

Idaho Asphalt Conference

Moscow, ID

October 25, 2018

Superpave5

Superpave Design at Five Percent Air Voids

Gerry Huber
Heritage Research Group

Marshall Mix Design

- Design Air Voids 3-5%

Construction (8%)

- Field Compaction
 - 8% after rolling
 - 4% after traffic

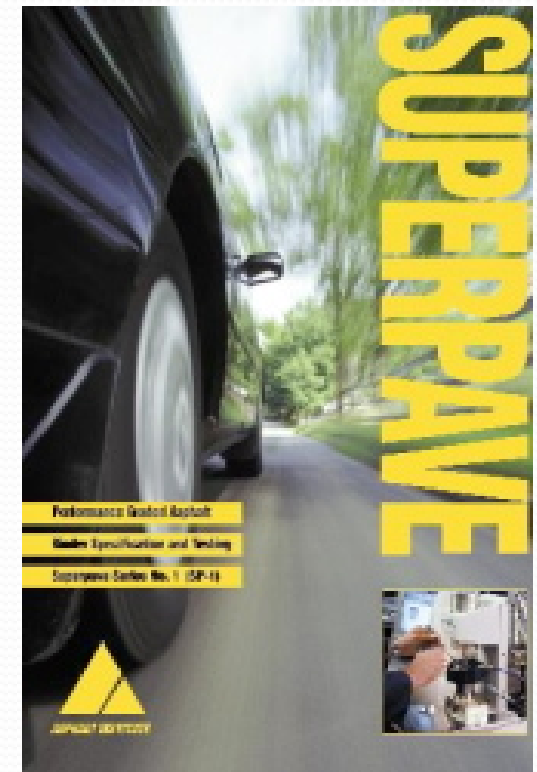
Decreases to

Service Life (4%)

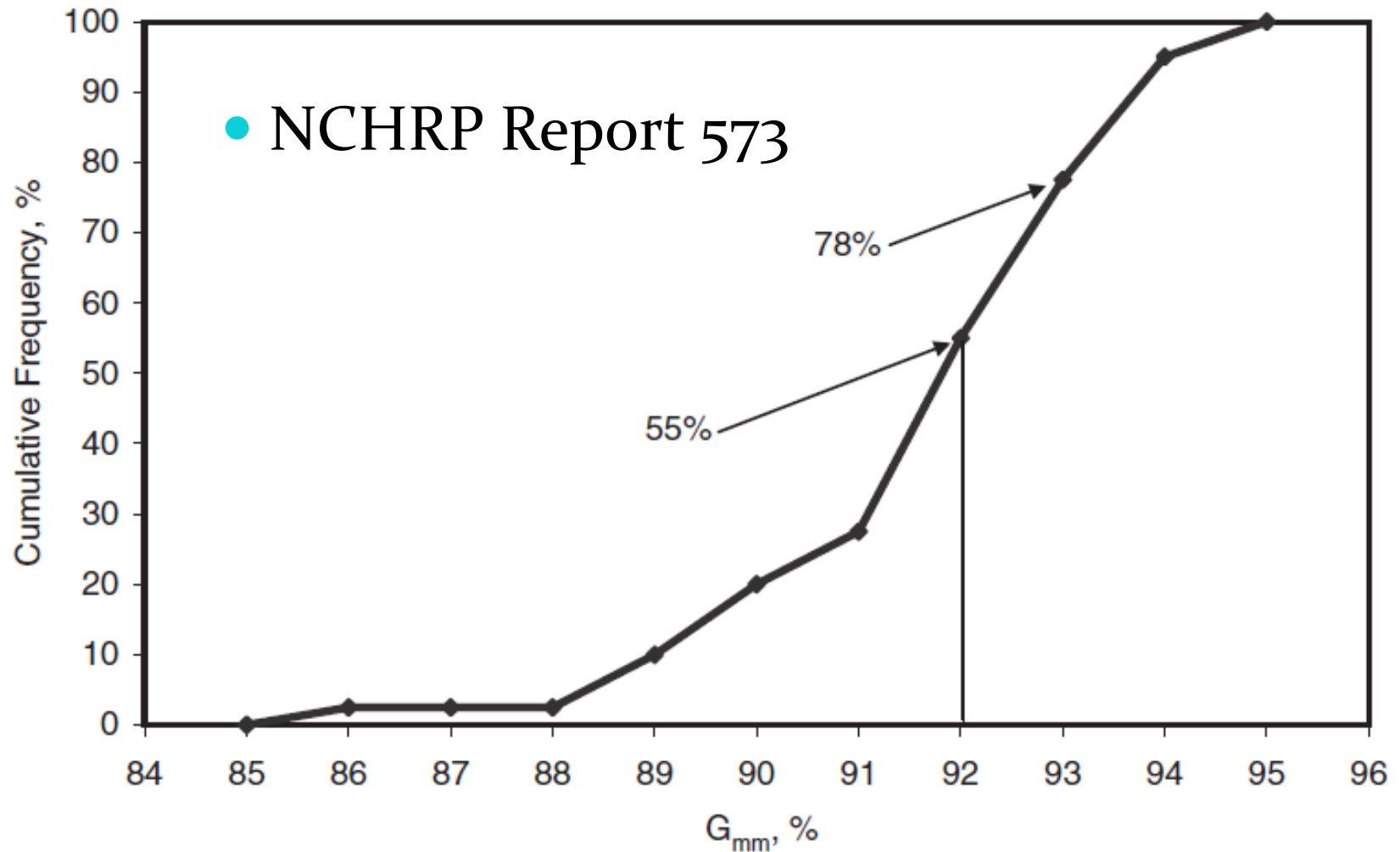


Strategic Highway Research Program

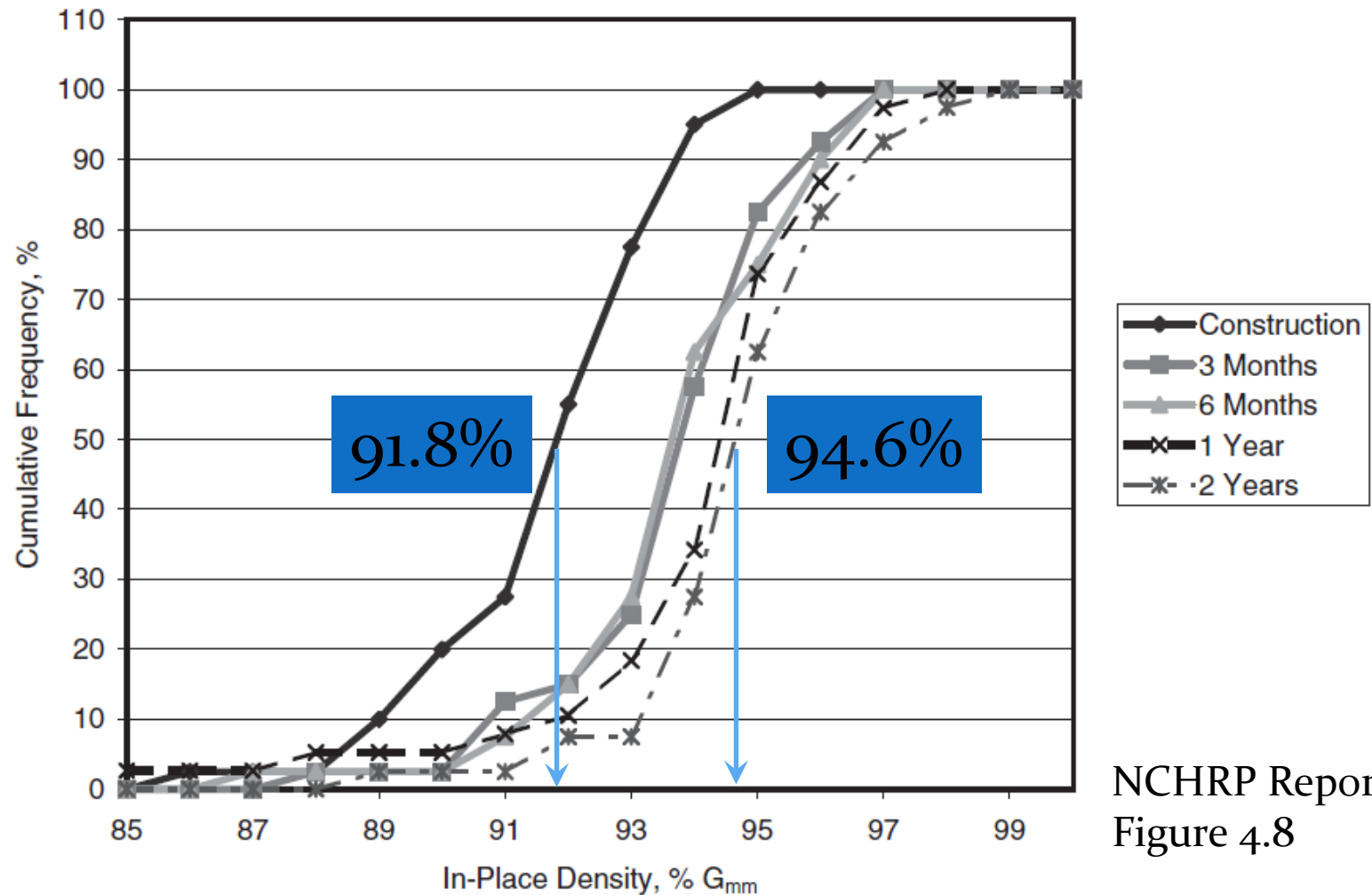
- “Marshall” carried forward
- Design air voids fixed at 4%
- Recommended compaction
 - Set at 92% Gmm



As-Constructed Air Voids



Typical Final Density



NCHRP Report 573
Figure 4.8

LCPC Developed Mix Design Method





Design to 5%



Construct to 5%

Performance Good



Superpave5

- Inspired by LCPC



Superpave 5 Concept

- Mix Design
5% air voids



- Field Compaction
95% Gmm



- No change in asphalt
content

Asphalt Content Remains Same

	Supernave ₄		
NMAS	VMA	4% voids	Vbe
10.0	15.0	4.0	11.0
12.5	14.0	4.0	10.0
19.0	13.0	4.0	9.0
25.0	12.0	4.0	8.0

Design Gyration
Must Change

Purdue University Evaluated Engineering Properties

ESAL	Gyrations	Mixture Type	
		9.5-mm	19.0-mm
3-10 million	70	X	
	50	X	
	30	X	
10-30 million	70	X	X
	50	X	X
	30	X	X

Study Conclusions

- Designs at 4% Air Voids
And 93% Gmm Compaction

100 gyrations

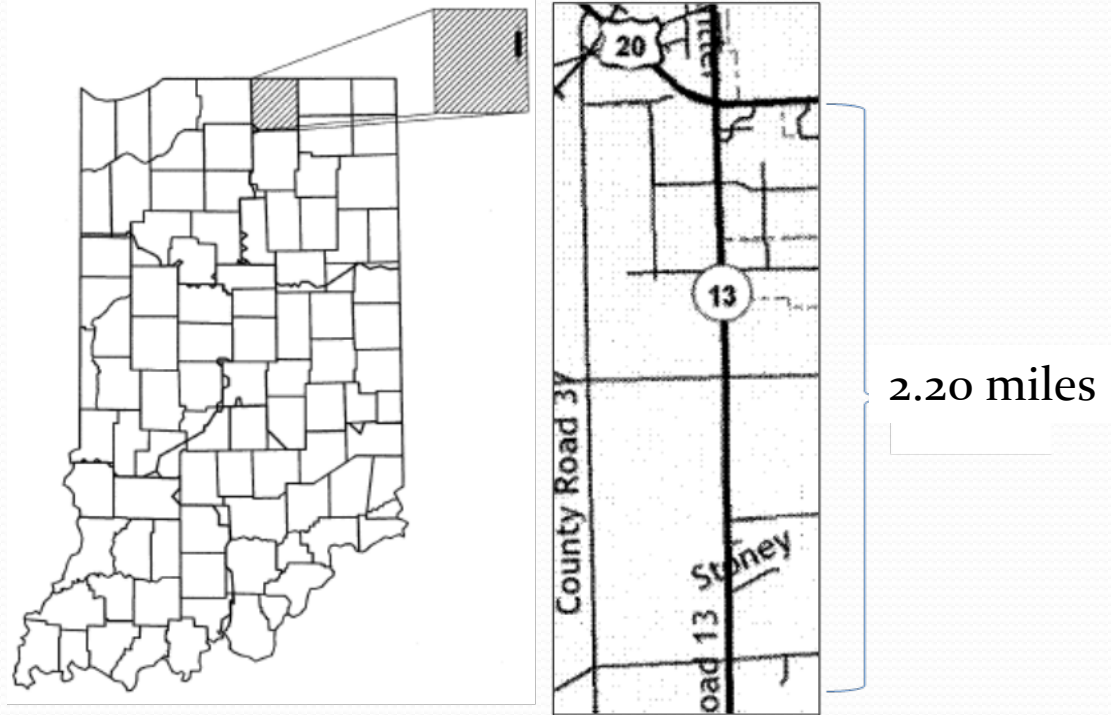


- Designs at 5% Air Voids
And 95% Gmm Compaction

30 gyrations

SR 13, Middlebury, Indiana

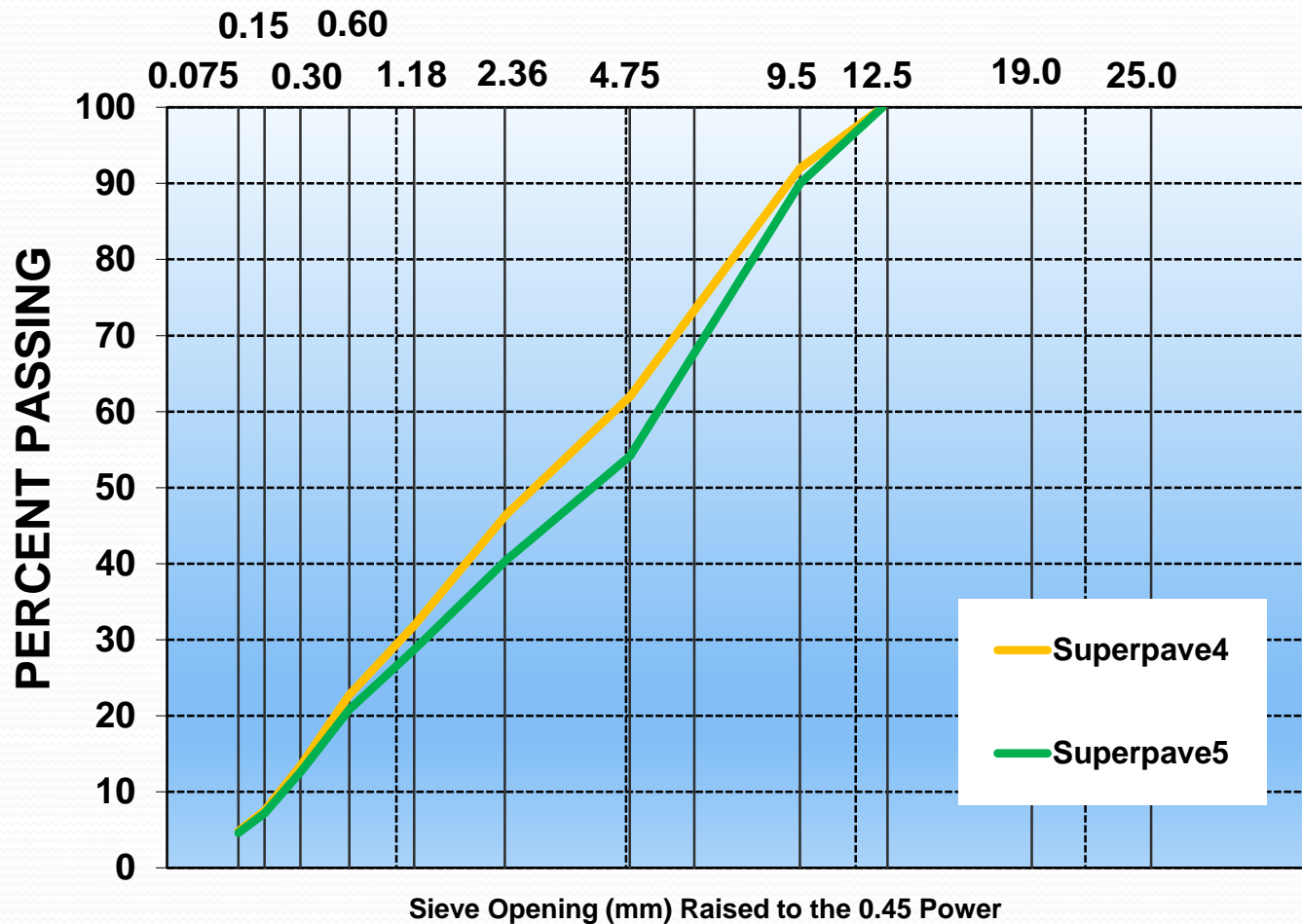
- 2013 Trial Project
 - 13,400 AADT
 - 19% heavy trucks



Mix Designs

	Superpave4	Superpave5
#11 Steel Slag	40	43
#12 Limestone	20	17
Stone Sand	15	18
Natural Sand	18	15
RAS (Shingles)	7	7

Gradation



Mix Designs

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	Superpave4	Superpave5
Gyration	100	30
Asphalt Content	5.1%	5.4%
Recycled Binder Ratio	0.206	0.193
Air Voids	4.0	5.0
VMA	15.5	17.0



Counter-Flow Drum Mix Plant



Superpave4



Superpave5 Compaction

Mix Construction Properties

	Superpave4			Superpave5		
	Design	QC	QA	Design	QC	QA
Asphalt, %	5.1	5.1	5.0	5.4	5.5	5.2
Air Voids, %	4.0	3.5	4.1	5.0	4.5	4.0
Density, %Gmm	-	-	91.6	-	94.7	96.9

2018 Core Locations

Location	Superpave4	Superpave5
1	206+66	155+95
2	147+37	180+25
3	124+74	214+74

Project built June 2013



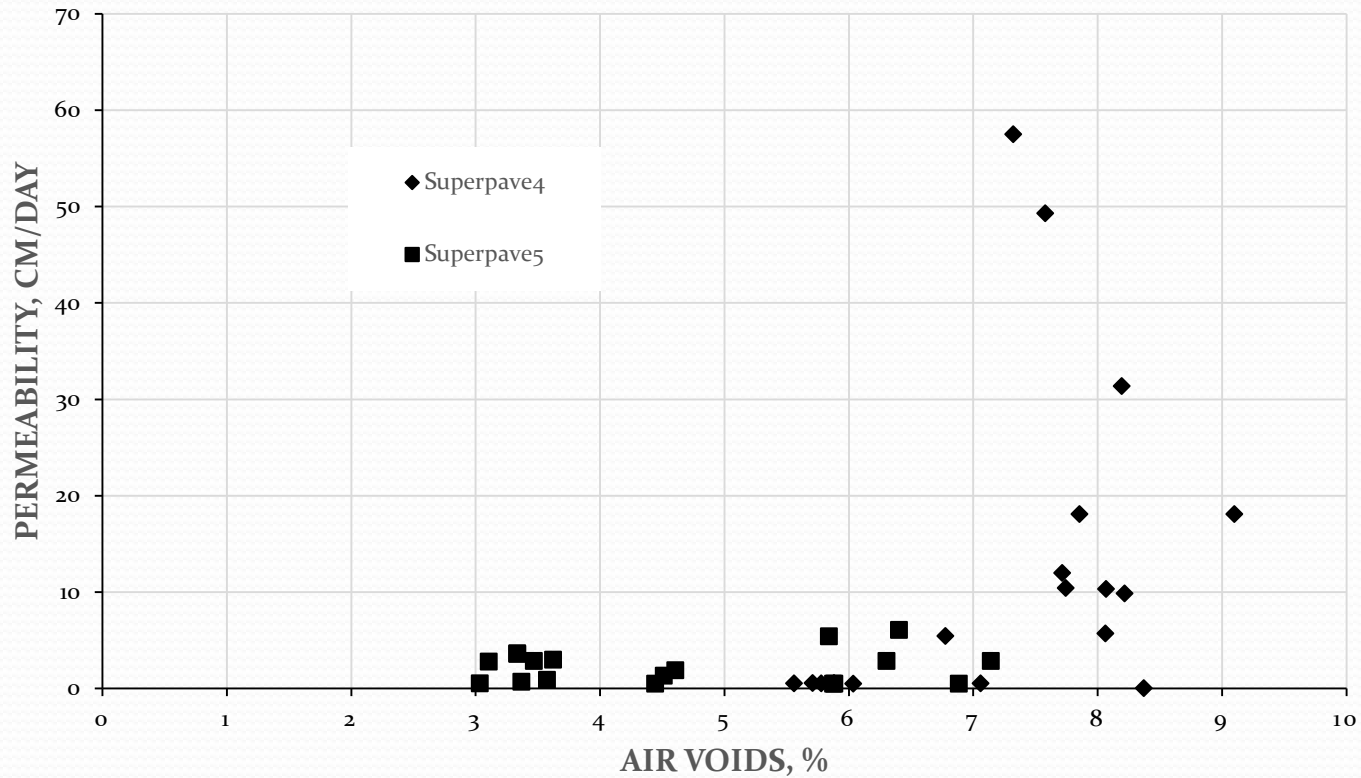
Six Cores At Each Location

Core Properties

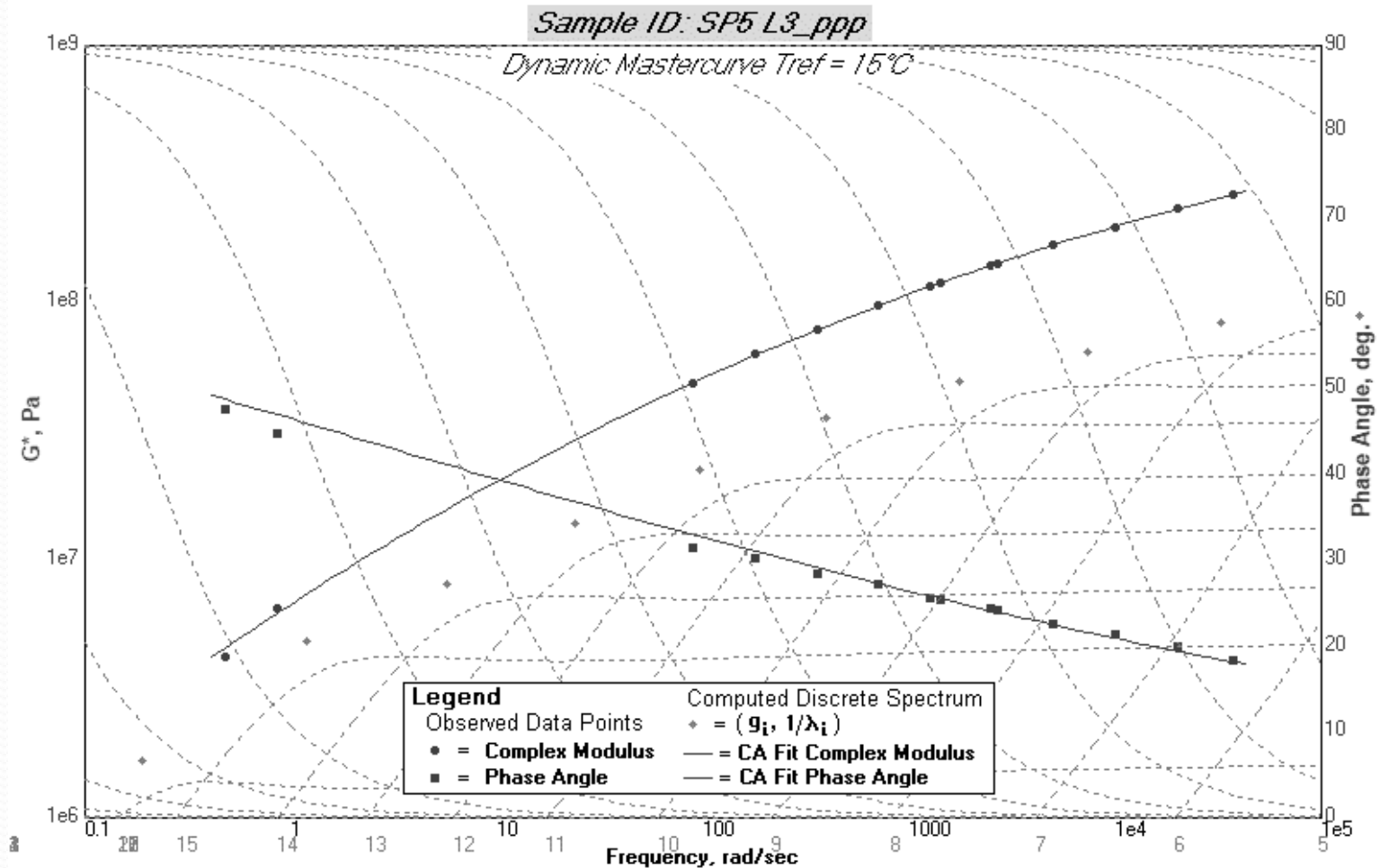
	Superpave4			Superpave5		
	Loc 1	Loc 2	Loc 3	Loc 1	Loc 2	Loc 3
Thickness, in.	1.47	1.48	1.36	1.39	1.43	1.69
Asphalt, %	5.34	5.35	5.56	5.67	5.36	5.82
Density, %Gmm	91.8	94.0	92.3	95.7	93.6	96.6

Average Values

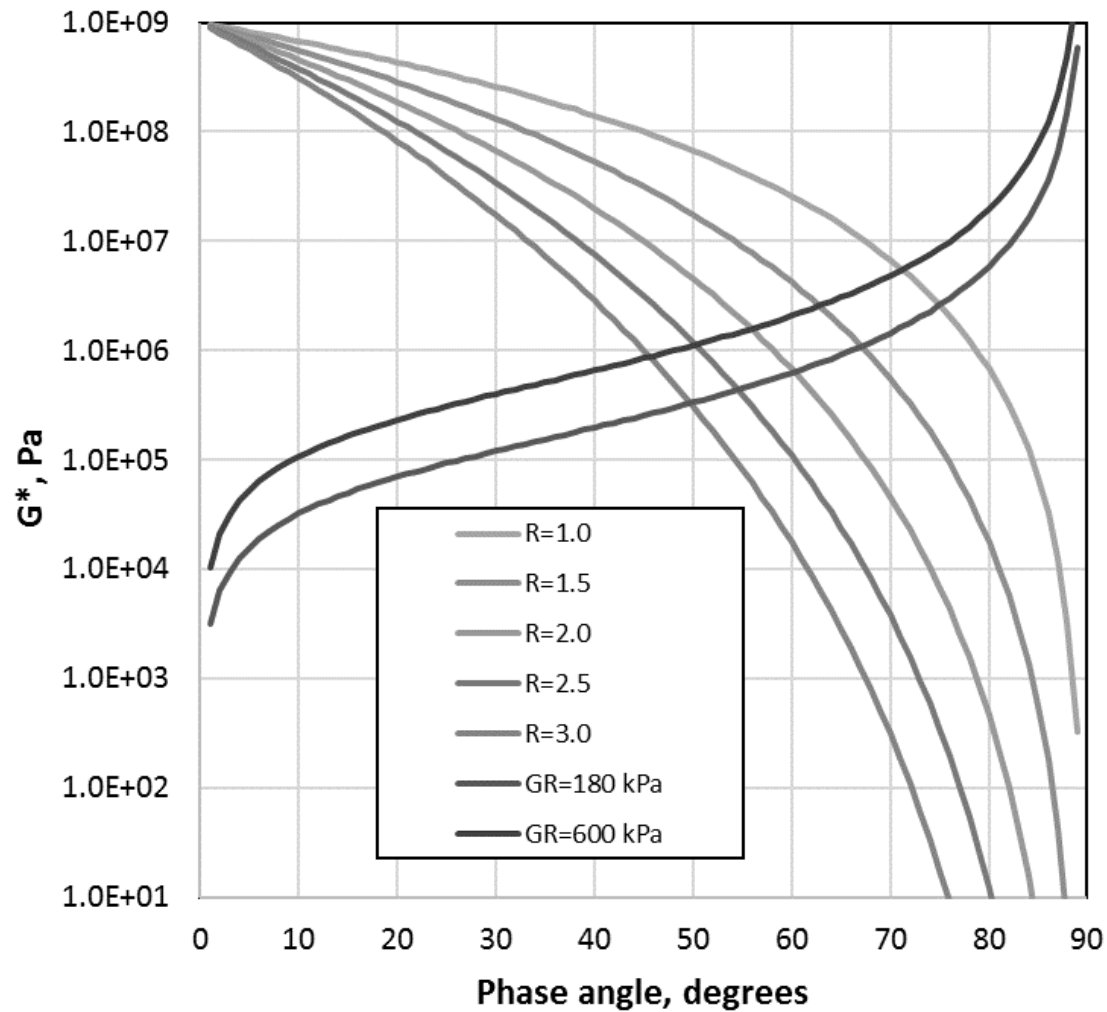
Permeability



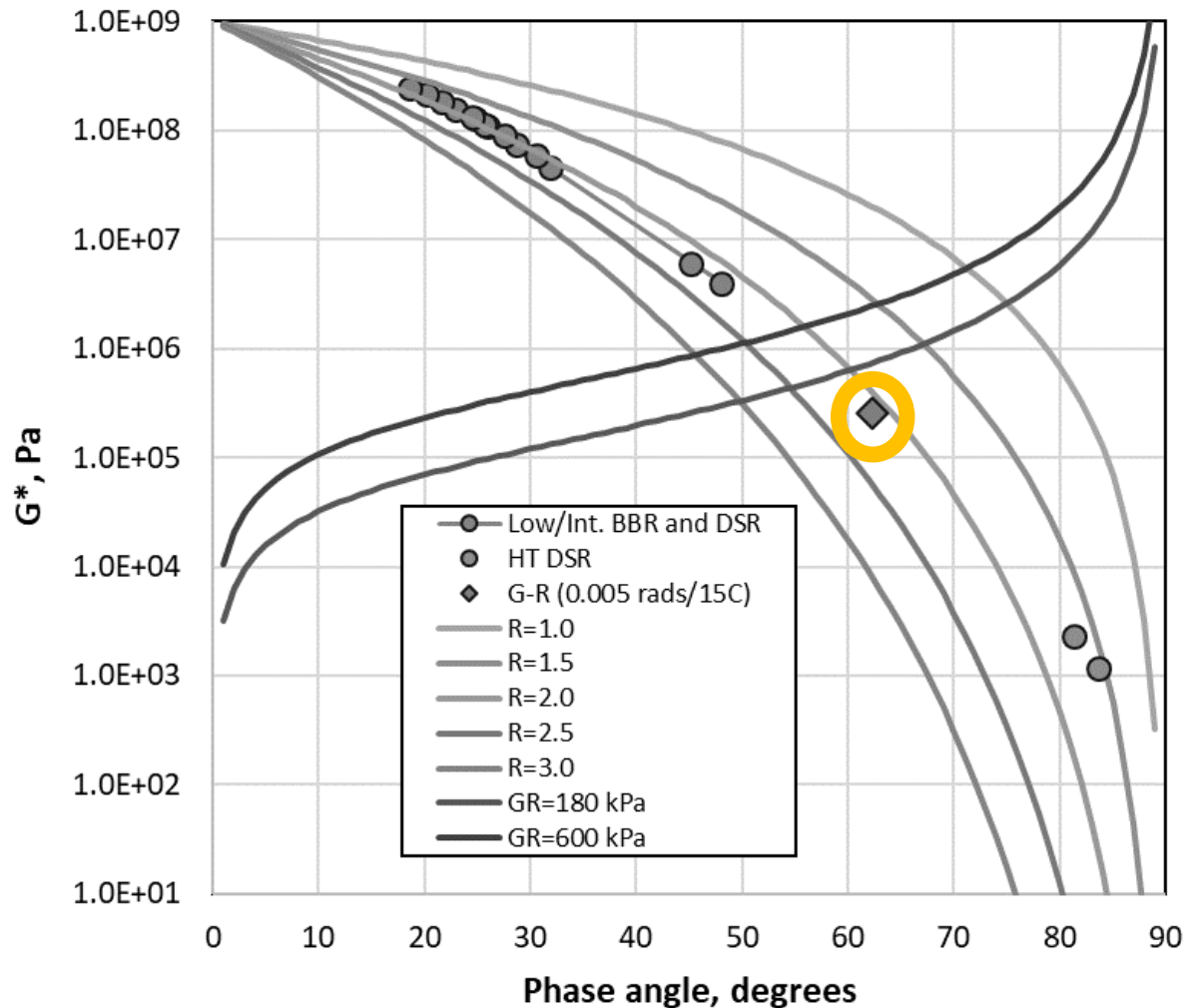
Recovered Binder Master Curve



Glover Rowe



Glover Rowe, SP5, Location 3



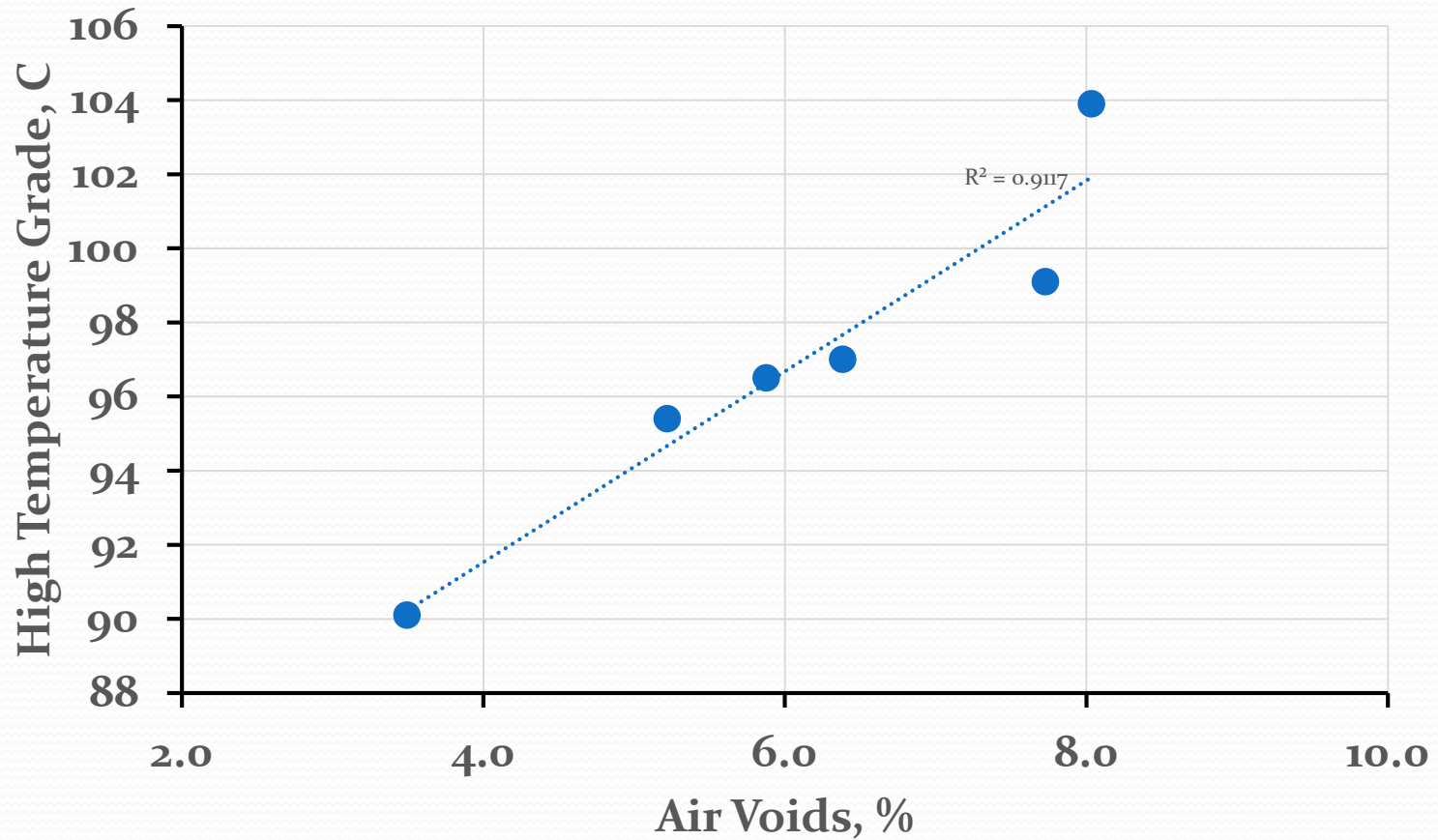
Glover Rowe Results

		Glover Rowe Value	Expected Performance
Superpave4	Location 1	880	Should crack
	Location 2	363	Might Crack
	Location 3	858	Should crack
Superpave5	Location 1	170	Should Not Crack
	Location 2	315	Might Crack
	Location 3	69	Should Not Crack

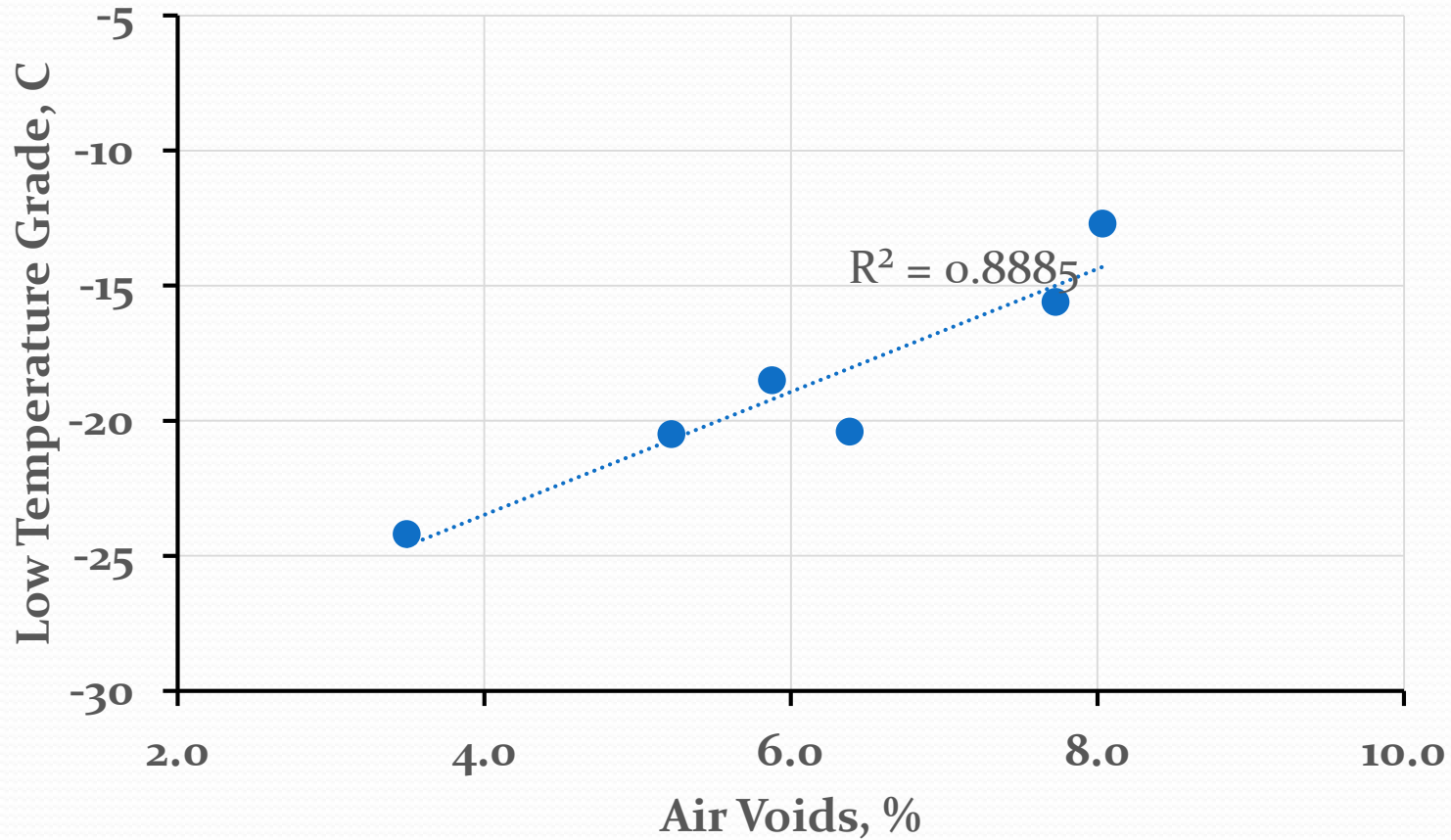
Recovered Asphalt Binder Grade

	Superpave4				Superpave5			
Location	High Fail Temp., °C	Low Fail Temp m, °C	Low Fail Temp, S, °C	ΔT_c , °C	High Temp Grade, °C	Low Temp Grade, m, °C	Low Fail Temp., S, °C	ΔT_c , °C
1	99.1	-15.6	-24.8	-9.2	95.4	-20.5	-24.9	-4.4
2	97.0	-20.4	-25.8	-5.4	96.5	-18.5	-23.4	-4.9
3	103.9	-12.7	-23.1	-10.4	90.1	-24.1	-25.7	-1.5
Average	100.0	-16.2	-24.6	-8.3	94.0	-21.0	-24.7	-3.6

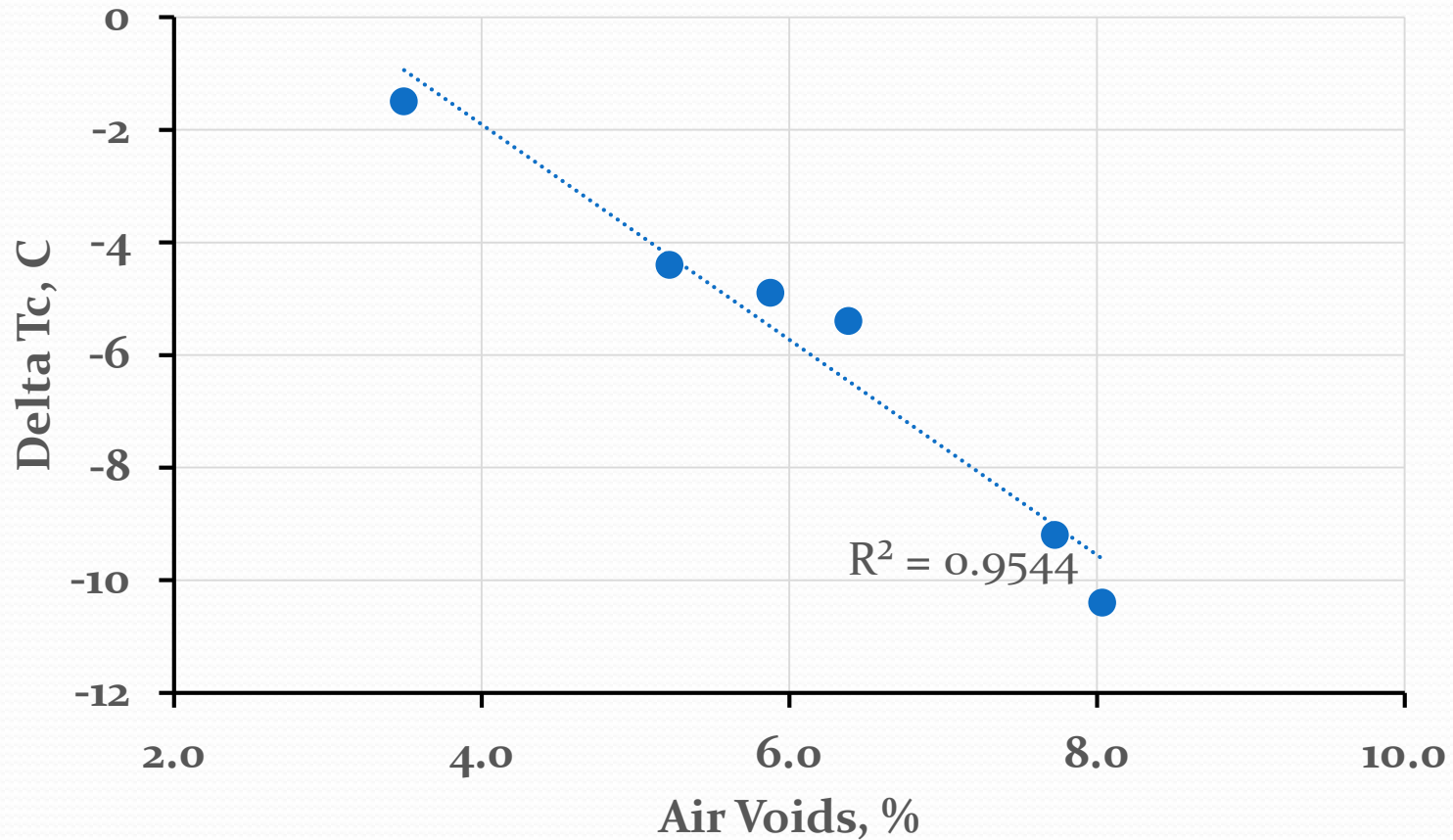
Correlation PG High Temp to In-Place Air Voids



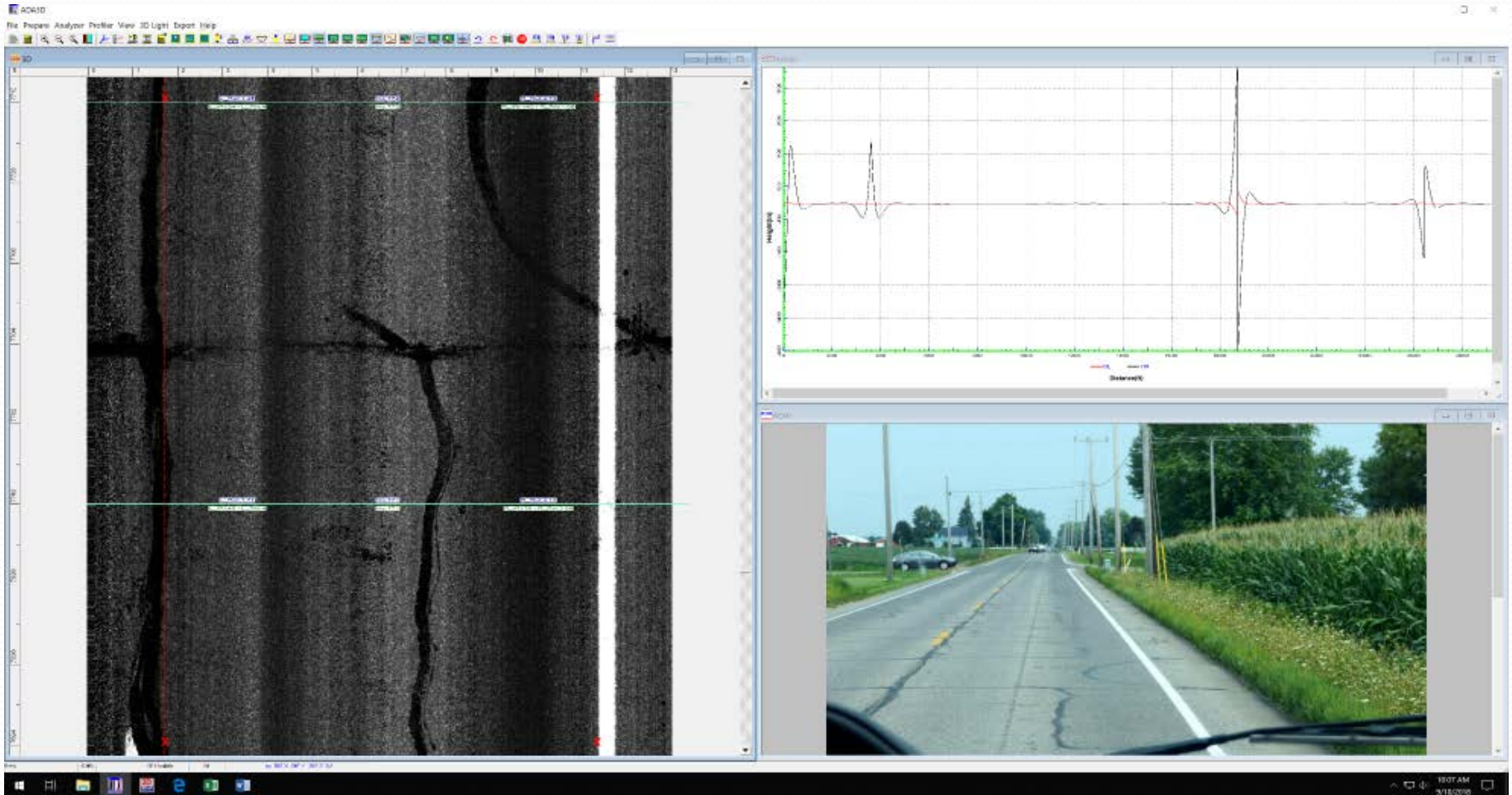
Correlation PG Low Temp to In-Place Air Voids



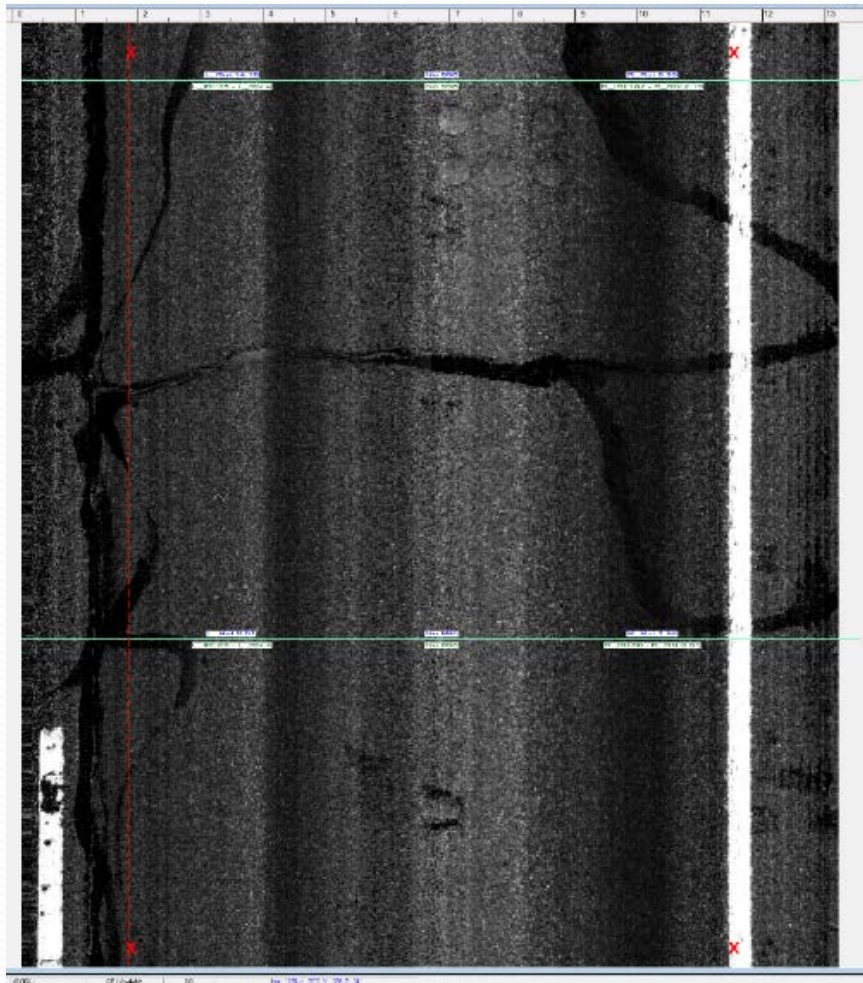
Correlation Delta Tc to In-Place Air Voids



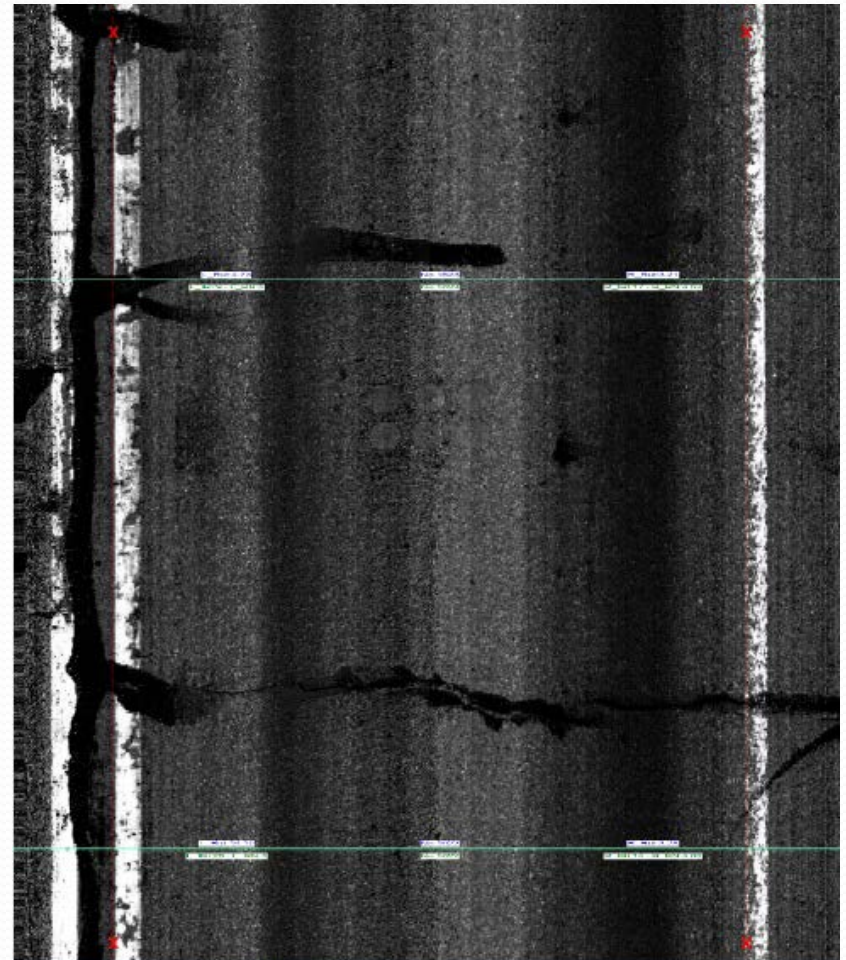
Pavement Condition Collection



Superpave4



Superpave5





Superpave4

Superpave5

A photograph of a road surface showing Superpave 4 asphalt. The road is dark grey with visible texture and some cracking. A yellow line is painted on the right side, and a white line is on the left. The text "Superpave4" is overlaid in yellow at the bottom left.

Superpave4



Superpave5



Superpave4

Superpave5

What Did We Learn?

**Aging of Asphalt Binder
Directly Related to
In-Place Air Voids**

Asphalt Binder Properties

- Construction
 - 80% PG 70-22
 - 20% PG 130 -0 (est.)
- Five Years in Service
 - Superpave₄ PG 100-16
 - Superpave₅ PG 94-21

Effect on
Life?

Superpave5

No



B/C ratio?