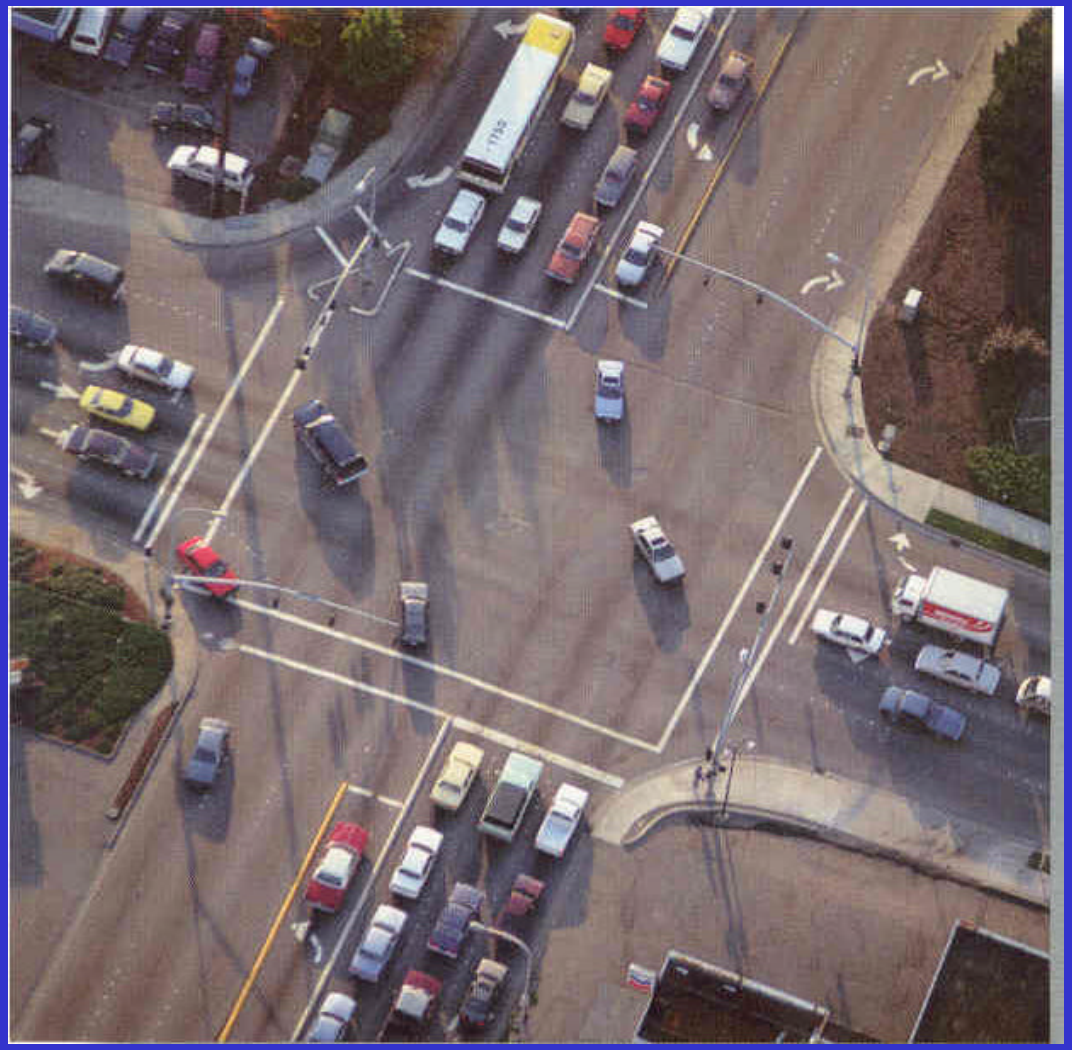
High Performance HMA



NEAUPG

Albany, NY

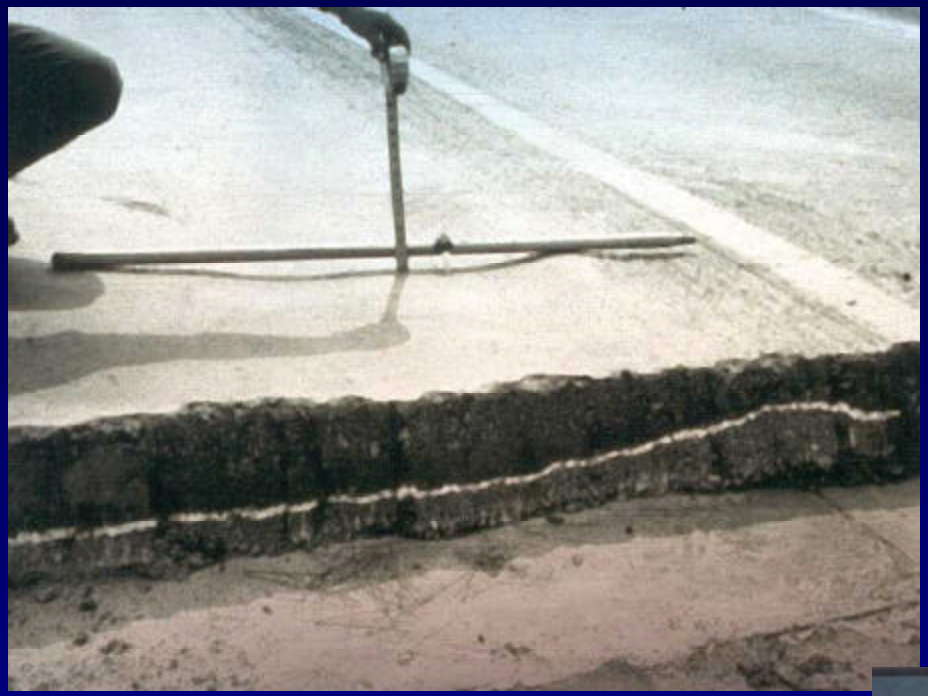
October 18, 2001

U.S. 40 & Rt. 213 - Elkton, MD

Completed 1994

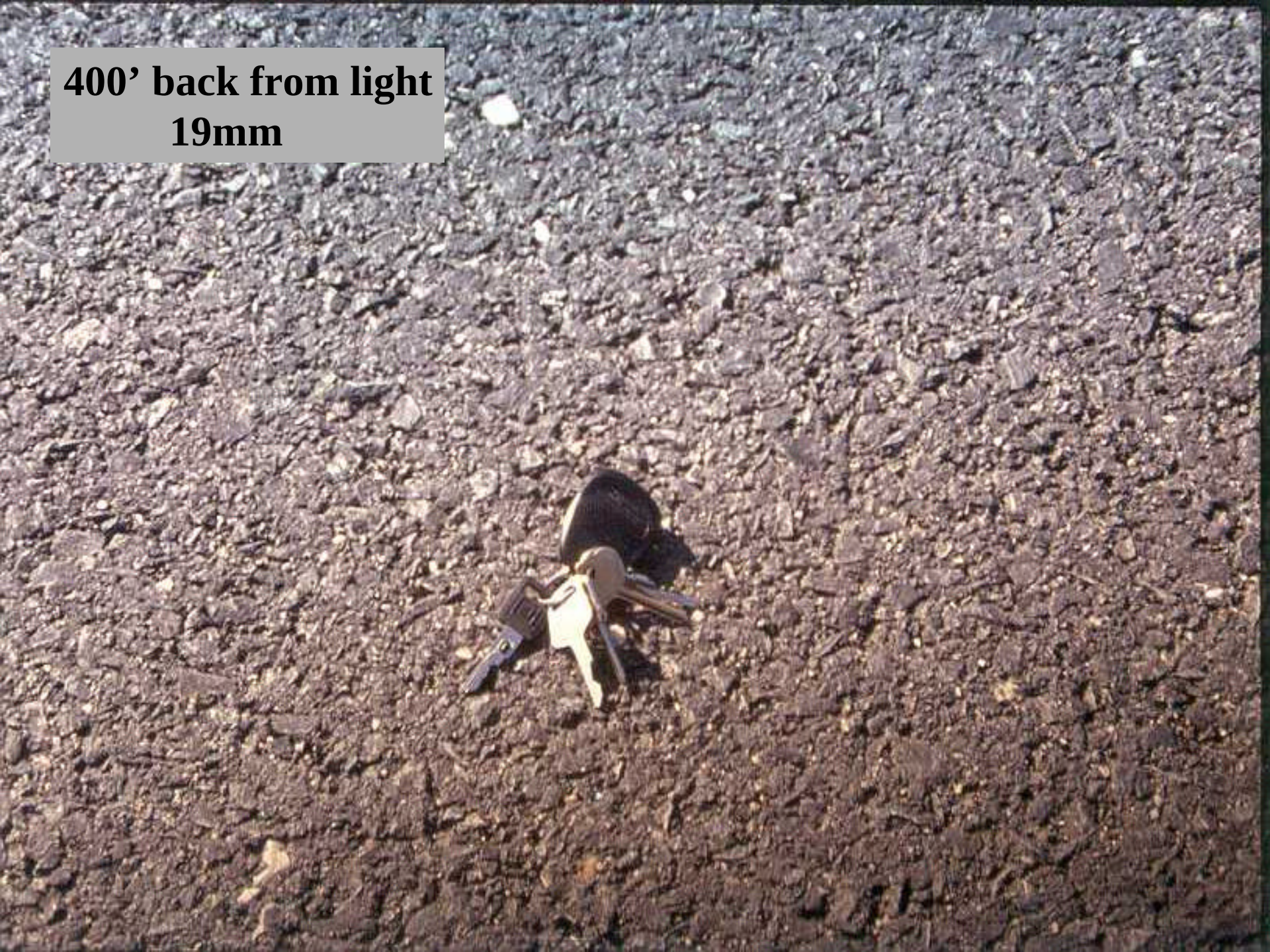
From this

To this



From this

To this


400’ back from light
19mm


50’ back from light
19mm

Sept. 2001

Aggregate (Elkton, MD)

Arundel	5s	40
Arundel	7s	20
Arundel	8s	15
Arundel	10s	15
York	Sand	10

LA	15.0
Na_2SO_4	<1
Abs.	0.3

State/Province: MD

Weather Station: ELKTON

Depth from Pavement Surface to Top of Layer, mm: 0

Station ID	0182860	Latitude	39.62
County / District	CECIL	Longitude	75.83
Last Year Data Avail.	1975	Elevation, m	12

Air Temperature	Mean	Std Dev	Min	Max	Years
High 7-day Air Temp., Deg. C	34.0	1.5	32.1	37.2	26
Low Air Temperature, Deg. C	-15.9	2.8	-21.7	-11.1	21
Low Air Temp. Drop, Deg. C	14.4	3.2	9.4	20.6	21
Degree Days over 30 Deg. C	133	52	69	224	26

Pavement Temperature and PG	HIGH	LOW	High Rel	Low Rel
50% Reliability Pvt Temp., C	51.9	-10.5	50	50
>50% Reliability PG	52	-16	51	96
	58	-16	97	96
	58	-22	97	98
	64	-22	98	98

Slow moving 1 “bump” PG 70-22

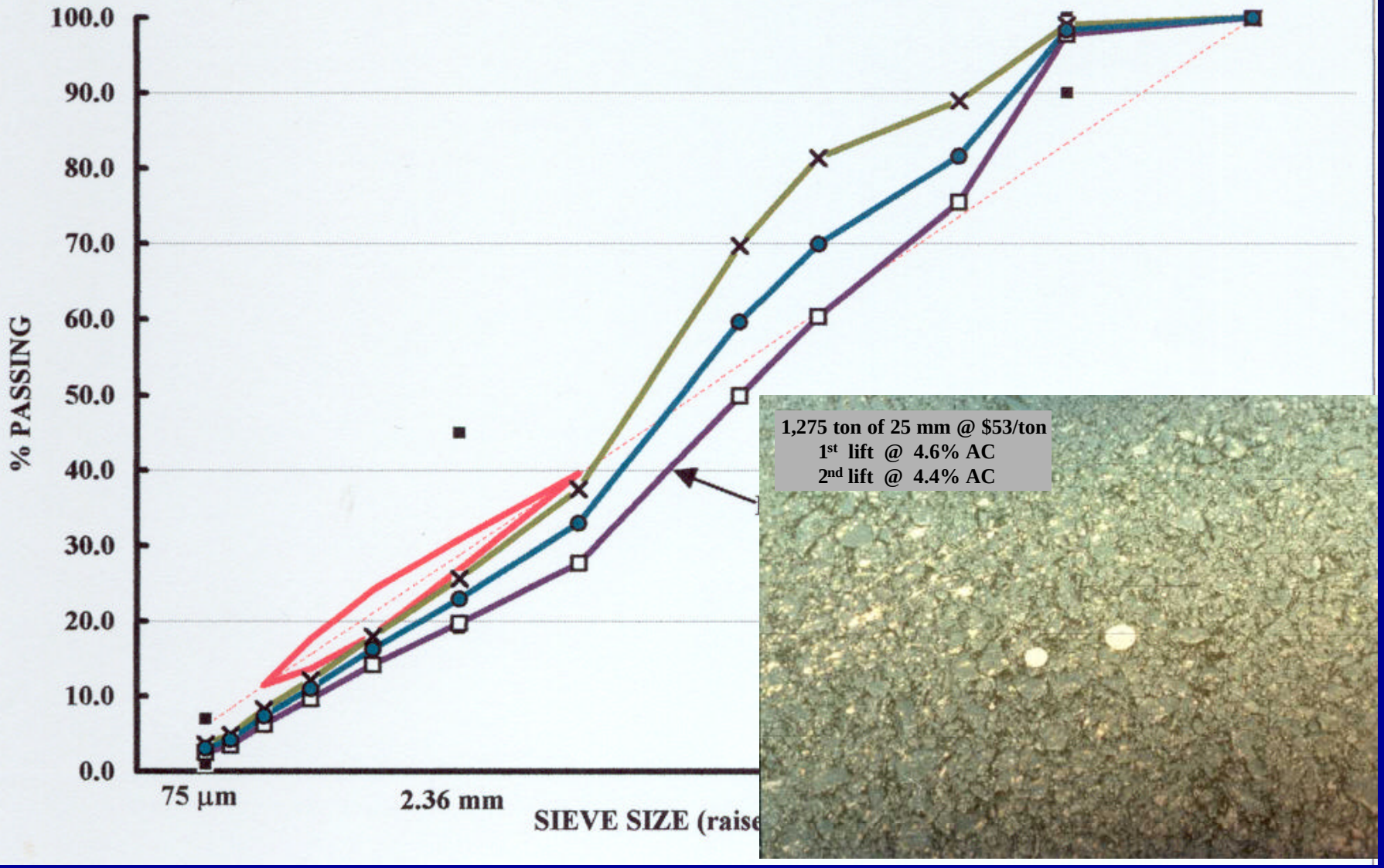
Standing 2 “bump” PG 76-22

64° C is 147° F

VS

76° C is 169° F

Maryland Intersection: 25 mm Nominal



Elkton, MD

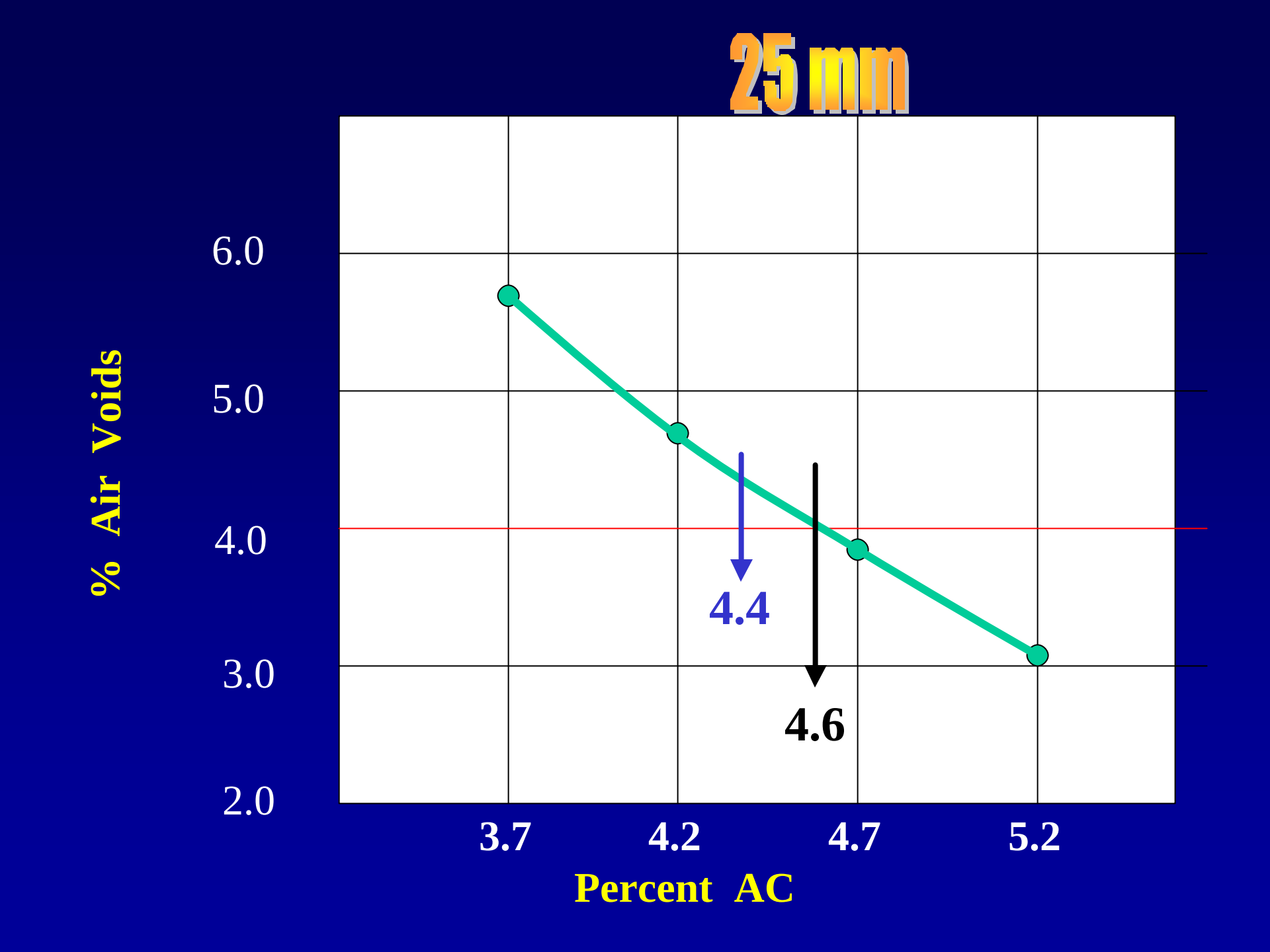
Design EALs = 18 million

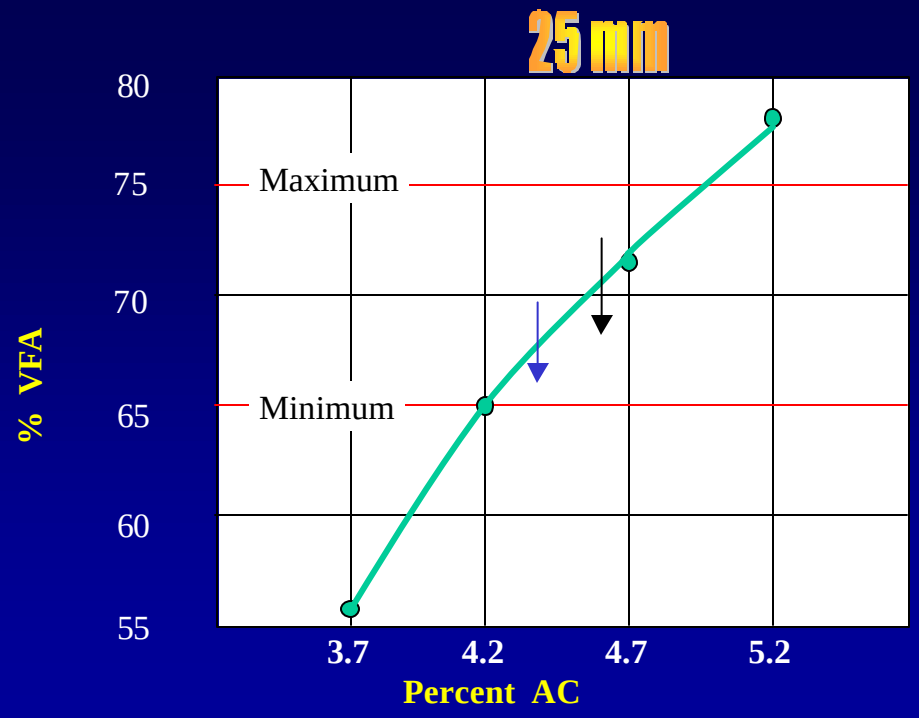
Design Gyrations = 8, 109, 174

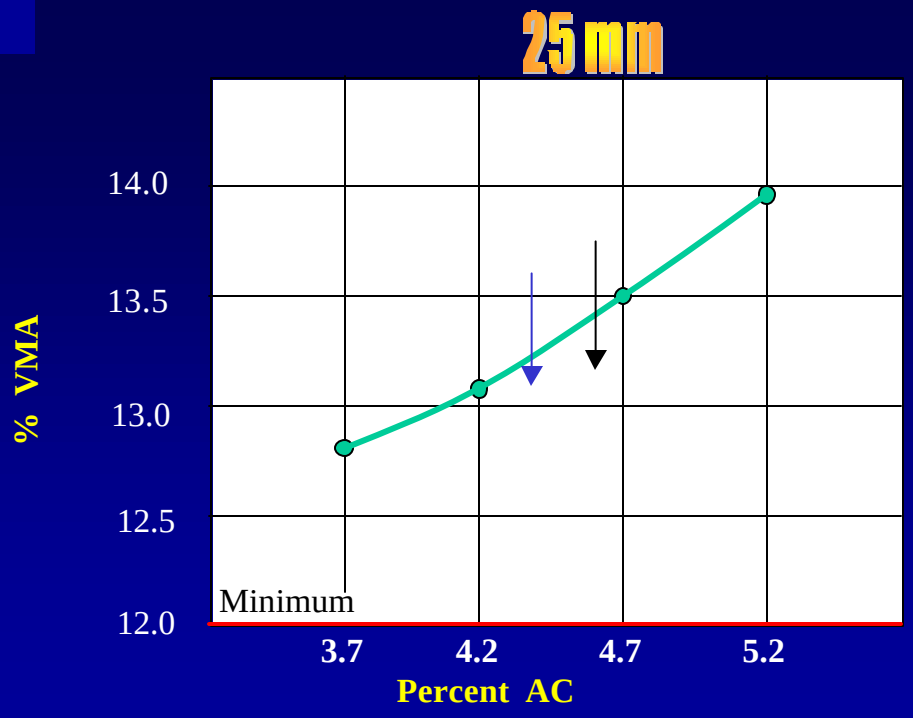
8, 100, 160

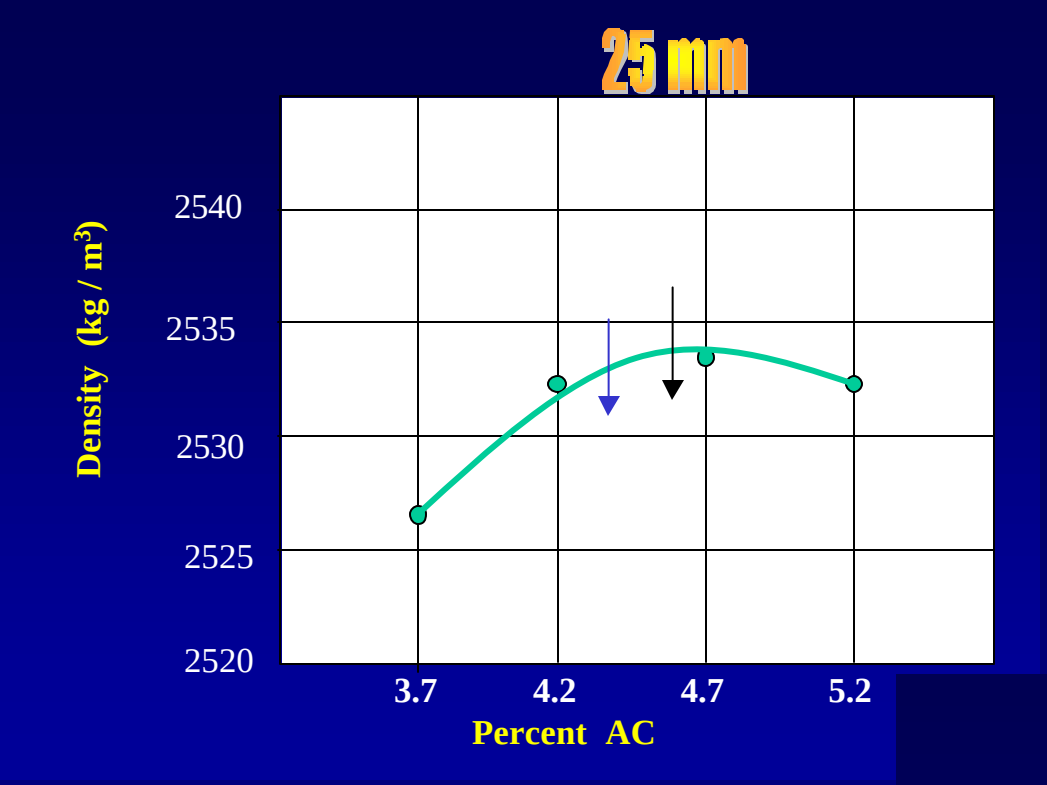
25 mm Summary @ 4.6% AC

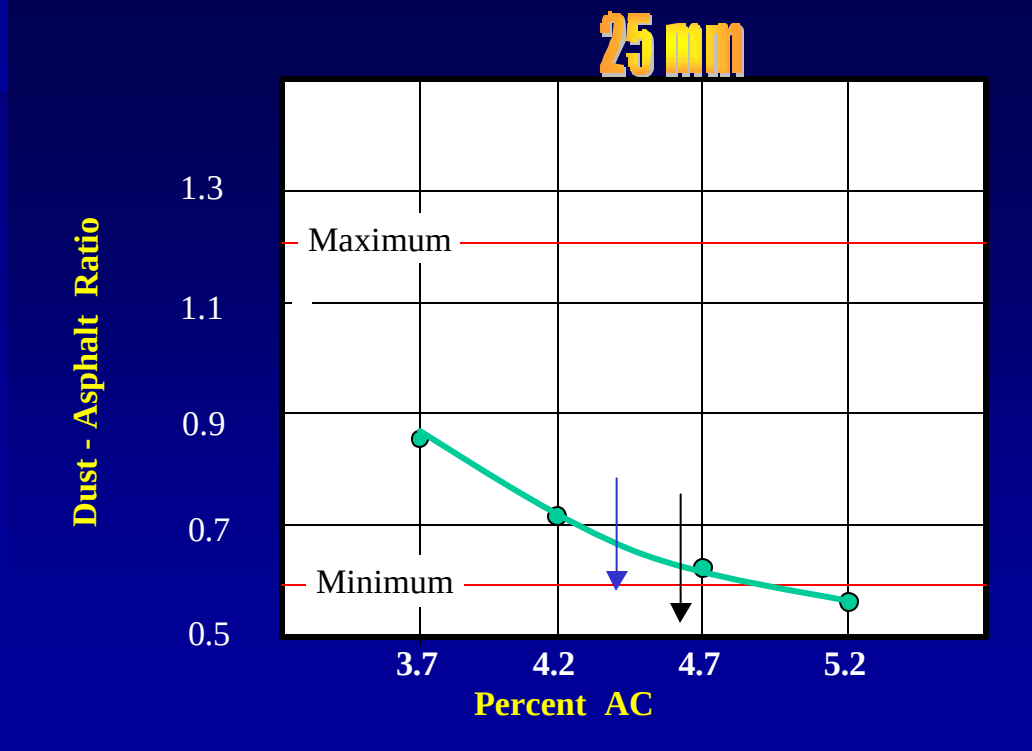
Air Voids	4.0%	4.0%
VMA	13.3%	12.0% min
VFA	70.0%	65 - 75%
N_{int}	84.8%	89% max
N_{max}	97.6%	98% max

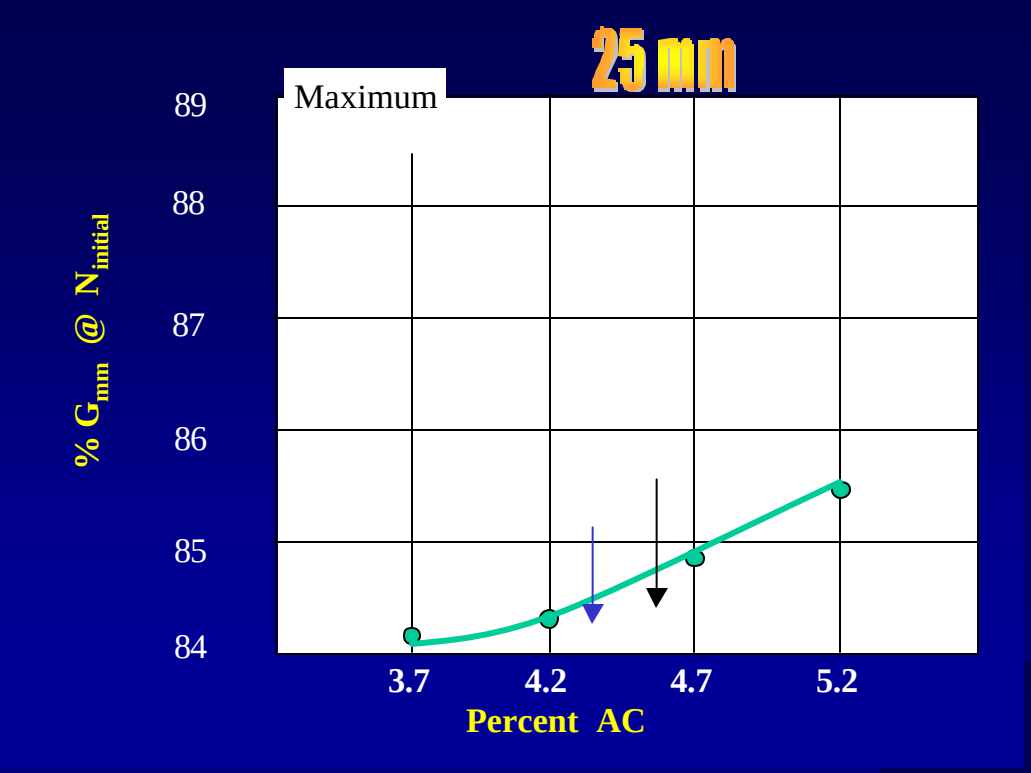

25 mm
% Air Voids
6.0
5.0
4.0
3.0
2.0
4.4
4.6
3.7
4.2
4.7
5.2
Percent AC

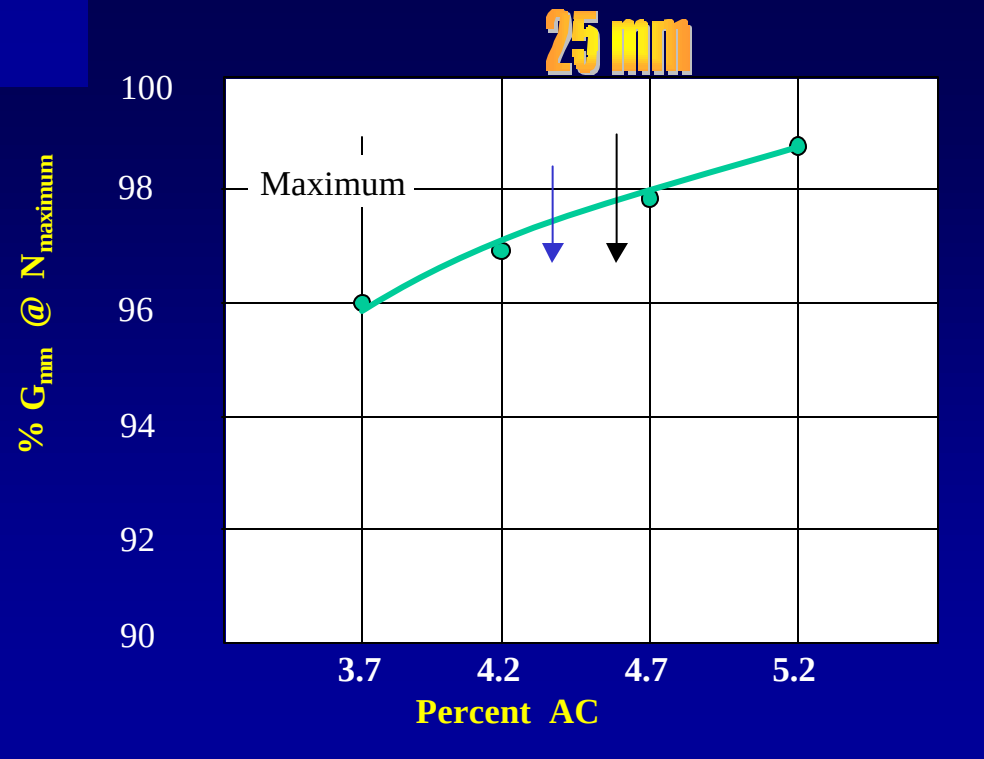

25 mm
80
75
70
65
60
55
Maximum
Minimum
% VFA
3.7
4.2
4.7
5.2
Percent AC


25 mm
14.0
13.5
13.0
12.5
12.0
Minimum
% VMA
3.7
4.2
4.7
5.2
Percent AC

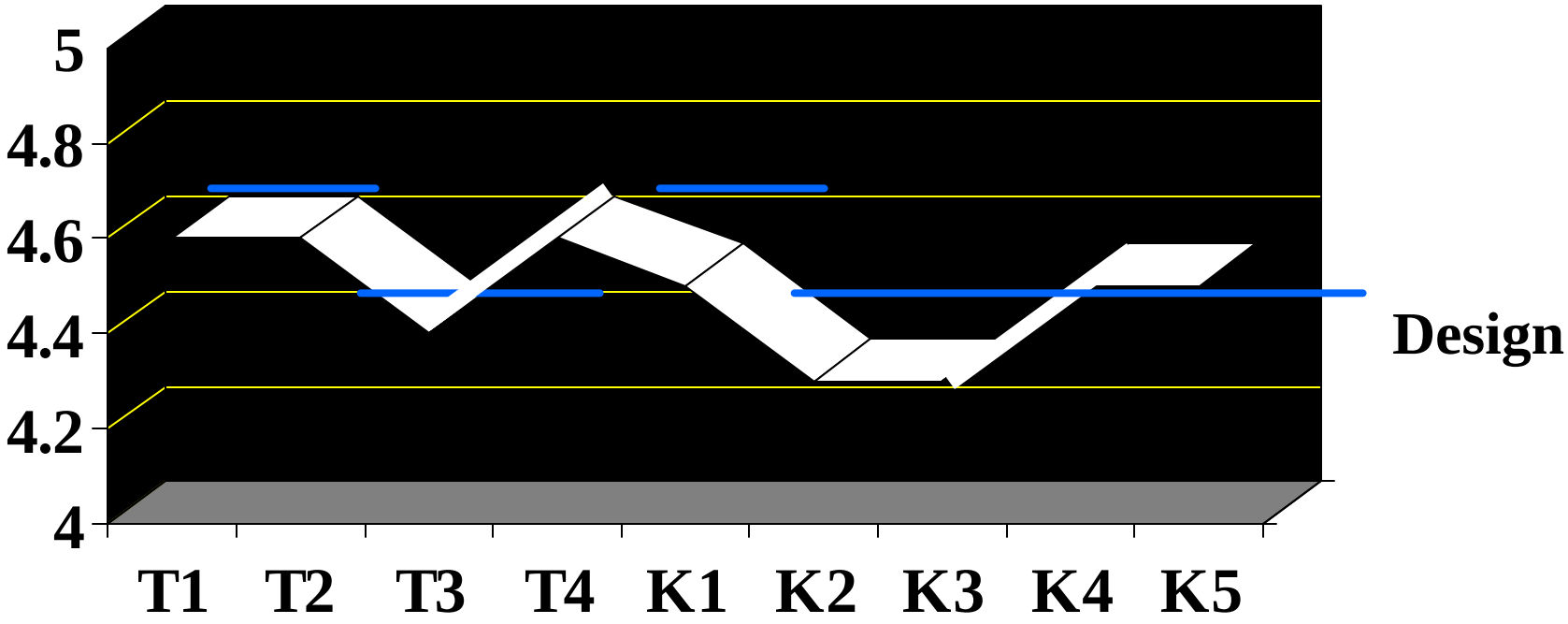

25 mm
Density (kg / m3)
2540
2535
2530
2525
2520
3.7
4.2
4.7
5.2
Percent AC


25 mm
Dust - Asphalt Ratio
1.3
1.1
0.9
0.7
0.5
Maximum
Minimum
3.7
4.2
4.7
5.2
Percent AC

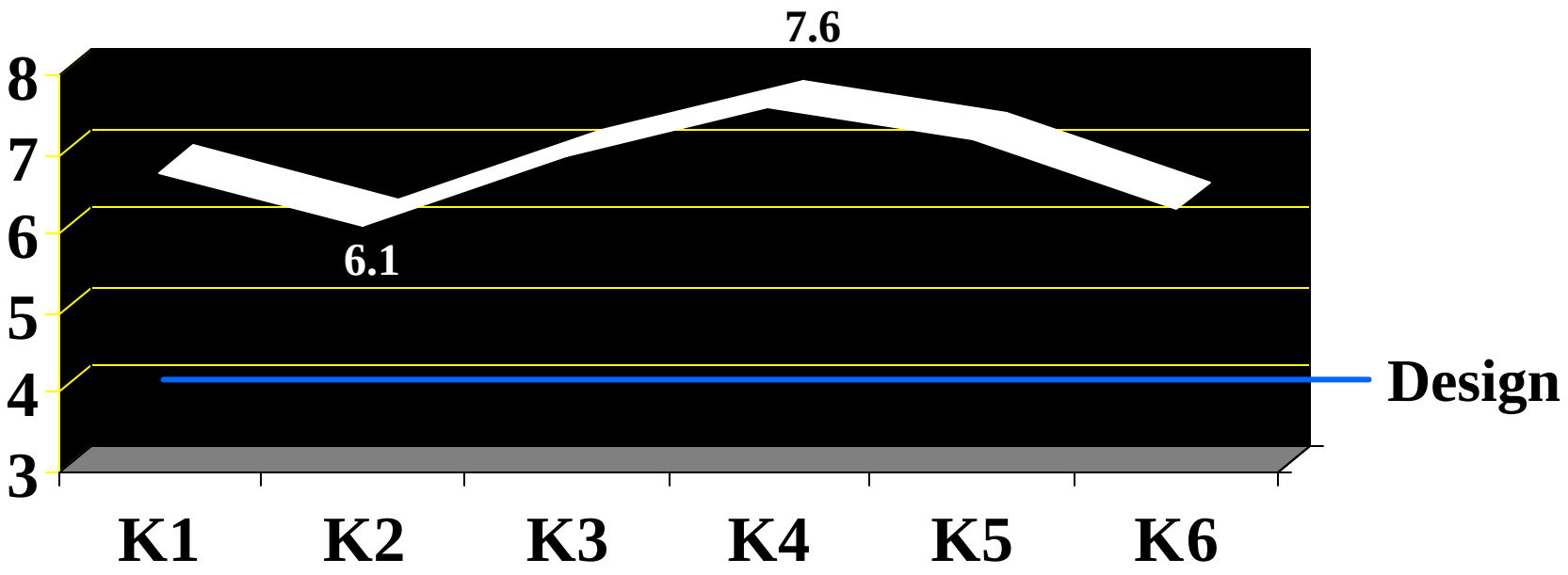

25 mm
Maximum
89
88
87
86
85
84
% G_{mm} @ $N_{initial}$
3.7
4.2
4.7
5.2
Percent AC


25 mm
Maximum
100
98
96
94
92
90
% G_{mm} @ $N_{maximum}$
3.7
4.2
4.7
5.2
Percent AC

Asphalt Content 25mm



In-place Air Voids 25mm



Koch (bulk)

Aggregate (Elkton, MD)

Arundel	6s	25
Arundel	7s	20
Arundel	8s	20
Arundel	10s	25
York	Sand	10

LA	15.0
Na_2SO_4	<1
Abs.	0.3

State/Province: MD

Weather Station: ELKTON

Depth from Pavement Surface to Top of Layer, mm: 0

Station ID	0182860	Latitude	39.62
County / District	CECIL	Longitude	75.83
Last Year Data Avail.	1975	Elevation, m	12

Air Temperature	Mean	Std Dev	Min	Max	Years
High 7-day Air Temp., Deg. C	34.0	1.5	32.1	37.2	26
Low Air Temperature, Deg. C	-15.9	2.8	-21.7	-11.1	21
Low Air Temp. Drop, Deg. C	14.4	3.2	9.4	20.6	21
Degree Days over 30 Deg. C	133	52	69	224	26

Pavement Temperature and PG	HIGH	LOW	High Rel	Low Rel
50% Reliability Pvt Temp., C	51.9	-10.5	50	50
>50% Reliability PG	52	-16	51	96
	58	-16	97	96
	58	-22	97	98
	64	-22	98	98

Slow moving 1 “bump” PG 70-22

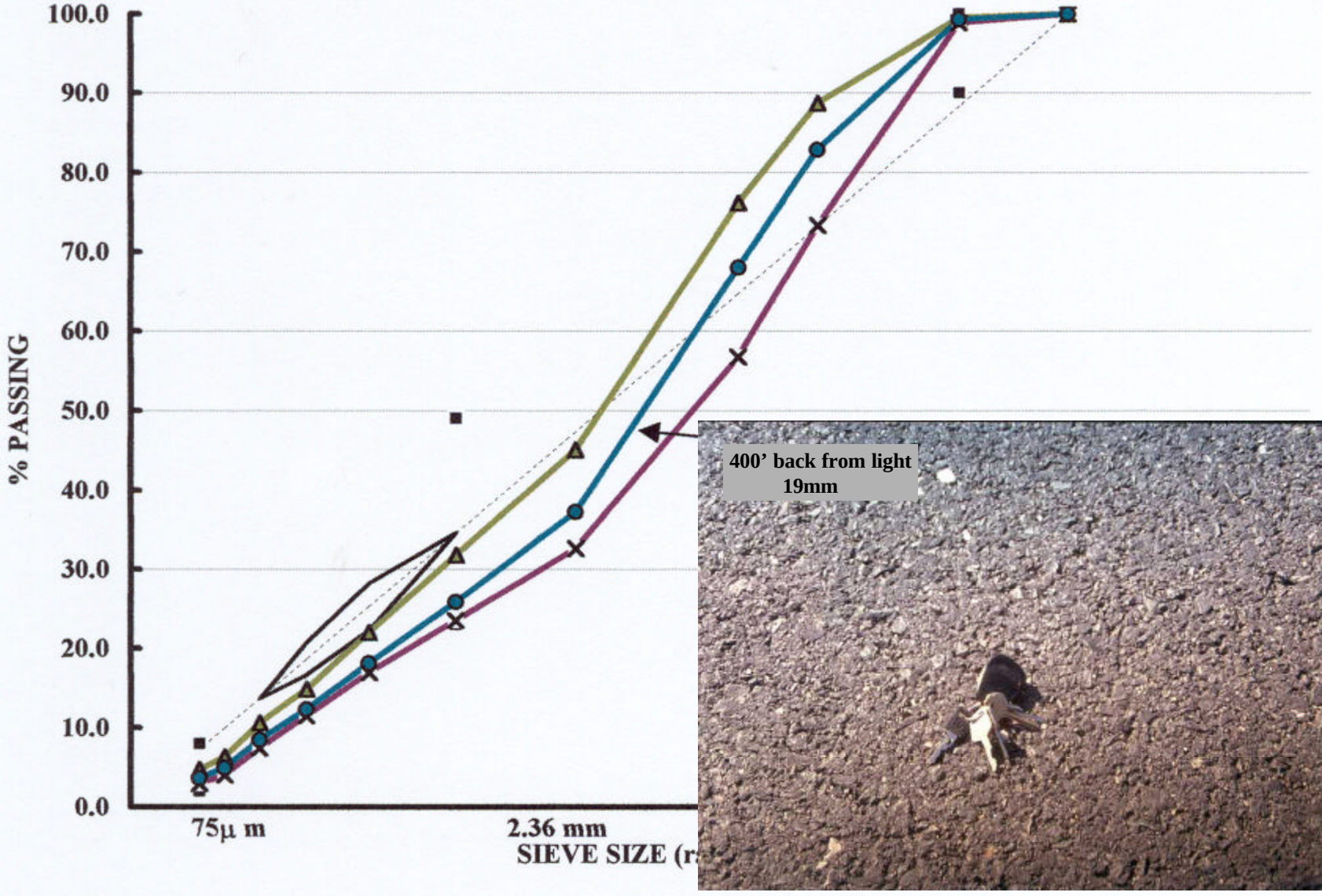
Standing 2 “bump” PG 76-22

64° C is 147° F

VS

76° C is 169° F

Maryland Intersection: 19 mm Nominal



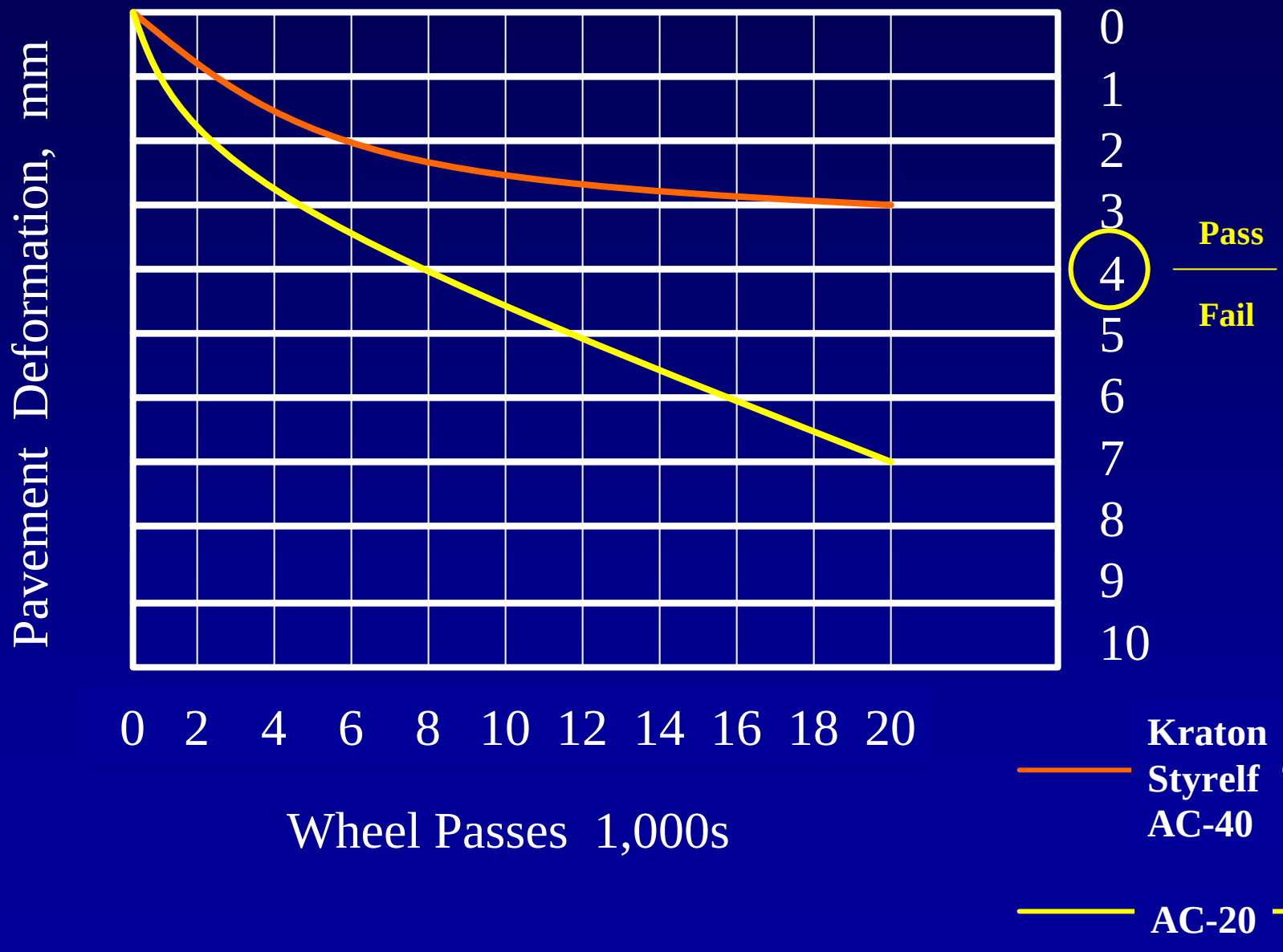
Elkton, MD

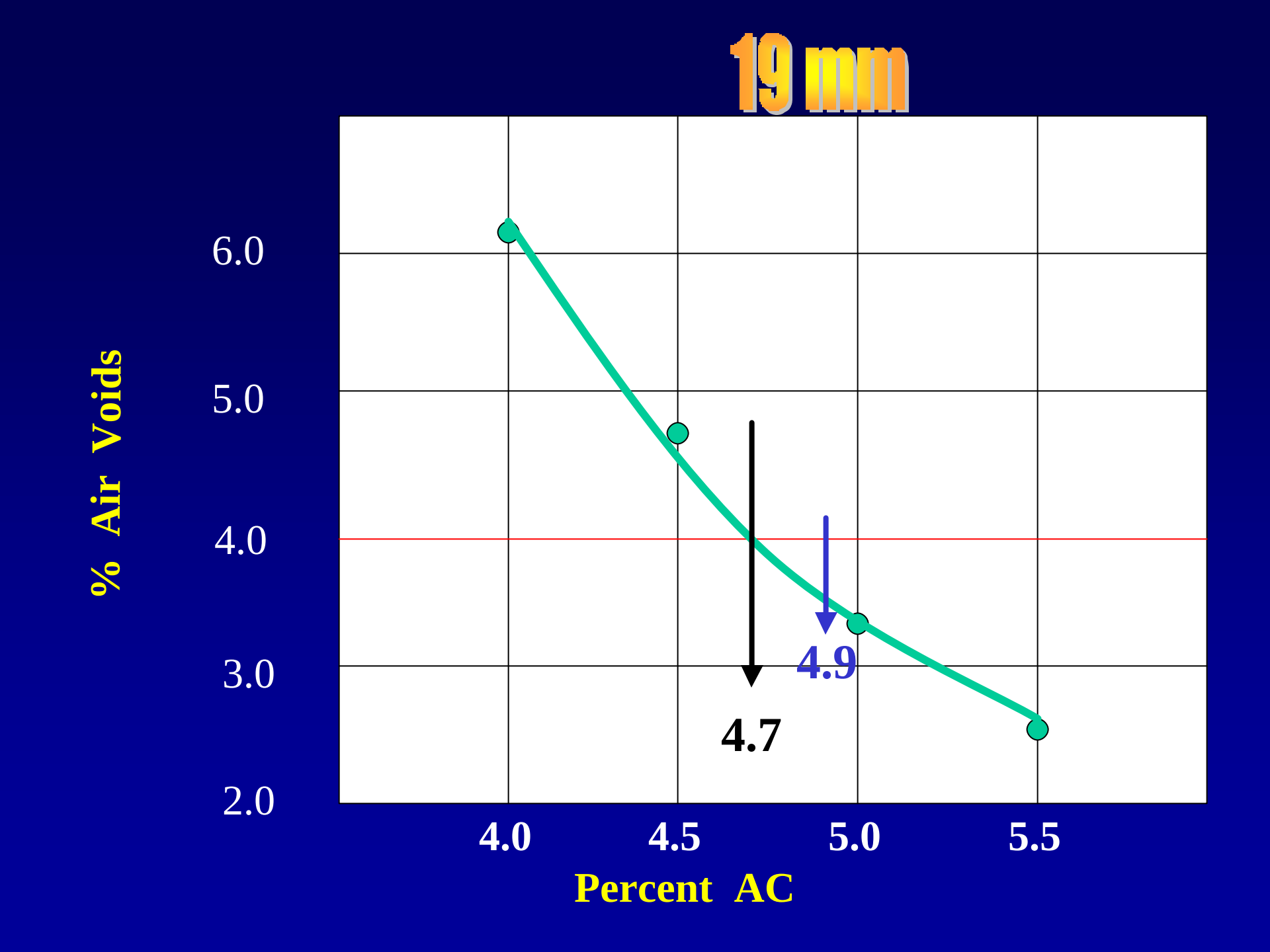
Design EALs = 18 million

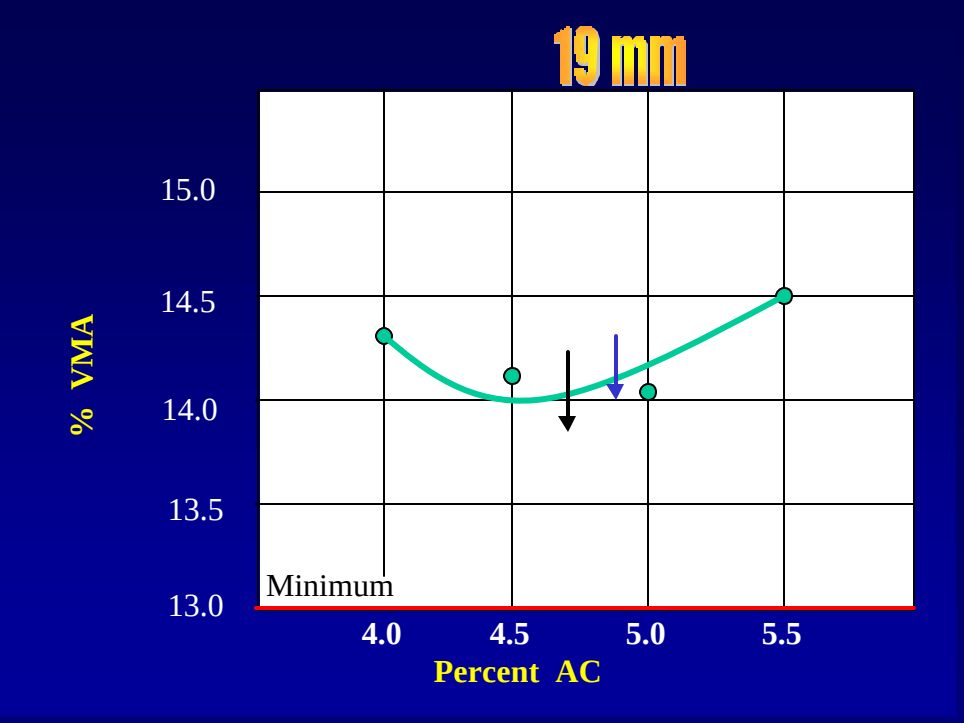
Design Gyrations = 8, 109, 174

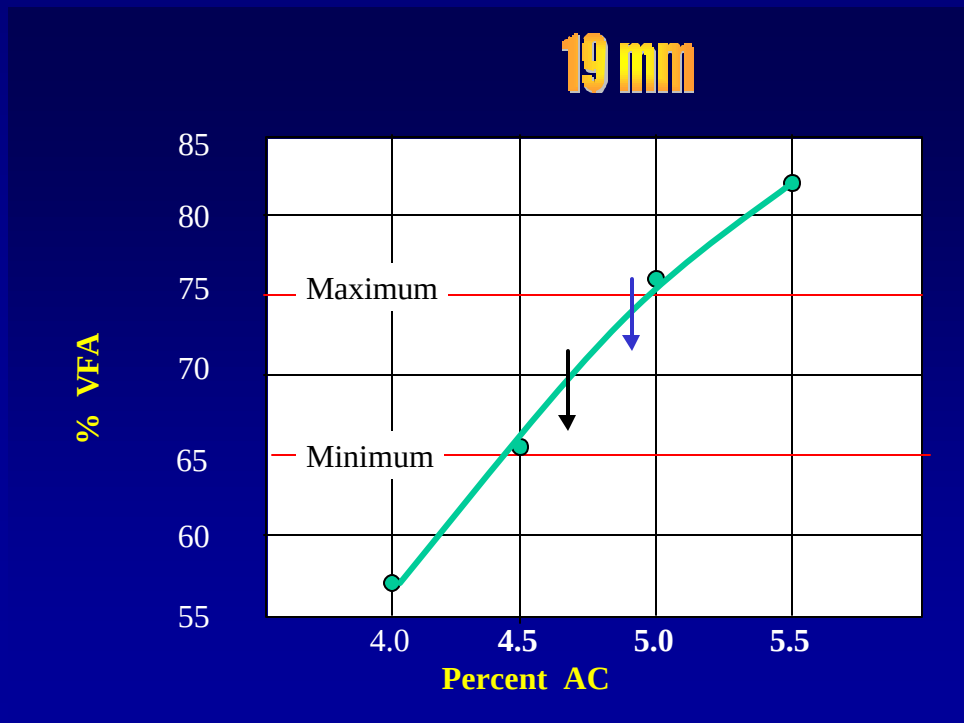
8, 100, 160

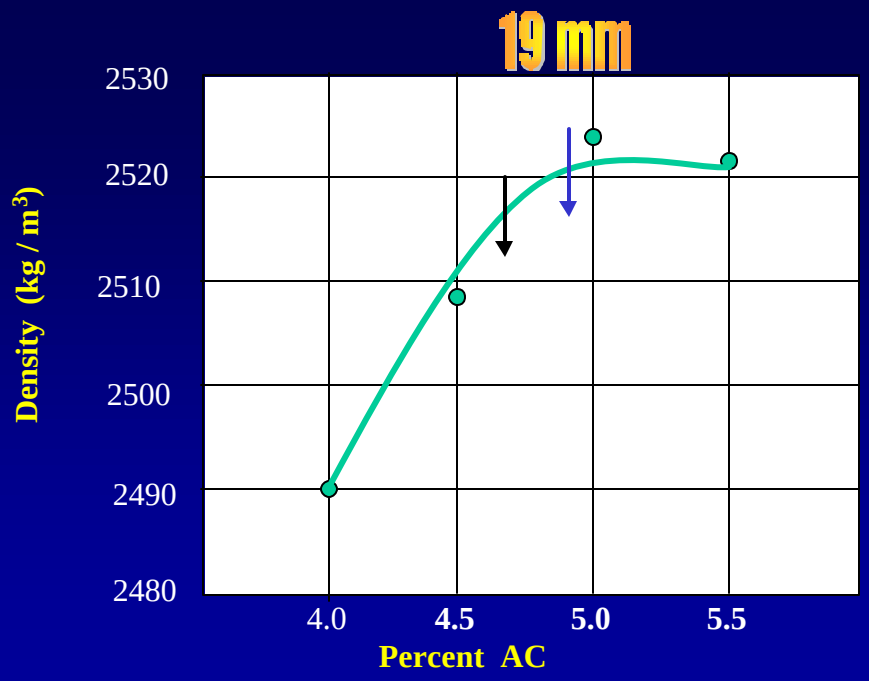
Hamburg Wheel Tracking Test @ 5.3%

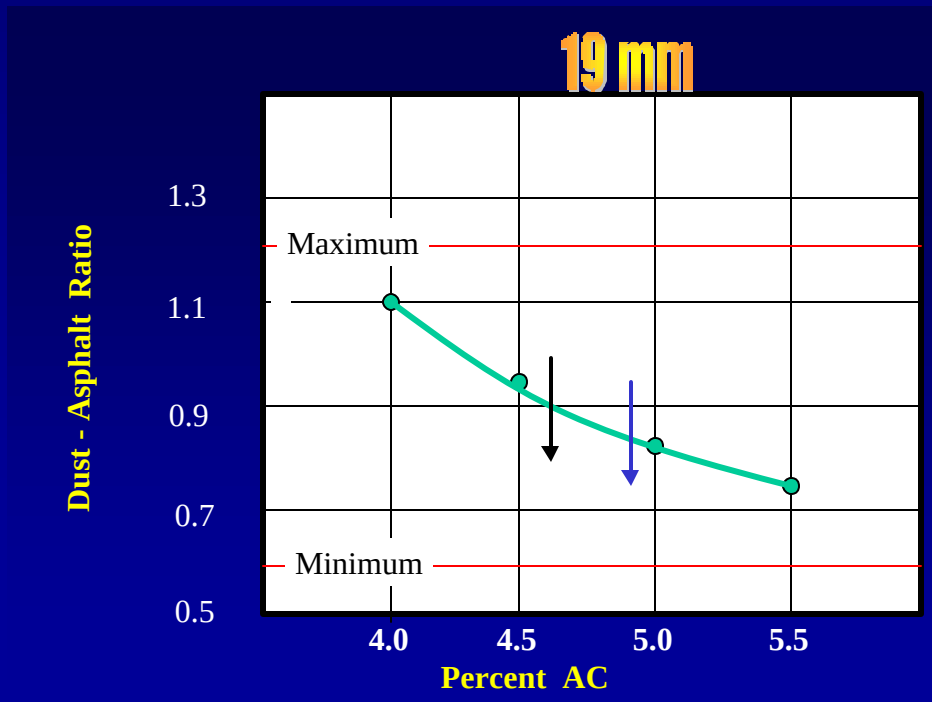


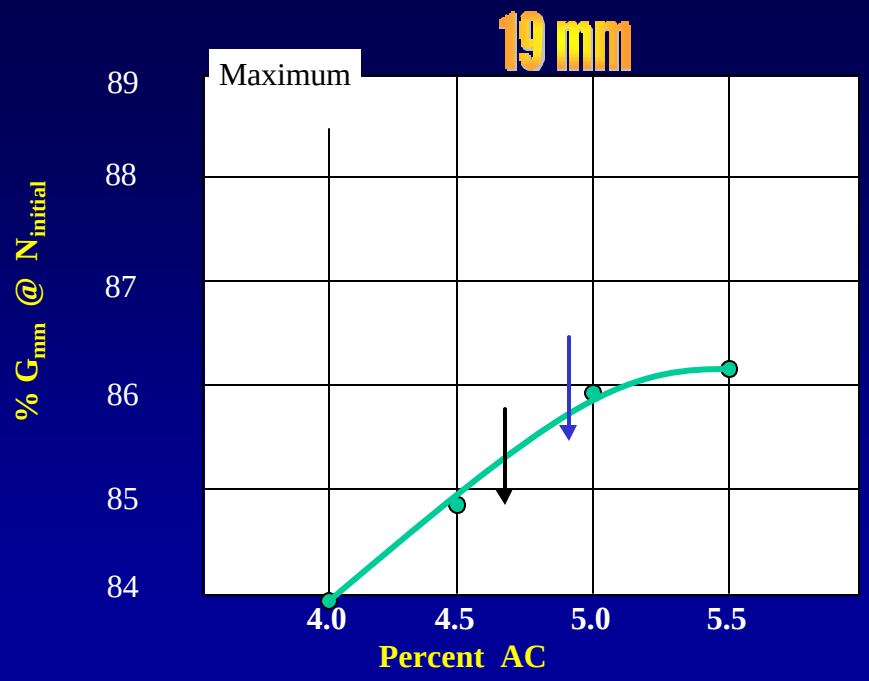

19 mm
% Air Voids
6.0
5.0
4.0
3.0
2.0
4.9
4.7
4.0
4.5
5.0
5.5
Percent AC

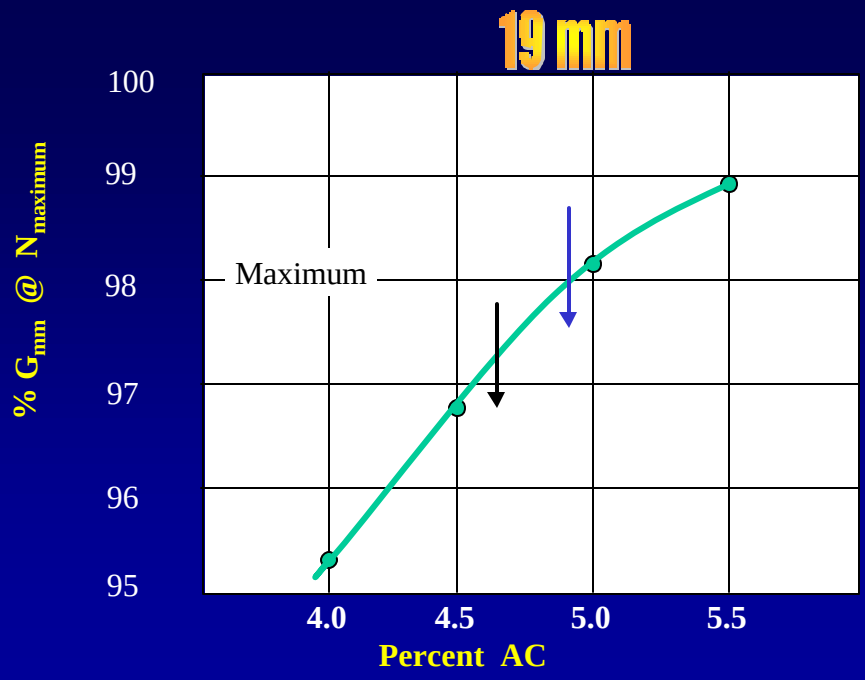

19 mm
15.0
14.5
14.0
13.5
13.0
% VMA
Minimum
4.0
4.5
5.0
5.5
Percent AC


19 mm
85
80
75
70
65
60
55
% VFA
Maximum
Minimum
4.0
4.5
5.0
5.5
Percent AC


19 mm
2530
2520
2510
2500
2490
2480
Density (kg / m3)
4.0
4.5
5.0
5.5
Percent AC


19 mm
1.3
1.1
0.9
0.7
0.5
Maximum
Minimum
Dust - Asphalt Ratio
4.0
4.5
5.0
5.5
Percent AC

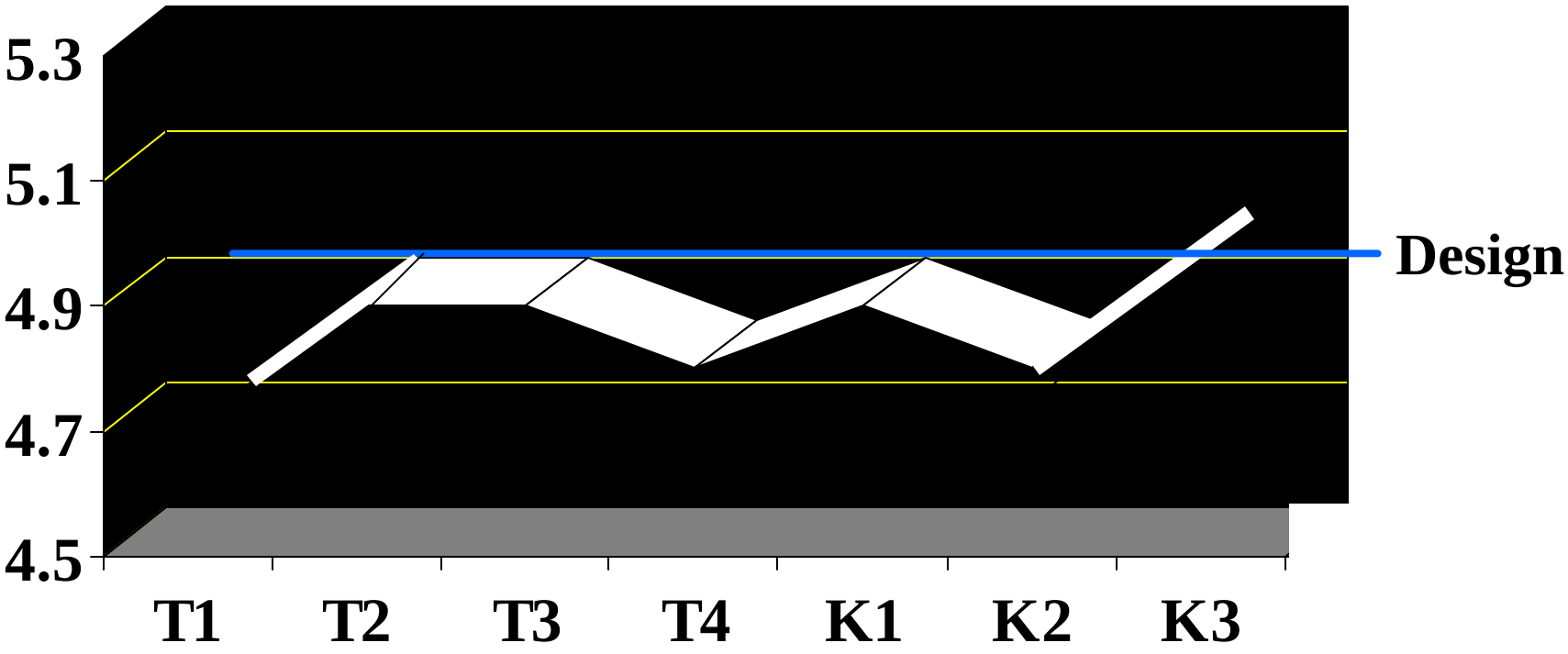

19 mm
Maximum
89
88
87
86
85
84
% G_{mm} @ $N_{initial}$
4.0
4.5
5.0
5.5
Percent AC


19 mm
100
99
98
97
96
95
Maximum
% G_{mm} @ $N_{maximum}$
4.0
4.5
5.0
5.5
Percent AC

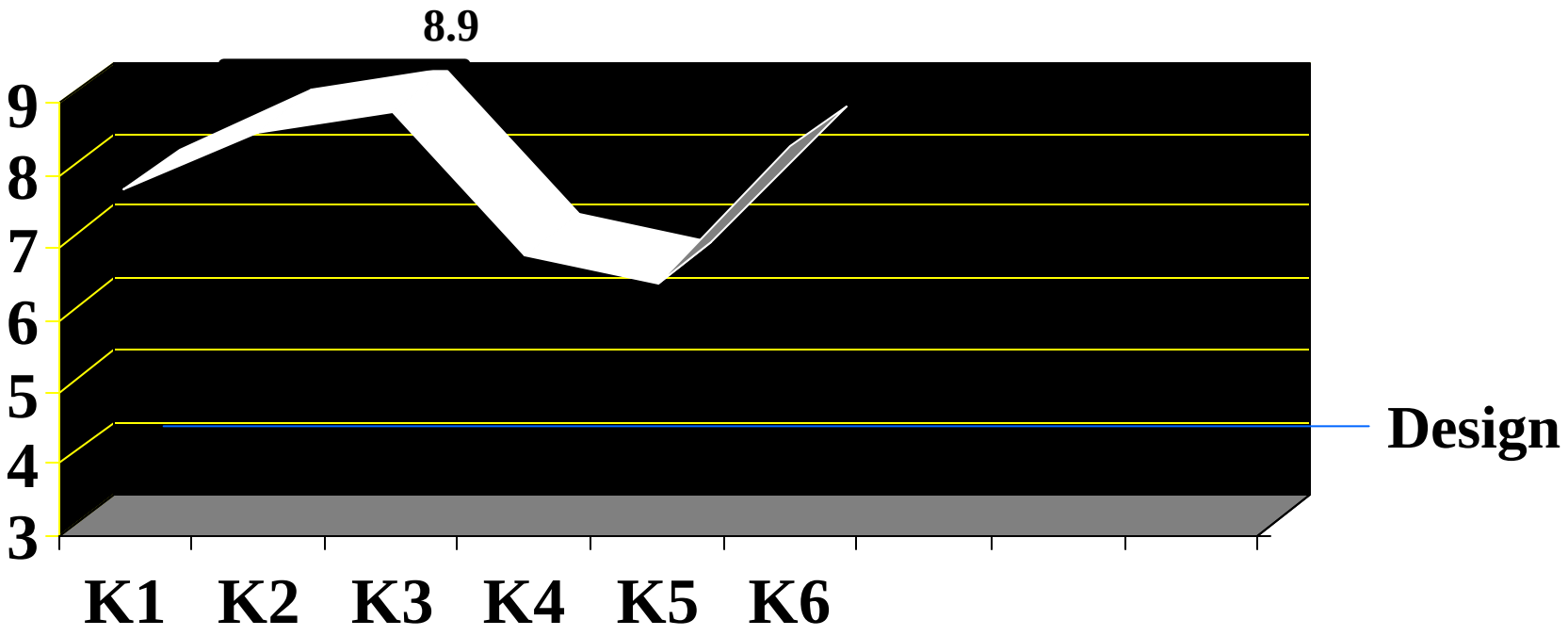
19 mm Summary @ 4.9% AC (Md)

	4.7	4.9	
Air Voids	4.0%	3.6	4.0%
VMA	14.1%	14.2	13.0% min
VFA	72.0%	75	65 - 75%
N_{int}	85.3%	85.6	89% max
N_{max}	97.5%	97.8	98% max

Asphalt Content 19mm



In-place Air Voids 19mm

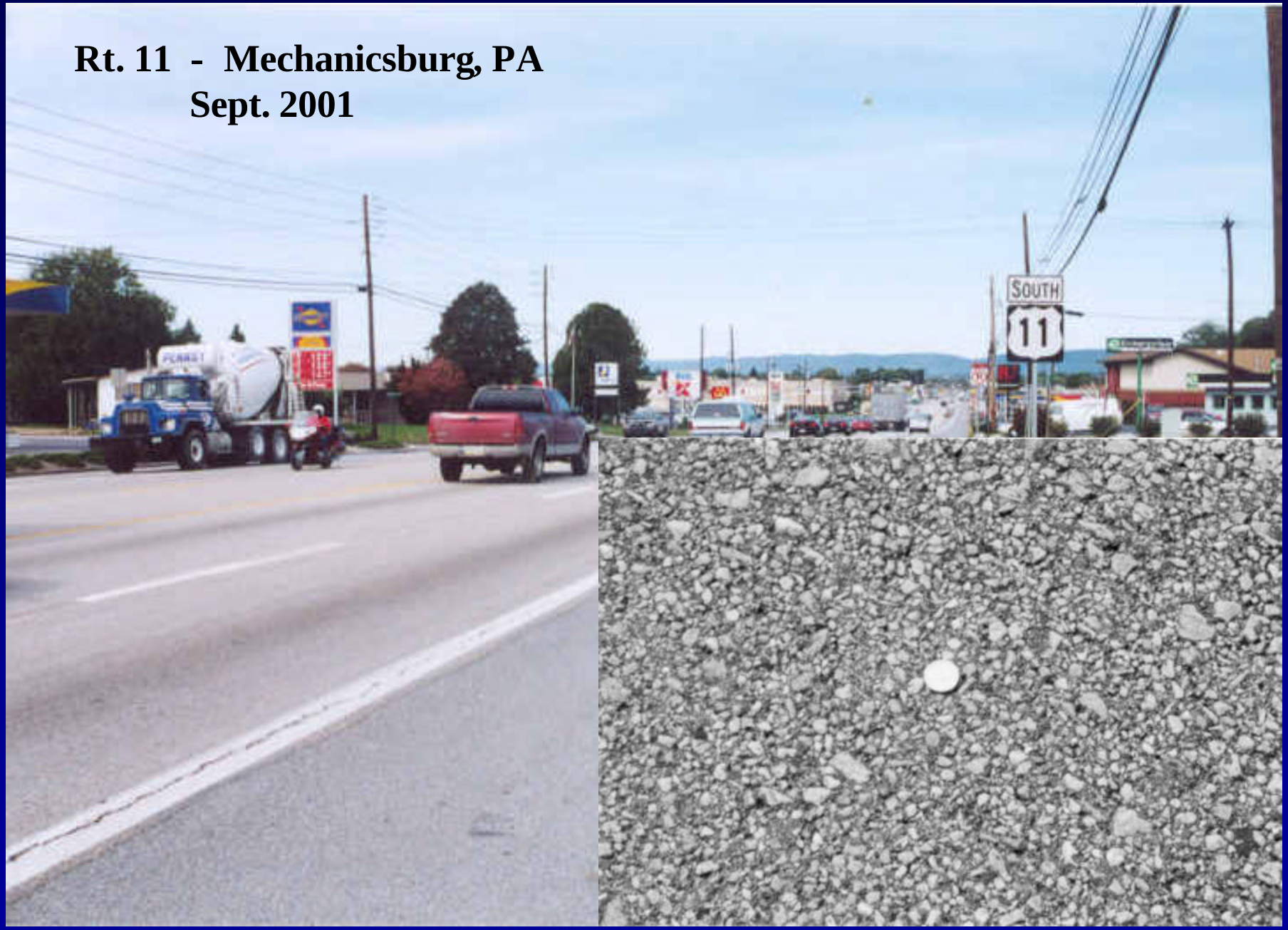


Koch (bulk)

Carlisle, PA
Flying "J" Truck Stop
Turn Lane

Constructed Oct. 1996

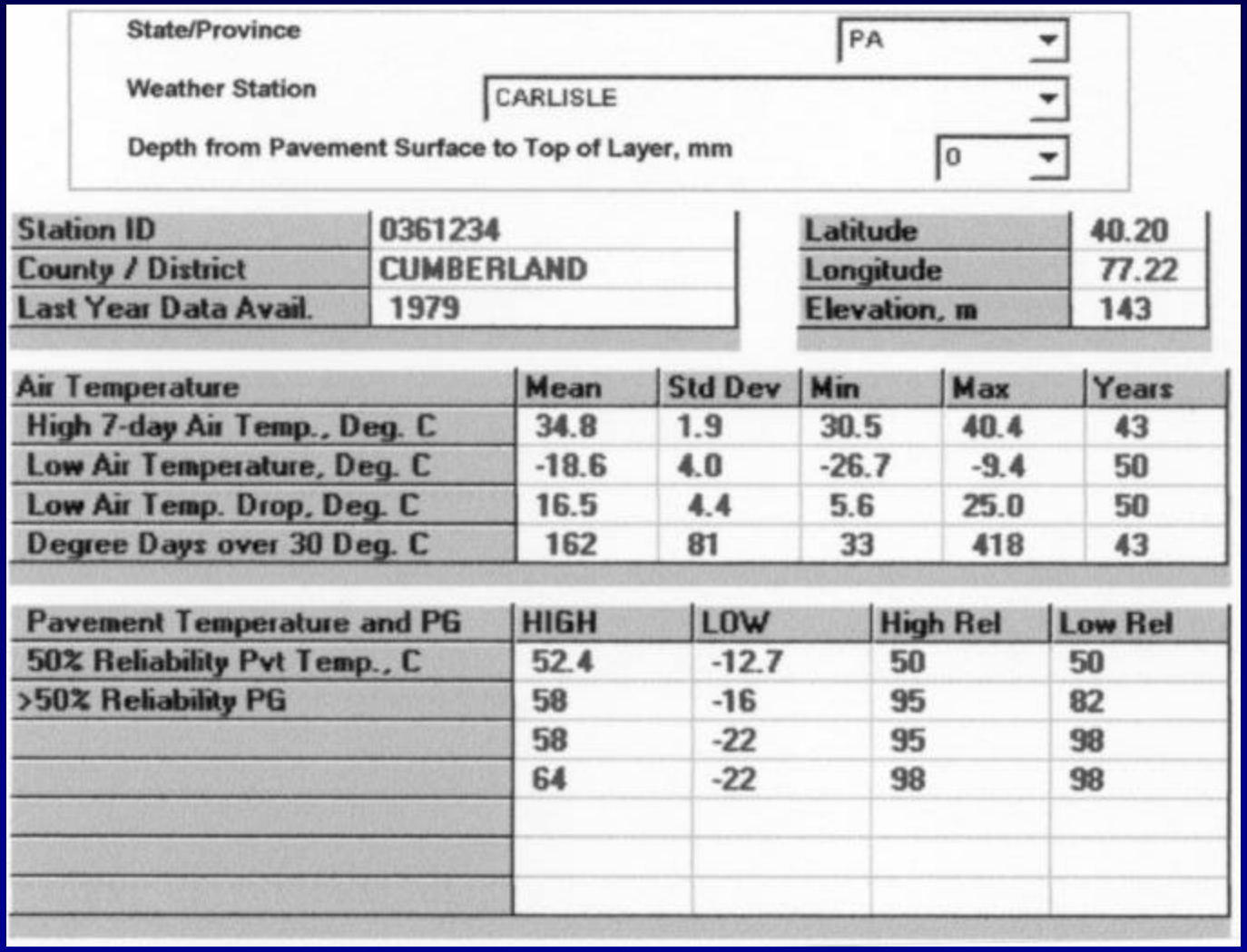
Rt. 11 - Mechanicsburg, PA
Sept. 2001



Flying “J”
Sept. 2001

Aggregate (Carlisle, PA)

Toland 67s	32	LA	33.7
Toland 8s	36	Na_2SO_4	3.4
Locust Point 10s	16	Abs.	1.02
Locust Point Bc sand	11	FAA	46.9
AC	5^1		



State/Province: PA

Weather Station: CARLISLE

Depth from Pavement Surface to Top of Layer, mm: 0

Station ID	0361234
County / District	CUMBERLAND
Last Year Data Avail.	1979

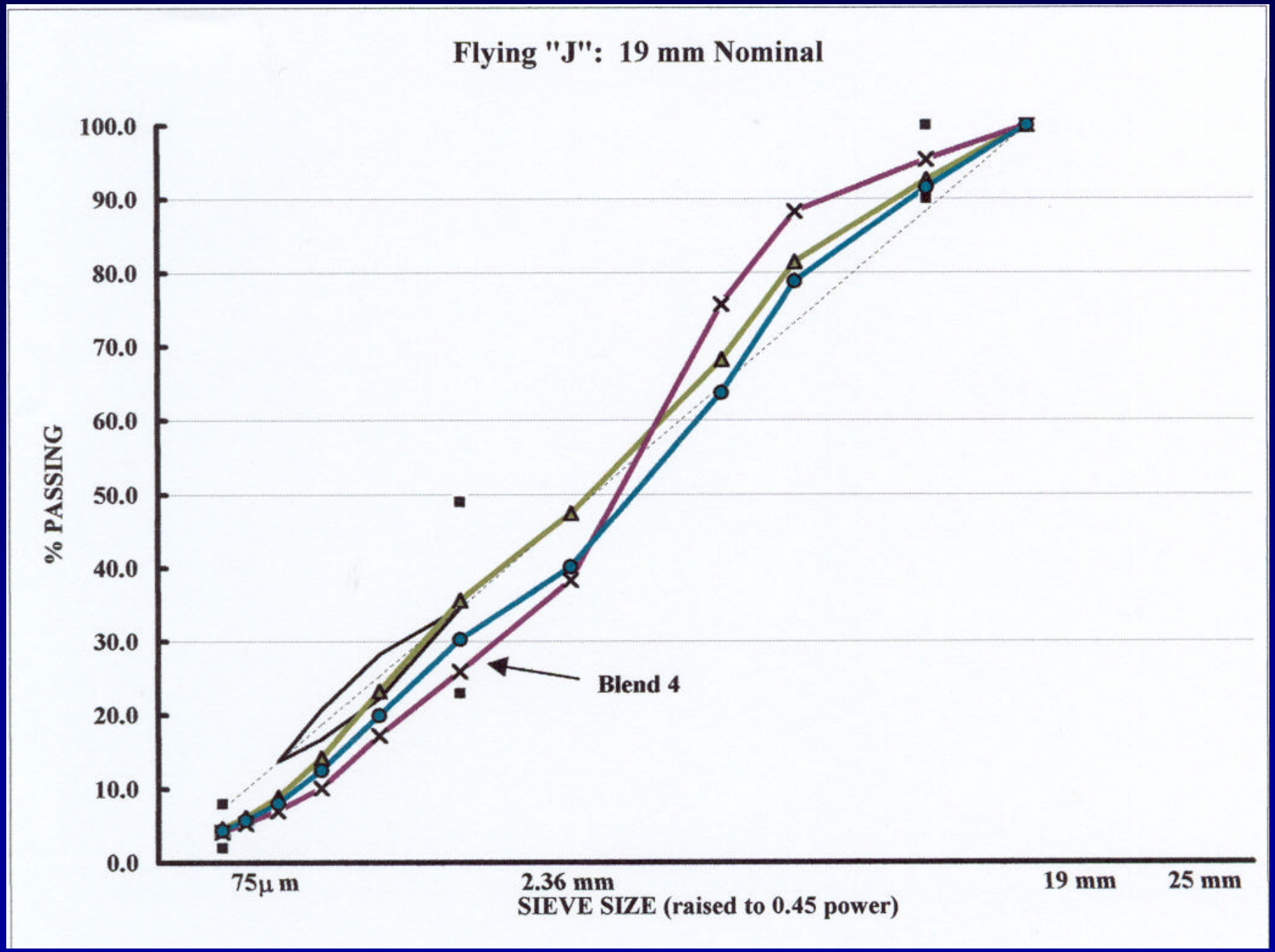
Latitude	40.20
Longitude	77.22
Elevation, m	143

Air Temperature	Mean	Std Dev	Min	Max	Years
High 7-day Air Temp., Deg. C	34.8	1.9	30.5	40.4	43
Low Air Temperature, Deg. C	-18.6	4.0	-26.7	-9.4	50
Low Air Temp. Drop, Deg. C	16.5	4.4	5.6	25.0	50
Degree Days over 30 Deg. C	162	81	33	418	43

Pavement Temperature and PG	HIGH	LOW	High Rel	Low Rel
50% Reliability Pvt Temp., C	52.4	-12.7	50	50
>50% Reliability PG	58	-16	95	82
	58	-22	95	98
	64	-22	98	98

Standing traffic bump to PG 76-22

64° C is 147° F vs 76° C is 169° F


Flying "J": 19 mm Nominal
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
% PASSING
Blend 4
75μ m
2.36 mm
19 mm
25 mm
SIEVE SIZE (raised to 0.45 power)

Carlisle, PA

Design EALs = 41 million

Design Gyrations = 9, 126, 204

9, 125, 205

19 mm Summary @ 5.1% AC (Flying J)

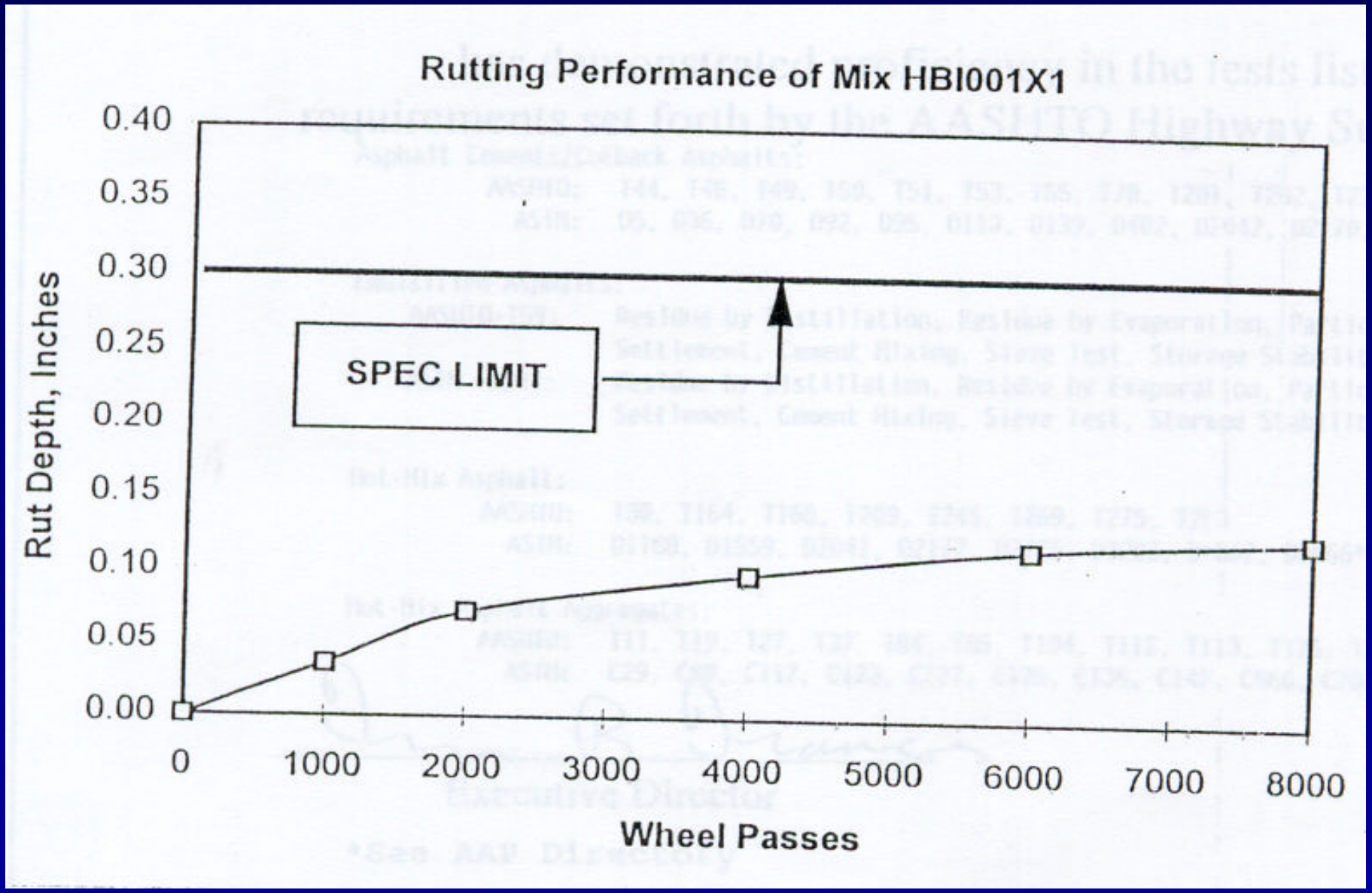
Air Voids	**4.0%**	**5.4**	**4.0%**
VMA	**13.3%**	**14.6**	**13.0% min**
VFA	**69.9%**	**69.9**	**65 - 75%**
N_{int}	**85.4%**	**----**	**89% max**
N_{max}	**97.5%**	**----**	**98% max**

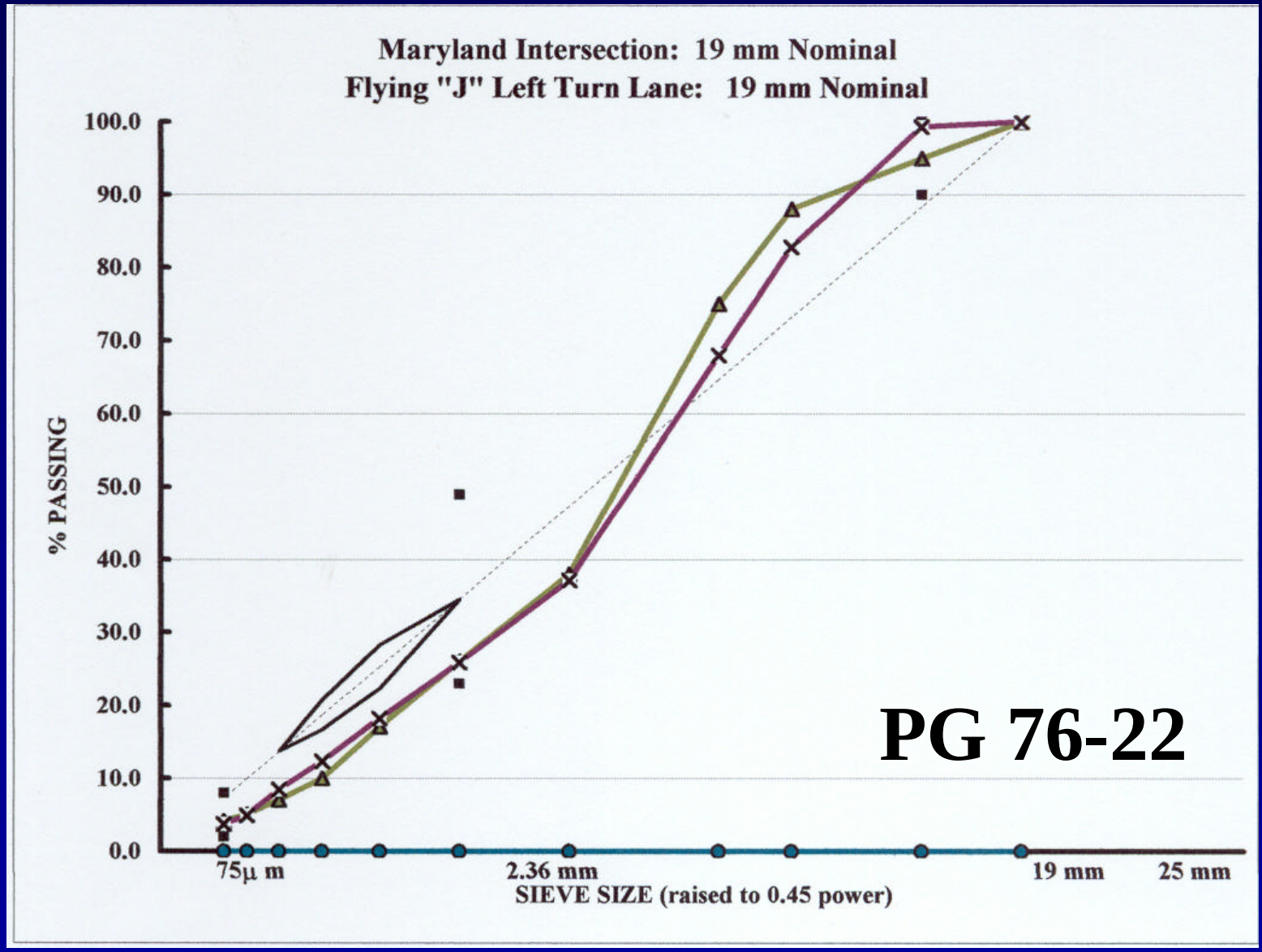
Marshall Tests at Plant

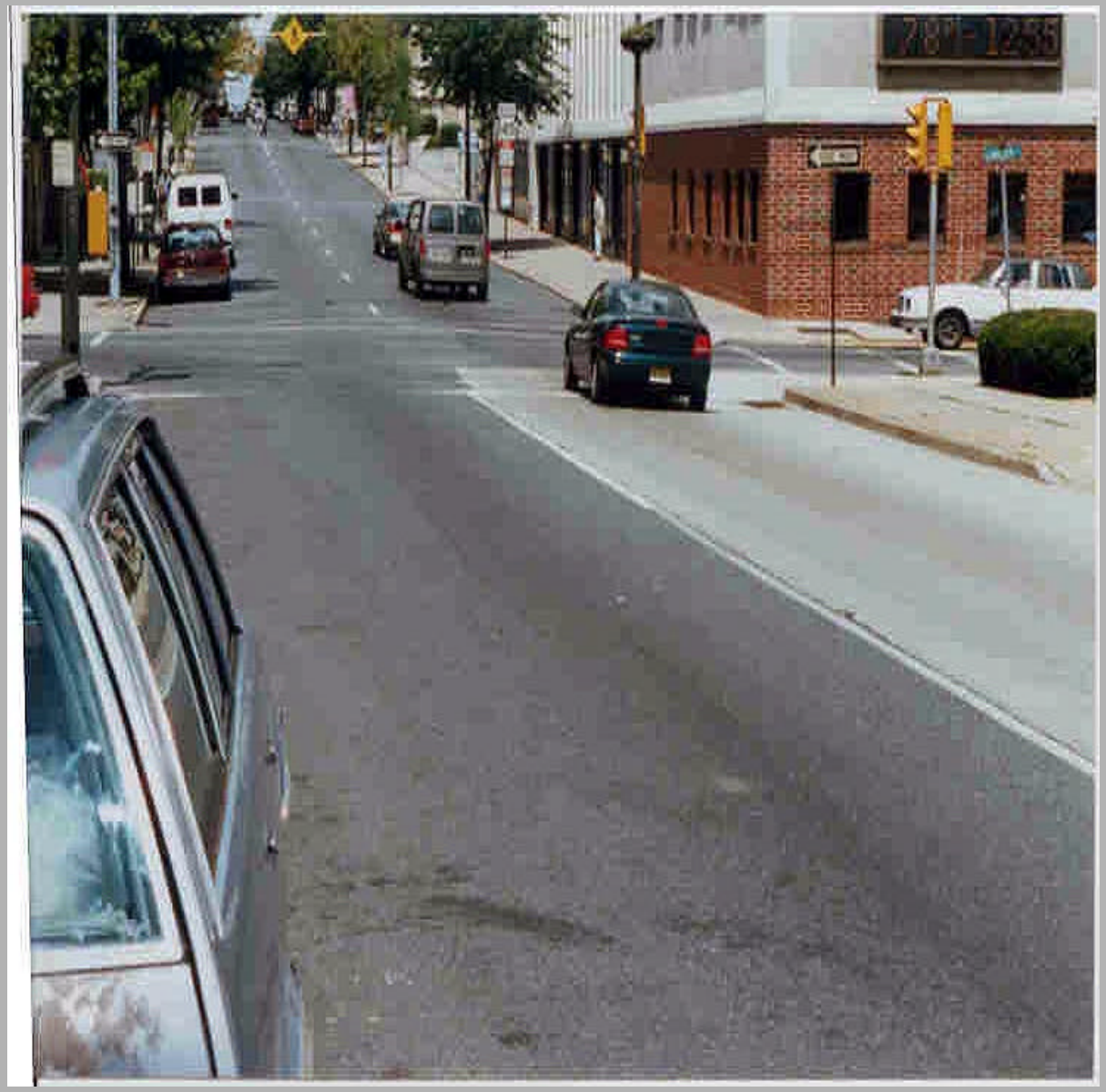
Plant Test Results

	Des	$\overline{X}$
3/4”	95	94
1/2”	88	86
#8	26	27
#50	10	11
#200	4.1	4.6
AC	5.1	4.7

Georgia Rut Tester




Maryland Intersection: 19 mm Nominal
Flying "J" Left Turn Lane: 19 mm Nominal
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
% PASSING
75µ m
2.36 mm
19 mm
25 mm
SIEVE SIZE (raised to 0.45 power)
PG 76-22



Allentown, PA

6st & Linden

19mm PG 76-22

Completed 1995

Aggregate (Allentown, PA)

Nazareth 67s	33
Nazareth 8s	24
Washed Scrn.	34
Baghouse Filler	4
AC	5[3]

LA	21.8
Na_2SO_4	2.0
Abs.	0.5
FAA	49

State/Province: PA

Weather Station: ALLENTOWN GAS COMPAN

Depth from Pavement Surface to Top of Layer, mm: 0

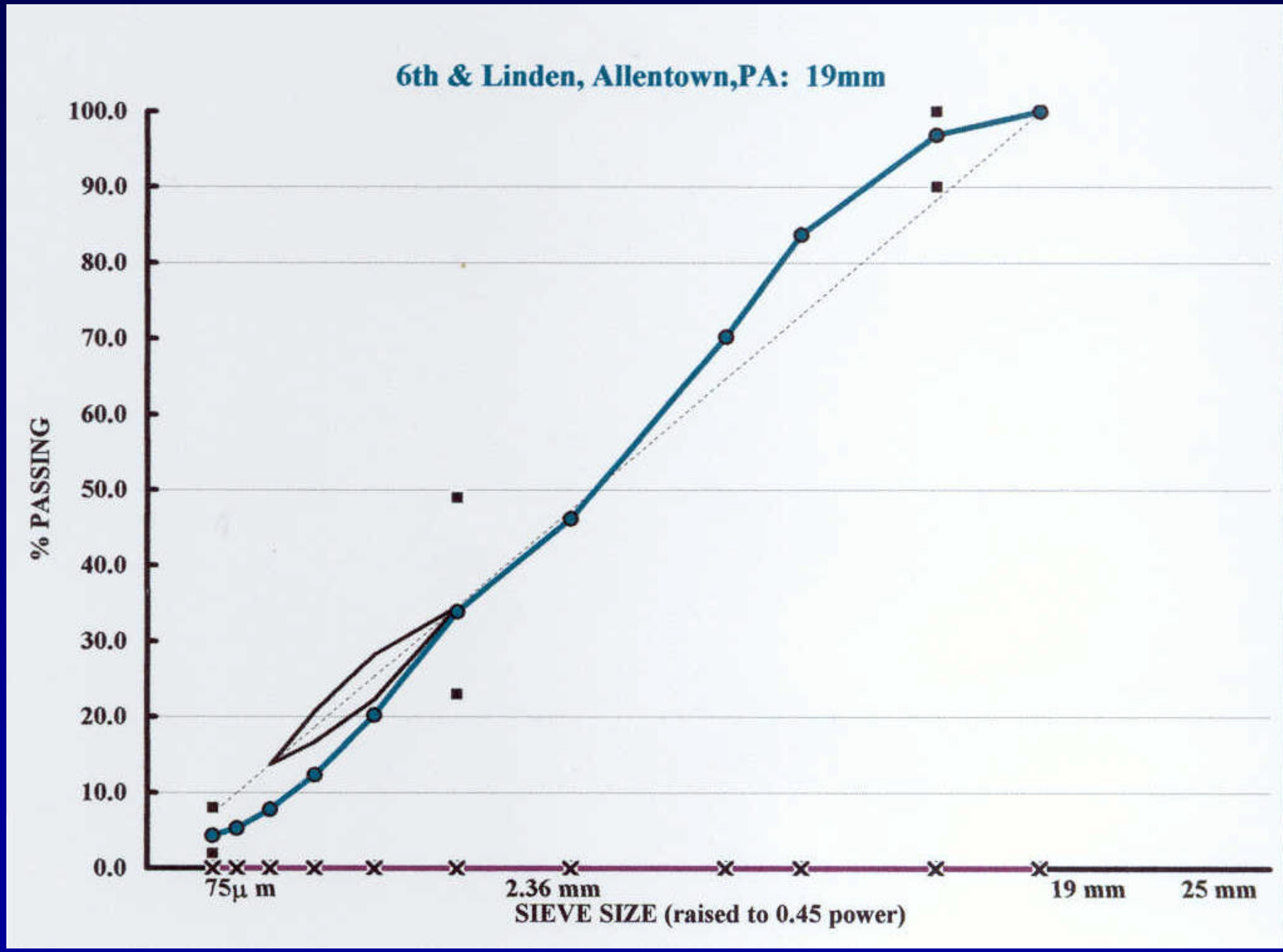
Station ID	0360111
County / District	LEHIGH
Last Year Data Avail.	1963

Latitude	40.60
Longitude	75.47
Elevation, m	76

Air Temperature	Mean	Std Dev	Min	Max	Years
High 7-day Air Temp., Deg. C	33.4	1.7	30.6	36.9	14
Low Air Temperature, Deg. C	-17.1	2.4	-19.4	-12.8	12
Low Air Temp. Drop, Deg. C	18.9	4.4	12.2	28.3	12
Degree Days over 30 Deg. C	98	44	43	173	14

Pavement Temperature and PG	HIGH	LOW	High Rel	Low Rel
50% Reliability Pvt Temp., C	51.2	-11.7	50	50
>50% Reliability PG	52	-16	59	94
	58	-16	98	94
	58	-22	98	98

Close | PG Chart | PG Distribution | Print | Save | Help


6th & Linden, Allentown,PA: 19mm
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
% PASSING
75μ m
2.36 mm
19 mm
25 mm
SIEVE SIZE (raised to 0.45 power)

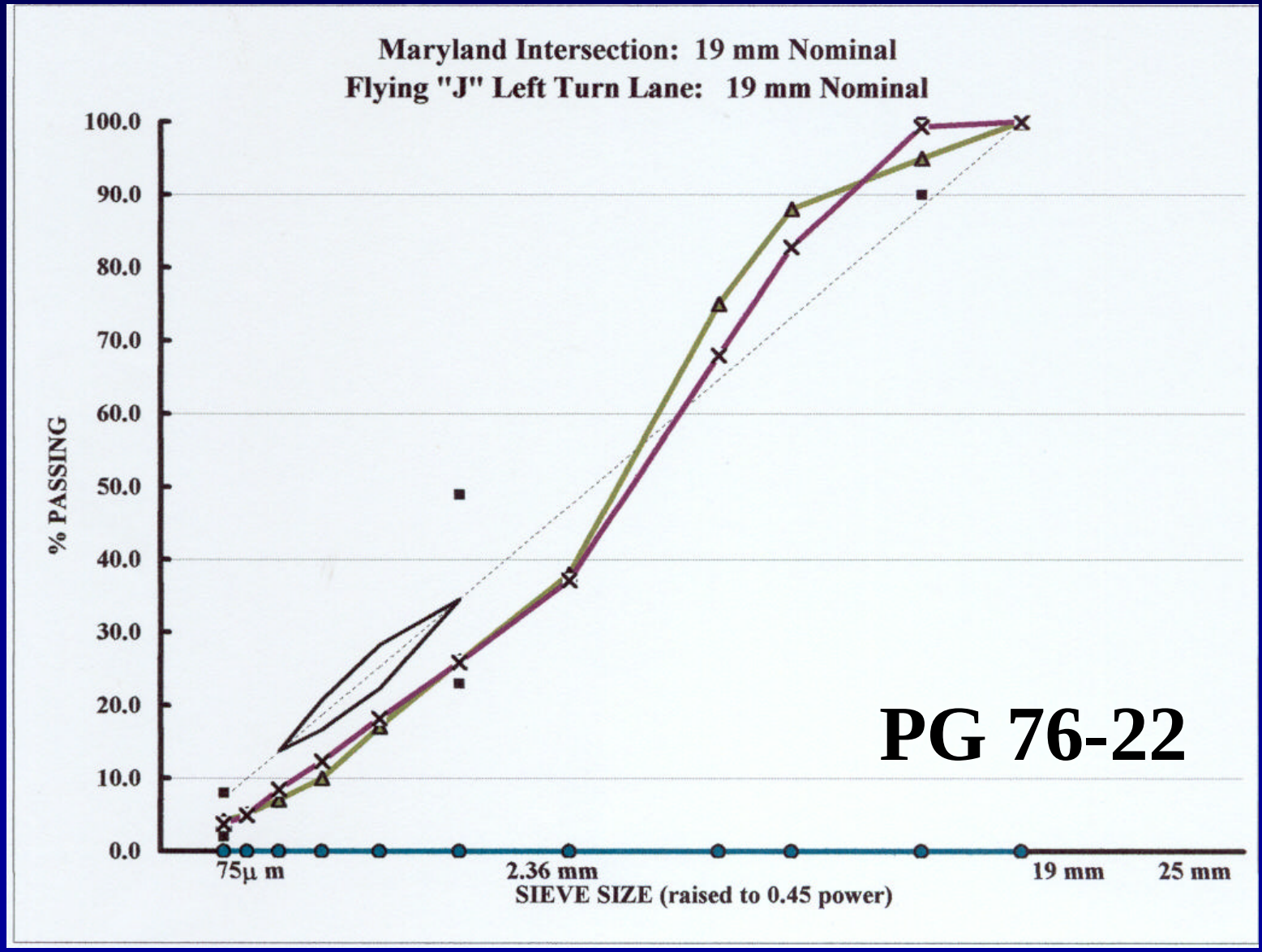
Allentown, PA

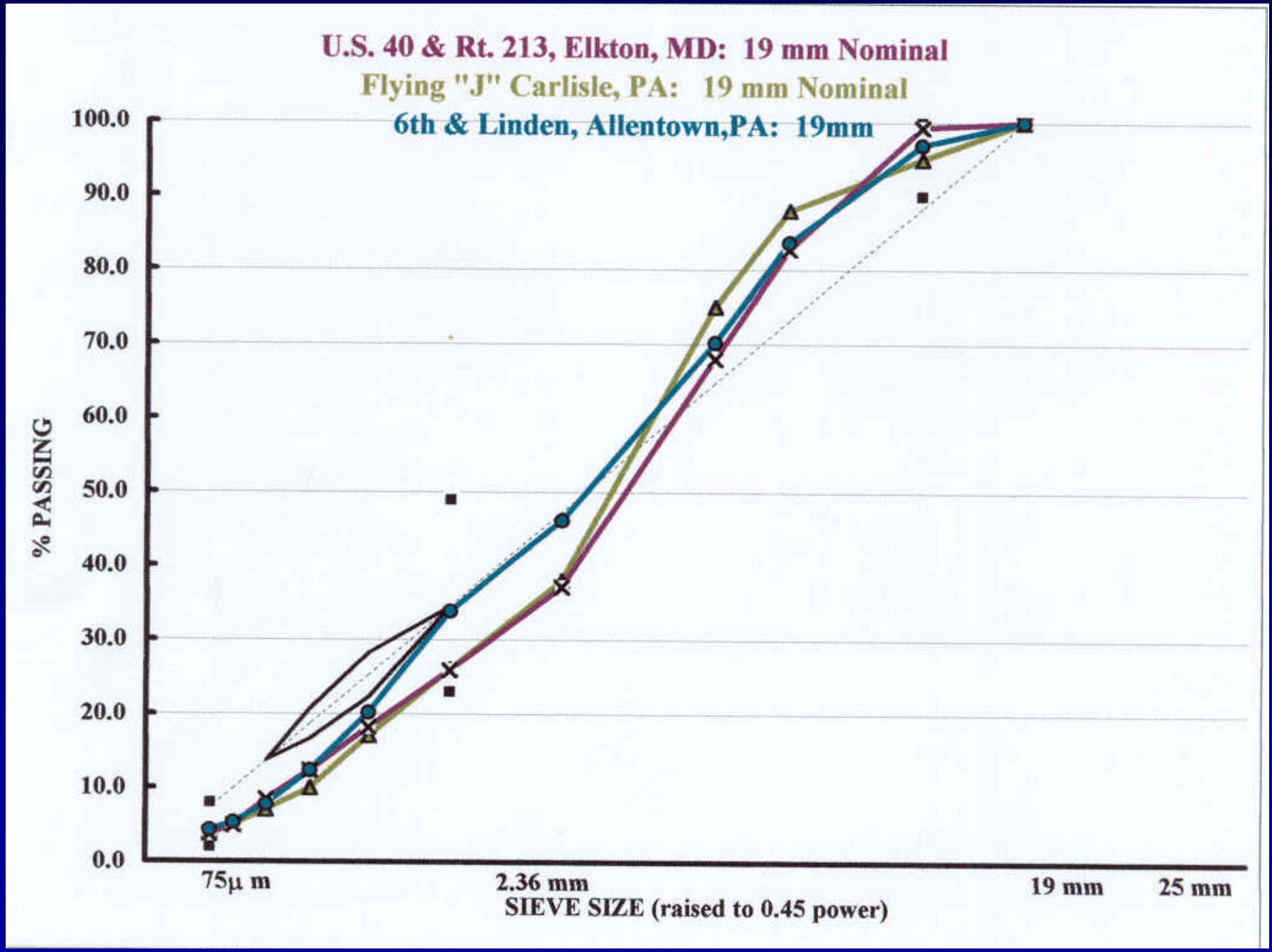
Design Gyrations = 8, 109, 174

8, 100, 160

19mm @ 5.3% AC

Air Voids	**4.0%**	**4.0%**
VMA	**15.5%**	**13.0% min**
VFA	**74.0%**	**65 - 75%**
N_{int}	**84.0%**	**89% max**
N_{max}	**97.7%**	**98% max**


Maryland Intersection: 19 mm Nominal
Flying "J" Left Turn Lane: 19 mm Nominal
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
% PASSING
75µ m
2.36 mm
19 mm
25 mm
SIEVE SIZE (raised to 0.45 power)
PG 76-22


U.S. 40 & Rt. 213, Elkton, MD: 19 mm Nominal
Flying "J" Carlisle, PA: 19 mm Nominal
6th & Linden, Allentown,PA: 19mm
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
% PASSING
75μ m
2.36 mm
19 mm
25 mm
SIEVE SIZE (raised to 0.45 power)

Final Thoughts

- **These designs were developed by laboratories with Superpave design experience and in some cases the designs were adjusted based on experience; we need to be diligent in developing future designs**

- **Modification of the binder is having a greater** influence than we have given it prior to the implementation of Superpave

Final Thoughts

- Required depth of rut resistant material still a question to be resolved

- Superpave has provided a tool to which provides a high reliability that rutting will not be a distress factor; the key will be to also provide durability. These three pavements appear to have provided both properties, anti-rutting and durability

Thank You

U.S. 40 & Landing Lane

T.C. Simons crews remove 6 1/2" whitetopping at US 40 & Landing Road.

Superpave replaces deteriorated concrete at Landing Road.

2000

Allentown @ 16th & Linden