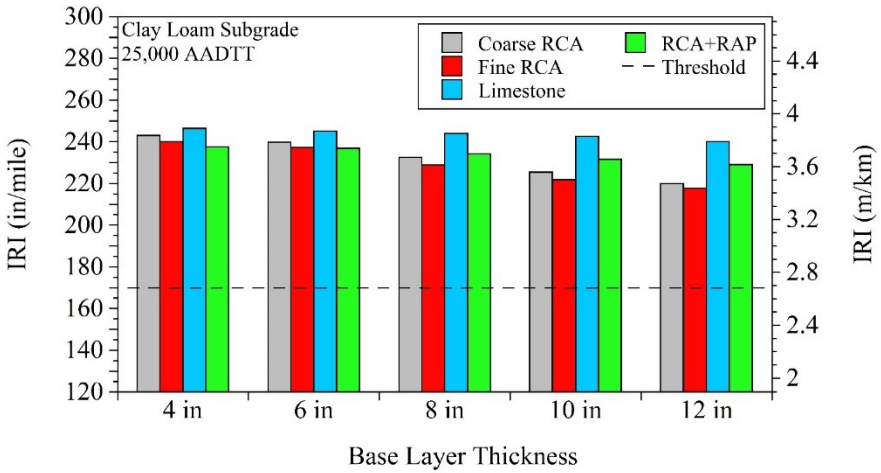

Clay Loam Subgrade
7,500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
0
0.5
1
1.5
2
0
10
20
30
40
50
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

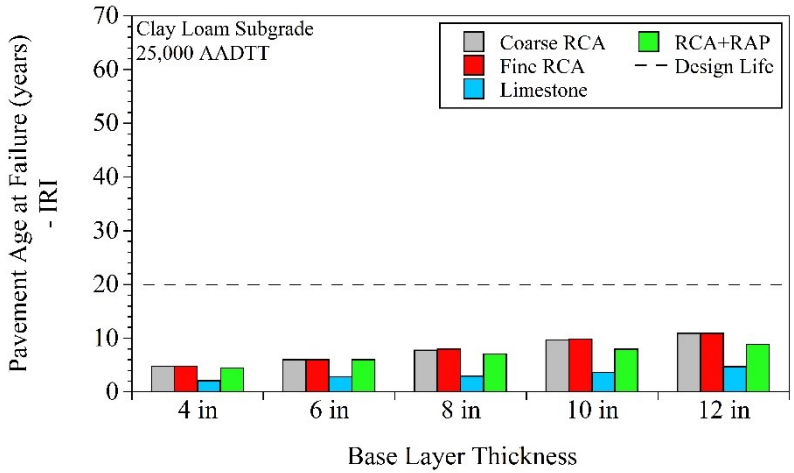

Clay Loam Subgrade
7,500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
0
10
20
30
40
50
60
70
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

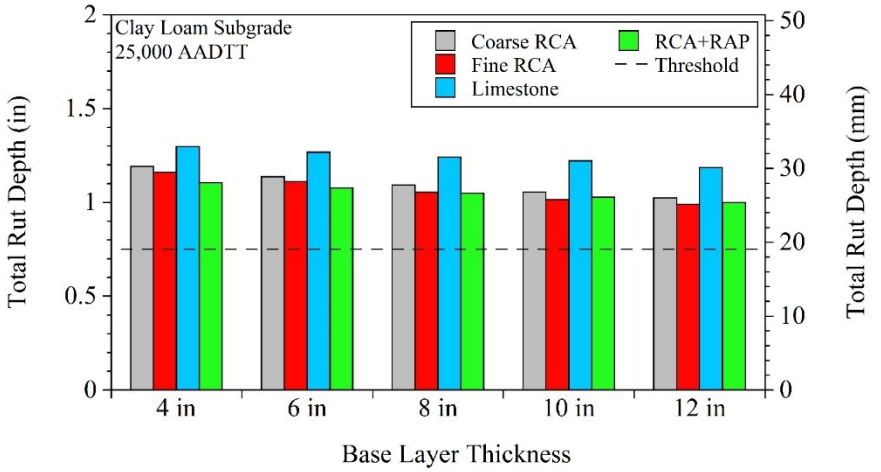

Clay Loam Subgrade
7,500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

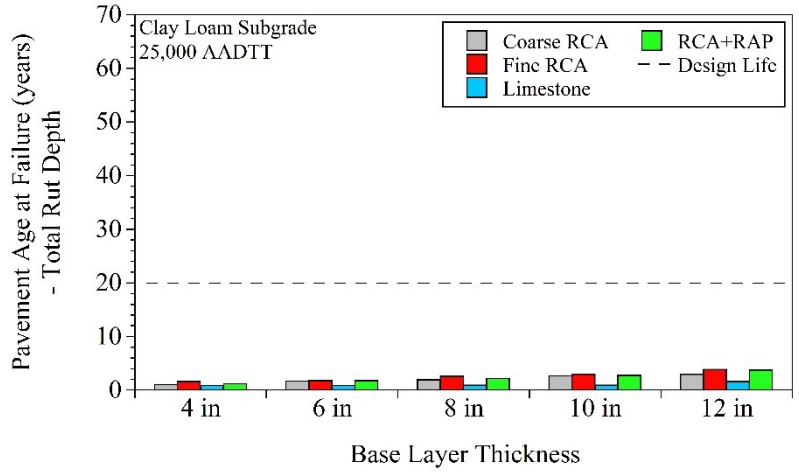

Clay Loam Subgrade
7,500 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

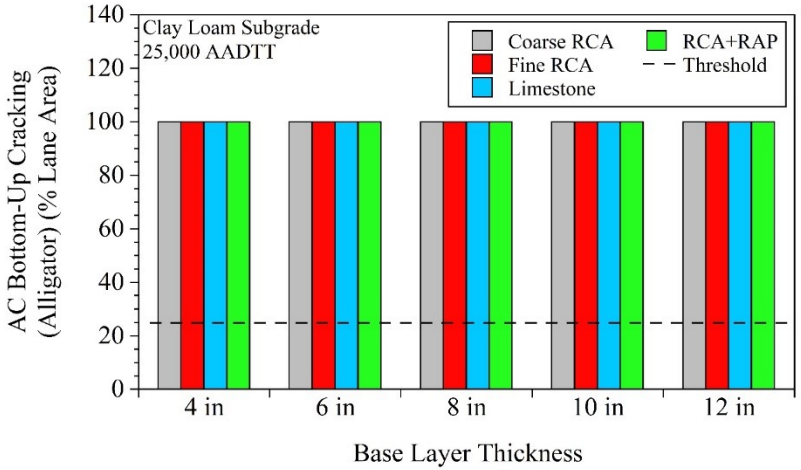
For pavements that contained Clay Loam subgrade - 25,000 AADTT:

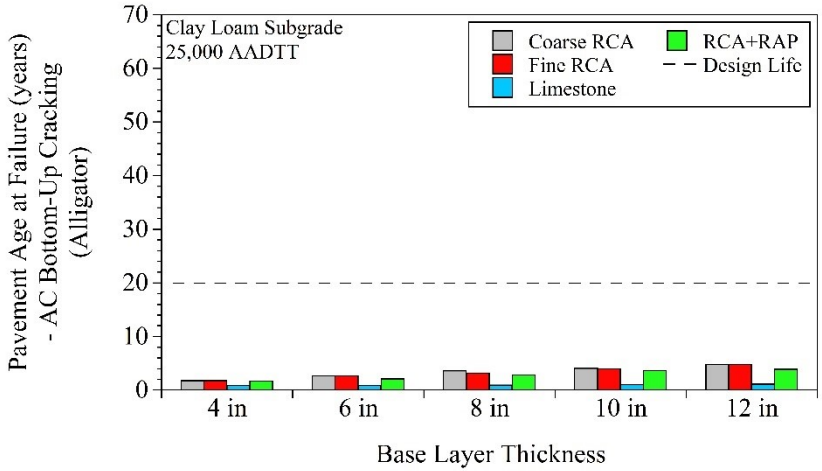






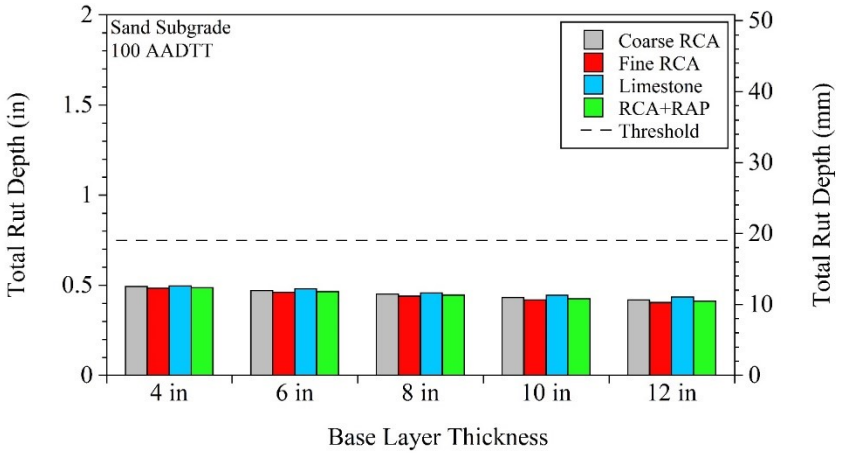


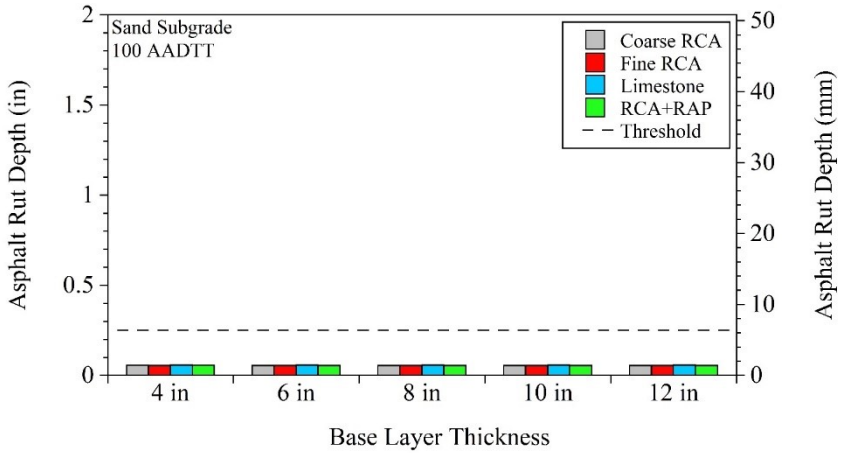

Clay Loam Subgrade
25,000 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

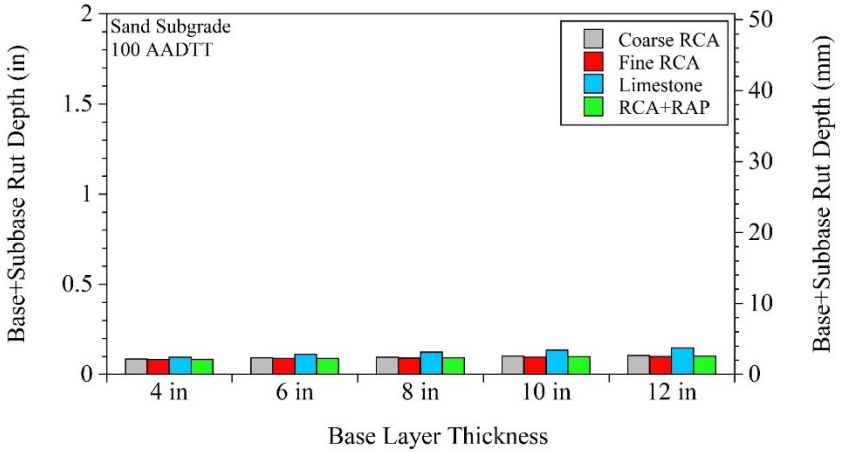

Clay Loam Subgrade
25,000 AADTT
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
4 in
6 in
8 in
10 in
12 in
Base Layer Thickness

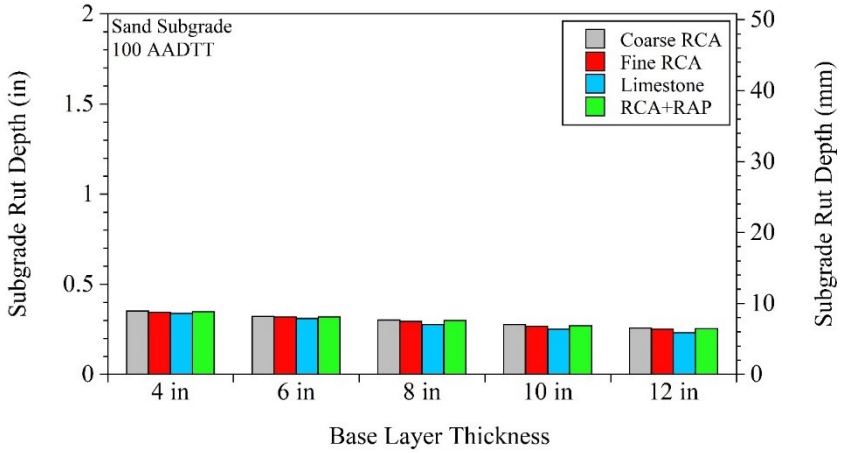
APPENDIX BC
TOTAL, ASPHALT, BASE+SUBBASE, AND SUBGRADE LAYER RUTTING AT 50% RELIABILITY FOR RECYCLED AGGREGATE BASE (RAB) GROUP

For pavements that contained Sand Subgrade - 100 AADTT:

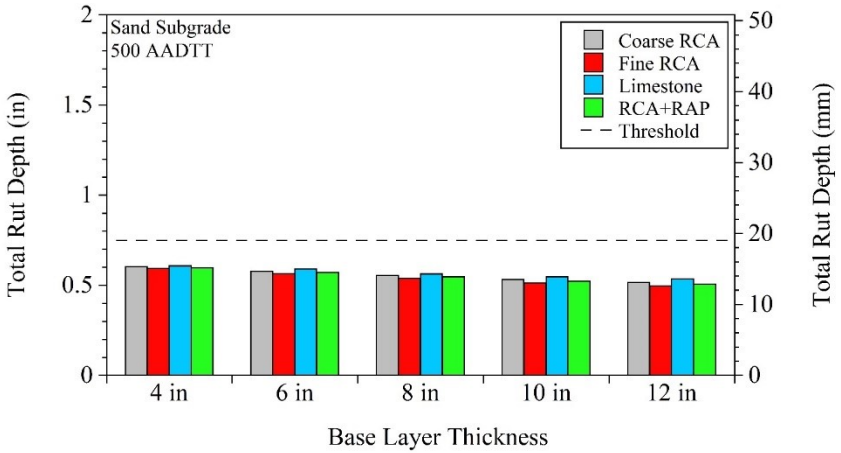


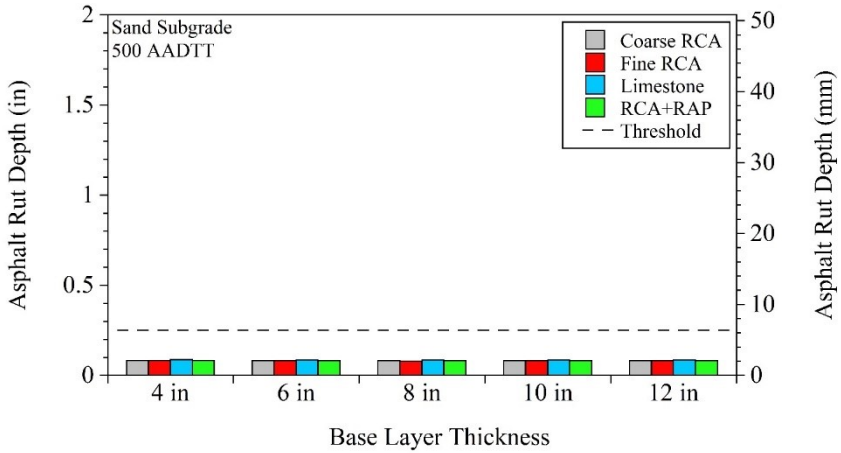


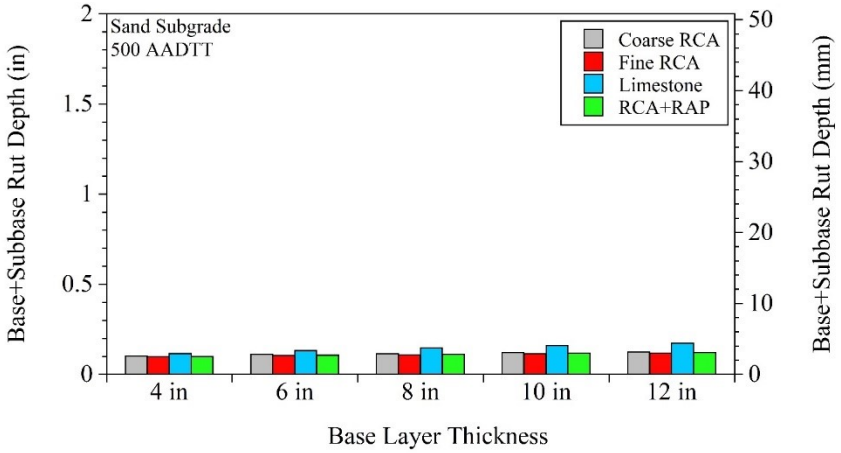


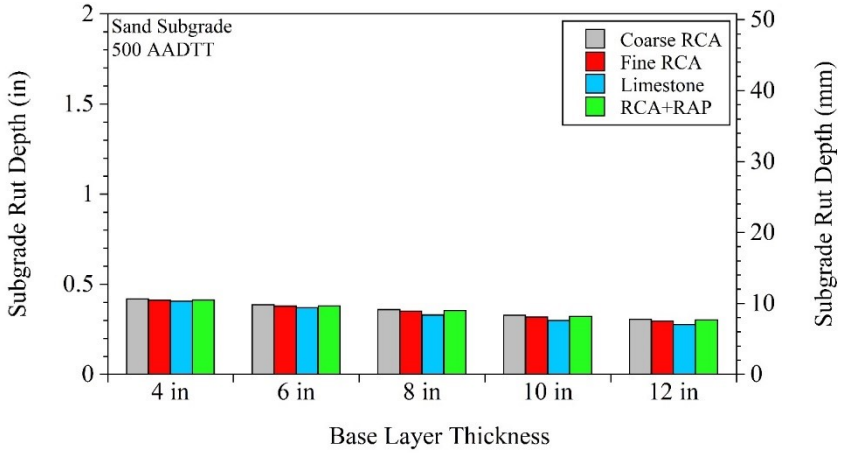


For pavements that contained Sand Subgrade - 500 AADTT:

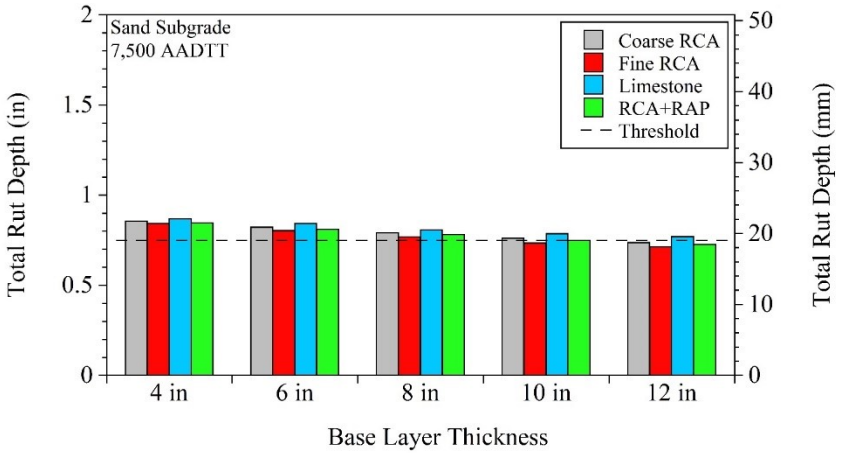


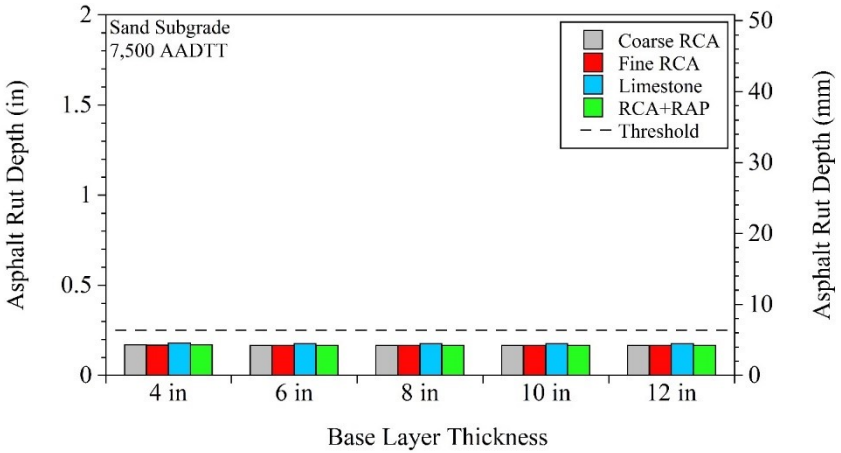


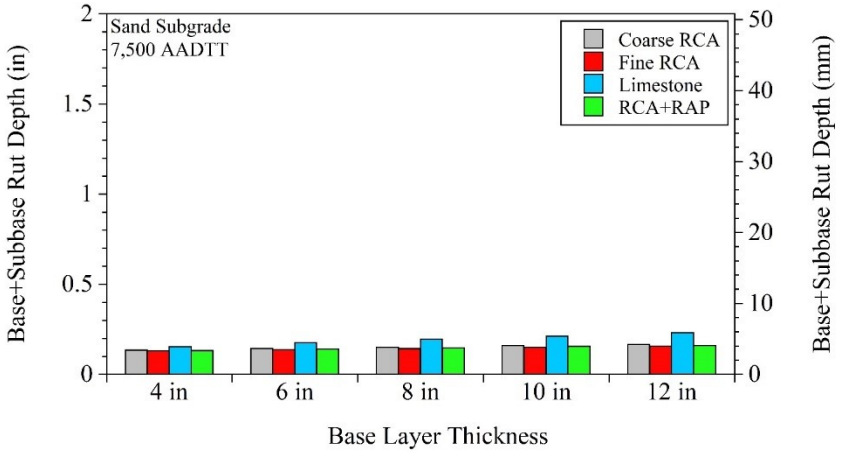


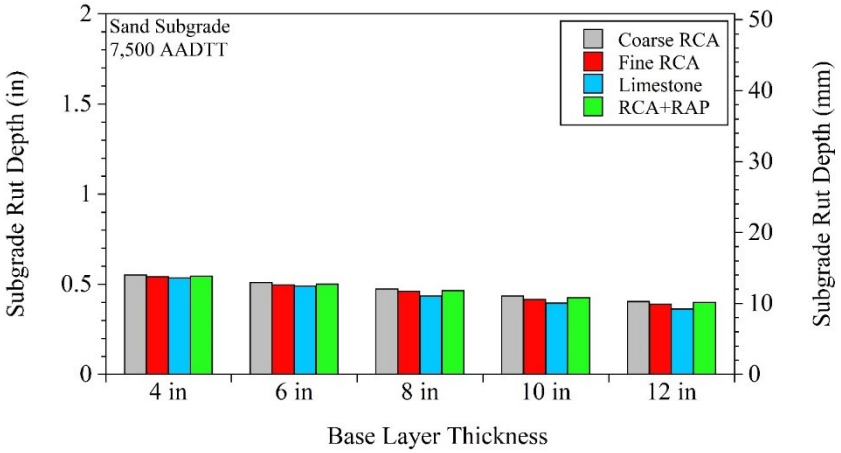


For pavements that contained Sand Subgrade - 7,500 AADTT:

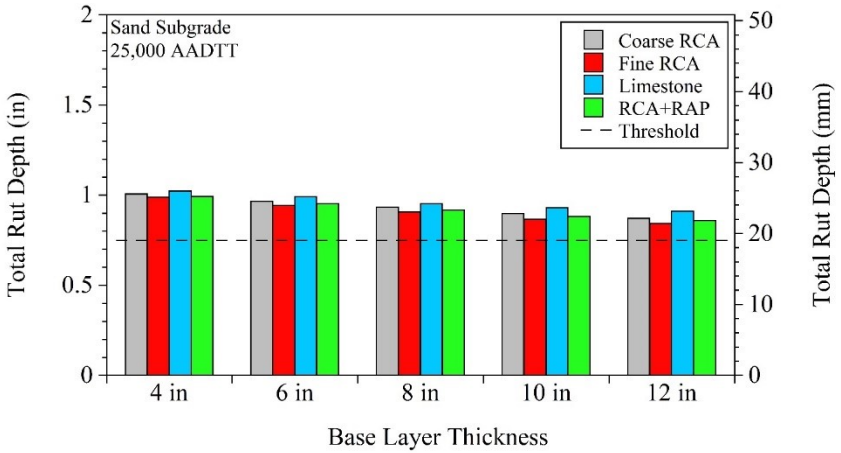


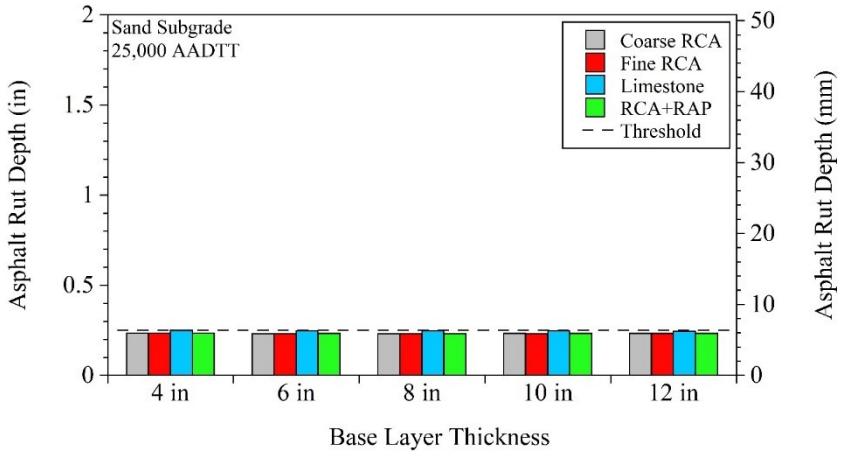


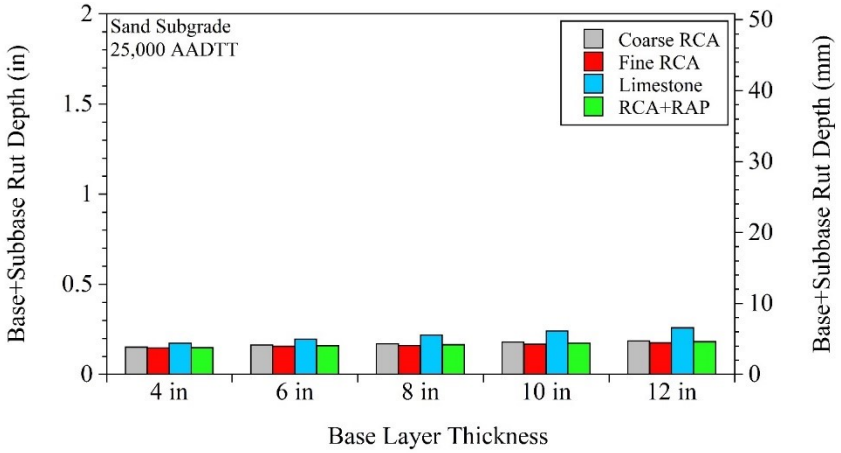


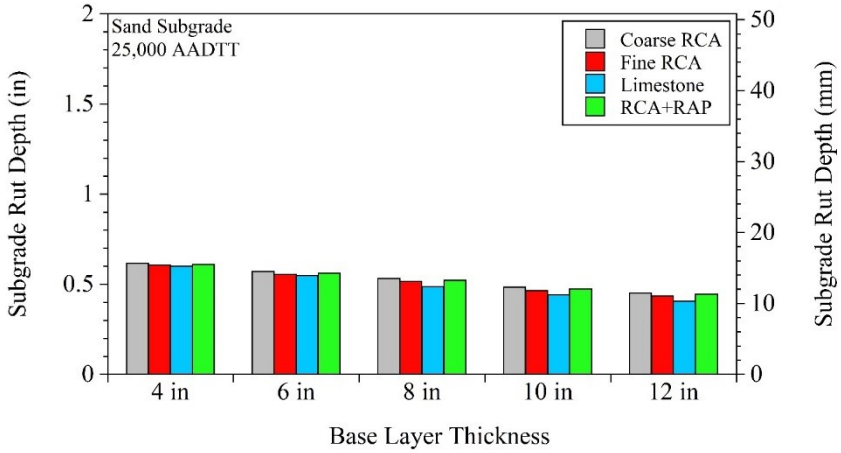


For pavements that contained Sand Subgrade - 25,000 AADTT:

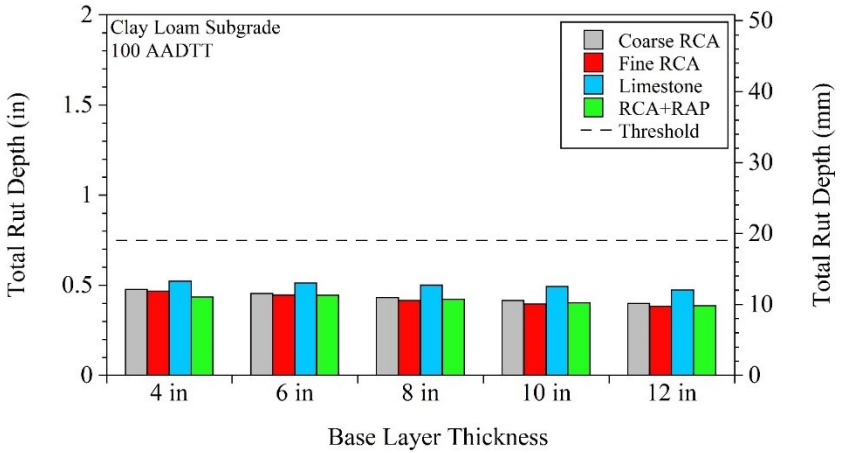


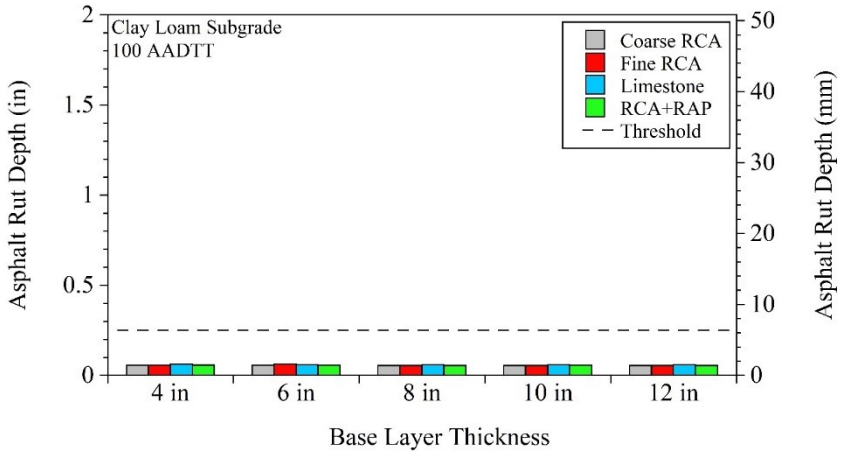


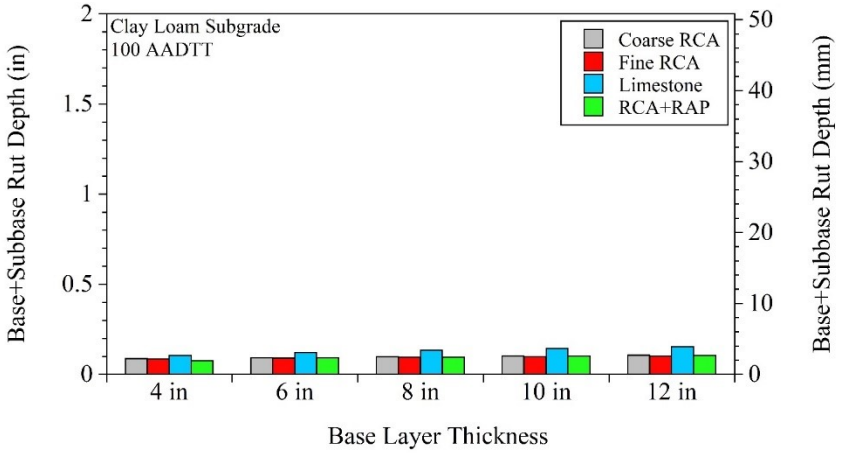


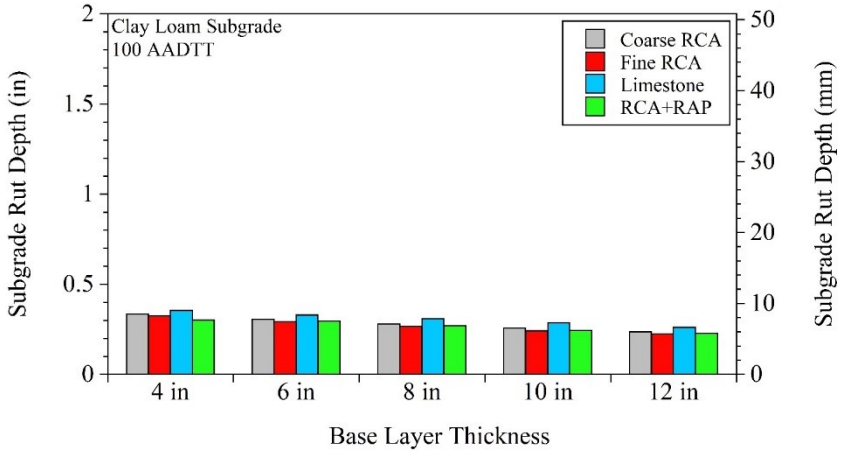


For pavements that contained Clay Loam subgrade - 100 AADTT:

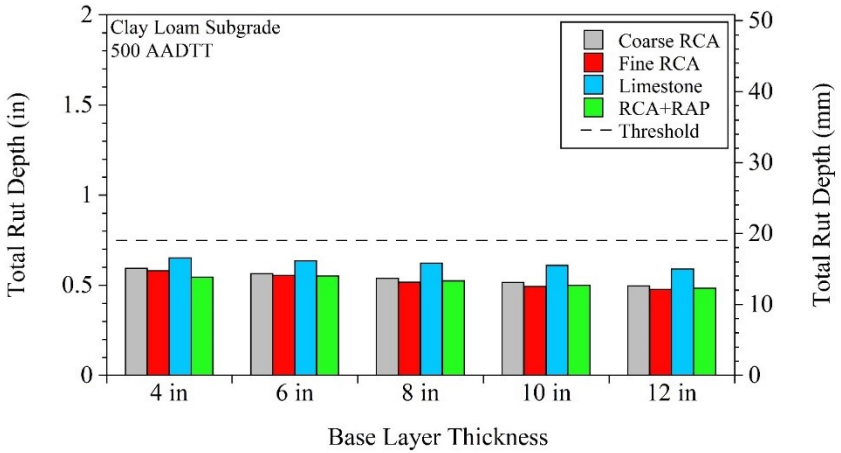


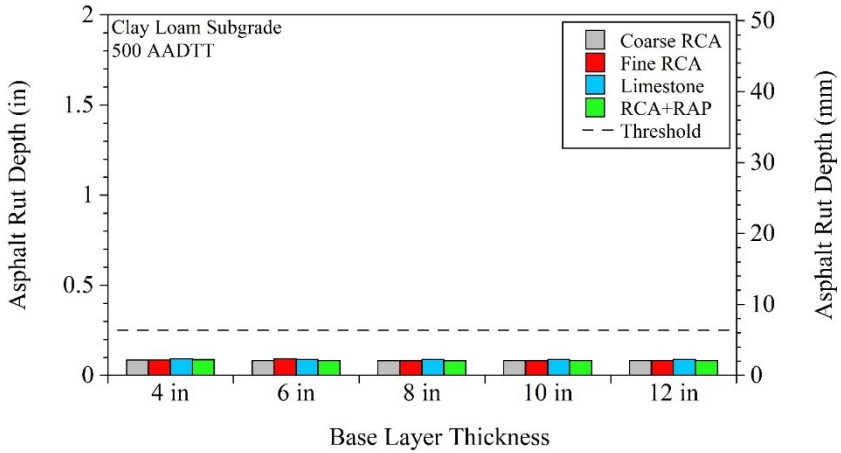


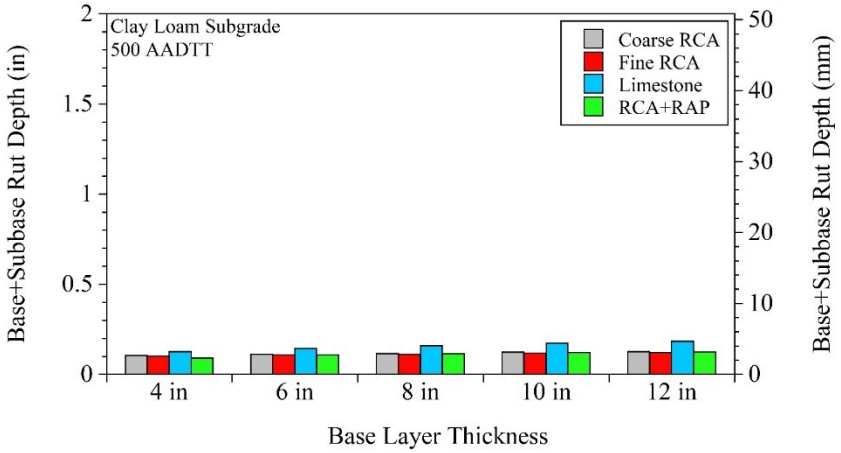


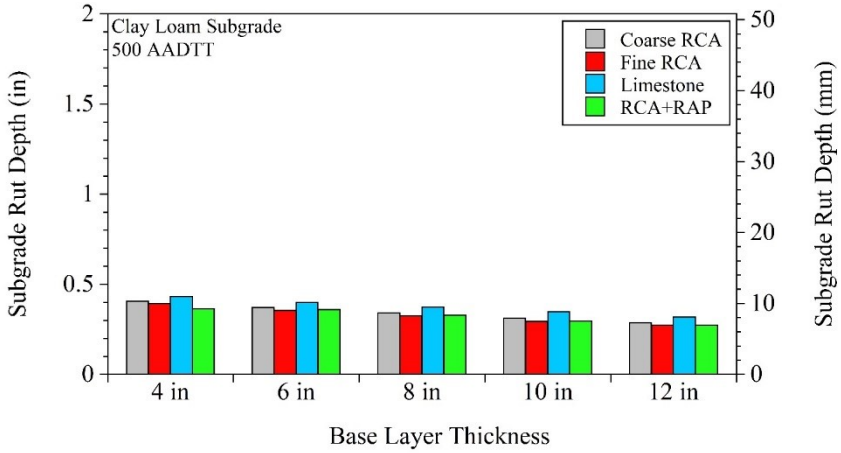


For pavements that contained Clay Loam subgrade - 500 AADTT:

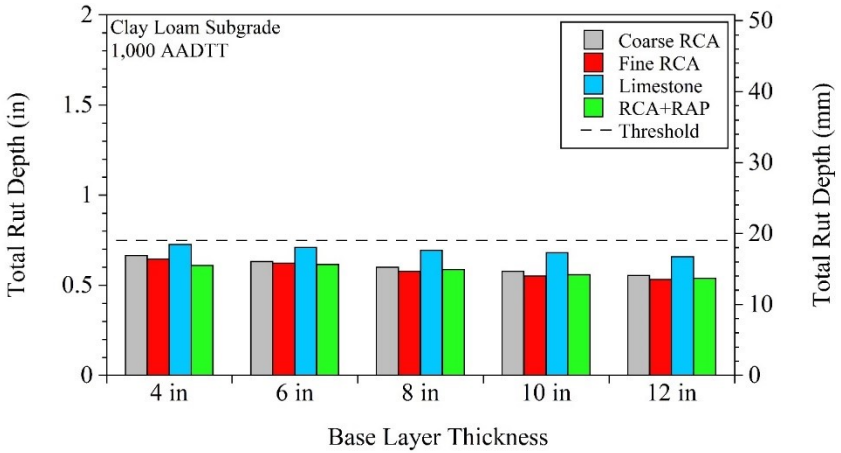


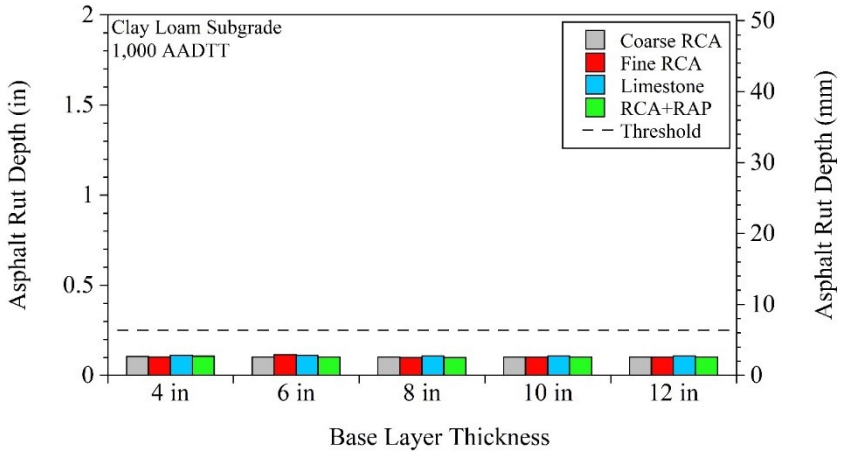


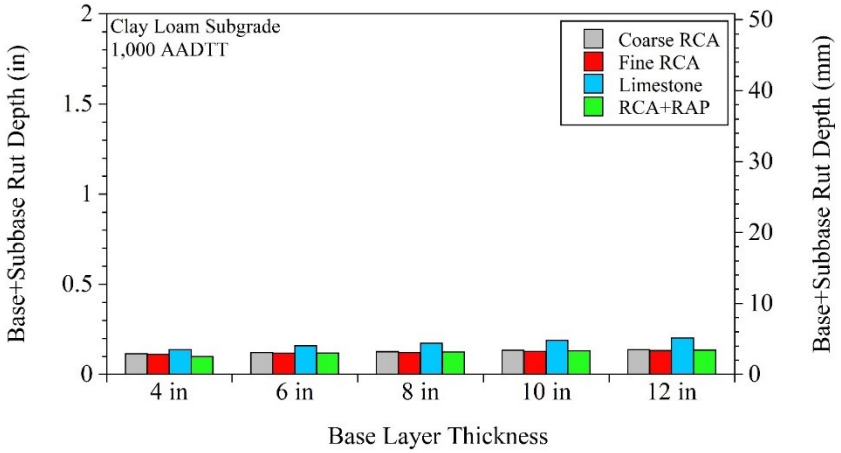


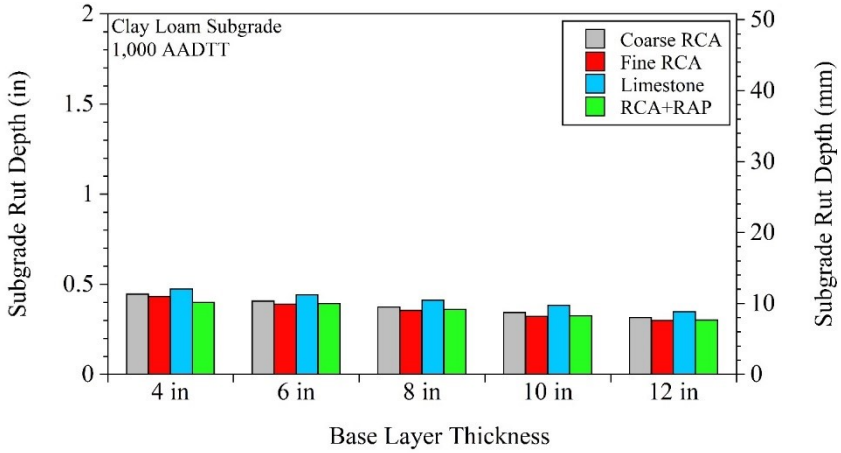


For pavements that contained Clay Loam subgrade - 1,000 AADTT:

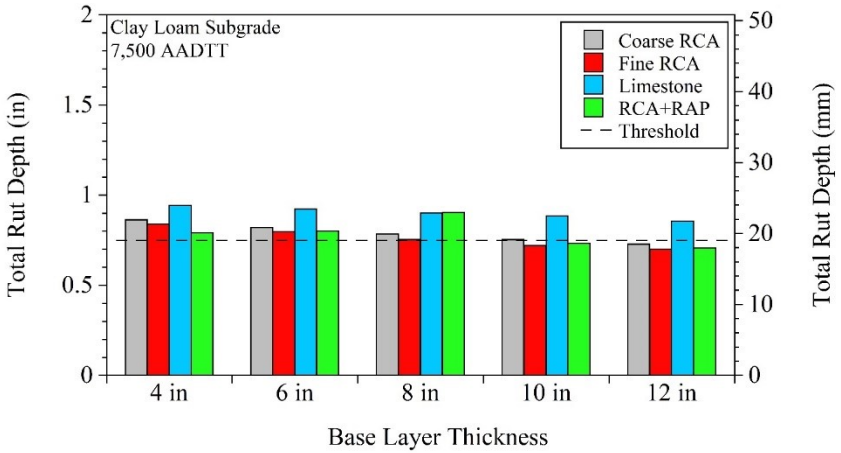


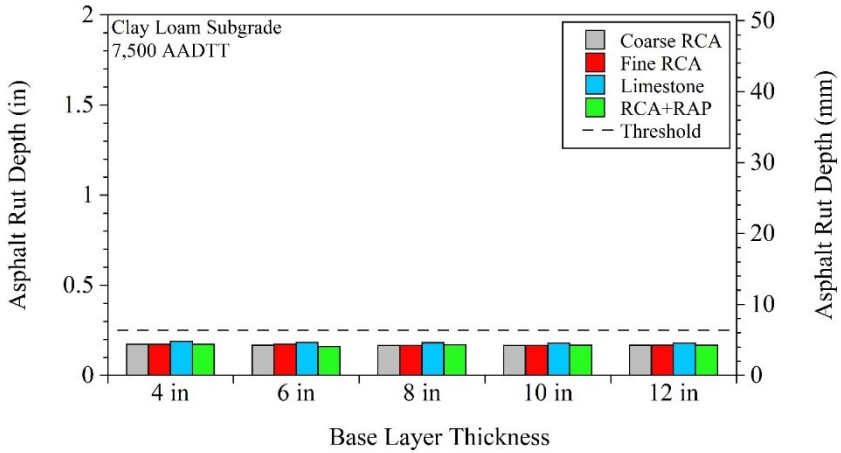


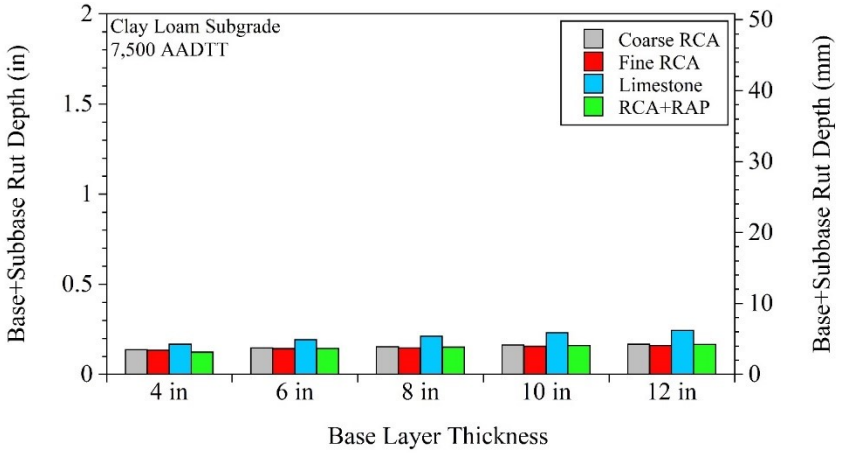


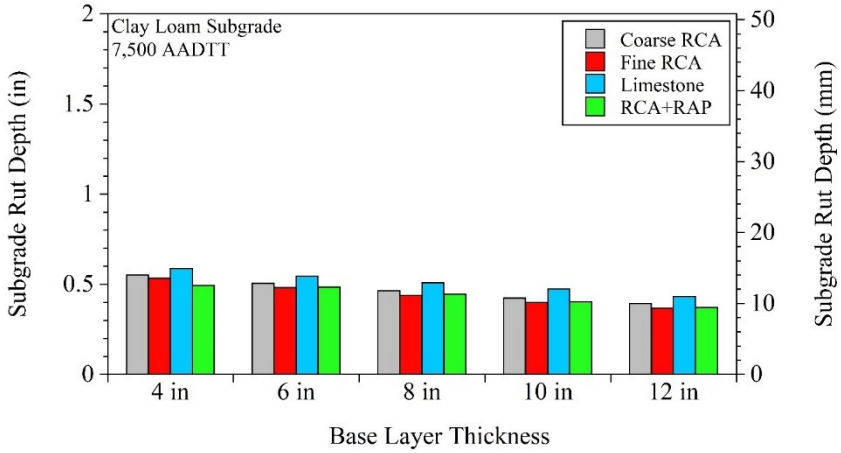


For pavements that contained Clay Loam subgrade - 7,500 AADTT:

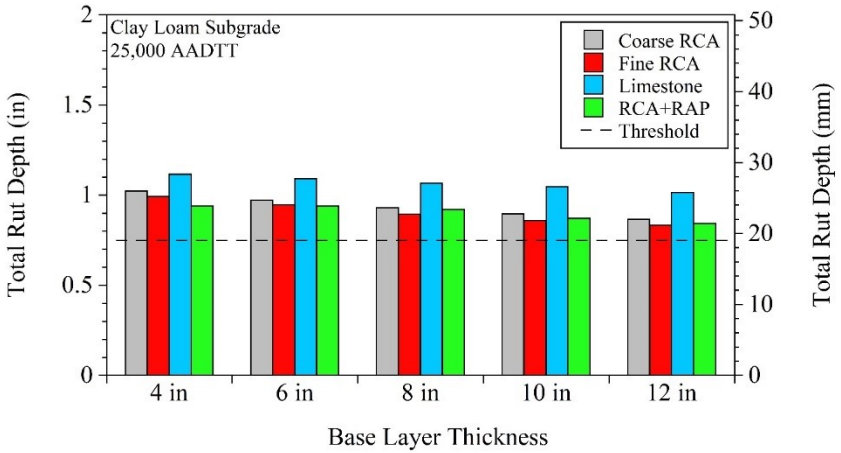


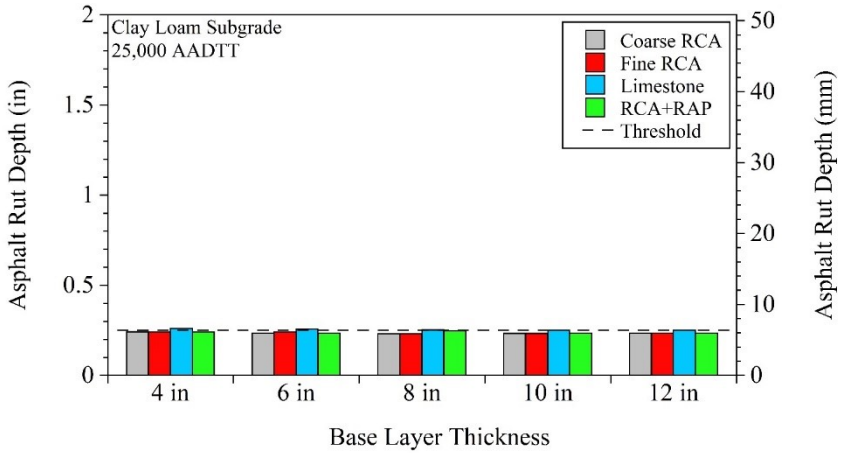


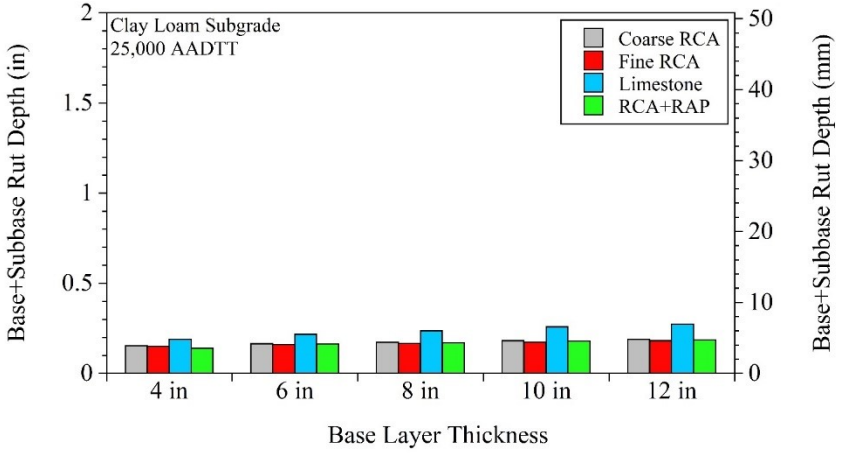


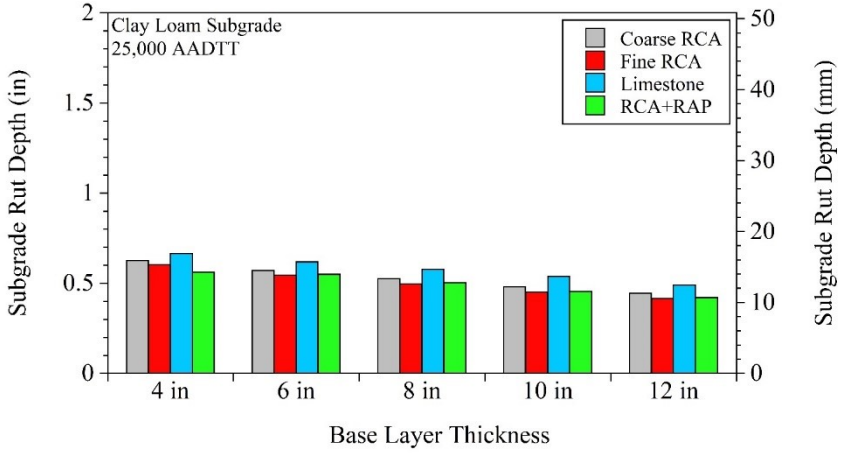


For pavements that contained Clay Loam subgrade - 25,000 AADTT:



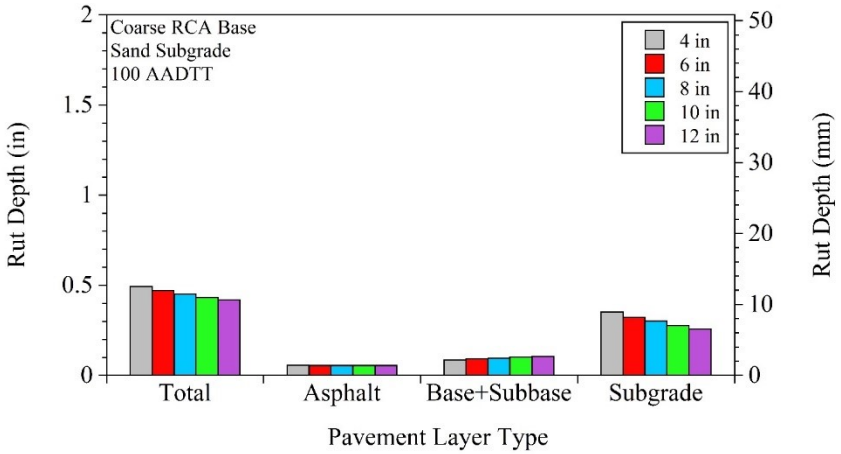


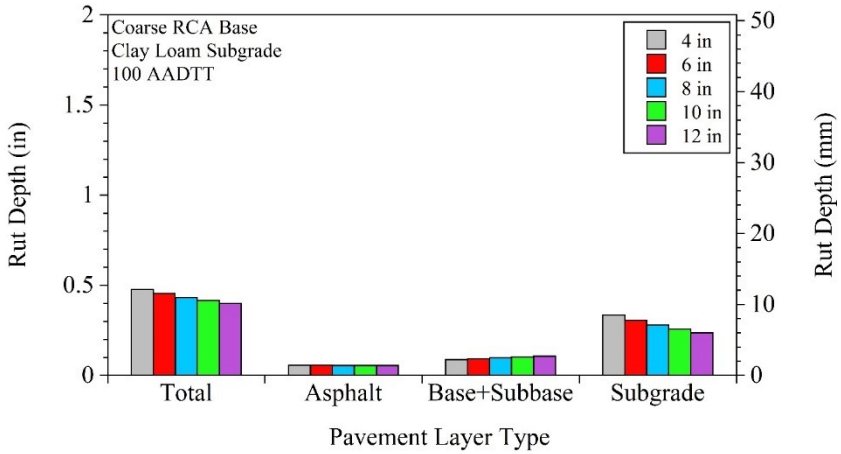




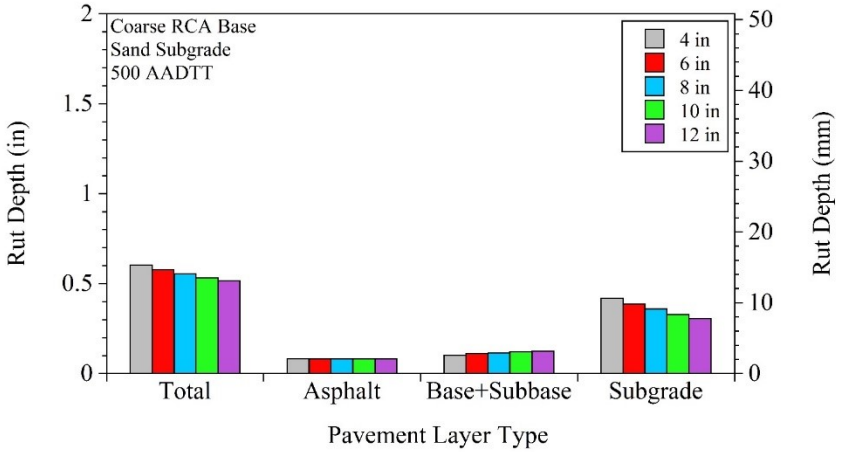
APPENDIX BD
TOTAL AND LAYER RUTTING AT 50% RELIABILITY FOR RECYCLED AGGREGATE BASE (RAB) GROUP

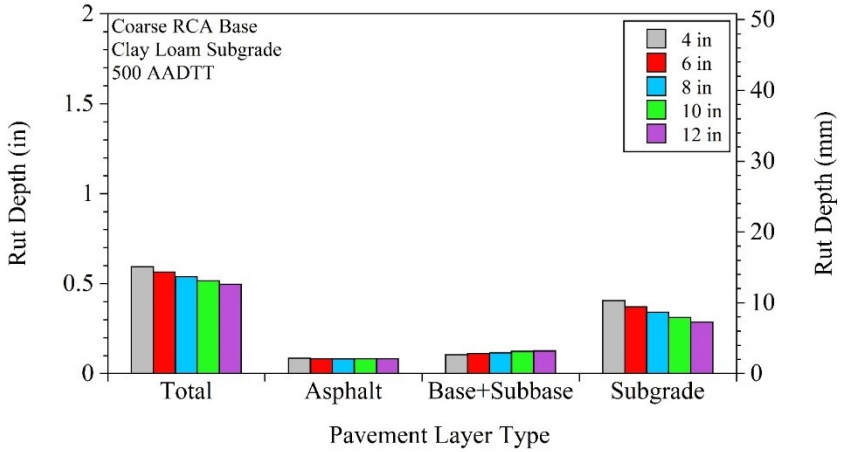
For pavements that contained Coarse RCA base - 100 AADTT:



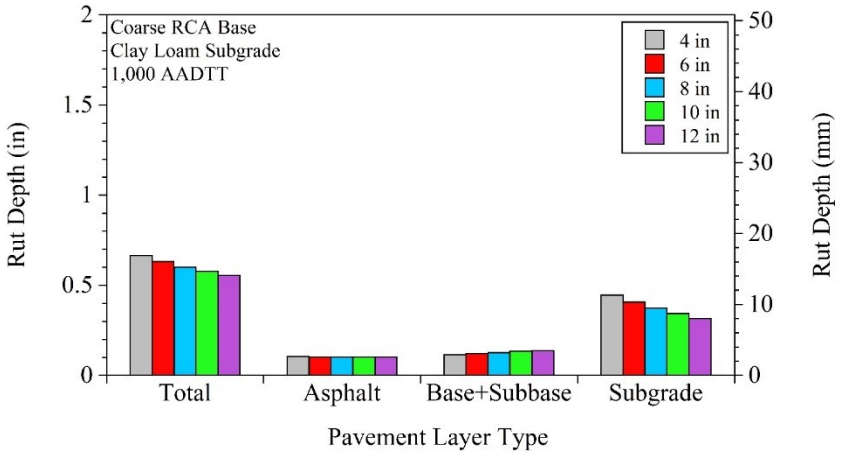


For pavements that contained Coarse RCA base - 500 AADTT:

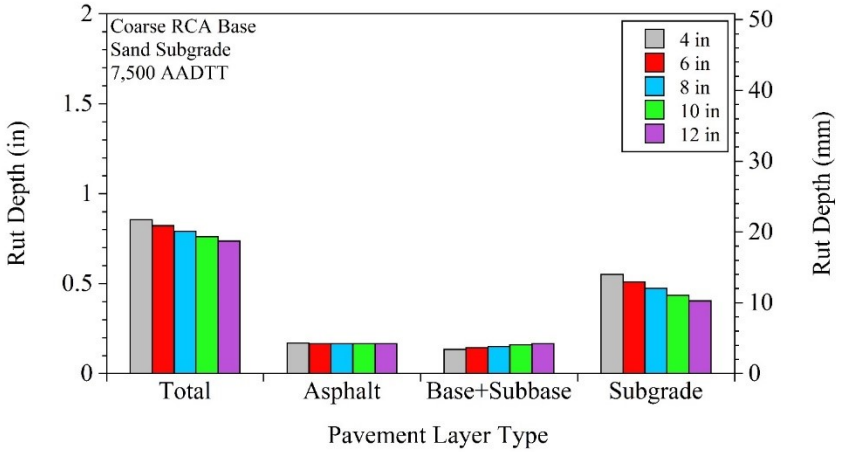


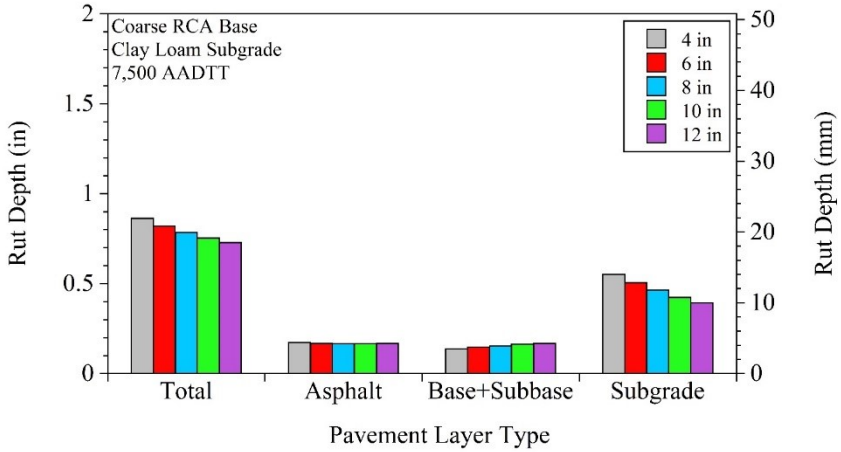


For pavements that contained Coarse RCA base - 1,000 AADTT:

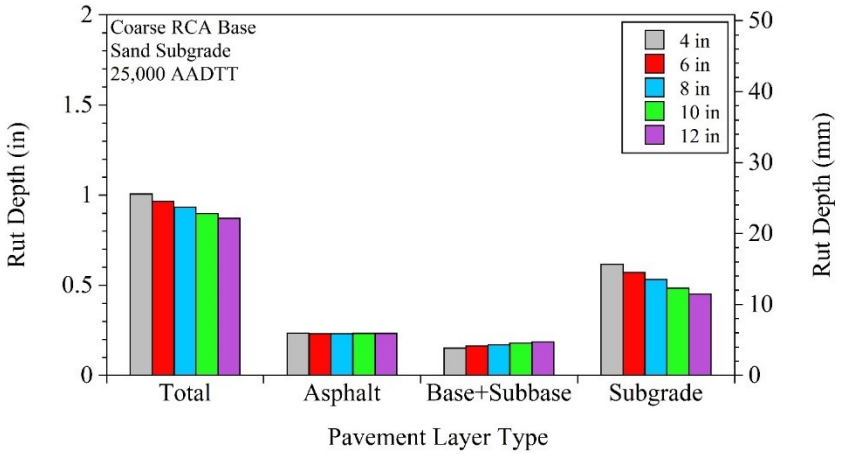


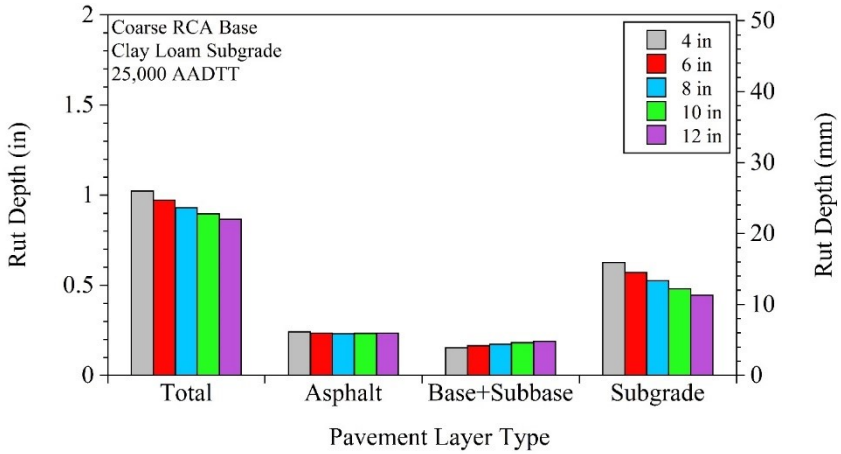
For pavements that contained Coarse RCA base - 7,500 AADTT:



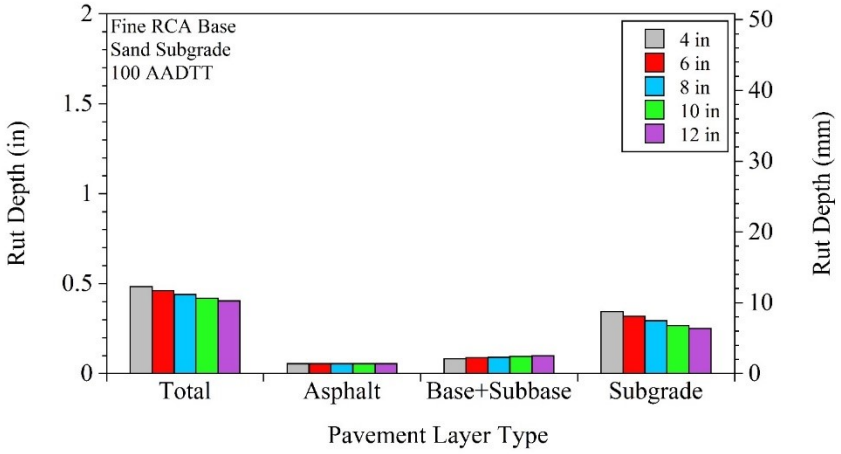


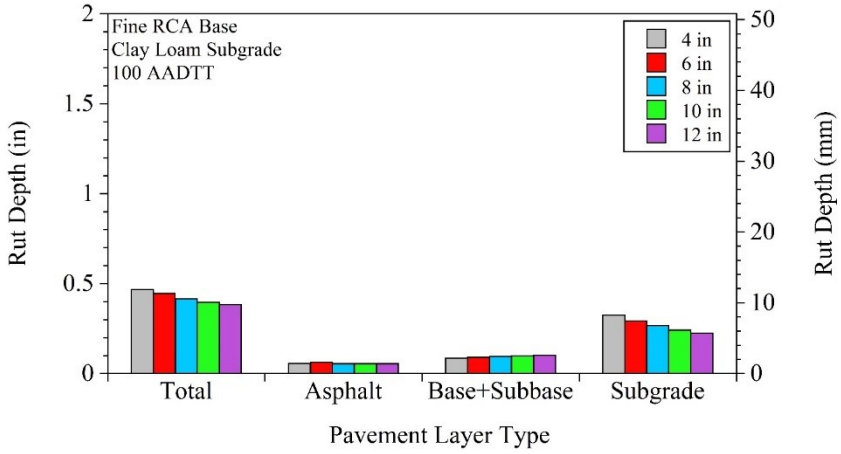
For pavements that contained Coarse RCA base - 25,000 AADTT:



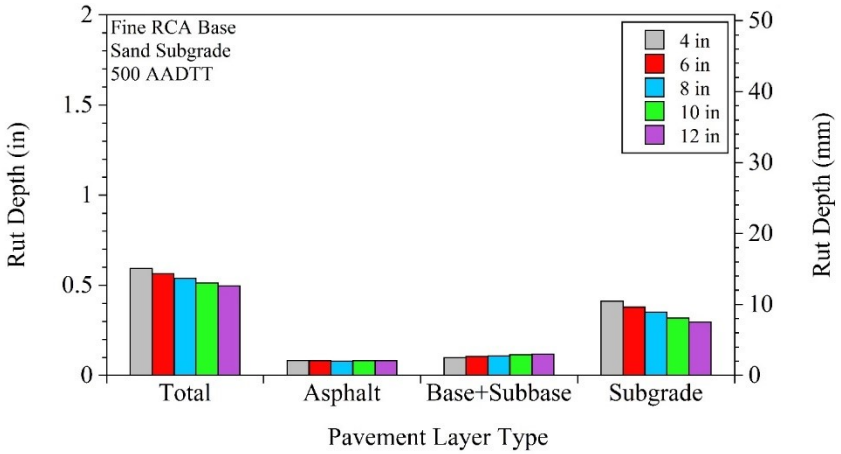


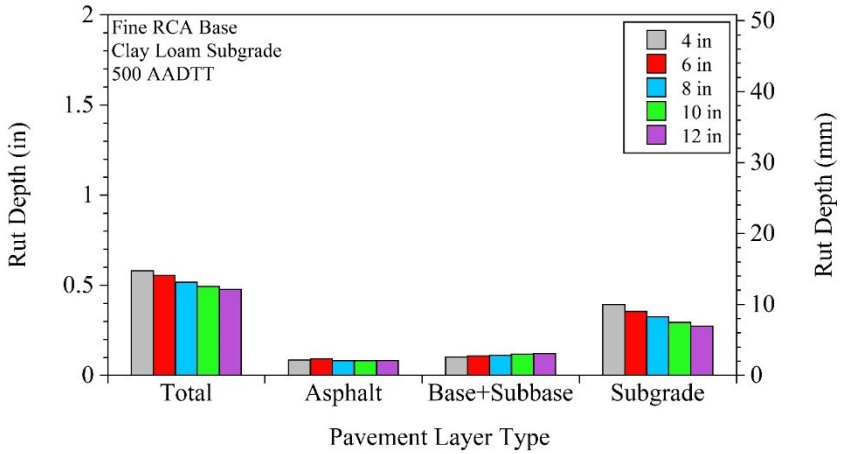
For pavements that contained Fine RCA base - 100 AADTT:



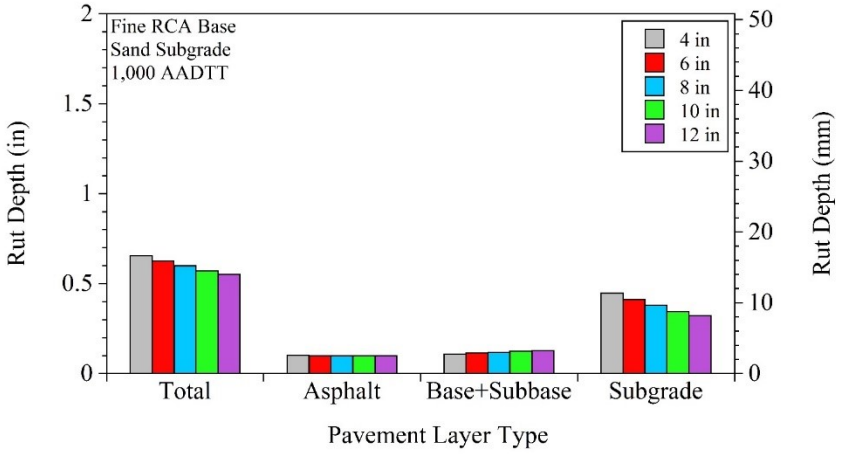


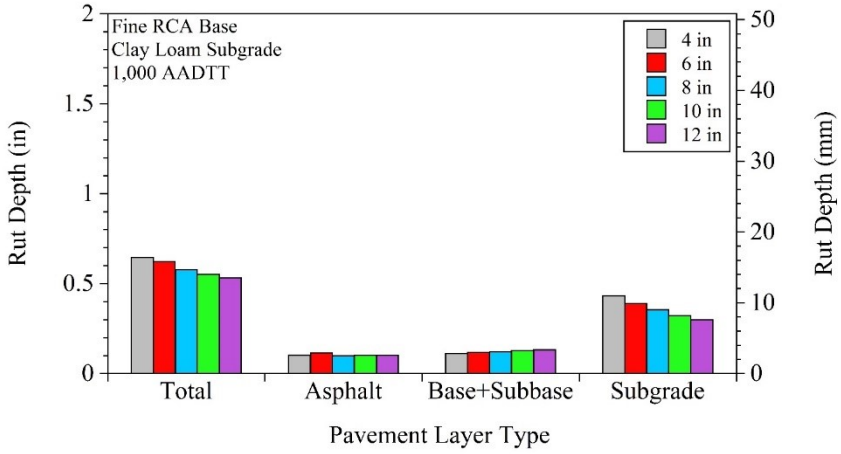
For pavements that contained Fine RCA base - 500 AADTT:



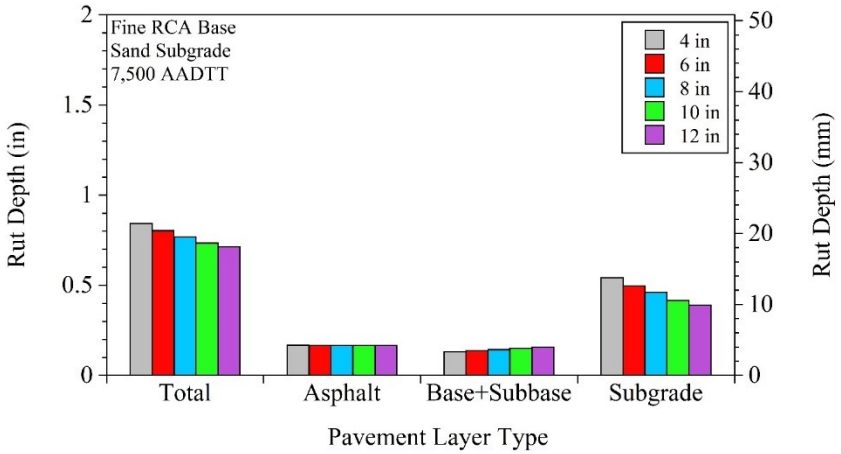


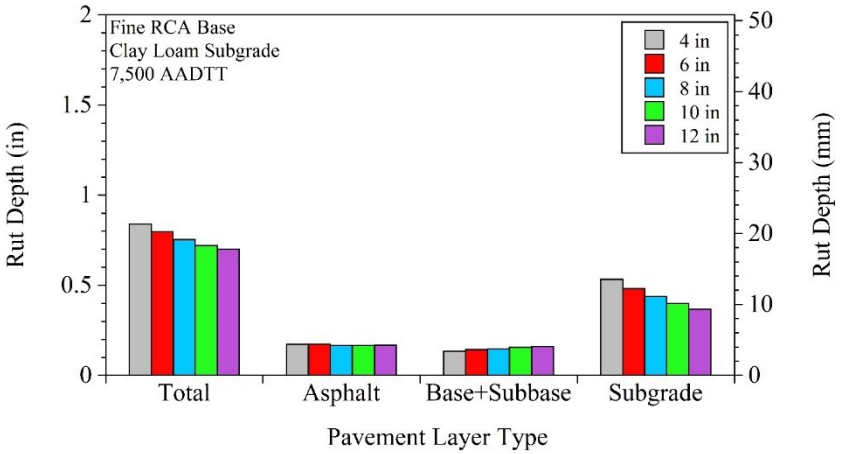
For pavements that contained Fine RCA base - 1,000 AADTT:



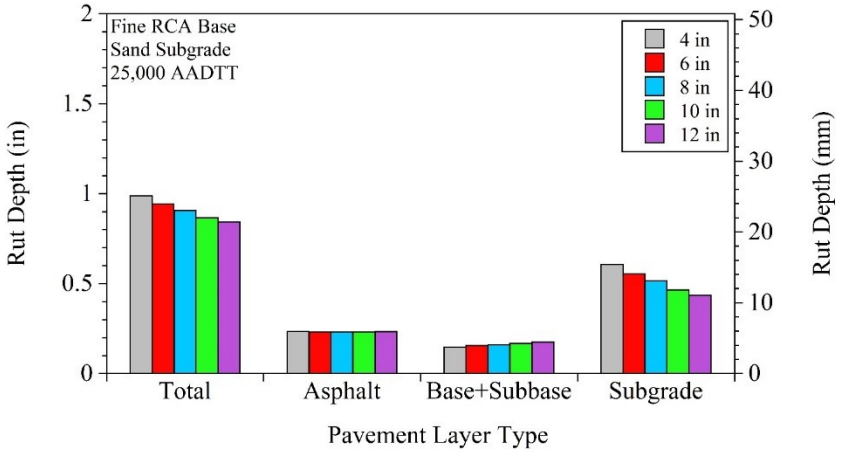


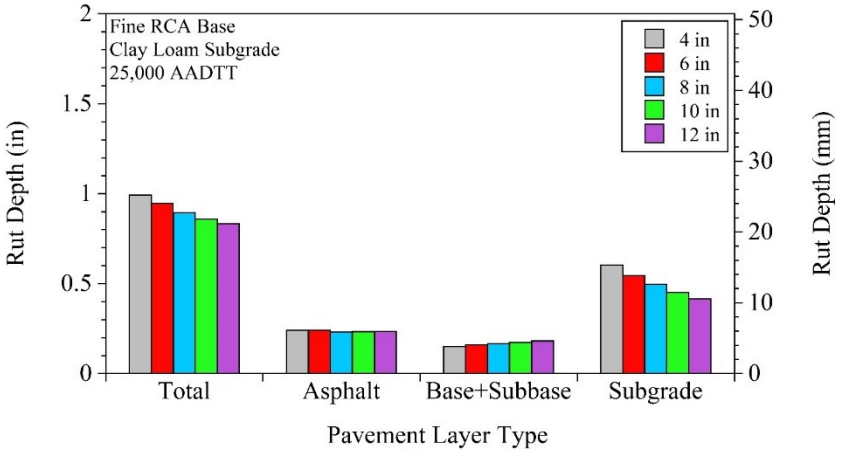
For pavements that contained Fine RCA base - 7,500 AADTT:



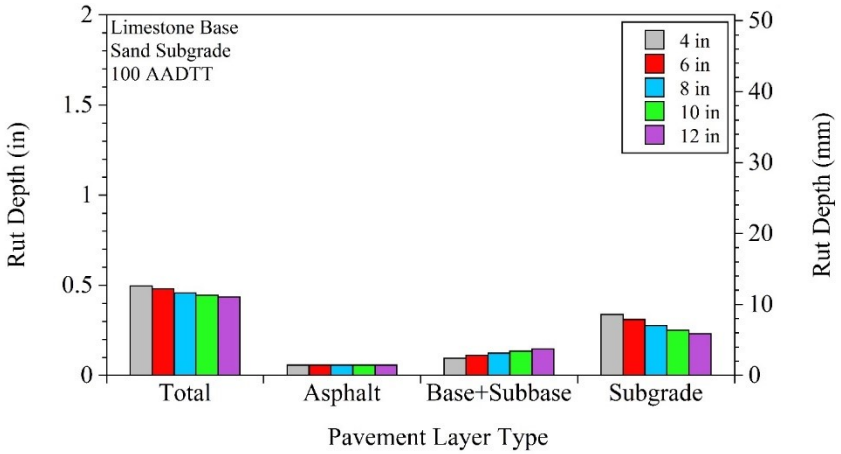


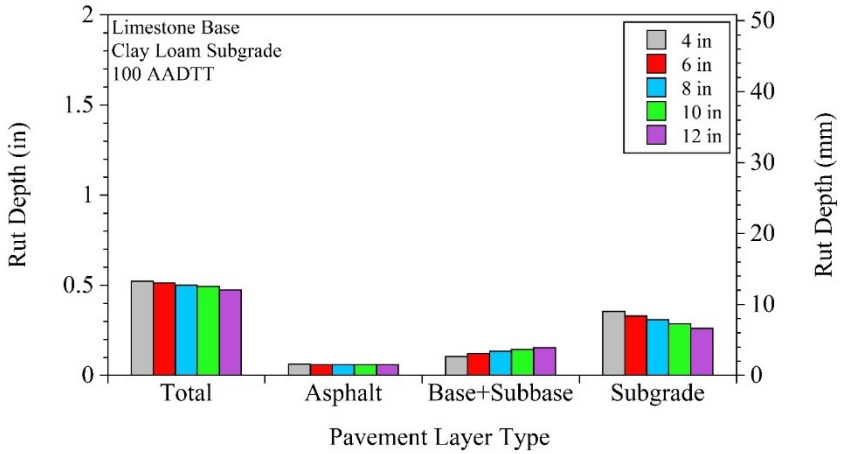
For pavements that contained Fine RCA base - 25,000 AADTT:



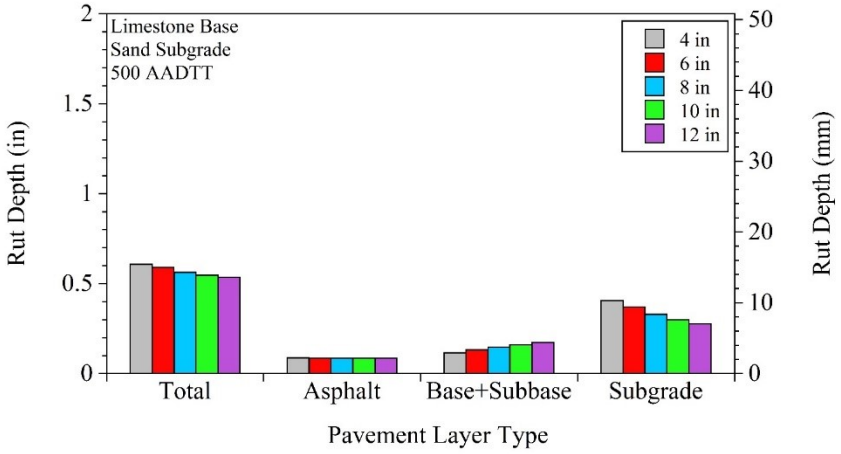


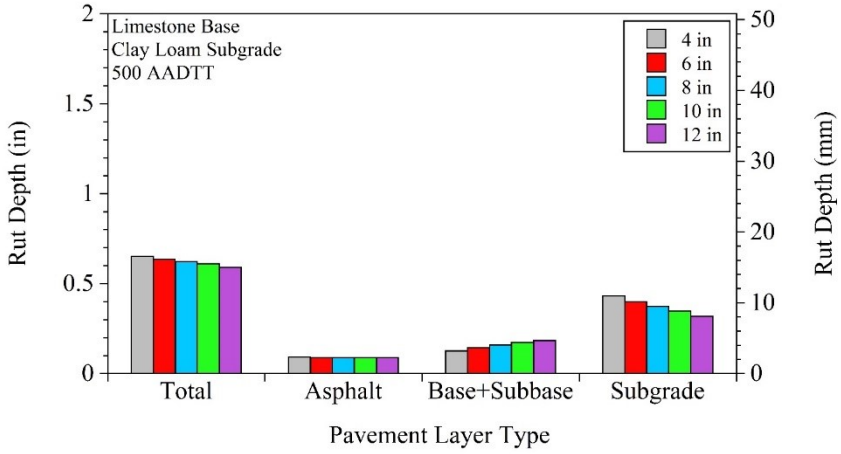
For pavements that contained Limestone base - 100 AADTT:



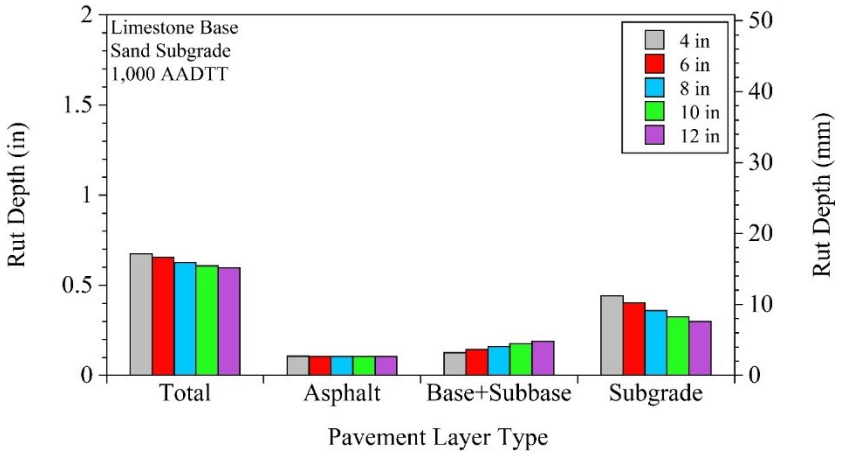


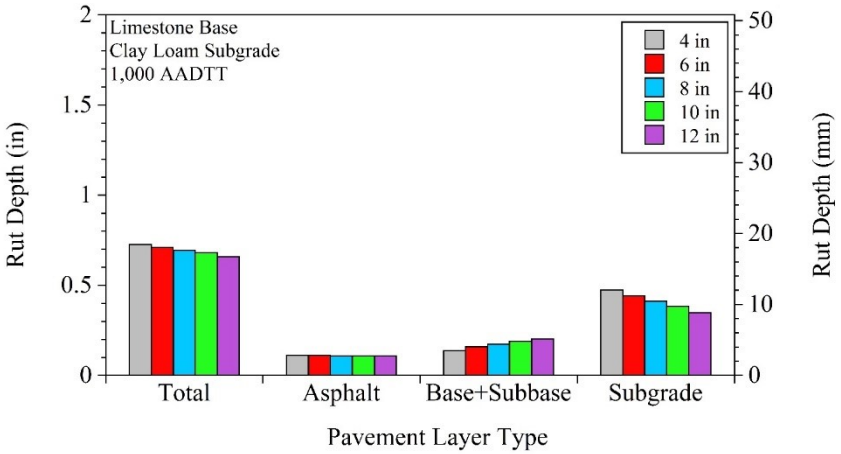
For pavements that contained Limestone base - 500 AADTT:



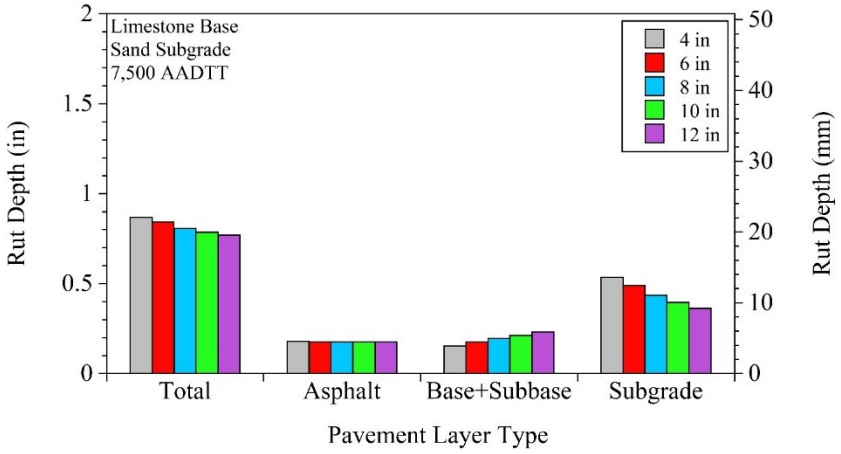


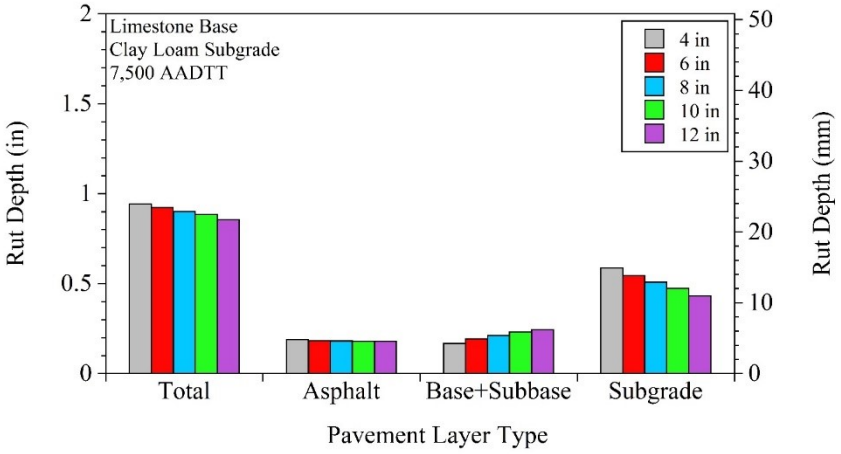
For pavements that contained Limestone base - 1,000 AADTT:



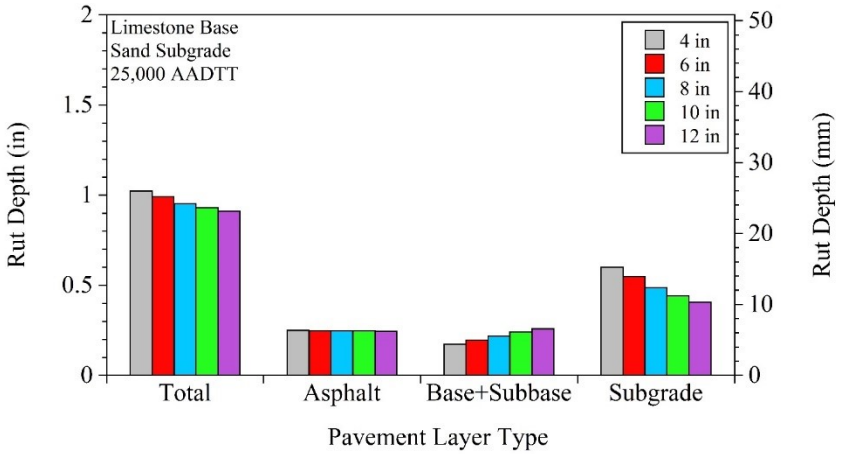


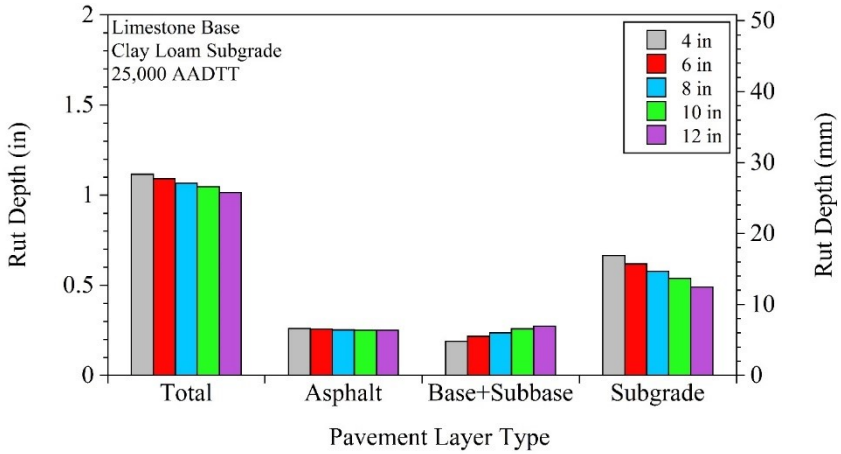
For pavements that contained Limestone base - 7,500 AADTT:



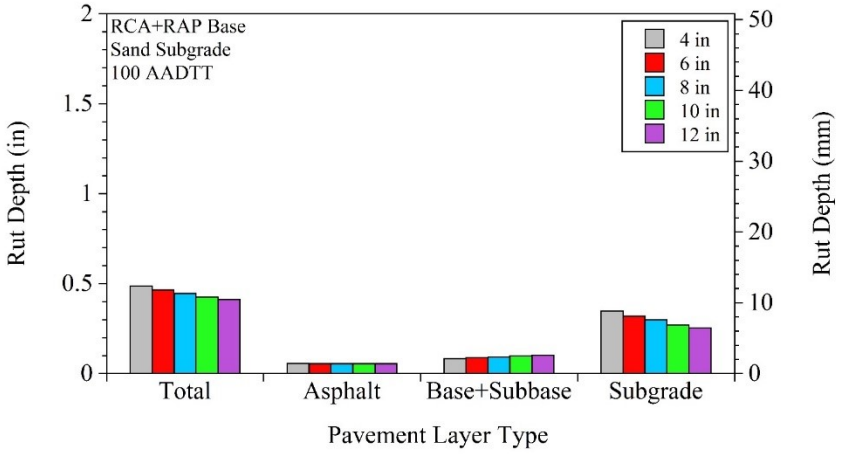


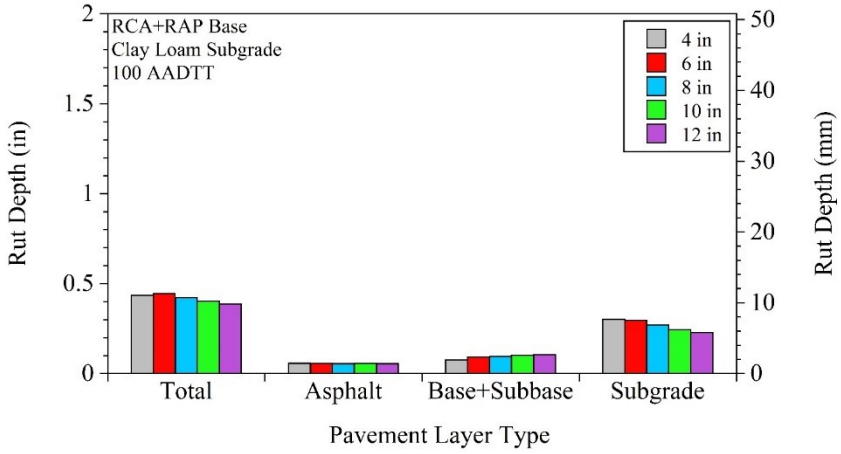
For pavements that contained Limestone base - 25,000 AADTT:



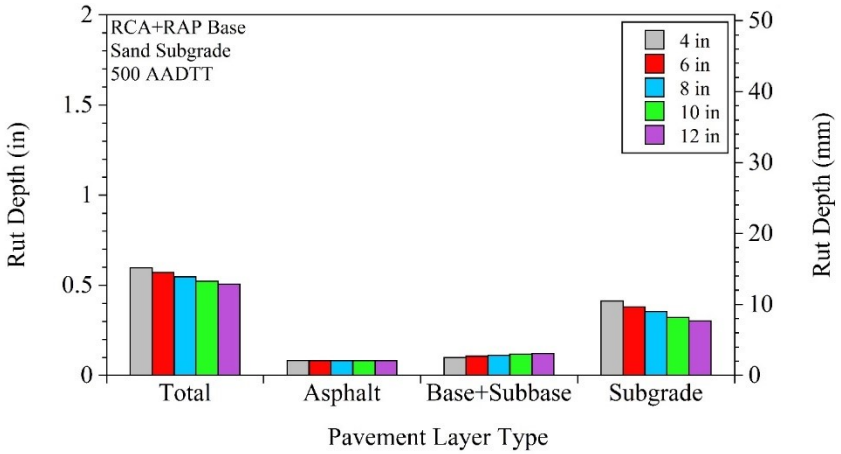


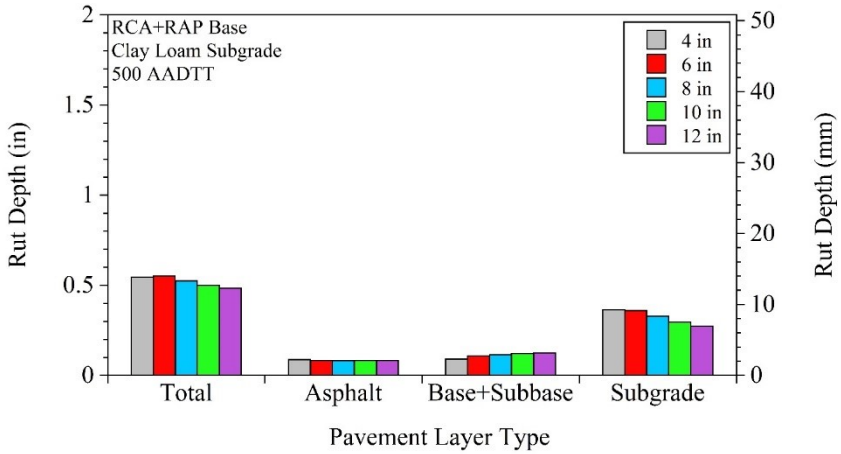
For pavements that contained RCA+RAP base - 100 AADTT:



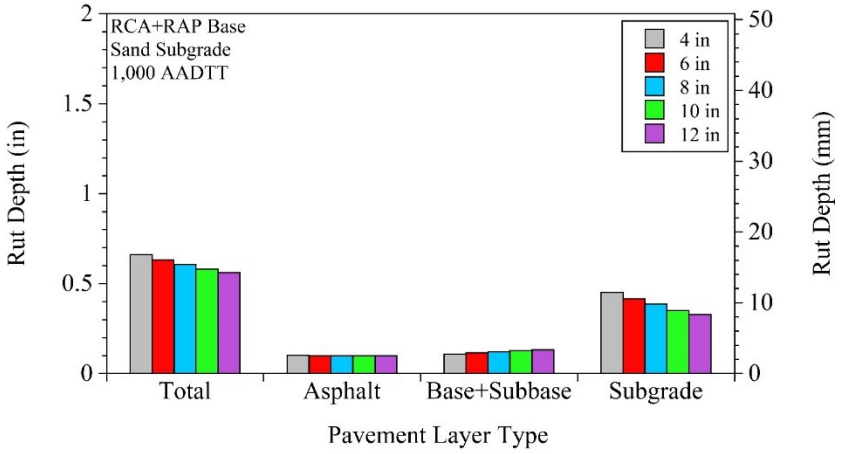


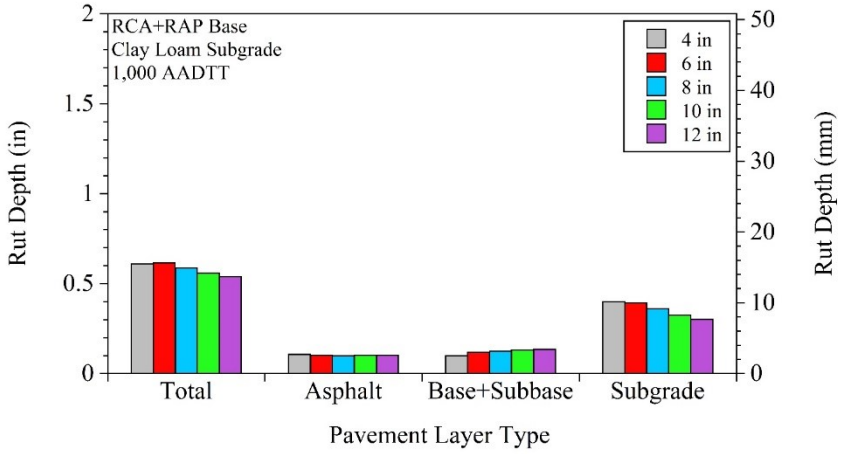
For pavements that contained RCA+RAP base - 500 AADTT:



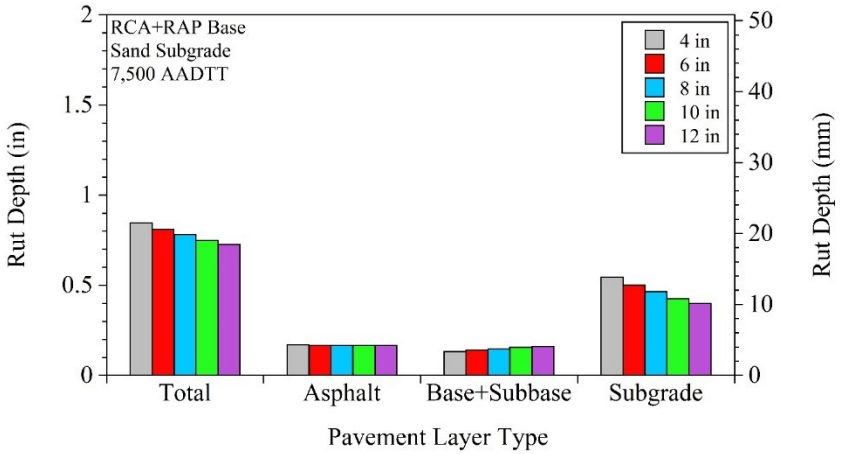


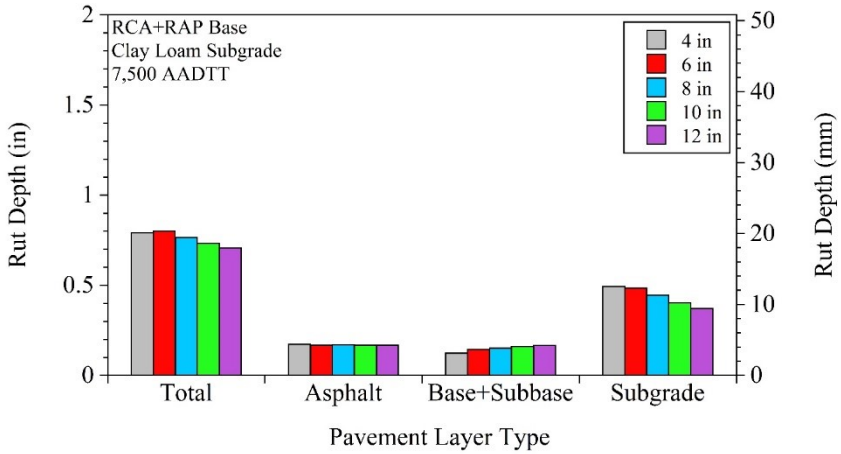
For pavements that contained RCA+RAP base - 1,000 AADTT:



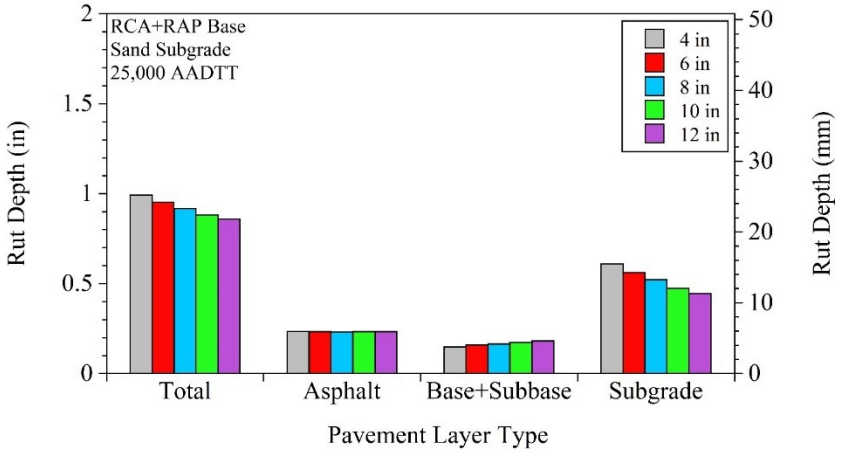


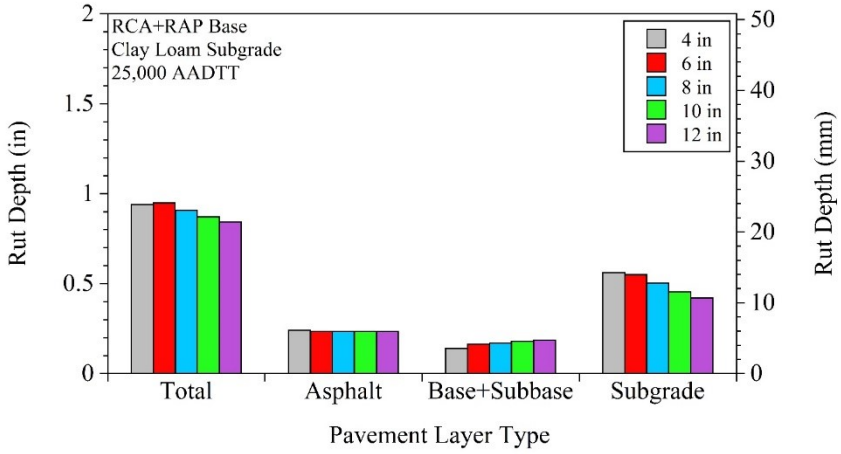
For pavements that contained RCA+RAP base - 7,500 AADTT:





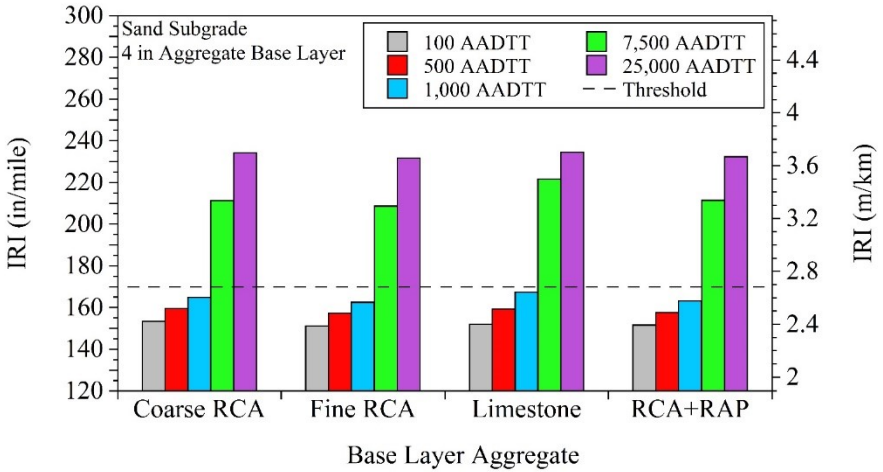
For pavements that contained RCA+RAP base - 25,000 AADTT:

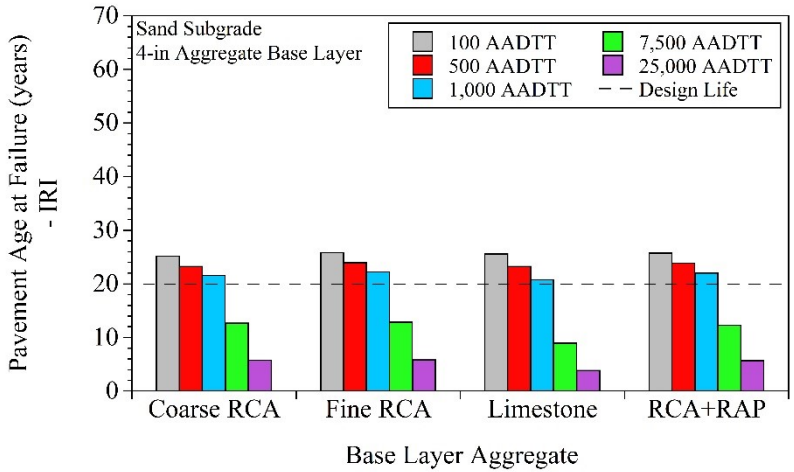


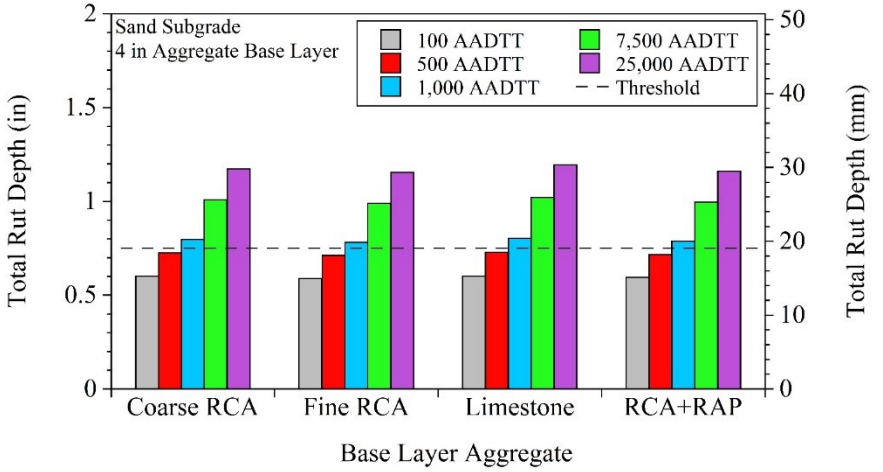


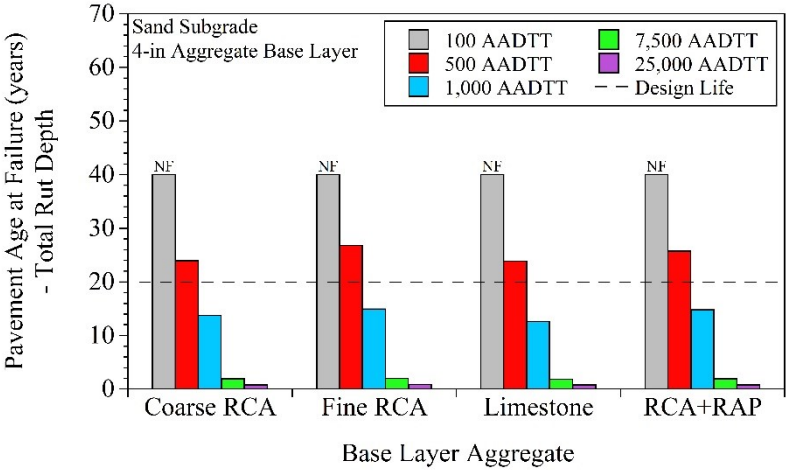
APPENDIX BE
EFFECT OF TRAFFIC LEVEL ON PAVEMENT PERFORMANCE PREDICTIONS

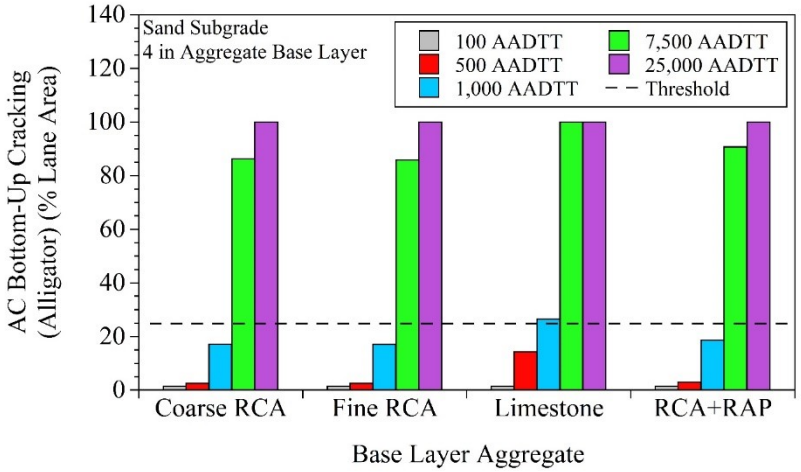
For pavements that contained Sand Subgrade and 4-in aggregate base:

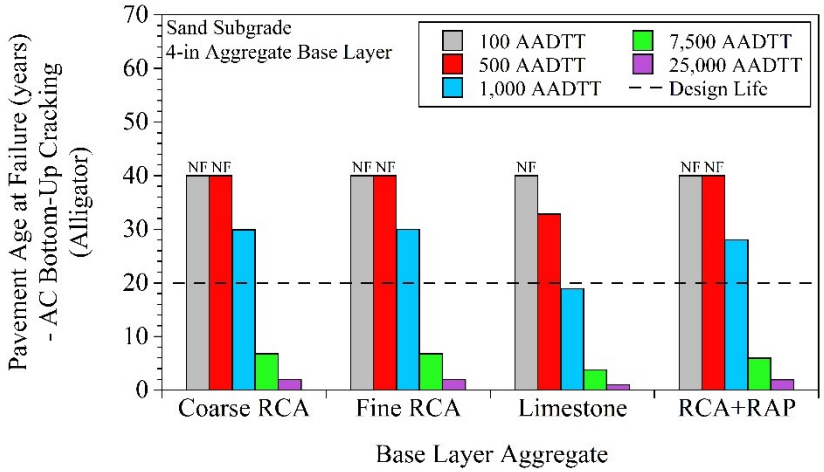


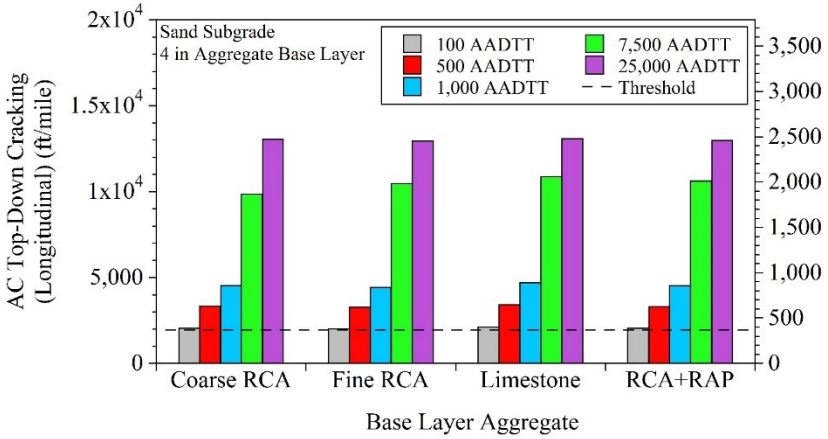


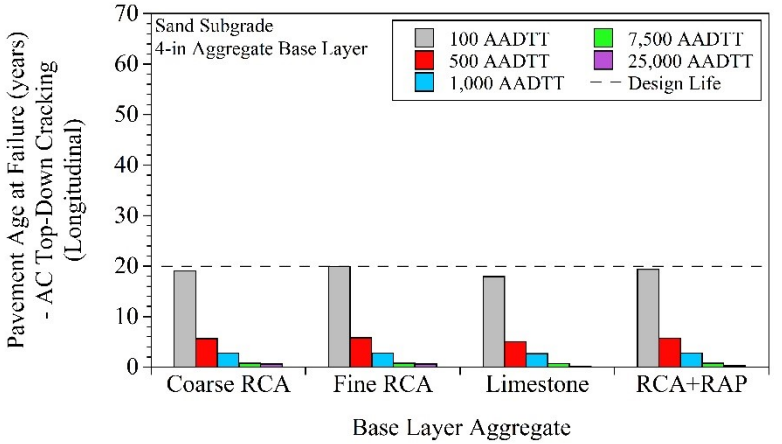




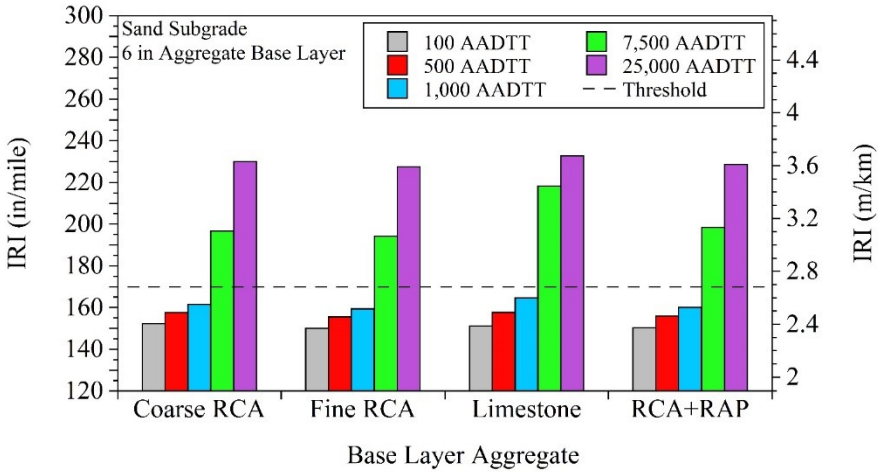

Sand Subgrade
4 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Bottom-Up Cracking (Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

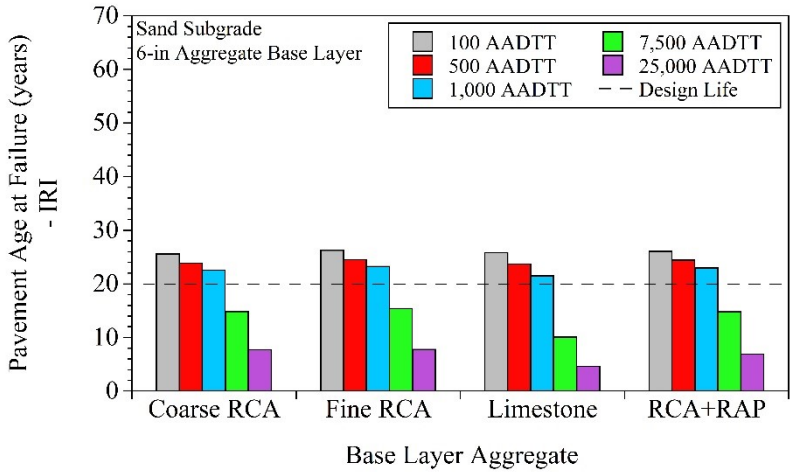

Sand Subgrade
4-in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years) - AC Bottom-Up Cracking (Alligator)
NF NF
NF NF
NF
NF NF
0
10
20
30
40
50
60
70
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

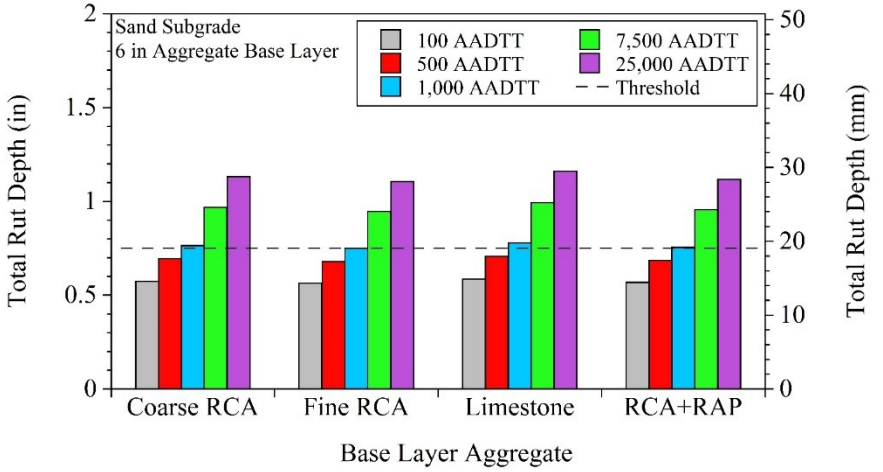

Sand Subgrade
4 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Top-Down Cracking (Longitudinal) (ft/mile)
0
5,000
1x10^4
1.5x10^4
2x10^4
AC Top-Down Cracking (Longitudinal) (m/km)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

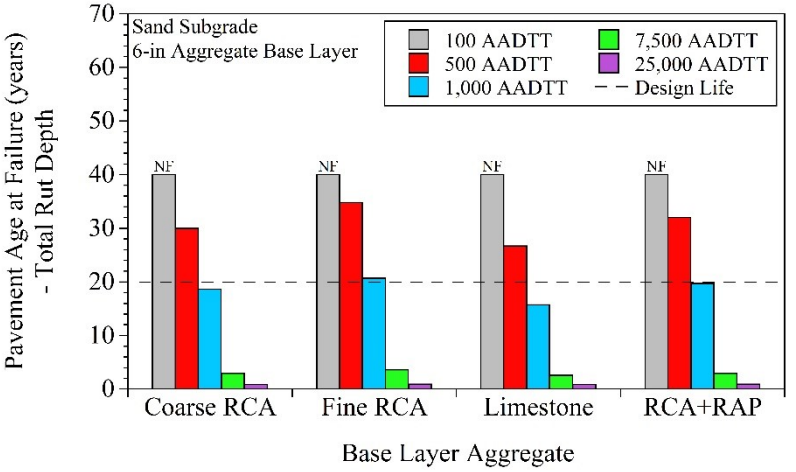

Sand Subgrade
4-in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years) - AC Top-Down Cracking (Longitudinal)
0
10
20
30
40
50
60
70
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

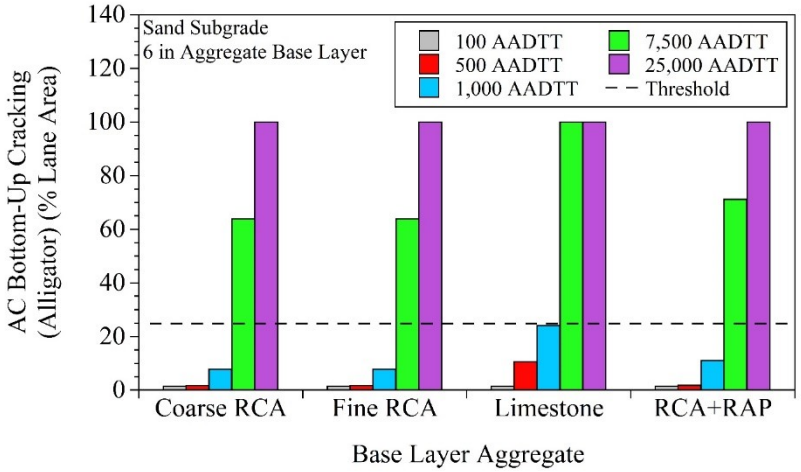
For pavements that contained Sand Subgrade and 6-in aggregate base:

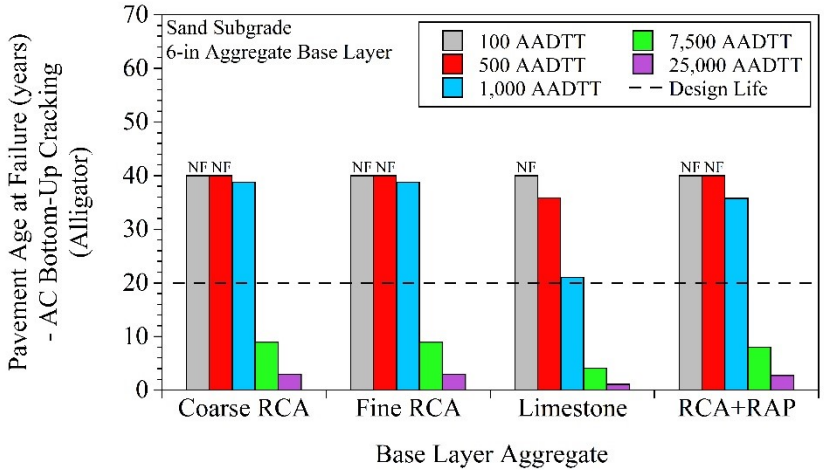


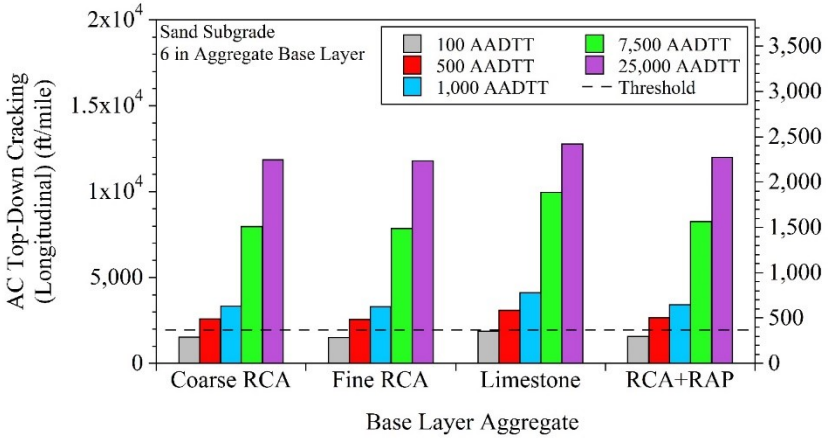


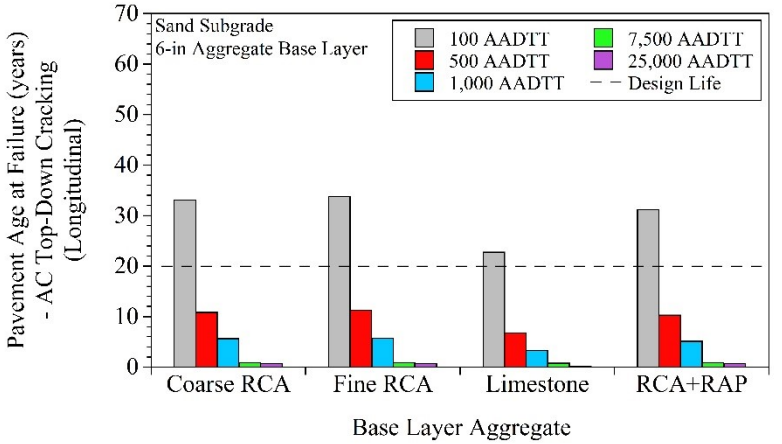




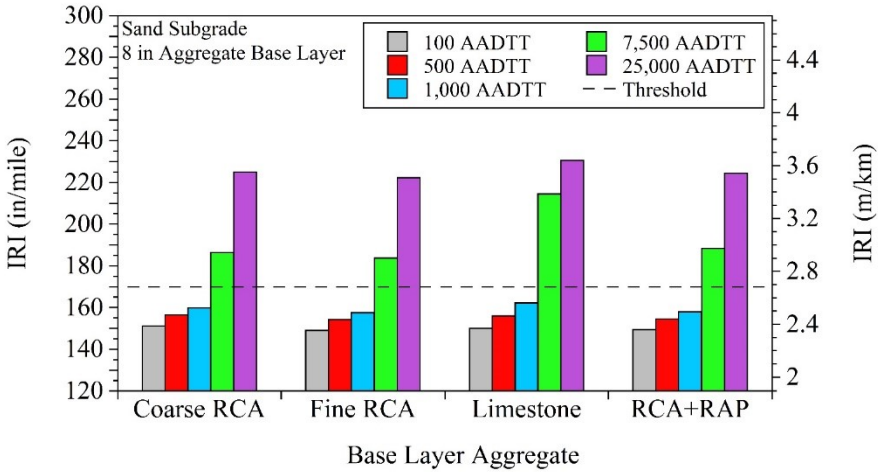

Sand Subgrade
6 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Bottom-Up Cracking (Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

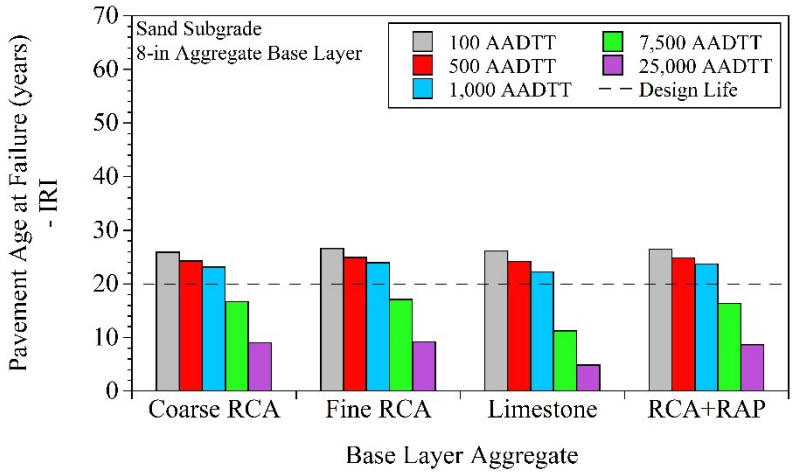

Sand Subgrade
6-in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years) - AC Bottom-Up Cracking (Alligator)
NF NF
NF NF
NF
NF NF
0
10
20
30
40
50
60
70
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

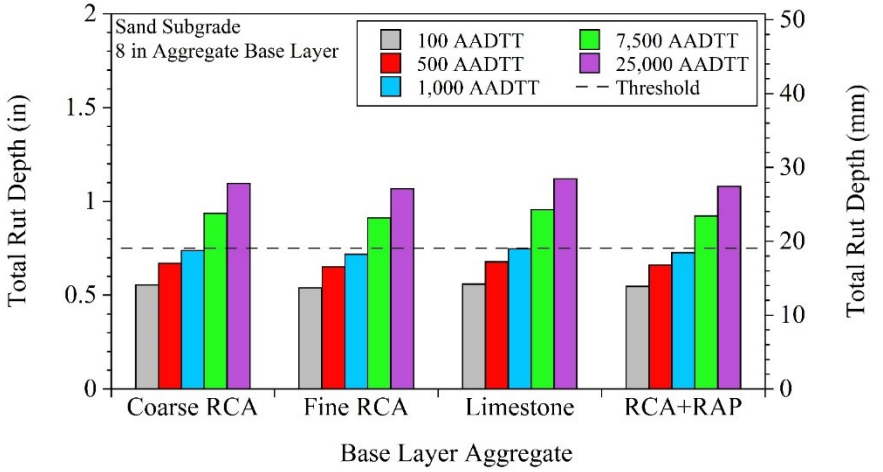

Sand Subgrade
6 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Top-Down Cracking (Longitudinal) (ft/mile)
0
5,000
1x10^4
1.5x10^4
2x10^4
AC Top-Down Cracking (Longitudinal) (m/km)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

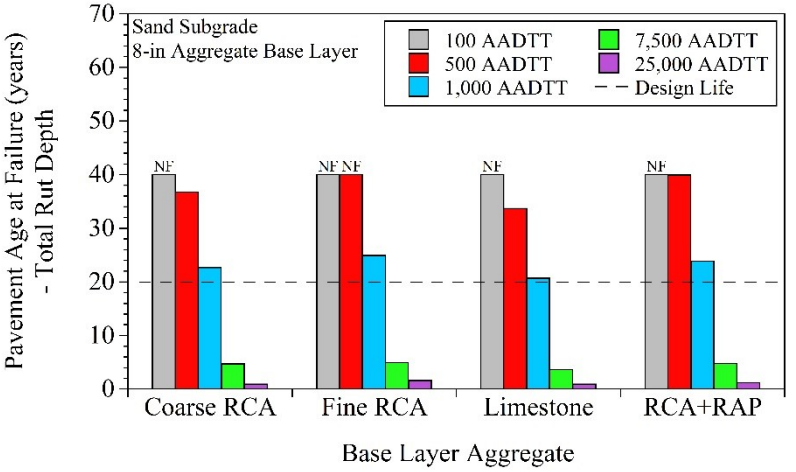

Sand Subgrade
6-in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years) - AC Top-Down Cracking (Longitudinal)
0
10
20
30
40
50
60
70
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

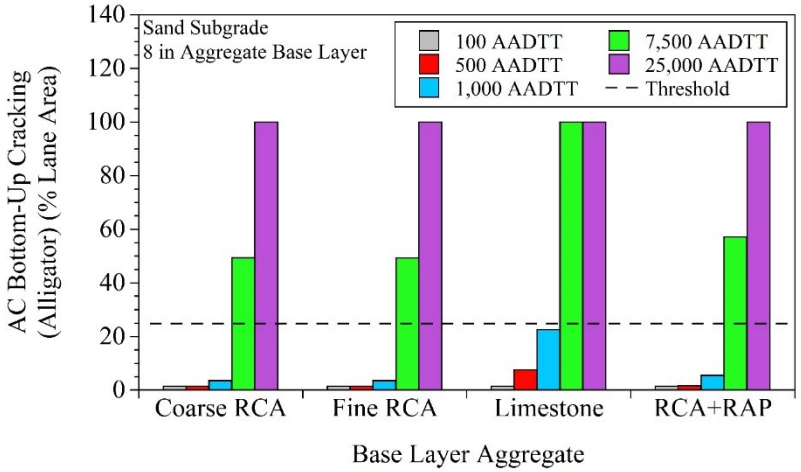
For pavements that contained Sand Subgrade and 8-in aggregate base:

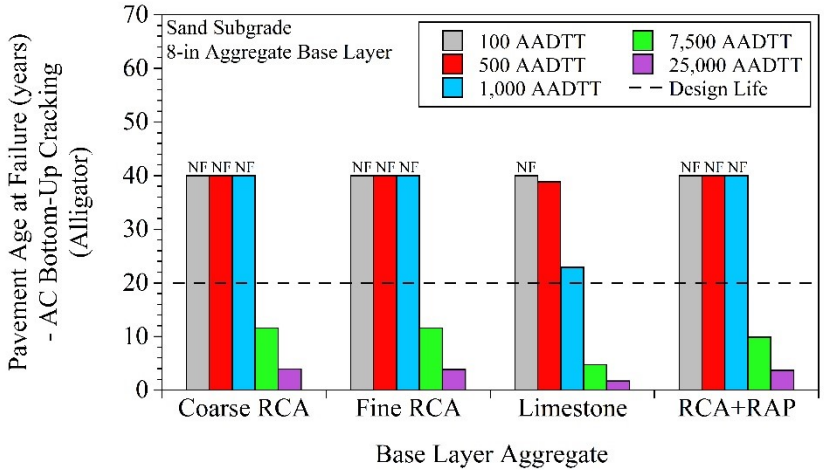


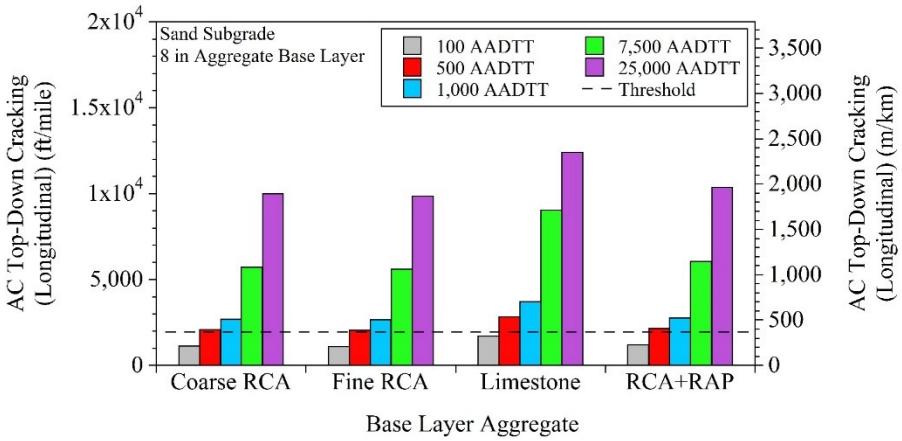


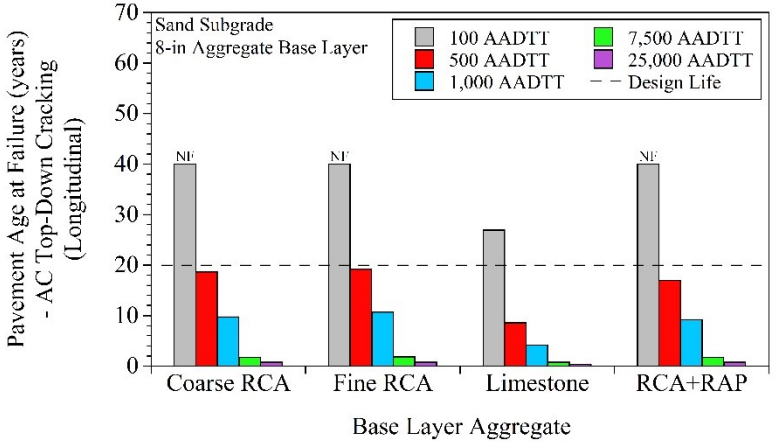




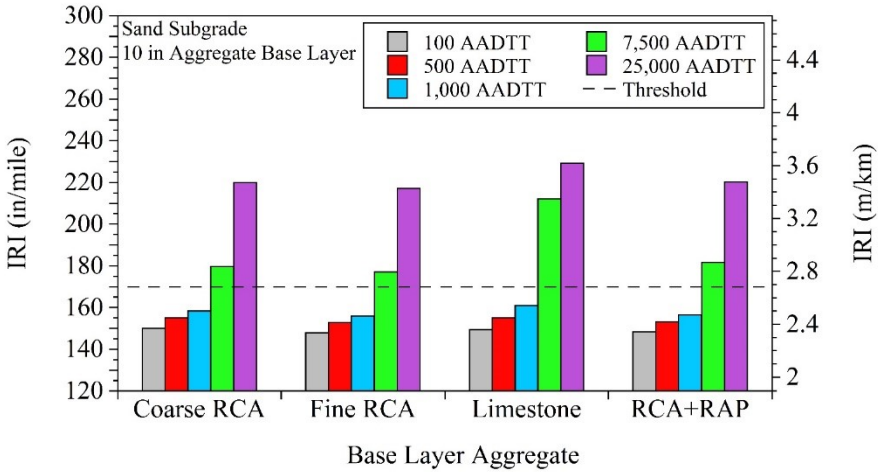

Sand Subgrade
8 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

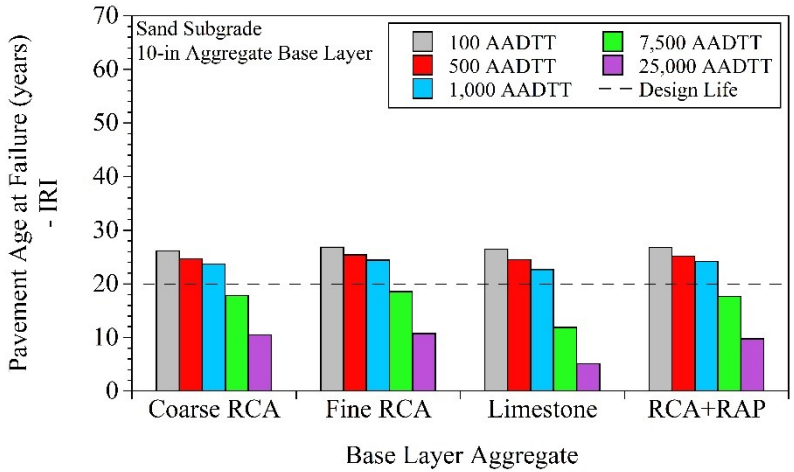

Sand Subgrade
8-in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
NF NF NF
NF NF NF
NF
NF NF NF
0
10
20
30
40
50
60
70
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

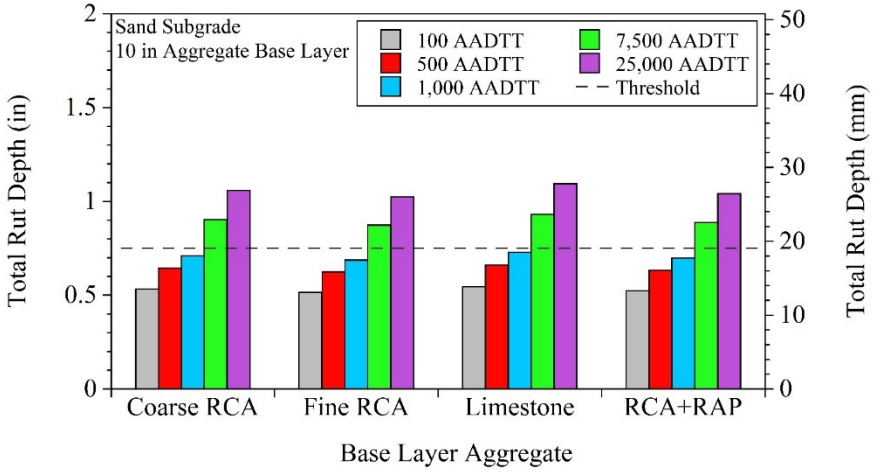

Sand Subgrade
8 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Top-Down Cracking
(Longitudinal) (ft/mile)
0
5,000
1x10^4
1.5x10^4
2x10^4
AC Top-Down Cracking
(Longitudinal) (m/km)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

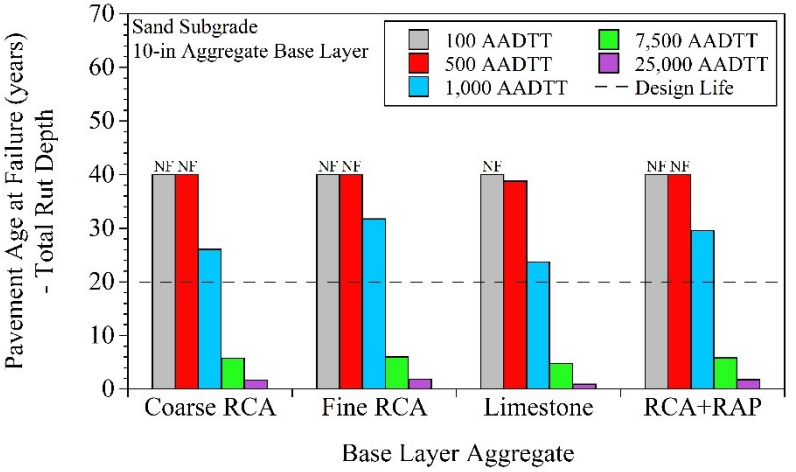

Sand Subgrade
8-in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years)
- AC Top-Down Cracking
(Longitudinal)
NF
NF
NF
0
10
20
30
40
50
60
70
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

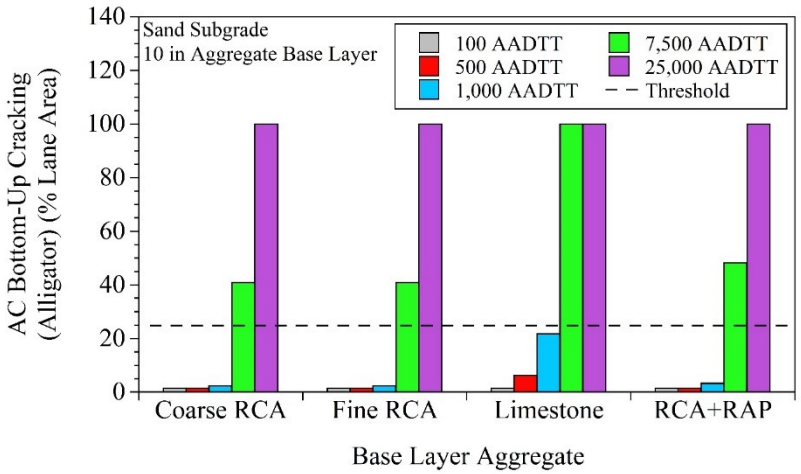
For pavements that contained Sand Subgrade and 10-in aggregate base:

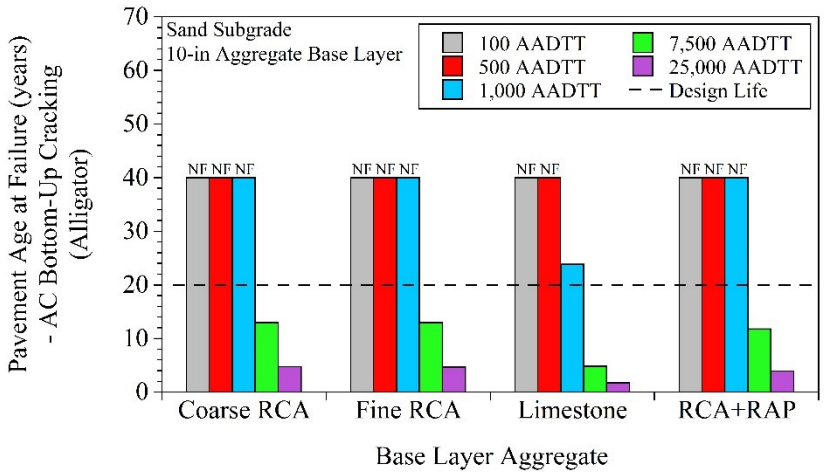


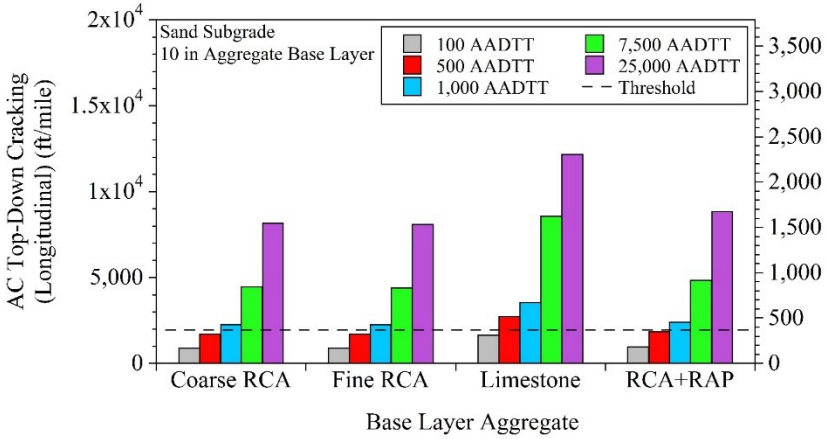


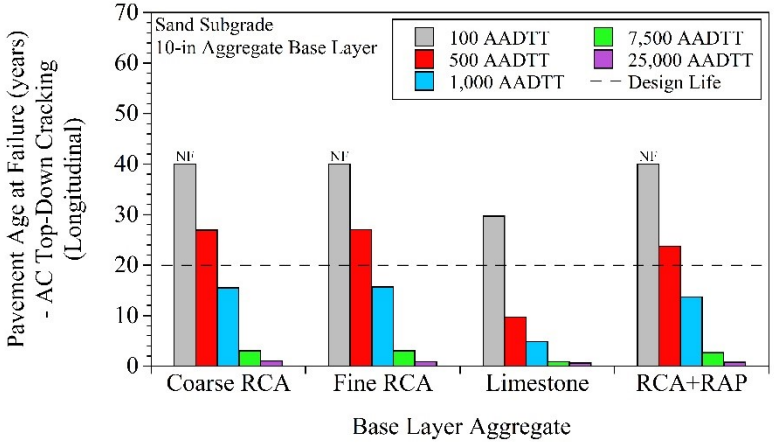




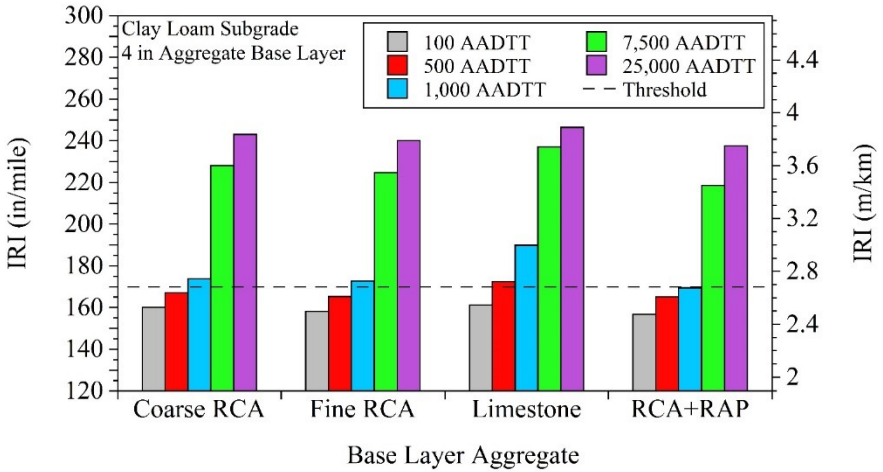

Sand Subgrade
10 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Bottom-Up Cracking (Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

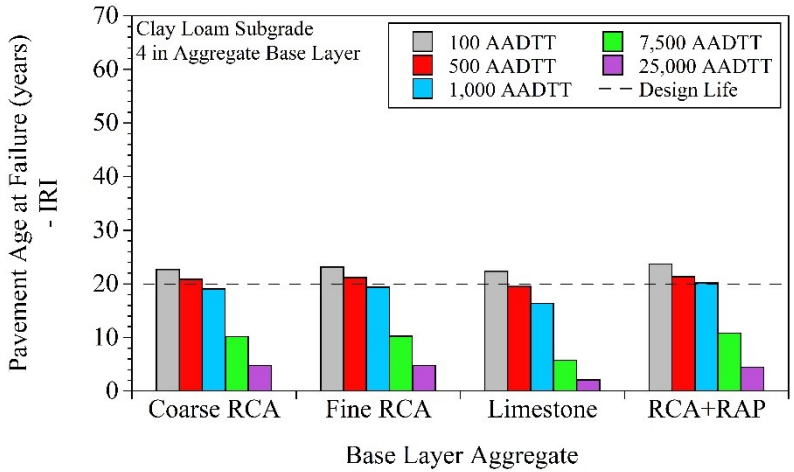

Sand Subgrade
10-in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years) - AC Bottom-Up Cracking (Alligator)
NF NF NF
NF NF NF
NF NF
NF NF NF
0
10
20
30
40
50
60
70
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

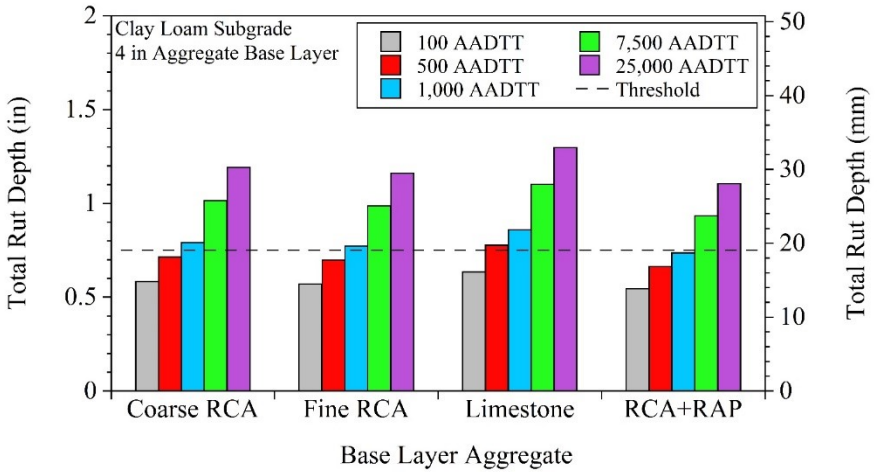

Sand Subgrade
10 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Top-Down Cracking (Longitudinal) (ft/mile)
0
5,000
1x10^4
1.5x10^4
2x10^4
AC Top-Down Cracking (Longitudinal) (m/km)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

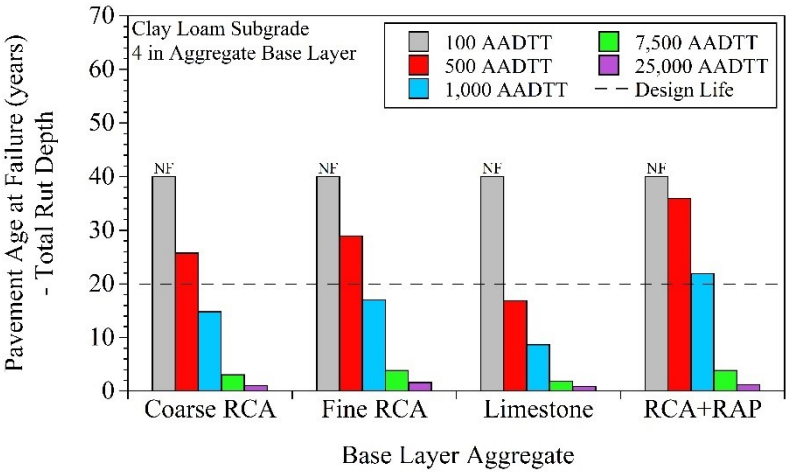

Sand Subgrade
10-in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years) - AC Top-Down Cracking (Longitudinal)
NF
NF
NF
0
10
20
30
40
50
60
70
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

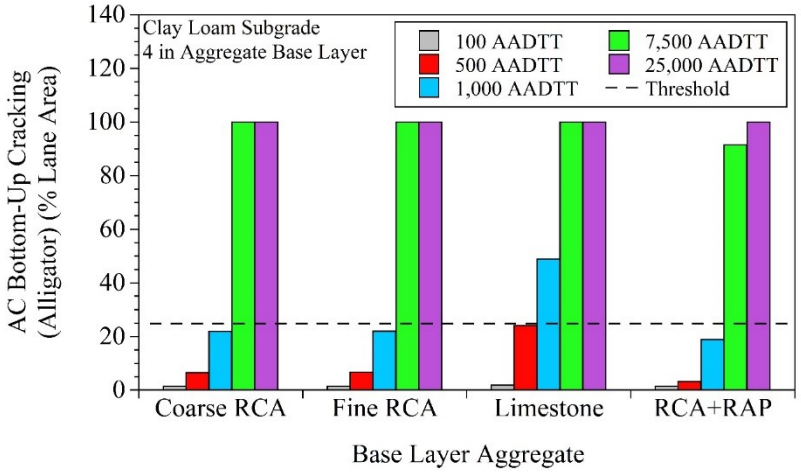
For pavements that contained Clay Loam subgrade and 4-in aggregate base:

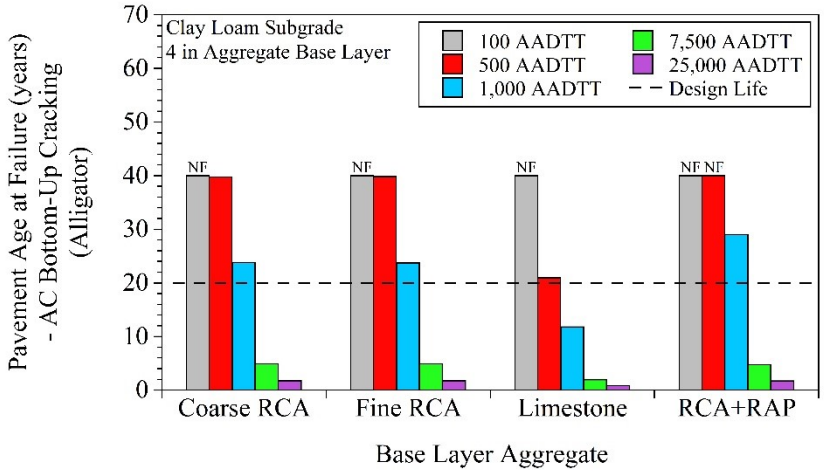




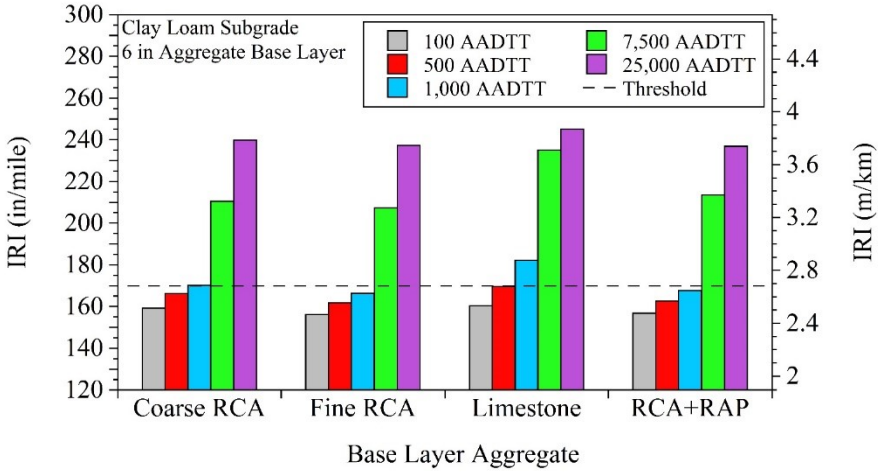


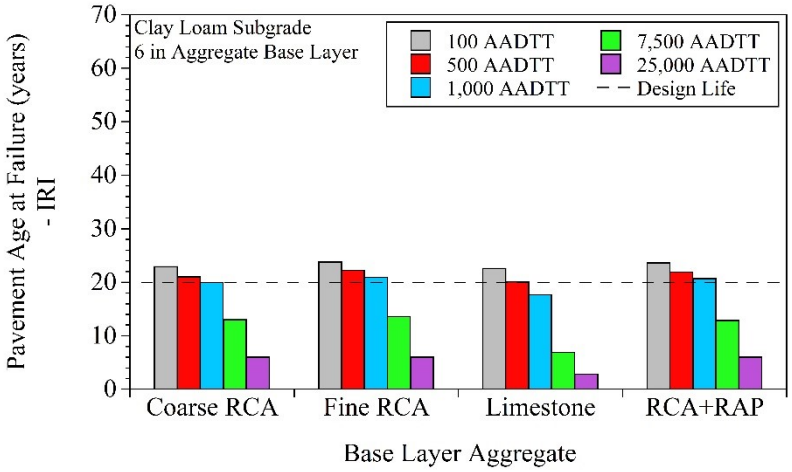


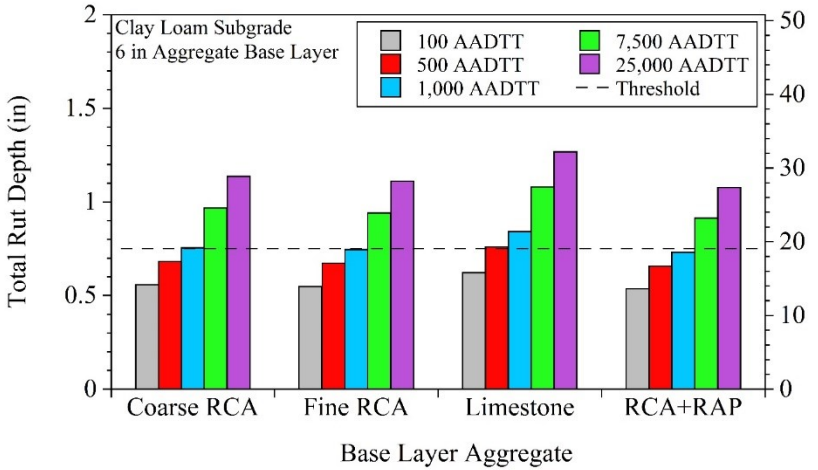


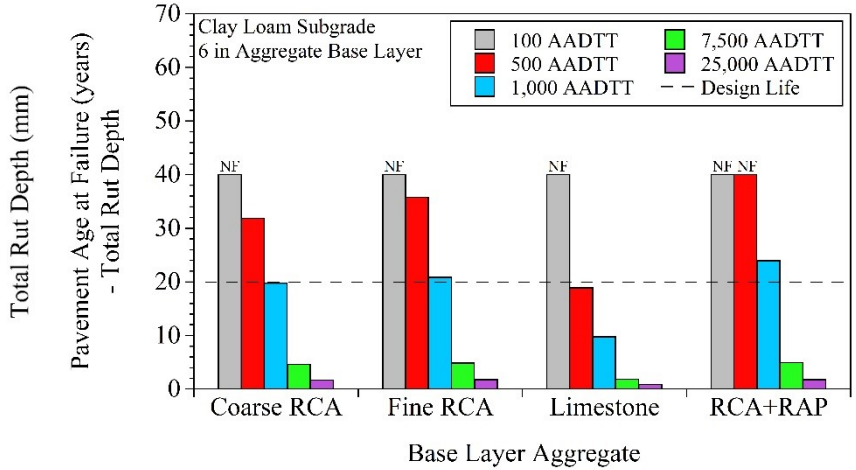


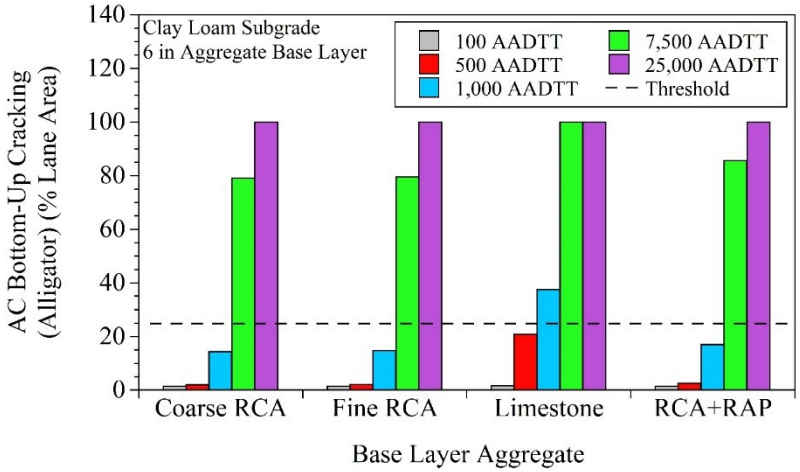
For pavements that contained Clay Loam subgrade and 6-in aggregate base:

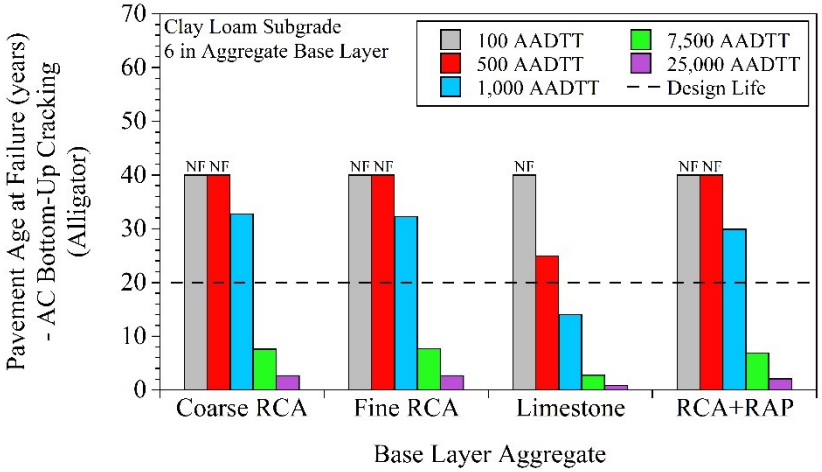




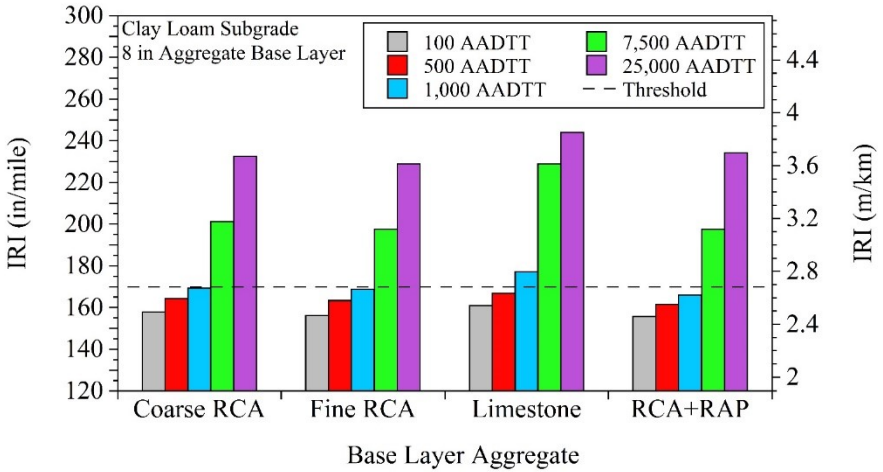

Clay Loam Subgrade
6 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

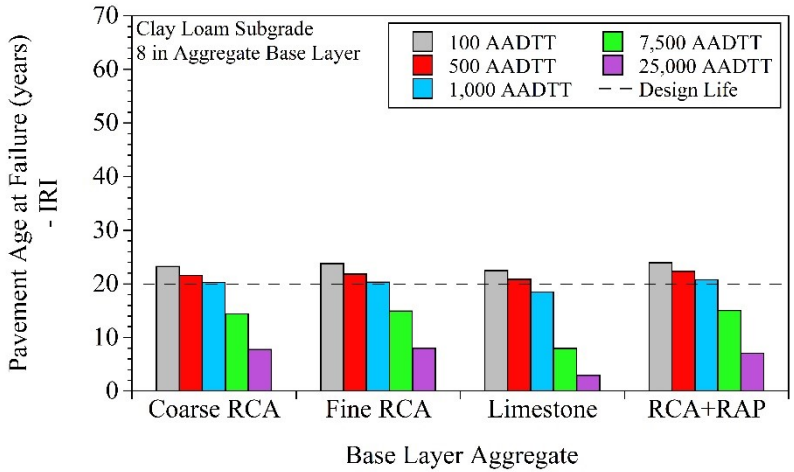

Clay Loam Subgrade
6 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
NF
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

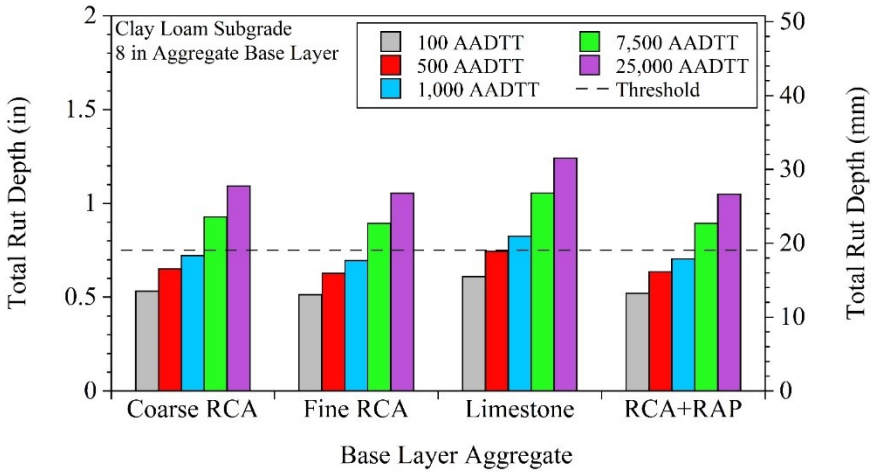

Clay Loam Subgrade
6 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

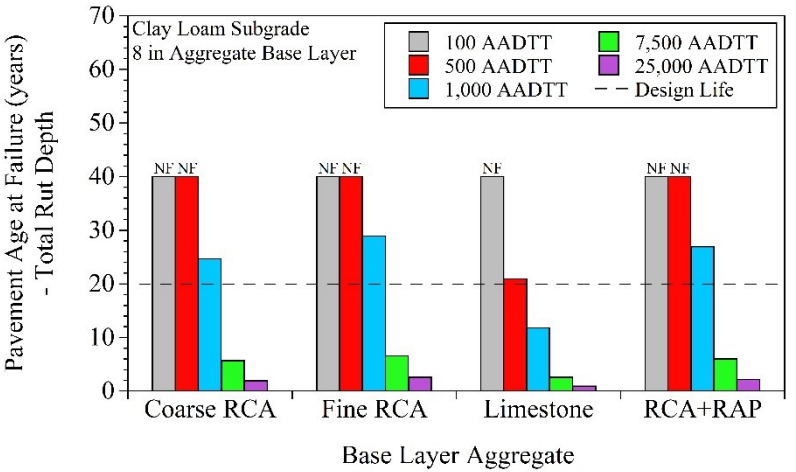

Clay Loam Subgrade
6 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
NF
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

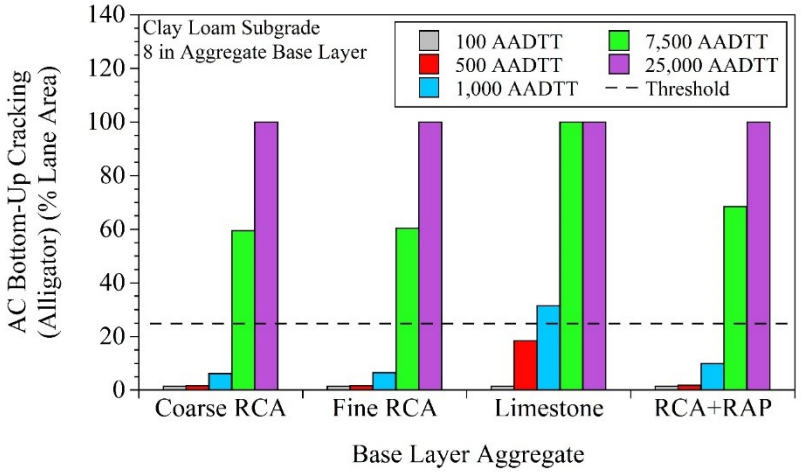
For pavements that contained Clay Loam subgrade and 8-in aggregate base:

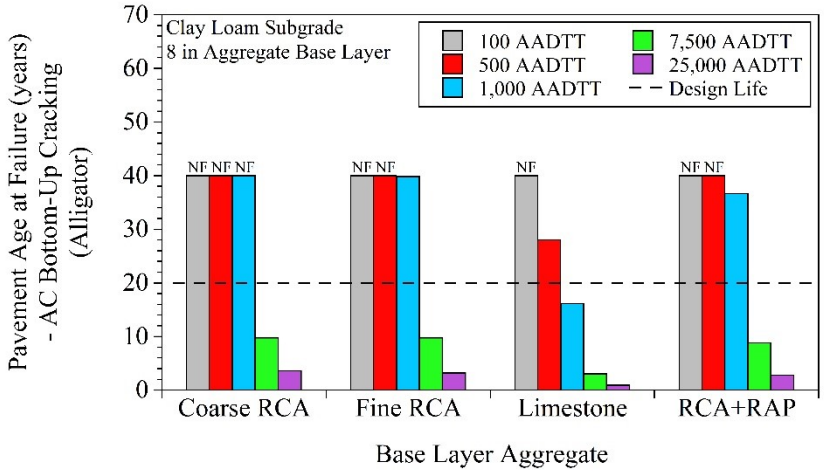




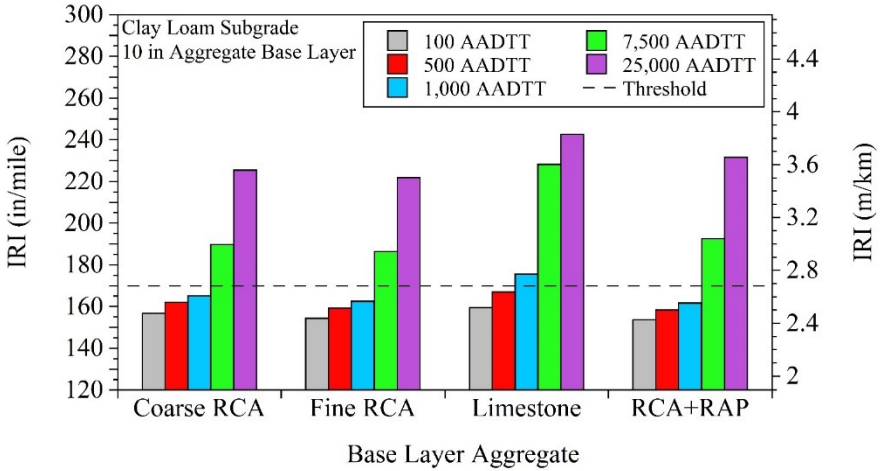


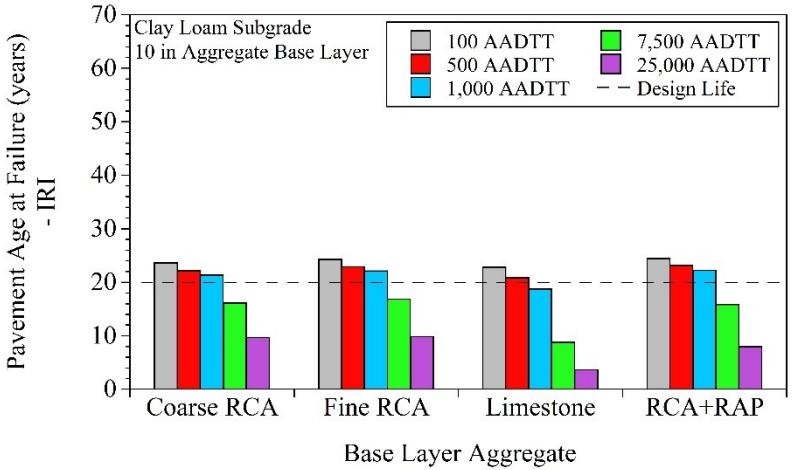


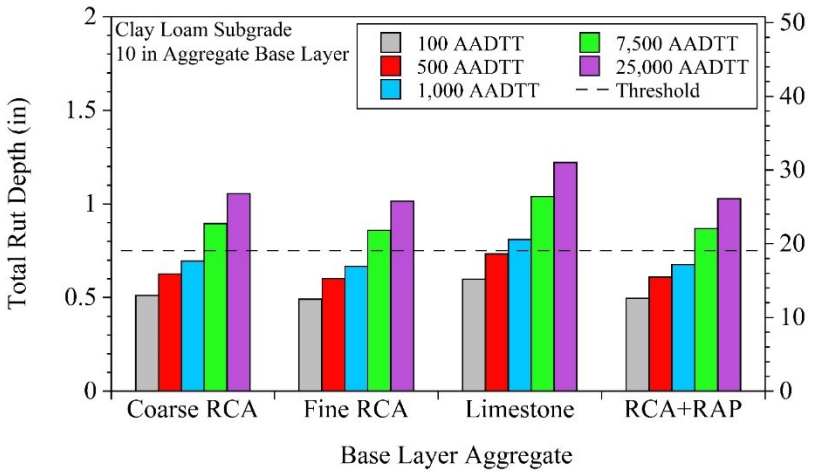


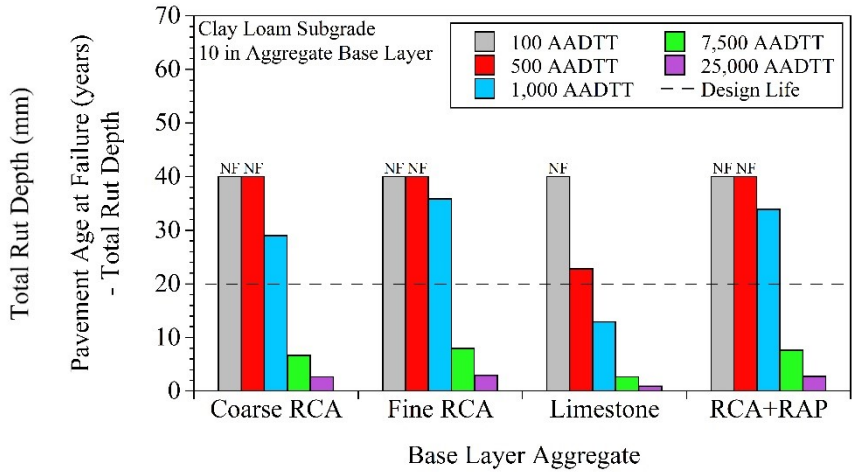


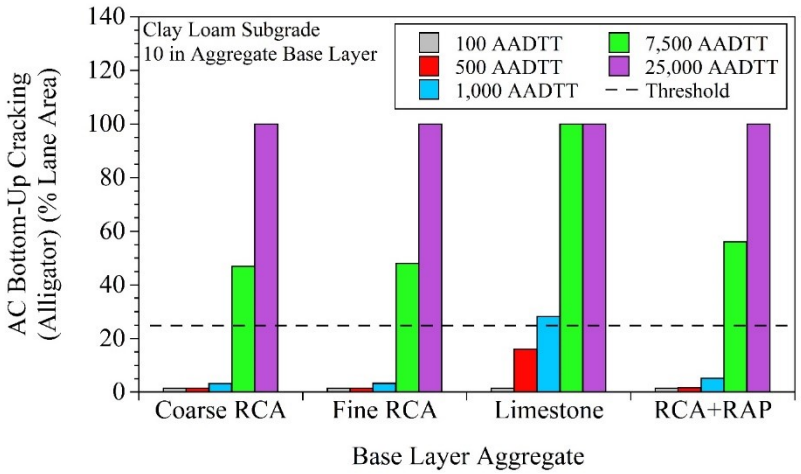
For pavements that contained Clay Loam subgrade and 10-in aggregate base:

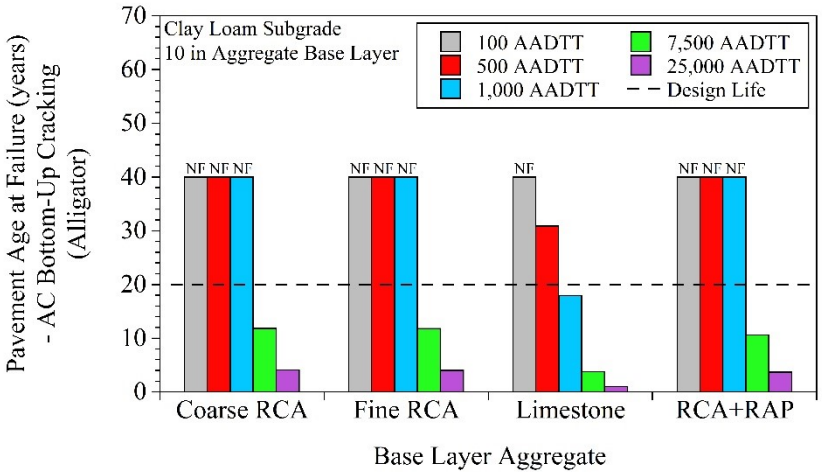




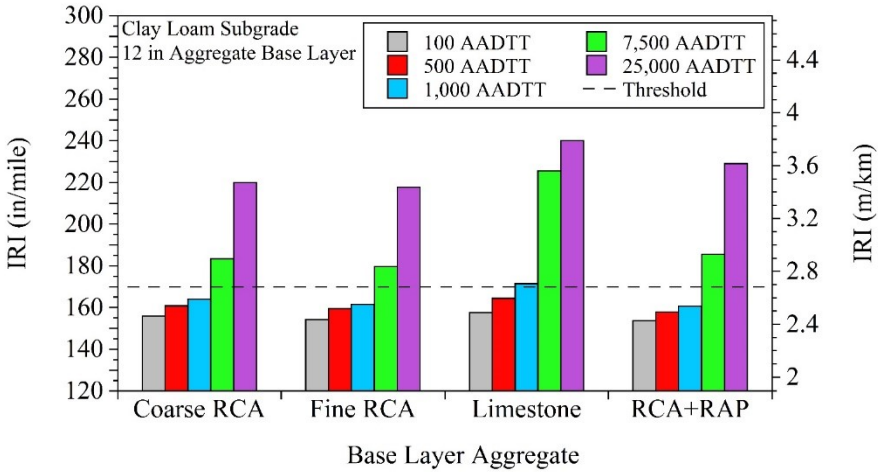

Clay Loam Subgrade
10 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

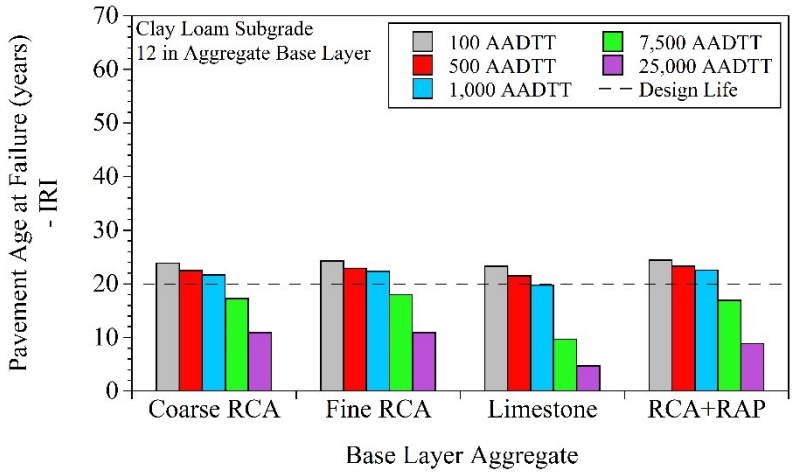

Clay Loam Subgrade
10 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
NF
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

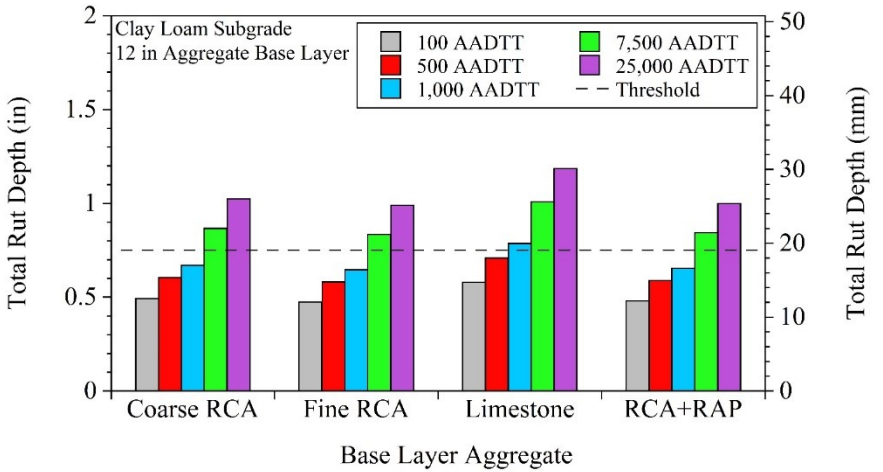

Clay Loam Subgrade
10 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

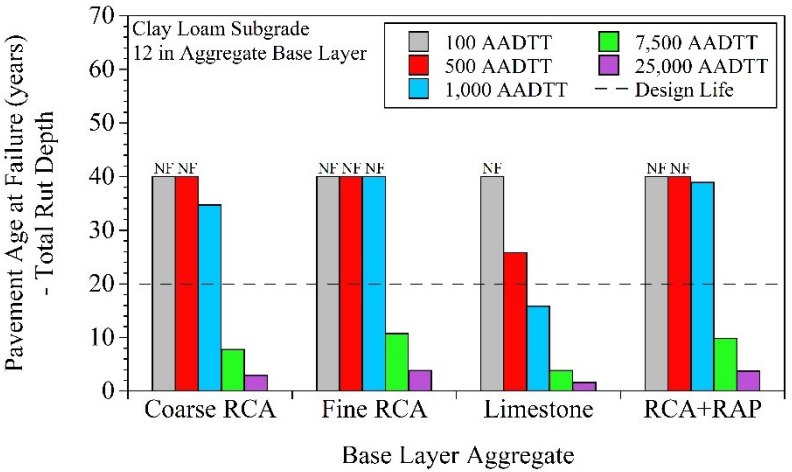

Clay Loam Subgrade
10 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
NF
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

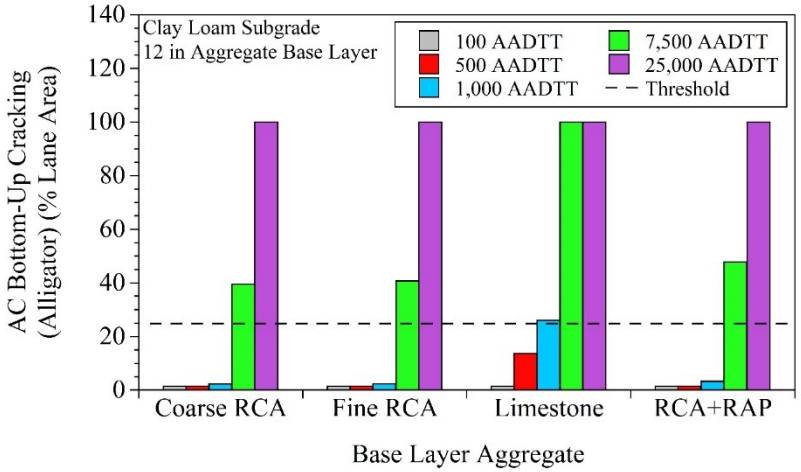
For pavements that contained Clay Loam subgrade and 12-in aggregate base:

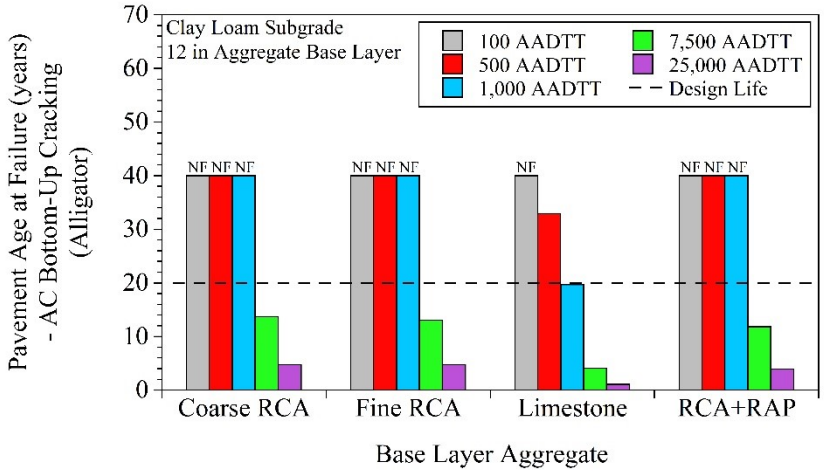






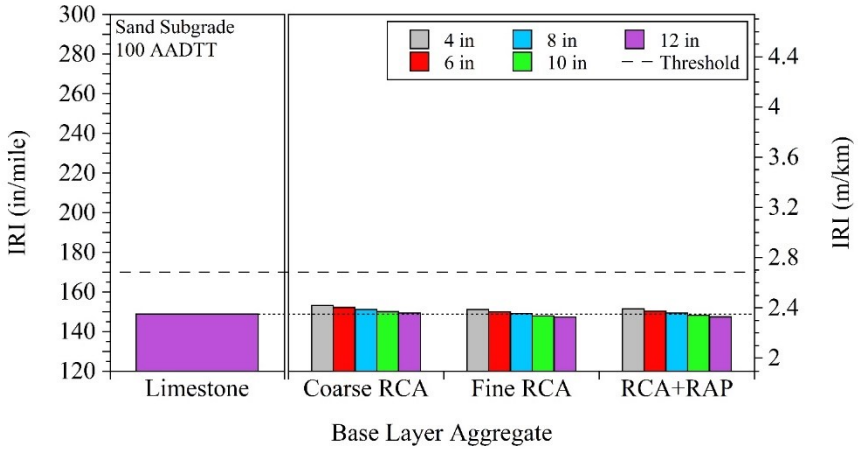


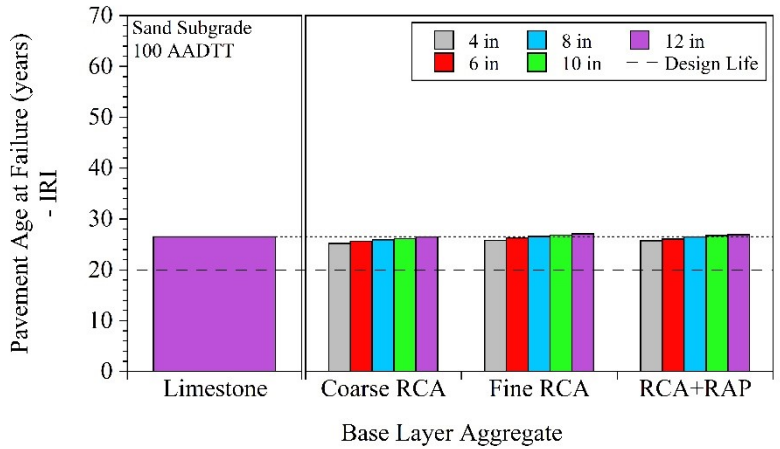

Clay Loam Subgrade
12 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Bottom-Up Cracking (Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

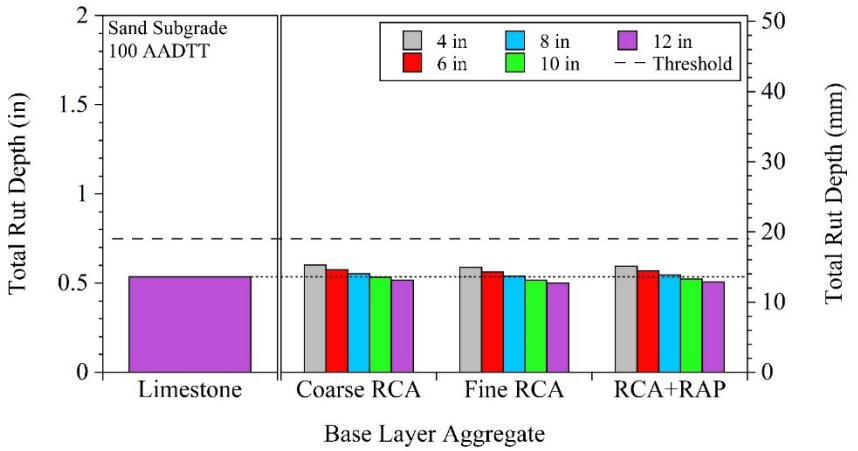

Clay Loam Subgrade
12 in Aggregate Base Layer
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years) - AC Bottom-Up Cracking (Alligator)
0
10
20
30
40
50
60
70
NF NF NF
NF NF NF
NF
NF NF NF
Coarse RCA
Fine RCA
Limestone
RCA+RAP
Base Layer Aggregate

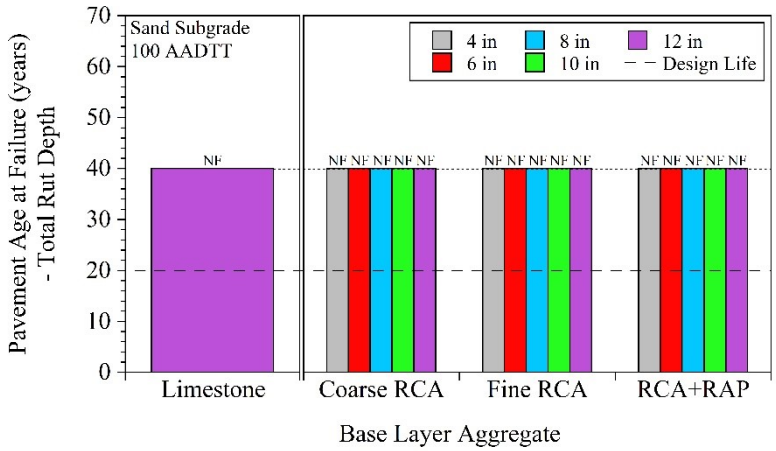
APPENDIX BF
RELATIVE RECYCLED AGGREGATE BASE (RAB) LAYER THICKNESS

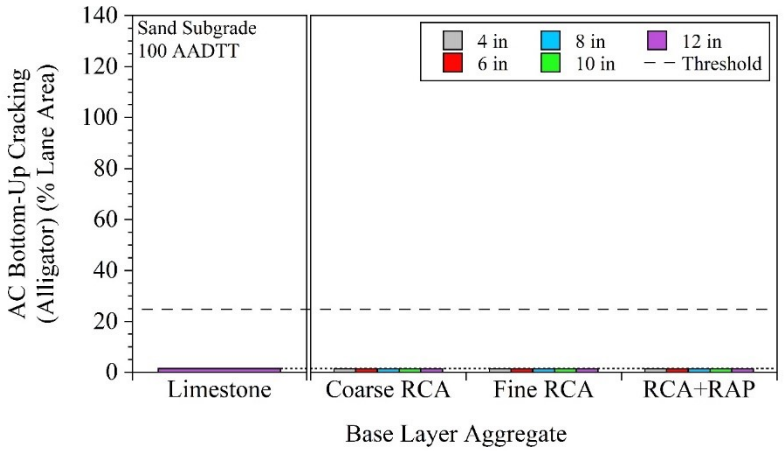
For pavements that contained Sand Subgrade - 100 AADTT:

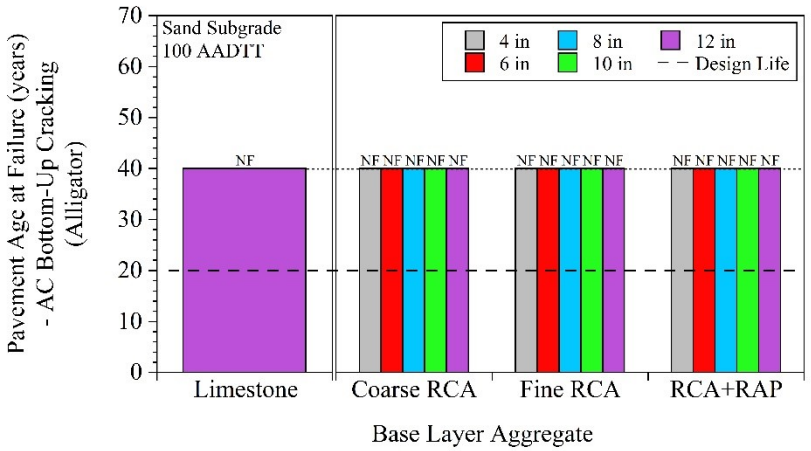


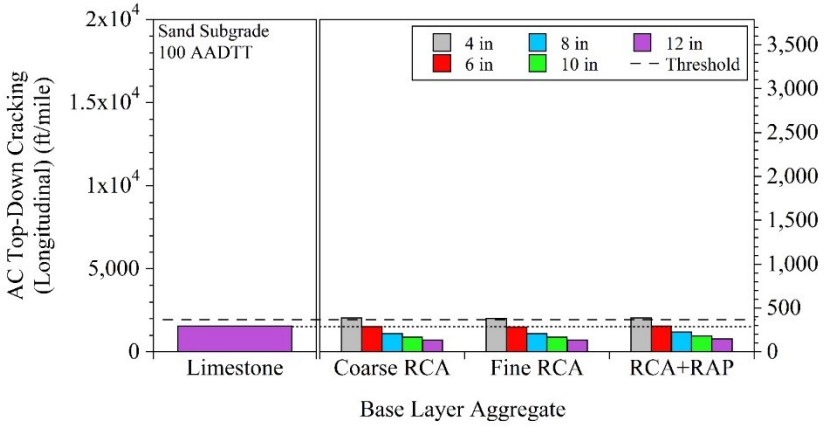


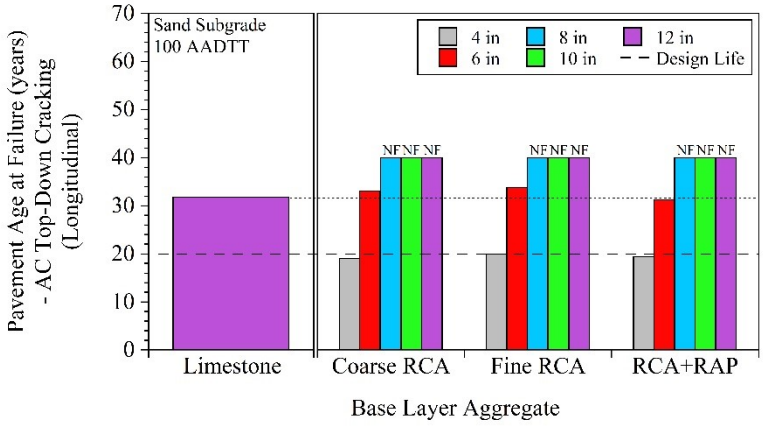




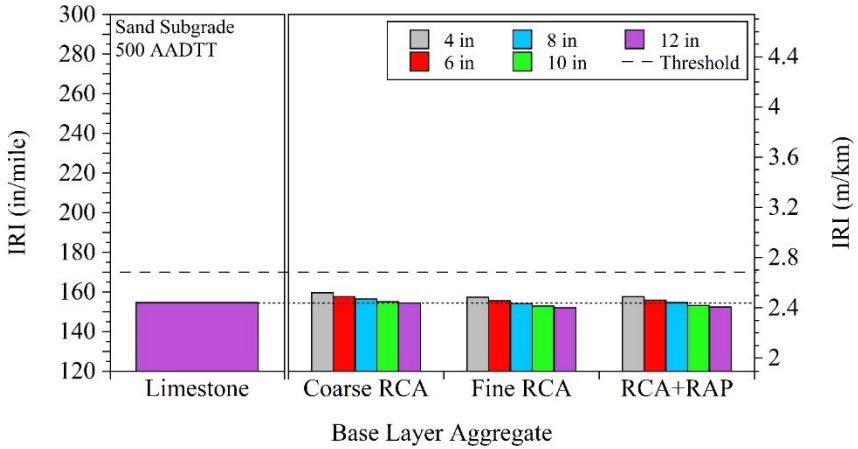

Sand Subgrade
100 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
140
120
100
80
60
40
20
0
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

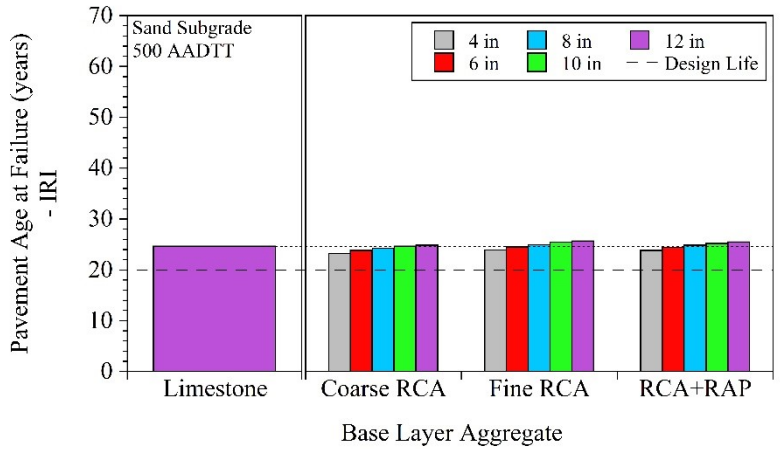

Sand Subgrade
100 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
70
60
50
40
30
20
10
0
NF
NF NF NF NF NF
NF NF NF NF NF
NF NF NF NF NF
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

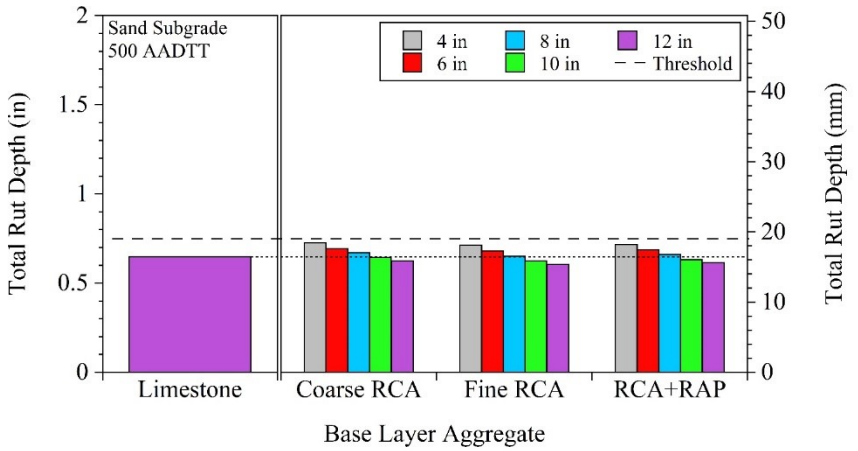

Sand Subgrade
100 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Top-Down Cracking
(Longitudinal) (ft/mile)
2x10^4
1.5x10^4
1x10^4
5,000
0
AC Top-Down Cracking
(Longitudinal) (m/km)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

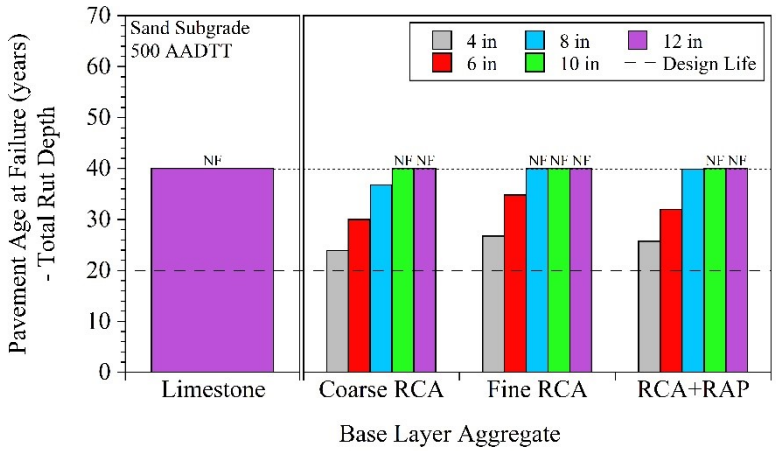

Sand Subgrade
100 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Top-Down Cracking
(Longitudinal)
70
60
50
40
30
20
10
0
NF NF NF
NF NF NF
NF NF NF
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

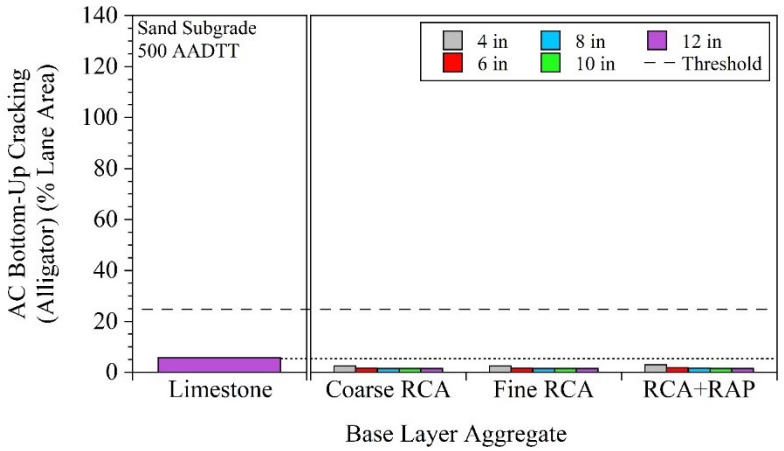
For pavements that contained Sand Subgrade - 500 AADTT:

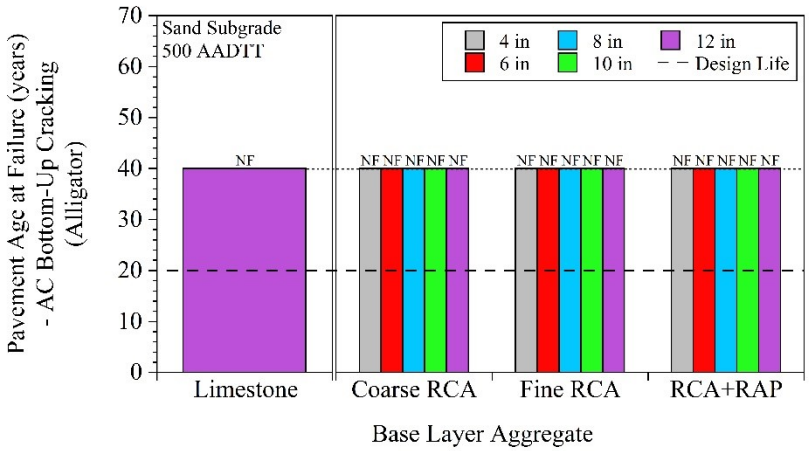


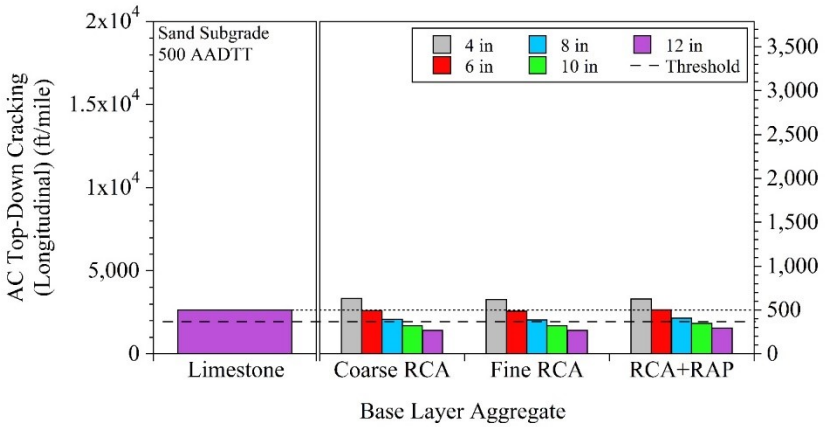


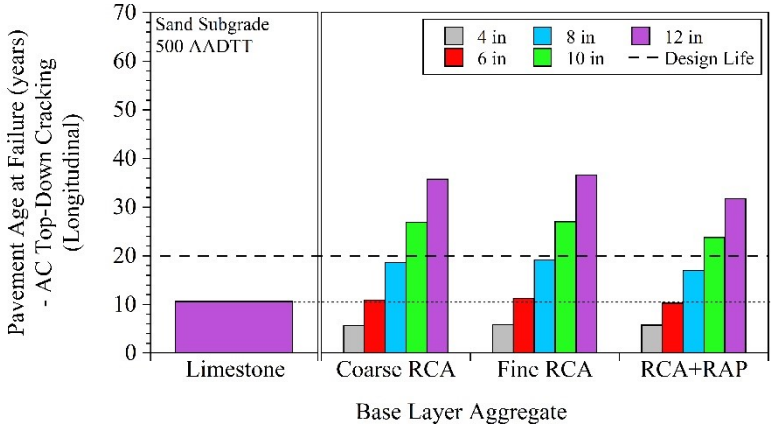




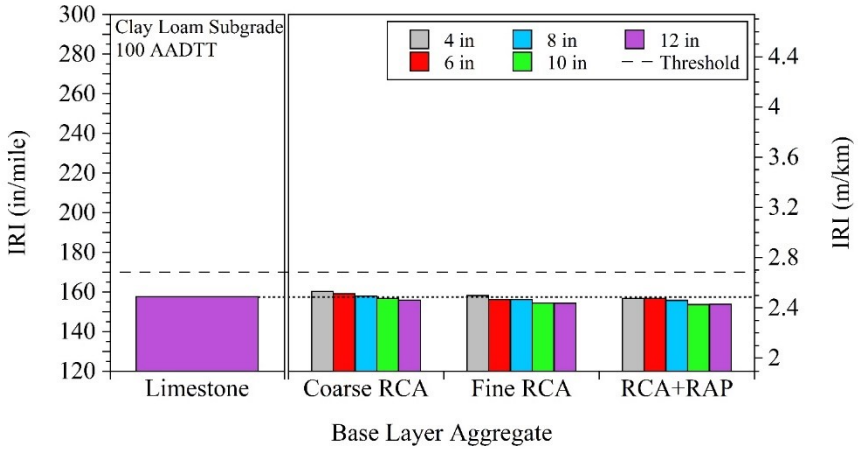

Sand Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

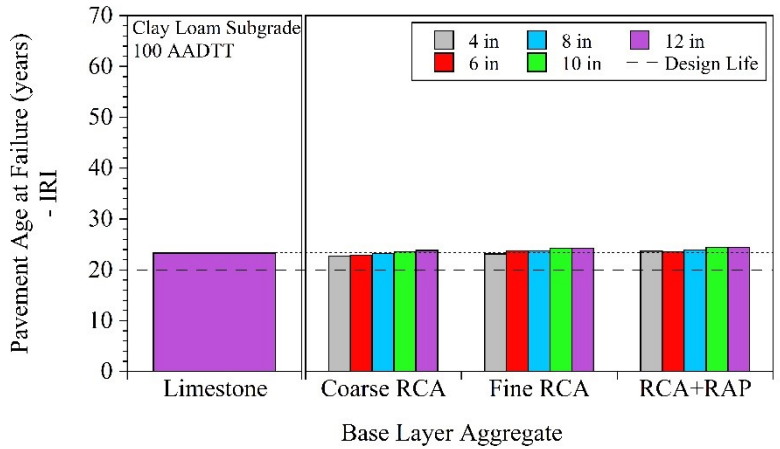

Sand Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
NF
NF NF NF NF NF
NF NF NF NF NF
NF NF NF NF NF
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

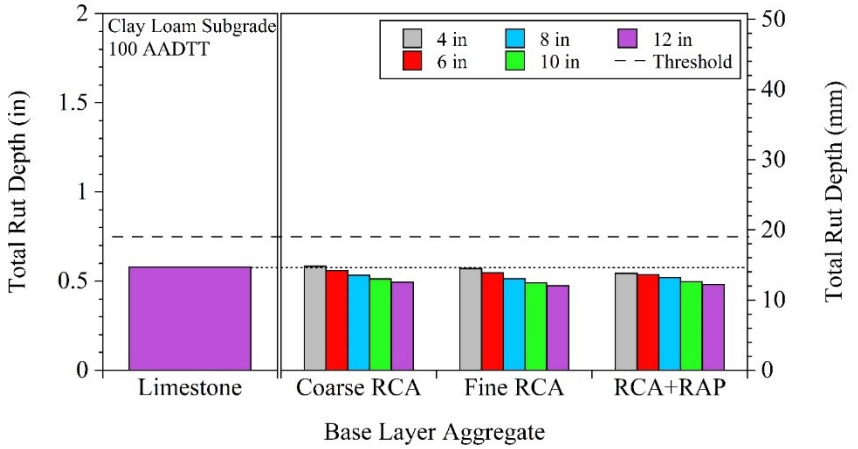

Sand Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Top-Down Cracking
(Longitudinal) (ft/mile)
0
5,000
1x10^4
1.5x10^4
2x10^4
AC Top-Down Cracking
(Longitudinal) (m/km)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

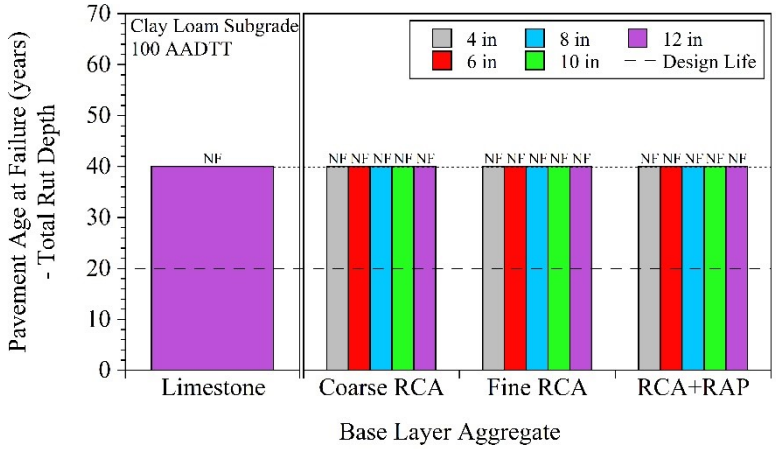

Sand Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Top-Down Cracking
(Longitudinal)
0
10
20
30
40
50
60
70
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

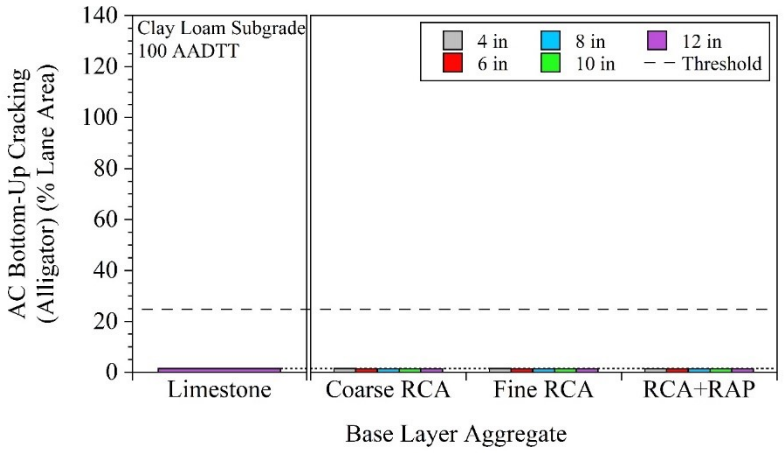
For pavements that contained Clay Loam subgrade - 100 AADTT:

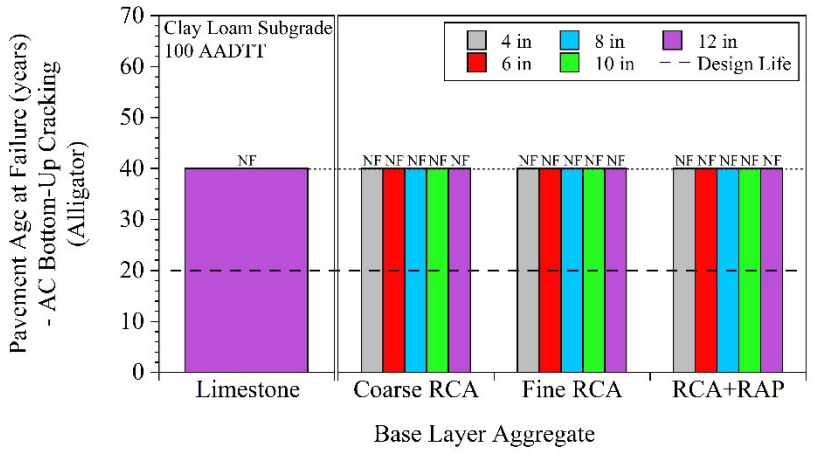




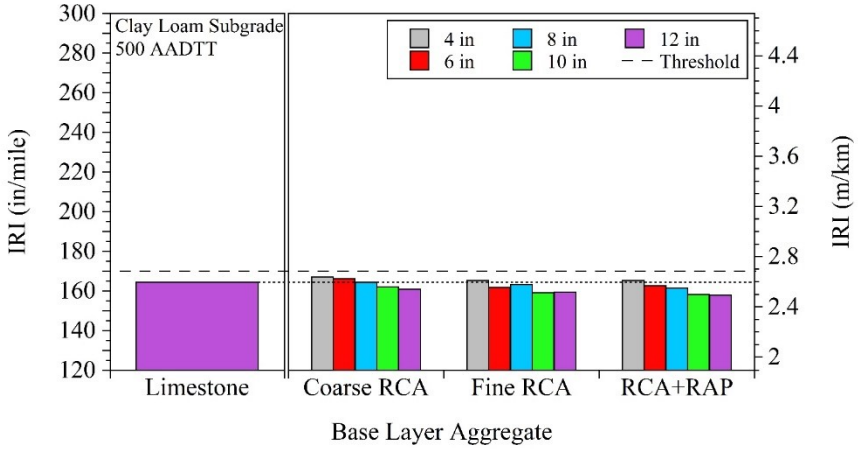


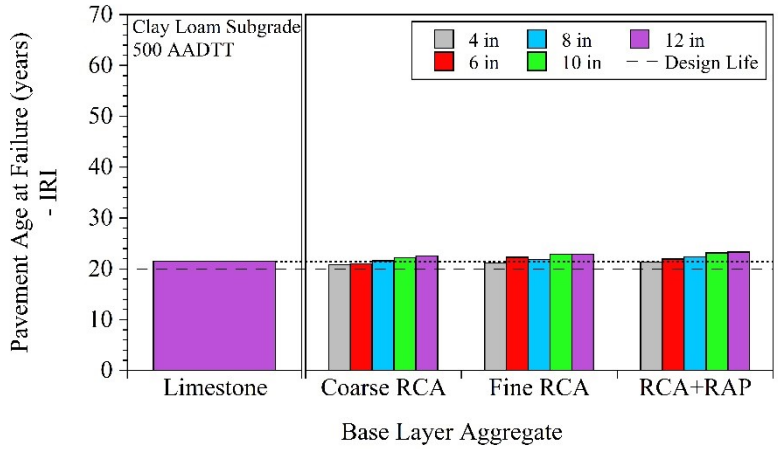


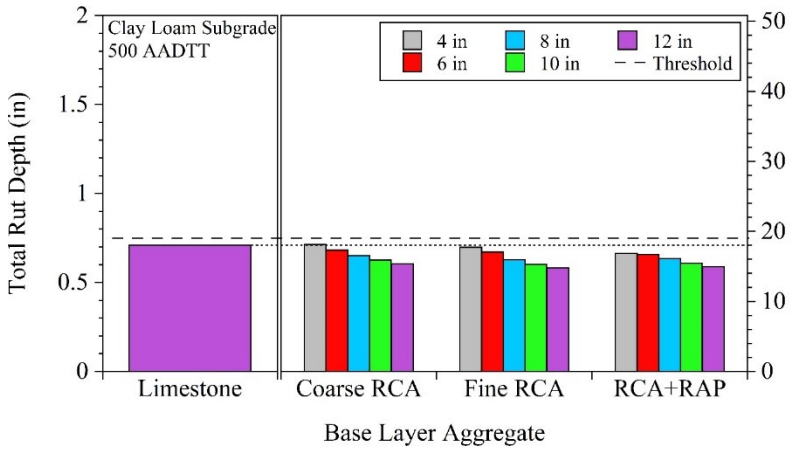


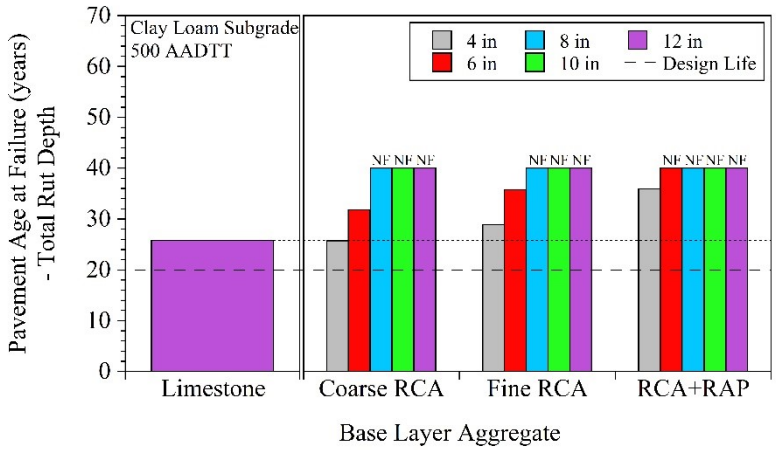


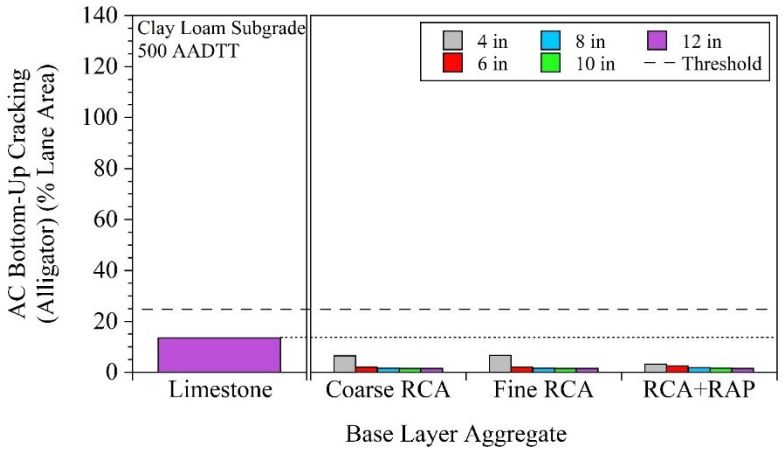
For pavements that contained Clay Loam subgrade - 500 AADTT:

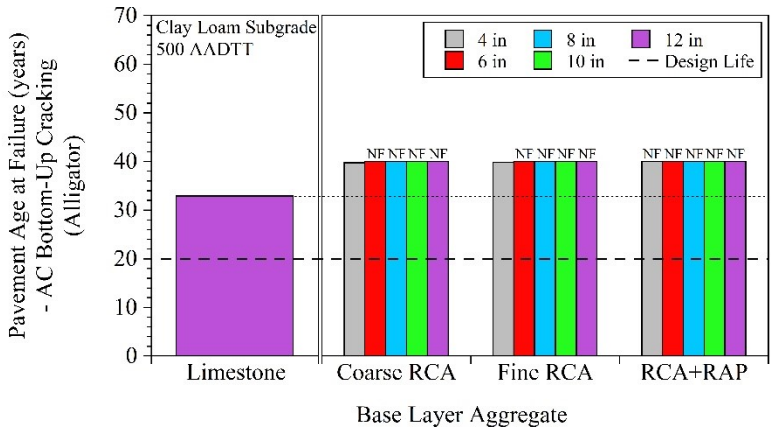




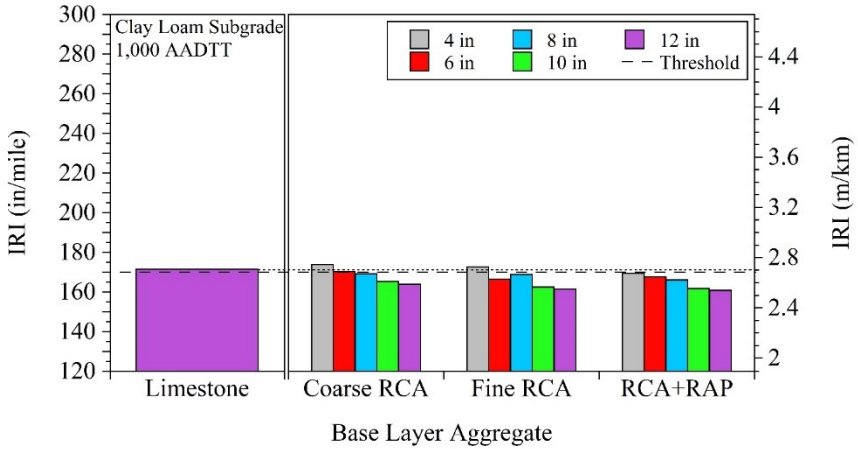

Clay Loam Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

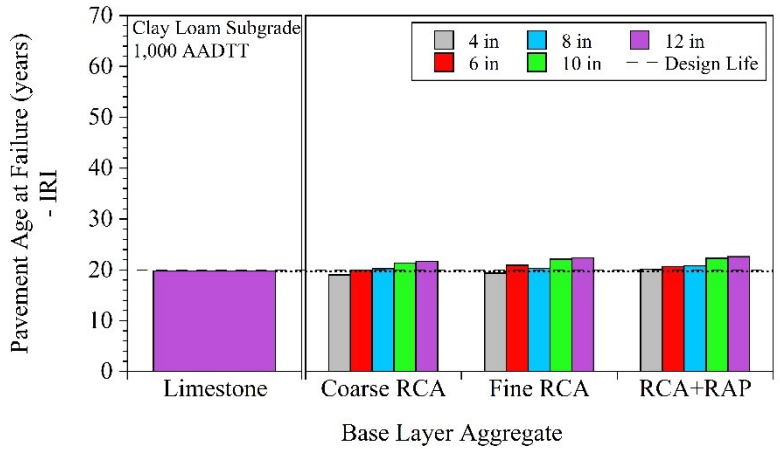

Clay Loam Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
NF NF NF
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

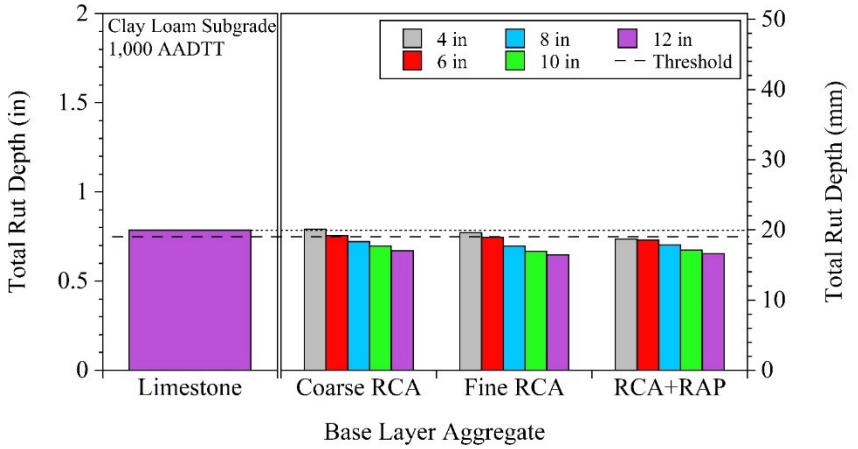

Clay Loam Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

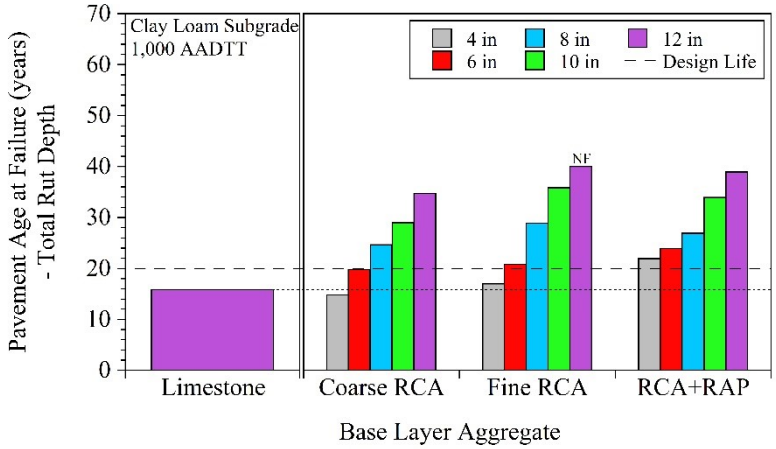

Clay Loam Subgrade
500 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
NF NF NF NF
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

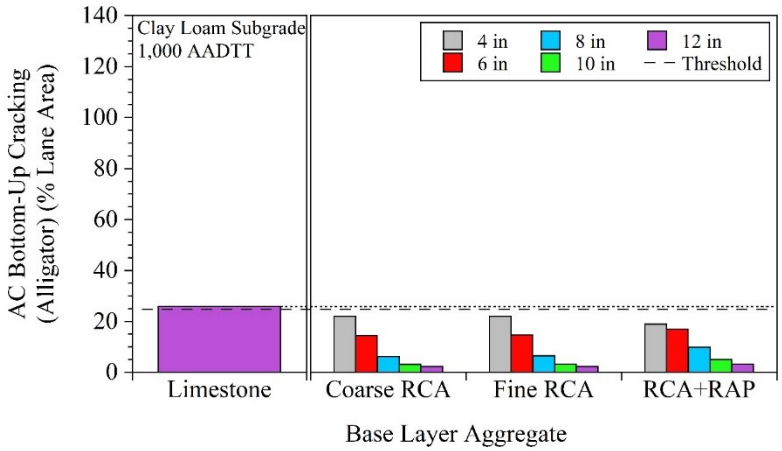
For pavements that contained Clay Loam subgrade - 1,000 AADTT:

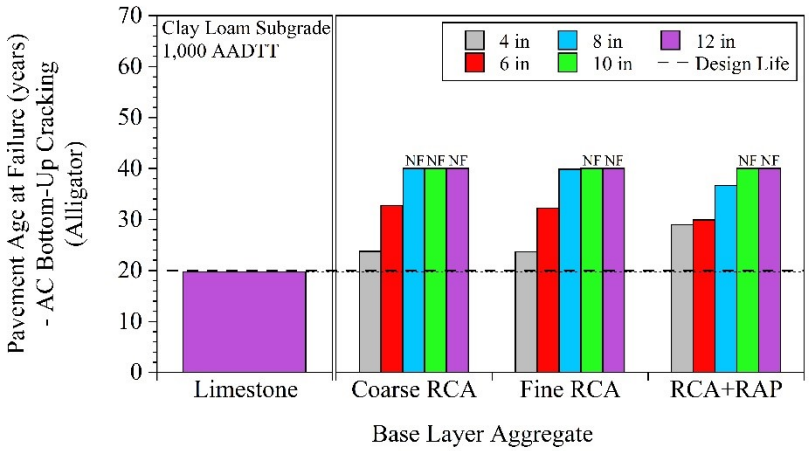






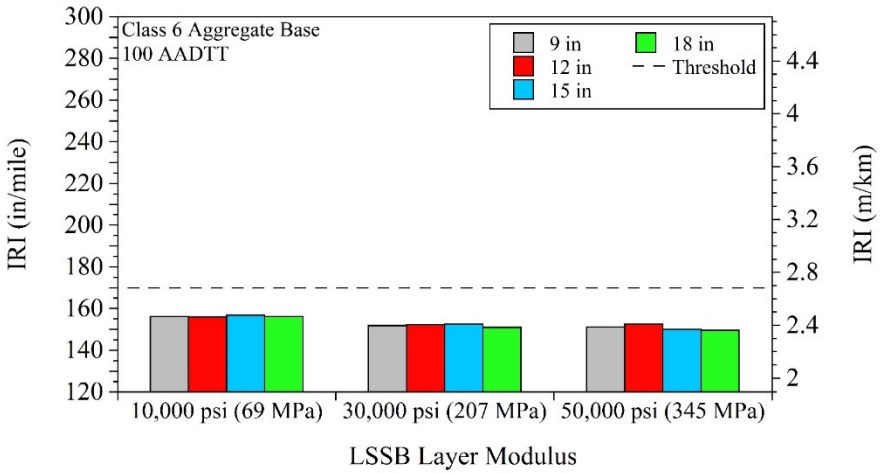


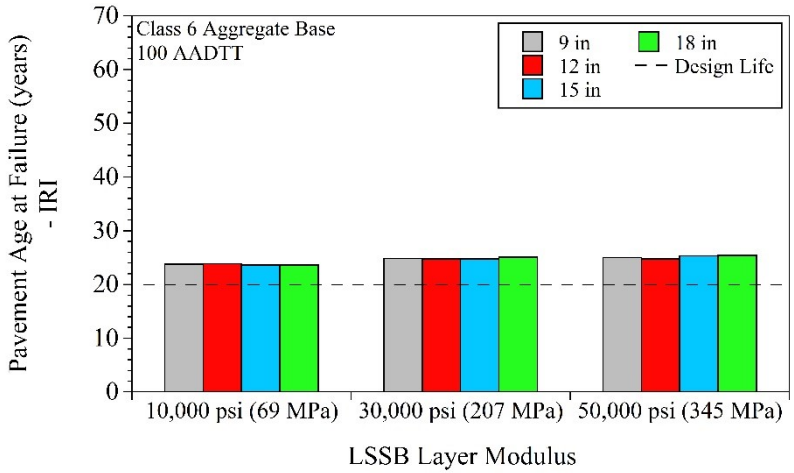

Clay Loam Subgrade
1,000 AADTT
4 in
6 in
8 in
10 in
12 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

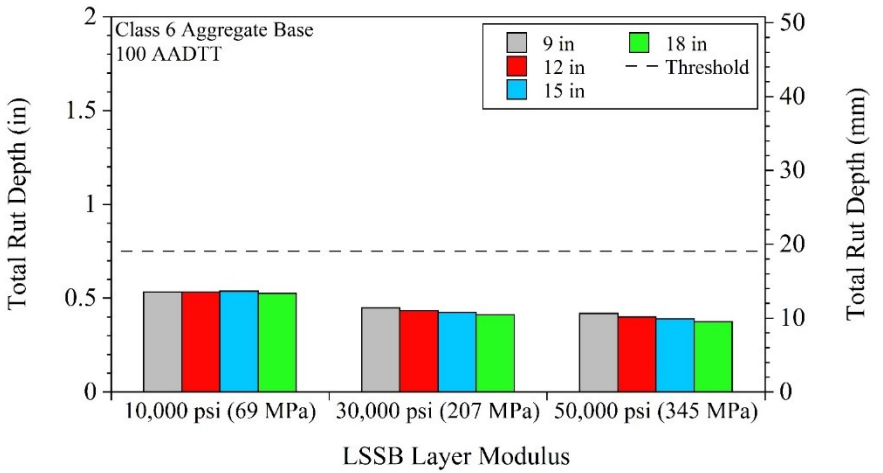

Clay Loam Subgrade
1,000 AADTT
4 in
6 in
8 in
10 in
12 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
NF NF NF
NF NF
NF NF
Limestone
Coarse RCA
Fine RCA
RCA+RAP
Base Layer Aggregate

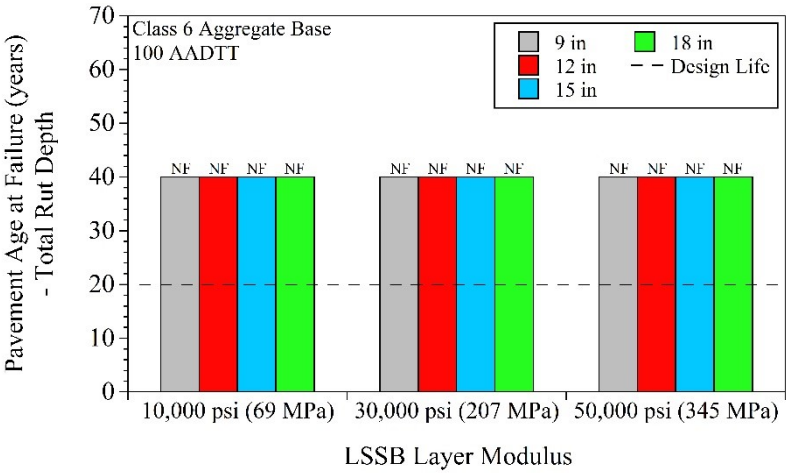
APPENDIX BG
EFFECT OF LARGE STONE SUBBASE (LSSB) THICKNESS ON PAVEMENT PERFORMANCE PREDICTIONS

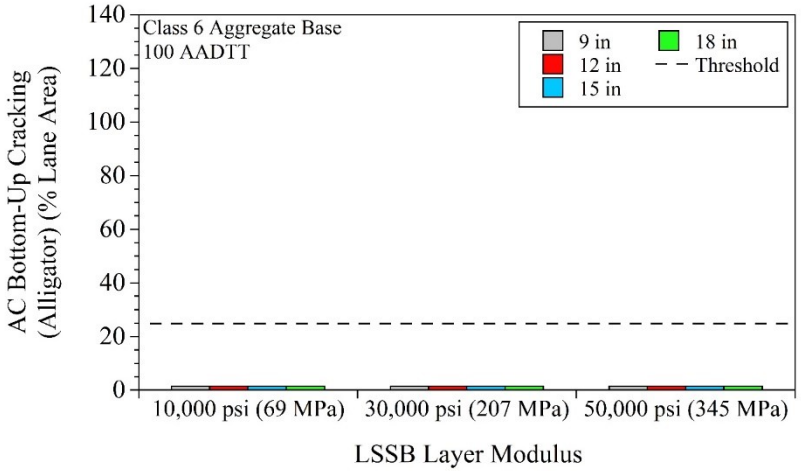
For pavement models that contained Class 6 Aggregate base - 100 AADTT:

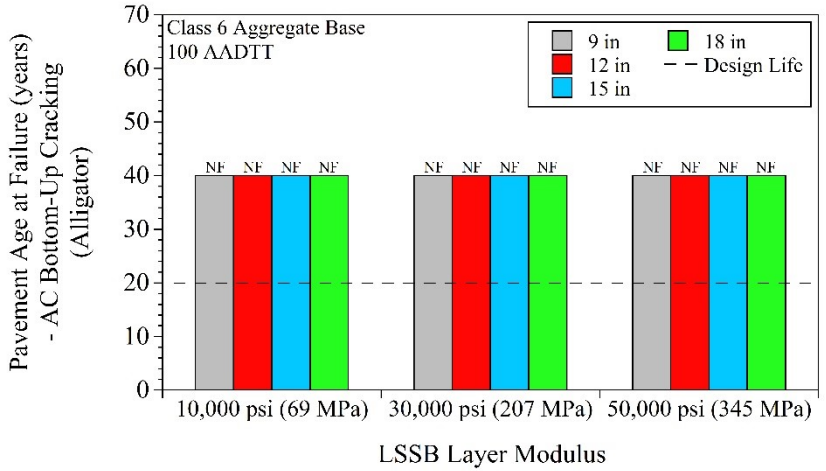




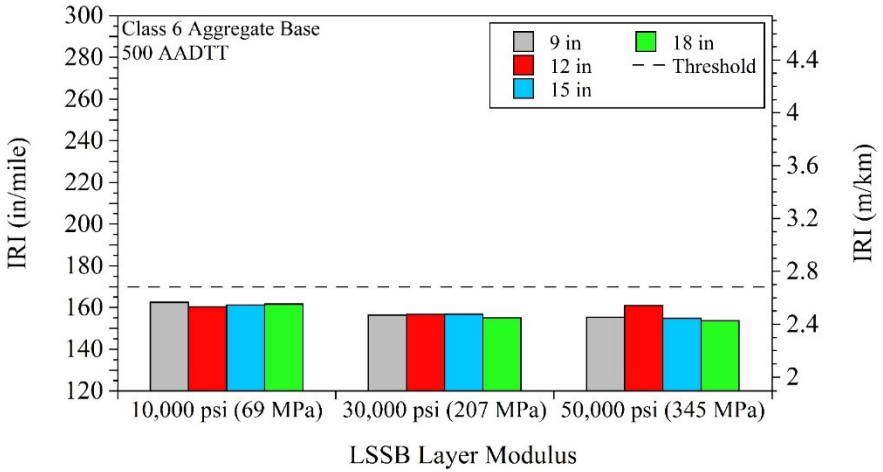


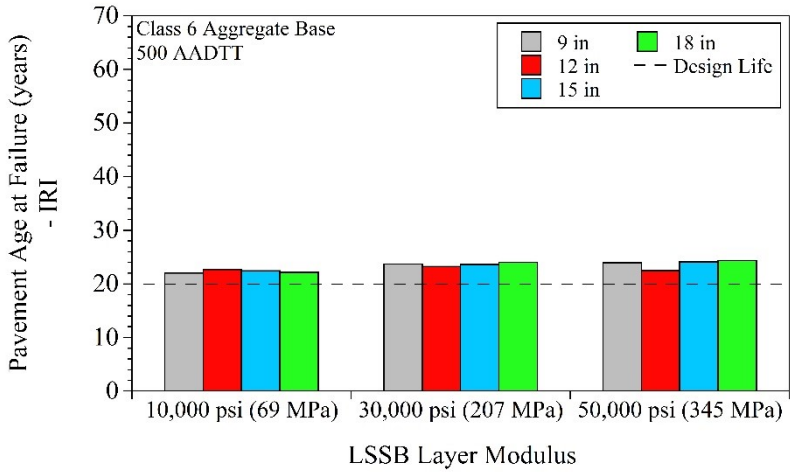


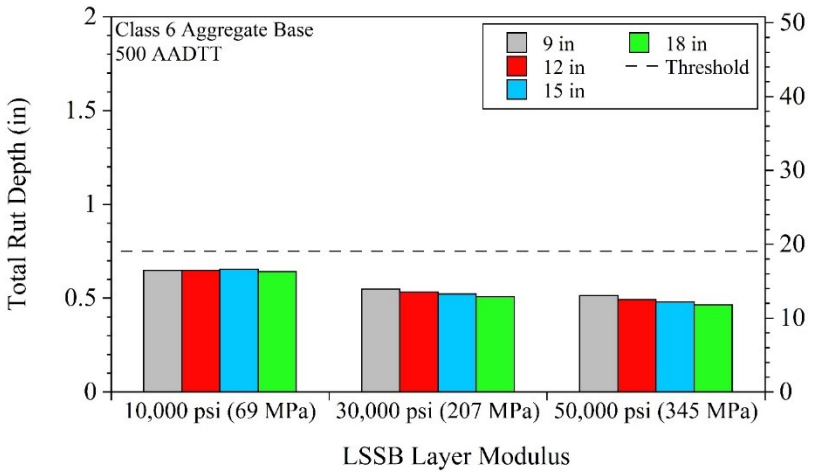


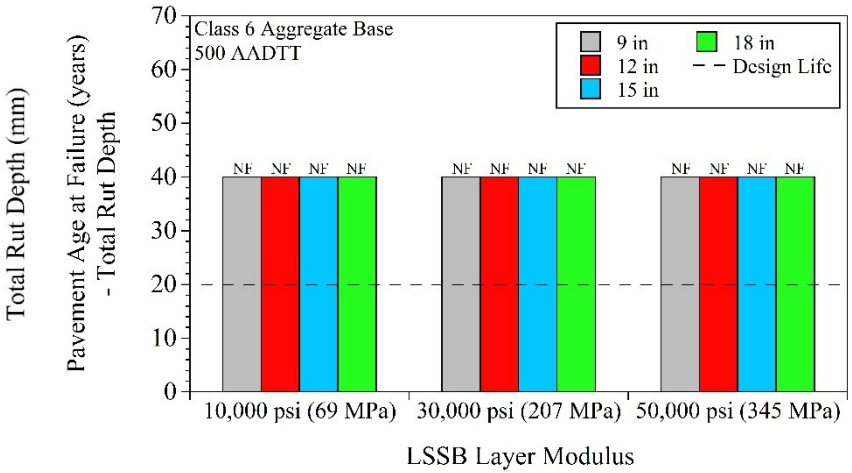


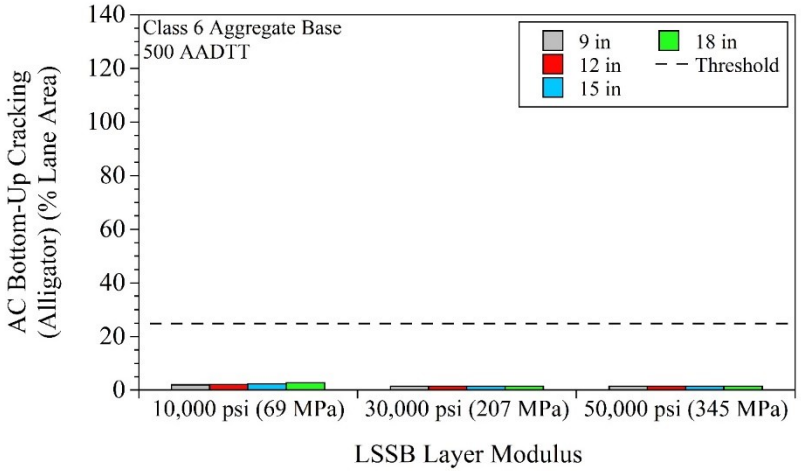
For pavement models that contained Class 6 Aggregate base - 500 AADTT:

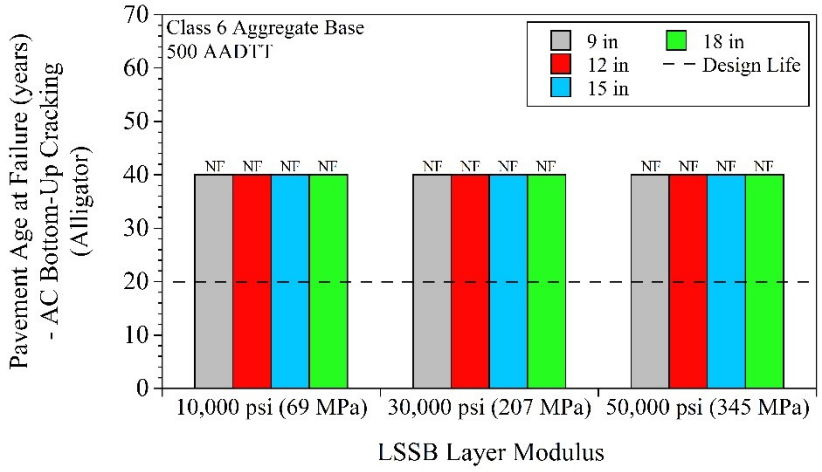




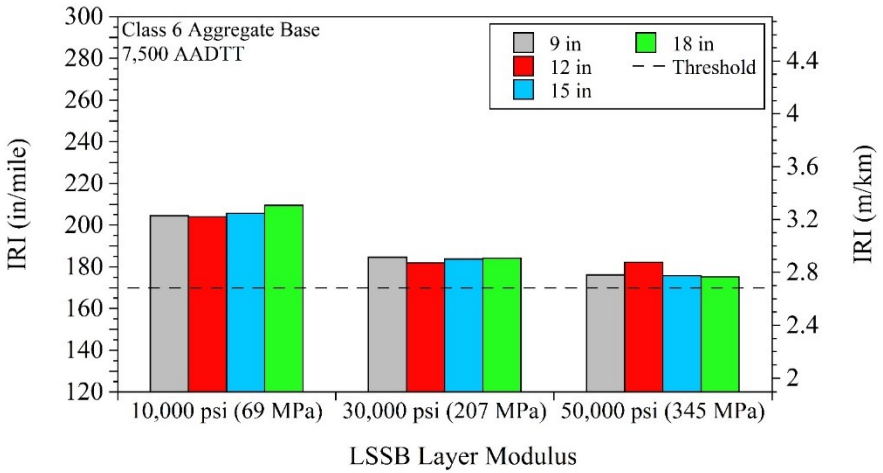

Class 6 Aggregate Base
500 AADTT
9 in
12 in
15 in
18 in
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
0
0.5
1
1.5
2
0
10
20
30
40
50
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

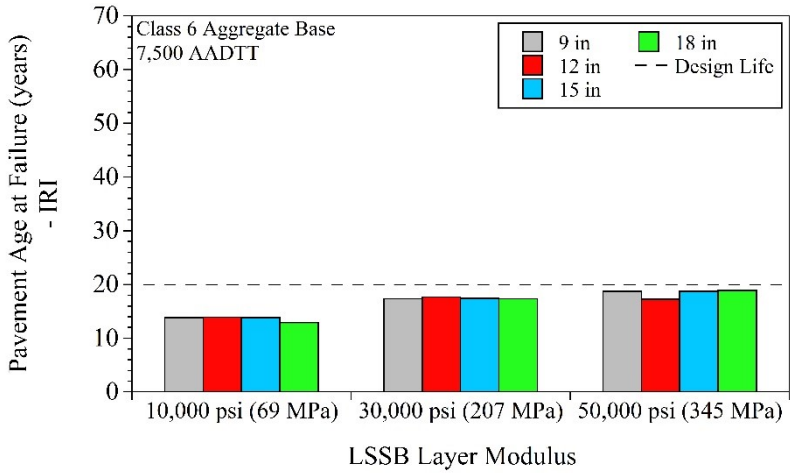

Class 6 Aggregate Base
500 AADTT
9 in
12 in
15 in
18 in
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
0
10
20
30
40
50
60
70
NF
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

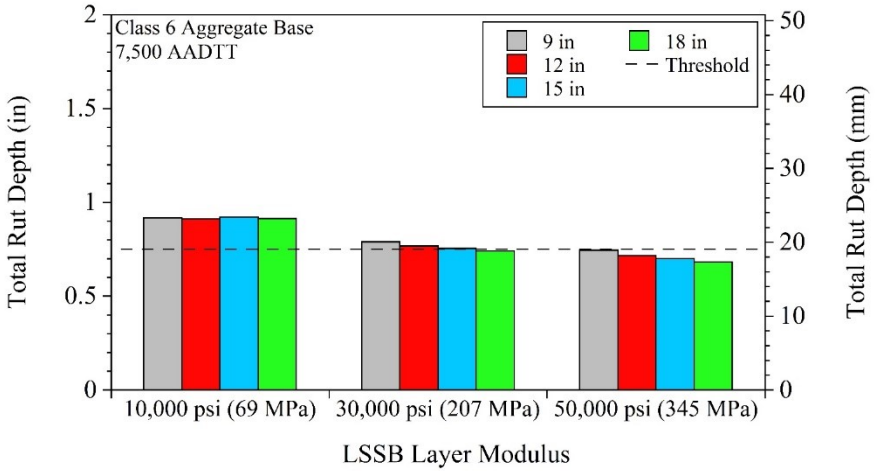

Class 6 Aggregate Base
500 AADTT
9 in
12 in
15 in
18 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

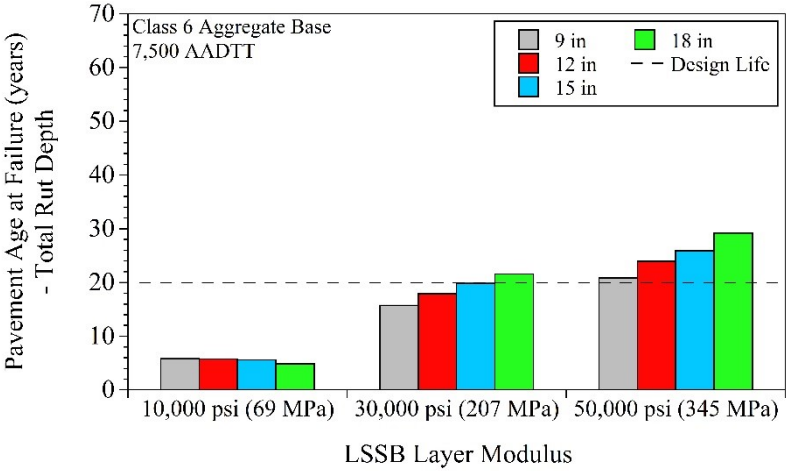

Class 6 Aggregate Base
500 AADTT
9 in
12 in
15 in
18 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
NF
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

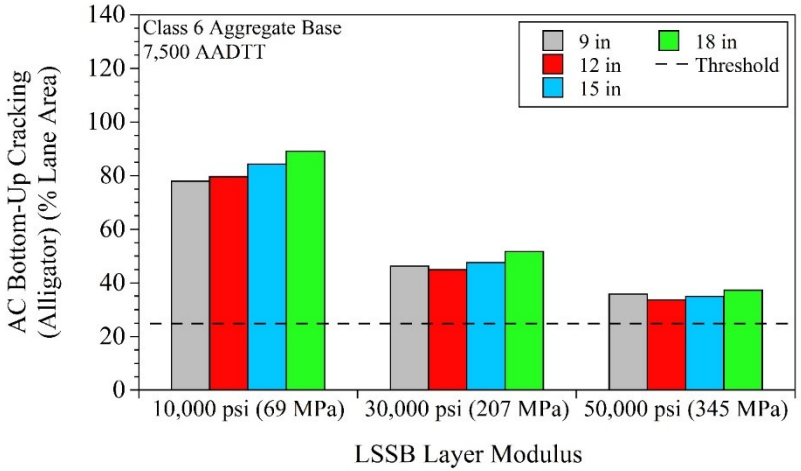
For pavement models that contained Class 6 Aggregate base - 7,500 AADTT:

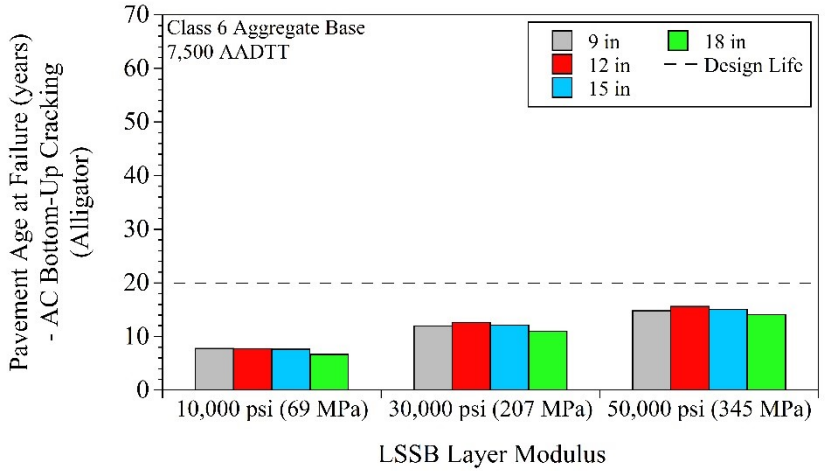




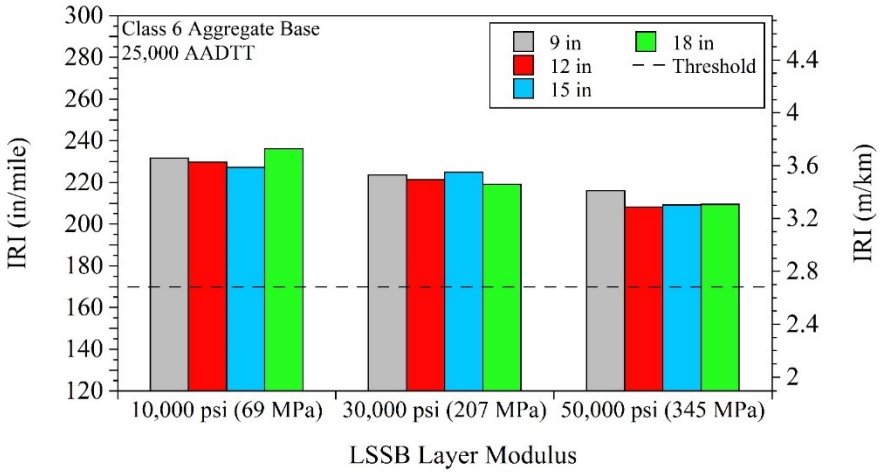


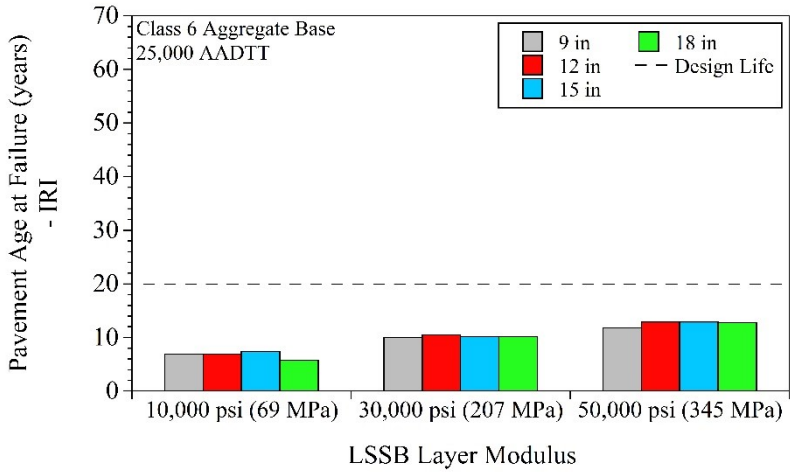


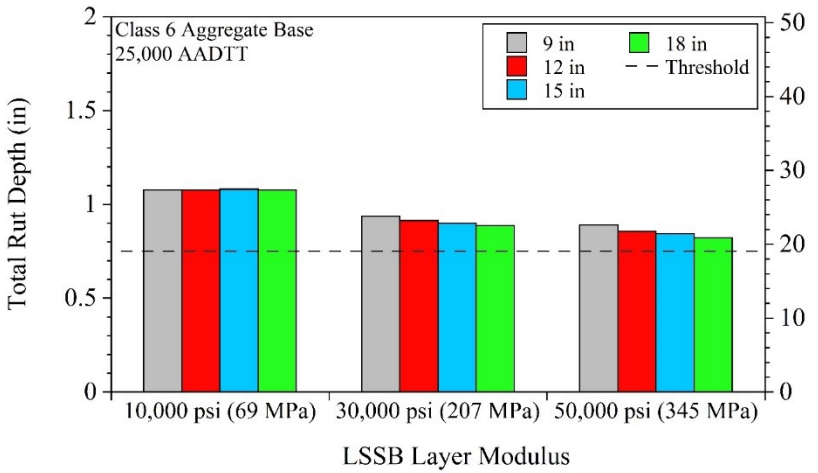


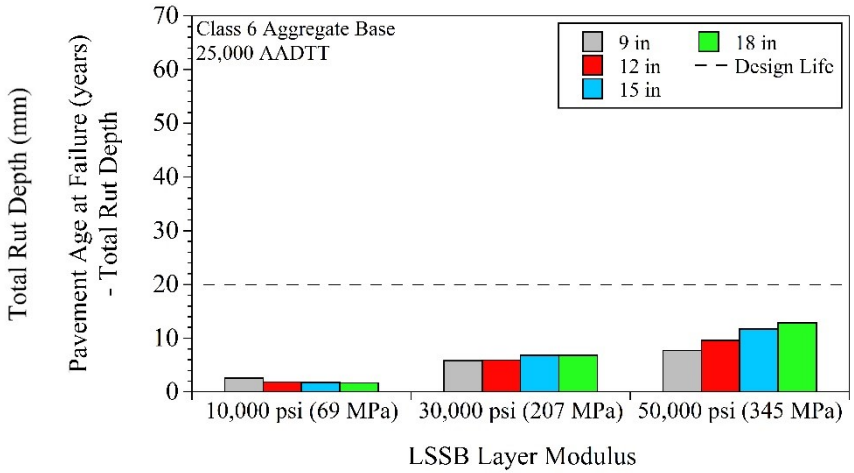


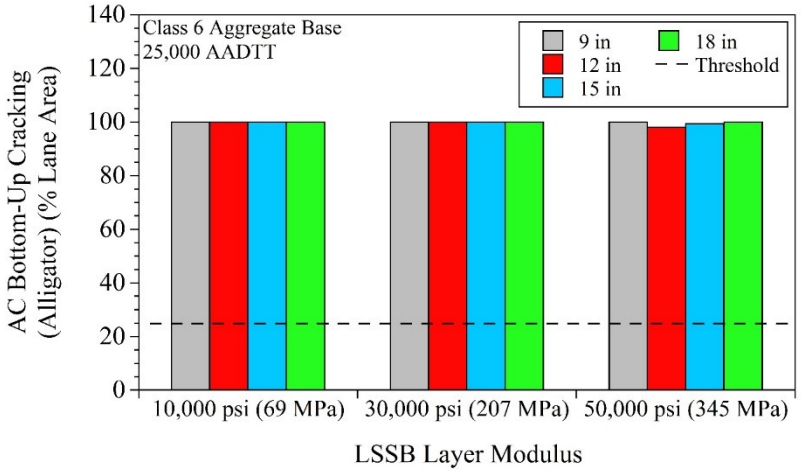
For pavement models that contained Class 6 Aggregate base - 25,000 AADTT:

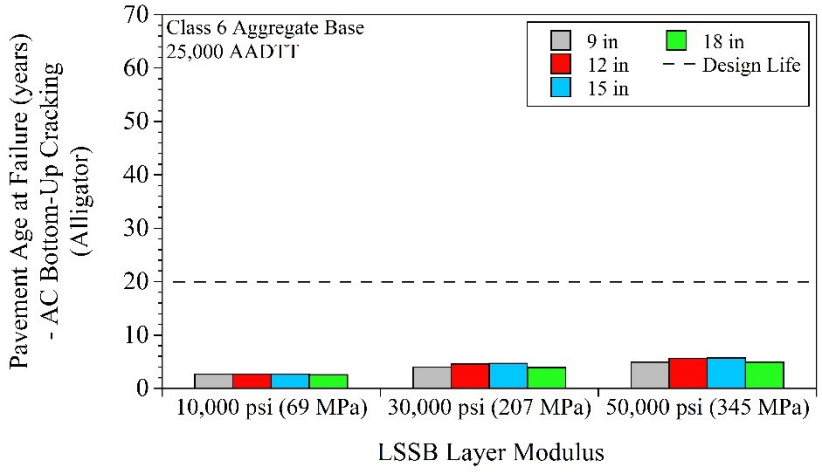




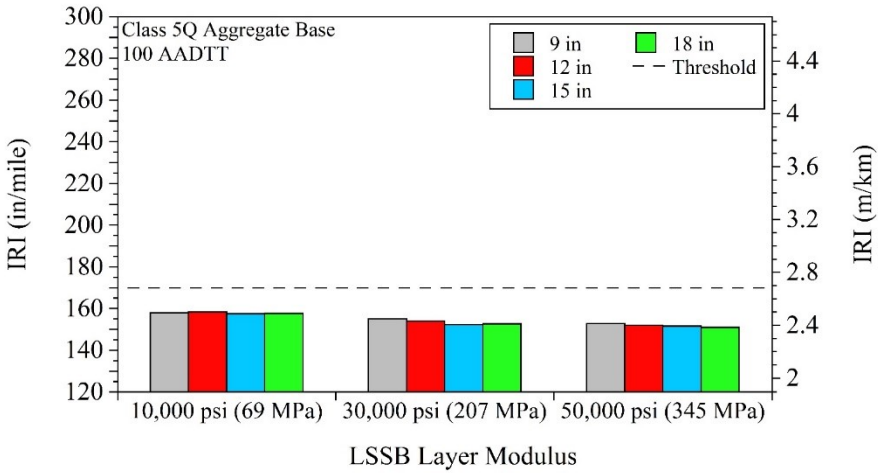

Class 6 Aggregate Base
25,000 AADTT
9 in
12 in
15 in
18 in
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
0
0.5
1
1.5
2
0
10
20
30
40
50
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

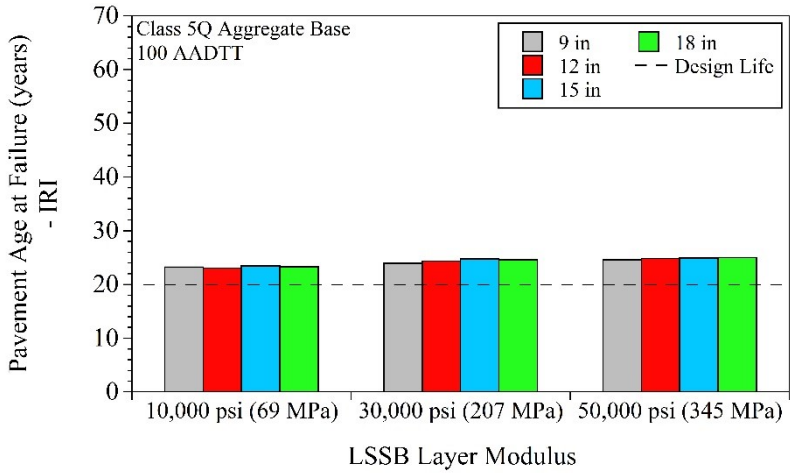

Class 6 Aggregate Base
25,000 AADTT
9 in
12 in
15 in
18 in
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
0
10
20
30
40
50
60
70
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

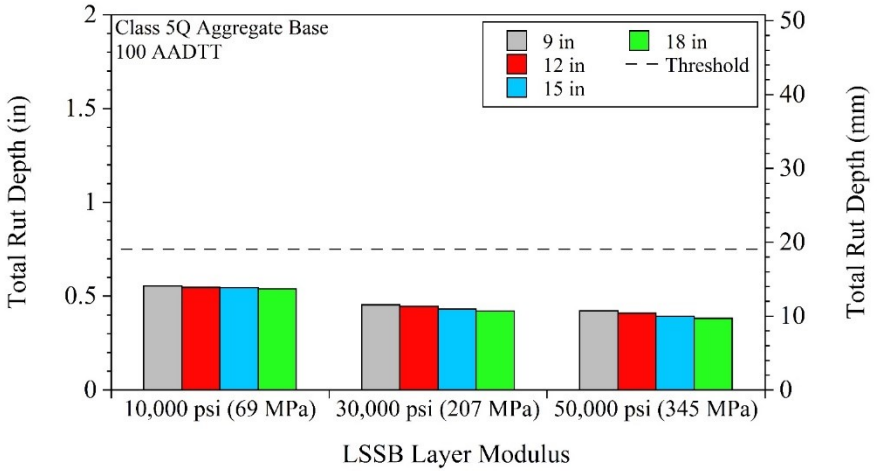

Class 6 Aggregate Base
25,000 AADTT
9 in
12 in
15 in
18 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

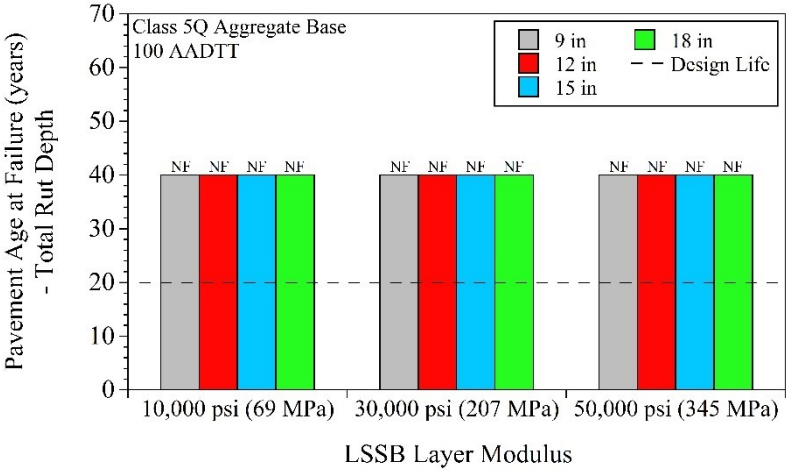

Class 6 Aggregate Base
25,000 AADTT
9 in
12 in
15 in
18 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

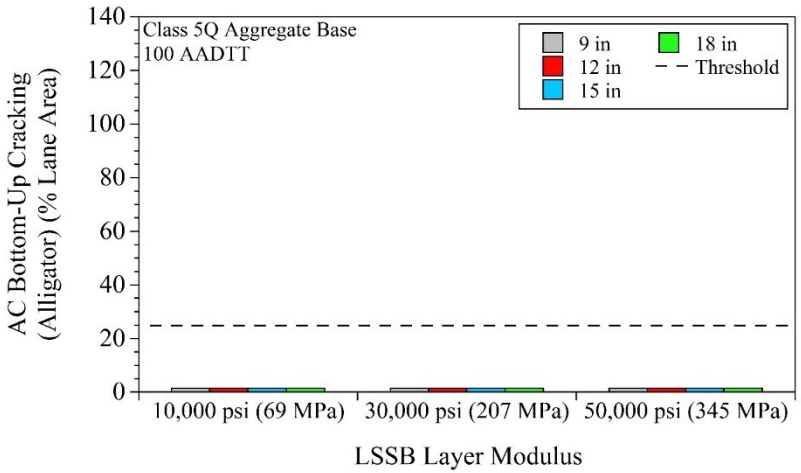
For pavement models that contained Class 5Q Aggregate base - 100 AADTT:

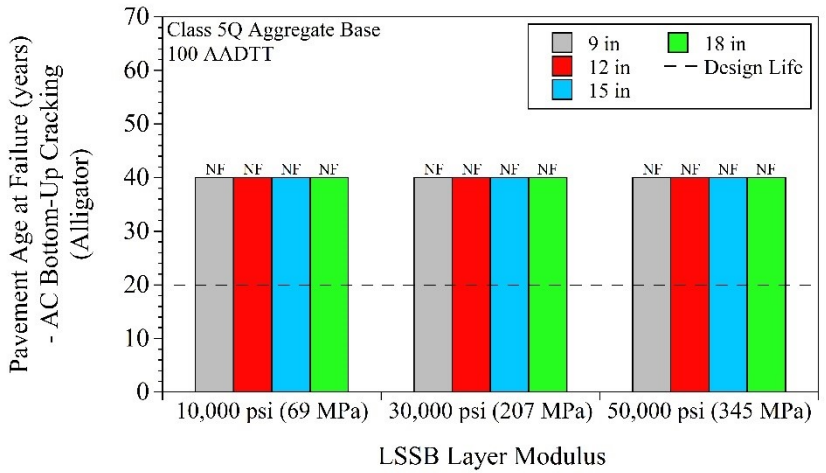




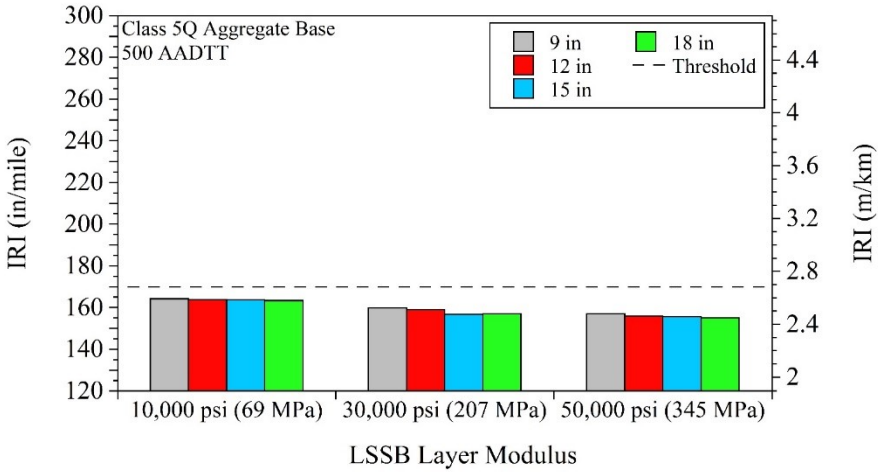


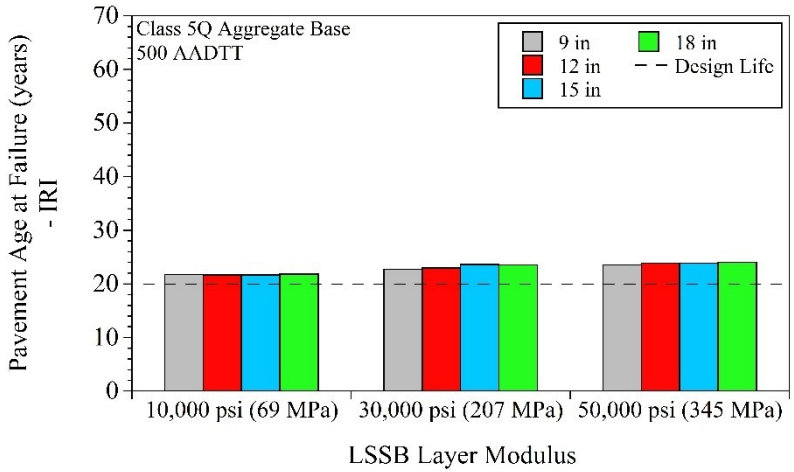


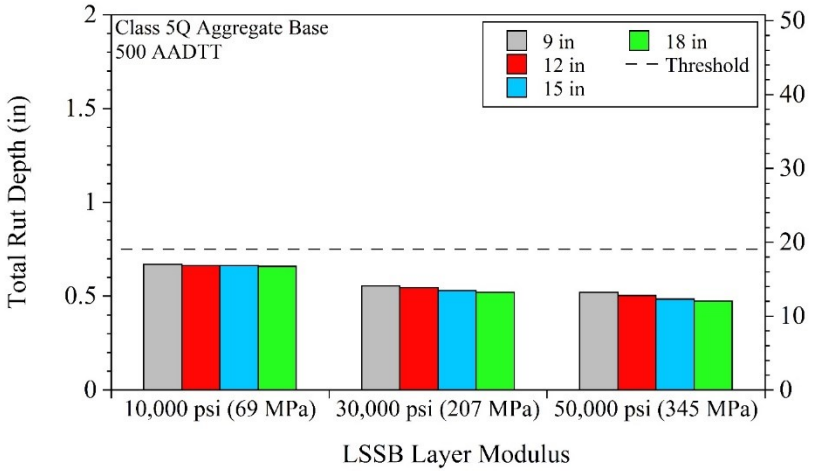


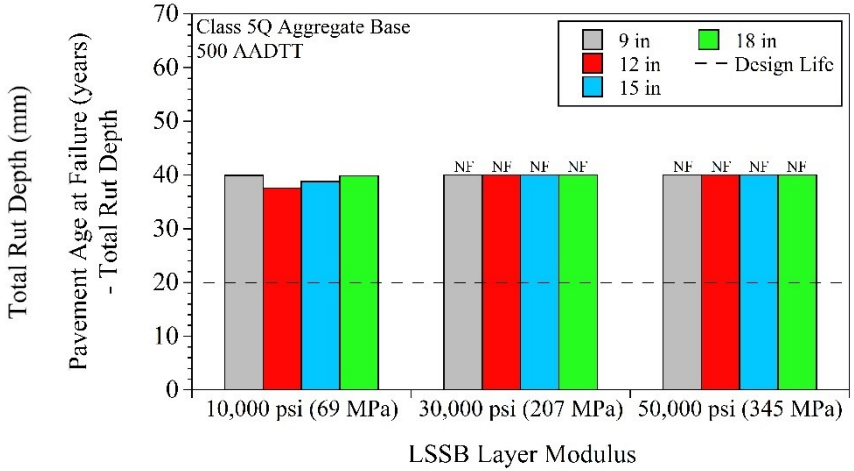


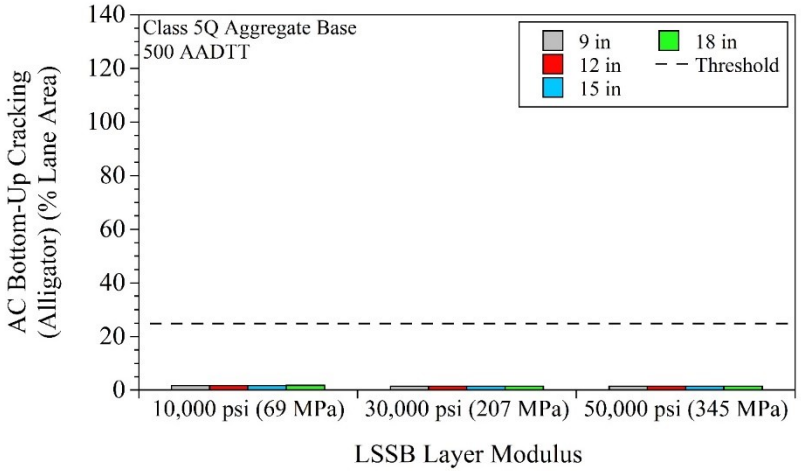
For pavement models that contained Class 5Q Aggregate base - 500 AADTT:

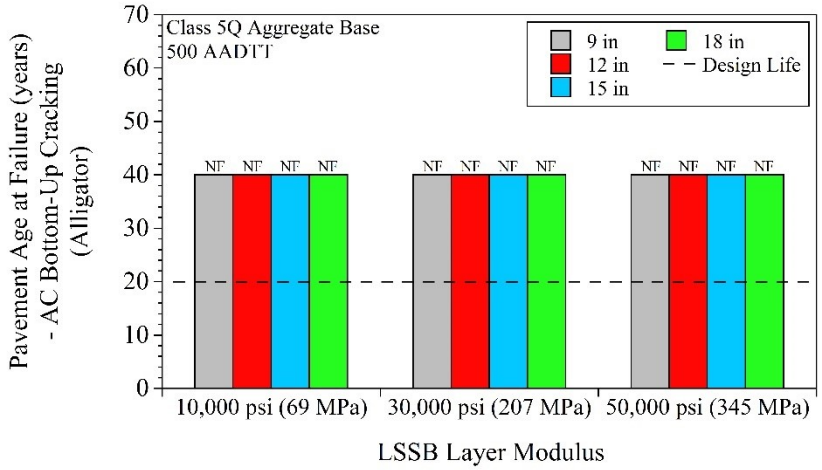




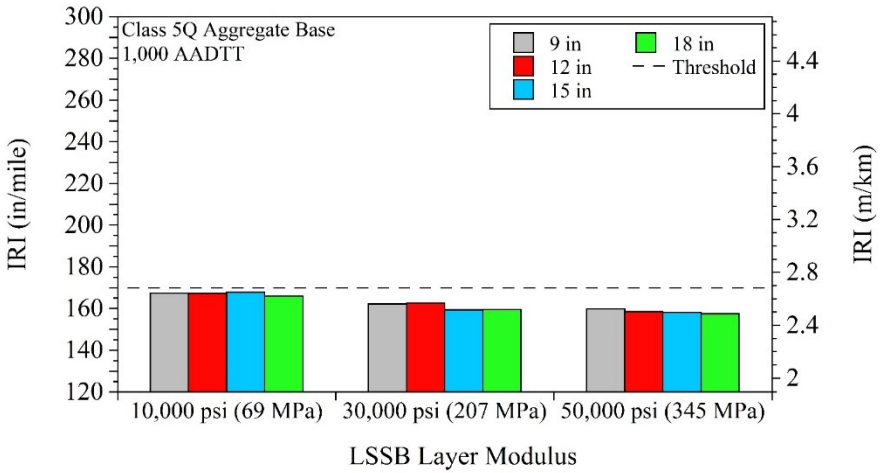

Class 5Q Aggregate Base
500 AADTT
9 in
12 in
15 in
18 in
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

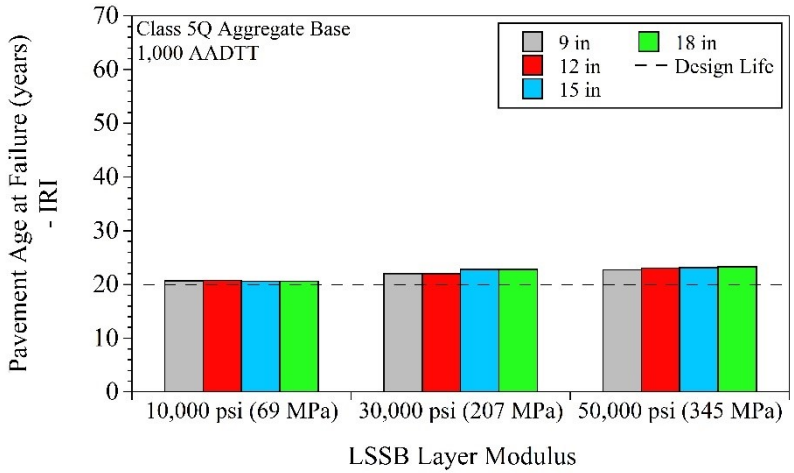

Class 5Q Aggregate Base
500 AADTT
9 in
12 in
15 in
18 in
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
NF
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

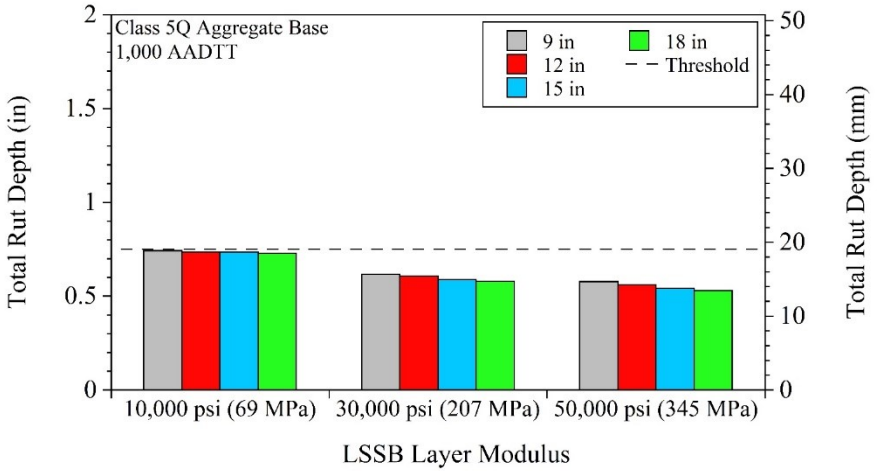

Class 5Q Aggregate Base
500 AADTT
9 in
12 in
15 in
18 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

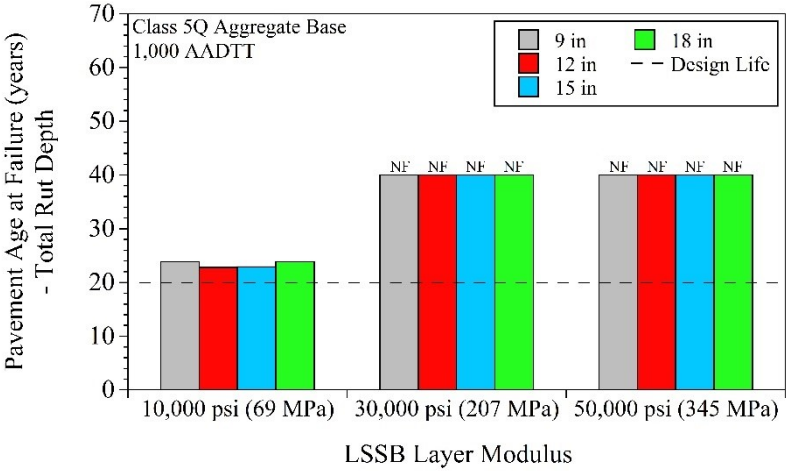

Class 5Q Aggregate Base
500 AADTT
9 in
12 in
15 in
18 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
NF
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

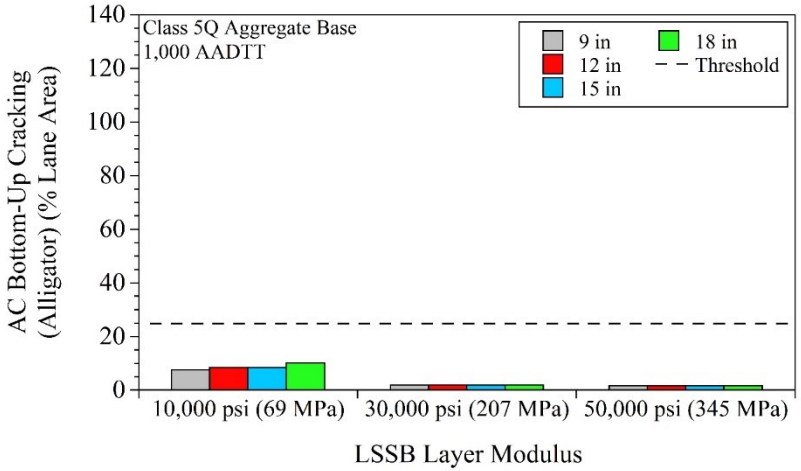
For pavement models that contained Class 5Q Aggregate base - 1,000 AADTT:

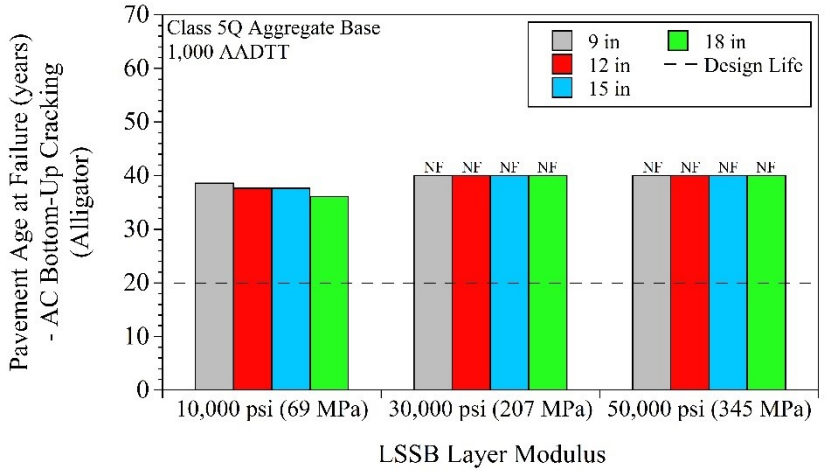




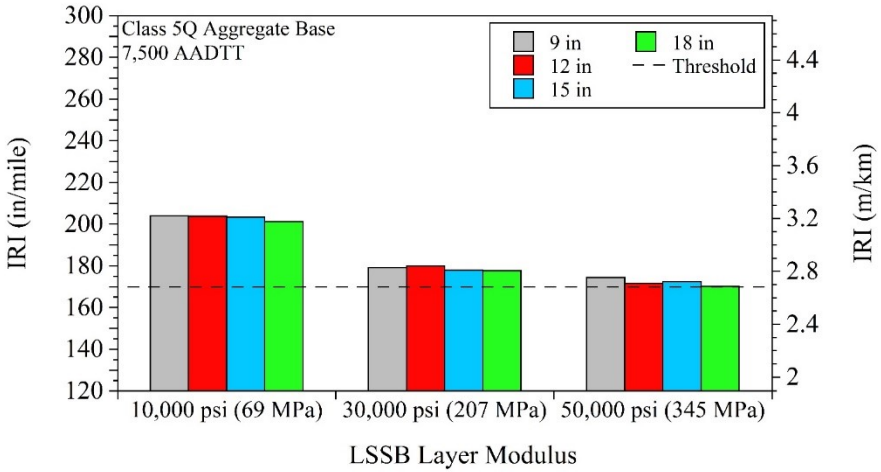


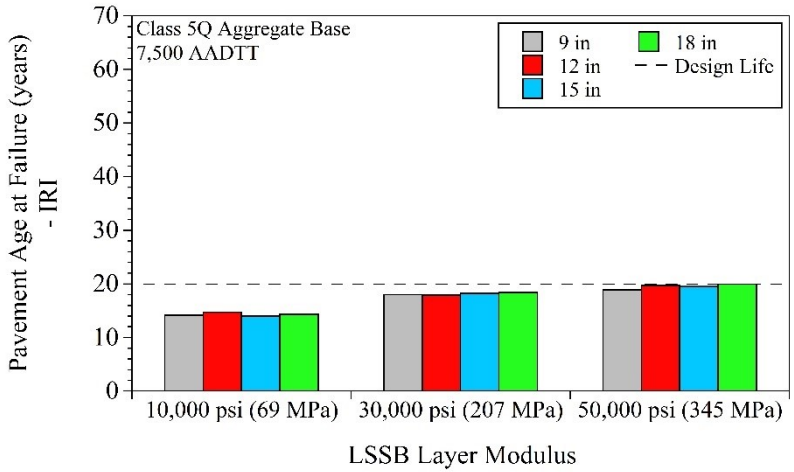


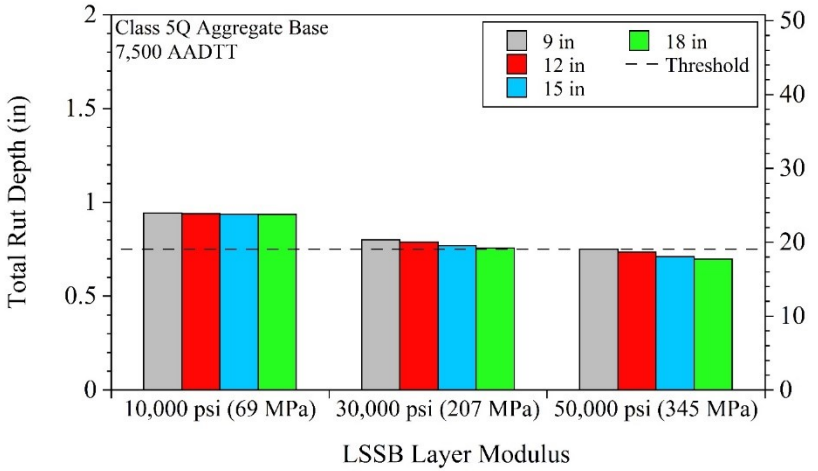


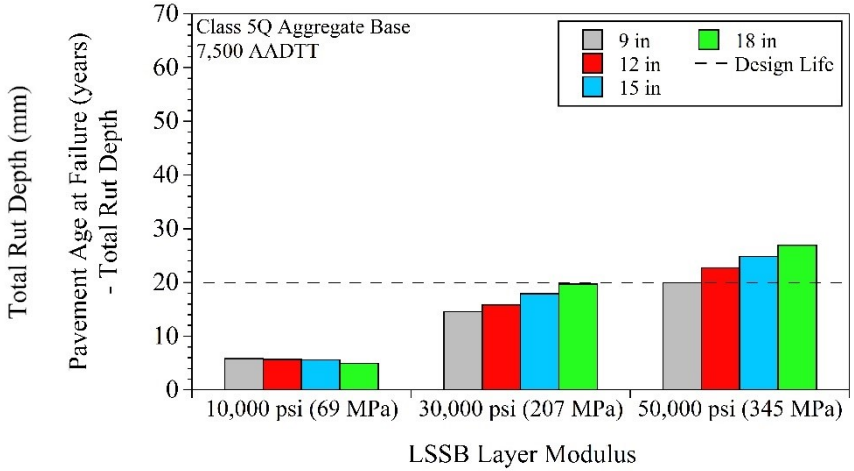


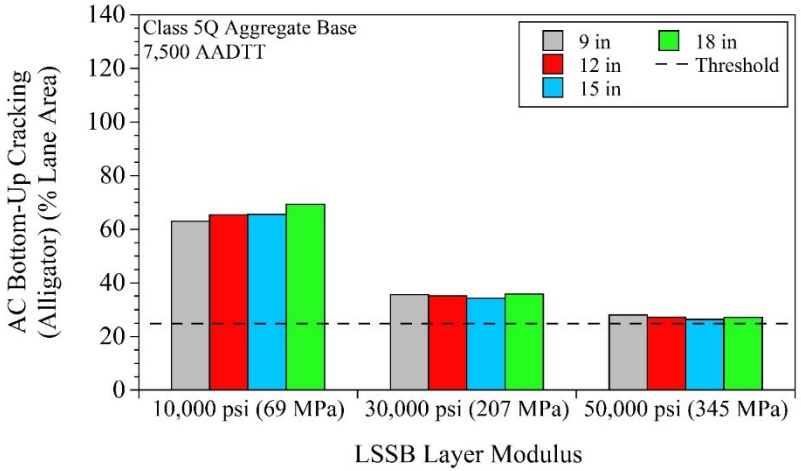
For pavement models that contained Class 5Q Aggregate base - 7,500 AADTT:

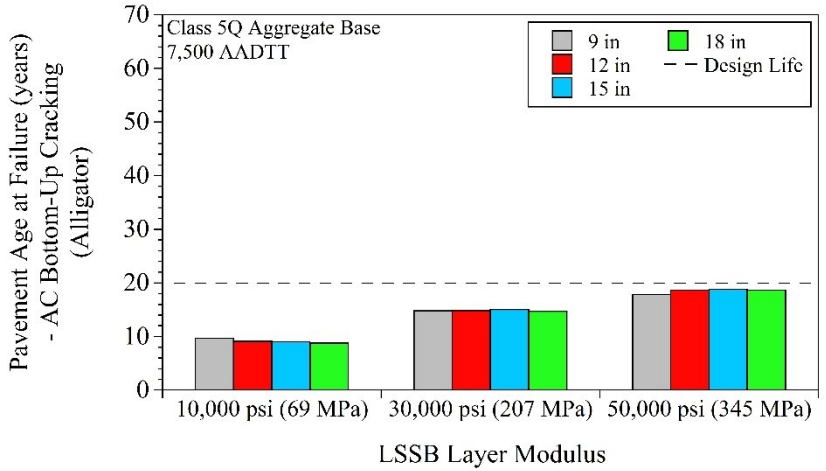




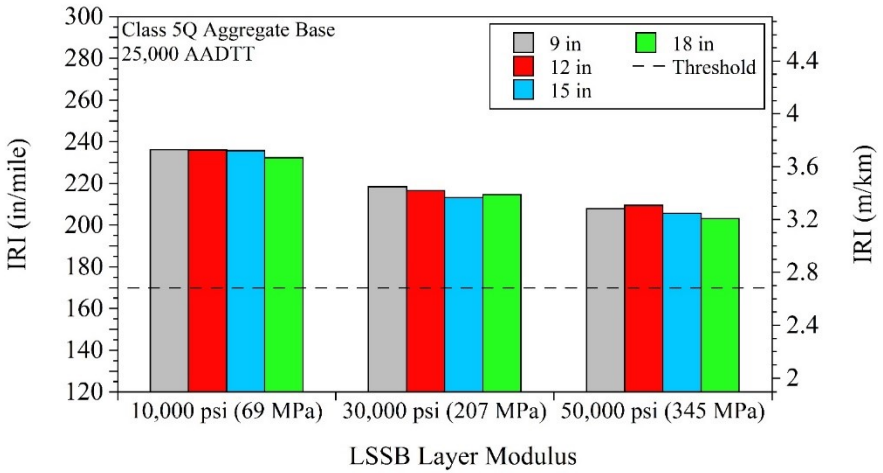

Class 5Q Aggregate Base
7,500 AADTT
9 in
12 in
15 in
18 in
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
0
0.5
1
1.5
2
0
10
20
30
40
50
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

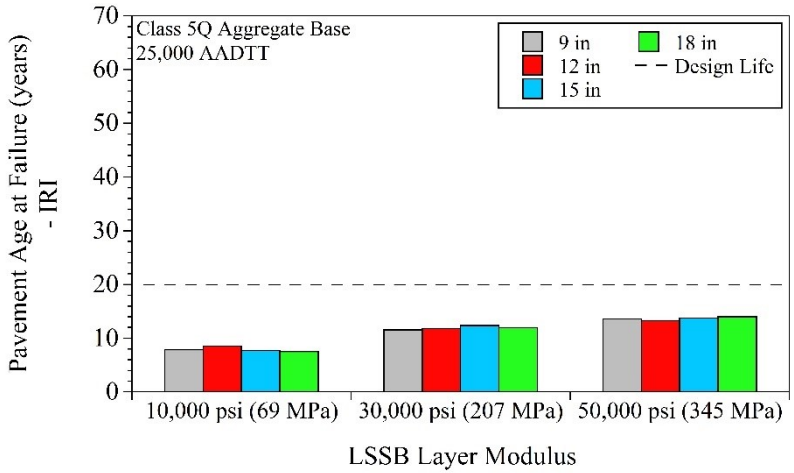

Class 5Q Aggregate Base
7,500 AADTT
9 in
12 in
15 in
18 in
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
0
10
20
30
40
50
60
70
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

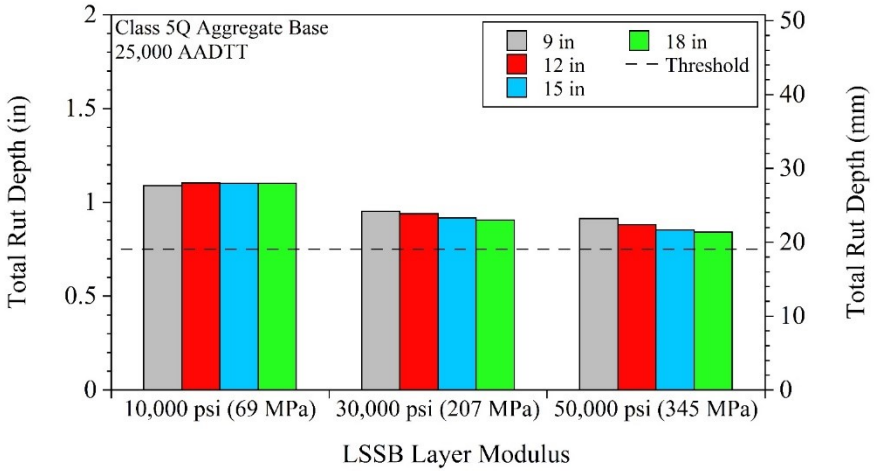

Class 5Q Aggregate Base
7,500 AADTT
9 in
12 in
15 in
18 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

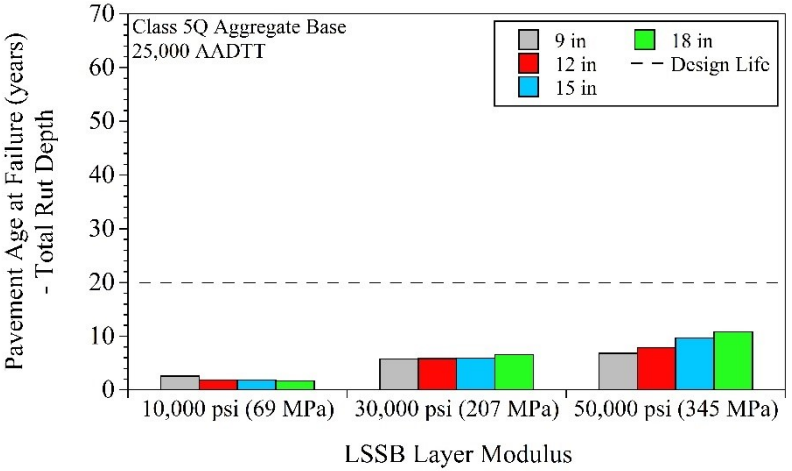

Class 5Q Aggregate Base
7,500 AADTT
9 in
12 in
15 in
18 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

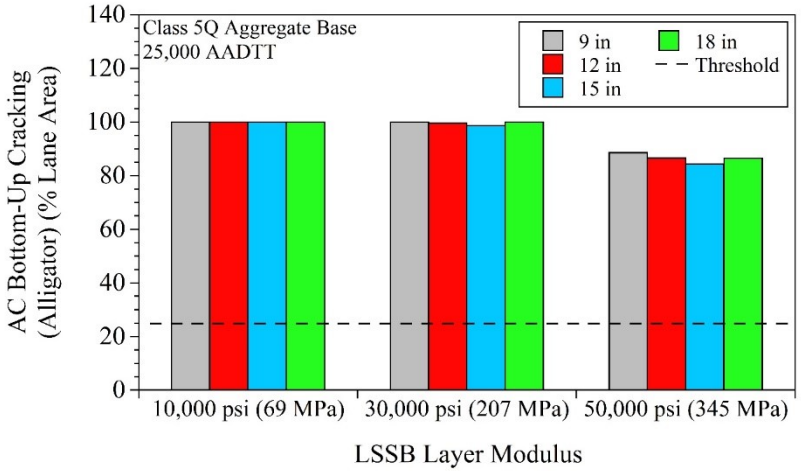
For pavement models that contained Class 5Q Aggregate base - 25,000 AADTT:

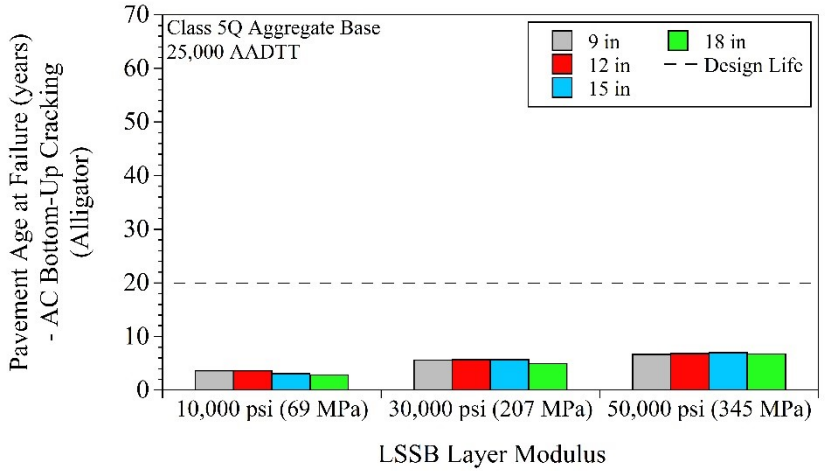






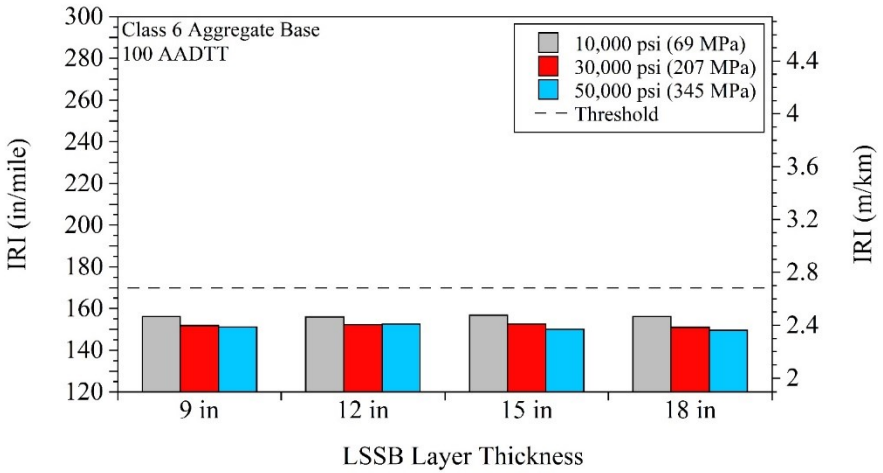


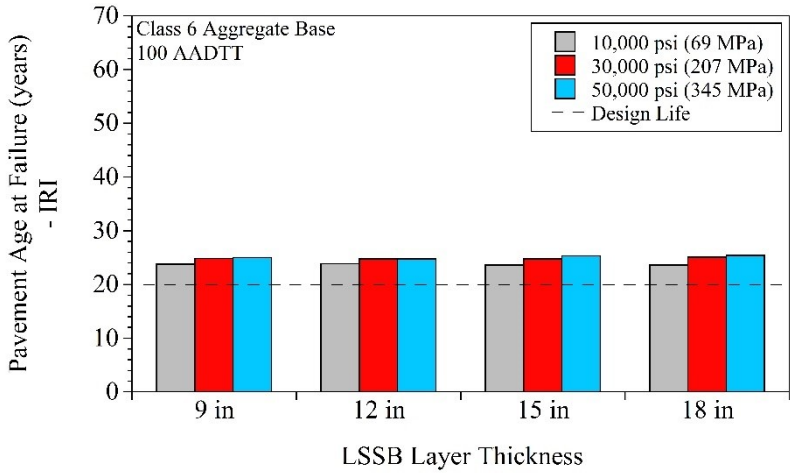

Class 5Q Aggregate Base
25,000 AADTT
9 in
12 in
15 in
18 in
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

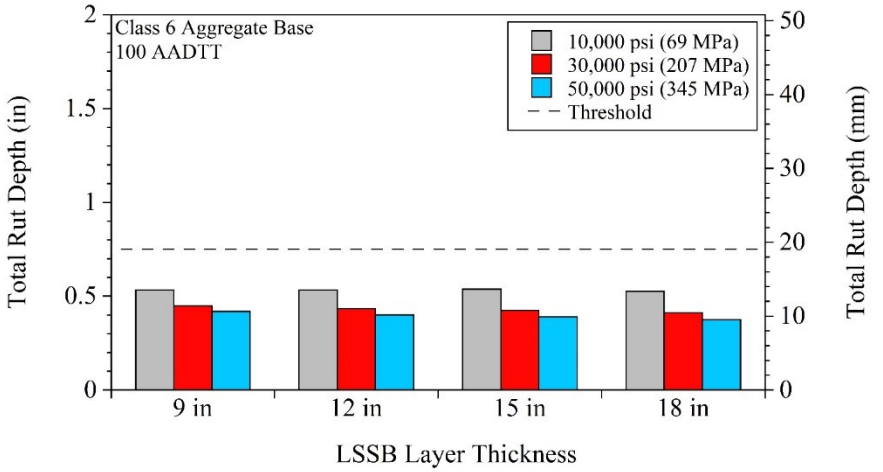

Class 5Q Aggregate Base
25,000 AADTT
9 in
12 in
15 in
18 in
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
LSSB Layer Modulus

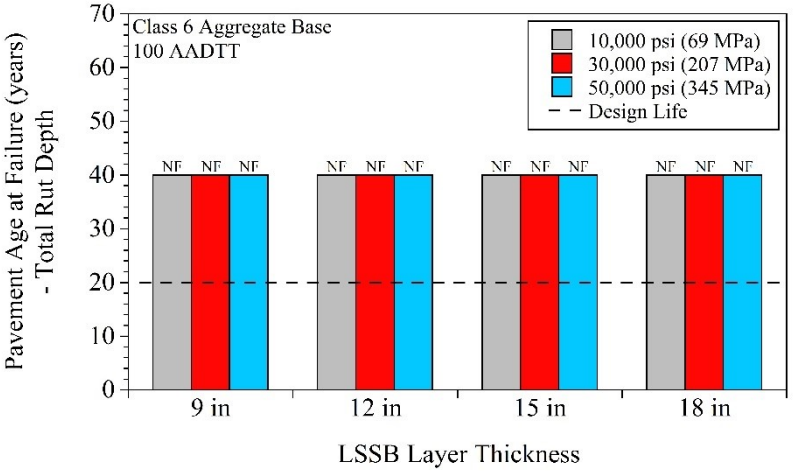
APPENDIX BH
EFFECT OF LARGE STONE SUBBASE (LSSB) LAYER MODULUS ON PAVEMENT PERFORMANCE PREDICTIONS

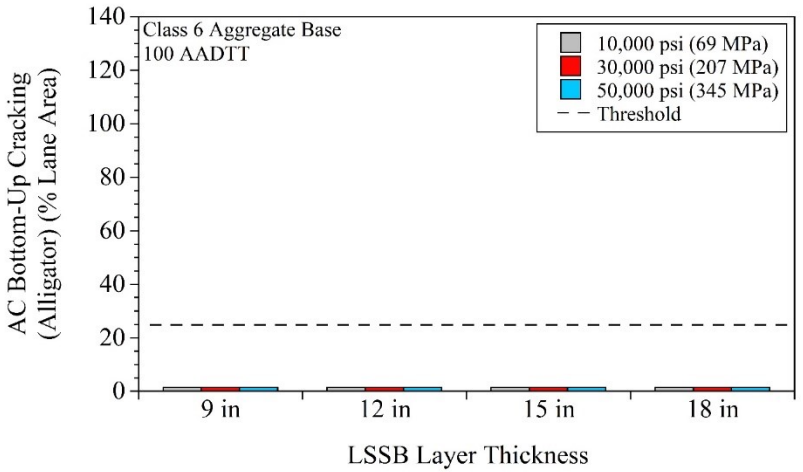
For pavement models that contained Class 6 Aggregate base - 100 AADTT:

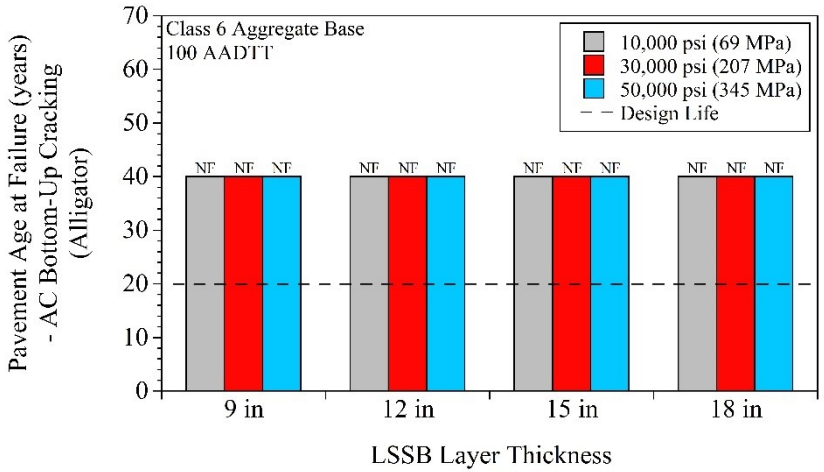




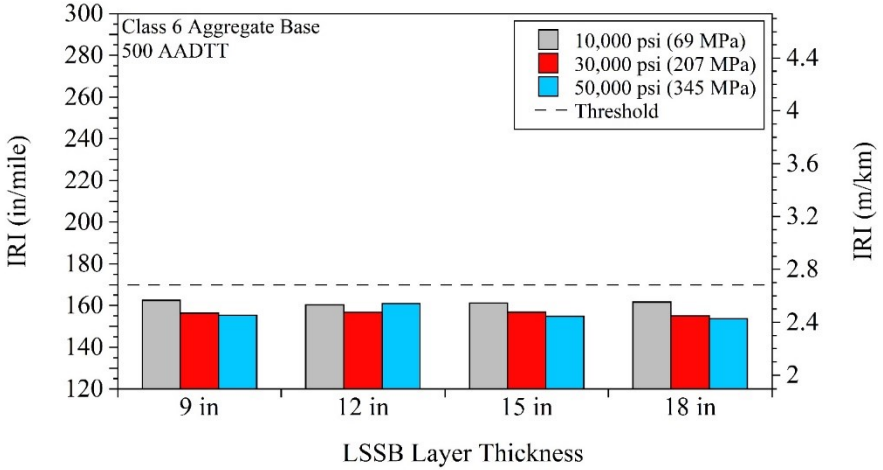


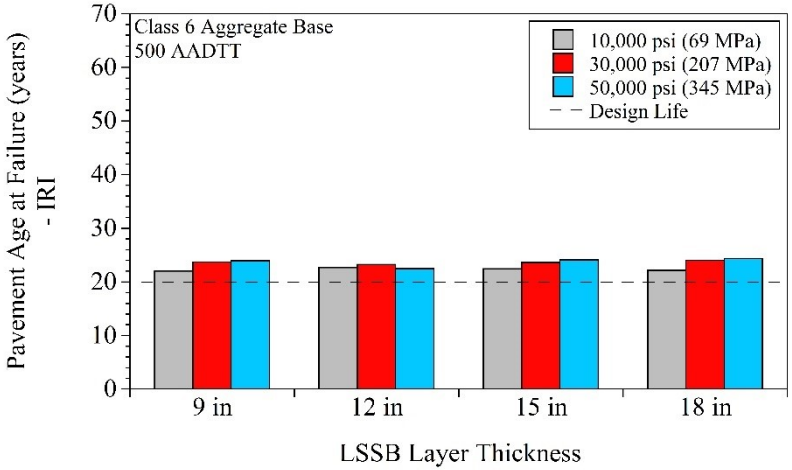


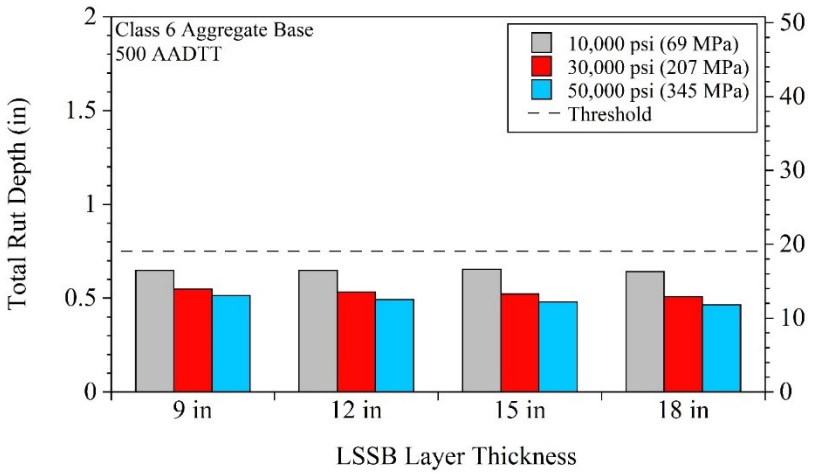


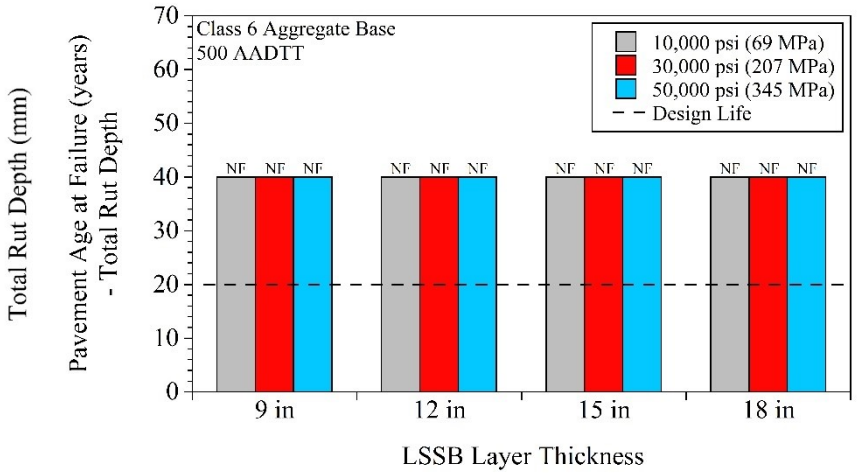


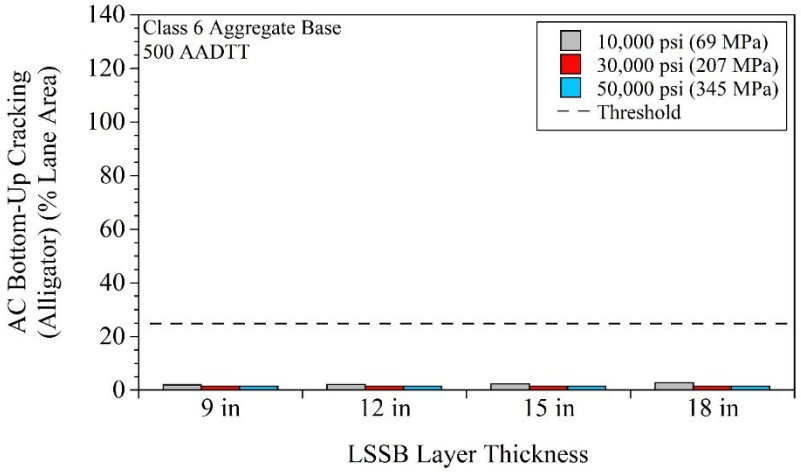
For pavement models that contained Class 6 Aggregate base - 500 AADTT:

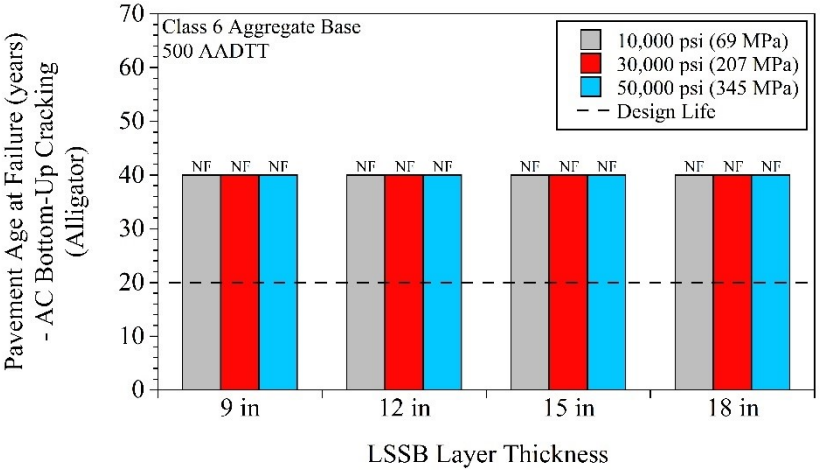




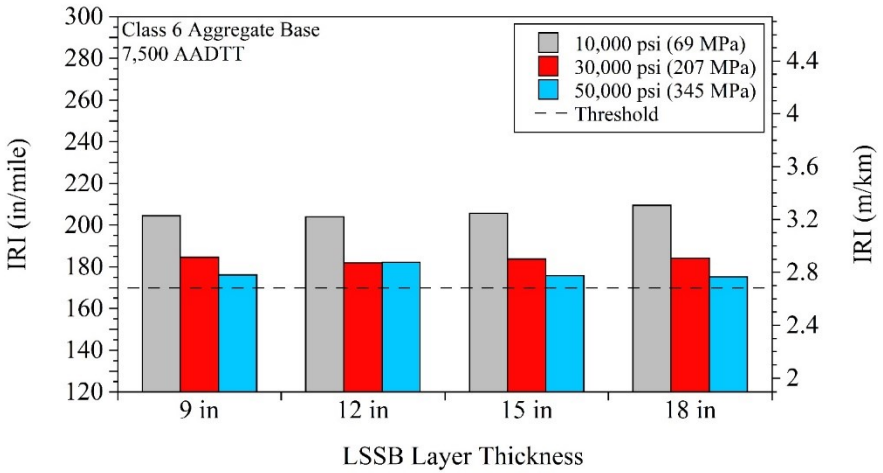

Class 6 Aggregate Base
500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
9 in
12 in
15 in
18 in
LSSB Layer Thickness

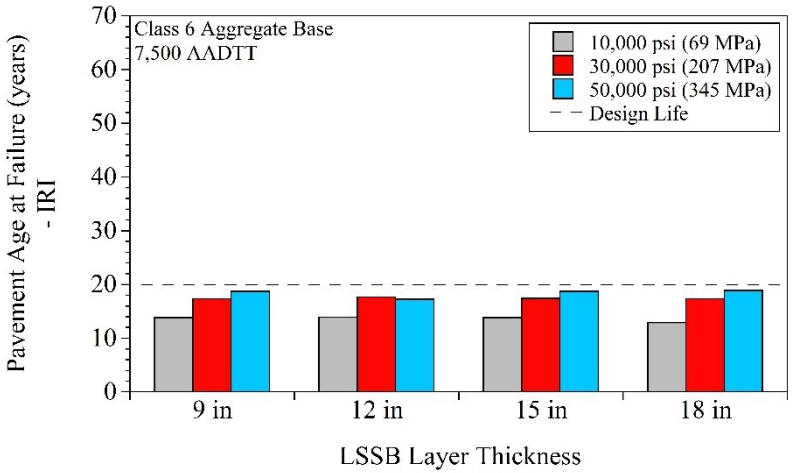

Class 6 Aggregate Base
500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
NF
9 in
12 in
15 in
18 in
LSSB Layer Thickness

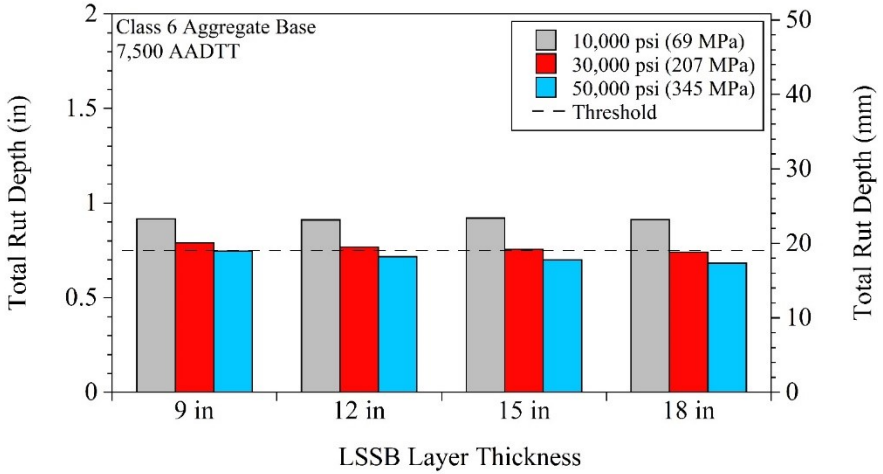

Class 6 Aggregate Base
500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
9 in
12 in
15 in
18 in
LSSB Layer Thickness

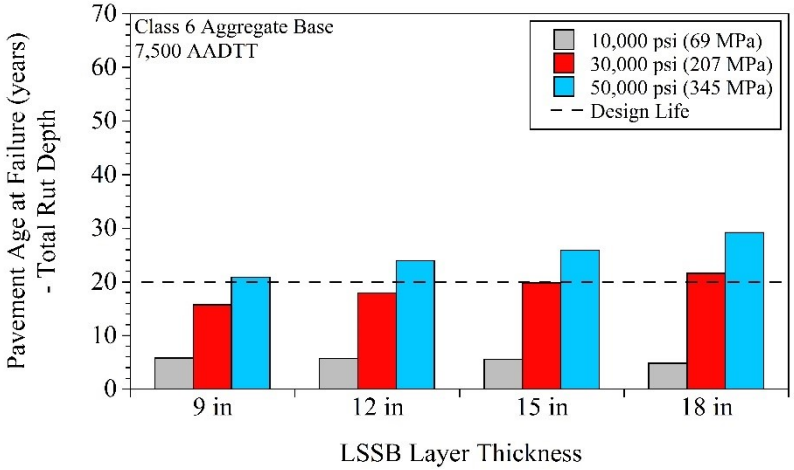

Class 6 Aggregate Base
500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
NF
9 in
12 in
15 in
18 in
LSSB Layer Thickness

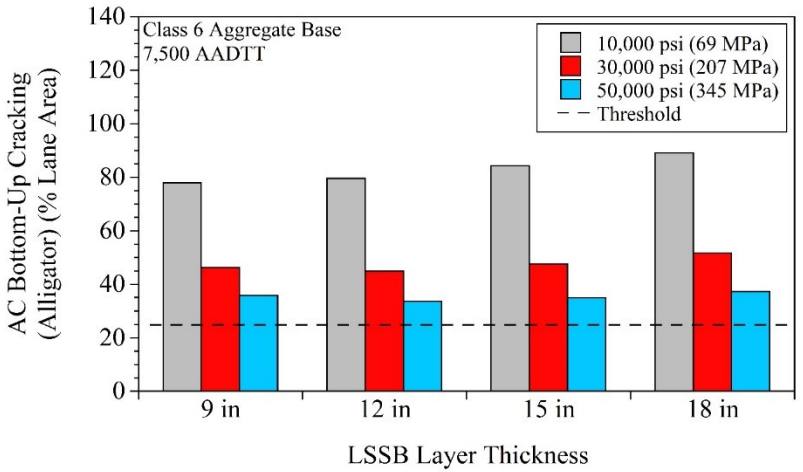
For pavement models that contained Class 6 Aggregate base - 7,500 AADTT:

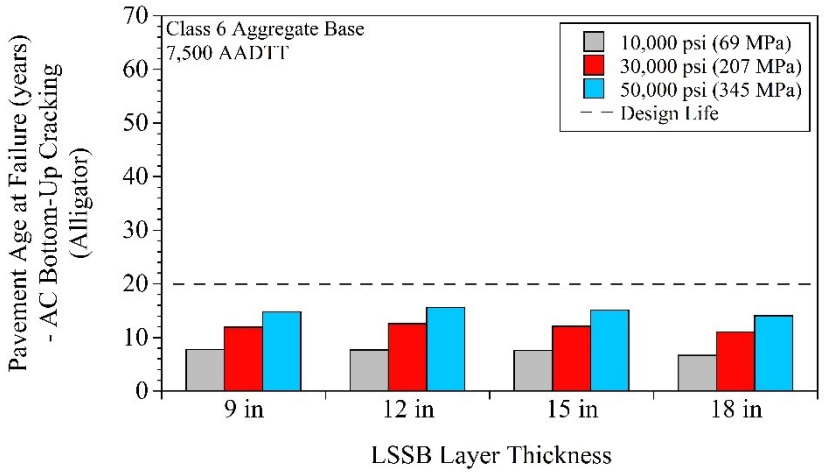




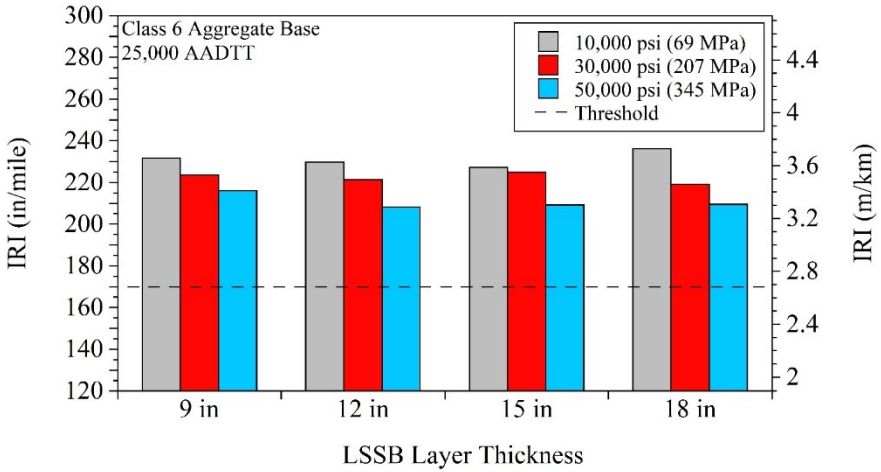


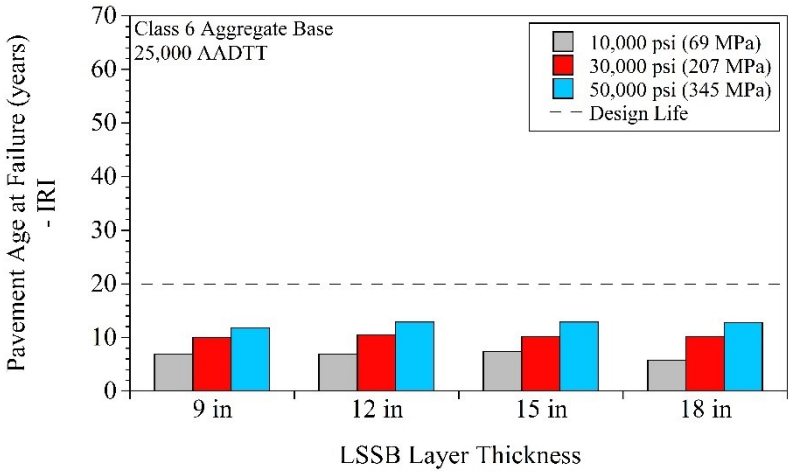


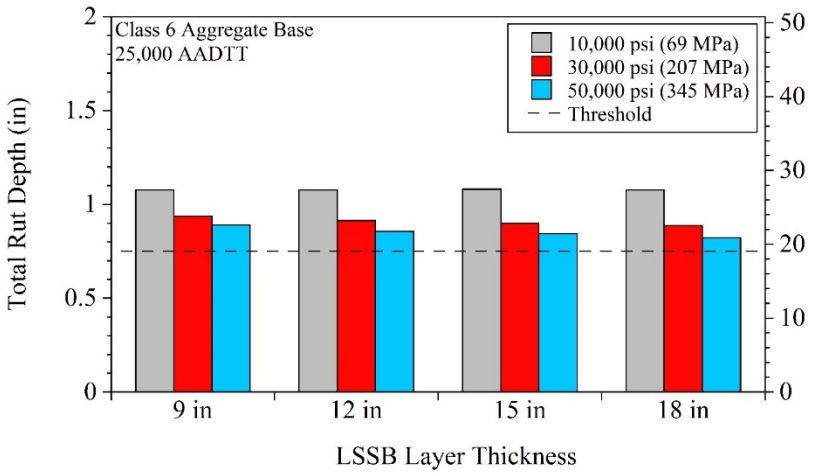


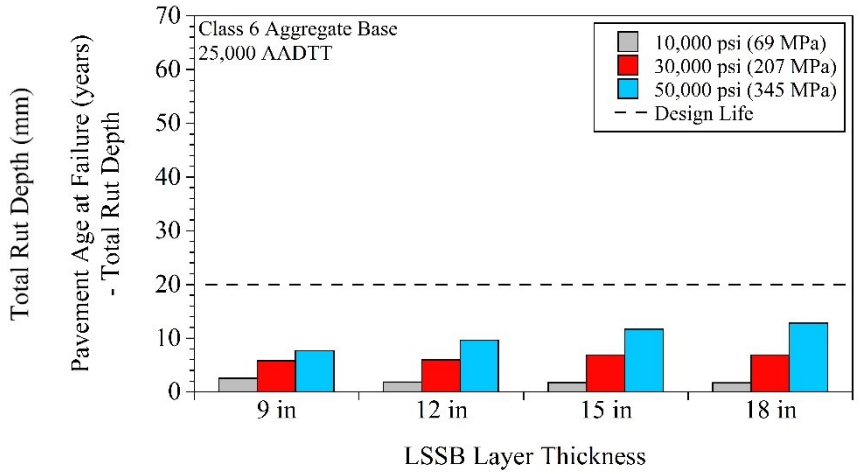


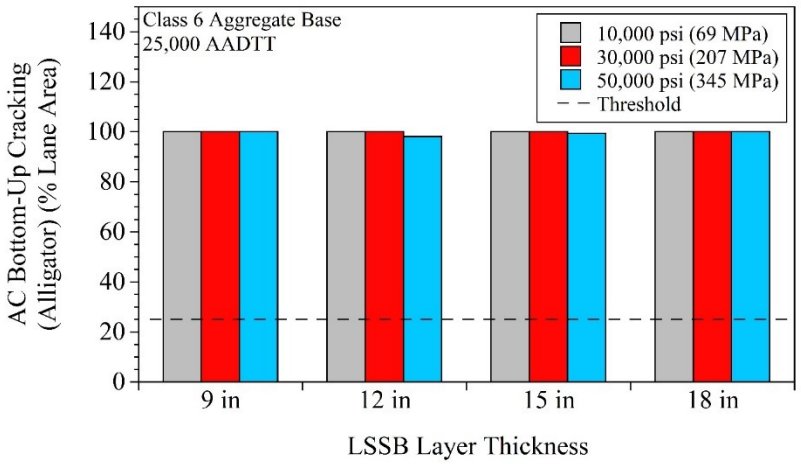
For pavement models that contained Class 6 Aggregate base - 25,000 AADTT:

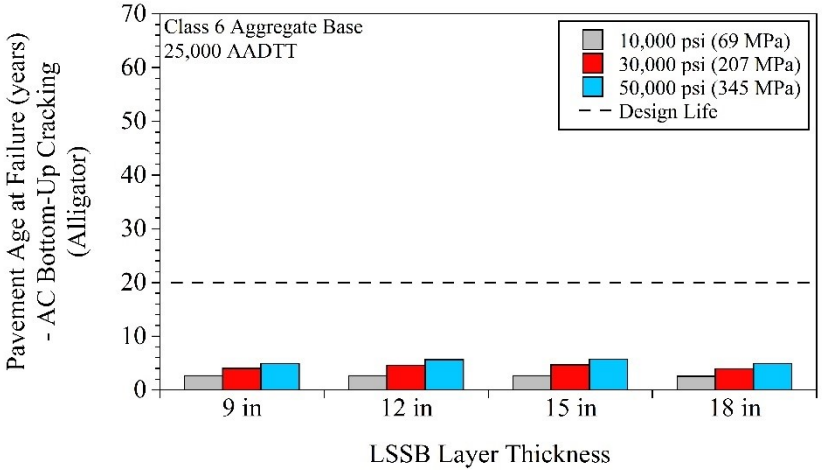




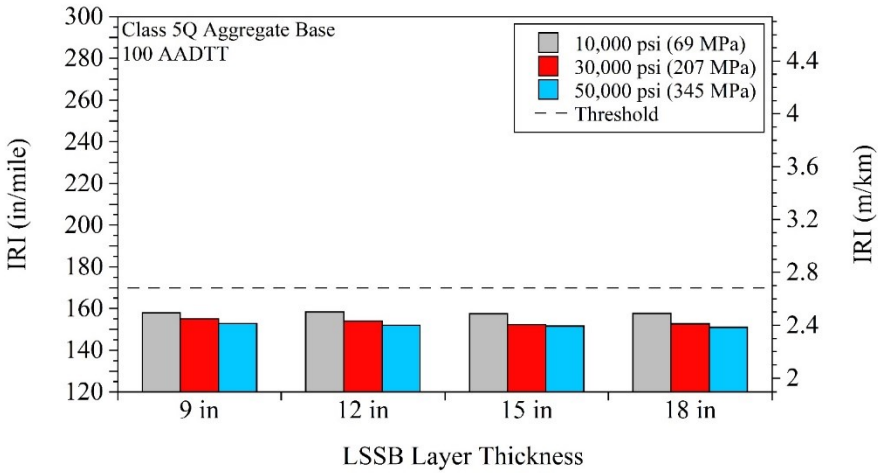

Class 6 Aggregate Base
25,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
0
0.5
1
1.5
2
0
10
20
30
40
50
9 in
12 in
15 in
18 in
LSSB Layer Thickness

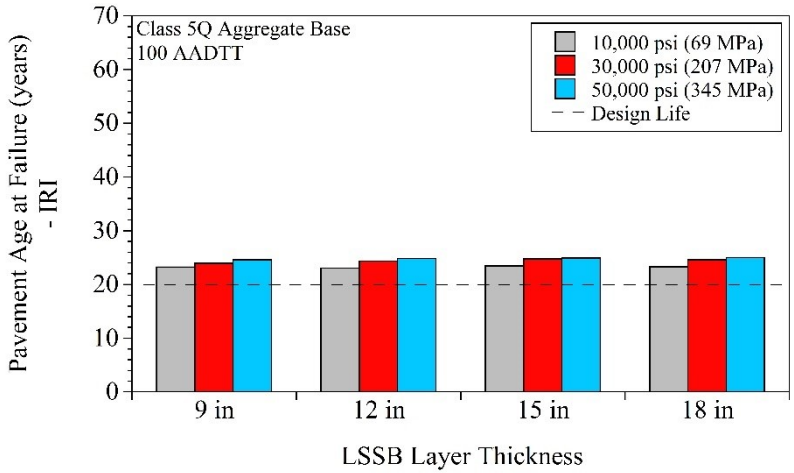

Class 6 Aggregate Base
25,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
0
10
20
30
40
50
60
70
9 in
12 in
15 in
18 in
LSSB Layer Thickness

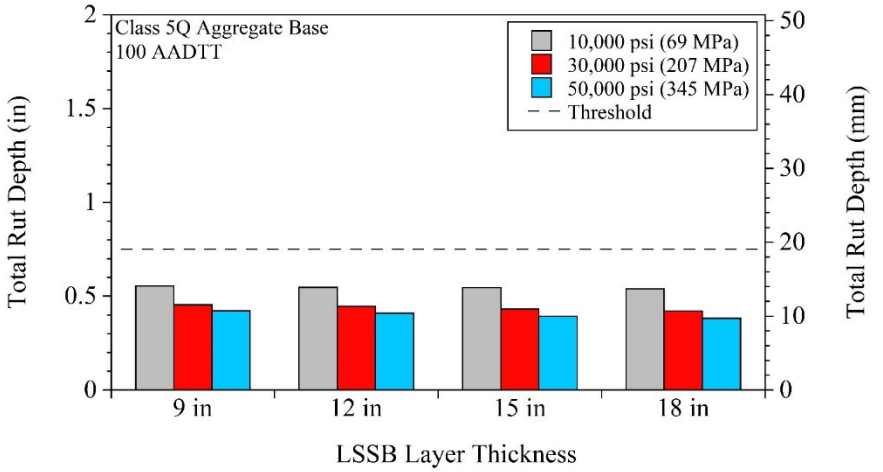

Class 6 Aggregate Base
25,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
9 in
12 in
15 in
18 in
LSSB Layer Thickness

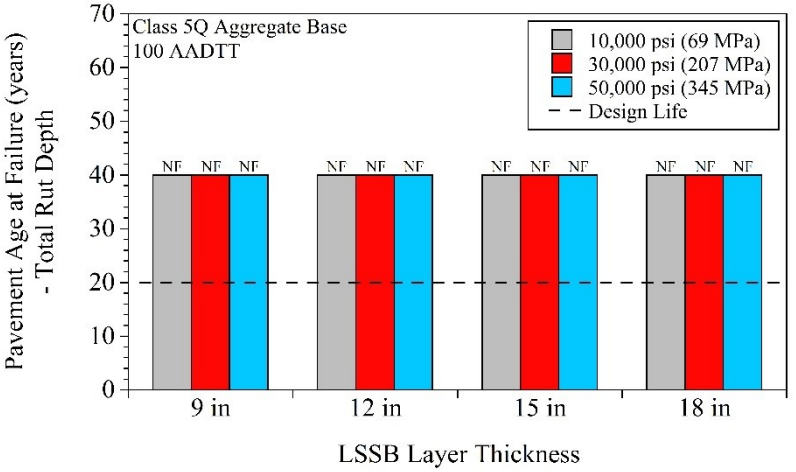

Class 6 Aggregate Base
25,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
9 in
12 in
15 in
18 in
LSSB Layer Thickness

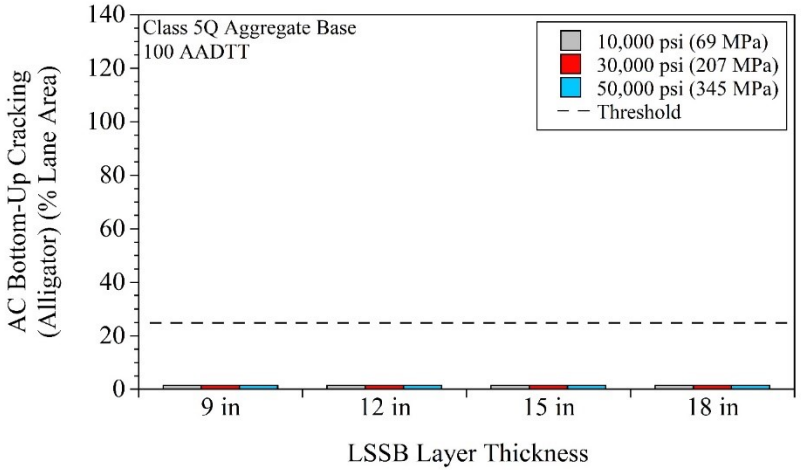
For pavement models that contained Class 5Q Aggregate base - 100 AADTT:

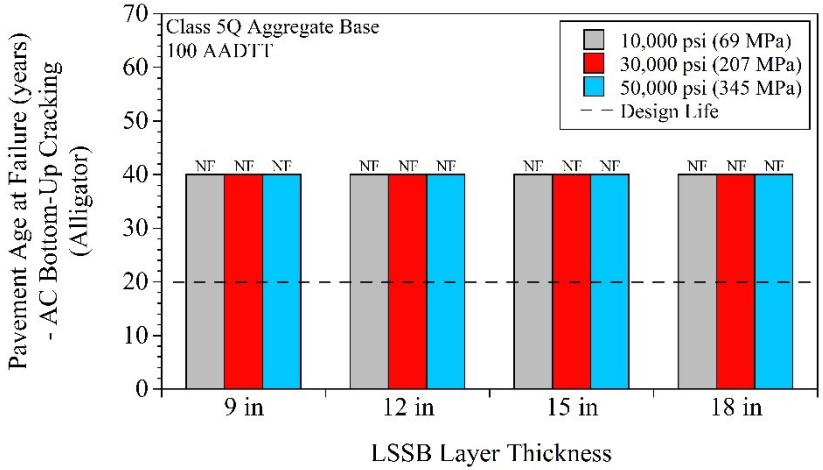




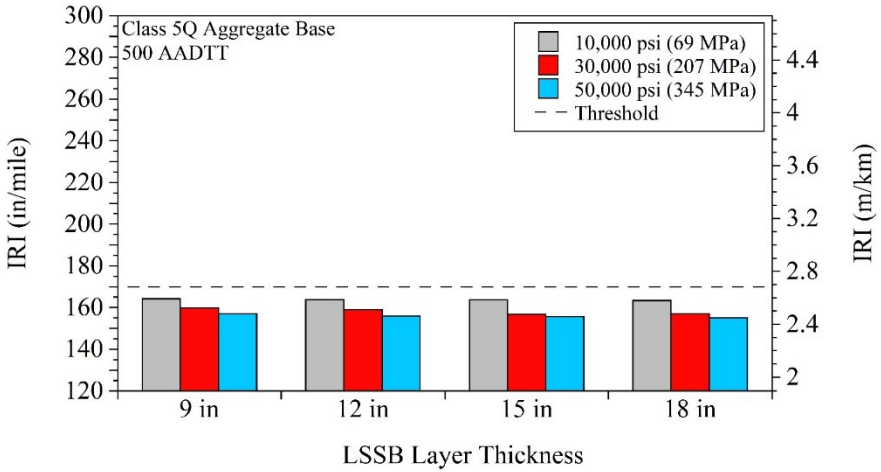


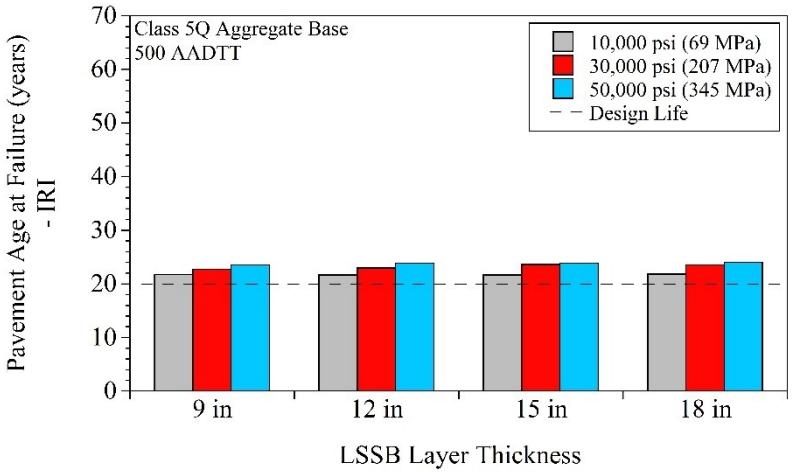


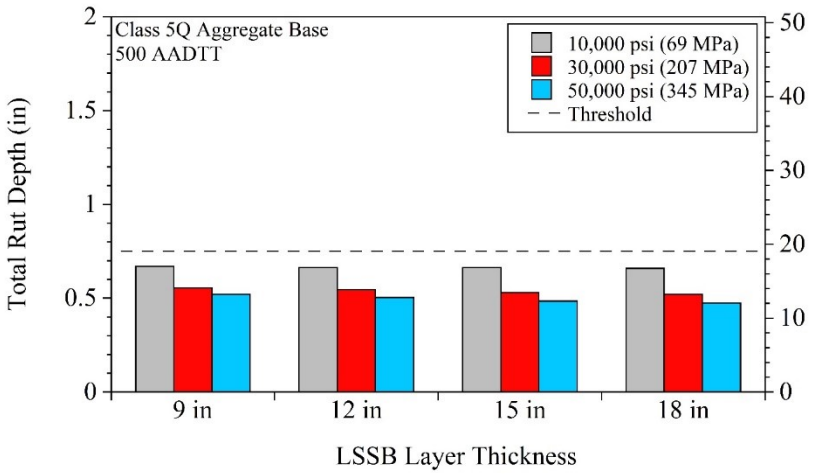


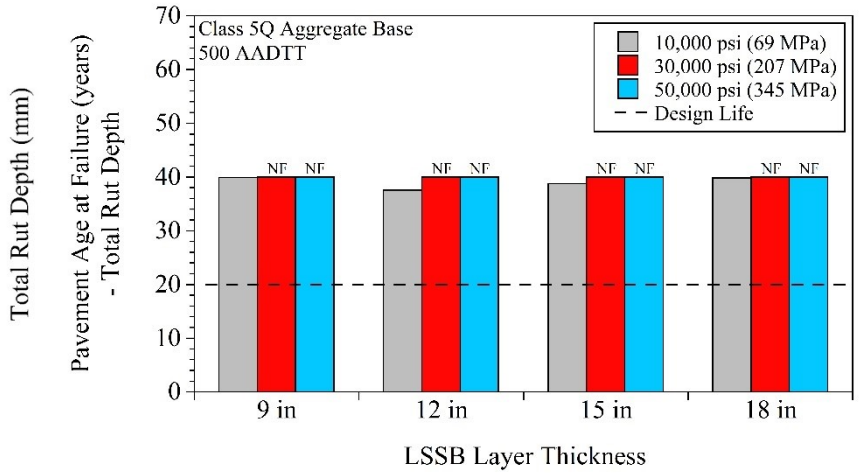


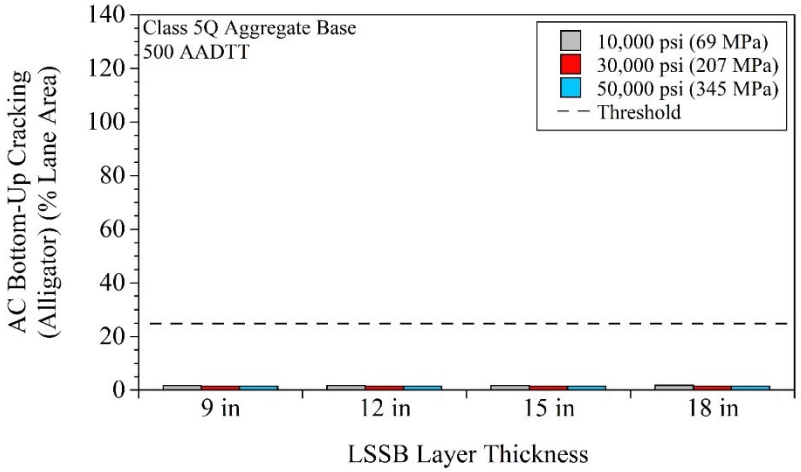
For pavement models that contained Class 5Q Aggregate base - 500 AADTT:

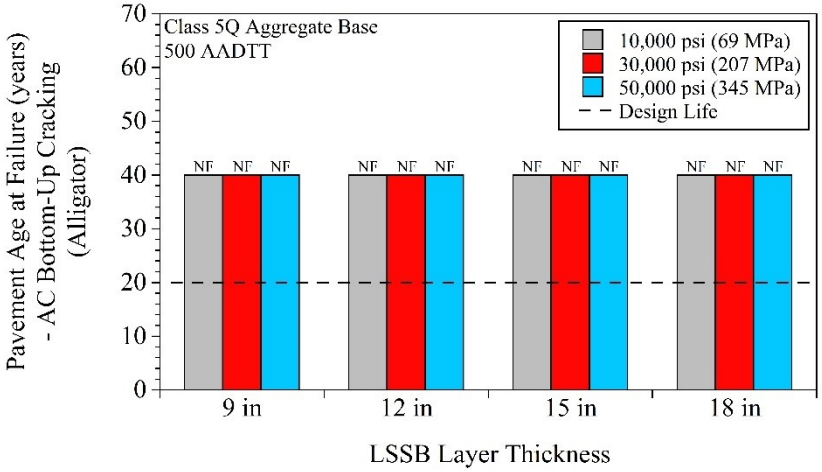




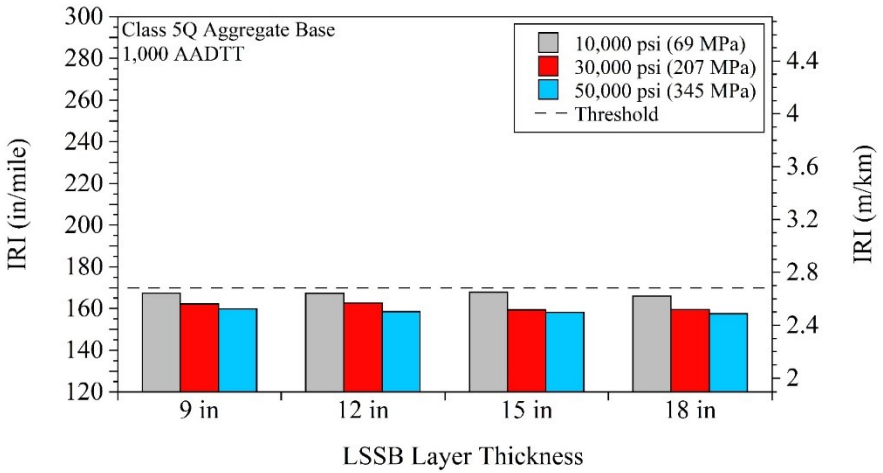

Class 5Q Aggregate Base
500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
0
0.5
1
1.5
2
0
10
20
30
40
50
9 in
12 in
15 in
18 in
LSSB Layer Thickness

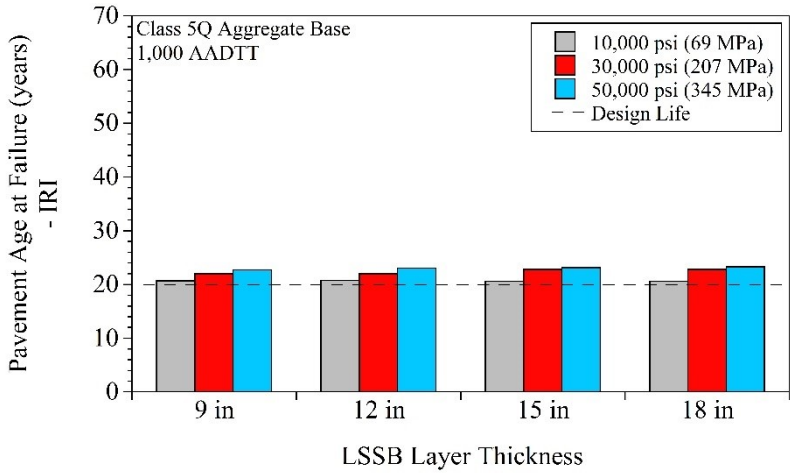

Class 5Q Aggregate Base
500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
NF
0
10
20
30
40
50
60
70
9 in
12 in
15 in
18 in
LSSB Layer Thickness

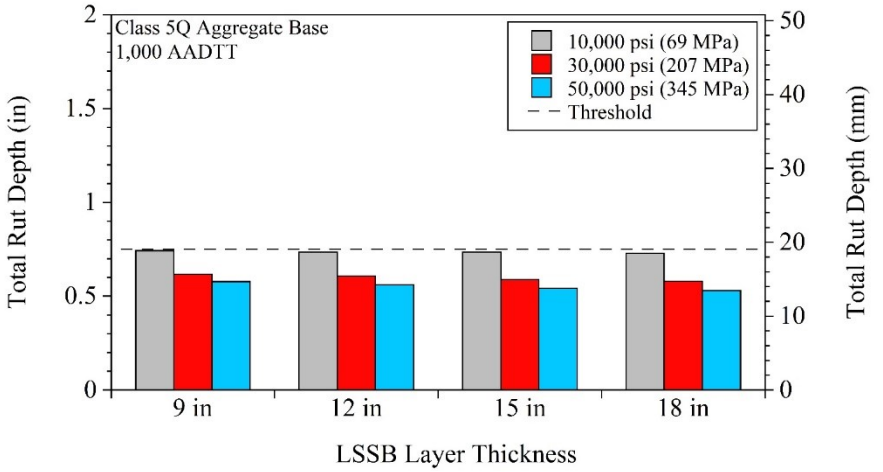

Class 5Q Aggregate Base
500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
9 in
12 in
15 in
18 in
LSSB Layer Thickness

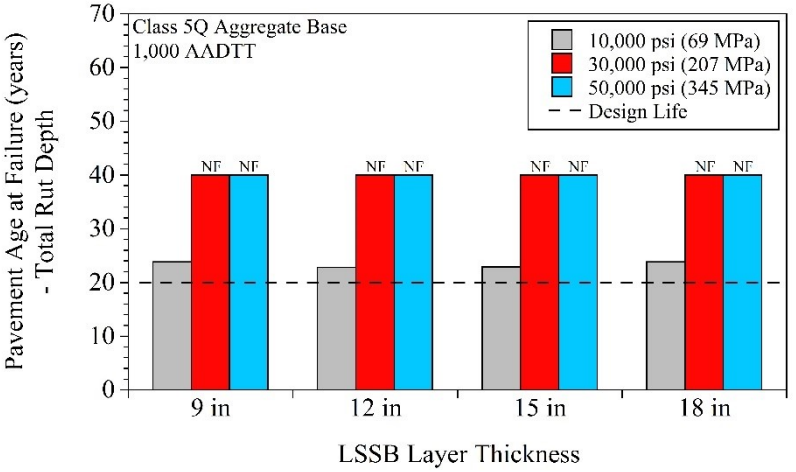

Class 5Q Aggregate Base
500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
NF
0
10
20
30
40
50
60
70
9 in
12 in
15 in
18 in
LSSB Layer Thickness

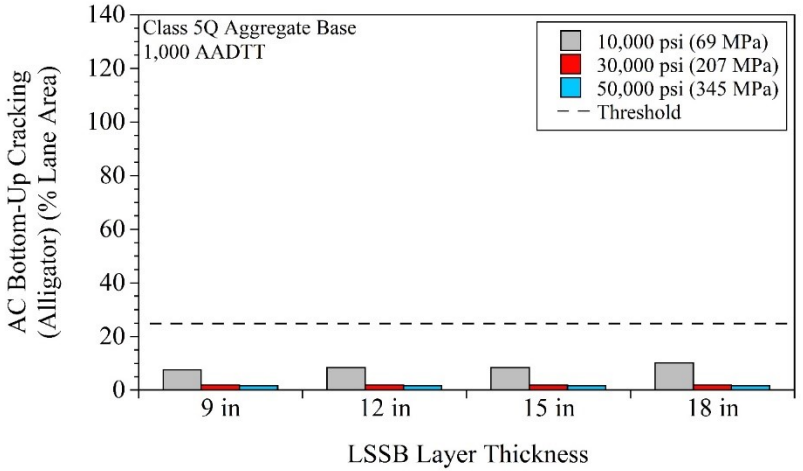
For pavement models that contained Class 5Q Aggregate base - 1,000 AADTT:

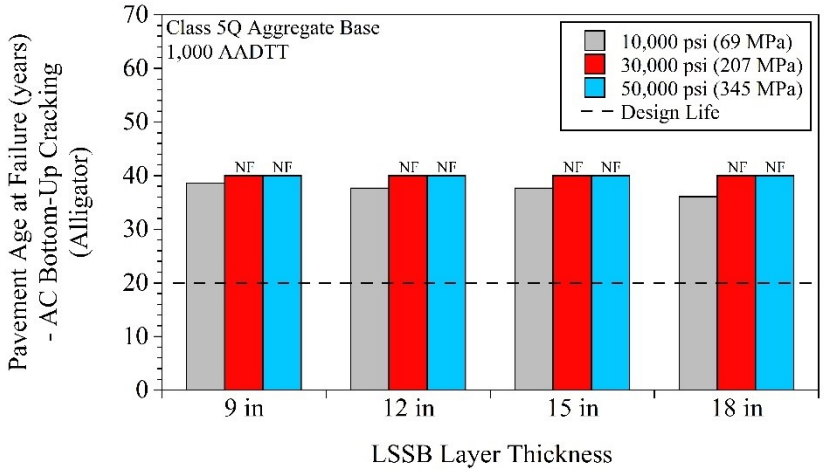




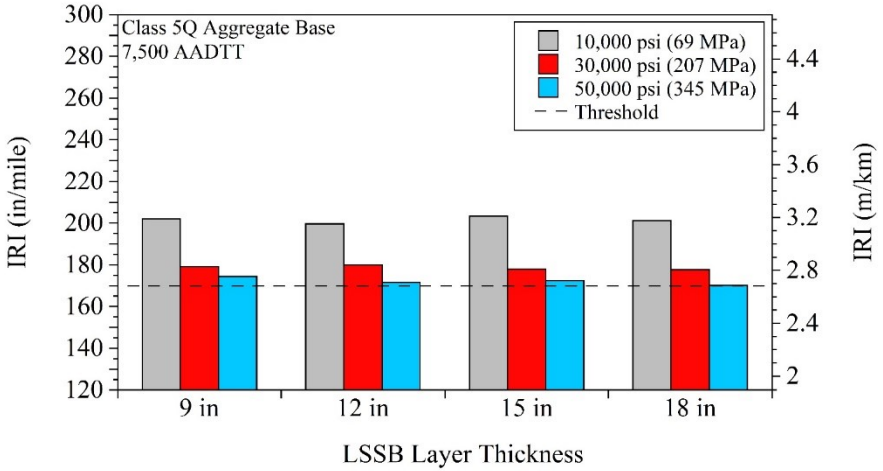


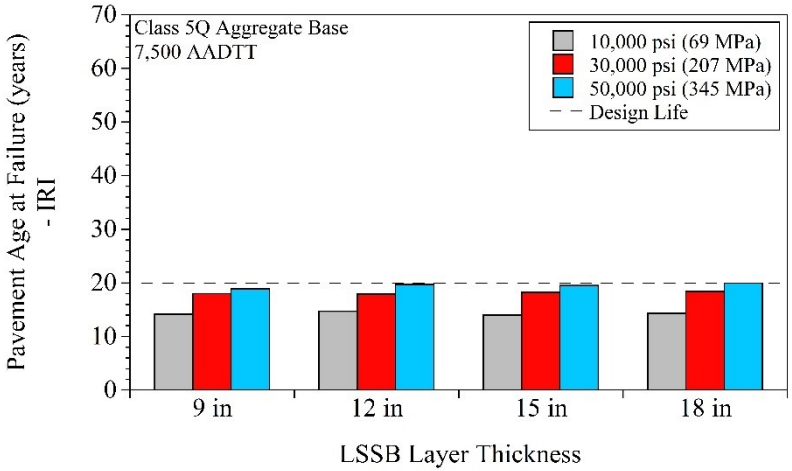


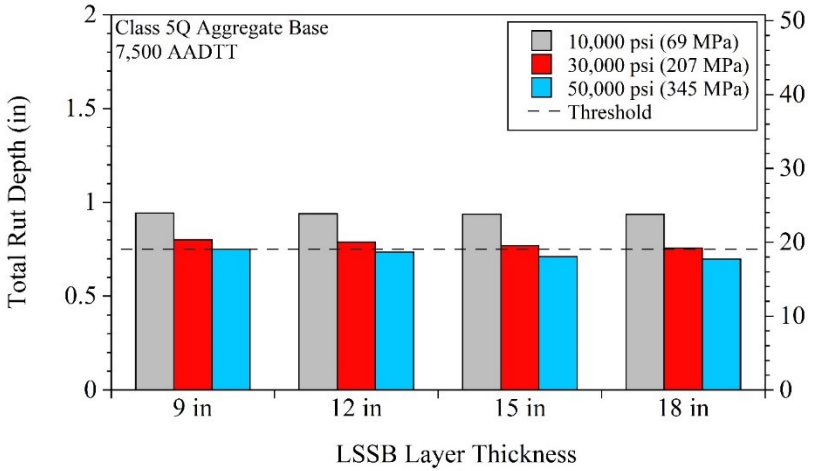


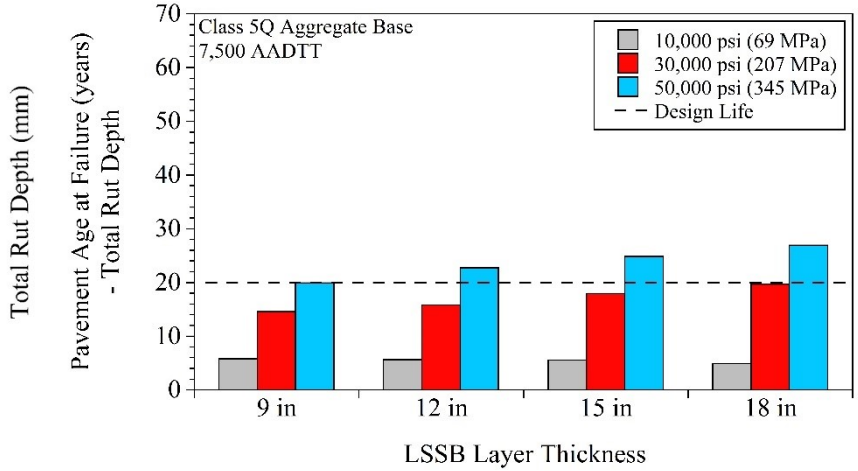


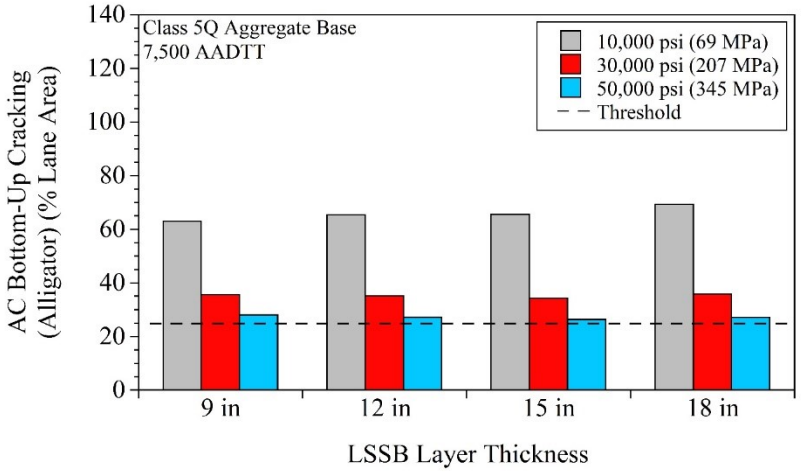
For pavement models that contained Class 5Q Aggregate base - 7,500 AADTT:

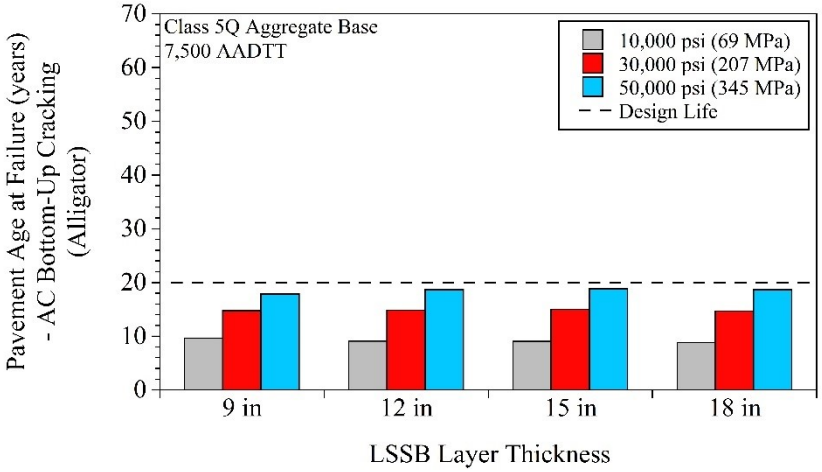




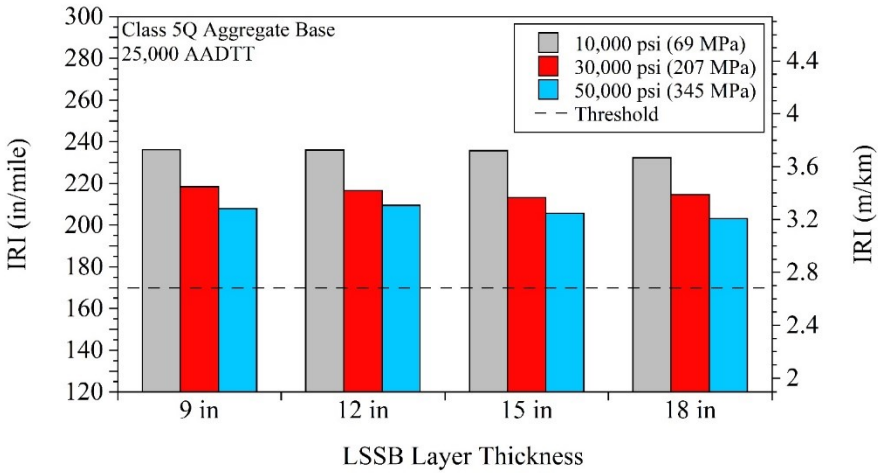

Class 5Q Aggregate Base
7,500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
9 in
12 in
15 in
18 in
LSSB Layer Thickness

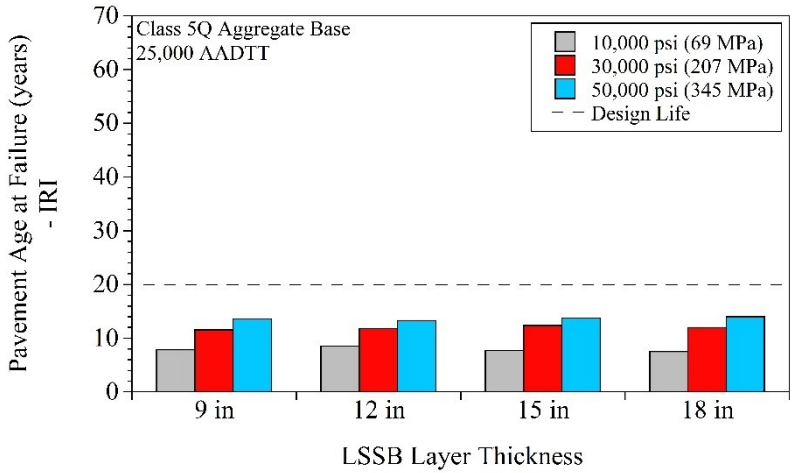

Class 5Q Aggregate Base
7,500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Design Life
Pavement Age at Failure (years)
- Total Rut Depth
9 in
12 in
15 in
18 in
LSSB Layer Thickness

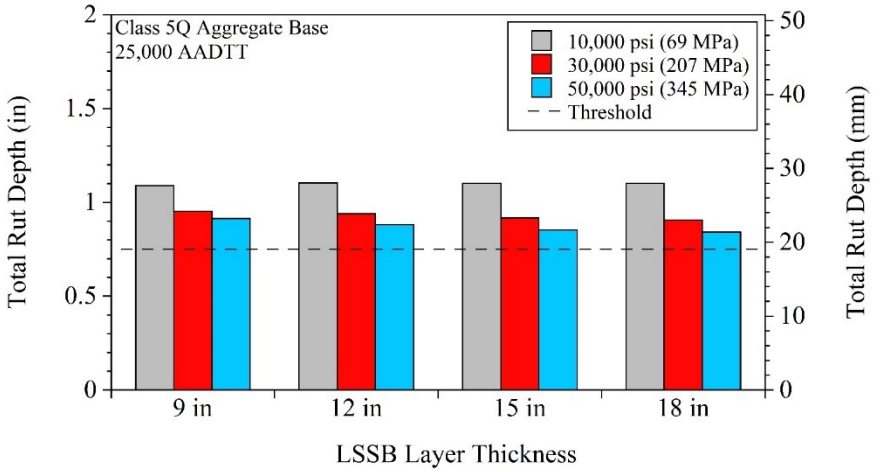

Class 5Q Aggregate Base
7,500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
9 in
12 in
15 in
18 in
LSSB Layer Thickness

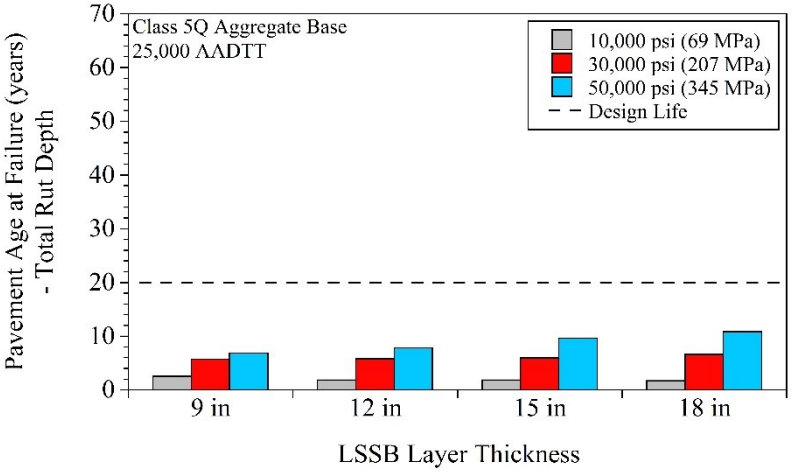

Class 5Q Aggregate Base
7,500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
9 in
12 in
15 in
18 in
LSSB Layer Thickness

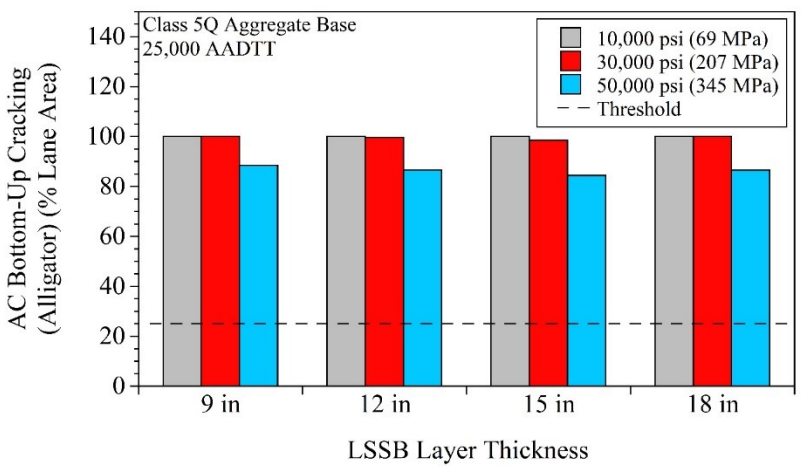
For pavement models that contained Class 5Q Aggregate base - 25,000 AADTT:

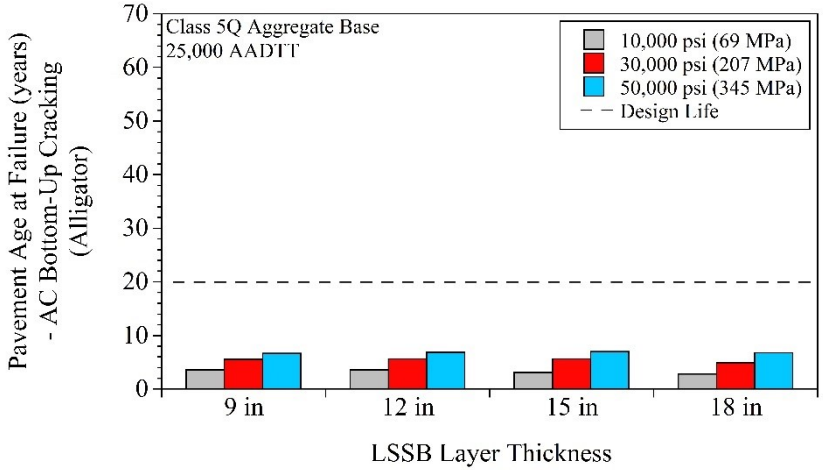






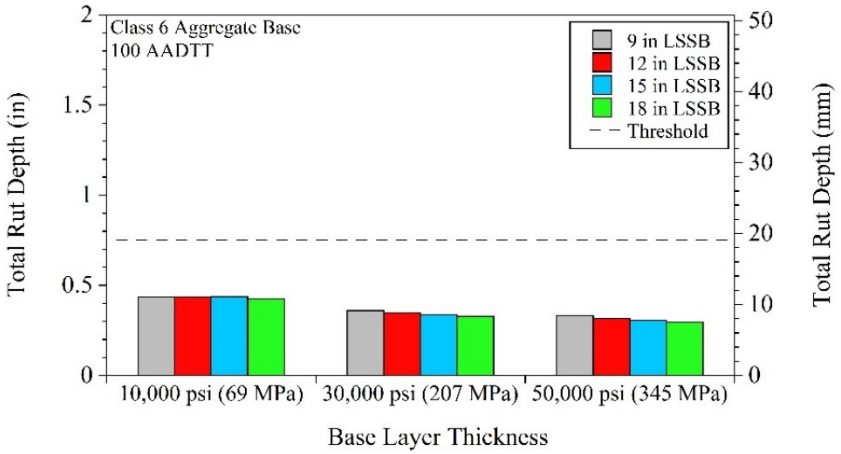


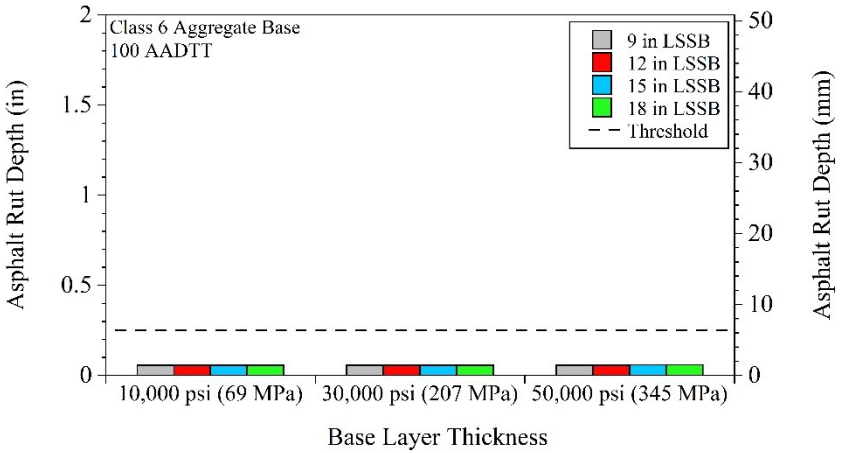

Class 5Q Aggregate Base
25,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
9 in
12 in
15 in
18 in
LSSB Layer Thickness

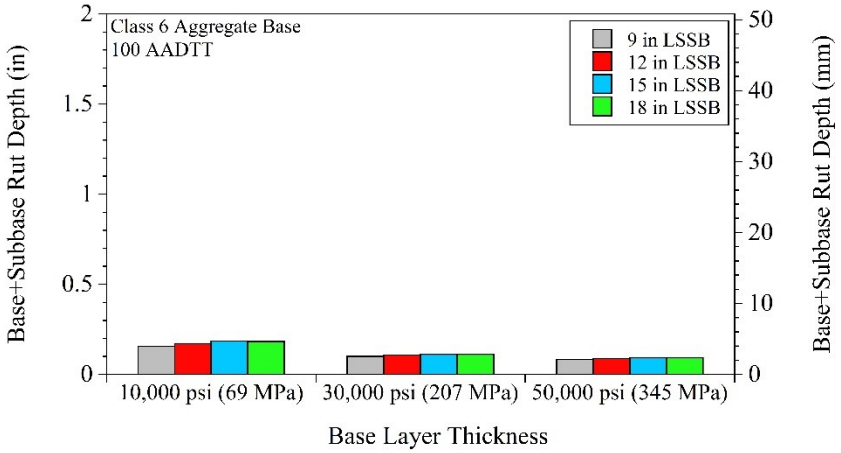

Class 5Q Aggregate Base
25,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Design Life
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
0
10
20
30
40
50
60
70
9 in
12 in
15 in
18 in
LSSB Layer Thickness

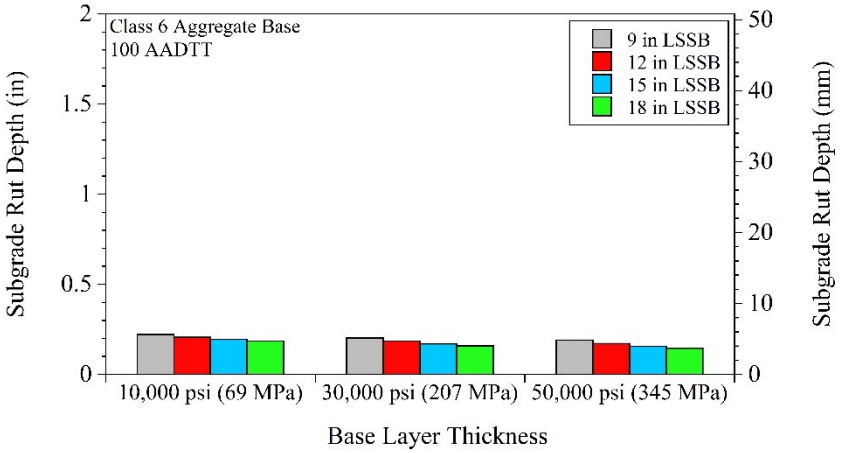
APPENDIX BI
TOTAL, ASPHALT, BASE+SUBBASE, AND SUBGRADE LAYER RUTTING AT 50% RELIABILITY FOR LARGE STONE SUBBASE (LSSB) GROUPS

For pavements that contained Class 6 Aggregate - 100 AADTT:

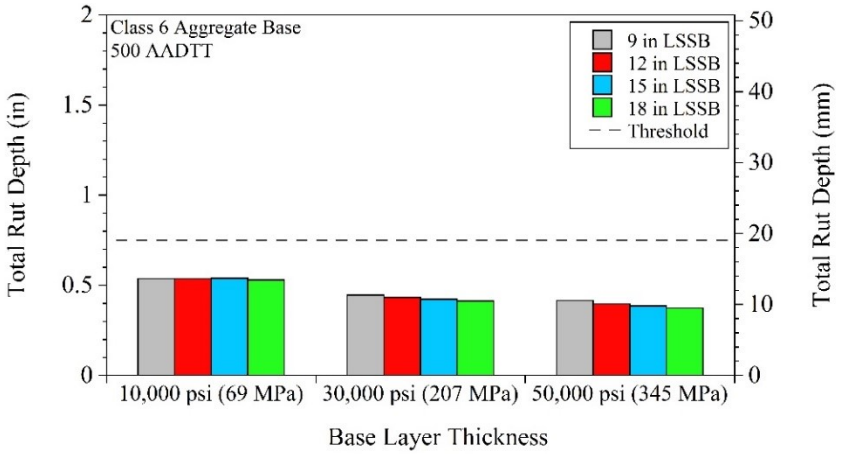


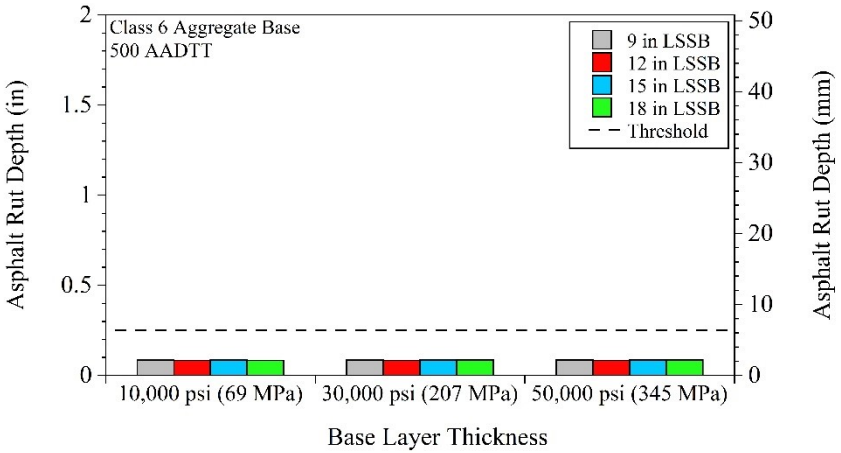


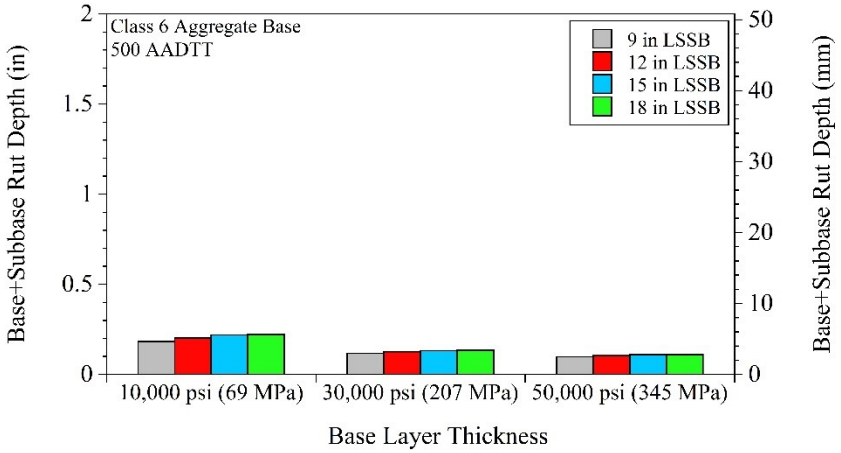


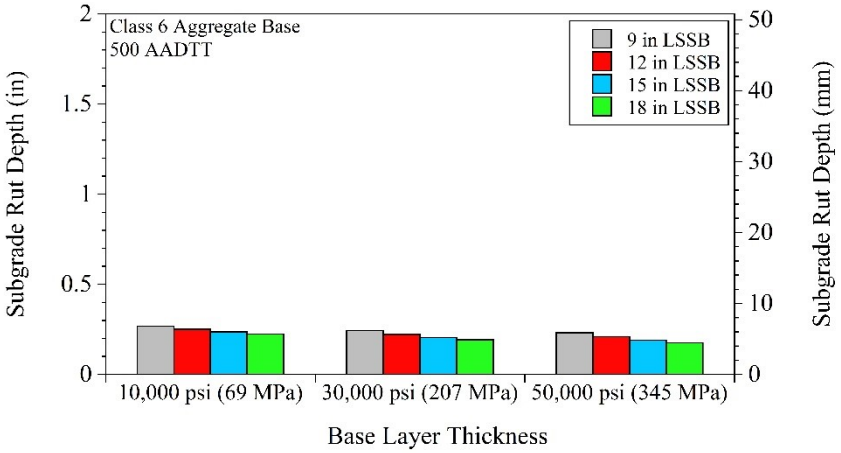


For pavements that contained Class 6 Aggregate - 500 AADTT:

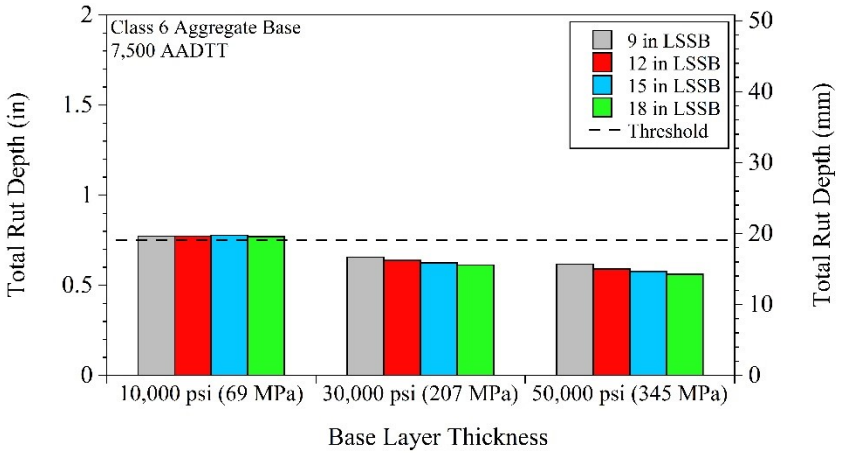


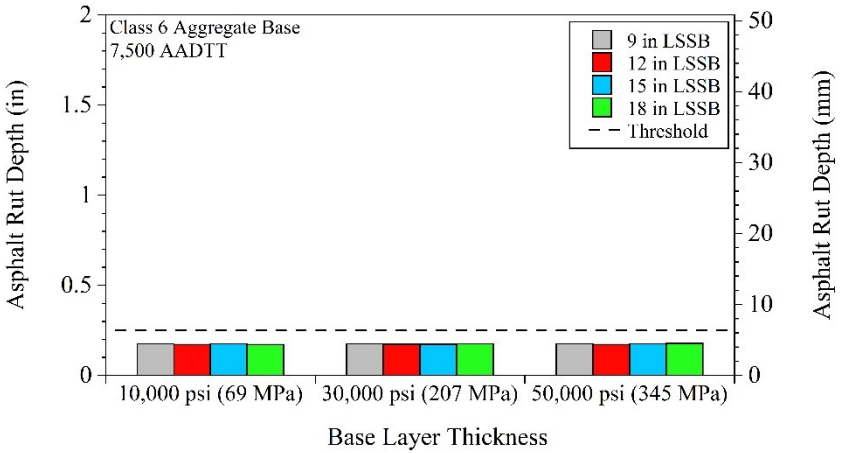


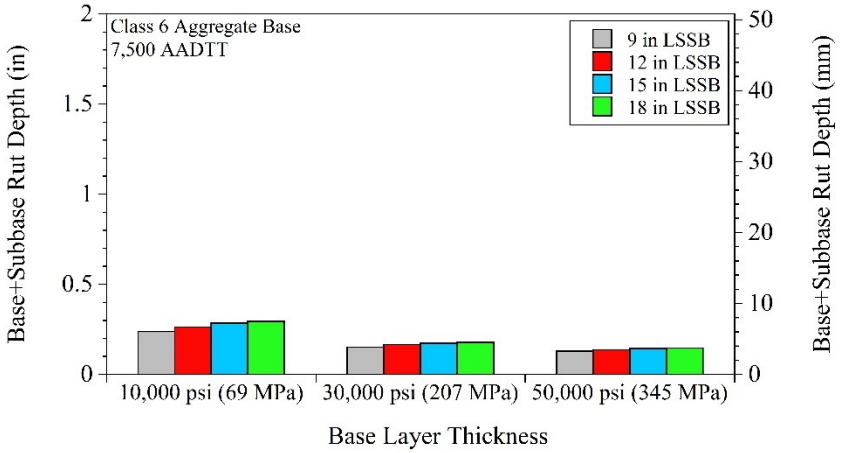


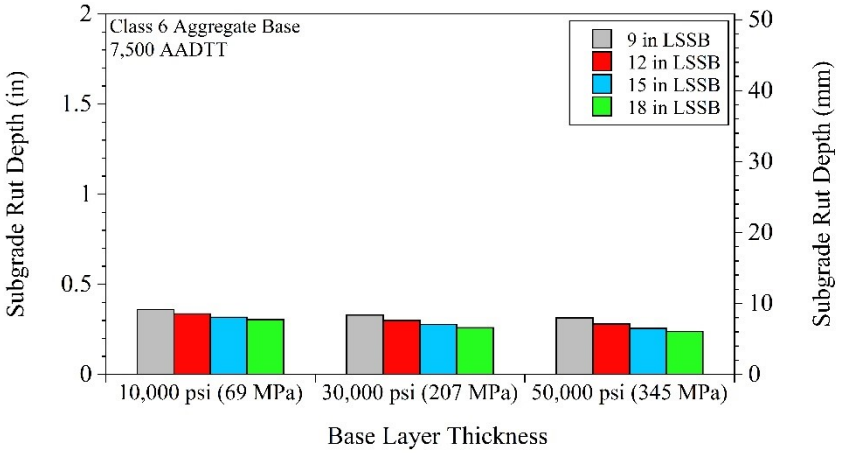


For pavements that contained Class 6 Aggregate - 7,500 AADTT:

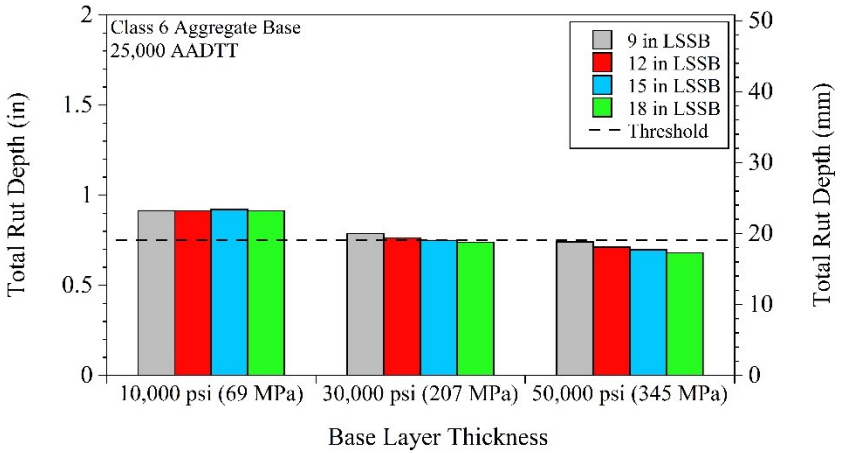


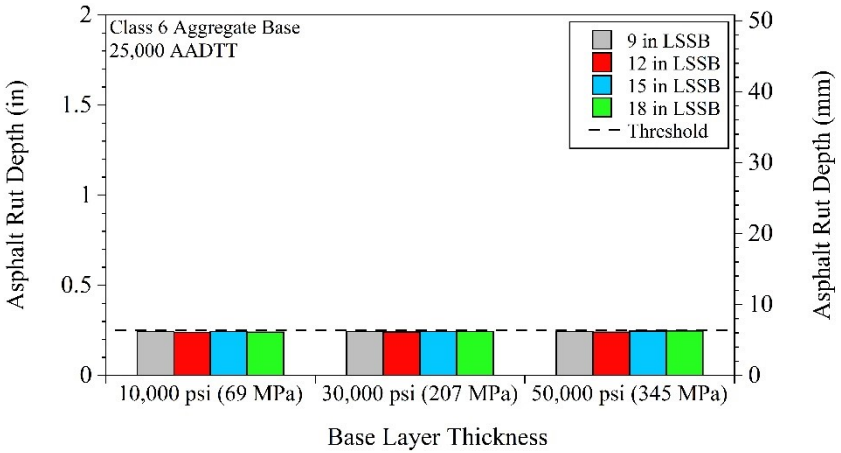


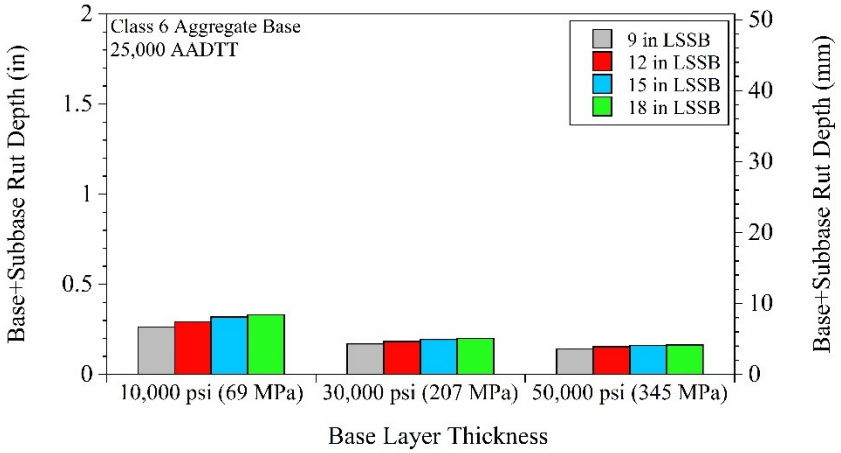


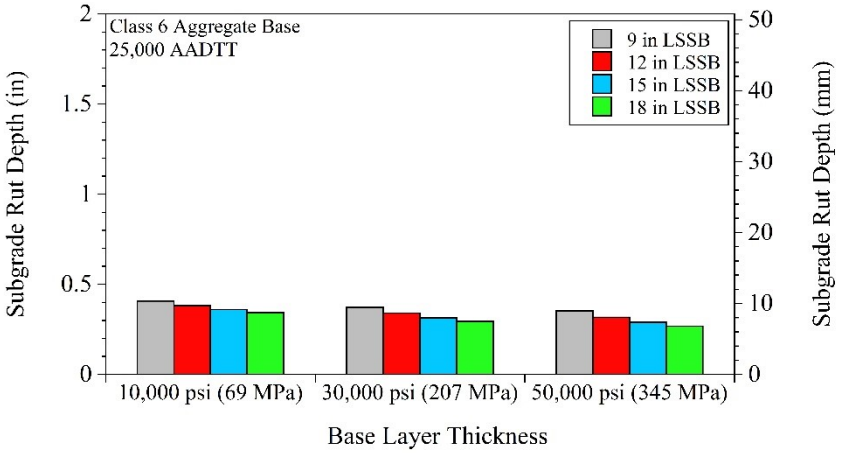


For pavements that contained Class 6 Aggregate - 25,000 AADTT:

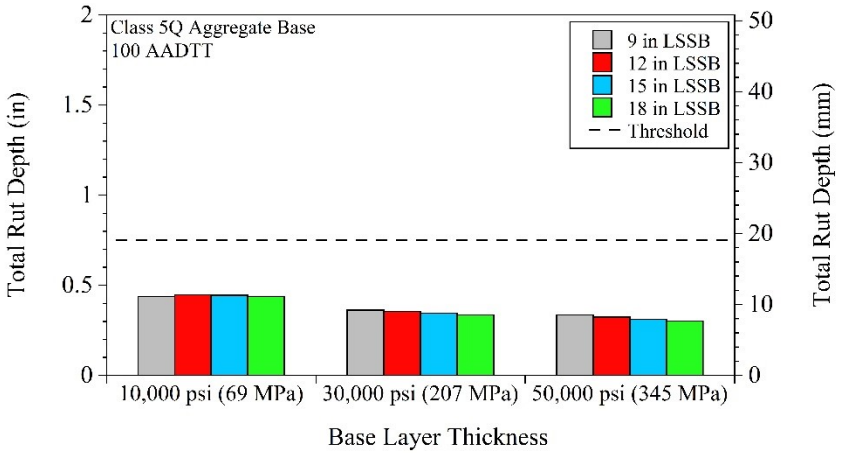


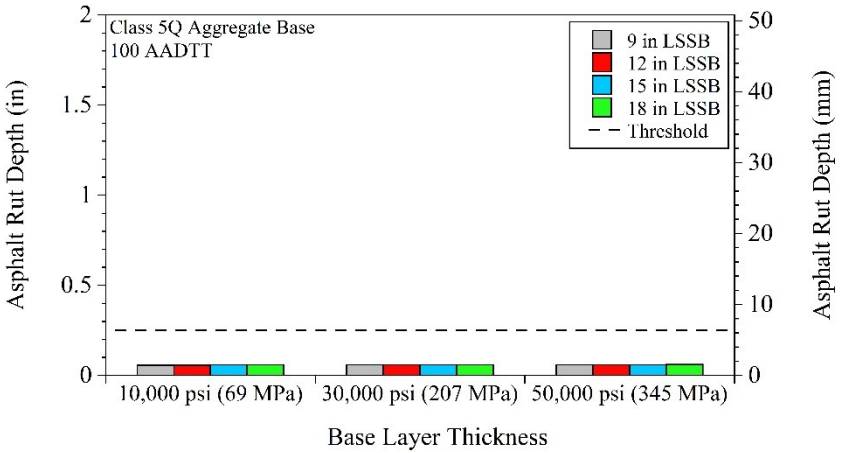


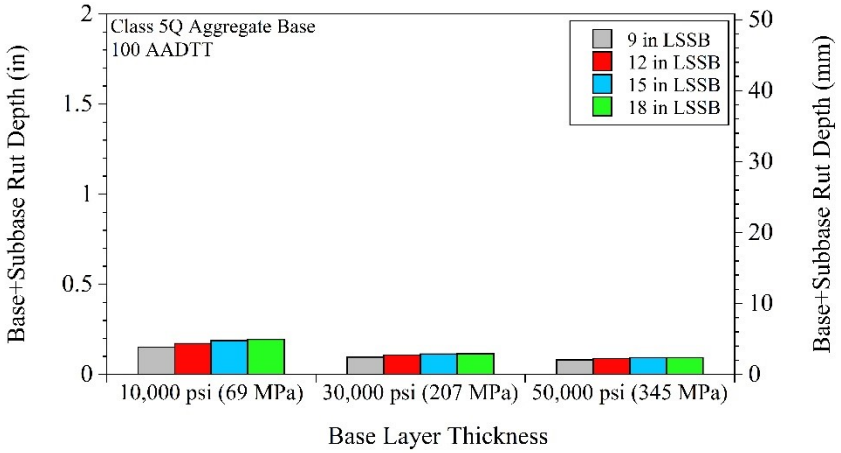


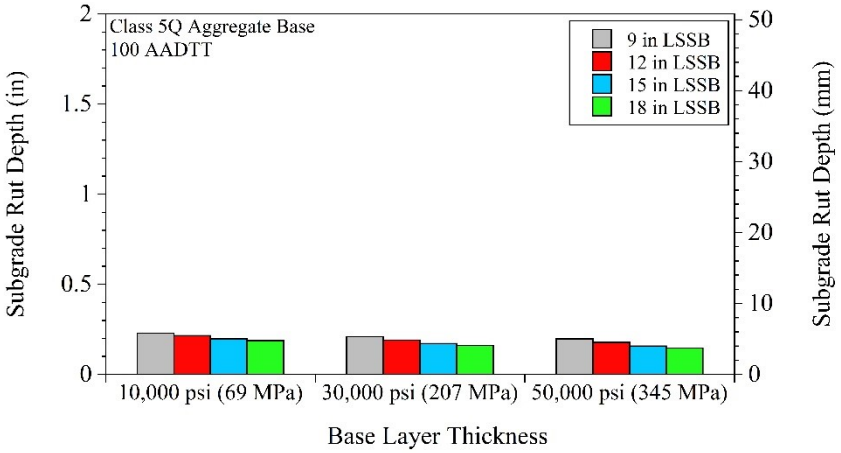


For pavements that contained Class 5Q Aggregate - 100 AADTT:

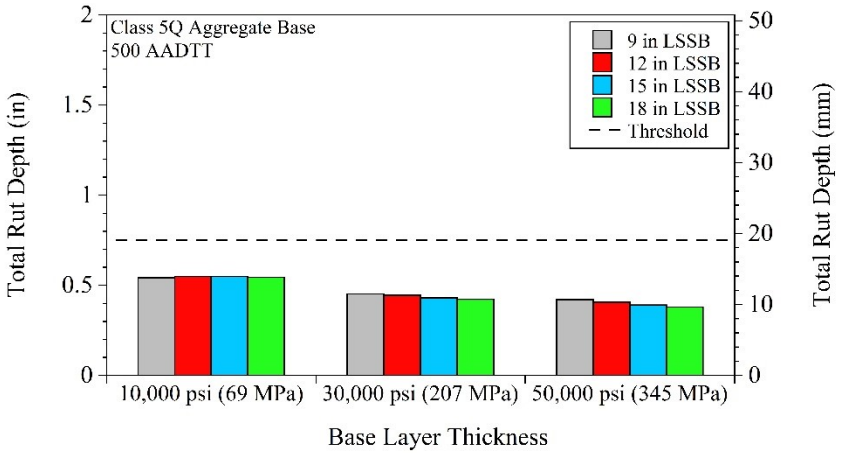


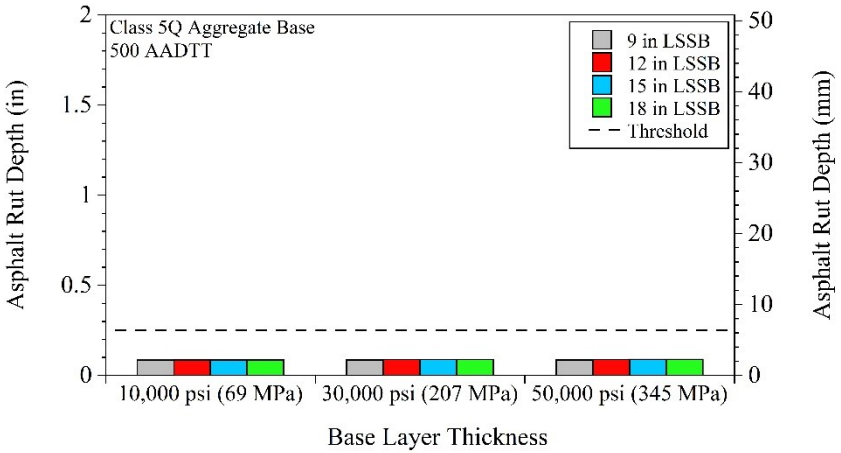


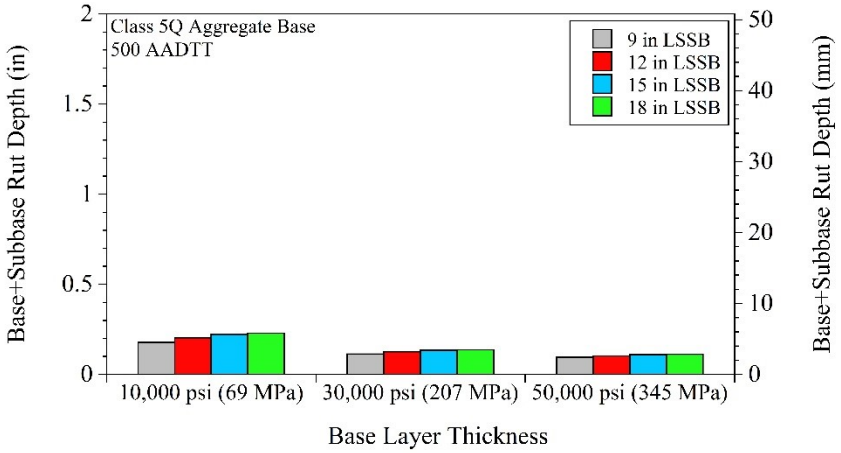


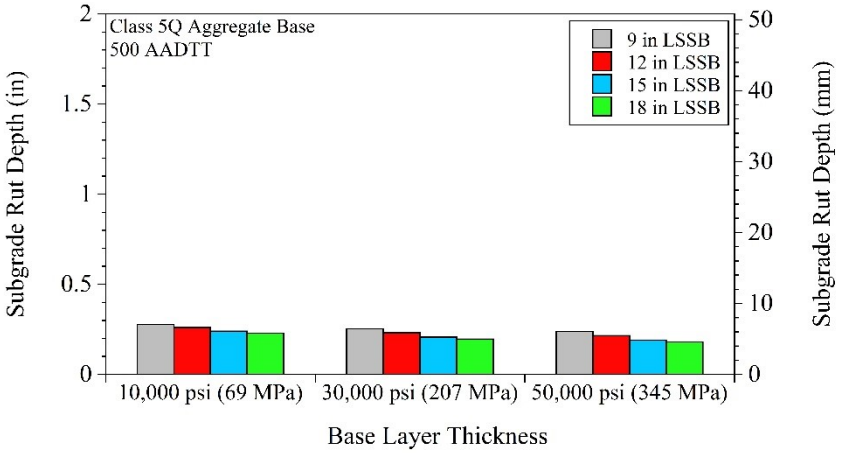


For pavements that contained Class 5Q Aggregate - 500 AADTT:

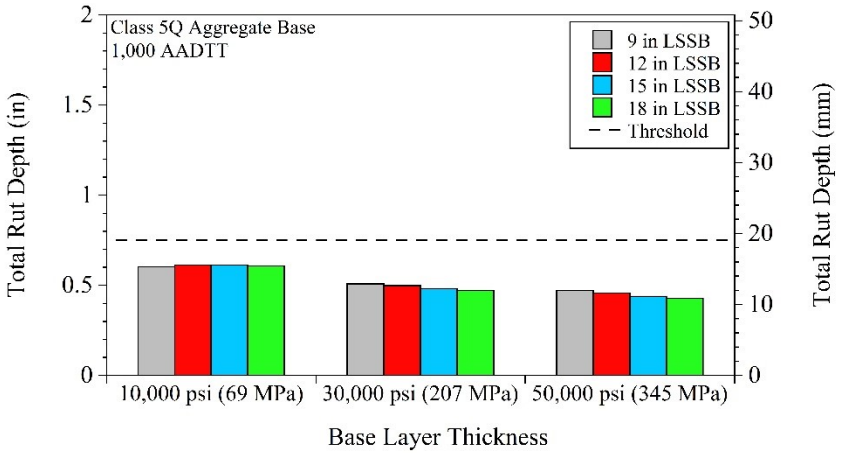


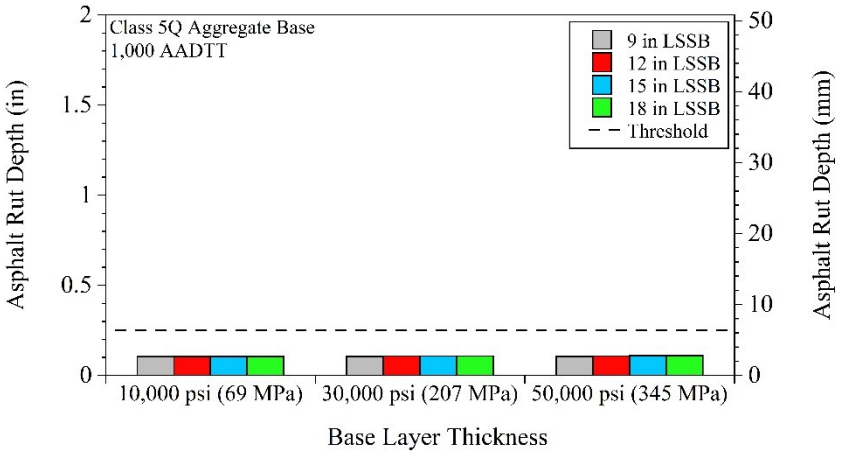


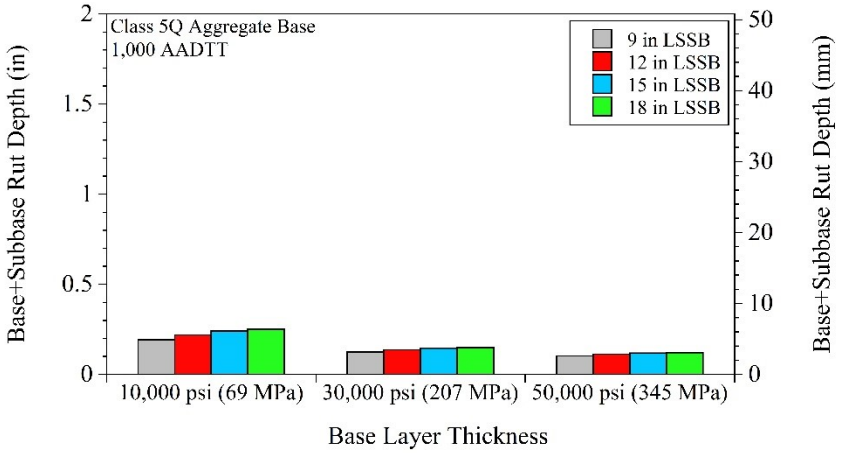


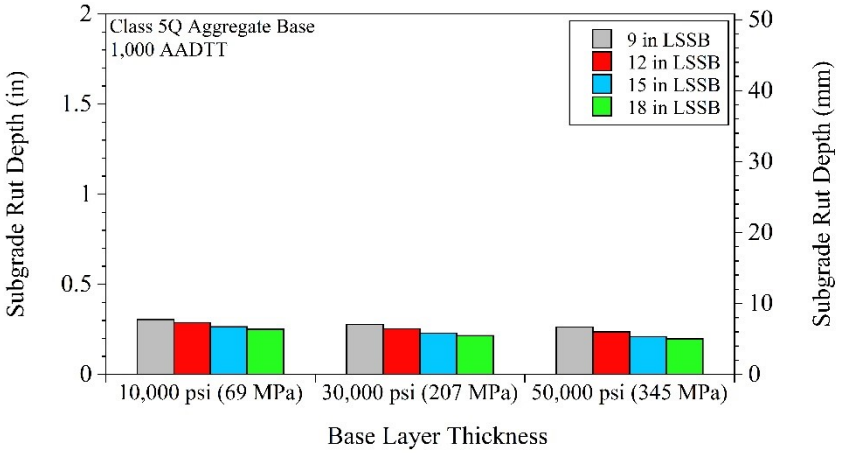


For pavements that contained Class 5Q Aggregate - 1,000 AADTT:

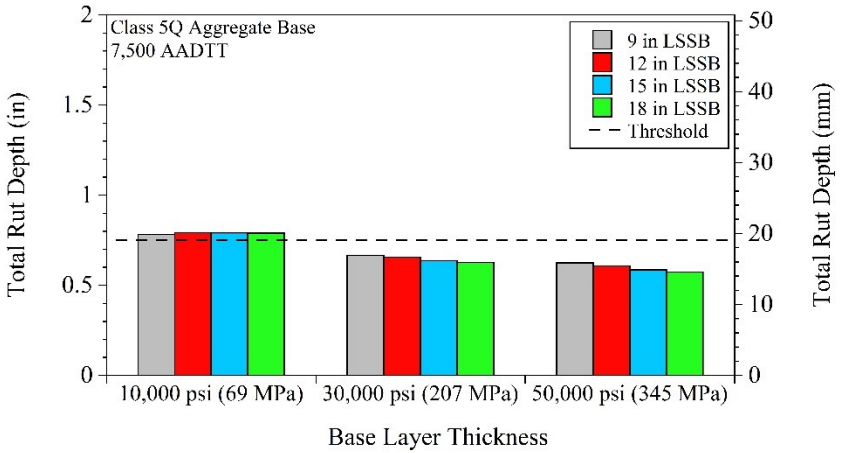


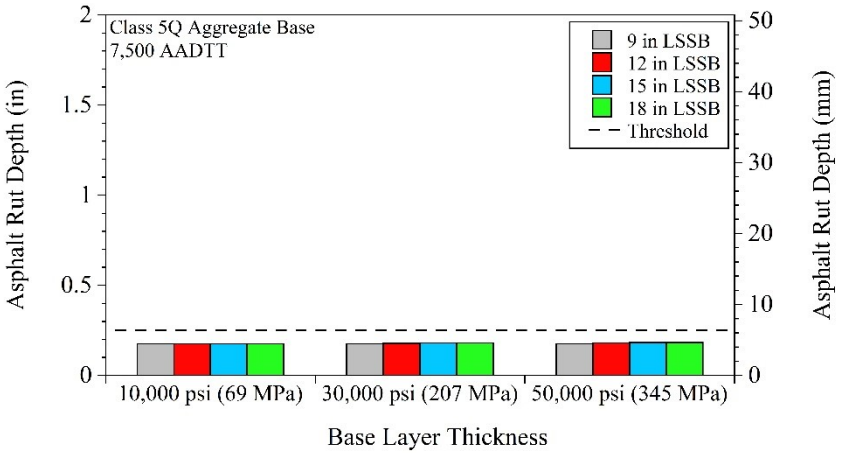


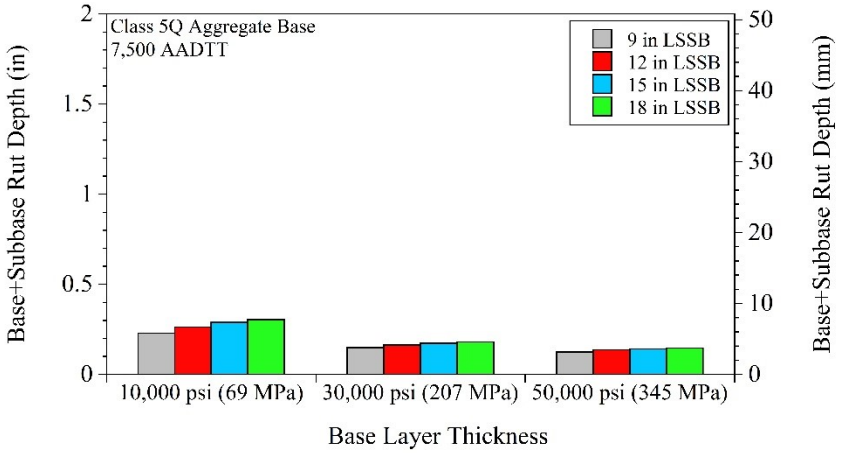


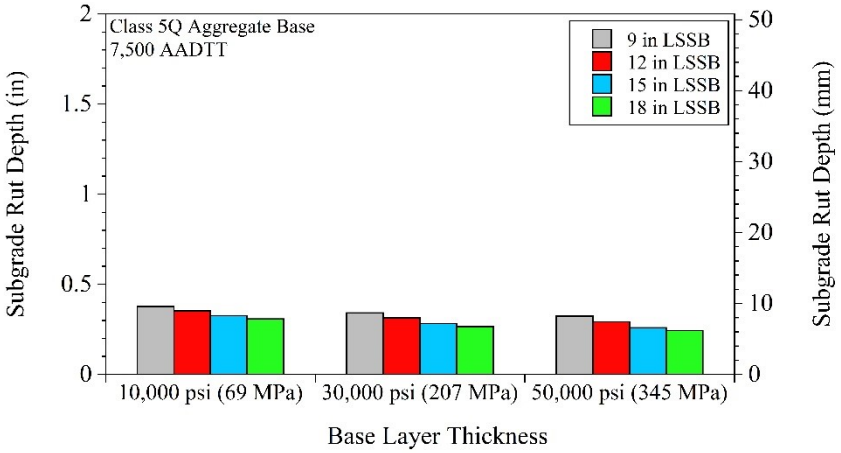


For pavements that contained Class 5Q Aggregate - 7,500 AADTT:

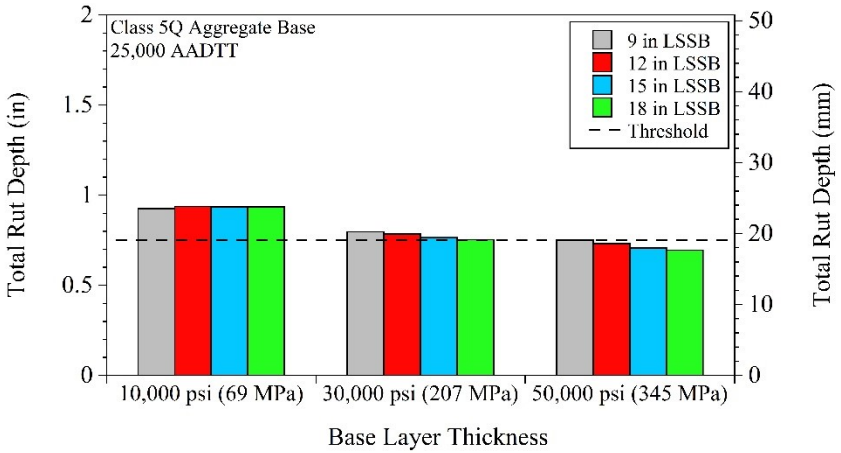


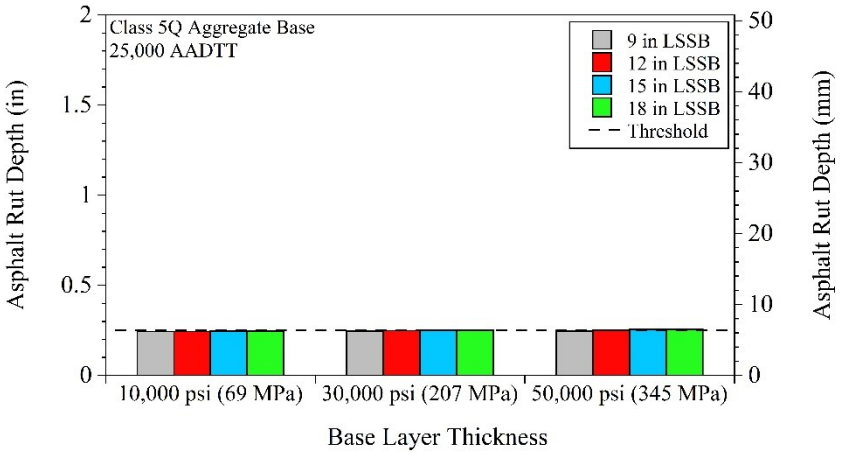


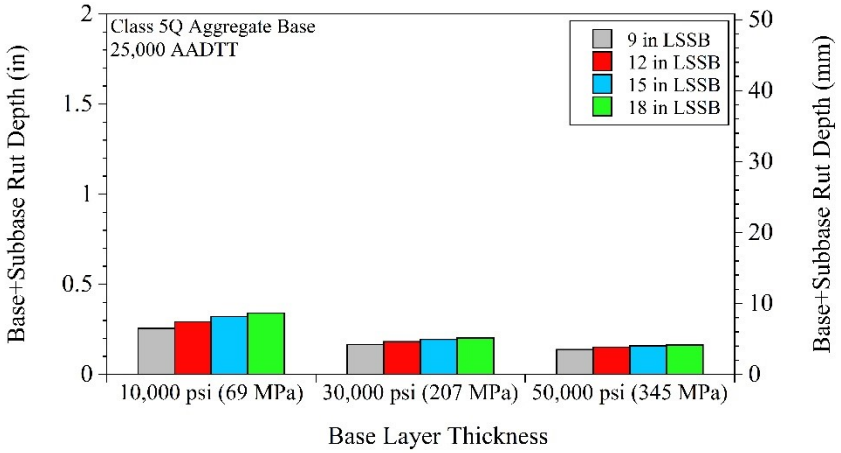


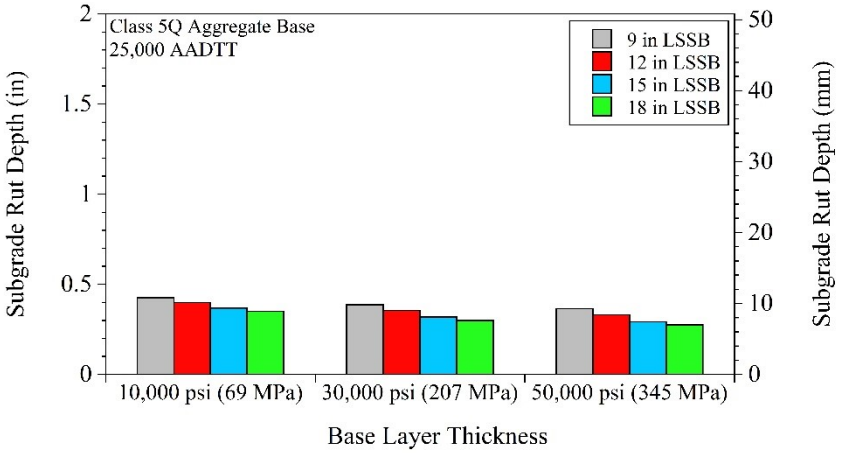


For pavements that contained Class 5Q Aggregate - 25,000 AADTT:



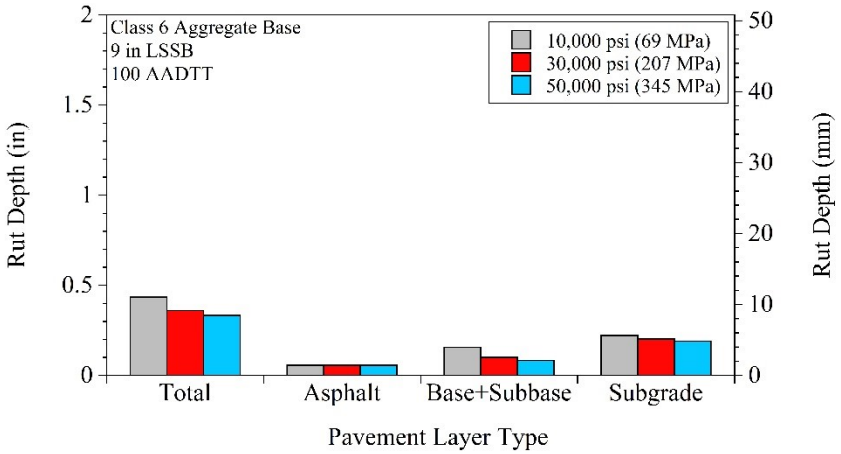


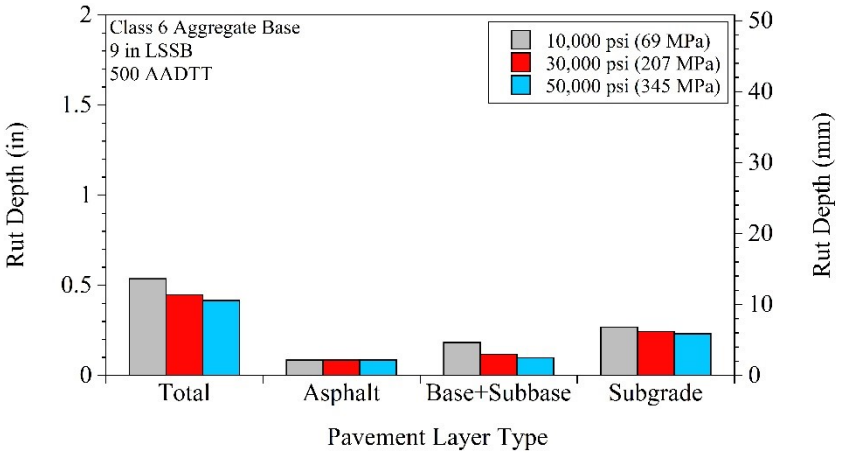


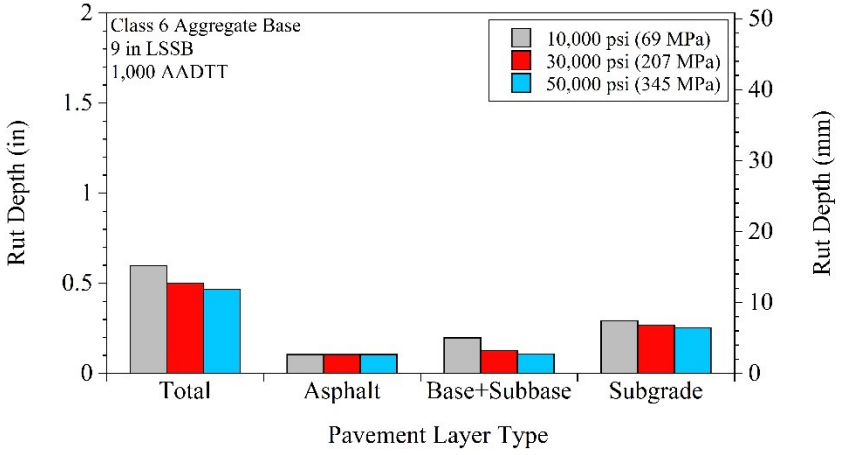


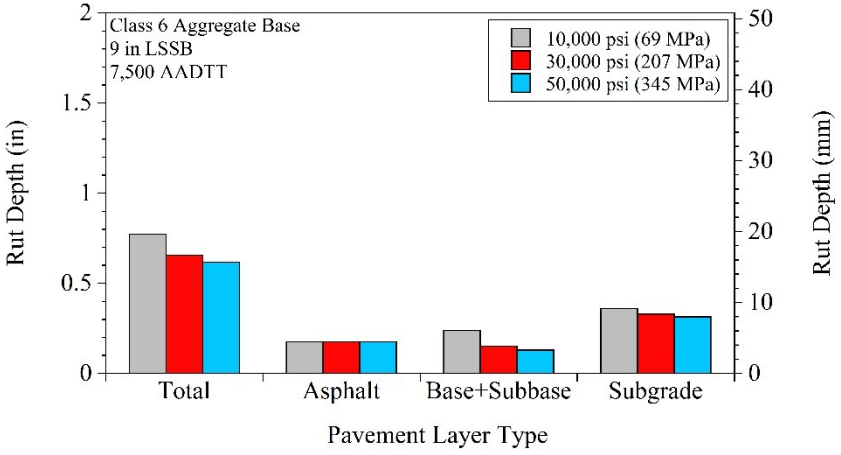
APPENDIX BJ
TOTAL AND LAYER RUTTING AT 50% RELIABILITY FOR LARGE STONE SUBBASE (LSSB) GROUPS

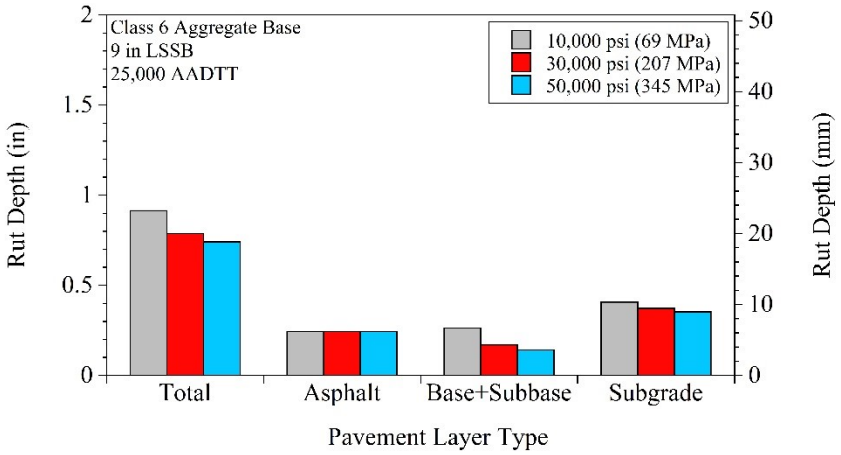
For pavements that contained Class 6 Aggregate and 9-in LSSB:



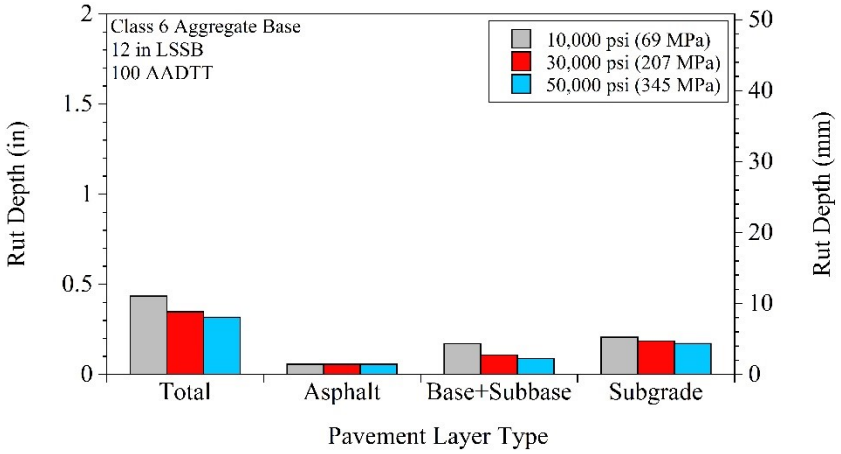


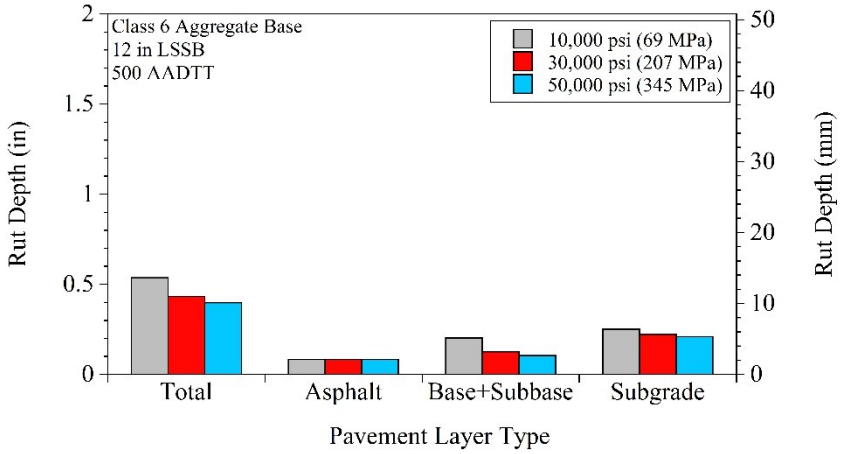


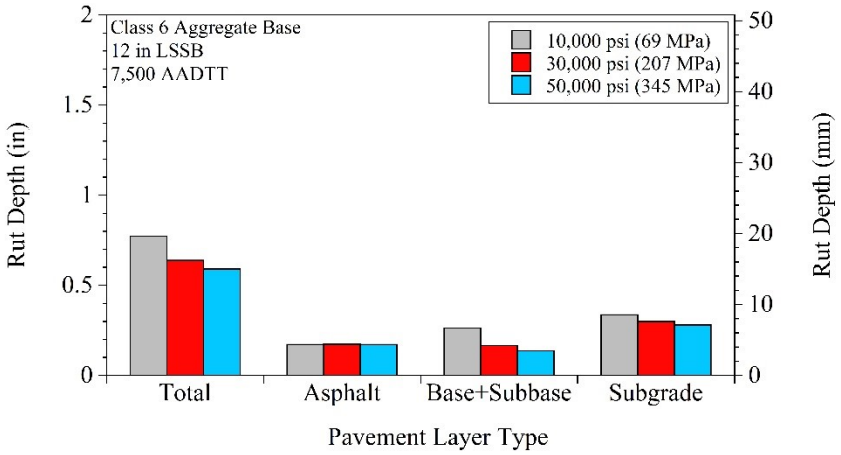


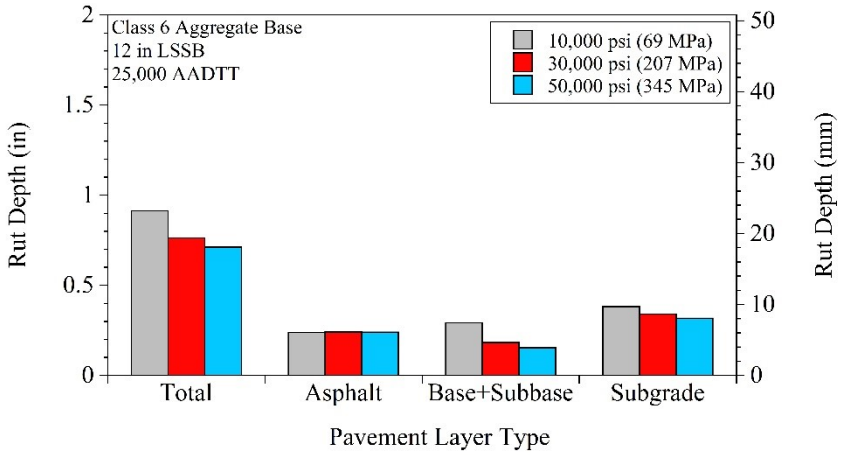


For pavements that contained Class 6 Aggregate and 12-in LSSB:

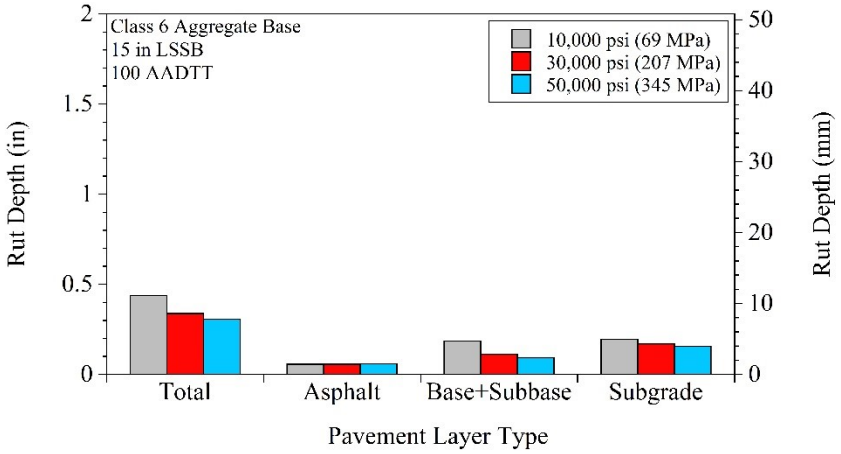


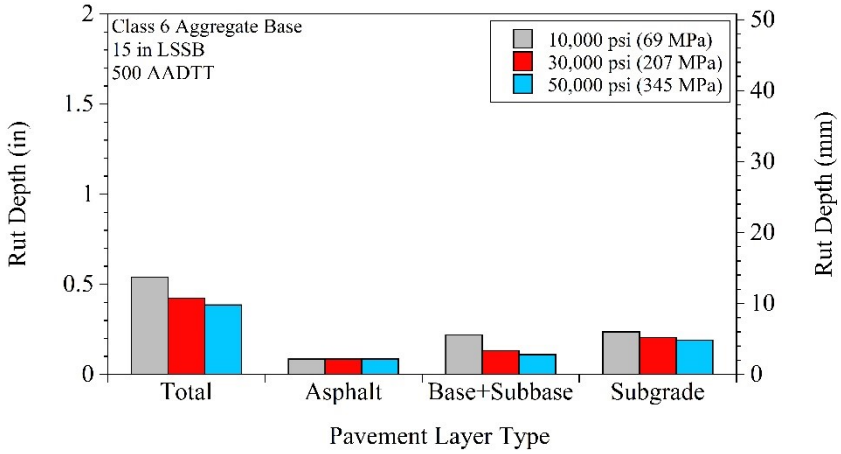


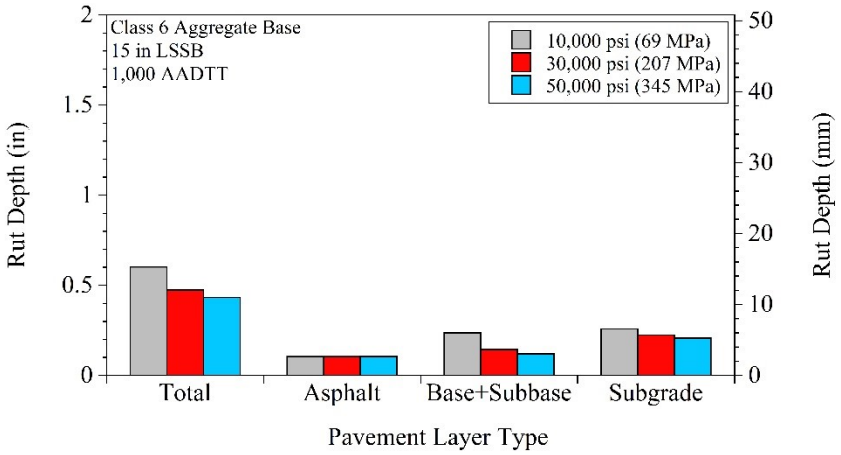


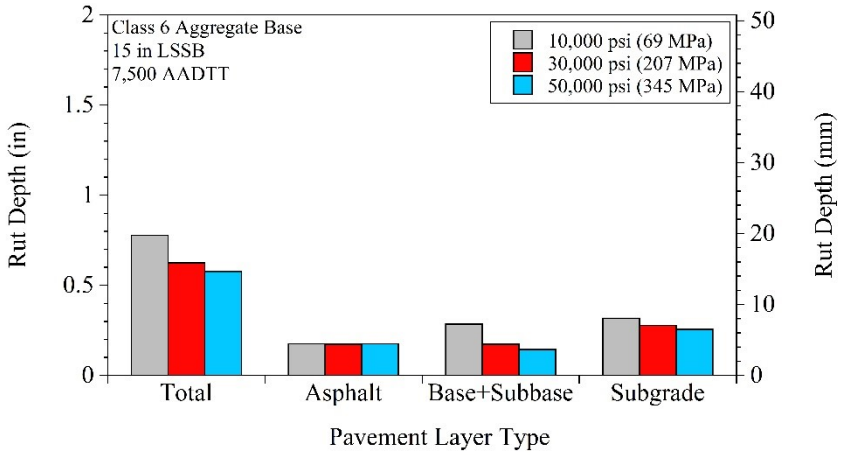


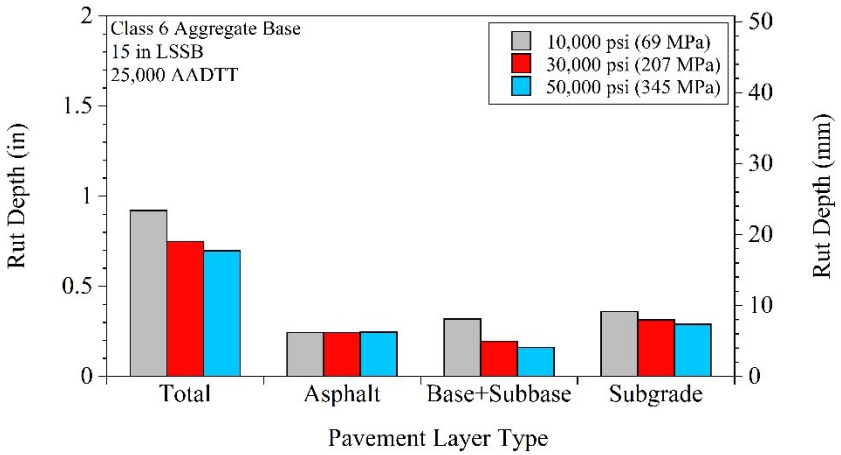
For pavements that contained Class 6 Aggregate and 15-in LSSB:



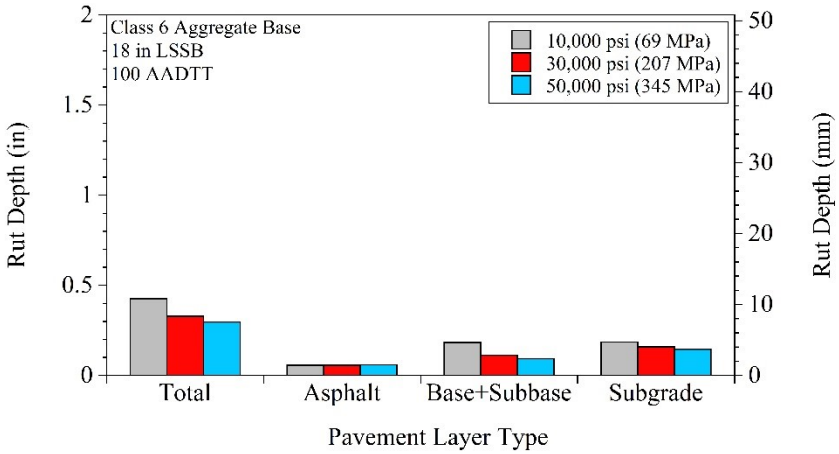


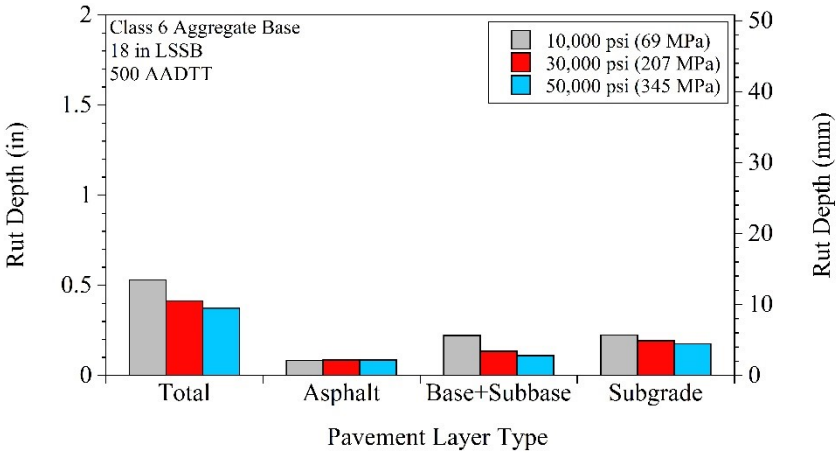

Class 6 Aggregate Base
15 in LSSB
1,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Rut Depth (in)
Rut Depth (mm)
Total
Asphalt
Base+Subbase
Subgrade
Pavement Layer Type

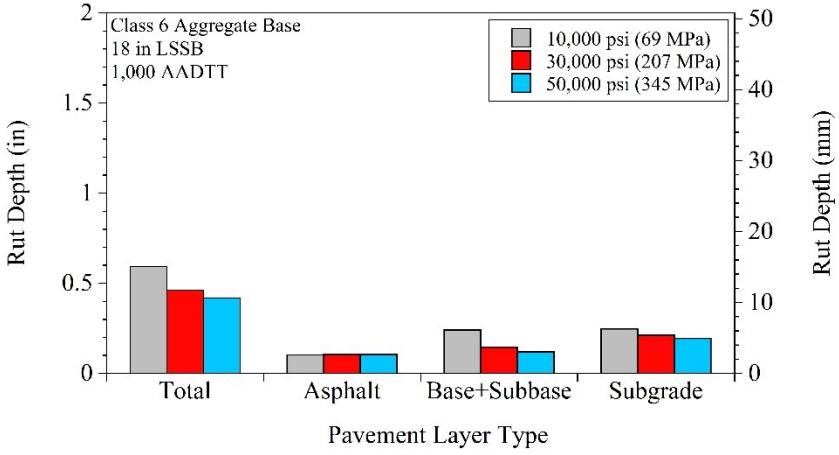

Class 6 Aggregate Base
15 in LSSB
7,500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Rut Depth (in)
Rut Depth (mm)
Total
Asphalt
Base+Subbase
Subgrade
Pavement Layer Type

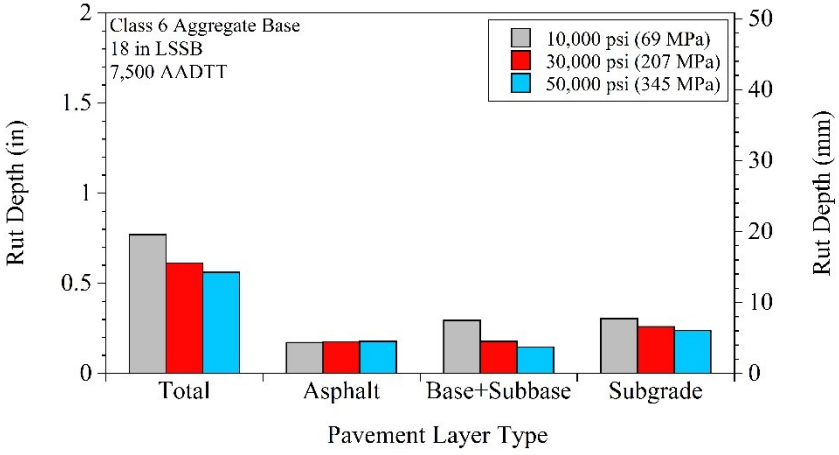

Class 6 Aggregate Base
15 in LSSB
25,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Rut Depth (in)
Rut Depth (mm)
Total
Asphalt
Base+Subbase
Subgrade
Pavement Layer Type

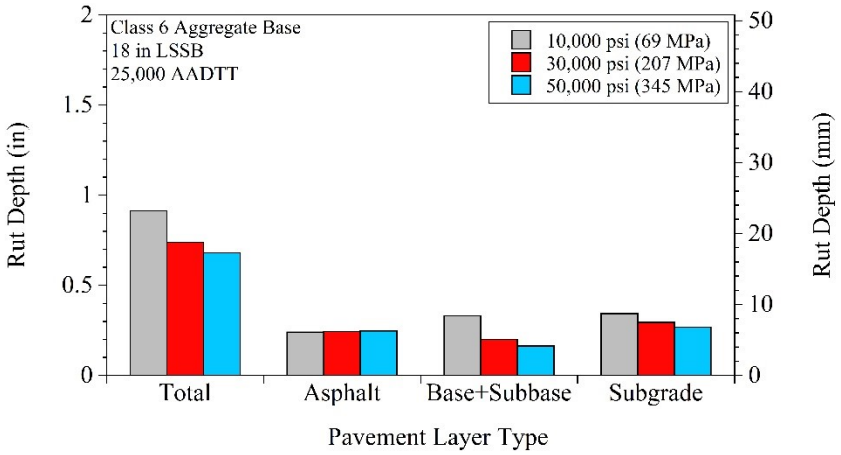
For pavements that contained Class 6 Aggregate and 18-in LSSB:



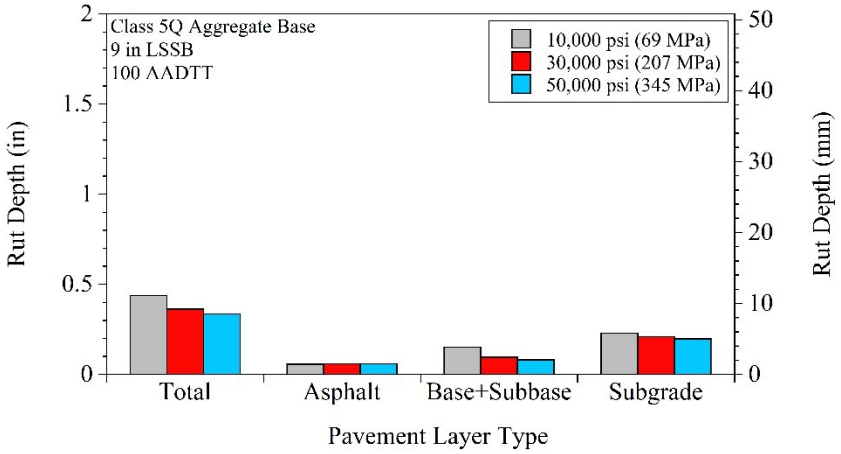


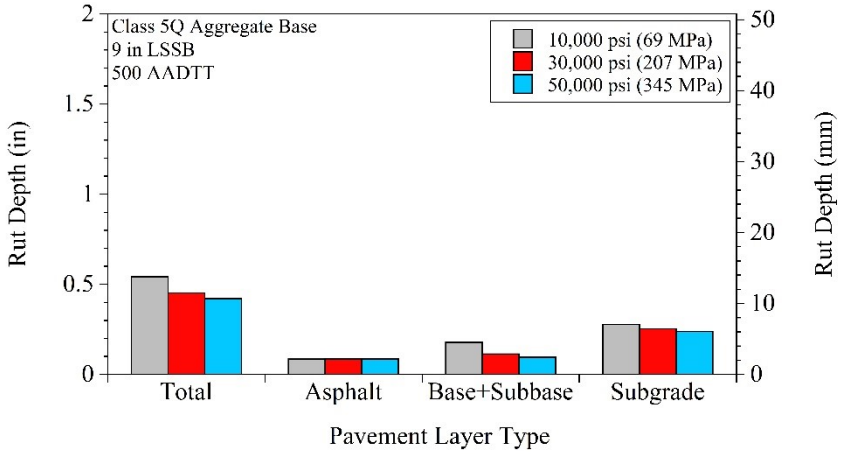


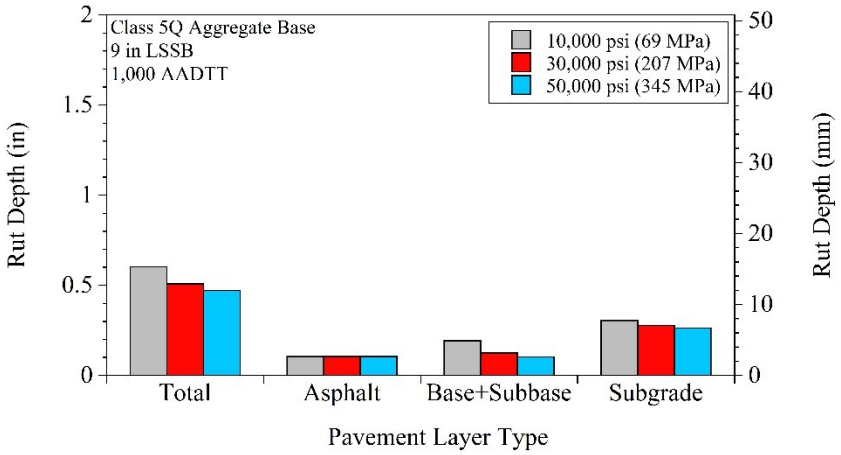


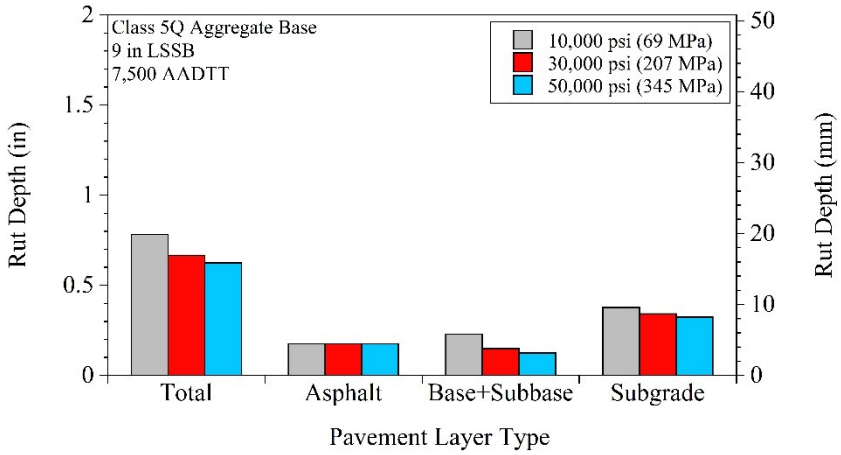


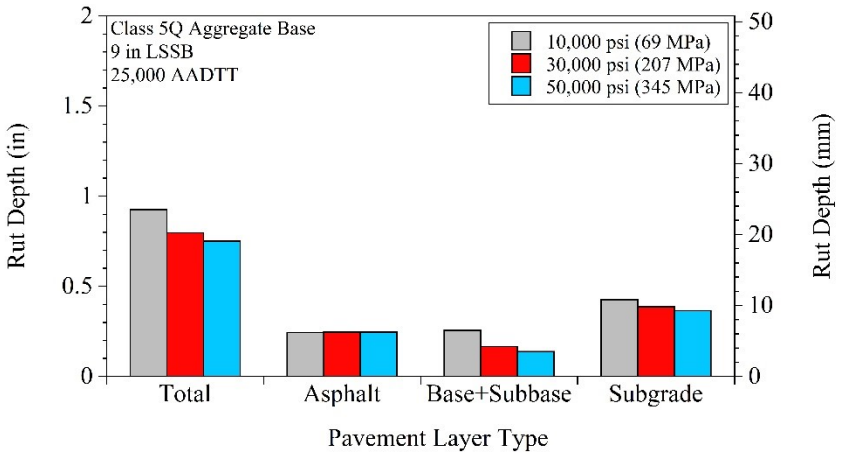
For pavements that contained Class 5Q Aggregate and 9-in LSSB:



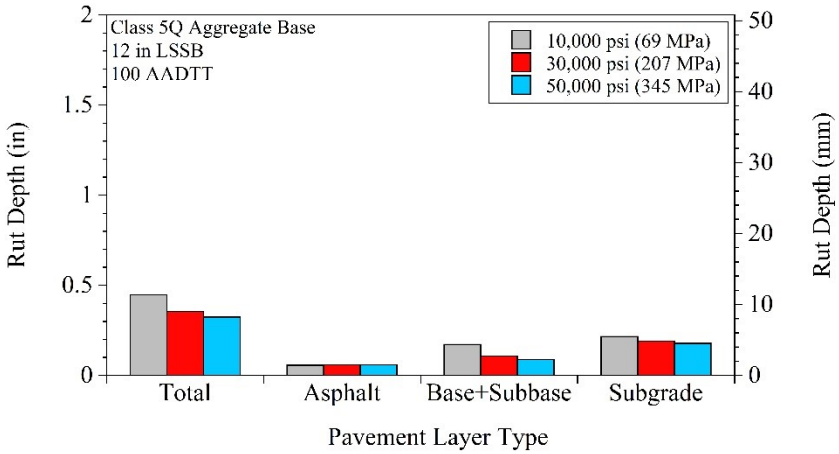


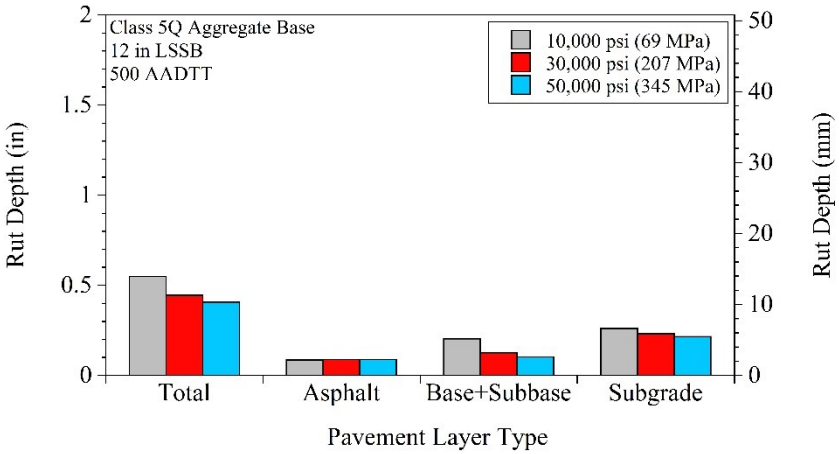

Class 5Q Aggregate Base
9 in LSSB
1,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Rut Depth (in)
Rut Depth (mm)
Total
Asphalt
Base+Subbase
Subgrade
Pavement Layer Type

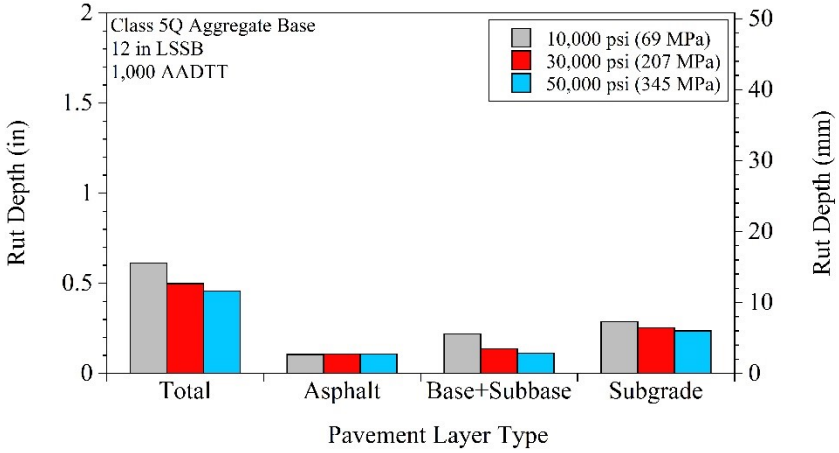

Class 5Q Aggregate Base
9 in LSSB
7,500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Rut Depth (in)
Rut Depth (mm)
Total
Asphalt
Base+Subbase
Subgrade
Pavement Layer Type

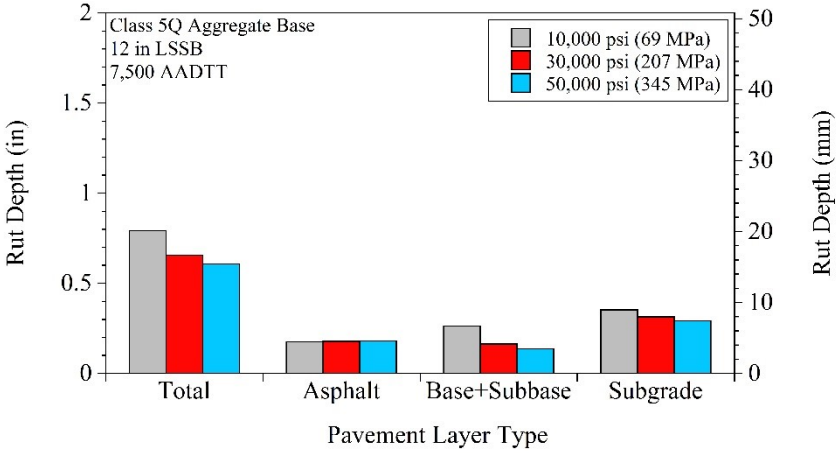

Class 5Q Aggregate Base
9 in LSSB
25,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Rut Depth (in)
Rut Depth (mm)
Total
Asphalt
Base+Subbase
Subgrade
Pavement Layer Type

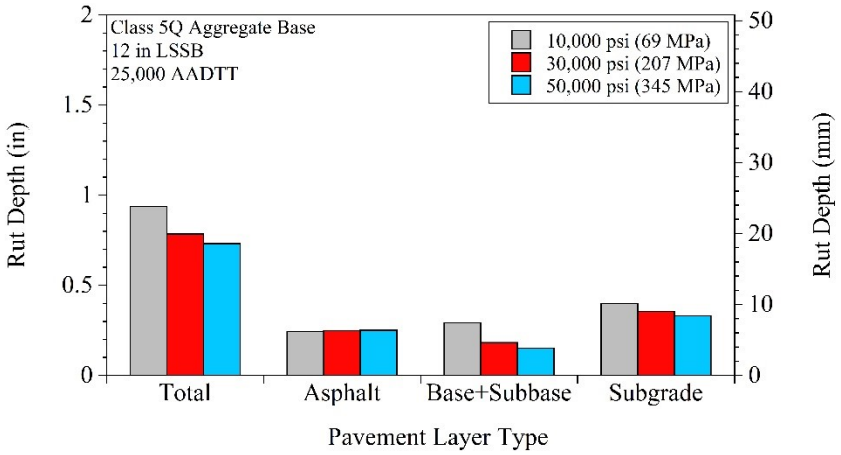
For pavements that contained Class 5Q Aggregate and 12-in LSSB:



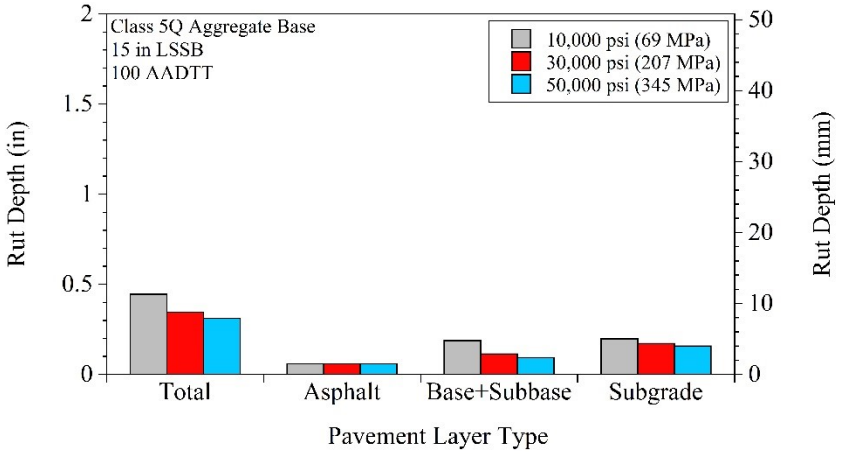


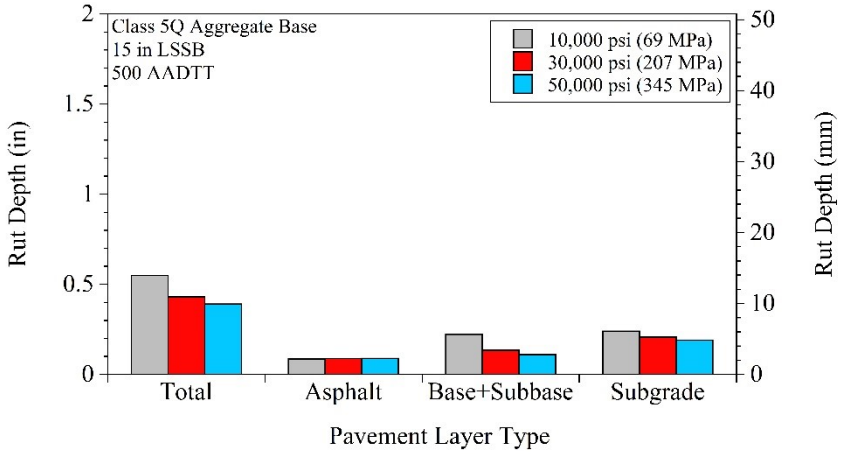


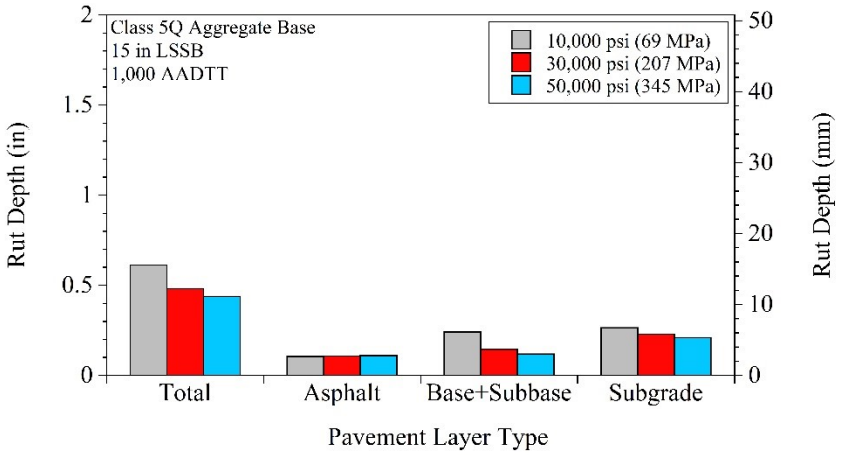


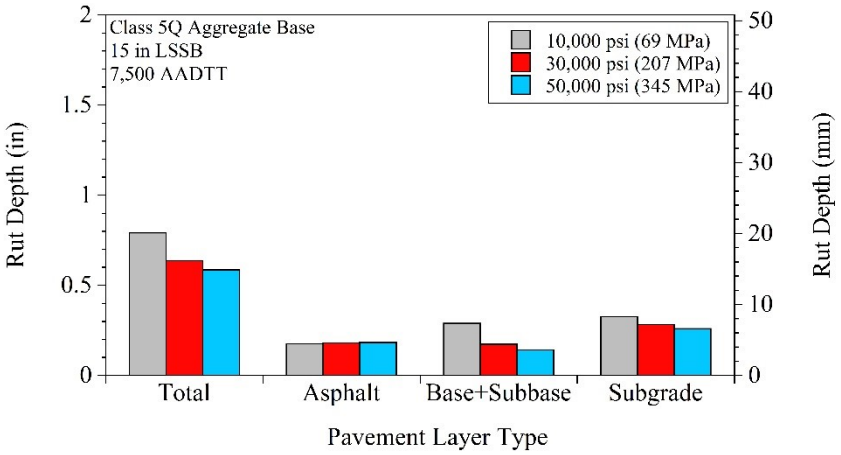


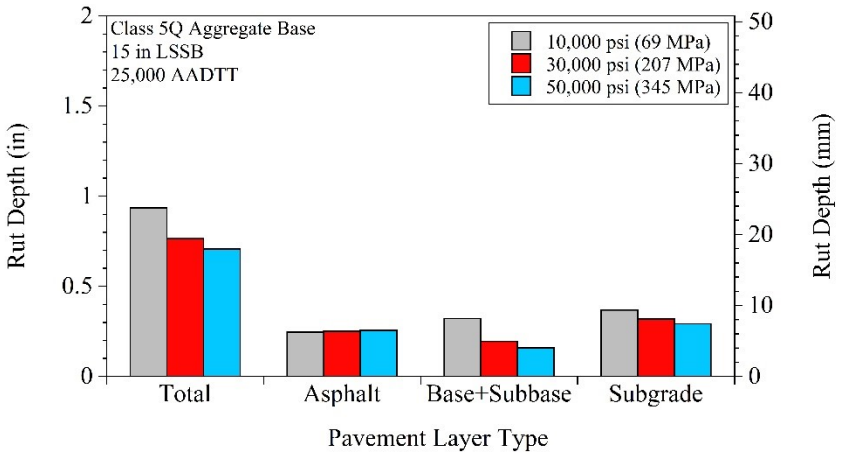
For pavements that contained Class 5Q Aggregate and 15-in LSSB:



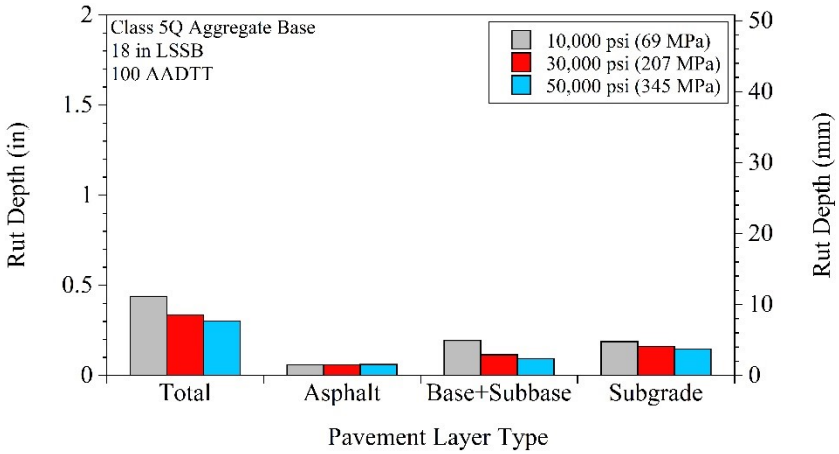


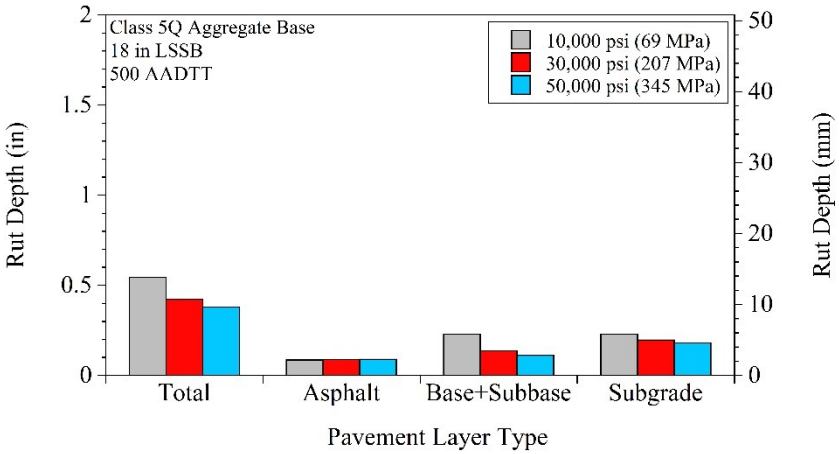

Class 5Q Aggregate Base
15 in LSSB
1,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Rut Depth (in)
Rut Depth (mm)
Total
Asphalt
Base+Subbase
Subgrade
Pavement Layer Type

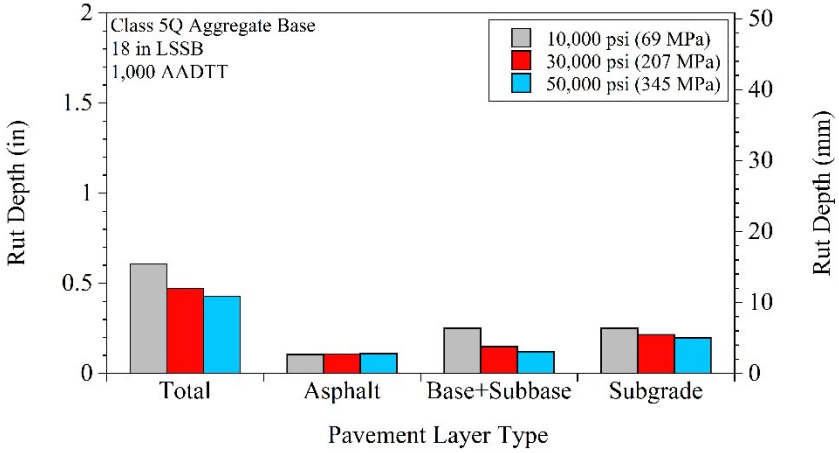

Class 5Q Aggregate Base
15 in LSSB
7,500 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Rut Depth (in)
Rut Depth (mm)
Total
Asphalt
Base+Subbase
Subgrade
Pavement Layer Type

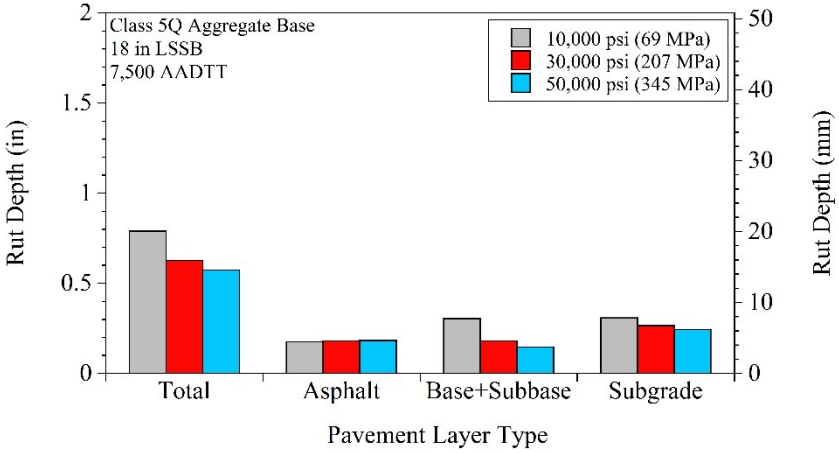

Class 5Q Aggregate Base
15 in LSSB
25,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Rut Depth (in)
Rut Depth (mm)
Total
Asphalt
Base+Subbase
Subgrade
Pavement Layer Type

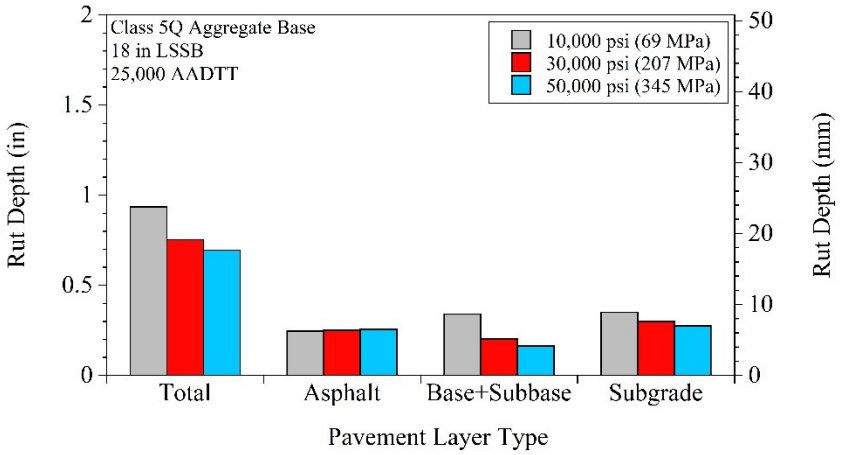
For pavements that contained Class 5Q Aggregate and 18-in LSSB:





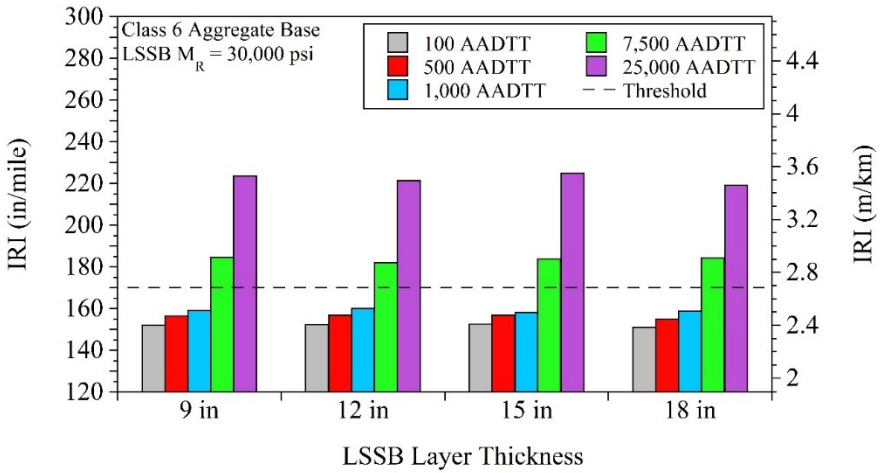


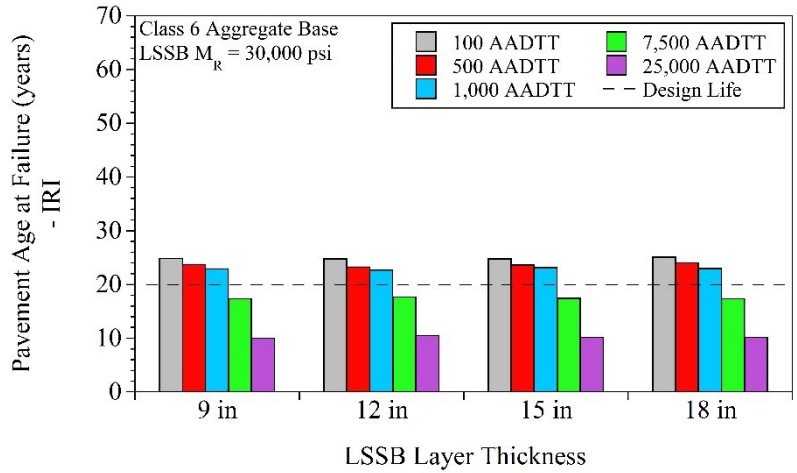


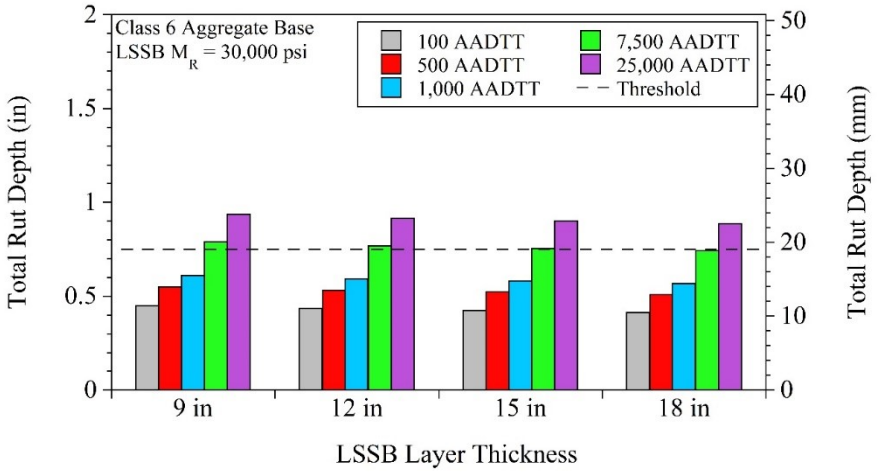

Class 5Q Aggregate Base
18 in LSSB
25,000 AADTT
10,000 psi (69 MPa)
30,000 psi (207 MPa)
50,000 psi (345 MPa)
Rut Depth (in)
Rut Depth (mm)
0
0.5
1
1.5
2
0
10
20
30
40
50
Total
Asphalt
Base+Subbase
Subgrade
Pavement Layer Type

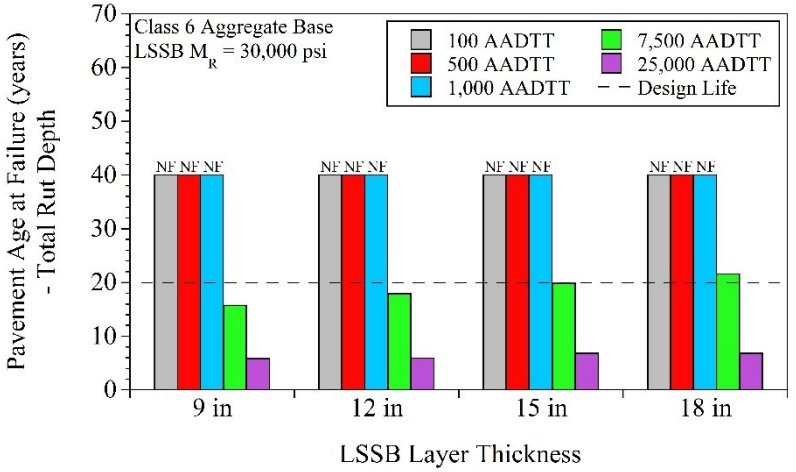
APPENDIX BK
EFFECT OF TRAFFIC LEVEL ON PAVEMENT PERFORMANCE PREDICTIONS

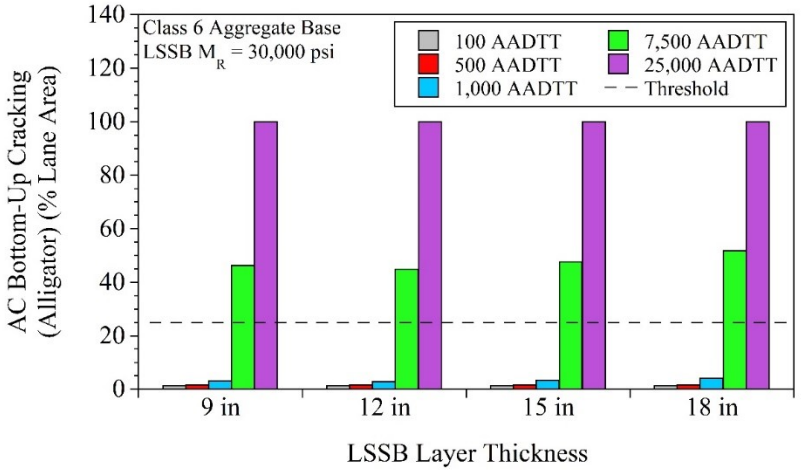
For pavements that contained Class 6 Aggregate and LSSB with M_R = 30,000 psi:

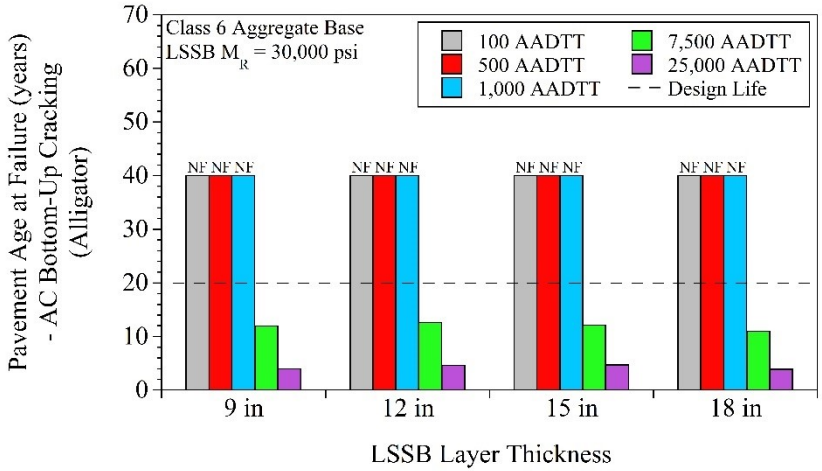




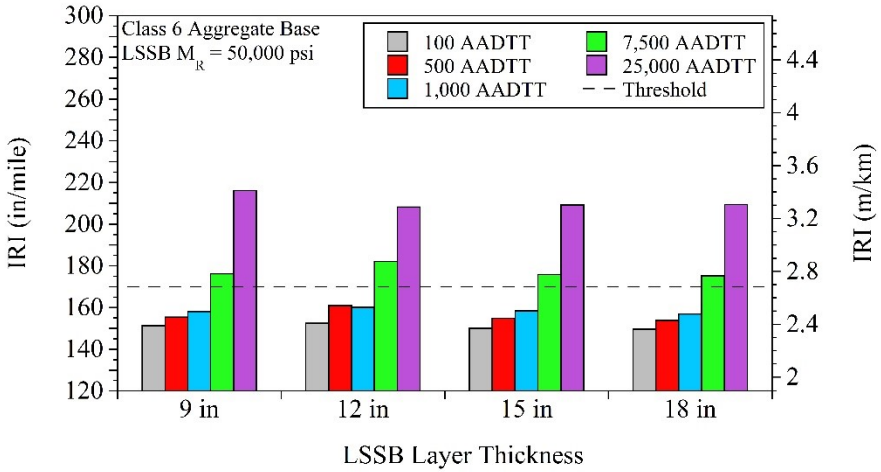


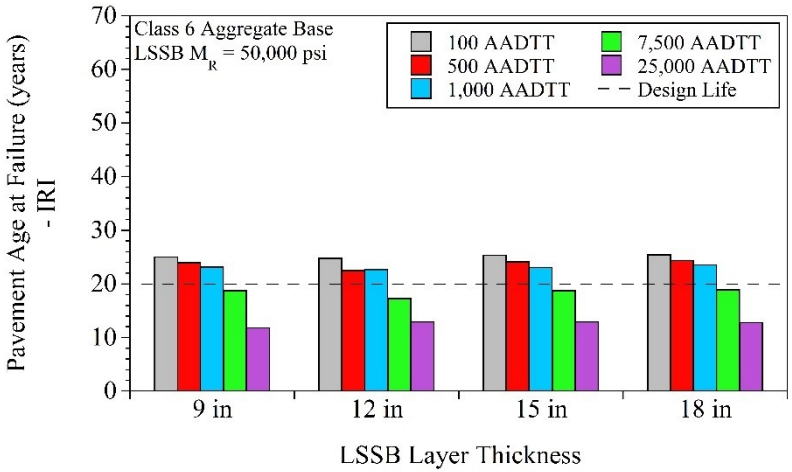


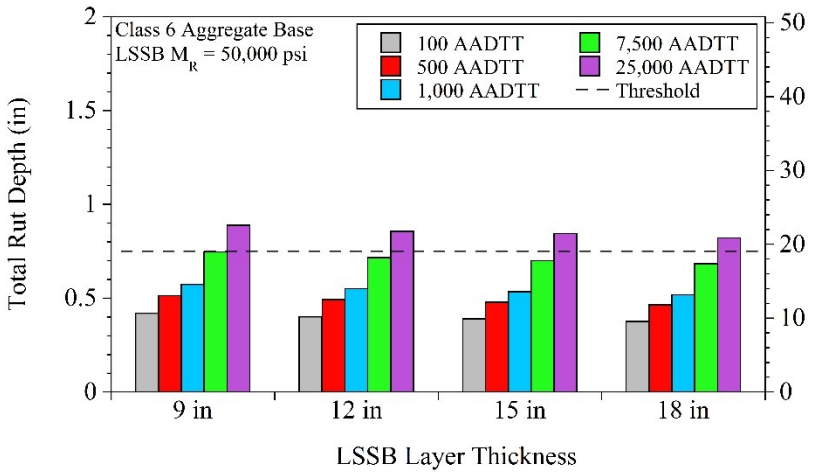


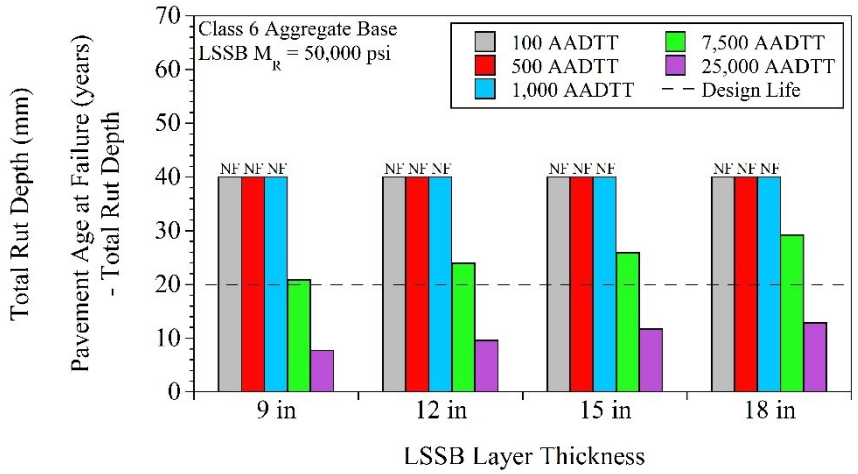


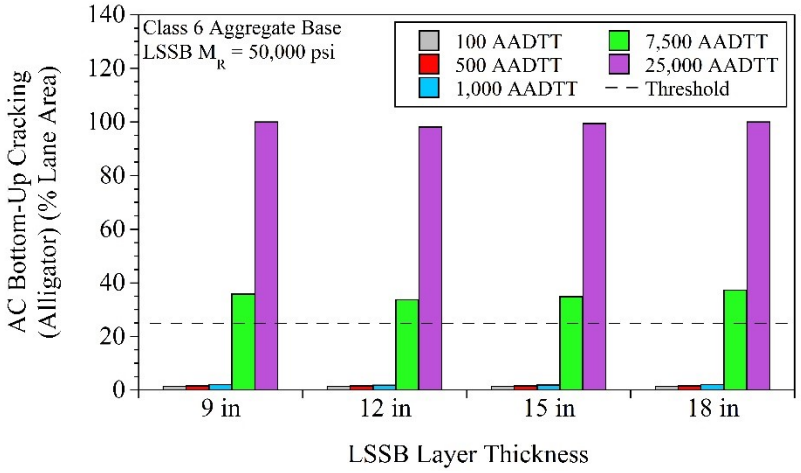
For pavements that contained Class 6 Aggregate and LSSB with M_R = 50,000 psi:

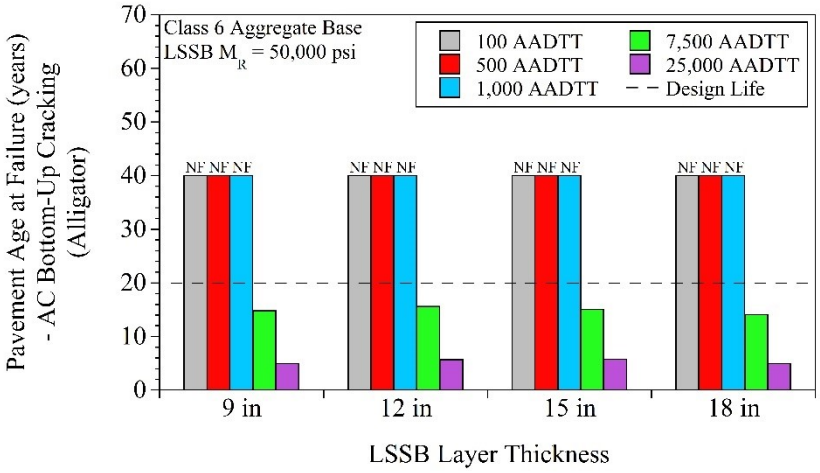




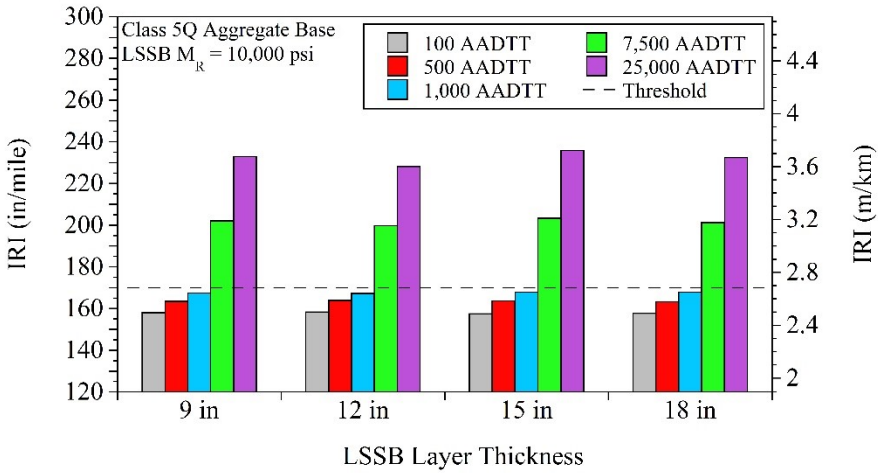

Class 6 Aggregate Base
LSSB M_R = 50,000 psi
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
9 in
12 in
15 in
18 in
LSSB Layer Thickness

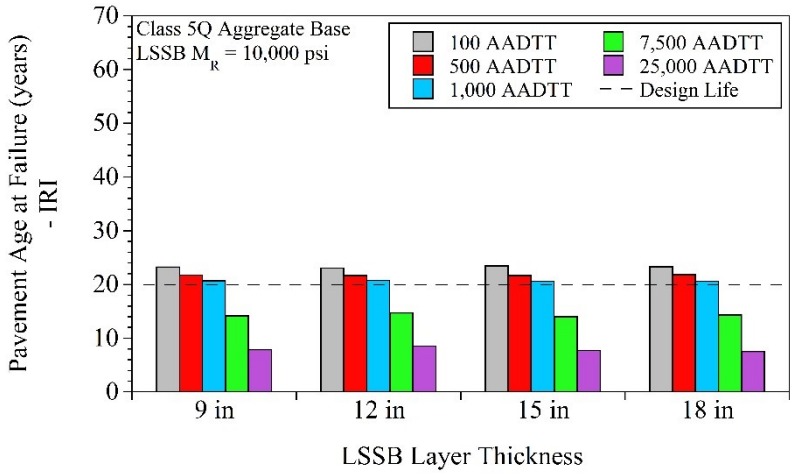

Class 6 Aggregate Base
LSSB M_R = 50,000 psi
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
NF NF NF
Pavement Age at Failure (years)
- Total Rut Depth
9 in
12 in
15 in
18 in
LSSB Layer Thickness

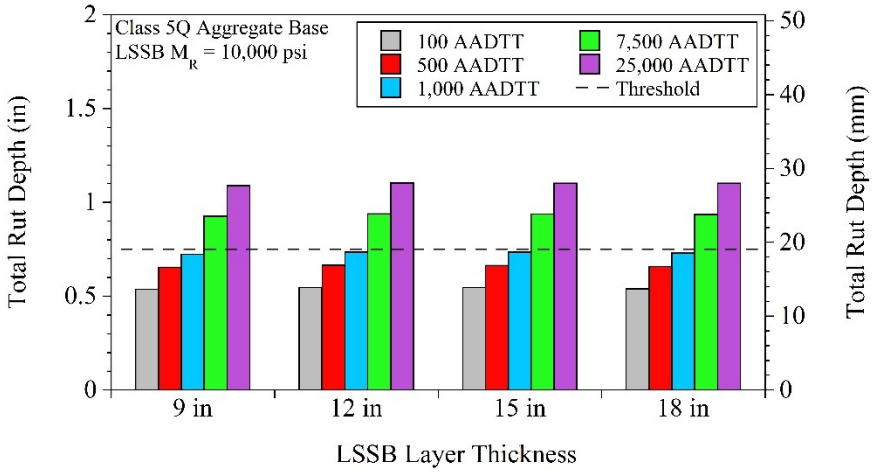

Class 6 Aggregate Base
LSSB M_R = 50,000 psi
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
9 in
12 in
15 in
18 in
LSSB Layer Thickness

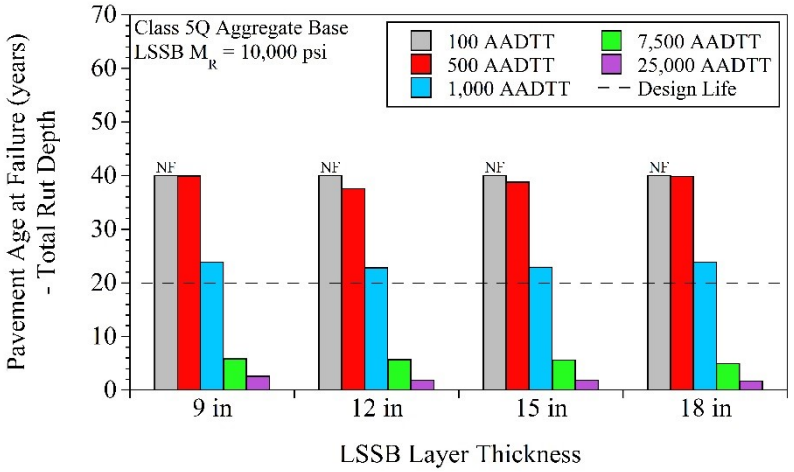

Class 6 Aggregate Base
LSSB M_R = 50,000 psi
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
NF NF NF
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
9 in
12 in
15 in
18 in
LSSB Layer Thickness

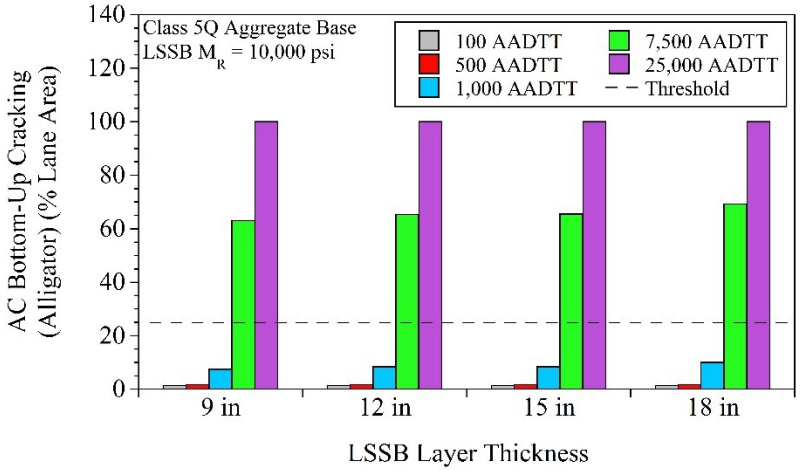
For pavements that contained Class 5Q Aggregate and LSSB with M_R = 10,000 psi:

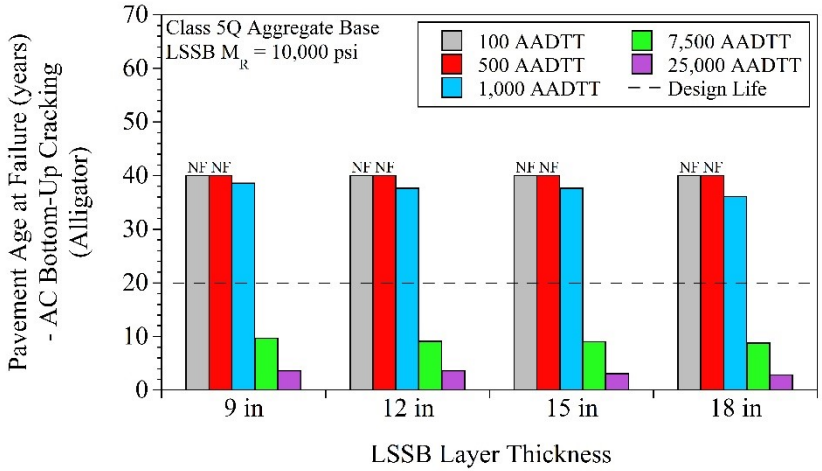




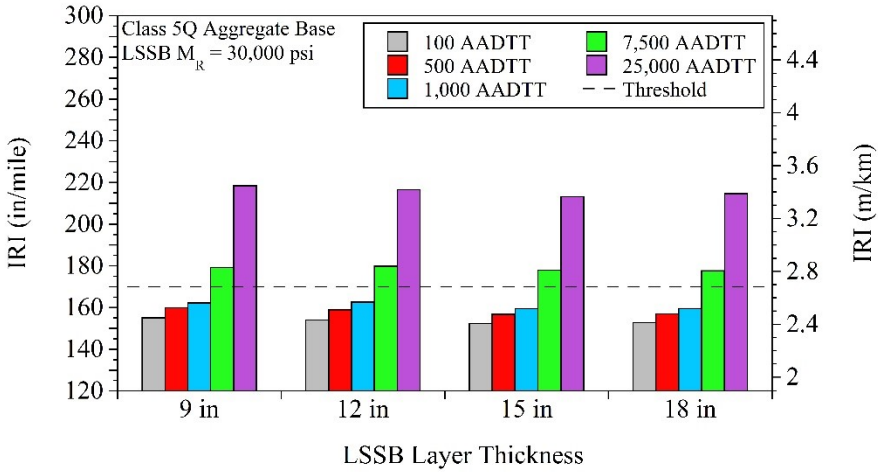


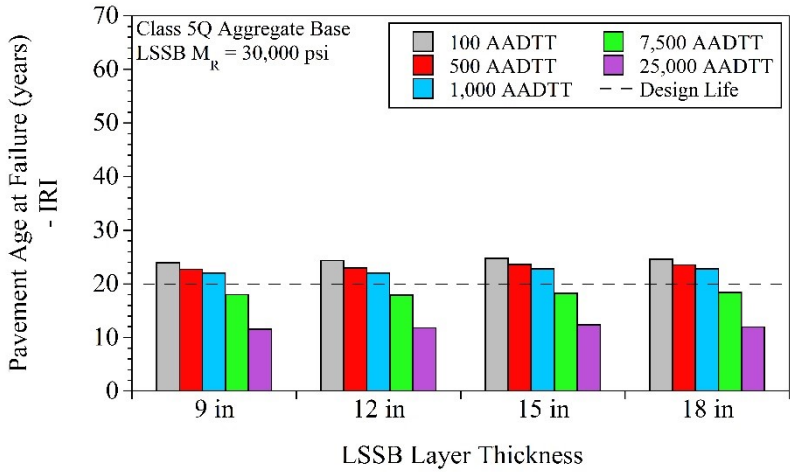


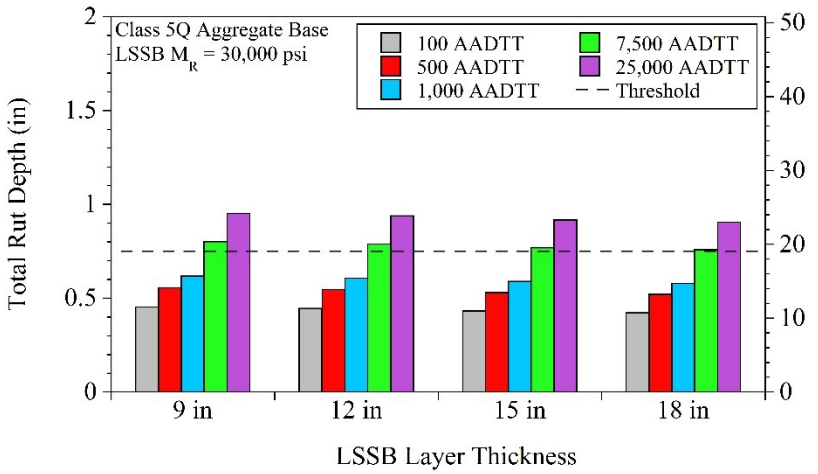


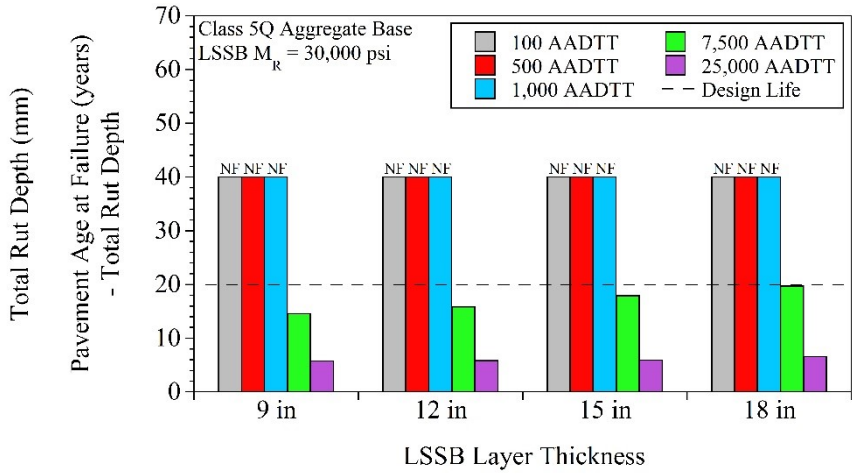


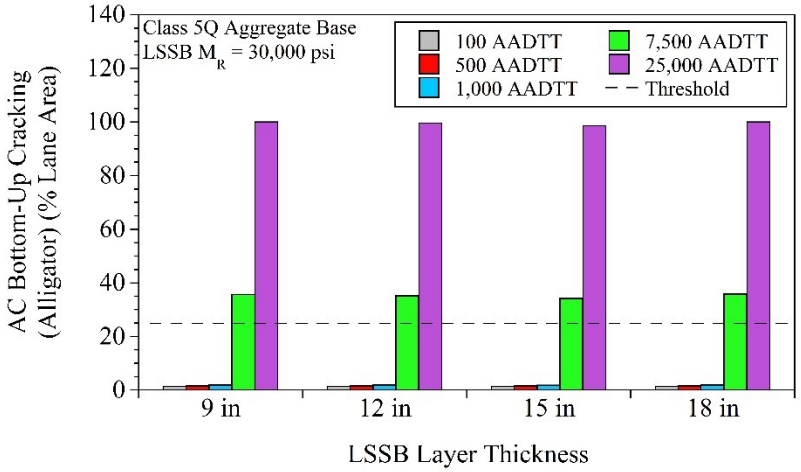
For pavements that contained Class 5Q Aggregate and LSSB with M_R = 30,000 psi:

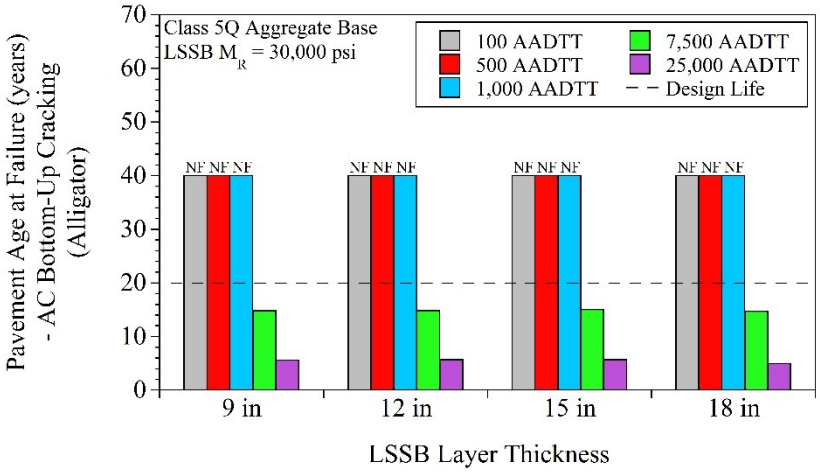




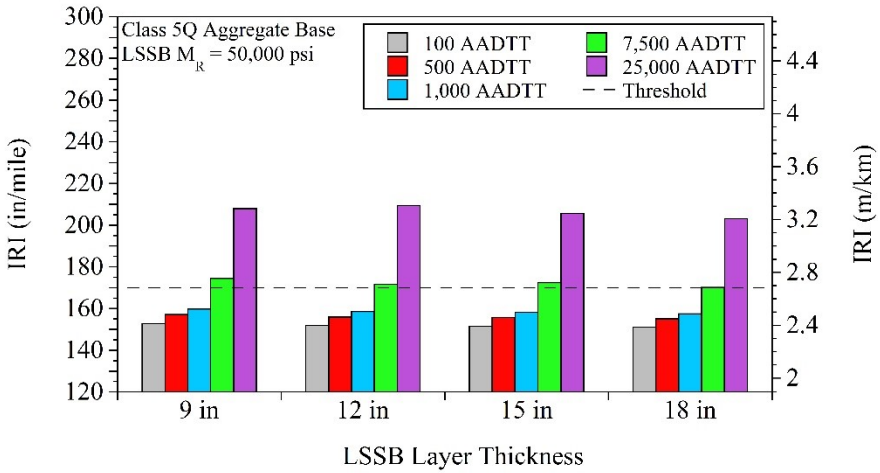

Class 5Q Aggregate Base
LSSB M_R = 30,000 psi
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
9 in
12 in
15 in
18 in
LSSB Layer Thickness

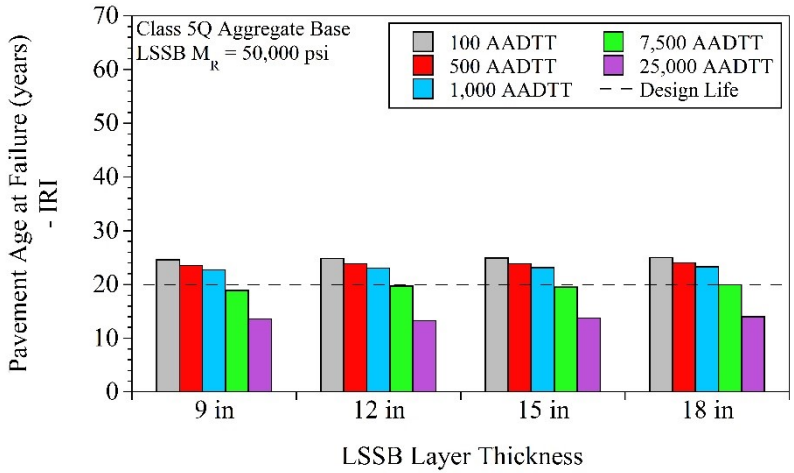

Class 5Q Aggregate Base
LSSB M_R = 30,000 psi
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
NF NF NF
Pavement Age at Failure (years)
- Total Rut Depth
9 in
12 in
15 in
18 in
LSSB Layer Thickness

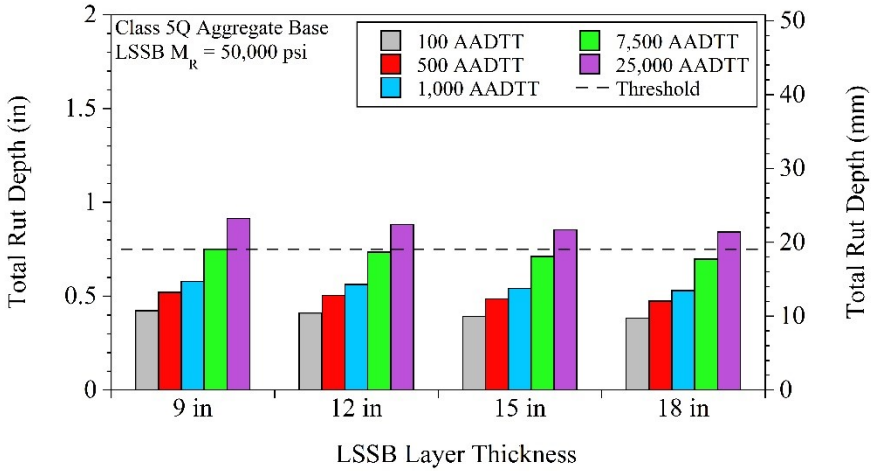

Class 5Q Aggregate Base
LSSB M_R = 30,000 psi
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Bottom-Up Cracking
(Alligator) (% Lane Area)
9 in
12 in
15 in
18 in
LSSB Layer Thickness

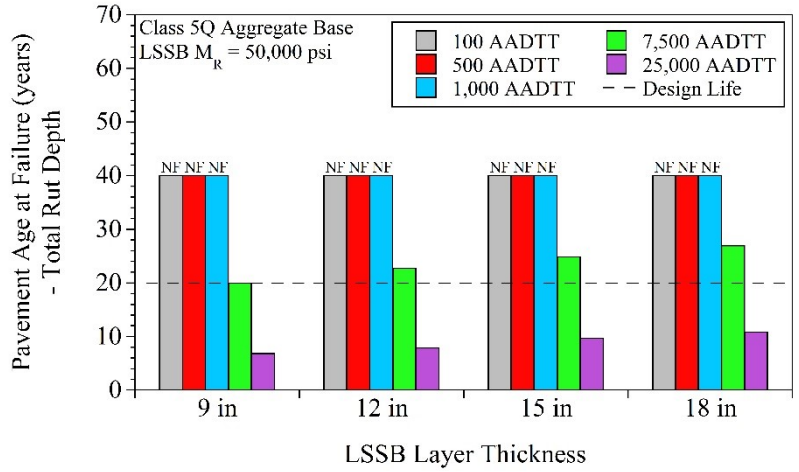

Class 5Q Aggregate Base
LSSB M_R = 30,000 psi
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
NF NF NF
Pavement Age at Failure (years)
- AC Bottom-Up Cracking
(Alligator)
9 in
12 in
15 in
18 in
LSSB Layer Thickness

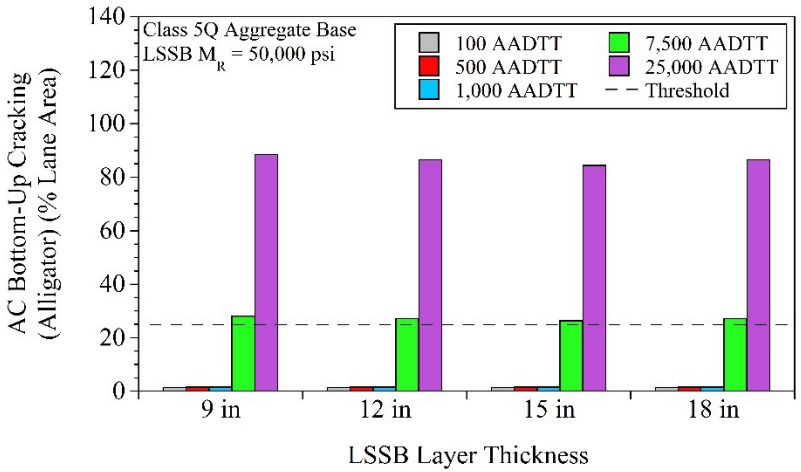
For pavements that contained Class 5Q Aggregate and LSSB with M_R = 50,000 psi:

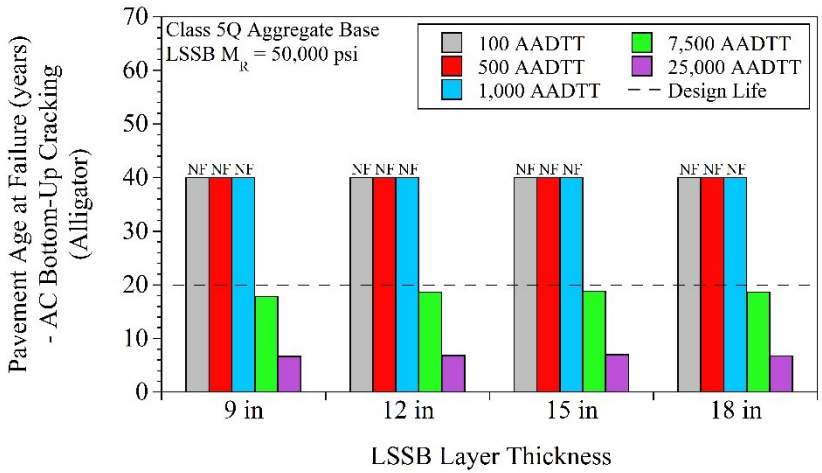






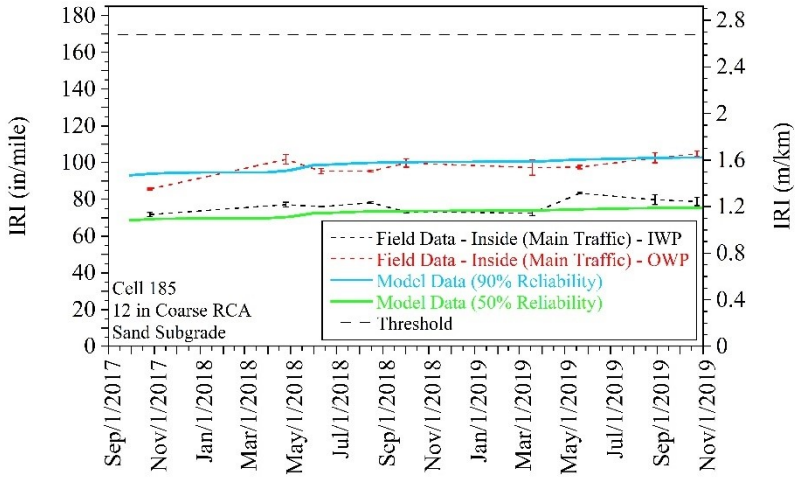


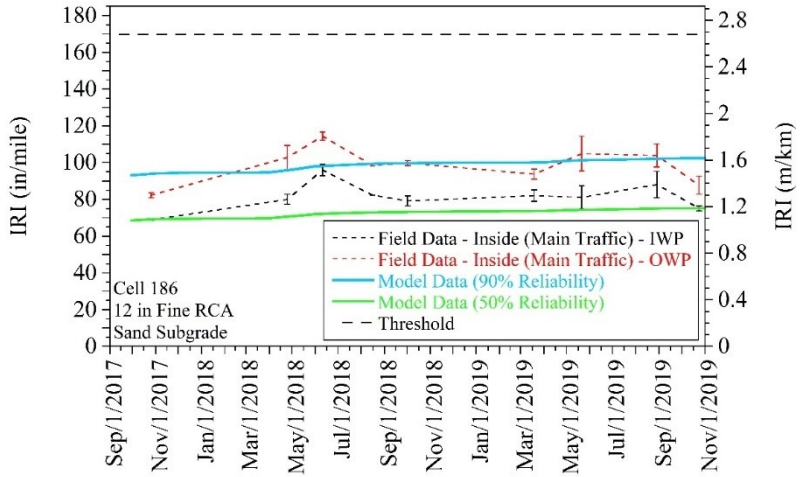

Class 5Q Aggregate Base
LSSB M_R = 50,000 psi
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Threshold
AC Bottom-Up Cracking (Alligator) (% Lane Area)
0
20
40
60
80
100
120
140
9 in
12 in
15 in
18 in
LSSB Layer Thickness

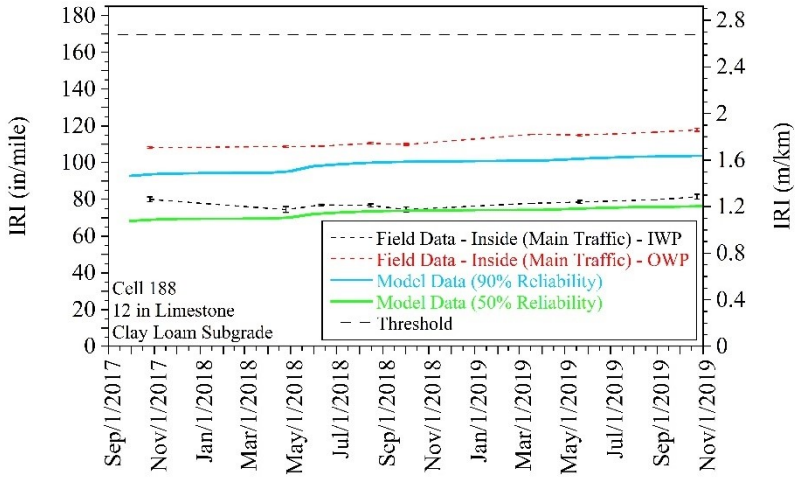

Class 5Q Aggregate Base
LSSB M_R = 50,000 psi
100 AADTT
500 AADTT
1,000 AADTT
7,500 AADTT
25,000 AADTT
Design Life
Pavement Age at Failure (years) - AC Bottom-Up Cracking (Alligator)
0
10
20
30
40
50
60
70
NF NF NF
NF NF NF
NF NF NF
NF NF NF
9 in
12 in
15 in
18 in
LSSB Layer Thickness

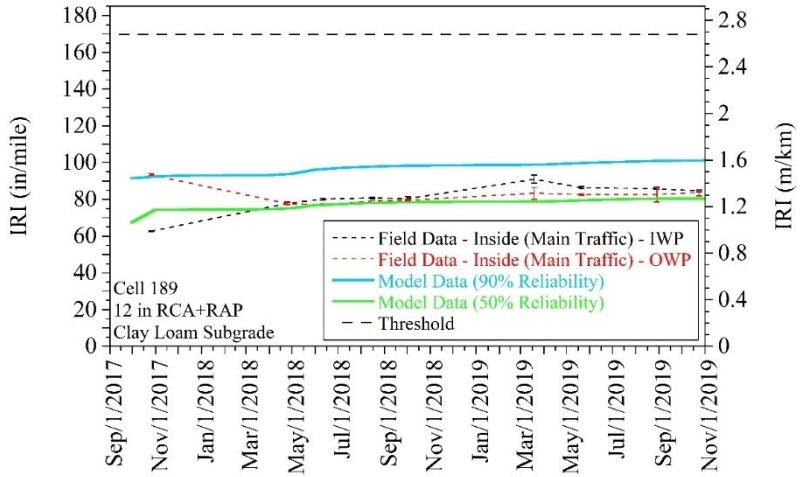
APPENDIX BL
COMPARISON BETWEEN FIELD DATA AND PAVEMENT ME MODELS

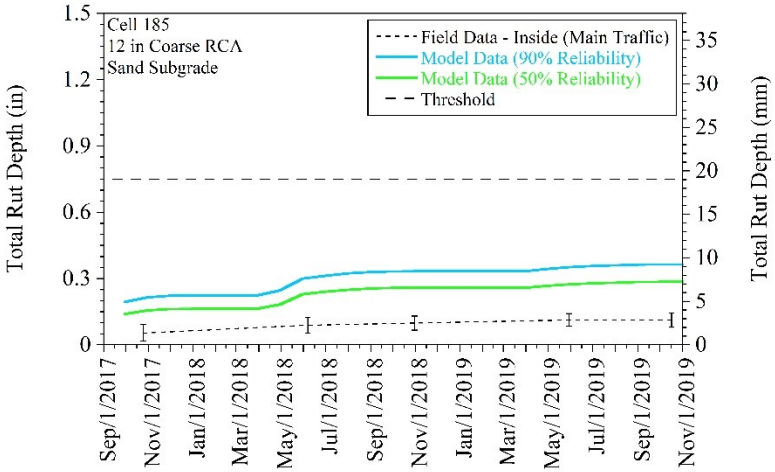
Recycled aggregate base (RAB) group:

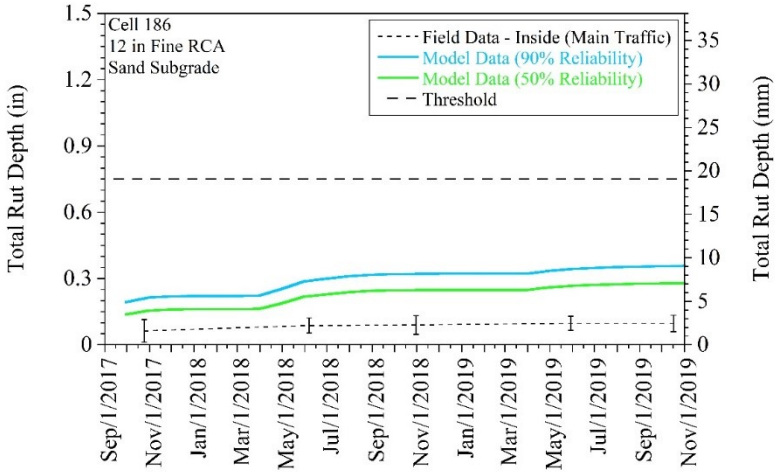


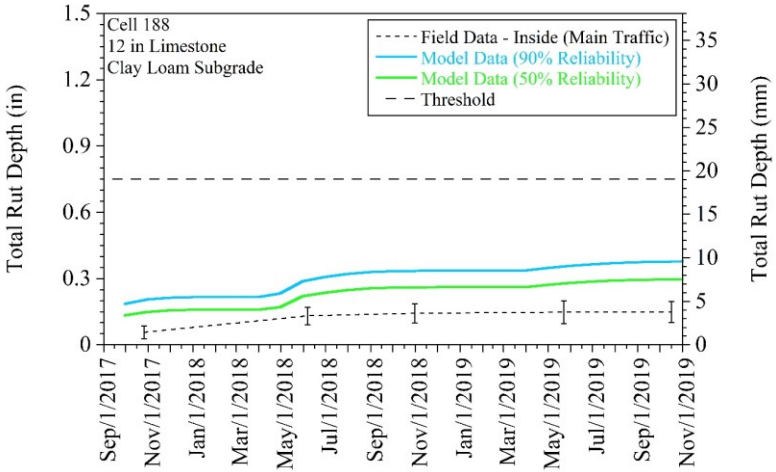


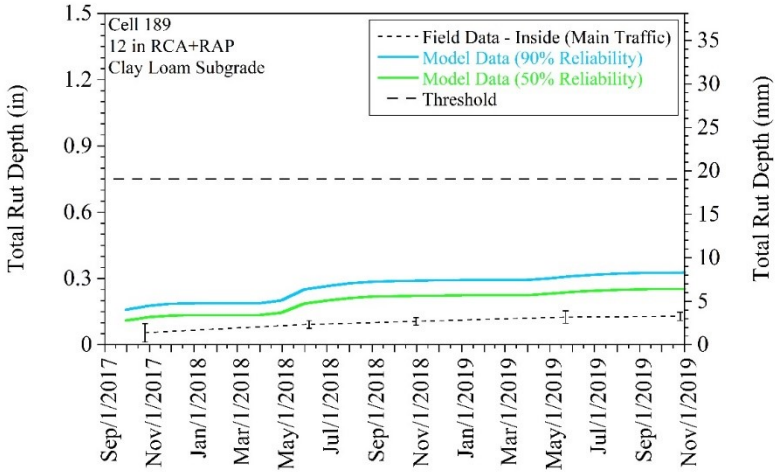


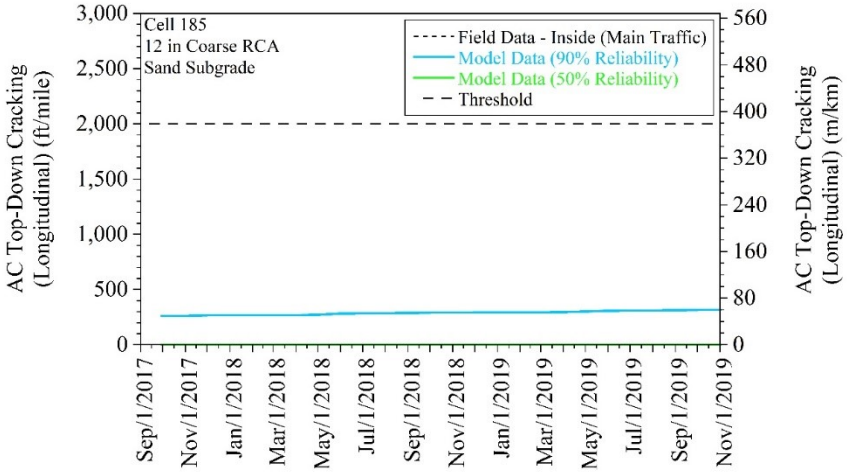


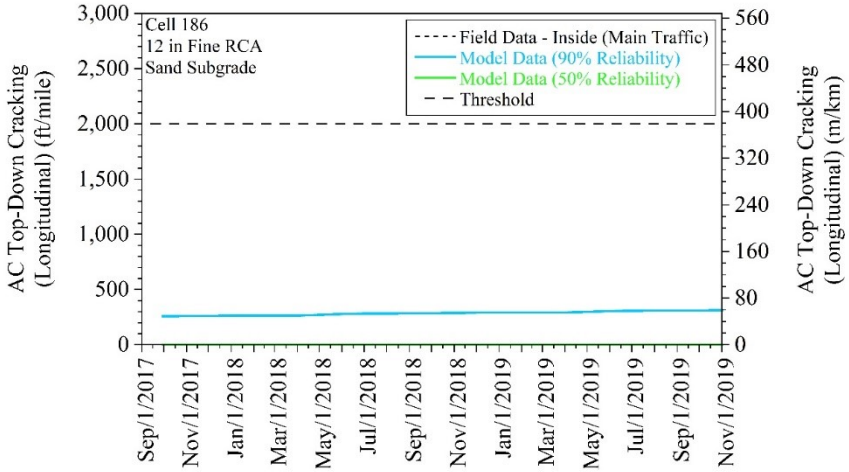

Cell 185
12 in Coarse RCA
Sand Subgrade
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 186
12 in Fine RCA
Sand Subgrade
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

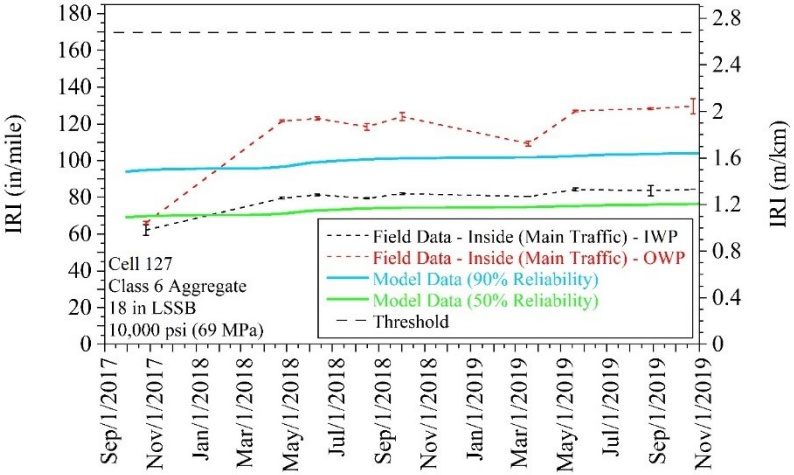

Cell 188
12 in Limestone
Clay Loam Subgrade
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

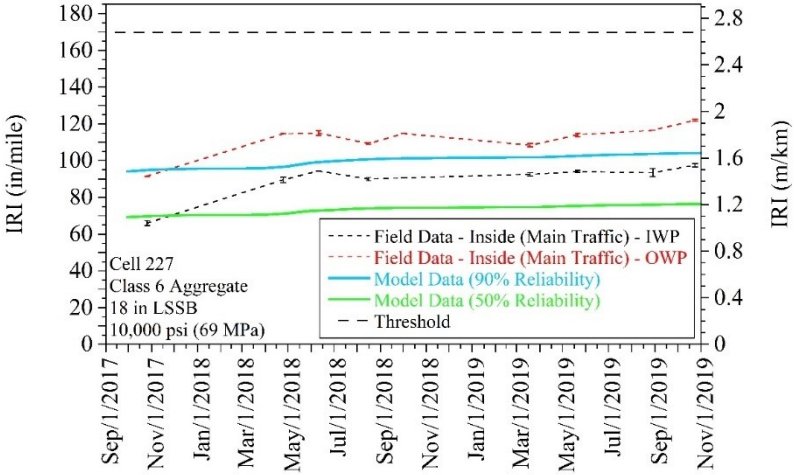

Cell 189
12 in RCA+RAP
Clay Loam Subgrade
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Total Rut Depth (in)
Total Rut Depth (mm)
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

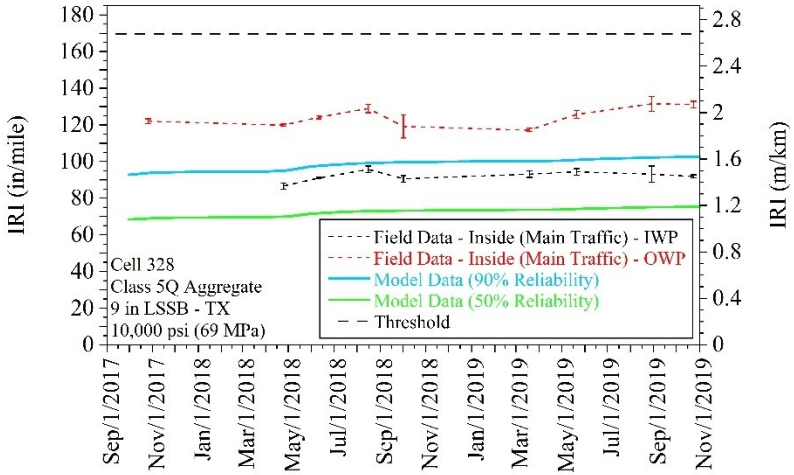


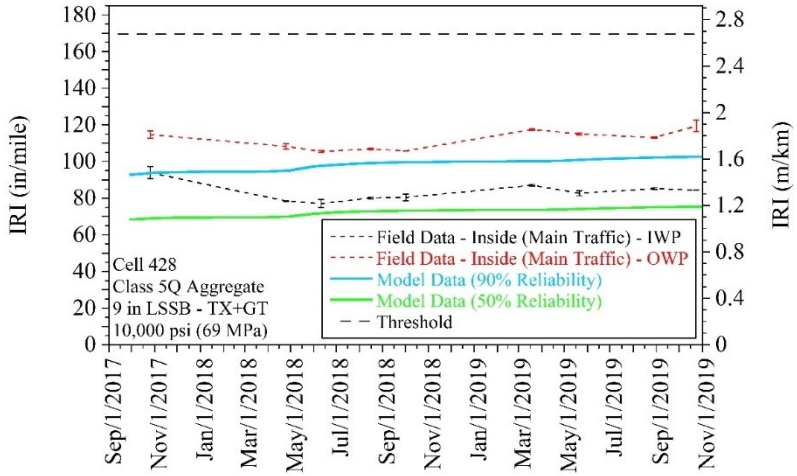


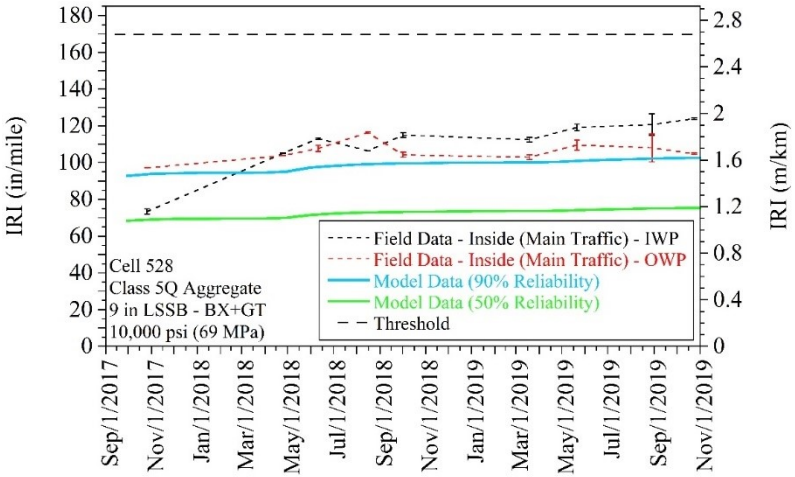
Large stone subbase (LSSB) groups - LSSB M_R = 10,000 psi:

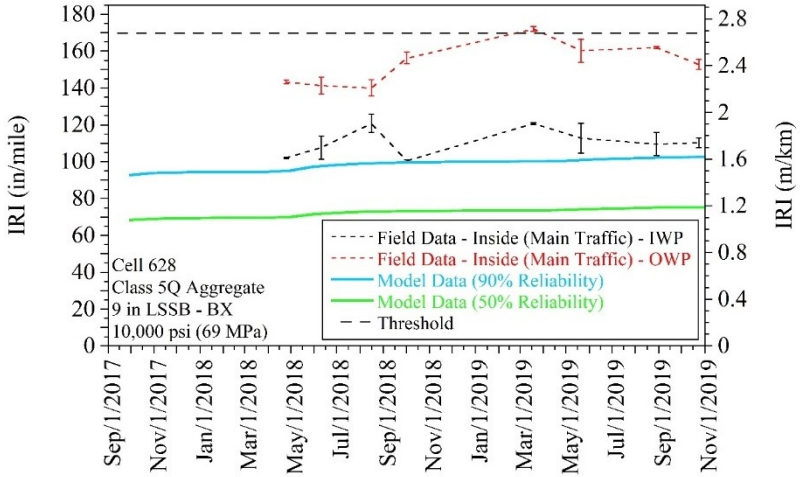


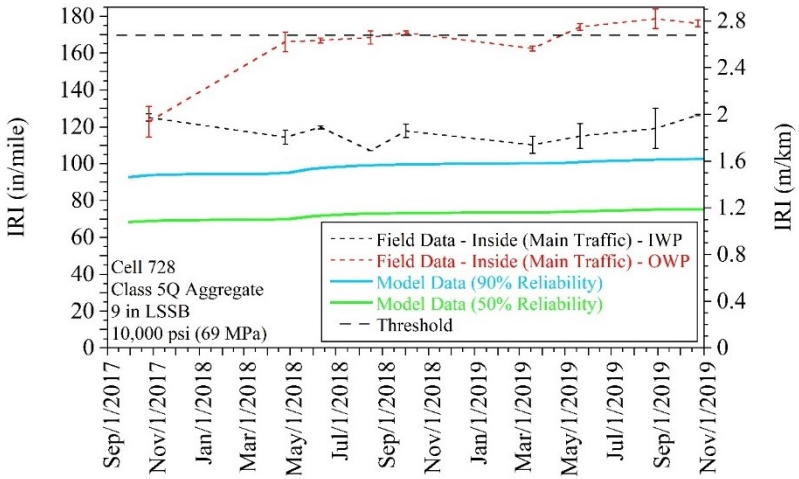


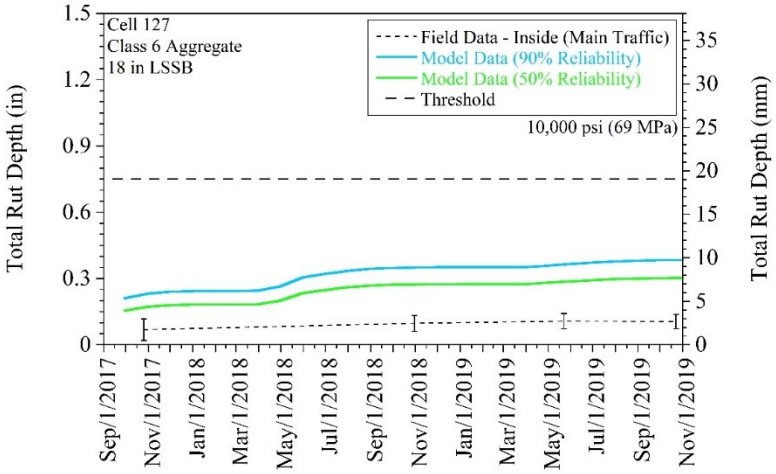

IRI (in/mile)
IRI (m/km)
Cell 328
Class 5Q Aggregate
9 in LSSB - TX
10,000 psi (69 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

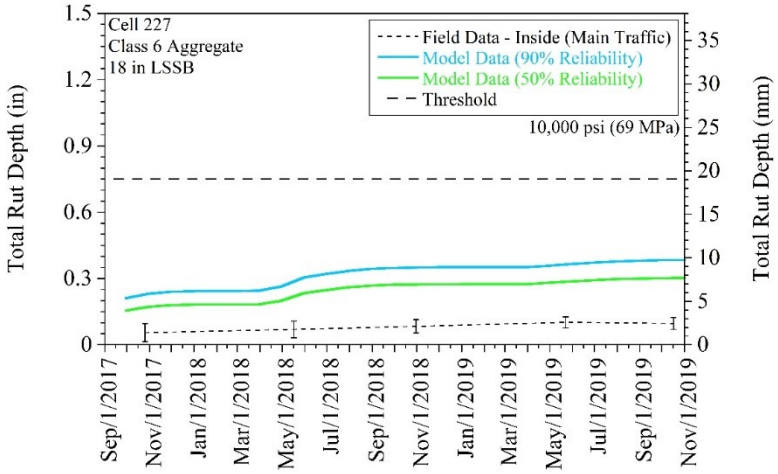

IRI (in/mile)
IRI (m/km)
Cell 428
Class 5Q Aggregate
9 in LSSB - TX+GT
10,000 psi (69 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

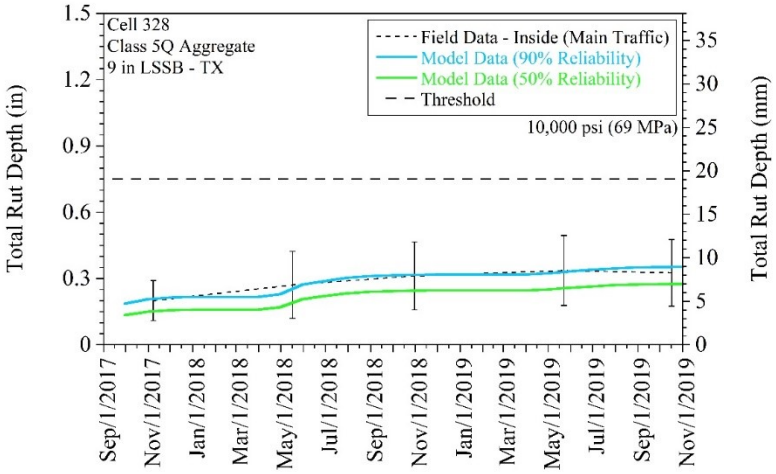

IRI (in/mile)
IRI (m/km)
Cell 528
Class 5Q Aggregate
9 in LSSB - BX+GT
10,000 psi (69 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

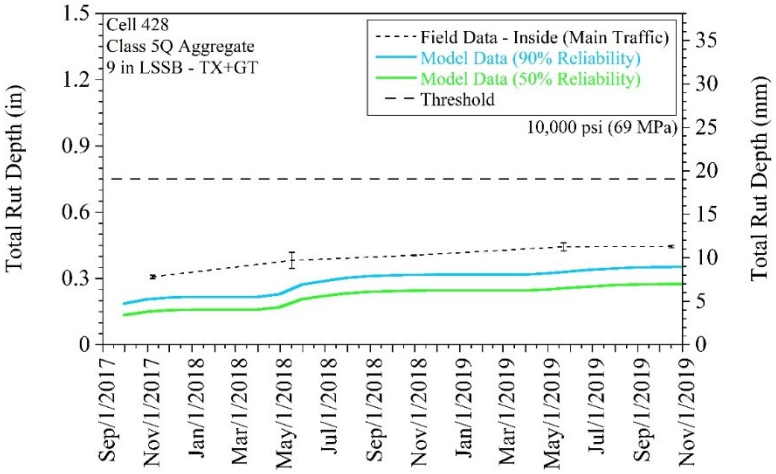

IRI (in/mile)
IRI (m/km)
Cell 628
Class 5Q Aggregate
9 in LSSB - BX
10,000 psi (69 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

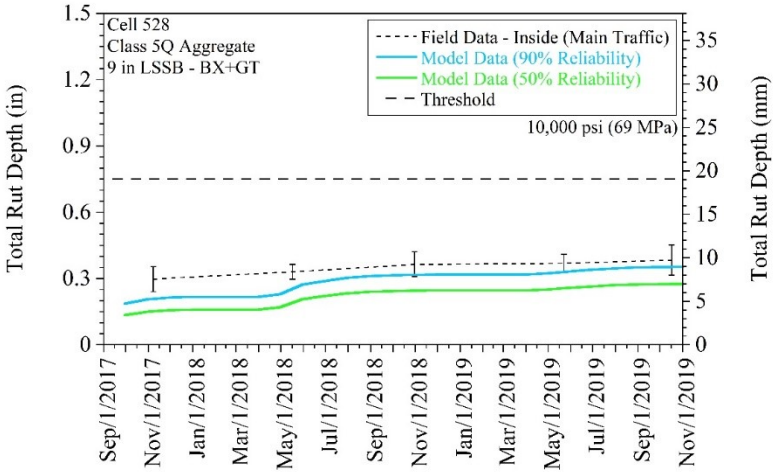

IRI (in/mile)
IRI (m/km)
Cell 728
Class 5Q Aggregate
9 in LSSB
10,000 psi (69 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

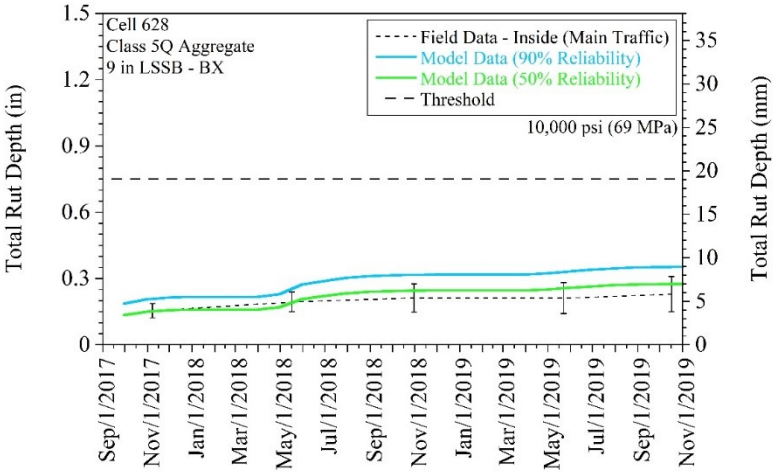

Total Rut Depth (in)
Total Rut Depth (mm)
Cell 127
Class 6 Aggregate
18 in LSSB
10,000 psi (69 MPa)
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

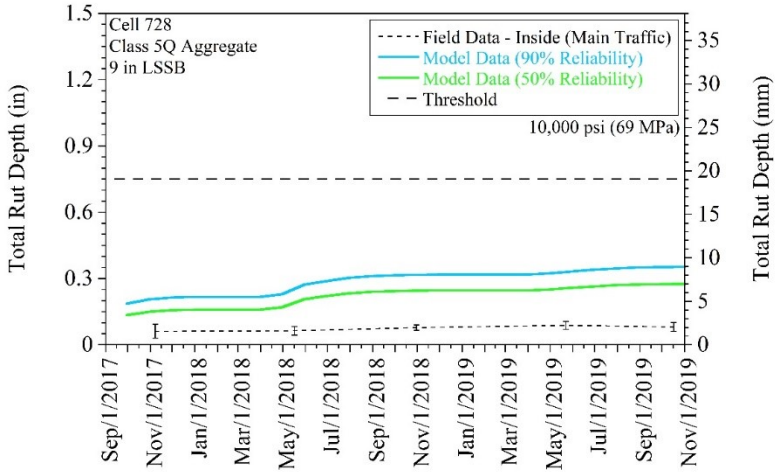

Total Rut Depth (in)
Total Rut Depth (mm)
Cell 227
Class 6 Aggregate
18 in LSSB
10,000 psi (69 MPa)
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 328
Class 5Q Aggregate
9 in LSSB - TX
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
10,000 psi (69 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

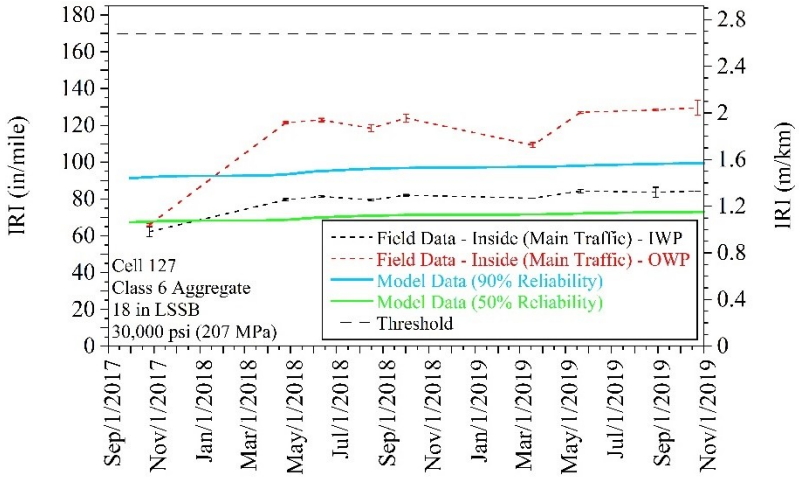

Cell 428
Class 5Q Aggregate
9 in LSSB - TX+GT
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
10,000 psi (69 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)

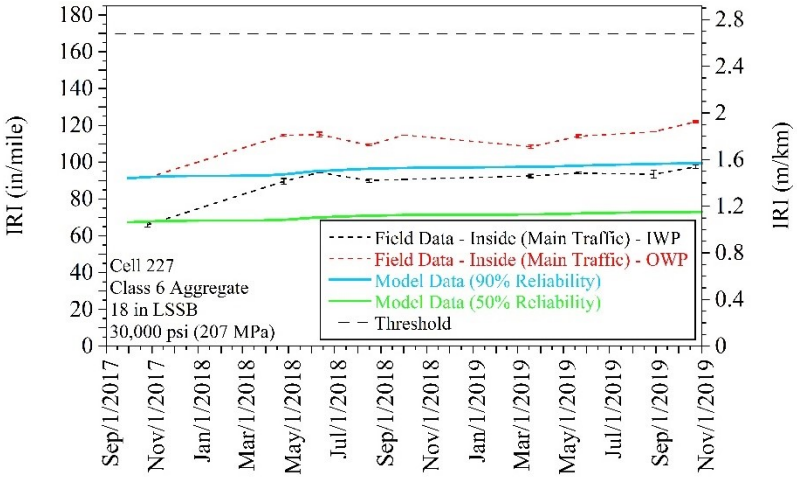

Cell 528
Class 5Q Aggregate
9 in LSSB - BX+GT
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
10,000 psi (69 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)

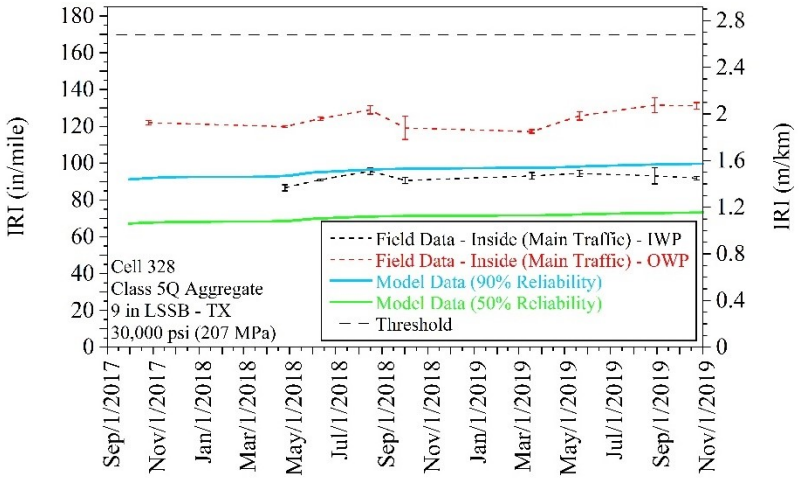

Cell 628
Class 5Q Aggregate
9 in LSSB - BX
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
10,000 psi (69 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)

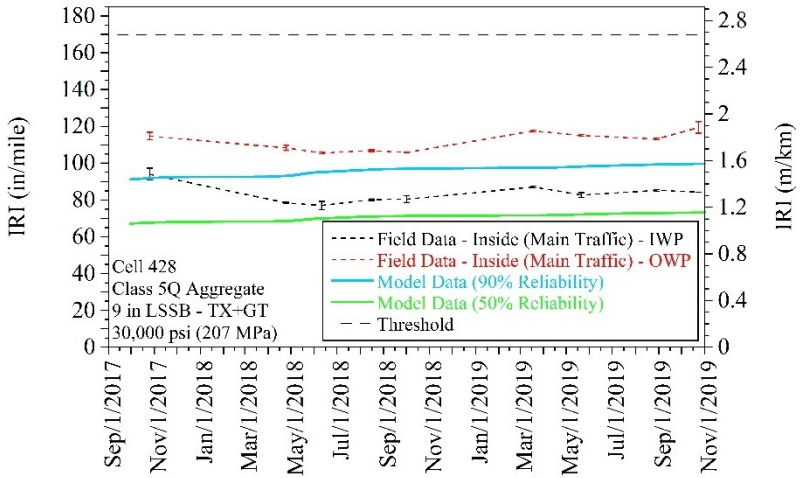


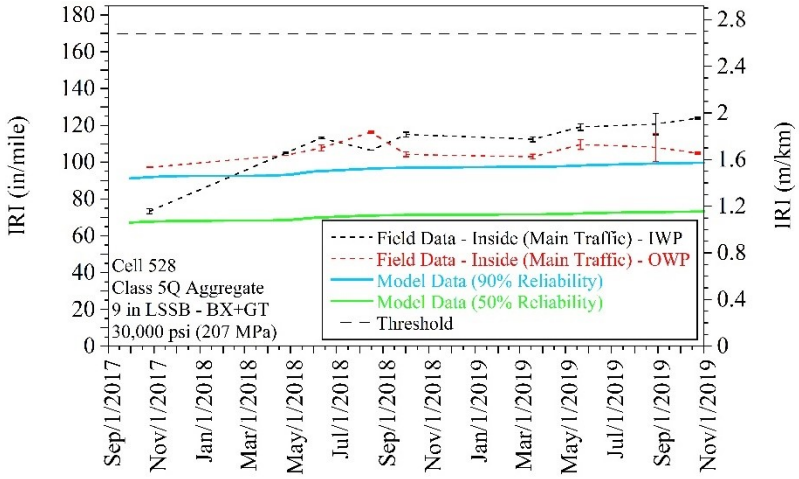
Large stone subbase (LSSB) groups - LSSB M_R = 30,000 psi:

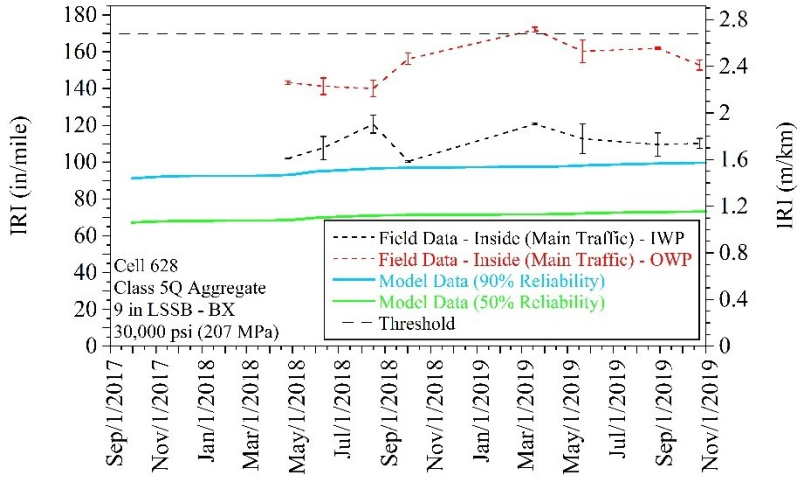





IRI (in/mile)
IRI (m/km)
Cell 328
Class 5Q Aggregate
9 in LSSB - TX
30,000 psi (207 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


IRI (in/mile)
IRI (m/km)
Cell 428
Class 5Q Aggregate
9 in LSSB - TX+GT
30,000 psi (207 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


IRI (in/mile)
IRI (m/km)
Cell 528
Class 5Q Aggregate
9 in LSSB - BX+GT
30,000 psi (207 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


IRI (in/mile)
IRI (m/km)
Cell 628
Class 5Q Aggregate
9 in LSSB - BX
30,000 psi (207 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
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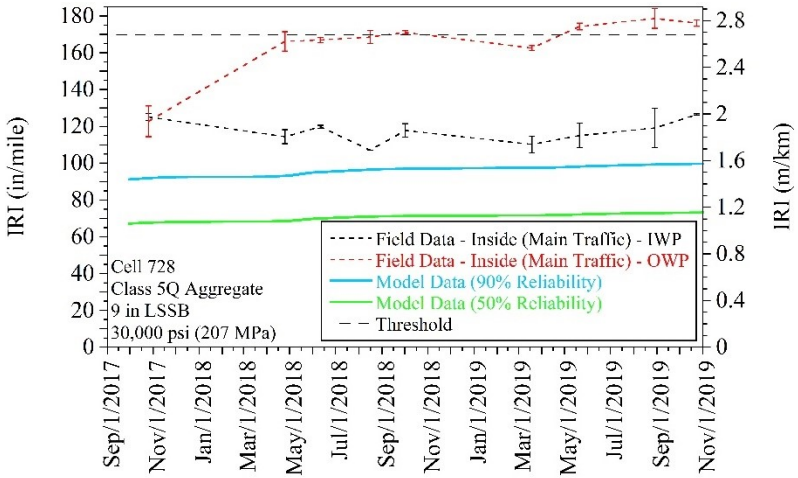
Sep/1/2019
Nov/1/2019


IRI (in/mile)
IRI (m/km)
Cell 728
Class 5Q Aggregate
9 in LSSB
30,000 psi (207 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
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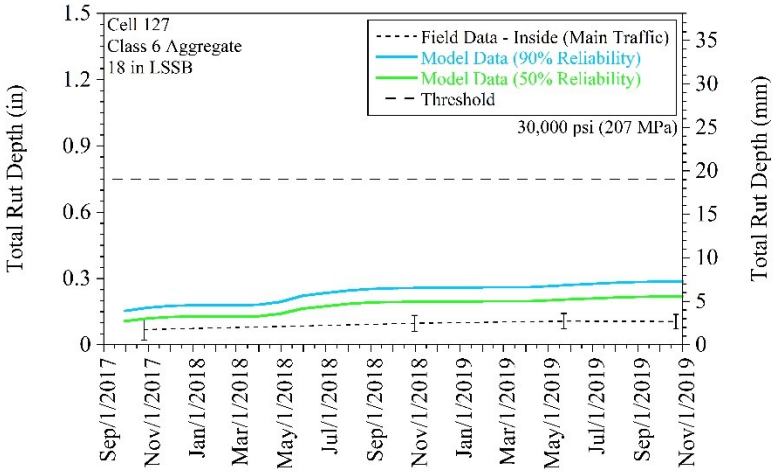
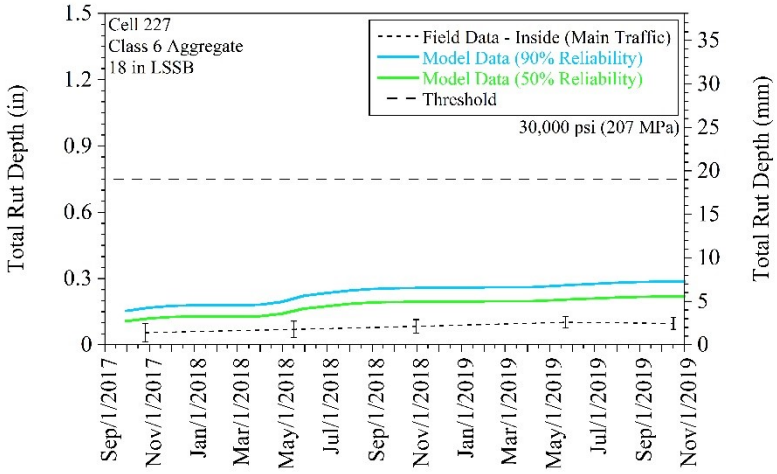
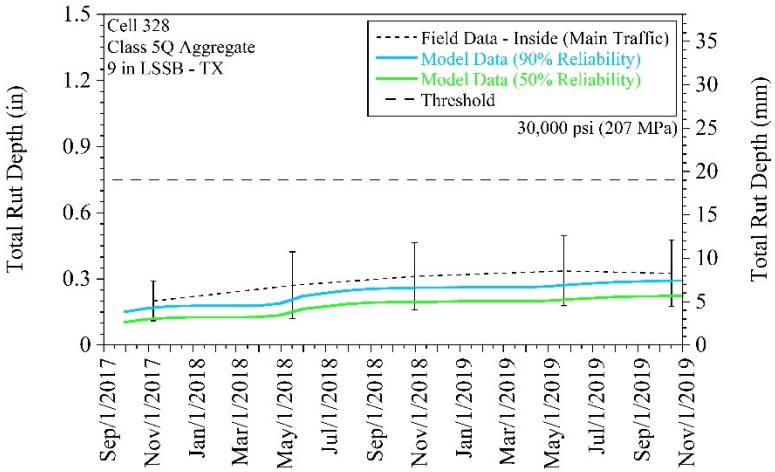
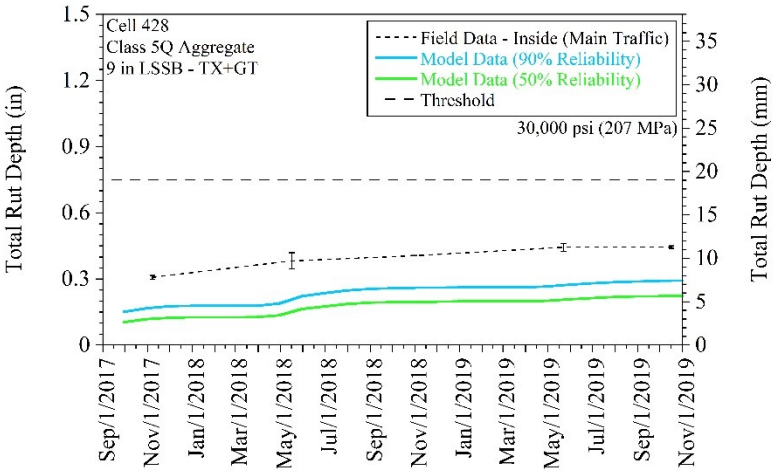
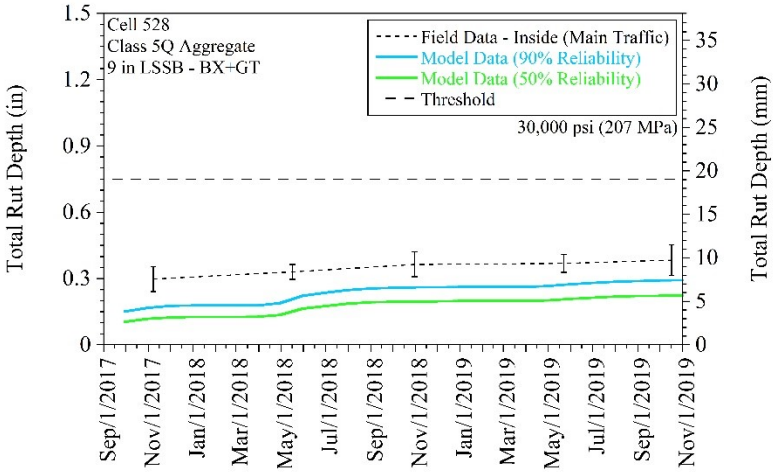
Jul/1/2019
Sep/1/2019
Nov/1/2019

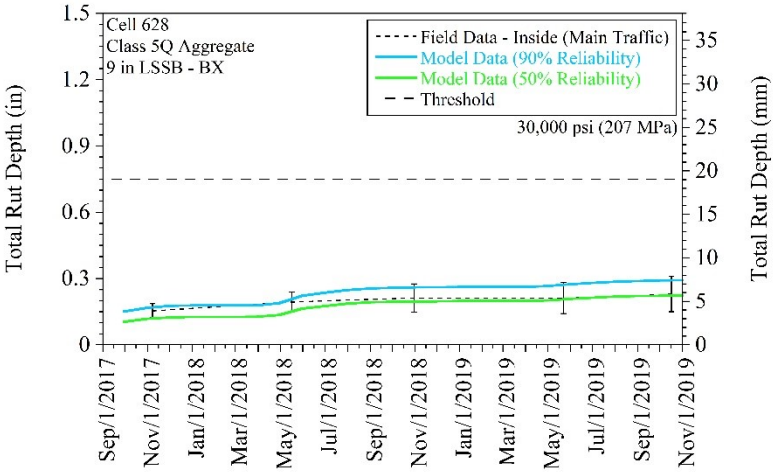

Total Rut Depth (in)
Total Rut Depth (mm)
Cell 127
Class 6 Aggregate
18 in LSSB
30,000 psi (207 MPa)
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

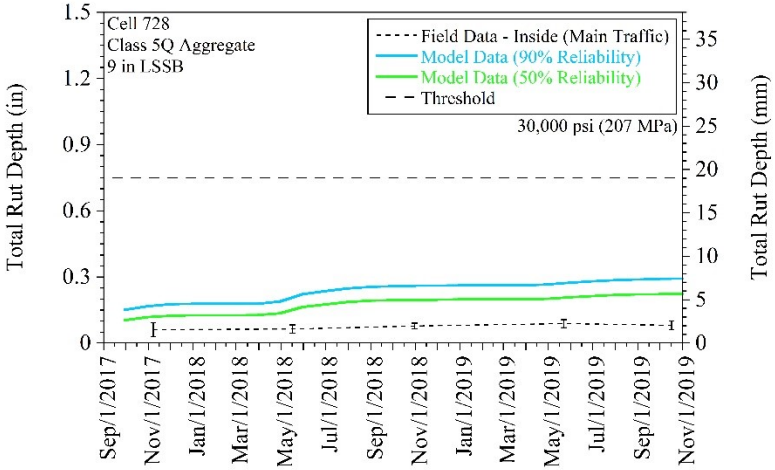

Total Rut Depth (in)
Total Rut Depth (mm)
Cell 227
Class 6 Aggregate
18 in LSSB
30,000 psi (207 MPa)
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 328
Class 5Q Aggregate
9 in LSSB - TX
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
30,000 psi (207 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

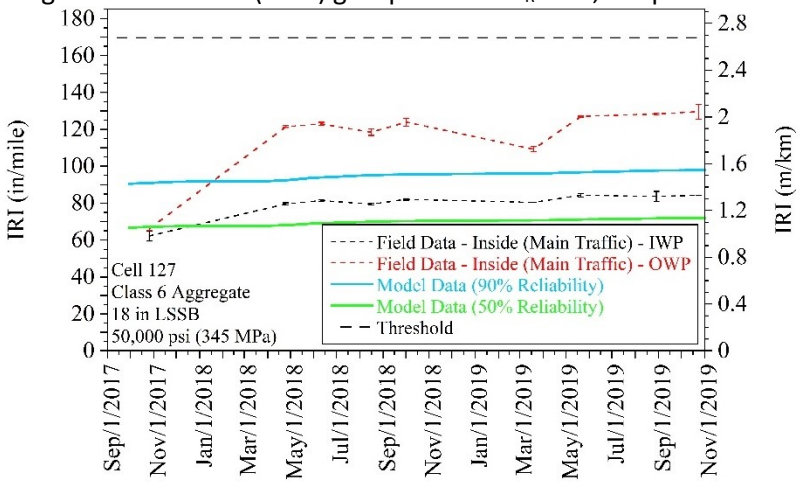

Cell 428
Class 5Q Aggregate
9 in LSSB - TX+GT
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
30,000 psi (207 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)

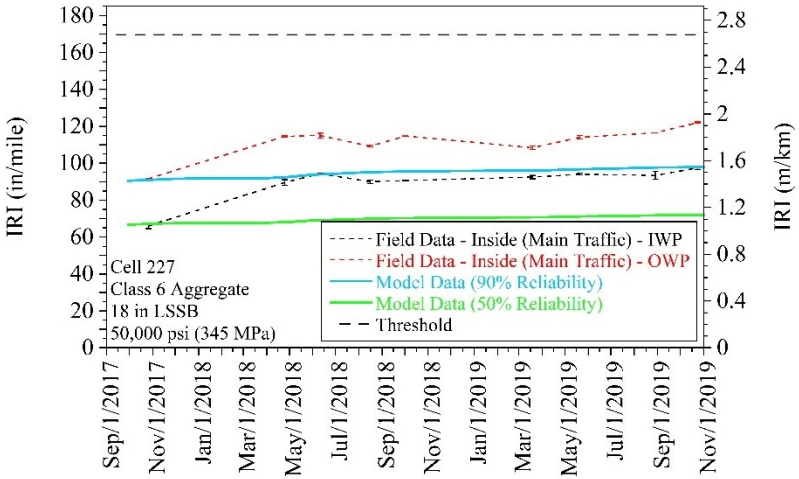

Cell 528
Class 5Q Aggregate
9 in LSSB - BX+GT
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
30,000 psi (207 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)

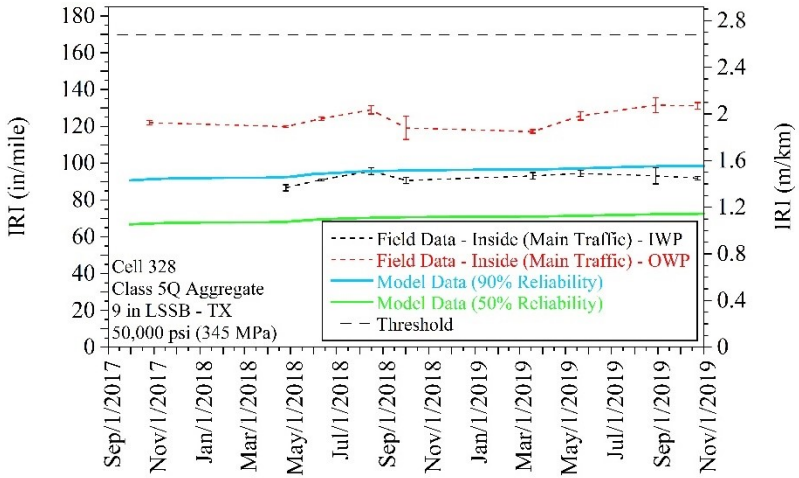

Cell 628
Class 5Q Aggregate
9 in LSSB - BX
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
30,000 psi (207 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)

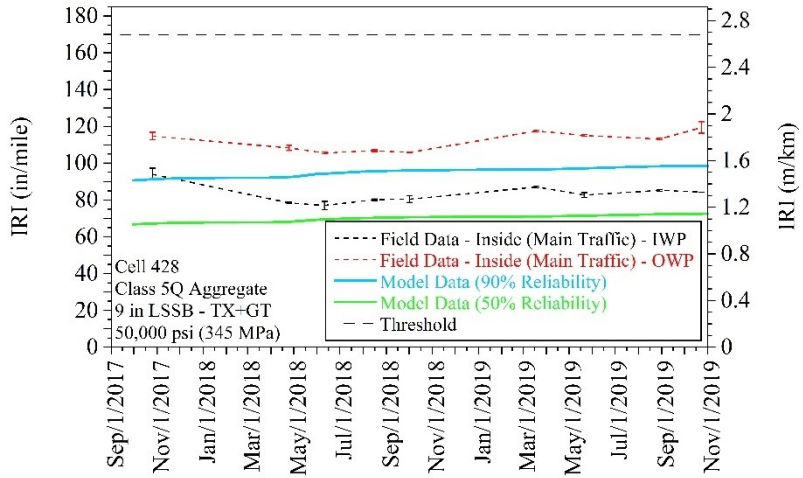


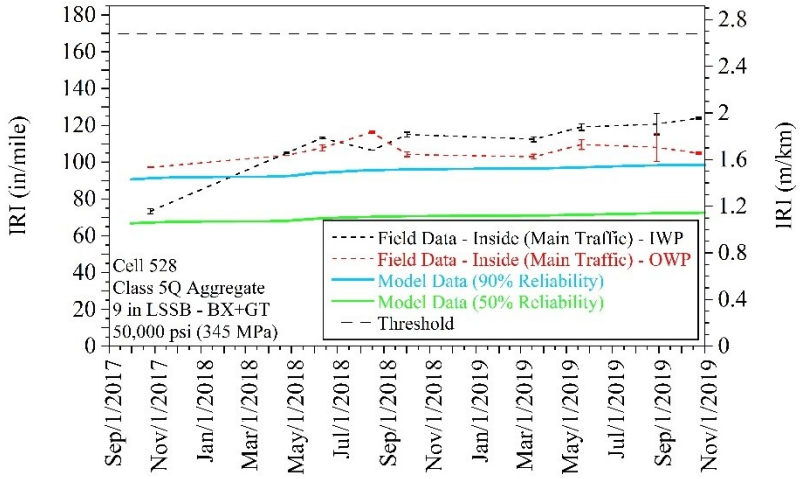
Large stone subbase (LSSB) groups - LSSB M_R = 50,000 psi:

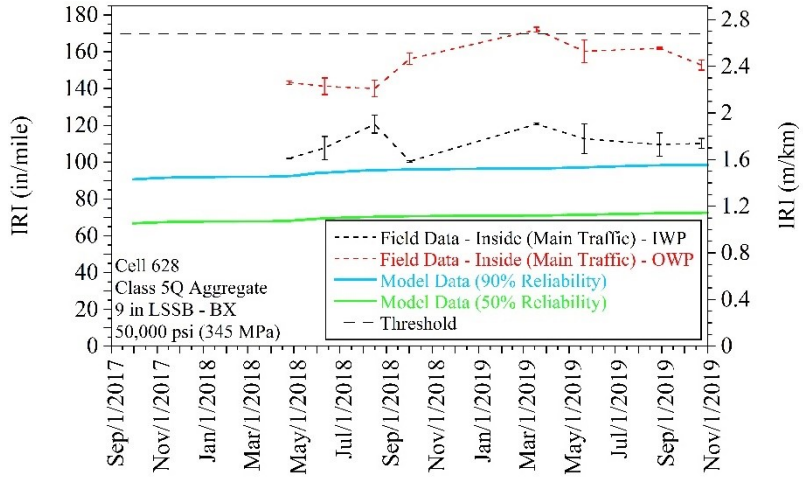


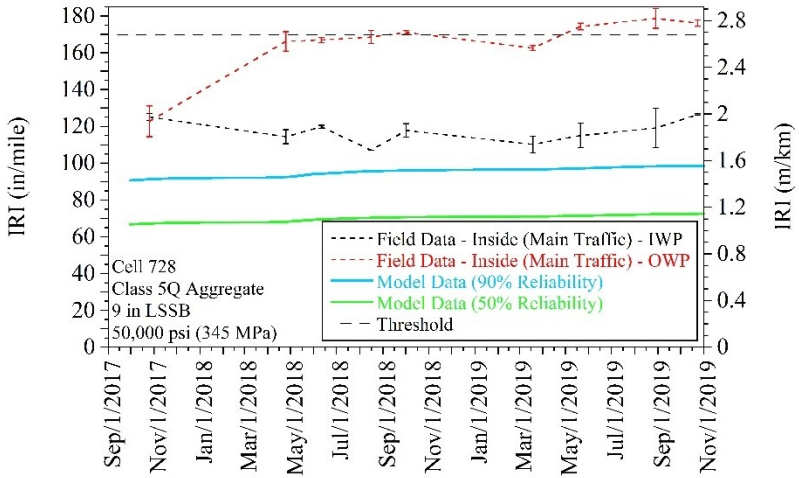


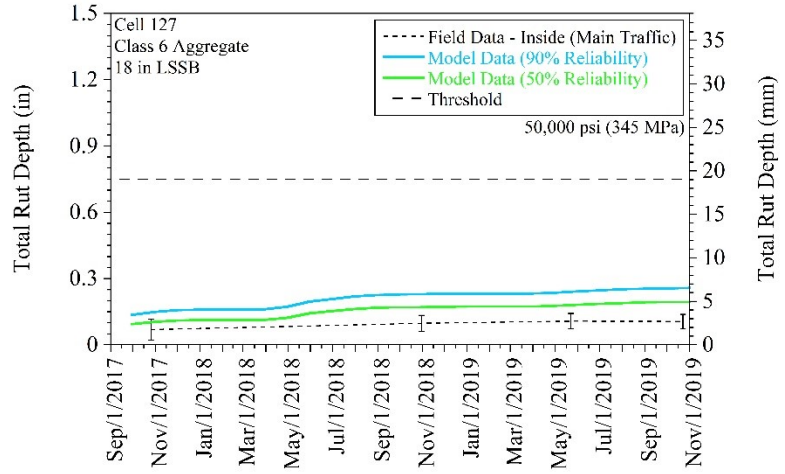

IRI (in/mile)
IRI (m/km)
Cell 328
Class 5Q Aggregate
9 in LSSB - TX
50,000 psi (345 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

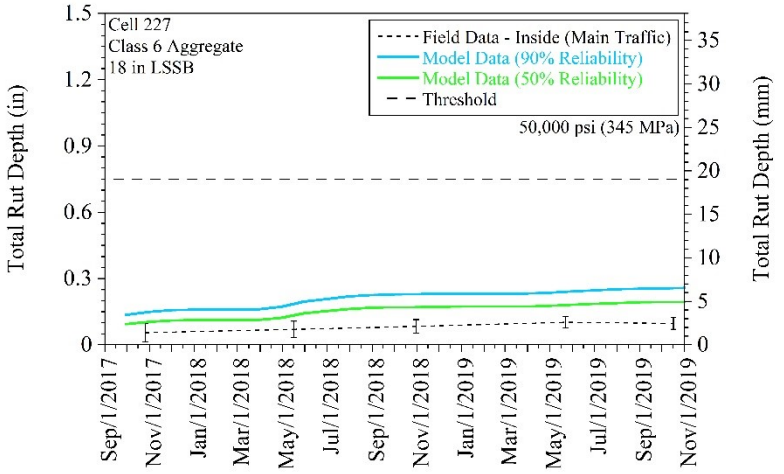

IRI (in/mile)
IRI (m/km)
Cell 428
Class 5Q Aggregate
9 in LSSB - TX+GT
50,000 psi (345 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

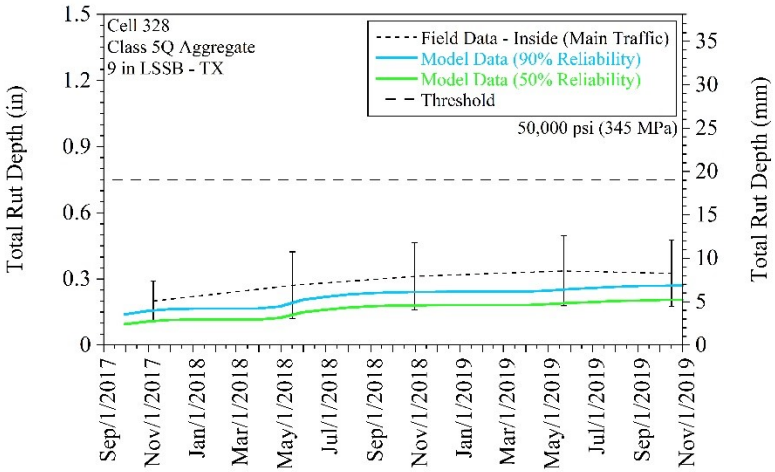

IRI (in/mile)
IRI (m/km)
Cell 528
Class 5Q Aggregate
9 in LSSB - BX+GT
50,000 psi (345 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

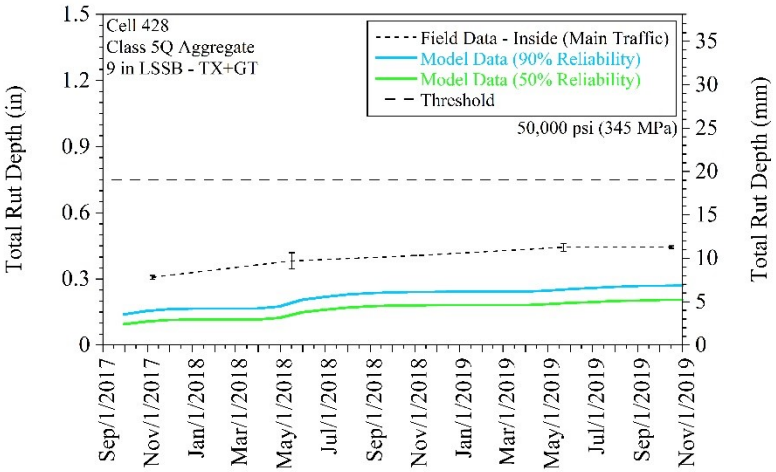

IRI (in/mile)
IRI (m/km)
Cell 628
Class 5Q Aggregate
9 in LSSB - BX
50,000 psi (345 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

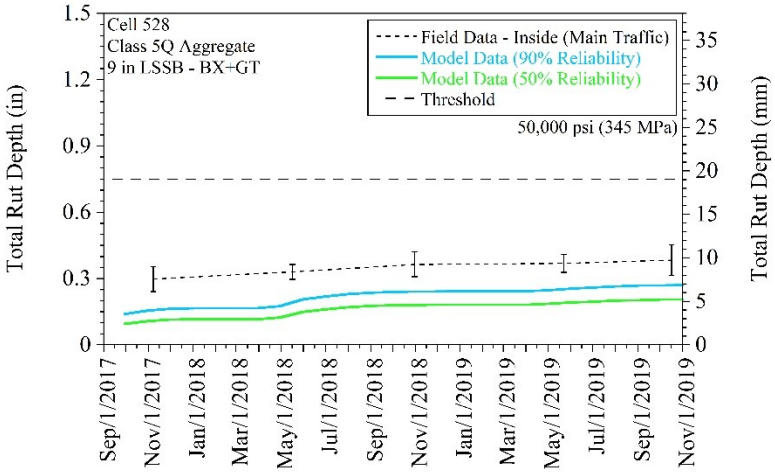

IRI (in/mile)
IRI (m/km)
Cell 728
Class 5Q Aggregate
9 in LSSB
50,000 psi (345 MPa)
Field Data - Inside (Main Traffic) - IWP
Field Data - Inside (Main Traffic) - OWP
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

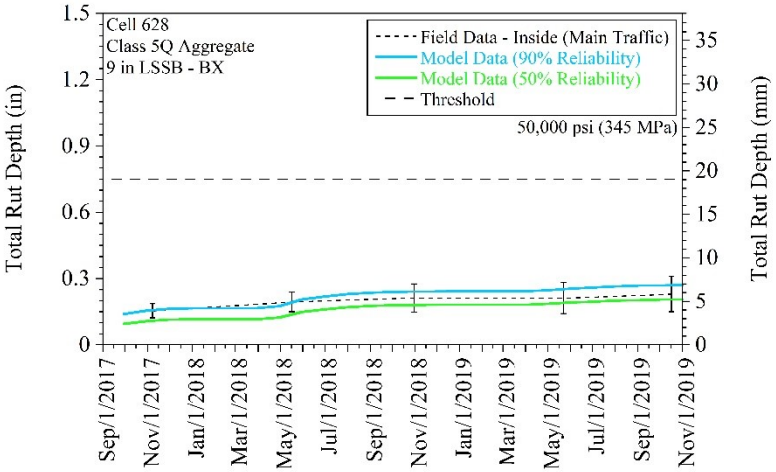

Total Rut Depth (in)
Total Rut Depth (mm)
Cell 127
Class 6 Aggregate
18 in LSSB
50,000 psi (345 MPa)
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Total Rut Depth (in)
Total Rut Depth (mm)
Cell 227
Class 6 Aggregate
18 in LSSB
50,000 psi (345 MPa)
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 328
Class 5Q Aggregate
9 in LSSB - TX
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
50,000 psi (345 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 428
Class 5Q Aggregate
9 in LSSB - TX+GT
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
50,000 psi (345 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 528
Class 5Q Aggregate
9 in LSSB - BX+GT
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
50,000 psi (345 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019


Cell 628
Class 5Q Aggregate
9 in LSSB - BX
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
50,000 psi (345 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
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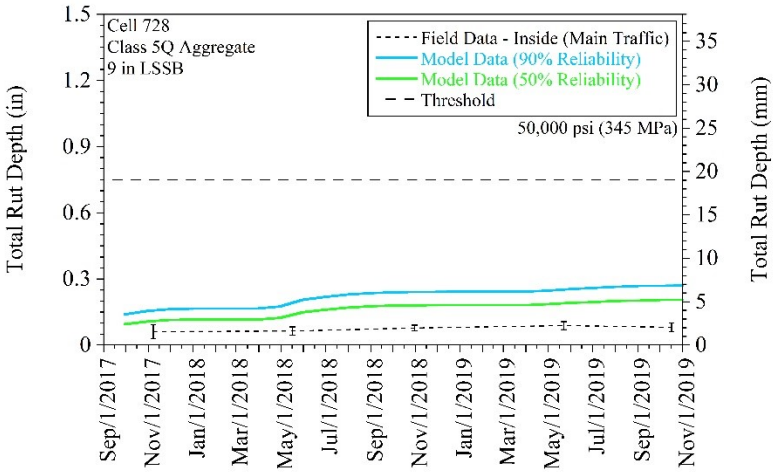
Sep/1/2019
Nov/1/2019


Cell 728
Class 5Q Aggregate
9 in LSSB
Field Data - Inside (Main Traffic)
Model Data (90% Reliability)
Model Data (50% Reliability)
Threshold
50,000 psi (345 MPa)
Total Rut Depth (in)
Total Rut Depth (mm)
1.5
1.2
0.9
0.6
0.3
0
35
30
25
20
15
10
5
0
Sep/1/2017
Nov/1/2017
Jan/1/2018
Mar/1/2018
May/1/2018
Jul/1/2018
Sep/1/2018
Nov/1/2018
Jan/1/2019
Mar/1/2019
May/1/2019
Jul/1/2019
Sep/1/2019
Nov/1/2019

APPENDIX BM
ASPHALT CONCRETE (AC) OVER AC OVERLAY DESIGNS

For Cell 185 (overlay asphalt binder = Superpave PG 58-34):

Design Inputs

Design Life:	40 years	Existing construction:	August, 2017	Climate Data Sources	45.5, -93.75
Design Type:	ACC_ACC	Pavement construction:	September, 2018		45, -93.75
		Traffic opening:	September, 2018		45.5, -93.125
					45, -93.125
					45.5, -94.375
					45, -94.375

Design Structure

Layer type	Material Type	Thickness (in)
Flexible (OL)	Default asphalt concrete	4.0
Flexible (existing)	Default asphalt concrete	2.5
NonStabilized	A-1-a	12.0
NonStabilized	A-1-b	3.5
Subgrade	A-1-b	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	11.6
Air voids (%)	7.0

Traffic

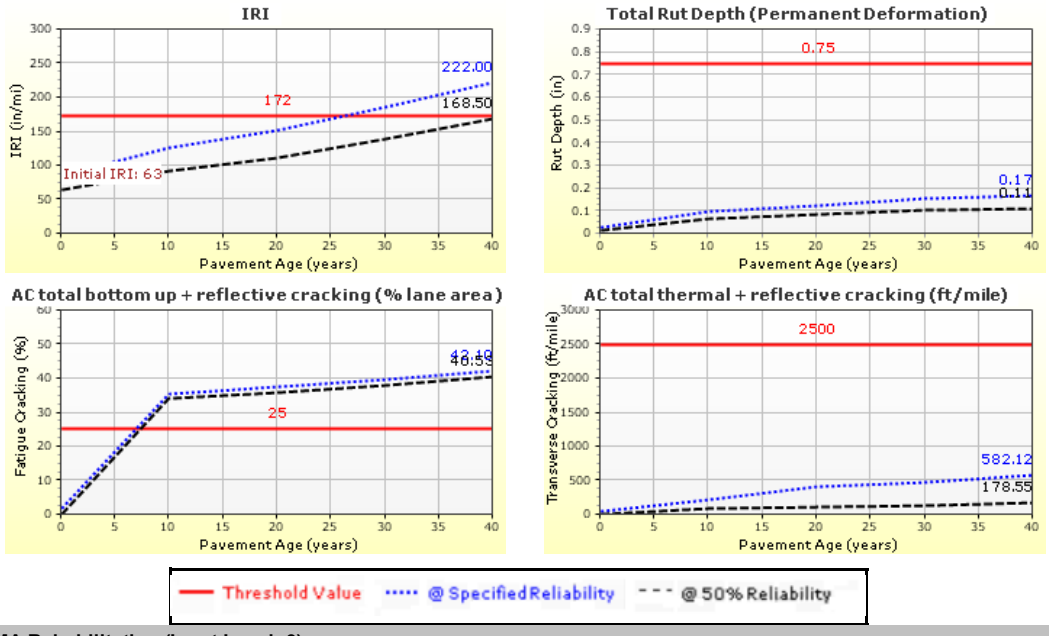
Age (year)	Heavy Trucks (cumulative)
2018 (initial)	1,000
2038 (20 years)	3,520,100
2058 (40 years)	8,683,820

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	222.01	90.00	53.33	Fail
Permanent deformation - total pavement (in)	0.75	0.17	90.00	100.00	Pass
AC total fatigue cracking: bottom up + reflective (% lane area)	25.00	42.10	90.00	0.00	Fail
AC total transverse cracking: thermal + reflective (ft/mile)	2500.00	582.12	90.00	100.00	Pass
Permanent deformation - AC only (in)	0.25	0.16	90.00	99.96	Pass
AC bottom-up fatigue cracking (% lane area)	25.00	0.00	50.00	100.00	Pass
AC thermal cracking (ft/mile)	1000.00	103.59	50.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	4257.96	90.00	60.88	Fail

Distress Charts



HMA Rehabilitation (Input Level: 3)

Milled thickness (in)	1.00
Structural rating	Fair
Environmental rating	Good
Total rut depth (in)	0.70

For Cell 186 (overlay asphalt binder = Superpave PG 58-34):

Design Inputs

Design Life:	40 years	Existing construction:	August, 2017	Climate Data Sources	45.5, -93.75 45, -93.75 45.5, -93.125 45. -93.125 45.5, -94.375 45, -94.375
Design Type:	ACC_ACC	Pavement construction:	September, 2018		
		Traffic opening:	September, 2018		

Design Structure

Layer type	Material Type	Thickness (in)
Flexible (OL)	Default asphalt concrete	4.0
Flexible (existing)	Default asphalt concrete	2.5
NonStabilized	A-1-a	12.0
NonStabilized	A-1-b	3.5
Subgrade	A-1-b	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	11.6
Air voids (%)	7.0

Traffic

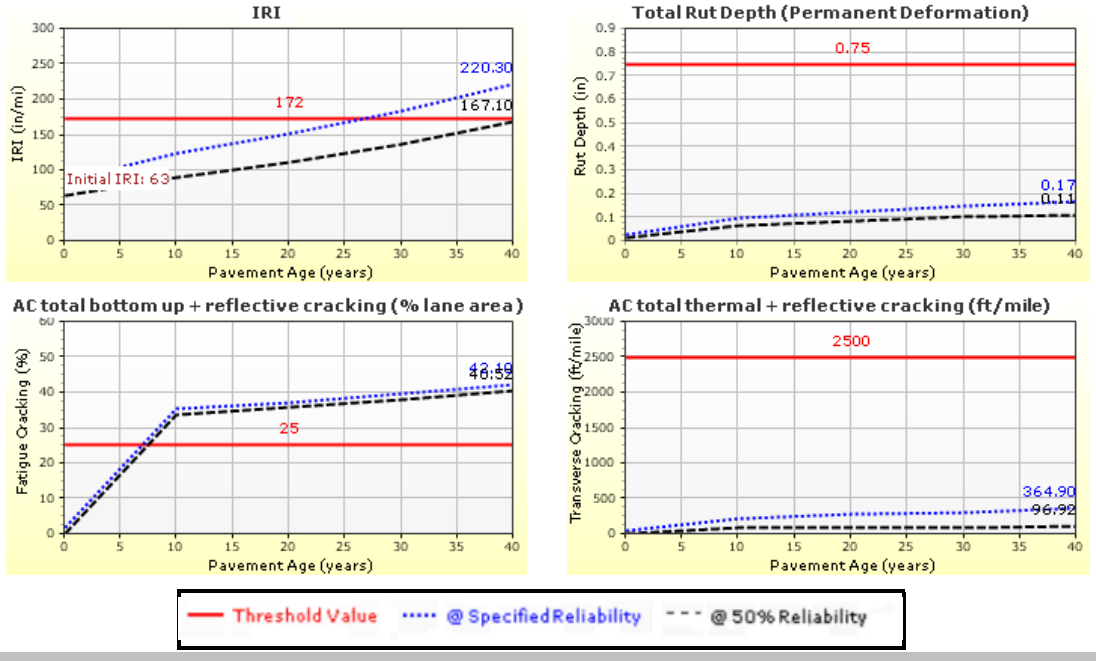
Age (year)	Heavy Trucks (cumulative)
2018 (initial)	1,000
2038 (20 years)	3,520,100
2058 (40 years)	8,683,820

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	220.28	90.00	54.71	Fail
Permanent deformation - total pavement (in)	0.75	0.17	90.00	100.00	Pass
AC total fatigue cracking: bottom up + reflective (% lane area)	25.00	42.10	90.00	0.00	Fail
AC total transverse cracking: thermal + reflective (ft/mile)	2500.00	364.90	90.00	100.00	Pass
Permanent deformation - AC only (in)	0.25	0.16	90.00	99.96	Pass
AC bottom-up fatigue cracking (% lane area)	25.00	0.00	50.00	100.00	Pass
AC thermal cracking (ft/mile)	1000.00	21.96	50.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	2646.38	90.00	82.52	Fail

Distress Charts



HMA Rehabilitation (Input Level: 3)

Milled thickness (in)	1.00
Structural rating	Fair
Environmental rating	Good
Total rut depth (in)	0.70

For Cell 188 (overlay asphalt binder = Superpave PG 58-34):

Design Inputs

Design Life:	40 years	Existing construction:	August, 2017	Climate Data Sources	45.5, -93.75 45, -93.75 45.5, -93.125 45. -93.125 45.5, -94.375 45, -94.375
Design Type:	ACC_ACC	Pavement construction:	September, 2018		
		Traffic opening:	September, 2018		

Design Structure

Layer type	Material Type	Thickness (in)
Flexible (OL)	Default asphalt concrete	4.0
Flexible (existing)	Default asphalt concrete	2.5
NonStabilized	A-1-a	12.0
NonStabilized	A-1-b	3.5
Subgrade	A-6	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	11.6
Air voids (%)	7.0

Traffic

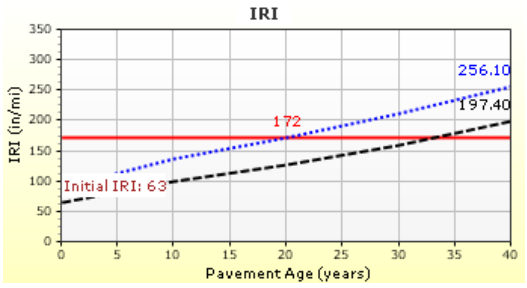
Age (year)	Heavy Trucks (cumulative)
2018 (initial)	1,000
2038 (20 years)	3,520,100
2058 (40 years)	8,683,820

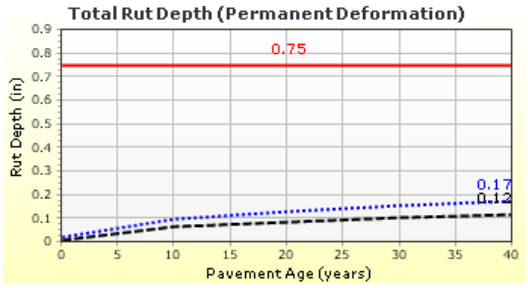
Design Outputs

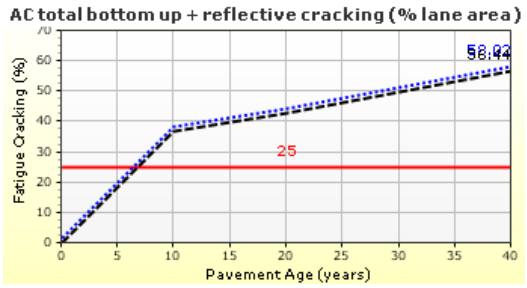
Distress Prediction Summary

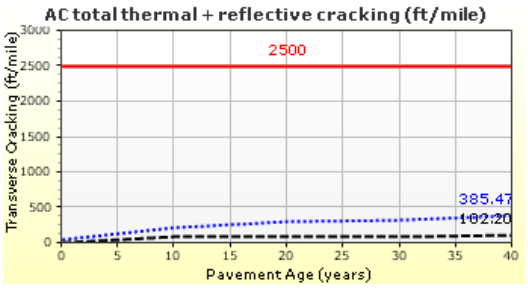
Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	256.08	90.00	28.97	Fail
Permanent deformation - total pavement (in)	0.75	0.17	90.00	100.00	Pass
AC total fatigue cracking: bottom up + reflective (% lane area)	25.00	58.02	90.00	0.00	Fail
AC total transverse cracking: thermal + reflective (ft/mile)	2500.00	385.47	90.00	100.00	Pass
Permanent deformation - AC only (in)	0.25	0.15	90.00	100.00	Pass
AC bottom-up fatigue cracking (% lane area)	25.00	0.00	50.00	100.00	Pass
AC thermal cracking (ft/mile)	1000.00	27.24	50.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	13803.87	90.00	0.03	Fail

Distress Charts









HMA Rehabilitation (Input Level: 3)

Milled thickness (in)	1.00
Structural rating	Fair
Environmental rating	Good
Total rut depth (in)	0.70

For Cell 189 (overlay asphalt binder = Superpave PG 58-34):

Design Inputs

Design Life:	40 years	Existing construction:	August, 2017	Climate Data Sources	45.5, -93.75 45, -93.75 45.5, -93.125 45. -93.125 45.5, -94.375 45, -94.375
Design Type:	ACC_ACC	Pavement construction:	September, 2018		
		Traffic opening:	September, 2018		

Design Structure

Layer type	Material Type	Thickness (in)
Flexible (OL)	Default asphalt concrete	4.0
Flexible (existing)	Default asphalt concrete	2.5
NonStabilized	A-1-a	12.0
NonStabilized	A-1-b	3.5
Subgrade	A-6	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	11.6
Air voids (%)	7.0

Traffic

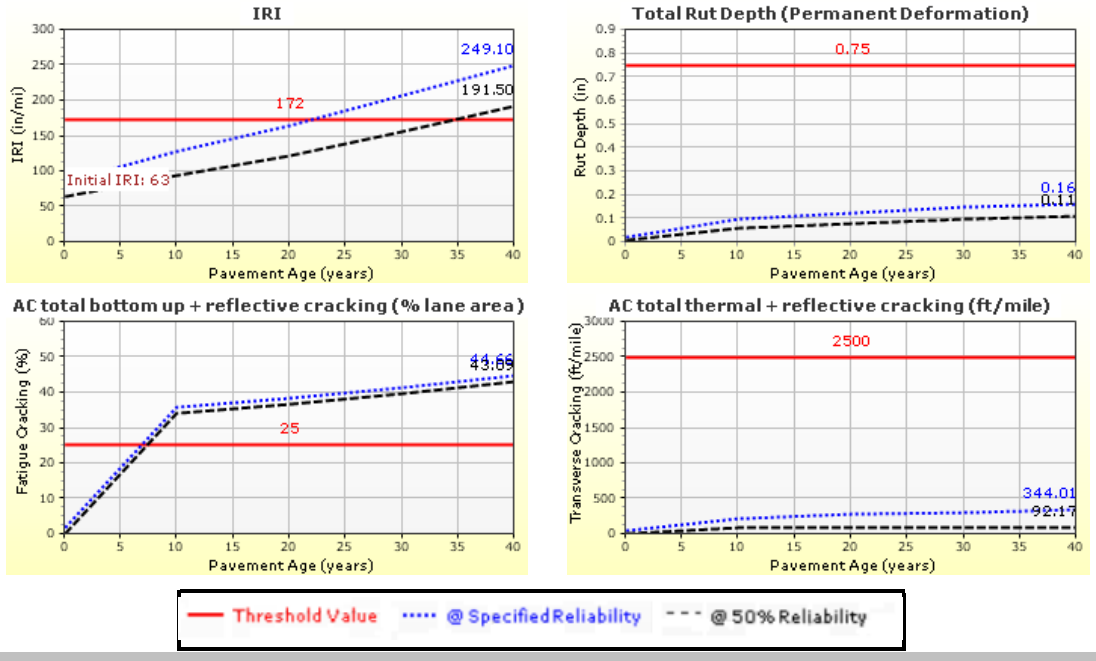
Age (year)	Heavy Trucks (cumulative)
2018 (initial)	1,000
2038 (20 years)	3,520,100
2058 (40 years)	8,683,820

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	249.07	90.00	33.17	Fail
Permanent deformation - total pavement (in)	0.75	0.16	90.00	100.00	Pass
AC total fatigue cracking: bottom up + reflective (% lane area)	25.00	44.66	90.00	0.00	Fail
AC total transverse cracking: thermal + reflective (ft/mile)	2500.00	344.01	90.00	100.00	Pass
Permanent deformation - AC only (in)	0.25	0.16	90.00	99.98	Pass
AC bottom-up fatigue cracking (% lane area)	25.00	0.00	50.00	100.00	Pass
AC thermal cracking (ft/mile)	1000.00	17.21	50.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	13803.16	90.00	0.03	Fail

Distress Charts



HMA Rehabilitation (Input Level: 3)

Milled thickness (in)	1.00
Structural rating	Fair
Environmental rating	Good
Total rut depth (in)	0.70

For Cell 127/227 (overlay asphalt binder = Superpave PG 58-34) (LSSB M_R = 10,000 psi):

Design Inputs

Design Life:	40 years	Existing construction:	August, 2017	Climate Data Sources	45.5, -93.75 45, -93.75 45.5, -93.125 45. -93.125 45.5, -94.375 45, -94.375
Design Type:	ACC_ACC	Pavement construction:	September, 2018		
		Traffic opening:	September, 2018		

Design Structure

Layer type	Material Type	Thickness (in)
Flexible (OL)	Default asphalt concrete	4.0
Flexible (existing)	Default asphalt concrete	2.5
NonStabilized	A-1-a	6.0
NonStabilized	A-1-b	18.0
Subgrade	A-6	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	11.6
Air voids (%)	7.0

Traffic

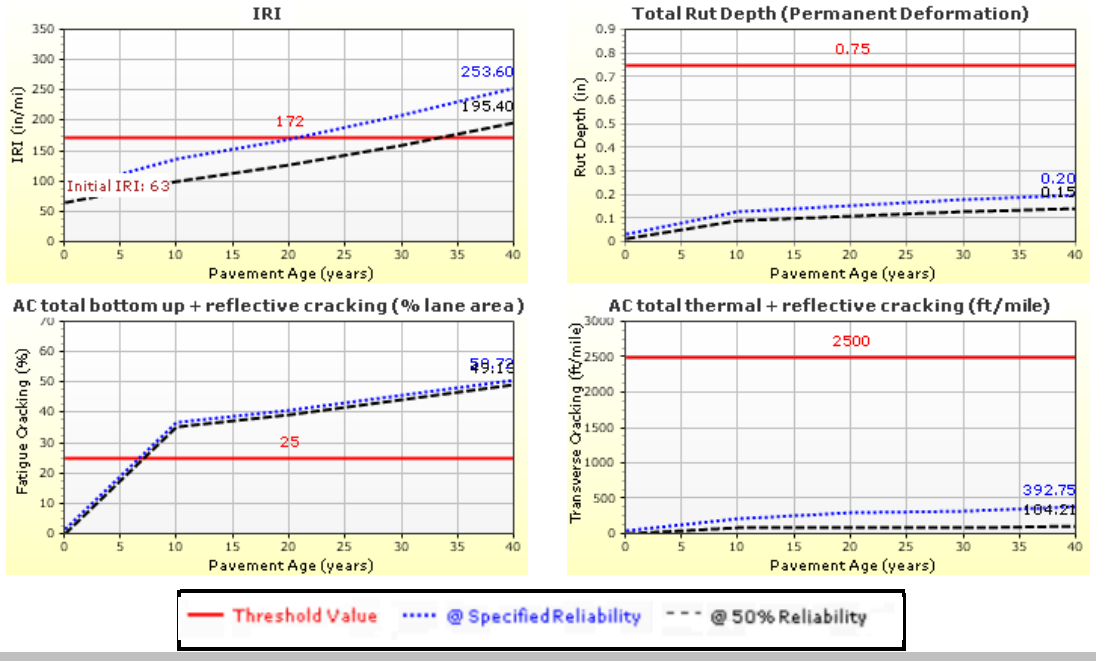
Age (year)	Heavy Trucks (cumulative)
2018 (initial)	1,000
2038 (20 years)	3,520,100
2058 (40 years)	8,683,820

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	253.65	90.00	30.33	Fail
Permanent deformation - total pavement (in)	0.75	0.20	90.00	100.00	Pass
AC total fatigue cracking: bottom up + reflective (% lane area)	25.00	50.72	90.00	0.00	Fail
AC total transverse cracking: thermal + reflective (ft/mile)	2500.00	392.75	90.00	100.00	Pass
Permanent deformation - AC only (in)	0.25	0.15	90.00	99.99	Pass
AC bottom-up fatigue cracking (% lane area)	25.00	0.00	50.00	100.00	Pass
AC thermal cracking (ft/mile)	1000.00	29.25	50.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	13701.19	90.00	0.03	Fail

Distress Charts



HMA Rehabilitation (Input Level: 3)

Milled thickness (in)	1.00
Structural rating	Fair
Environmental rating	Good
Total rut depth (in)	0.70

For Cell 127/227 (overlay asphalt binder = Superpave PG 58-34) (LSSB M_R = 30,000 psi):

Design Inputs

Design Life:	40 years	Existing construction:	August, 2017	Climate Data Sources	45.5, -93.75 45, -93.75 45.5, -93.125 45. -93.125 45.5, -94.375 45, -94.375
Design Type:	ACC_ACC	Pavement construction:	September, 2018		
		Traffic opening:	September, 2018		

Design Structure

Layer type	Material Type	Thickness (in)
Flexible (OL)	Default asphalt concrete	4.0
Flexible (existing)	Default asphalt concrete	2.5
NonStabilized	A-1-a	6.0
NonStabilized	A-1-b	18.0
Subgrade	A-6	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	11.6
Air voids (%)	7.0

Traffic

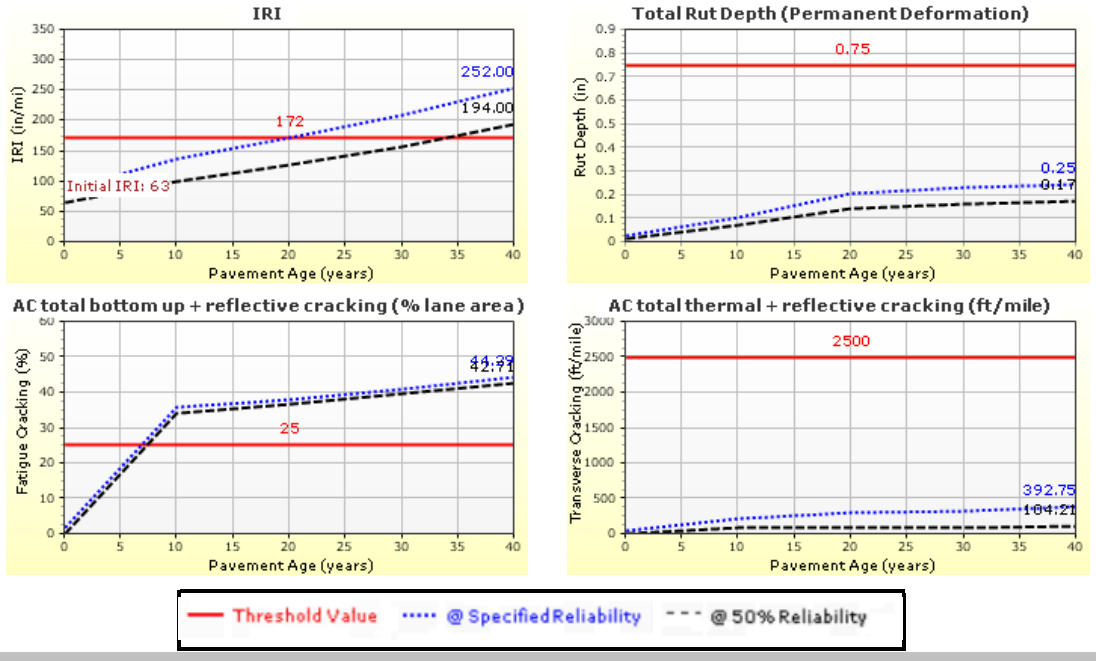
Age (year)	Heavy Trucks (cumulative)
2018 (initial)	1,000
2038 (20 years)	3,520,100
2058 (40 years)	8,683,820

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	251.95	90.00	31.30	Fail
Permanent deformation - total pavement (in)	0.75	0.25	90.00	100.00	Pass
AC total fatigue cracking: bottom up + reflective (% lane area)	25.00	44.29	90.00	0.00	Fail
AC total transverse cracking: thermal + reflective (ft/mile)	2500.00	392.75	90.00	100.00	Pass
Permanent deformation - AC only (in)	0.25	0.23	90.00	94.41	Pass
AC bottom-up fatigue cracking (% lane area)	25.00	0.00	50.00	100.00	Pass
AC thermal cracking (ft/mile)	1000.00	29.25	50.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	13803.55	90.00	0.03	Fail

Distress Charts



HMA Rehabilitation (Input Level: 3)

Milled thickness (in)	1.00
Structural rating	Fair
Environmental rating	Good
Total rut depth (in)	0.70

For Cell 127/227 (overlay asphalt binder = Superpave PG 58-34) (LSSB M_R = 50,000 psi):

Design Inputs

Design Life:	40 years	Existing construction:	August, 2017	Climate Data Sources	45.5, -93.75 45, -93.75 45.5, -93.125 45. -93.125 45.5, -94.375 45, -94.375
Design Type:	ACC_ACC	Pavement construction:	September, 2018		
		Traffic opening:	September, 2018		

Design Structure

Layer type	Material Type	Thickness (in)
Flexible (OL)	Default asphalt concrete	4.0
Flexible (existing)	Default asphalt concrete	2.5
NonStabilized	A-1-a	6.0
NonStabilized	A-1-b	18.0
Subgrade	A-6	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	11.6
Air voids (%)	7.0

Traffic

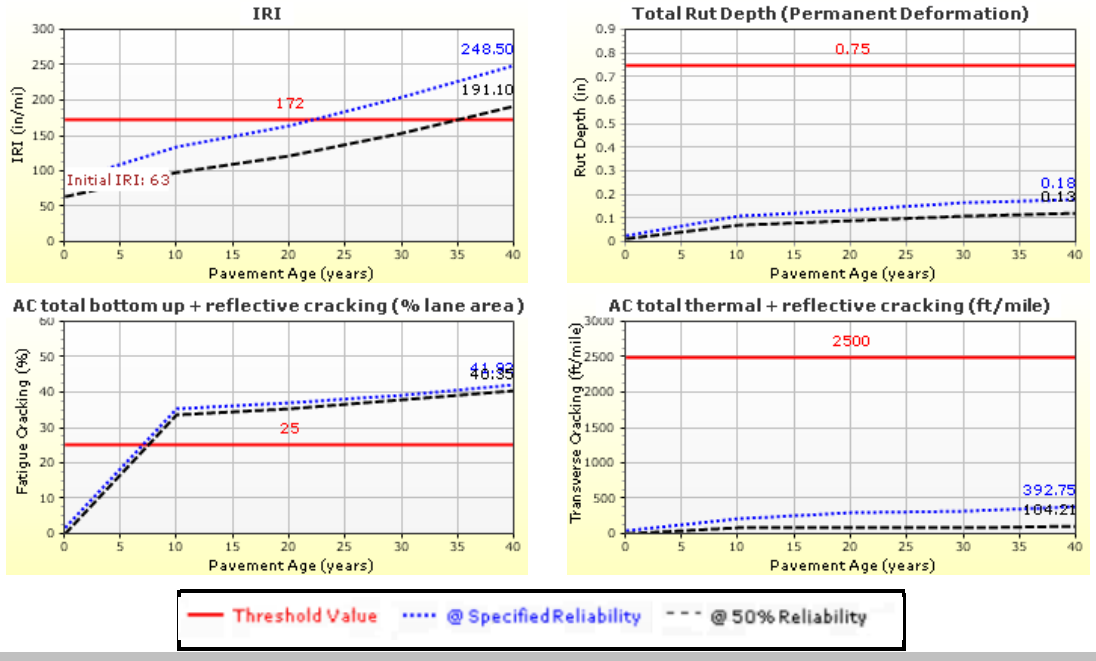
Age (year)	Heavy Trucks (cumulative)
2018 (initial)	1,000
2038 (20 years)	3,520,100
2058 (40 years)	8,683,820

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	248.52	90.00	33.49	Fail
Permanent deformation - total pavement (in)	0.75	0.18	90.00	100.00	Pass
AC total fatigue cracking: bottom up + reflective (% lane area)	25.00	41.92	90.00	0.00	Fail
AC total transverse cracking: thermal + reflective (ft/mile)	2500.00	392.75	90.00	100.00	Pass
Permanent deformation - AC only (in)	0.25	0.17	90.00	99.93	Pass
AC bottom-up fatigue cracking (% lane area)	25.00	0.00	50.00	100.00	Pass
AC thermal cracking (ft/mile)	1000.00	29.25	50.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	13697.57	90.00	0.03	Fail

Distress Charts



HMA Rehabilitation (Input Level: 3)

Milled thickness (in)	1.00
Structural rating	Fair
Environmental rating	Good
Total rut depth (in)	0.70

For Cell 328/728 (overlay asphalt binder = Superpave PG 58-34) (LSSB M_R = 10,000 psi):

Design Inputs

Design Life:	40 years	Existing construction:	August, 2017	Climate Data Sources	45.5, -93.75 45, -93.75 45.5, -93.125 45. -93.125 45.5, -94.375 45, -94.375
Design Type:	ACC_ACC	Pavement construction:	September, 2018		
		Traffic opening:	September, 2018		

Design Structure

Layer type	Material Type	Thickness (in)
Flexible (OL)	Default asphalt concrete	4.0
Flexible (existing)	Default asphalt concrete	2.5
NonStabilized	A-1-a	6.0
NonStabilized	A-1-b	9.0
Subgrade	A-6	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	11.6
Air voids (%)	7.0

Traffic

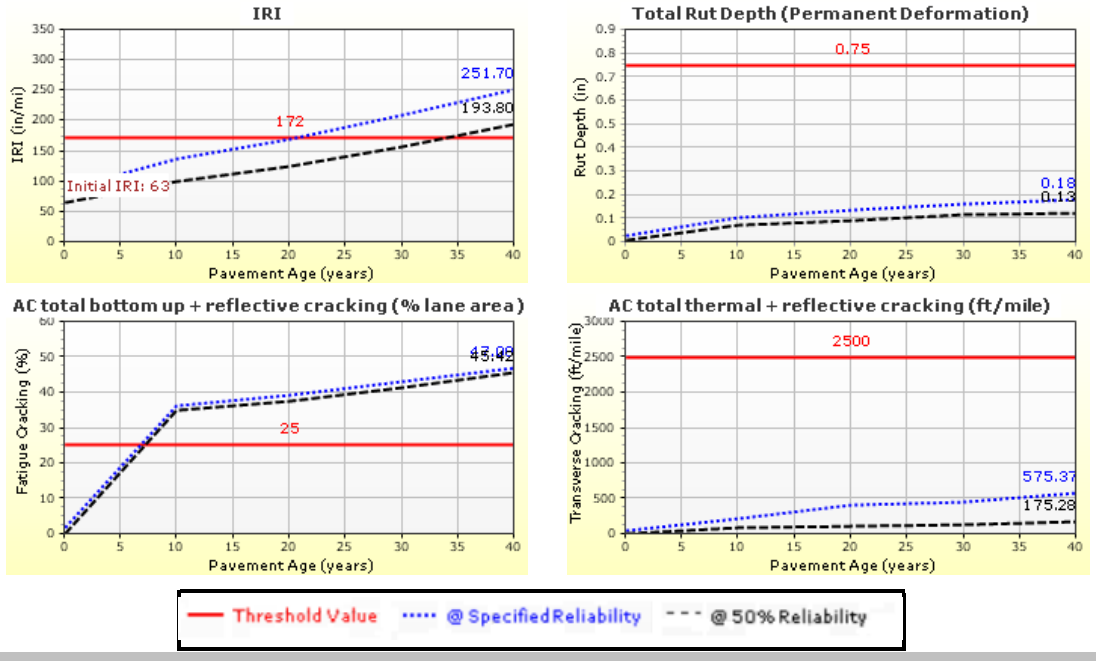
Age (year)	Heavy Trucks (cumulative)
2018 (initial)	1,000
2038 (20 years)	3,520,100
2058 (40 years)	8,683,820

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	251.71	90.00	31.52	Fail
Permanent deformation - total pavement (in)	0.75	0.18	90.00	100.00	Pass
AC total fatigue cracking: bottom up + reflective (% lane area)	25.00	47.00	90.00	0.00	Fail
AC total transverse cracking: thermal + reflective (ft/mile)	2500.00	575.37	90.00	100.00	Pass
Permanent deformation - AC only (in)	0.25	0.15	90.00	99.99	Pass
AC bottom-up fatigue cracking (% lane area)	25.00	0.00	50.00	100.00	Pass
AC thermal cracking (ft/mile)	1000.00	100.32	50.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	13701.82	90.00	0.03	Fail

Distress Charts



HMA Rehabilitation (Input Level: 3)

Milled thickness (in)	1.00
Structural rating	Fair
Environmental rating	Good
Total rut depth (in)	0.70

For Cell 328/728 (overlay asphalt binder = Superpave PG 58-34) (LSSB M_R = 30,000 psi):

Design Inputs

Design Life:	40 years	Existing construction:	August, 2017	Climate Data Sources	45.5, -93.75 45, -93.75 45.5, -93.125 45. -93.125 45.5, -94.375 45, -94.375
Design Type:	ACC_ACC	Pavement construction:	September, 2018		
		Traffic opening:	September, 2018		

Design Structure

Layer type	Material Type	Thickness (in)
Flexible (OL)	Default asphalt concrete	4.0
Flexible (existing)	Default asphalt concrete	2.5
NonStabilized	A-1-a	6.0
NonStabilized	A-1-b	9.0
Subgrade	A-6	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	11.6
Air voids (%)	7.0

Traffic

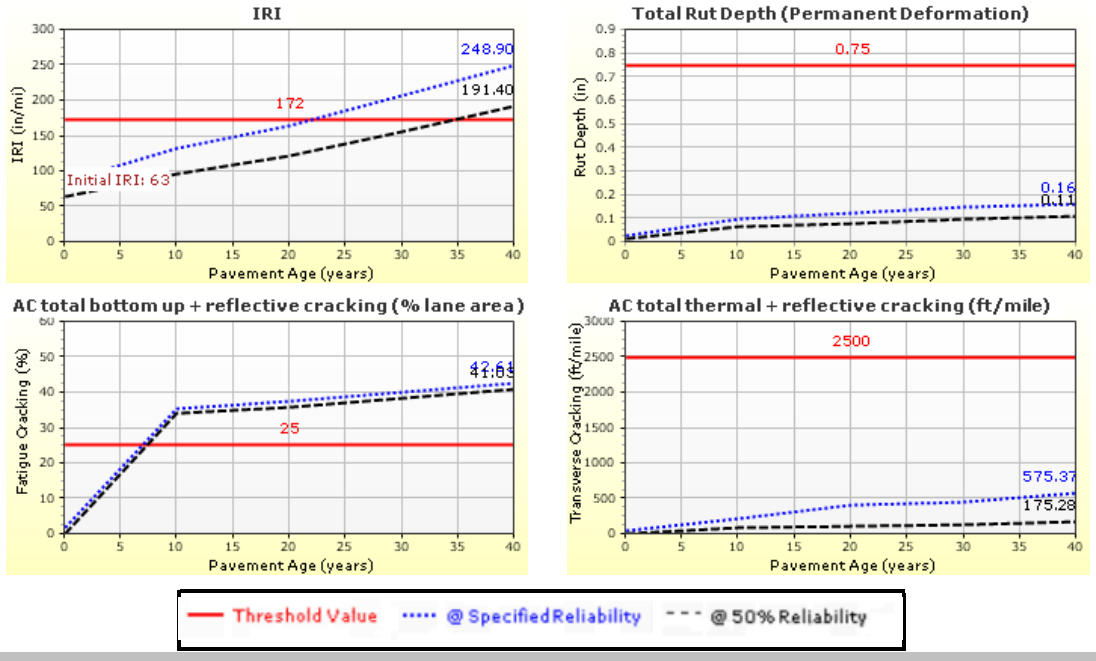
Age (year)	Heavy Trucks (cumulative)
2018 (initial)	1,000
2038 (20 years)	3,520,100
2058 (40 years)	8,683,820

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	248.89	90.00	33.29	Fail
Permanent deformation - total pavement (in)	0.75	0.16	90.00	100.00	Pass
AC total fatigue cracking: bottom up + reflective (% lane area)	25.00	42.61	90.00	0.00	Fail
AC total transverse cracking: thermal + reflective (ft/mile)	2500.00	575.37	90.00	100.00	Pass
Permanent deformation - AC only (in)	0.25	0.16	90.00	99.97	Pass
AC bottom-up fatigue cracking (% lane area)	25.00	0.00	50.00	100.00	Pass
AC thermal cracking (ft/mile)	1000.00	100.32	50.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	13803.87	90.00	0.03	Fail

Distress Charts



HMA Rehabilitation (Input Level: 3)

Milled thickness (in)	1.00
Structural rating	Fair
Environmental rating	Good
Total rut depth (in)	0.70

For Cell 328/728 (overlay asphalt binder = Superpave PG 58-34) (LSSB M_R = 50,000 psi):

Design Inputs

Design Life:	40 years	Existing construction:	August, 2017	Climate Data Sources	45.5, -93.75 45, -93.75 45.5, -93.125 45. -93.125 45.5, -94.375 45, -94.375
Design Type:	ACC_ACC	Pavement construction:	September, 2018		
		Traffic opening:	September, 2018		

Design Structure

Layer type	Material Type	Thickness (in)
Flexible (OL)	Default asphalt concrete	4.0
Flexible (existing)	Default asphalt concrete	2.5
NonStabilized	A-1-a	6.0
NonStabilized	A-1-b	9.0
Subgrade	A-6	Semi-infinite

Volumetric at Construction:	
Effective binder content (%)	11.6
Air voids (%)	7.0

Traffic

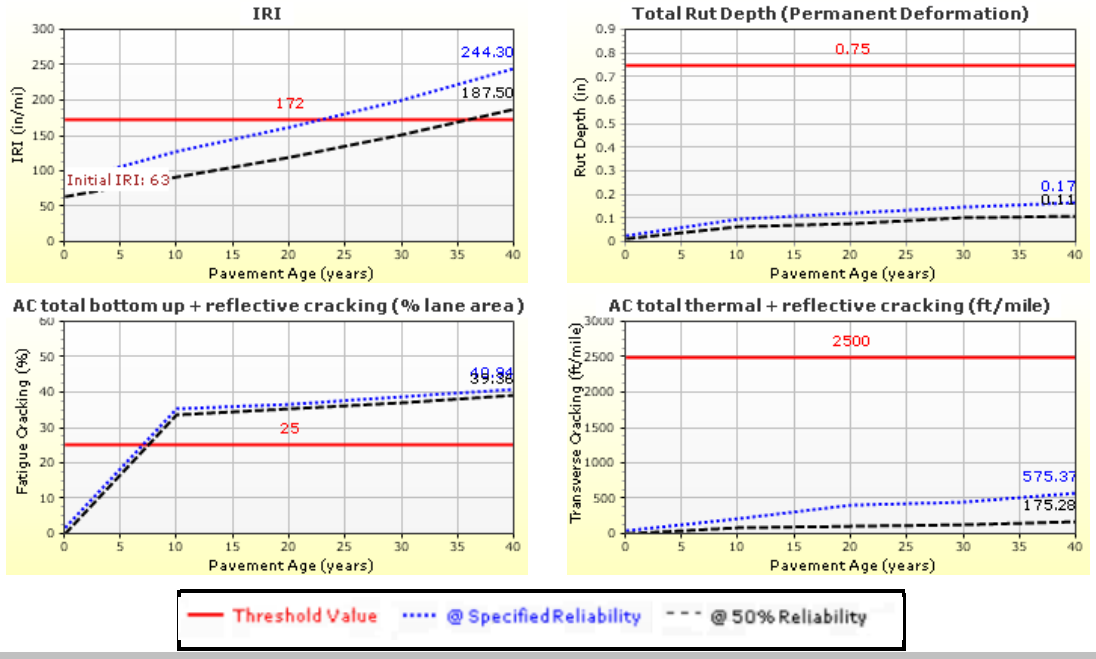
Age (year)	Heavy Trucks (cumulative)
2018 (initial)	1,000
2038 (20 years)	3,520,100
2058 (40 years)	8,683,820

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	244.29	90.00	36.37	Fail
Permanent deformation - total pavement (in)	0.75	0.17	90.00	100.00	Pass
AC total fatigue cracking: bottom up + reflective (% lane area)	25.00	40.94	90.00	0.00	Fail
AC total transverse cracking: thermal + reflective (ft/mile)	2500.00	575.37	90.00	100.00	Pass
Permanent deformation - AC only (in)	0.25	0.16	90.00	99.95	Pass
AC bottom-up fatigue cracking (% lane area)	25.00	0.00	50.00	100.00	Pass
AC thermal cracking (ft/mile)	1000.00	100.32	50.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	8559.50	90.00	7.63	Fail

Distress Charts



HMA Rehabilitation (Input Level: 3)

Milled thickness (in)	1.00
Structural rating	Fair
Environmental rating	Good
Total rut depth (in)	0.70