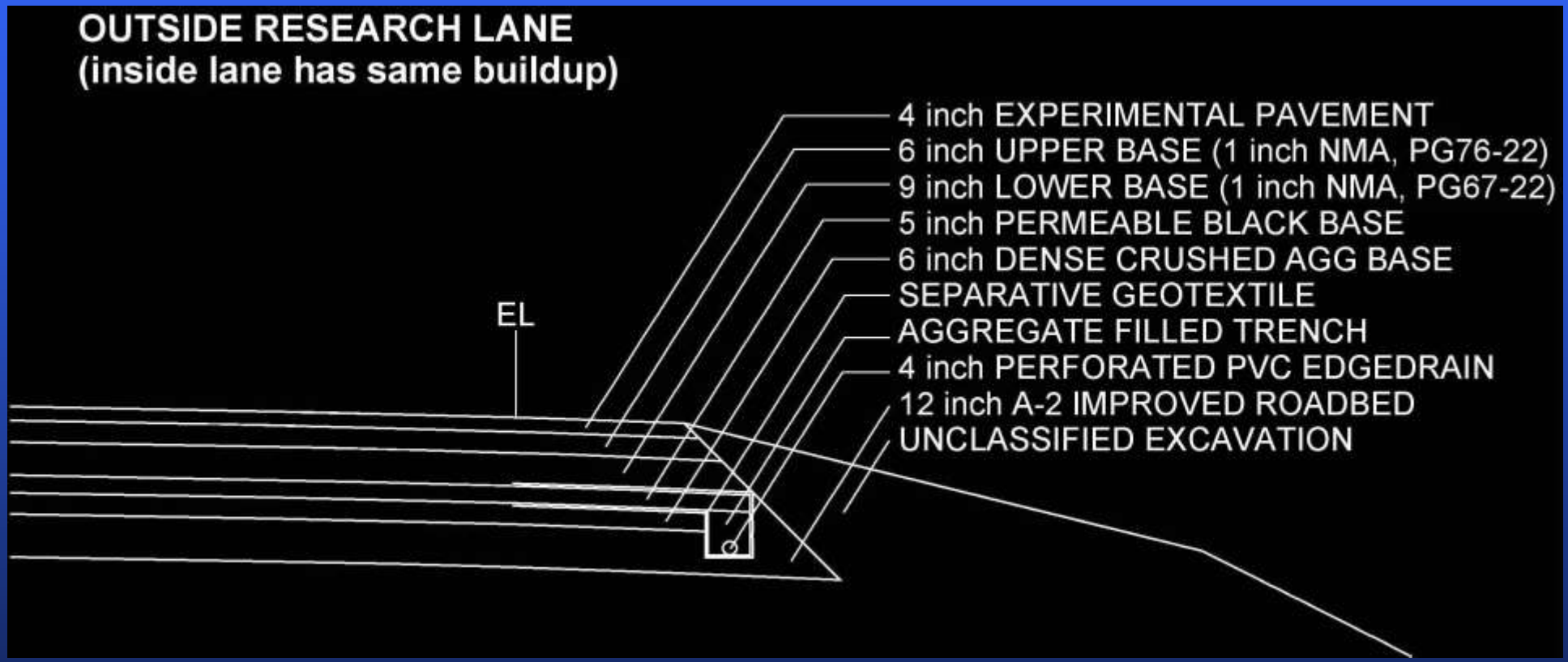
NCAT Update: Ongoing Research to Produce Long-Lasting Flexible Pavements

Brian D. Prowell, PE

TEST TRACK OVERVIEW

- Materials and Methods (Not Thickness) were 2000 Study Variables
- Materials, Methods and Thickness Studied in 2003 Experiment
- Anticipate Larger Structural Experiment in 2006 Track

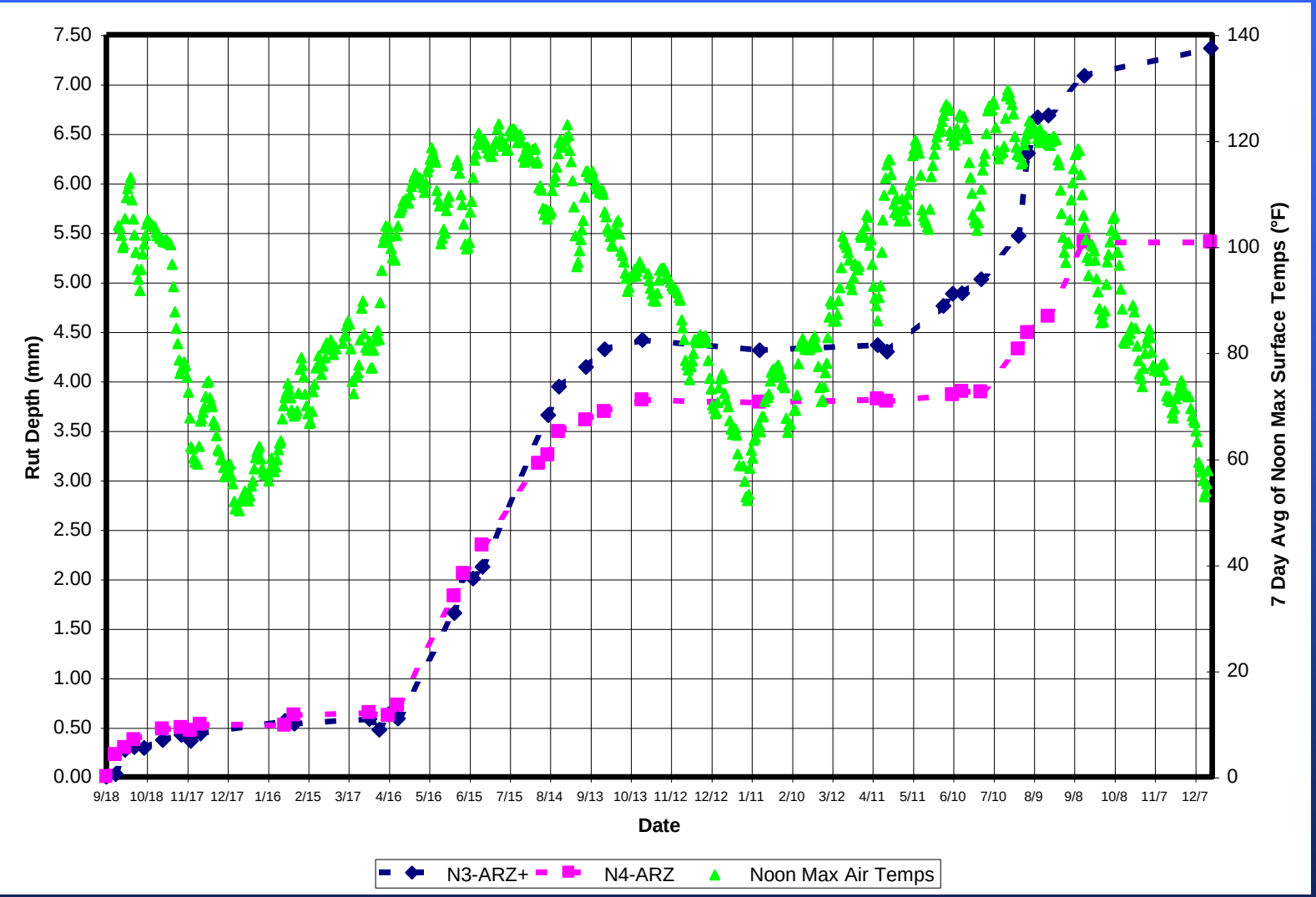
2000 NCAT Track Buildup



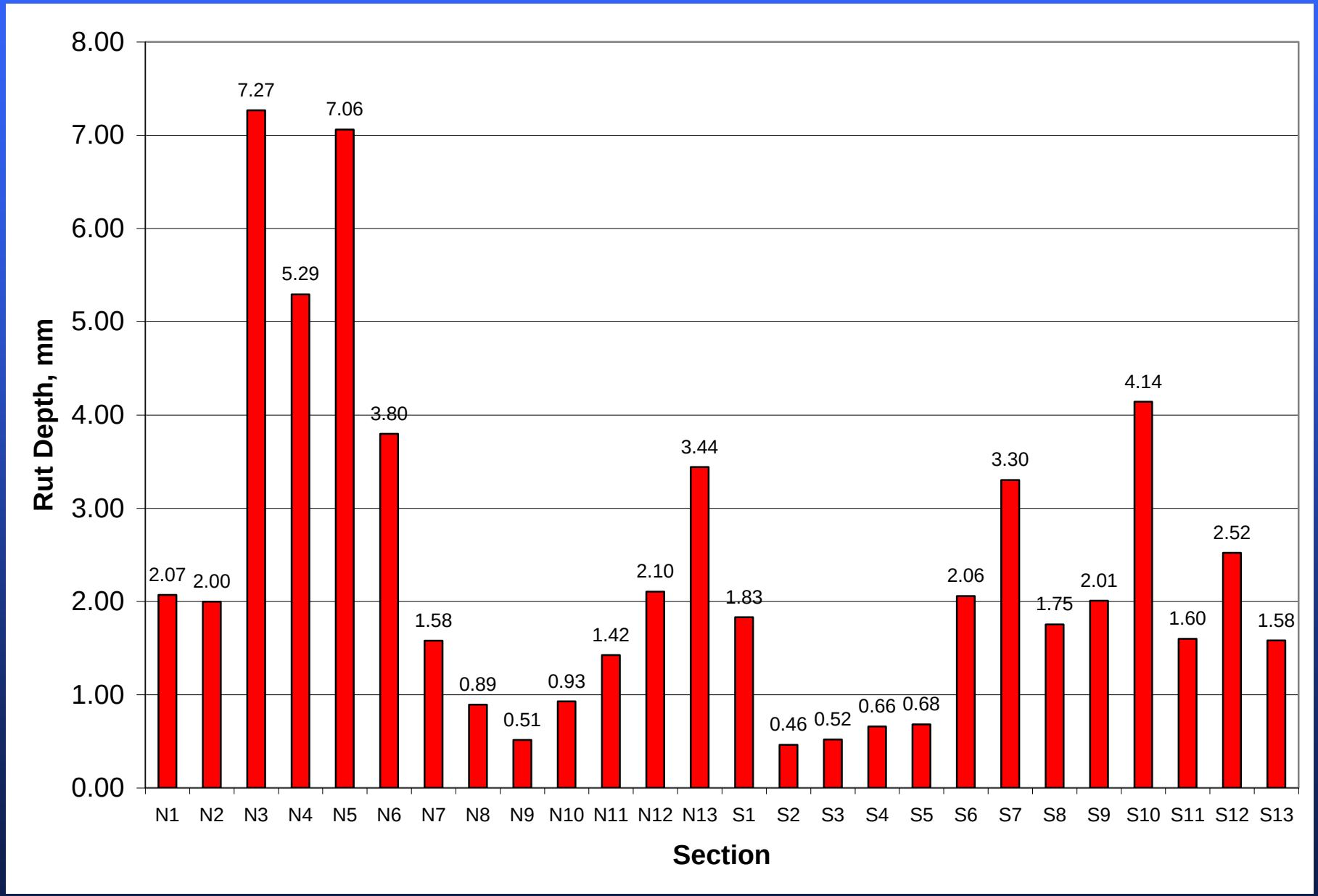
21” HMA, 5” AC Treated Drainable Base, 6” Aggregate

Trucking Operations

Effect Of Age & Temperature

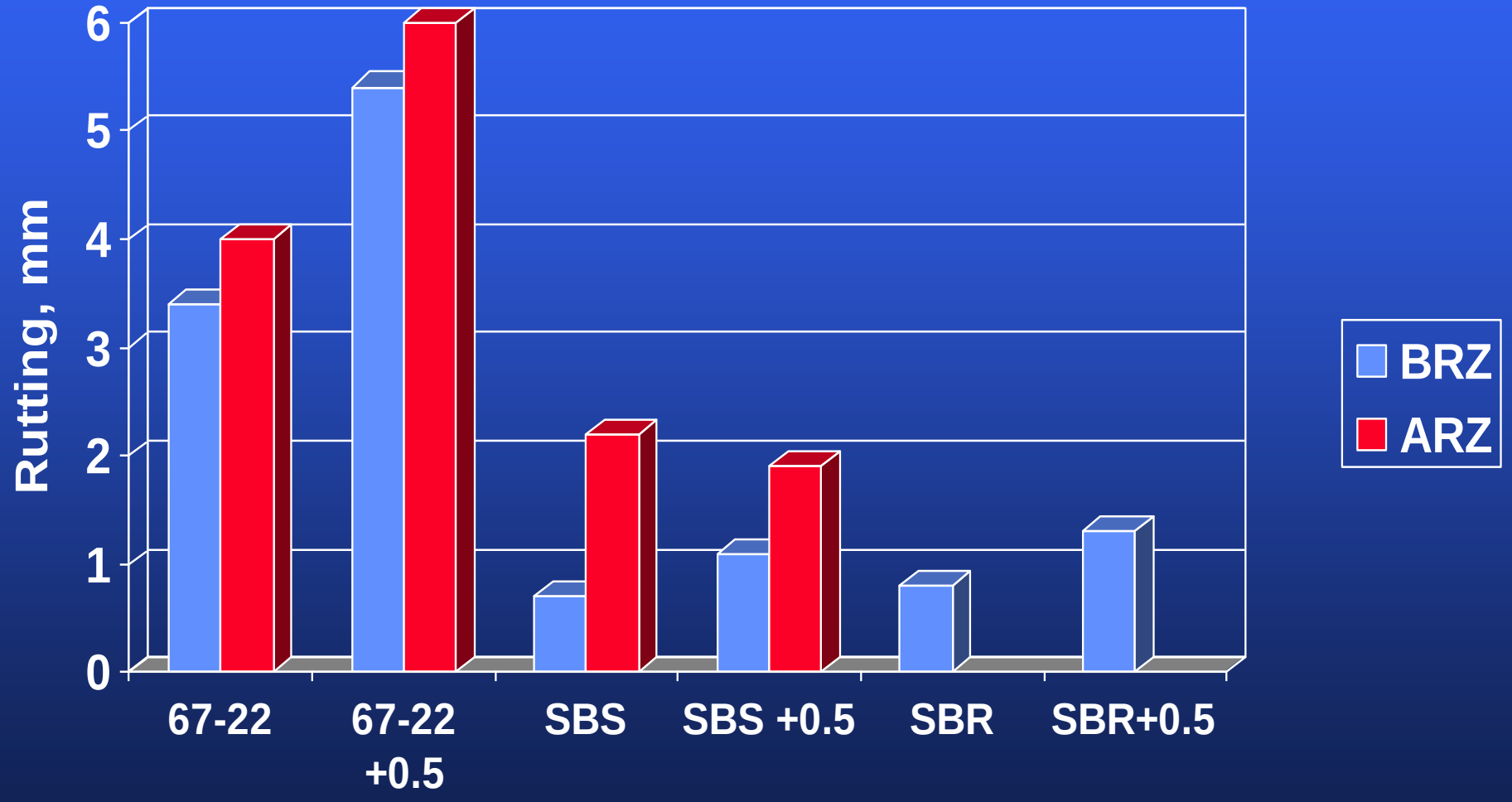


2000 Tangent Rutting after 10 million ESAL



The two sections that rutted most (N3 and N5) had additional 0.5% AC and were not modified

North Tangent Slag/Limestone



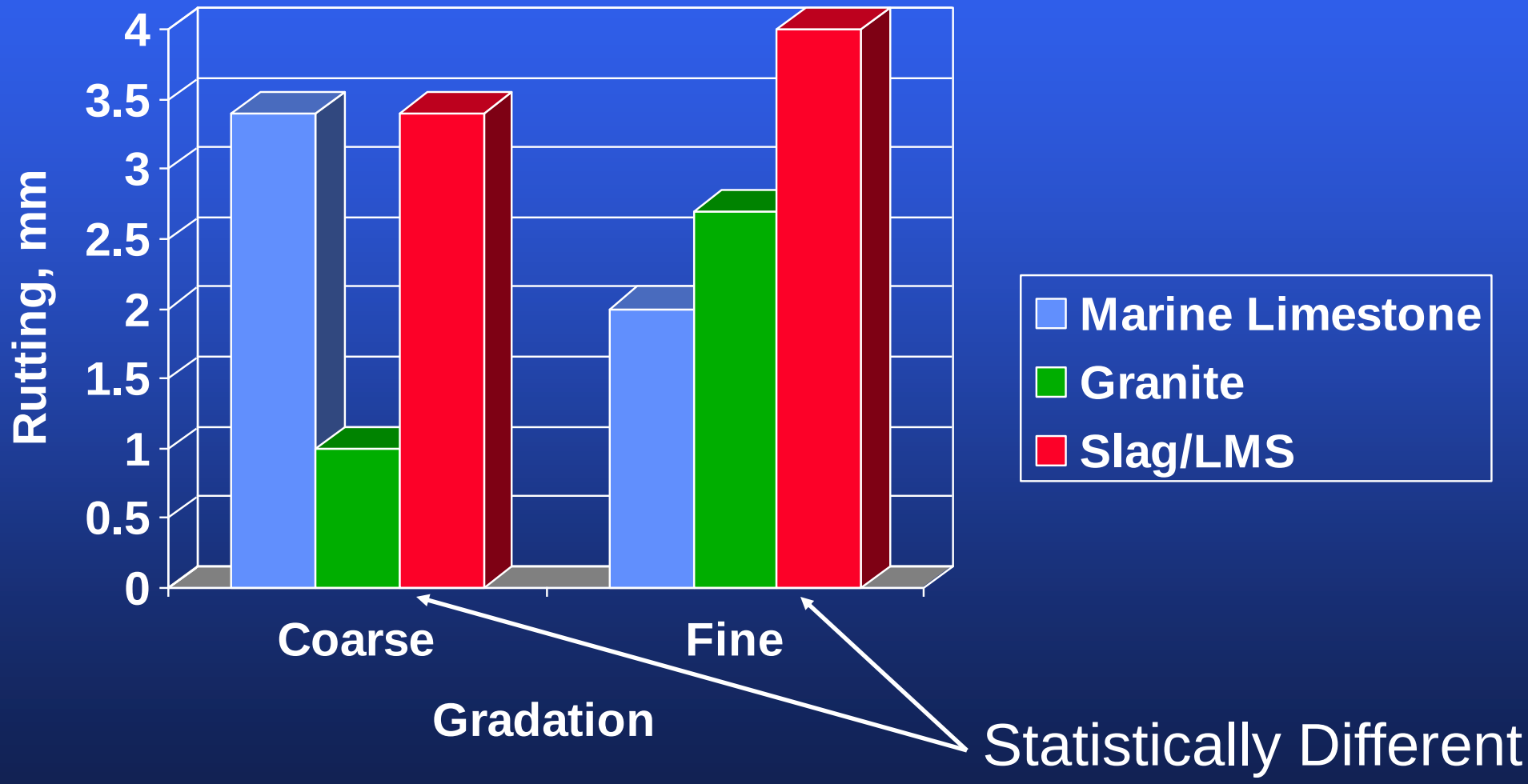
Modified mixes (PG-76) rutted 66% less than unmodified (PG-67) mixes

Effect of 0.5% Increase in Asphalt Content

- 54% increase in rutting when mix uses non-modified asphalt
- No significant increase when mix uses modified asphalt

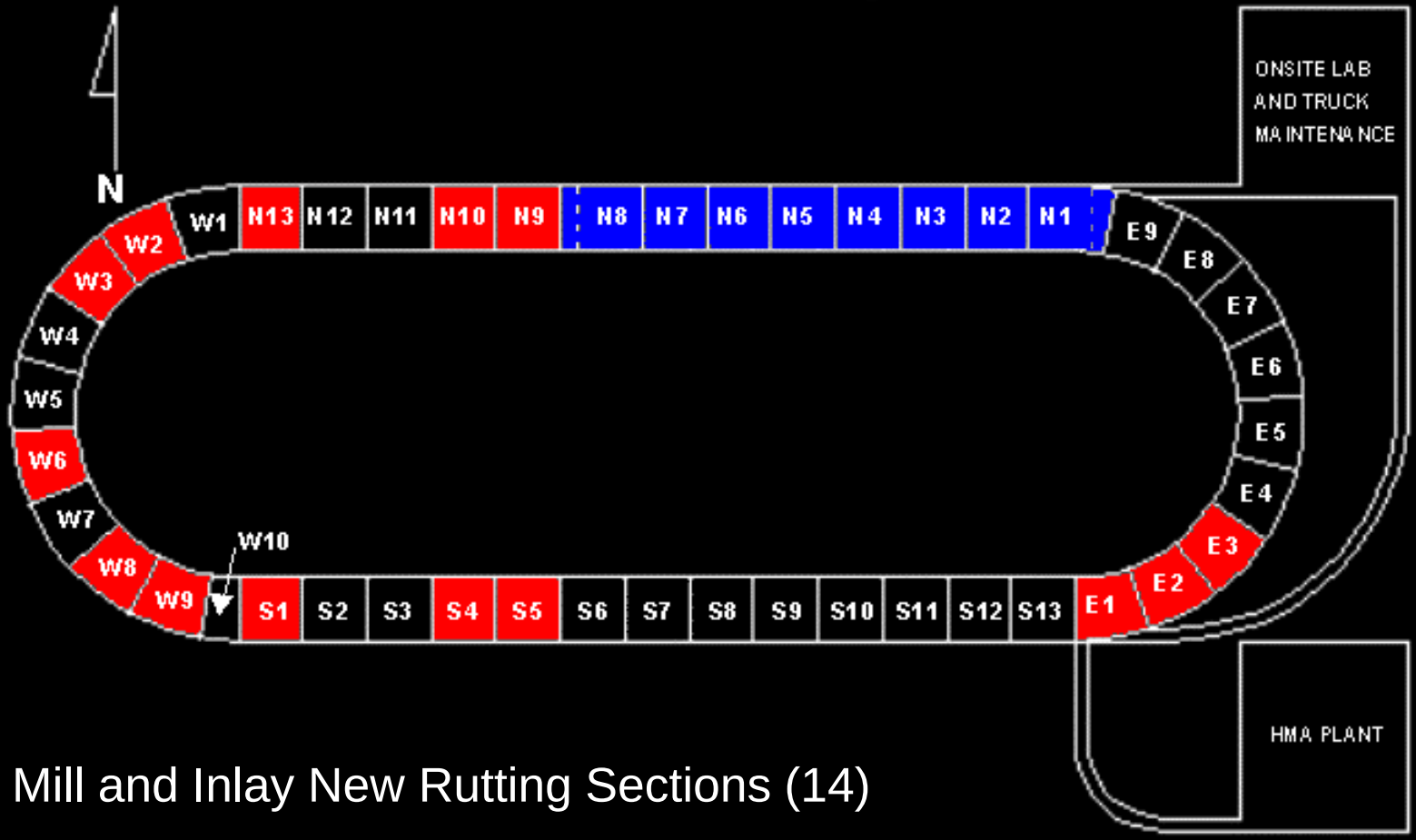
Note: The Superpave rule of thumbs states 1% air voids = 0.4% AC and a change in 25 gyrations results in a 1% change in air voids

Rutting vs Gradation Type



Fine graded and coarse graded mixes perform approximately the same in rutting

2003 Mixed Experiment

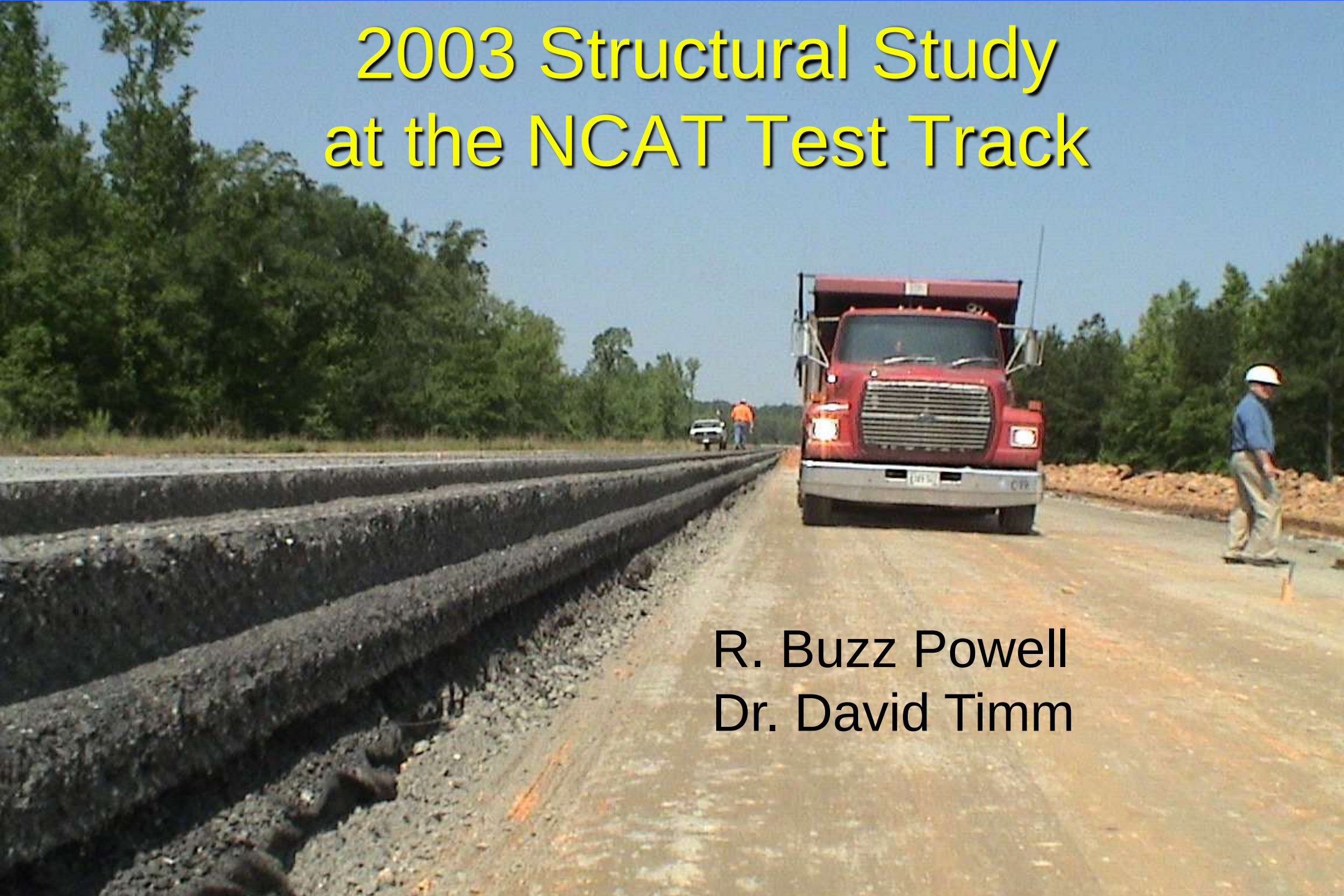


Red – Mill and Inlay New Rutting Sections (14)

Blue – Excavate and Install New Structural Sections (8)

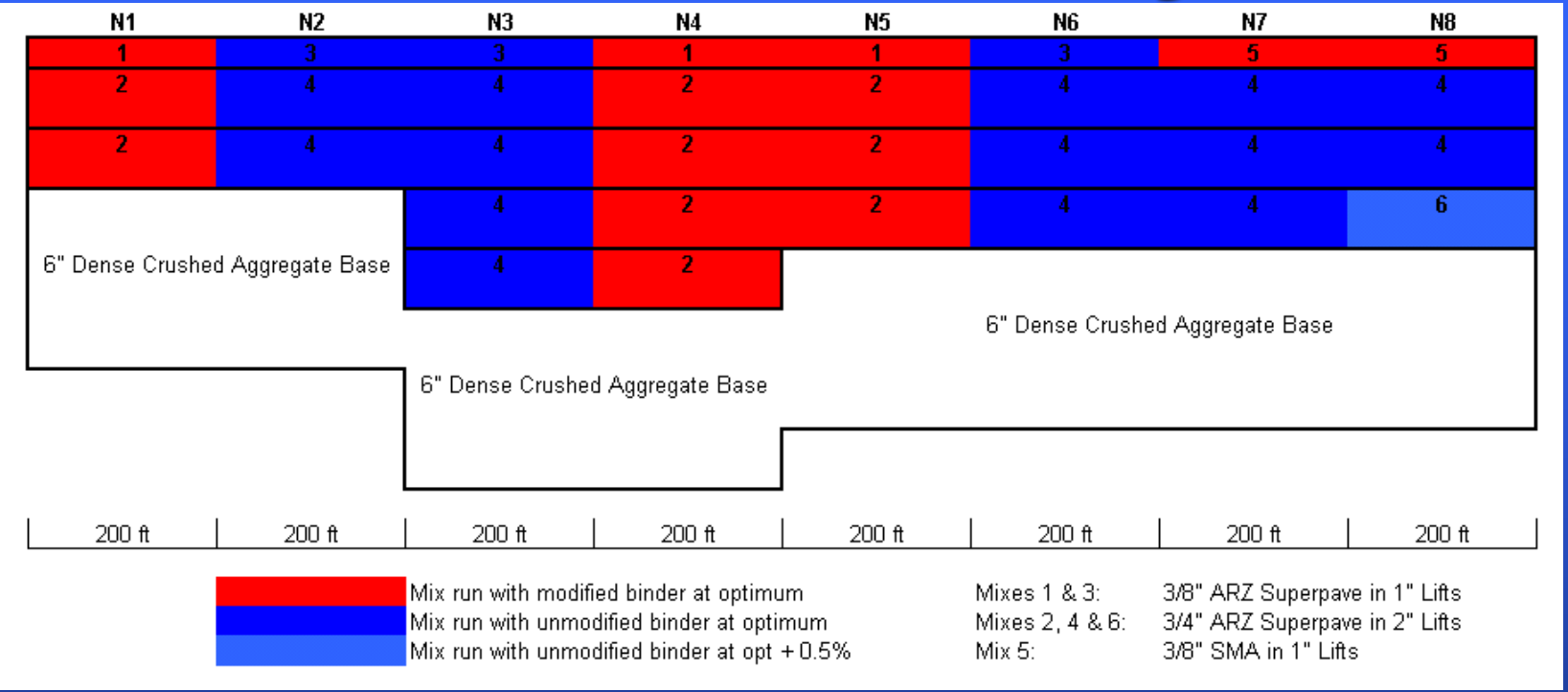
Black – Extend Original Rutting Study to 20M ESALs (23)

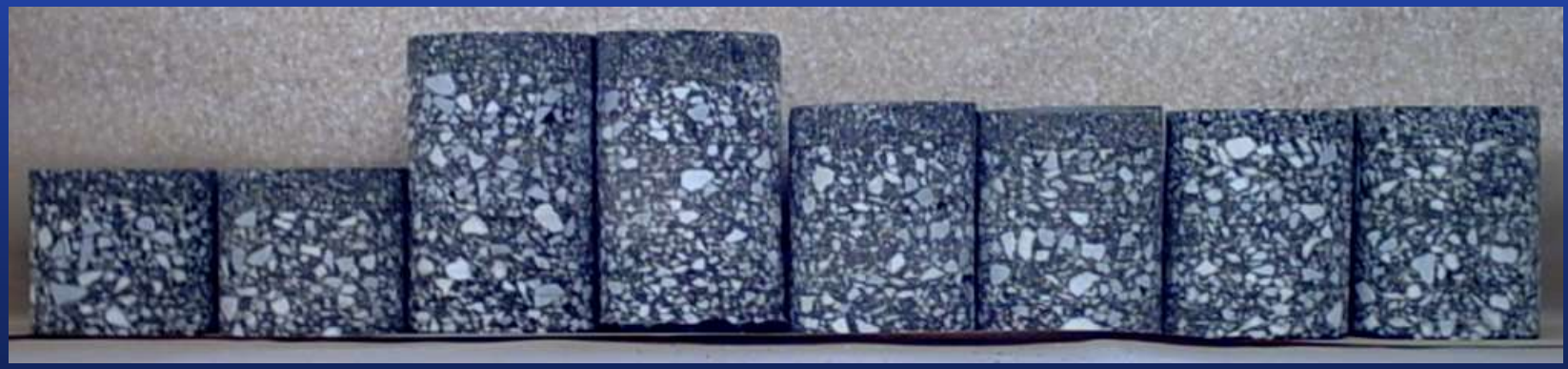
2003 Structural Study at the NCAT Test Track



R. Buzz Powell
Dr. David Timm

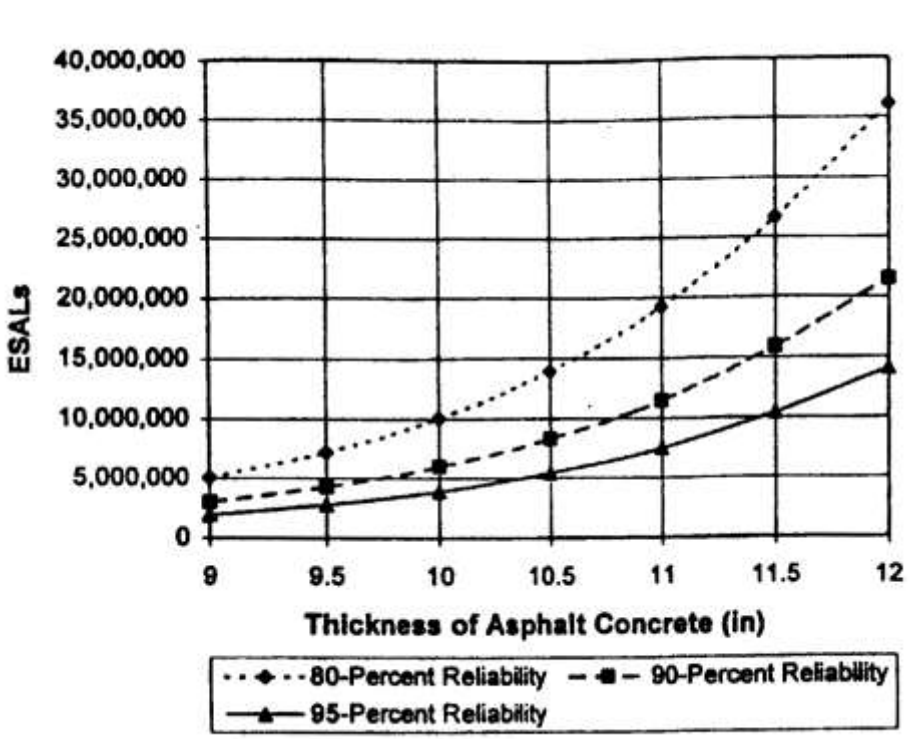
Structural Study



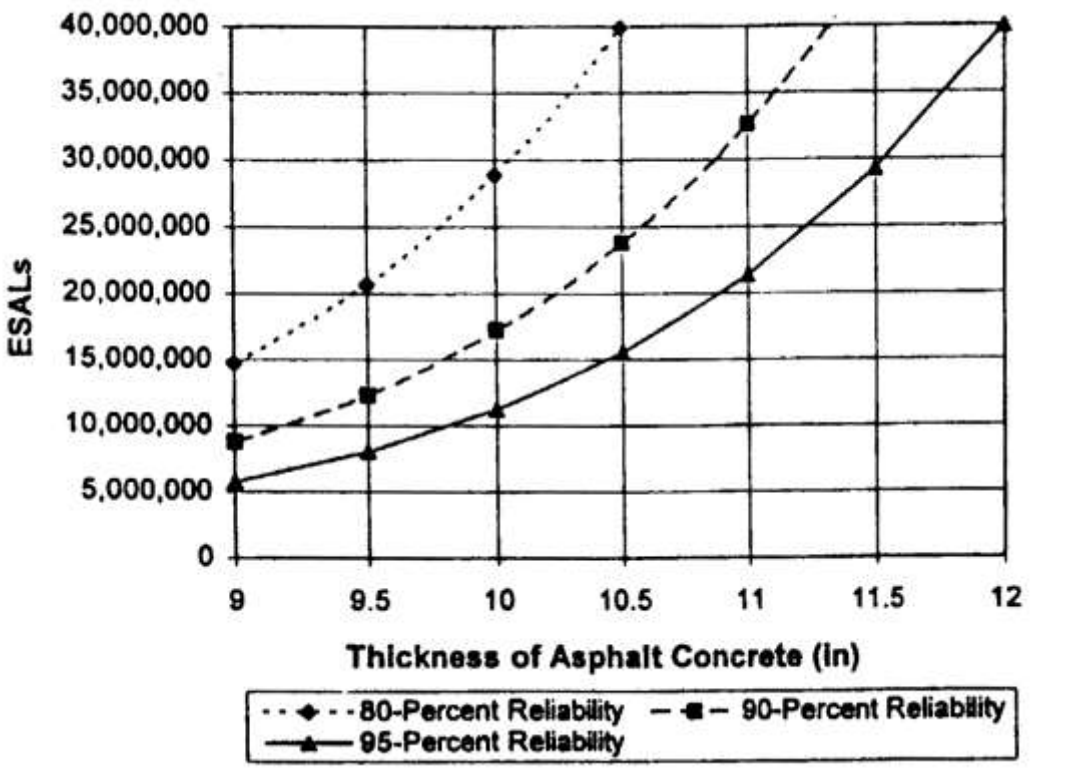


Concept of Rich Bottom Layer (Harvey et al)

Conventional

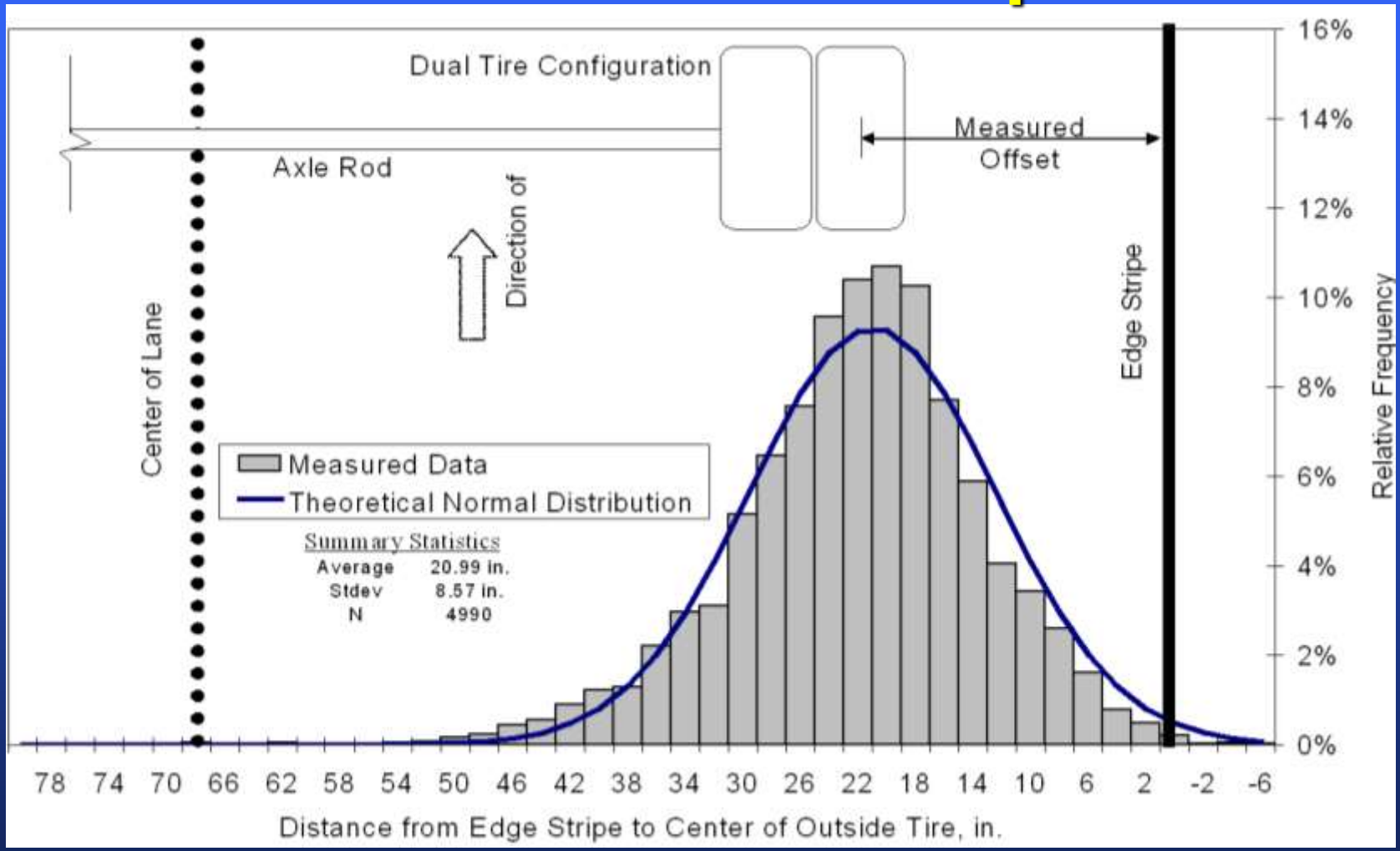


Rich Bottom Layer

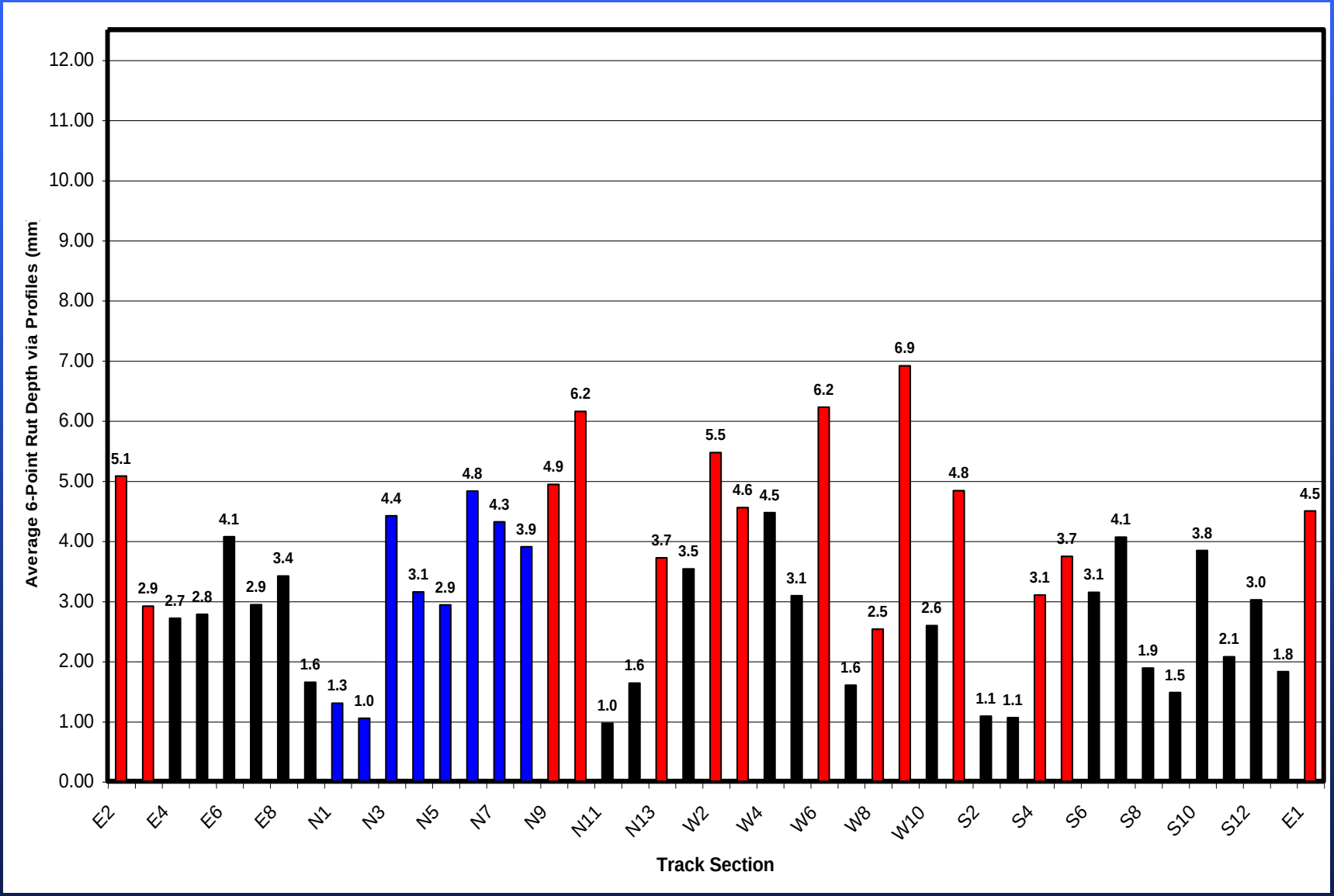


Response Instrumentation

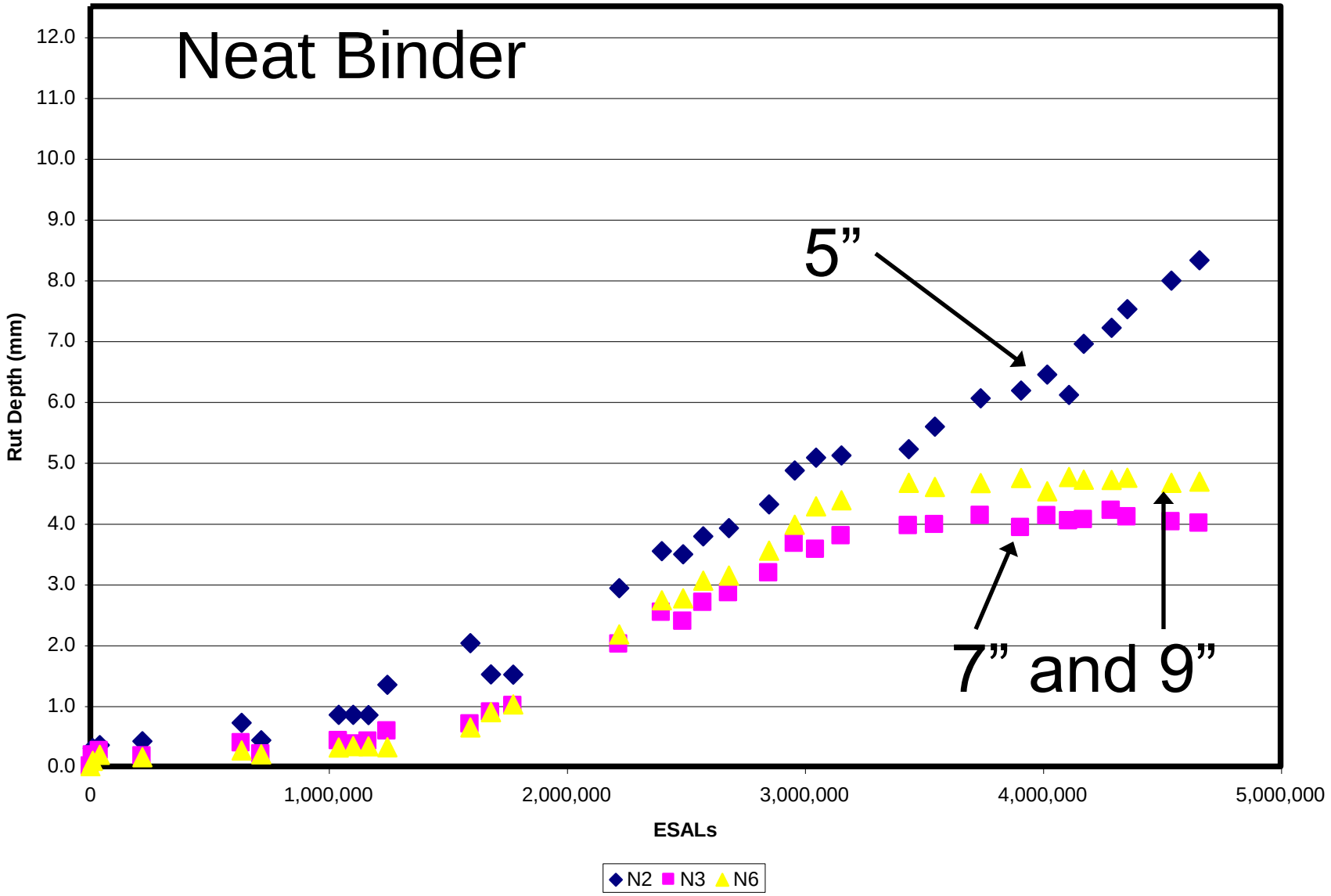
Interstate-like Wheelpaths



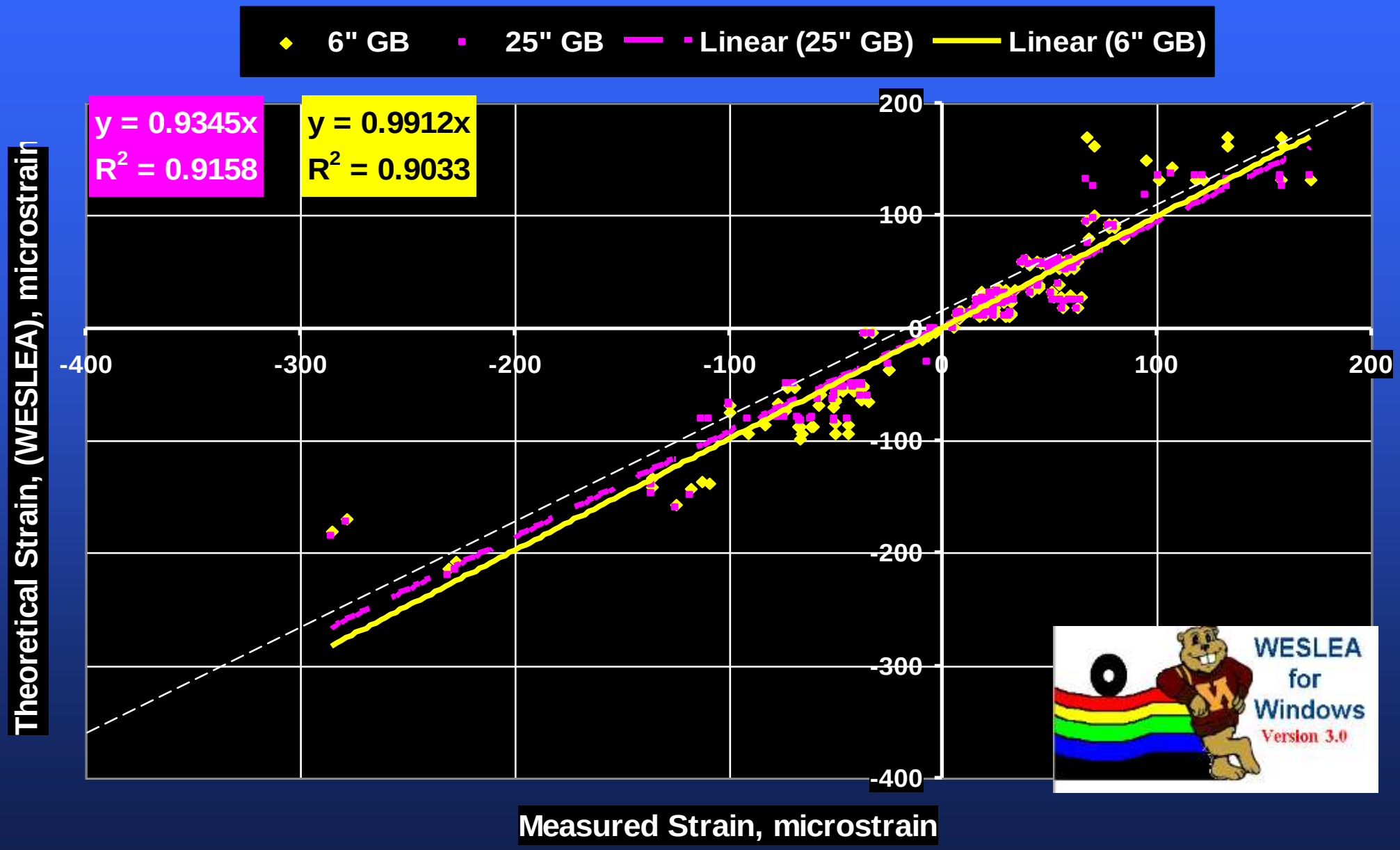
11/29/04 Rutting



Structural Section Rutting



Measured vs. Theoretical Strain (excluding coordinates (0,0))



Summary Observations for 2003 Experiment

- 5 inch layers failed about as predicted
- Some cracking in 7 inch layers
- Modified section failed first but not by much
- Less rutting in modified sections

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NCAT Pavement Test Track

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The Official NCAT Web Site Other Test Track Sites

Driving Conditons as of
7:00 AM CDT
Fair
64°F
SE 3 MPH
www.weatherforyou.com

4,448,301 ESALs as of 2400 hours on October 10h, 2001 (44% of the 10,000,000 ESAL goal).

RUTTING now ranges from 0.15 mm to 5.87 mm, with an overall average of 2.47 mm.

Recent Aerial Photograph of the 309 Acre Site Track Cam (Click to Stream!)

GOD BLESS AMERICA !

TheCounter.com VISITOR 12557

WELCOME to the home page for the NCAT Pavement Test Track. The primary objective of this site is to successfully communicate our experiences to the world as we strive to assist governmental agencies nationwide in streamlining the practical application of research designed to extend the life of flexible pavements. We appreciate your feedback.

SPONSOR MEETING INFORMATION - This cooperatively funded research project provides for 2 onsite meetings each year as a benefit of sponsorship. The purpose of these meetings is to insure that research efforts are meeting sponsors' expectations. During the last onsite meeting (on June 11th and 12th), sponsor representatives decided to next meet some time in November or December. This timeframe is intended to

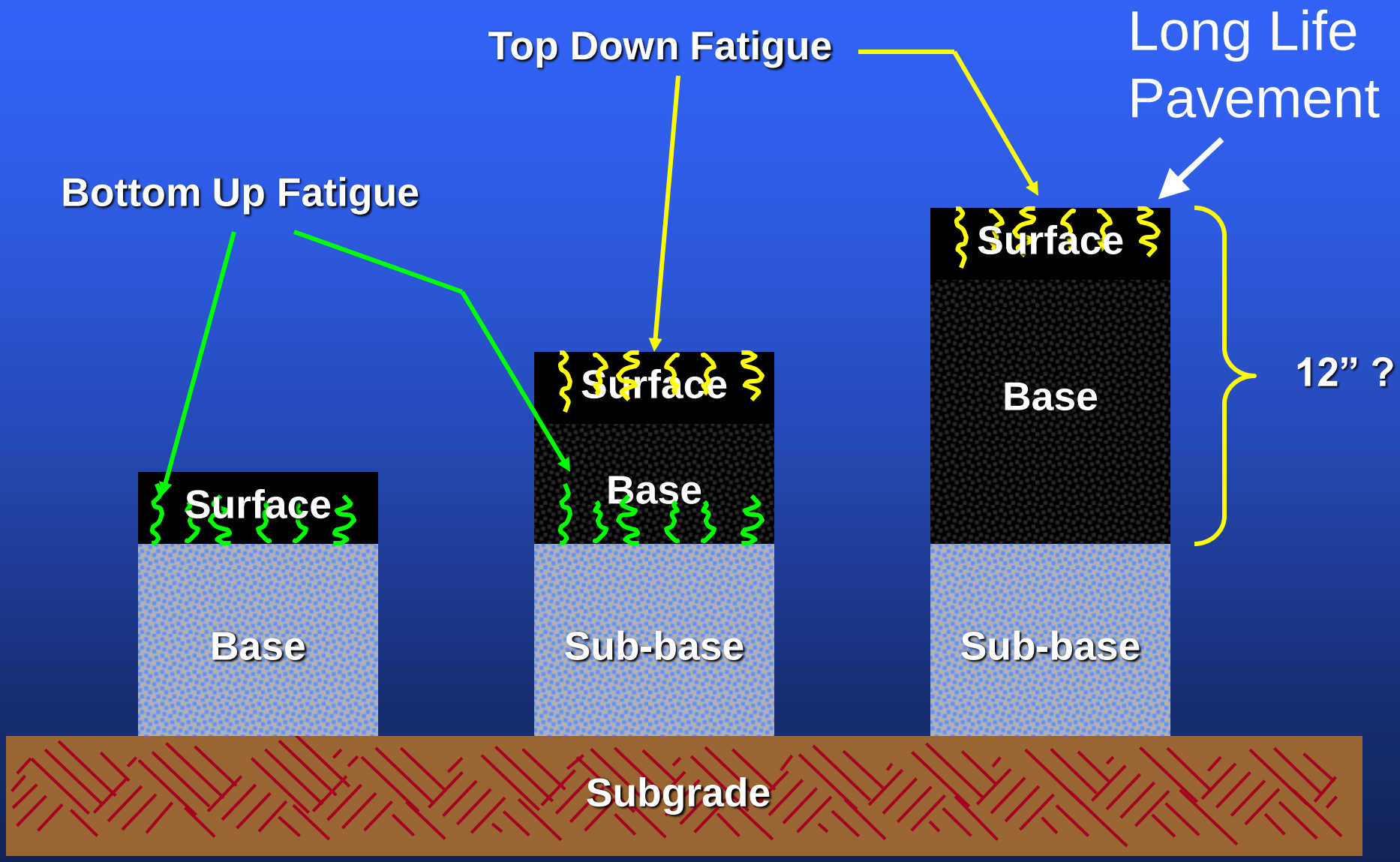
Internet

Endurance Limit of Hot Mix Asphalt Mixtures to Prevent Fatigue Cracking in Flexible Pavements

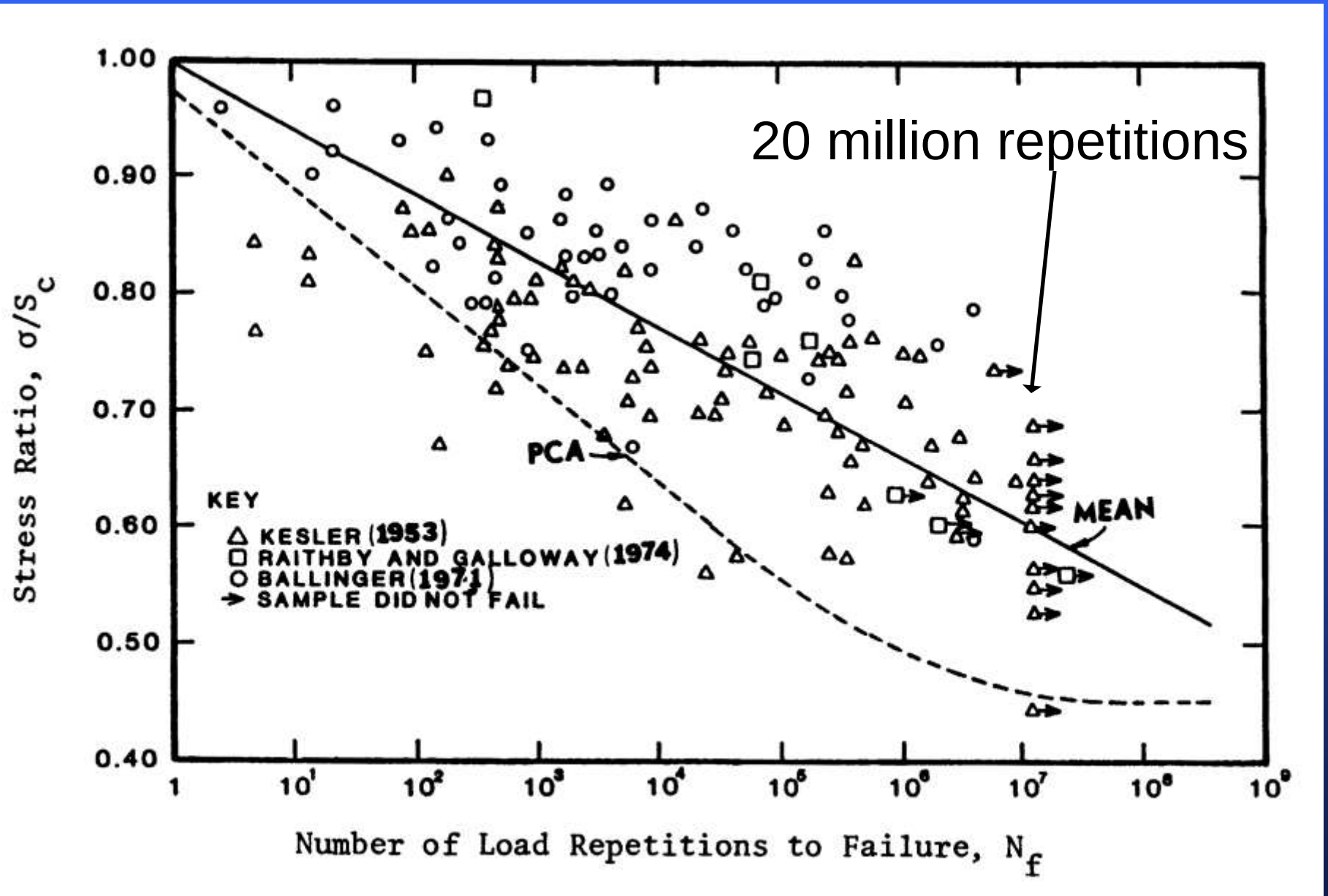
NCHRP 9-38

Ray Brown
Brian Prowell

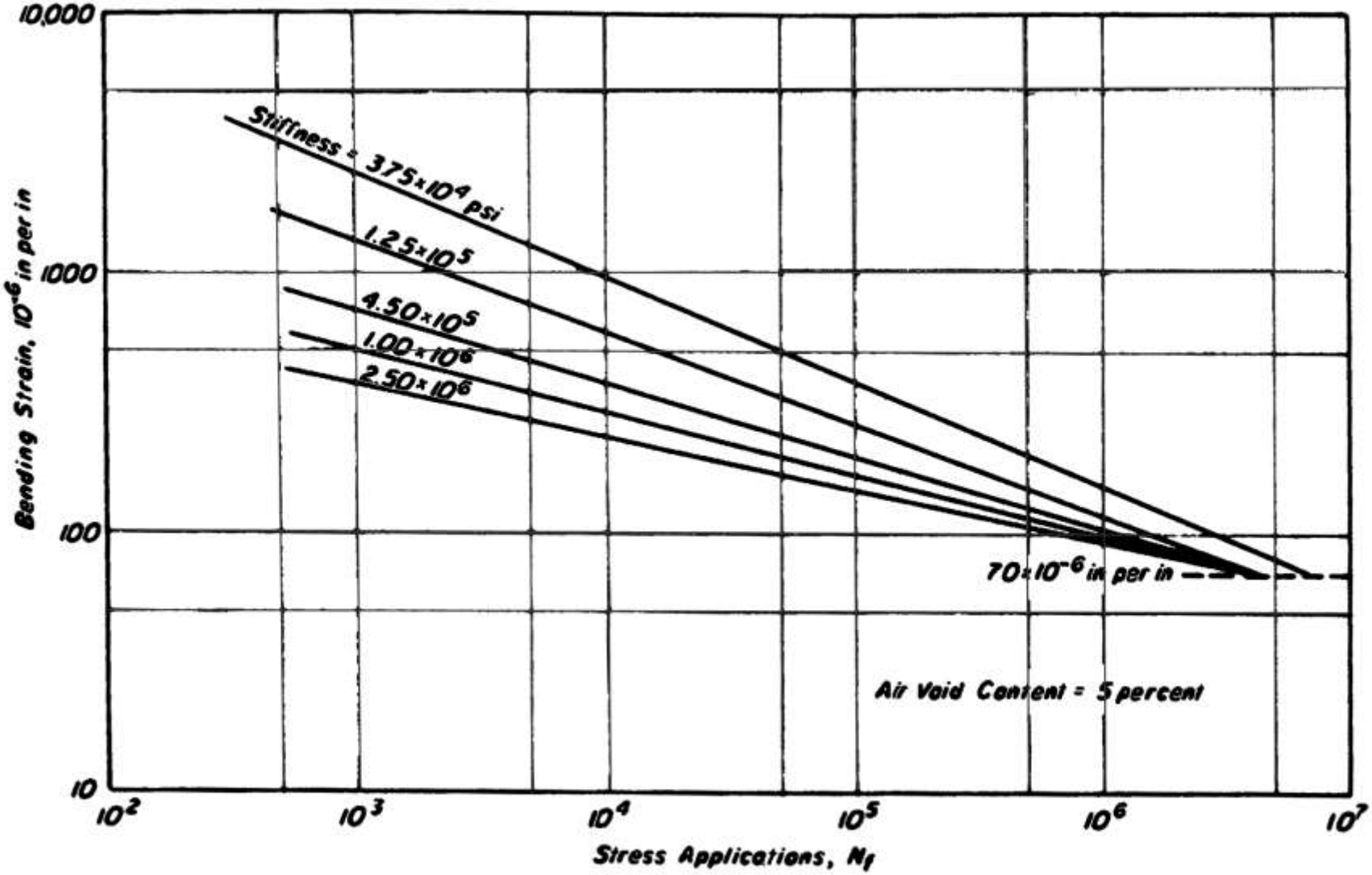
Flexible (Asphalt) Pavement Fatigue



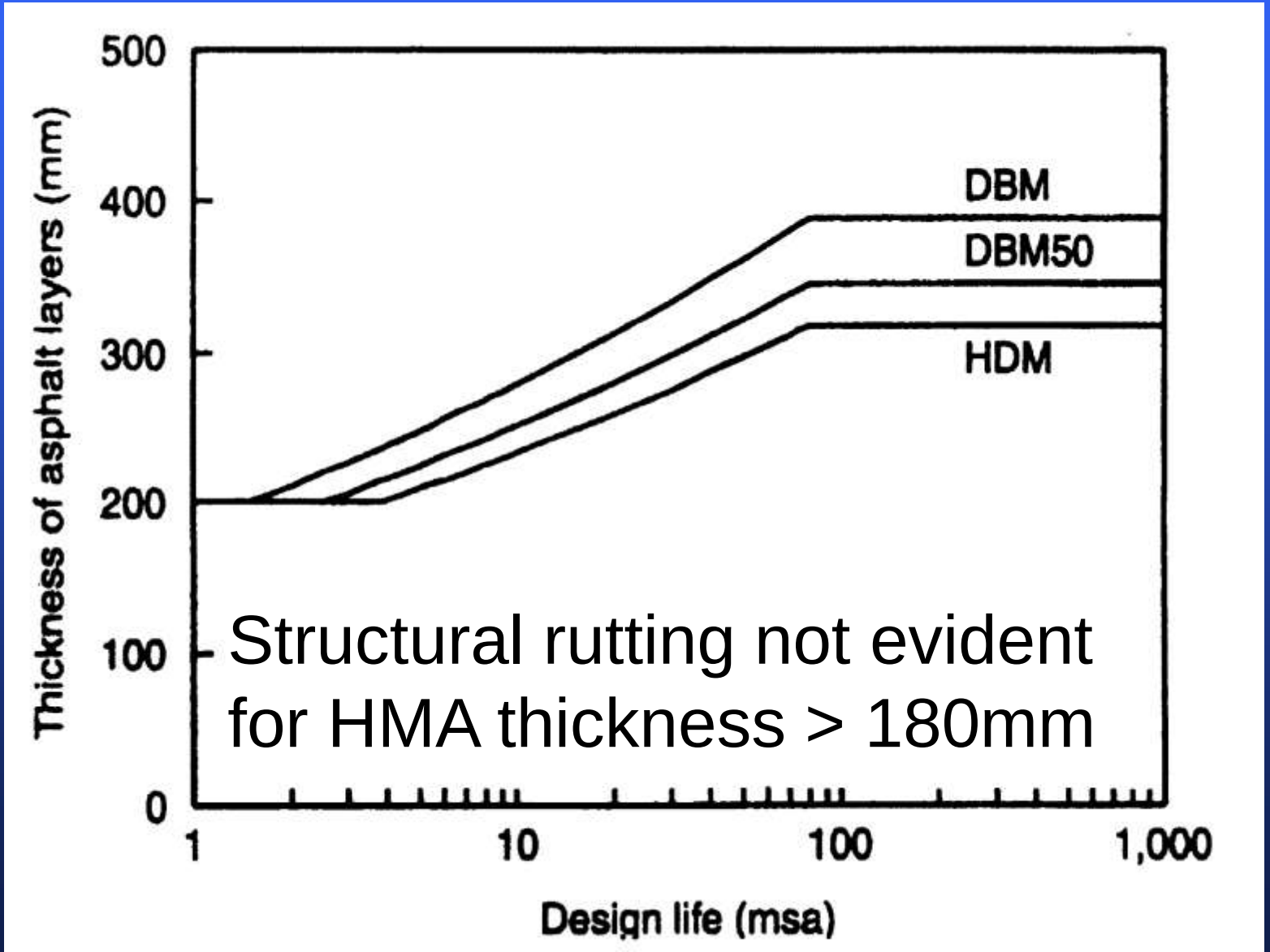
Definition of Endurance Limit for PCC (Huang)



Concept of Endurance Limit for HMA (Monismith and Mclean)

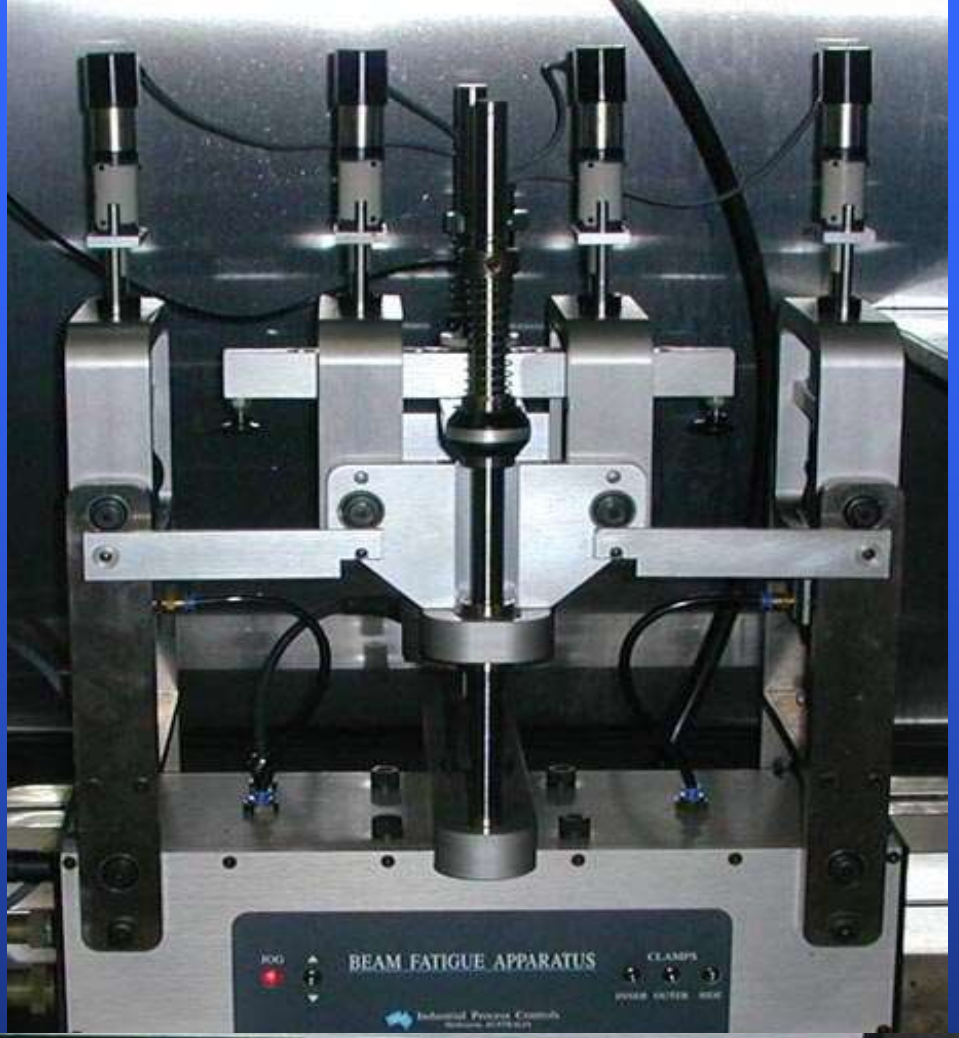


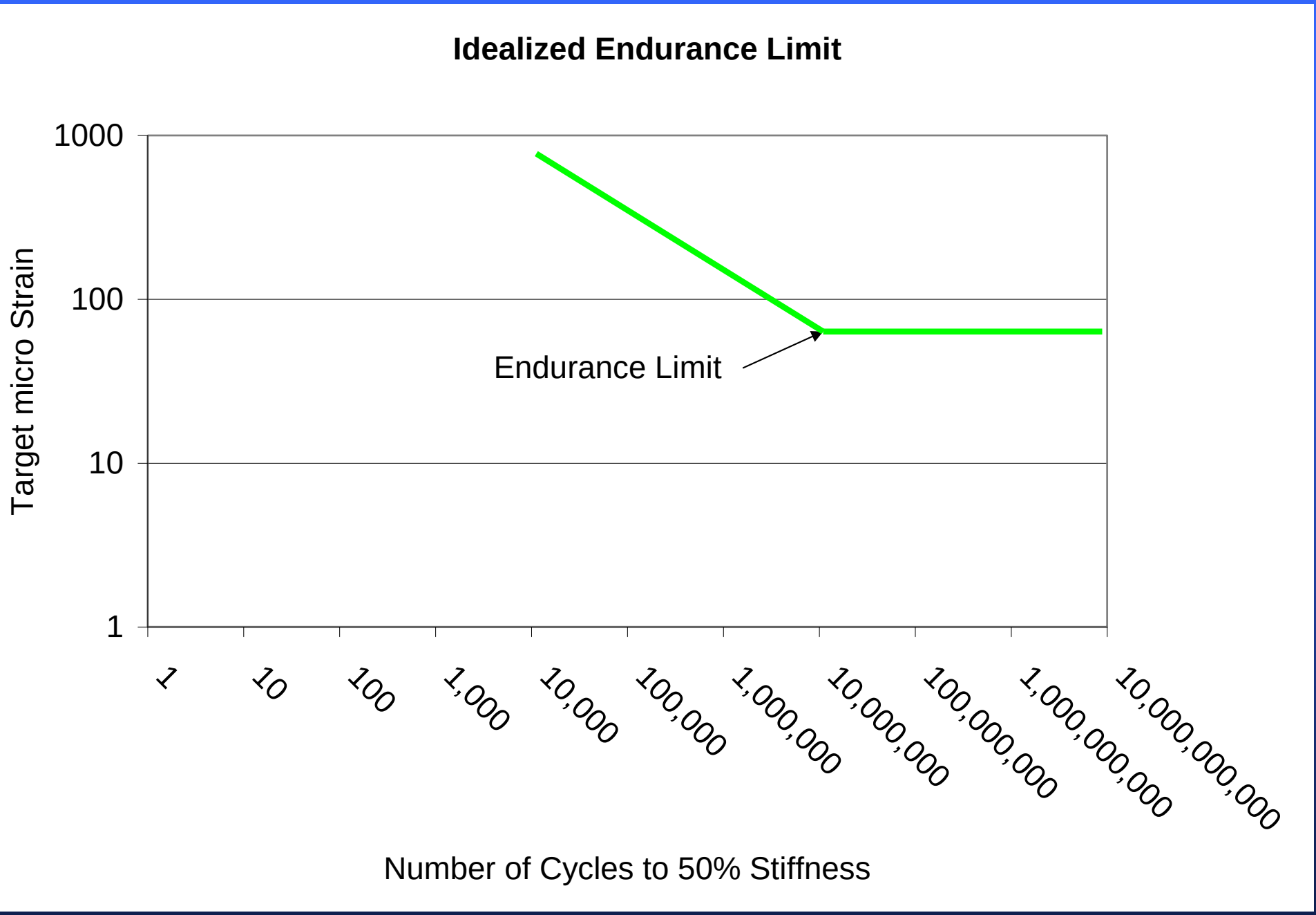
Long Life Pavement (Nunn)



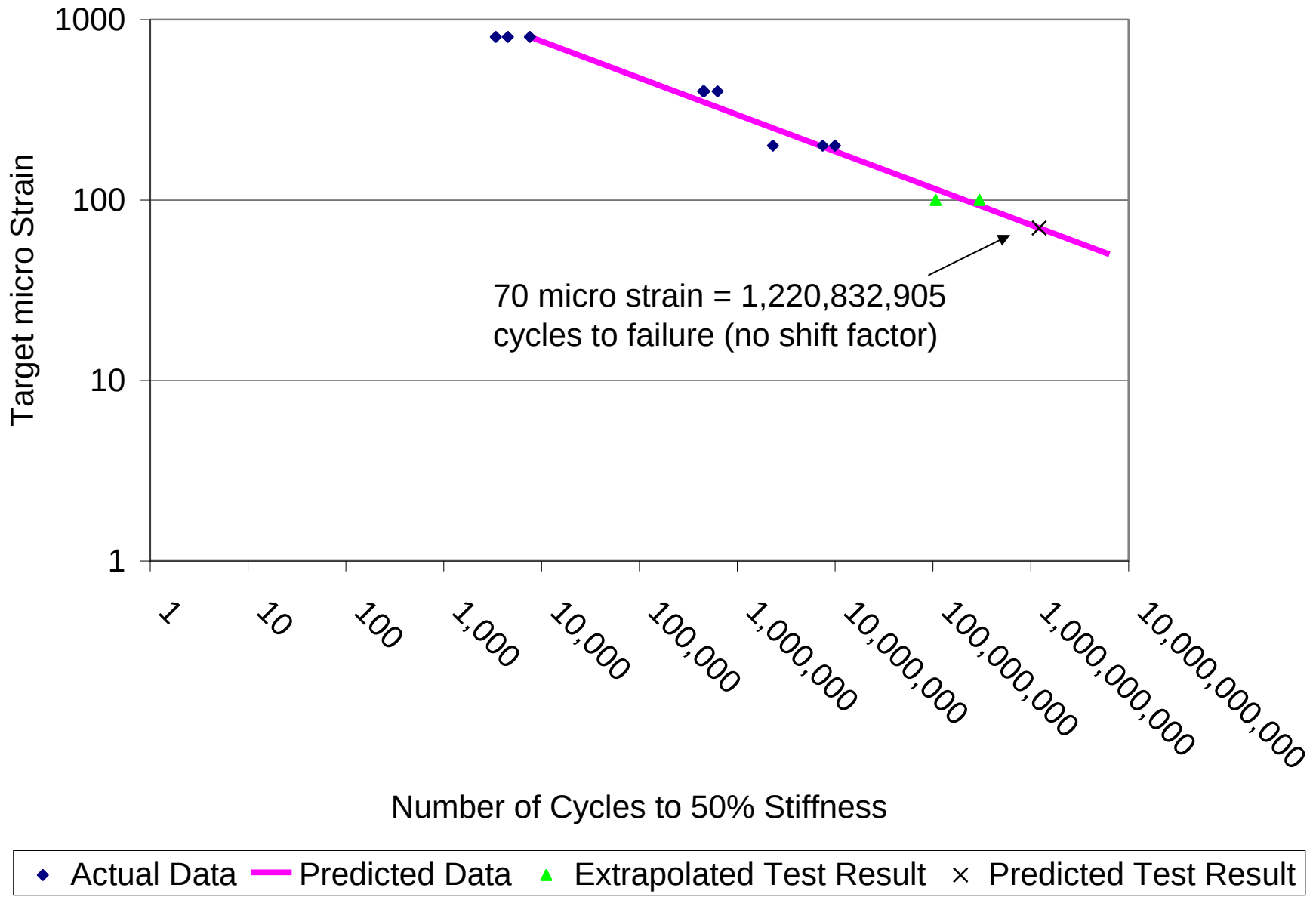
Defining the Endurance Limit

Beam Fatigue

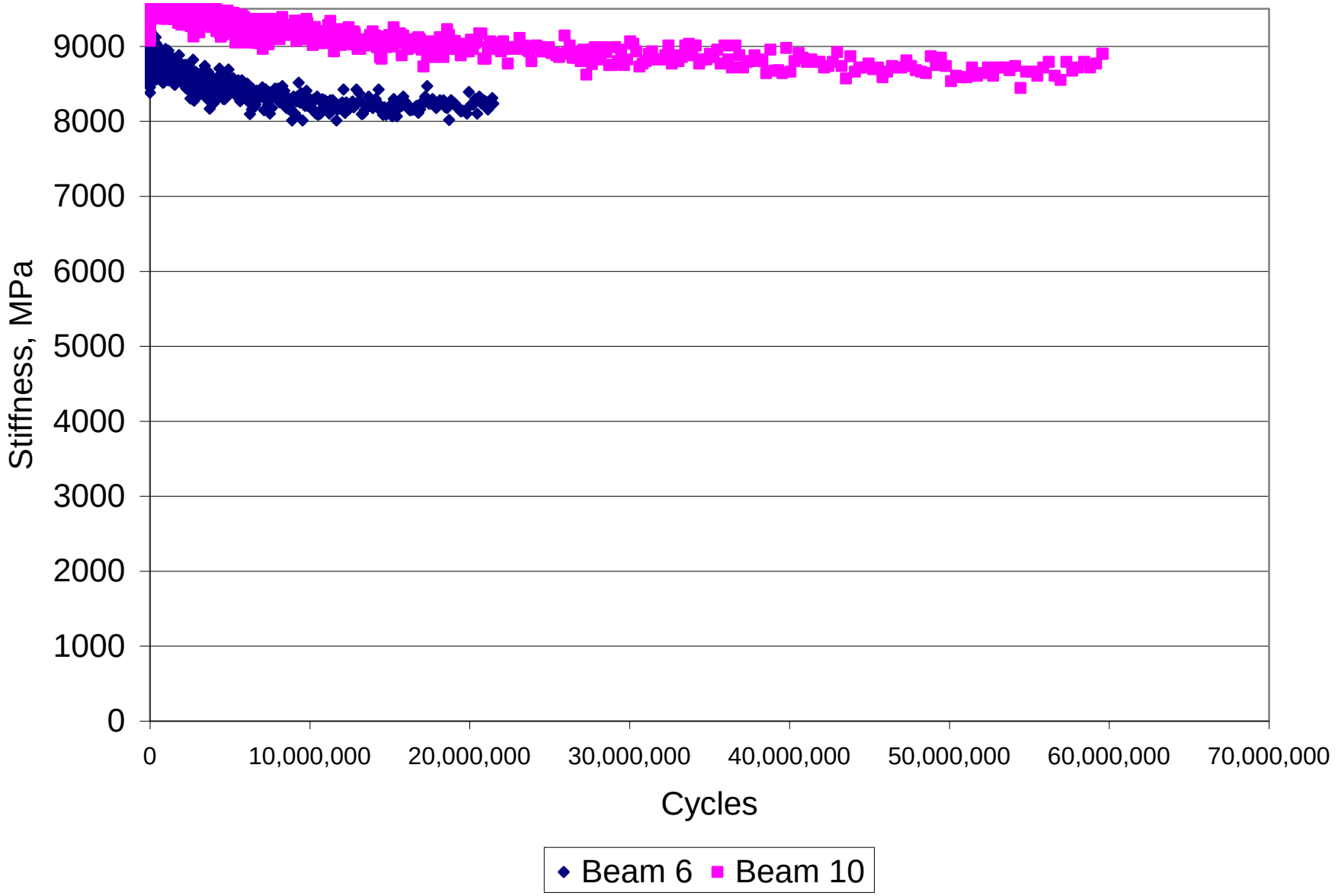



Idealized Endurance Limit
1000
100
10
1
Target micro Strain
Endurance Limit
1
10
100
1,000
10,000
100,000
1,000,000
10,000,000
100,000,000
1,000,000,000
10,000,000,000
Number of Cycles to 50% Stiffness

Preliminary Experiment 25.0 mm NMAS



Samples Tested at 100 micro Strain



Test Track 19.0 mm PG 67-22

Beam ID	Air Voids, %	Micro-Strain	Cycles to 50% Initial Stiffness	Avg. Cycles to Failure
18	6.6	800	6,000	6,377
3	6.8	800	7,130	
7	7.4	800	6,000	
10	6.8	400	246,220	252,136
15	7.7[1]	400	79,840	
46	7.0	400	267,808[2]	
1	7.0	400	242,380	
2	6.6	200	26,029,000	23,400,290
6	7.2	200	12,930,000[3]	
21	7.4	200	20,771,580	
4	6.7	100	50,000,000[4]	167 *trillion*

Summary of Long-Lasting Pavement Research

- 2000 Test Track indicates we can produce rut resistant mixtures with a variety of materials
  - Modified binders reduced rutting by 66%
  - Good QC/QA important
- Strong evidence of long-life pavements at less than 150 micro-strain

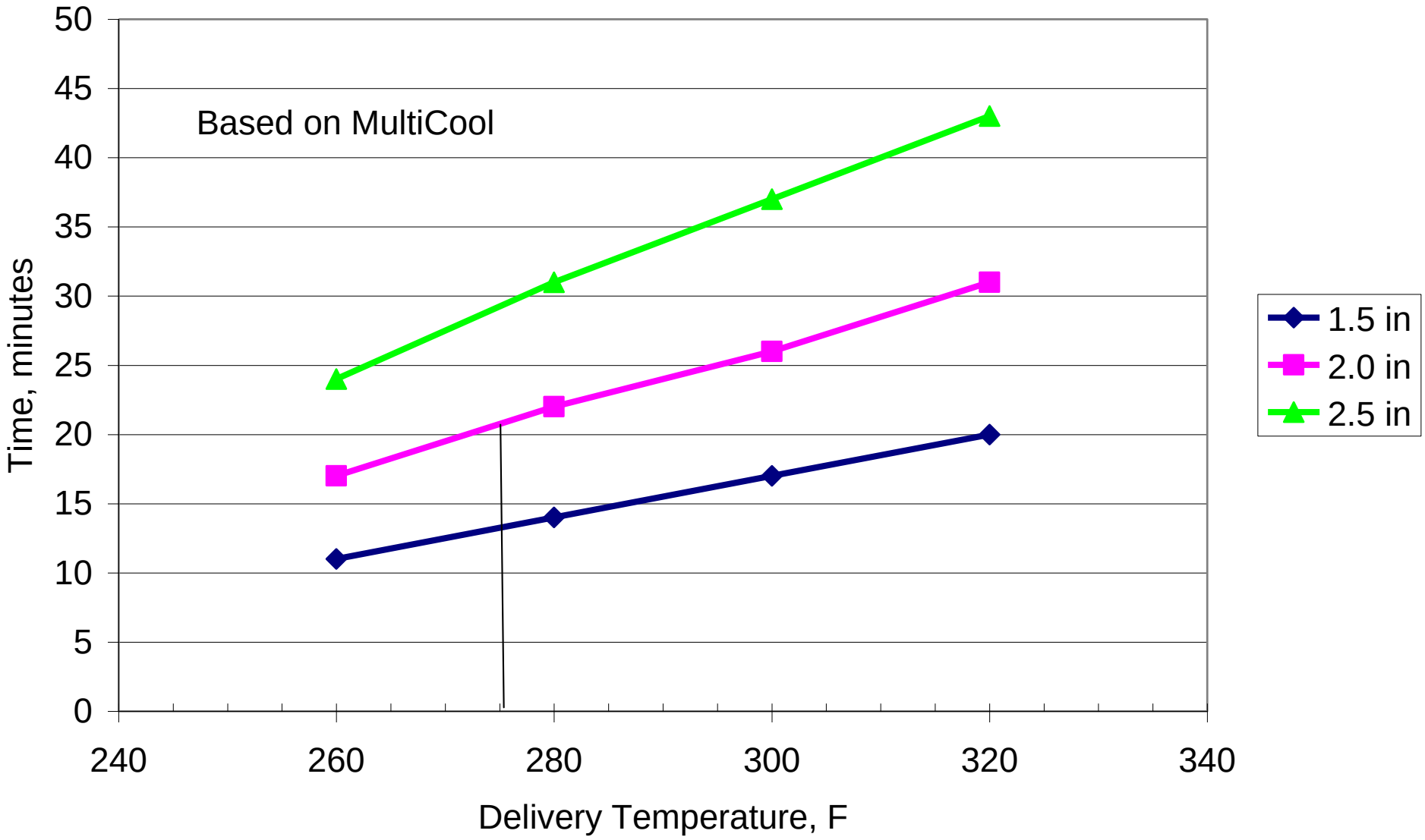
Why Warm Asphalt?

Research by Stroup-Gardiner and Lange at AU
Indicates increased emissions with increased temp.

We Can Reduce Temperatures Today with No Additives

- Pre-Superpave – typical compaction temperature 275 °F
- Place Thicker Lifts – NCHRP 9-27
  - 3 x NMAS for fine graded
  - 4 x NMAS for coarse graded
- Tarp Trucks
- Drier Aggregate – pave under stockpiles

Time Available for Compaction



What are Warm Asphalt Mixes?

Several process have been developed to improve mixture workability allowing lower production and laydown temperatures

- WAM Foam – Shell/Kolo Veidekke
- Zeolite – Eurovia/Hubbard Construction
- Sasobit – Sasol Int./Moore and Munger
- New processes

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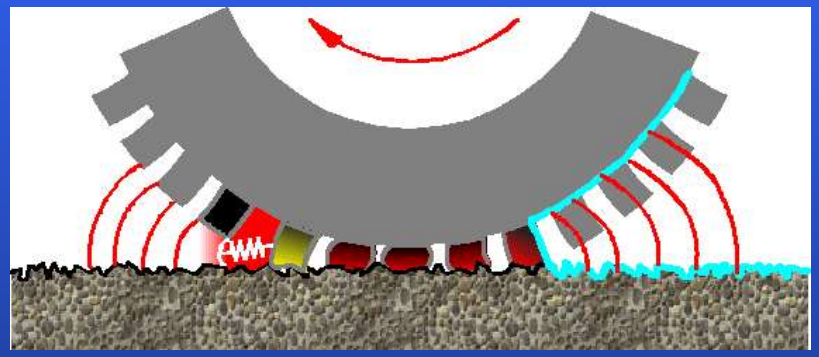
Tire/Pavement Noise

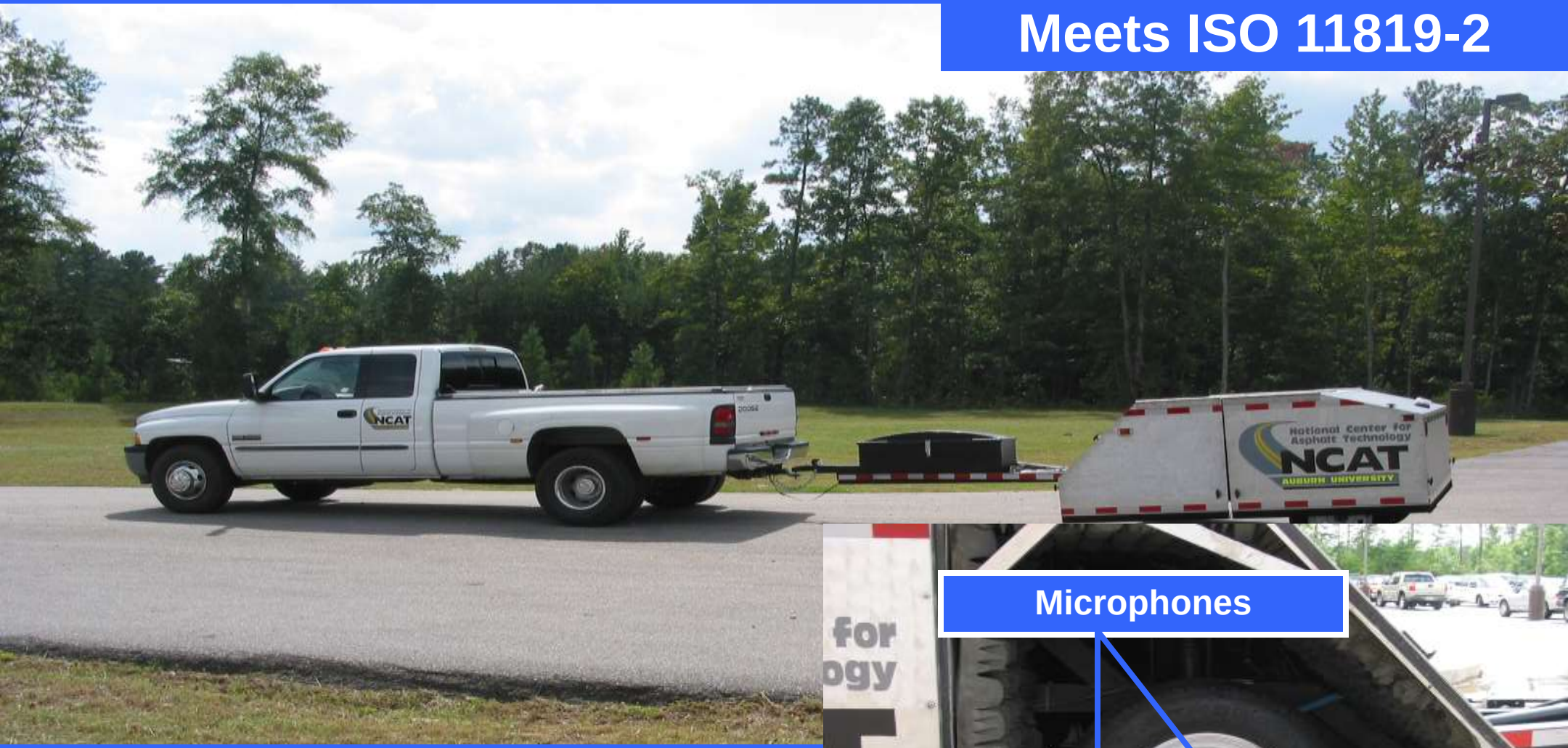
Nature of highway noise

Tire/pavement

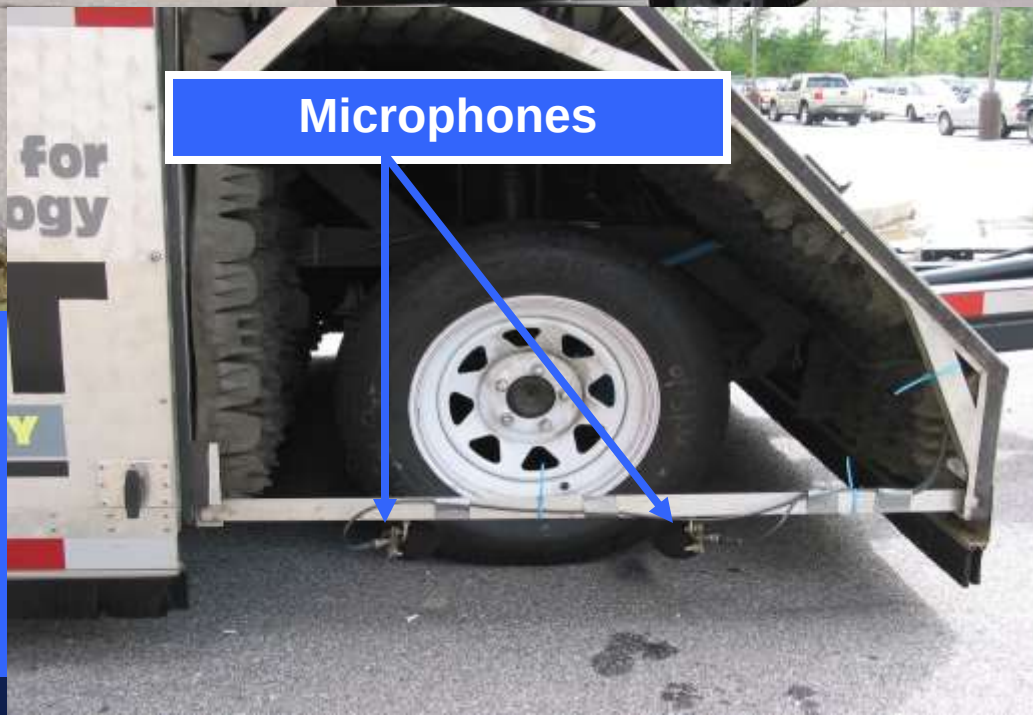
- Generally the primary source at highway speeds (greater than 35 mph)
  - Level is dependent on vehicle type, vehicle speed and tire type
- Other sources include
  - Vehicle – engine, exhaust, etc.
  - Aerodynamic sources



Meets ISO 11819-2



NCAT Close Proximity Noise Trailer



Pavements tested

- Locations
  - NCAT test track, Michigan, Alabama, New Jersey, Maryland, Colorado, Nevada, California, Arizona, Texas, Florida, Virginia, Minnesota and Colorado
- Numbers of surfaces tested
  - Total – 244 surfaces
  - HMA – 201 surfaces
  - PCCP – 43 surfaces

PCCP – NCAT Testing
(44 surfaces)

- Transverse Tined
  - Average - 103.6 dB(A)
  - Range - 100.5 to 106.5 dB(A)
- Longitudinally Ground
  - Average - 99.6 dB(A)
  - Range - 98.1 to 103.6 dB(A)
- Diamond Ground
  - Average - 98.9 dB(A)
  - Range - 97.7 to 101.0 dB(A)

DENSE GRADED HMA

Average of all testing – 97 dB(A)

Range 93 to 99 dB(A)


SMA
OLYMPUS
Average 97.6 dB(A)
Range 95.5 to 100.5


OGFC
OLYMPUS

OGFC GRADATIONS

Gradation	Arizona[1]	Nevada[1]	Colorado[2]	AL 1 – 7[2]
¾ inch	-	-	100	100
½ inch	-	100	98	89
3/8 inch	100	95	64	56
No. 4	38	45	11	14
No. 200	1.2	2	3.3	3.2
Fineness Modulus	5.42	5.00	6.00	6.14
Air Voids	-	-	21 %	17 %
Noise Level	91.5	93.8	95.1	98.6

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