HMA Quiet Pavement Overview

Illinois Bituminous Paving Conference

Urbana, Illinois

December 7,2006

Mark Swanlund

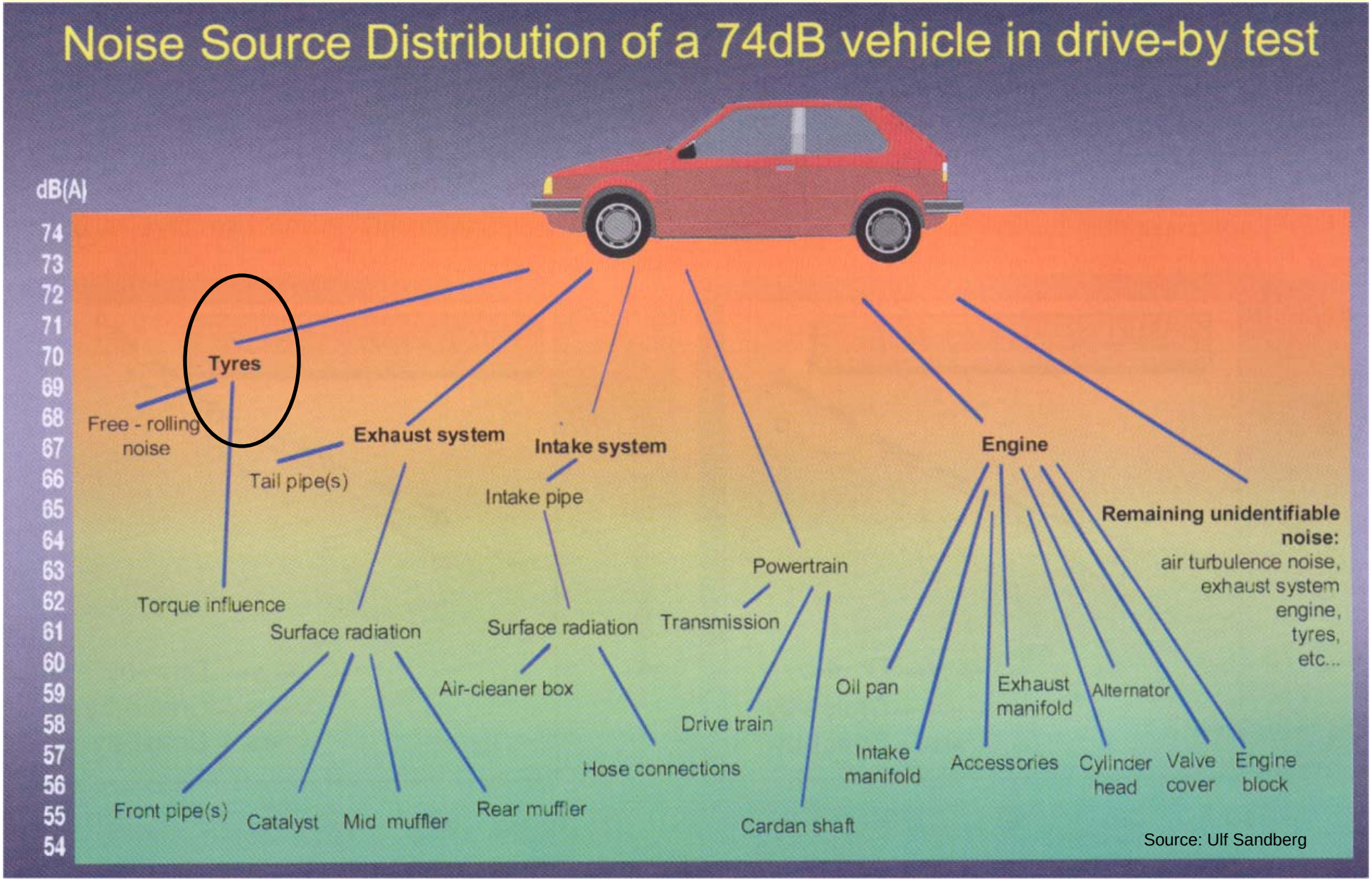
Office of Pavement Technology

U.S. Department of Transportation
Federal Highway Administration

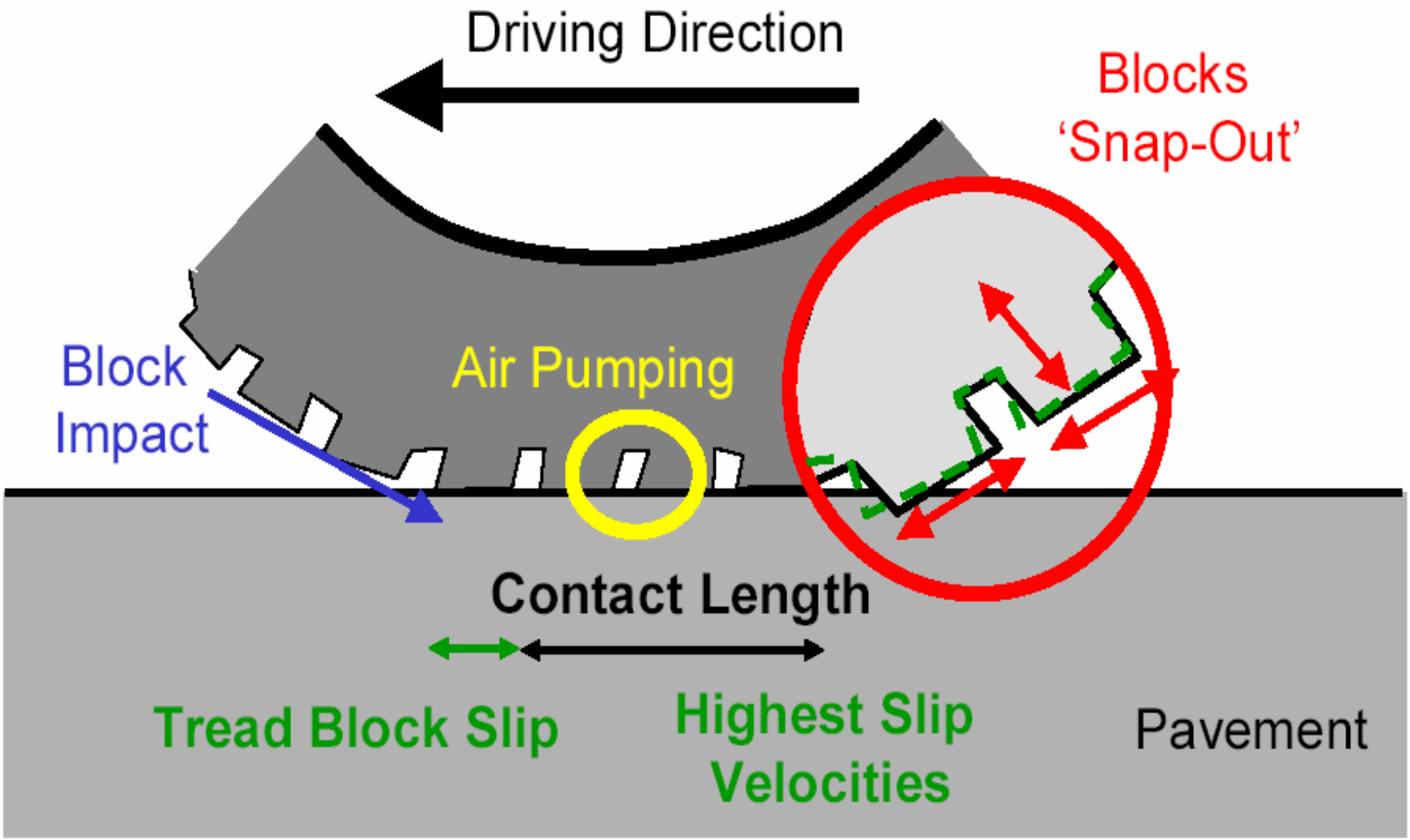
Presentation Outline

- Sources of traffic noise
- Tire-pavement noise mechanisms
- Methods for reducing noise on HMA
- Ongoing research

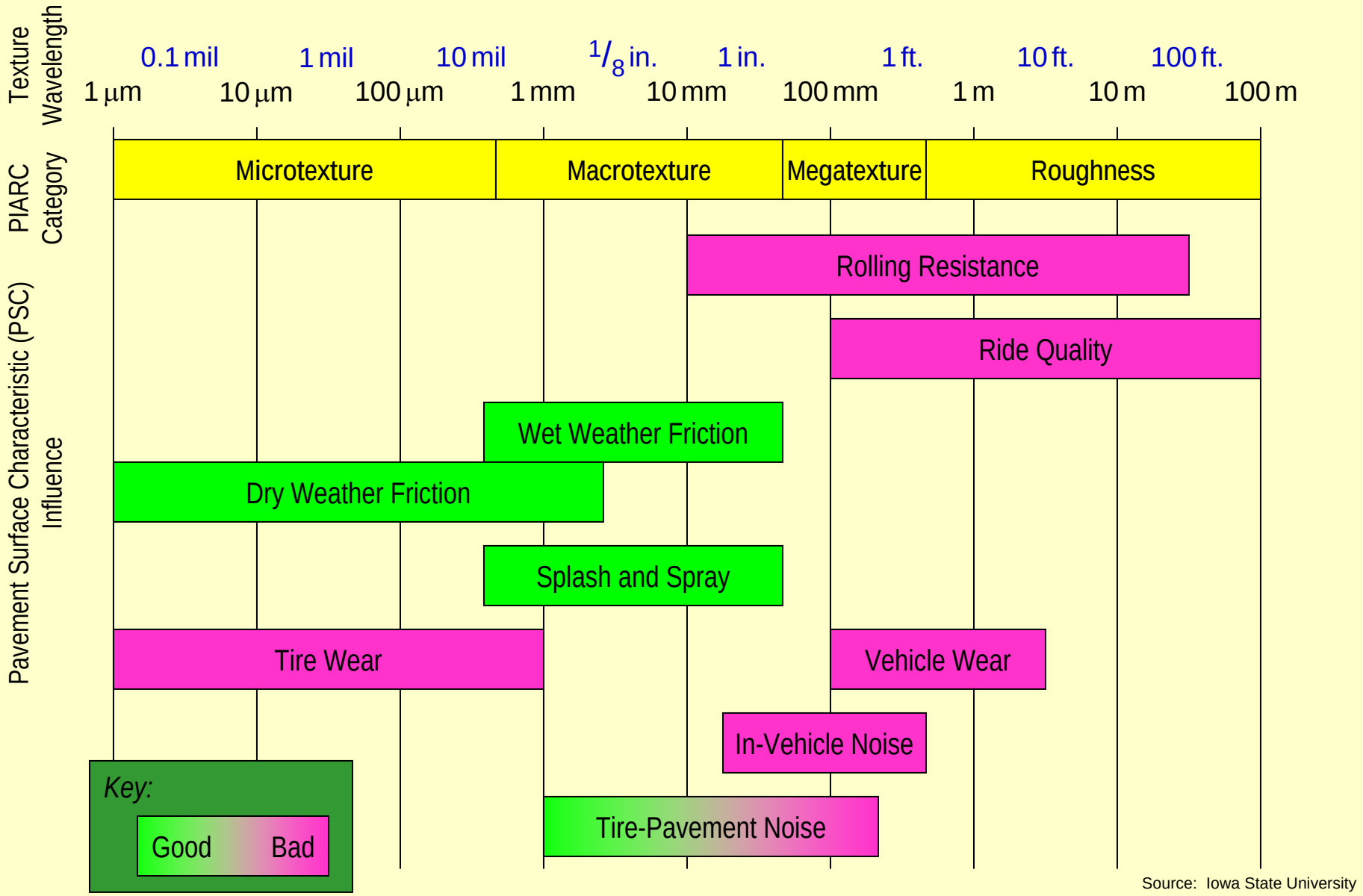
Sources of Traffic Noise



Components of Tire-Pavement Noise



Texture-Noise Relationship



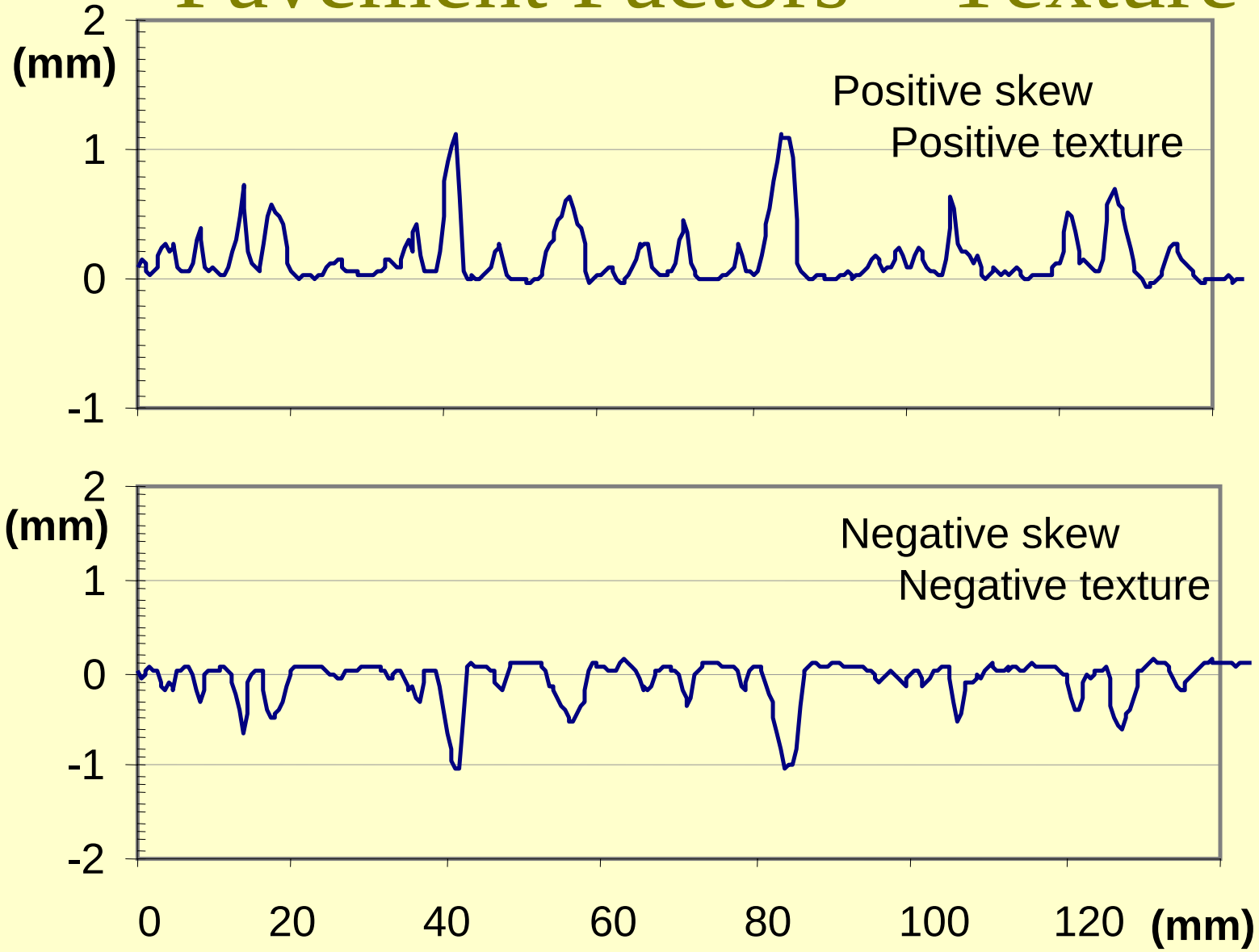
Source: Iowa State University

Pavement Factors

No.	Parameter	Degree of influence
1	Macrotexture	Very high
2	Megatexture	High
3	Microtexture	Low -moderate
4	Unevenness	Minor
5	Porosity	Very high
6	Thickness of layer	High, for porous surfaces
7	Adhesion (normal)	Low/moderate
8	Friction (tangent.)	See microtexture
9	Stiffness	Uncertain, moderate (?)

Source: Ulf Sandberg

Pavement Factors – Texture



Source: Ulf Sandberg

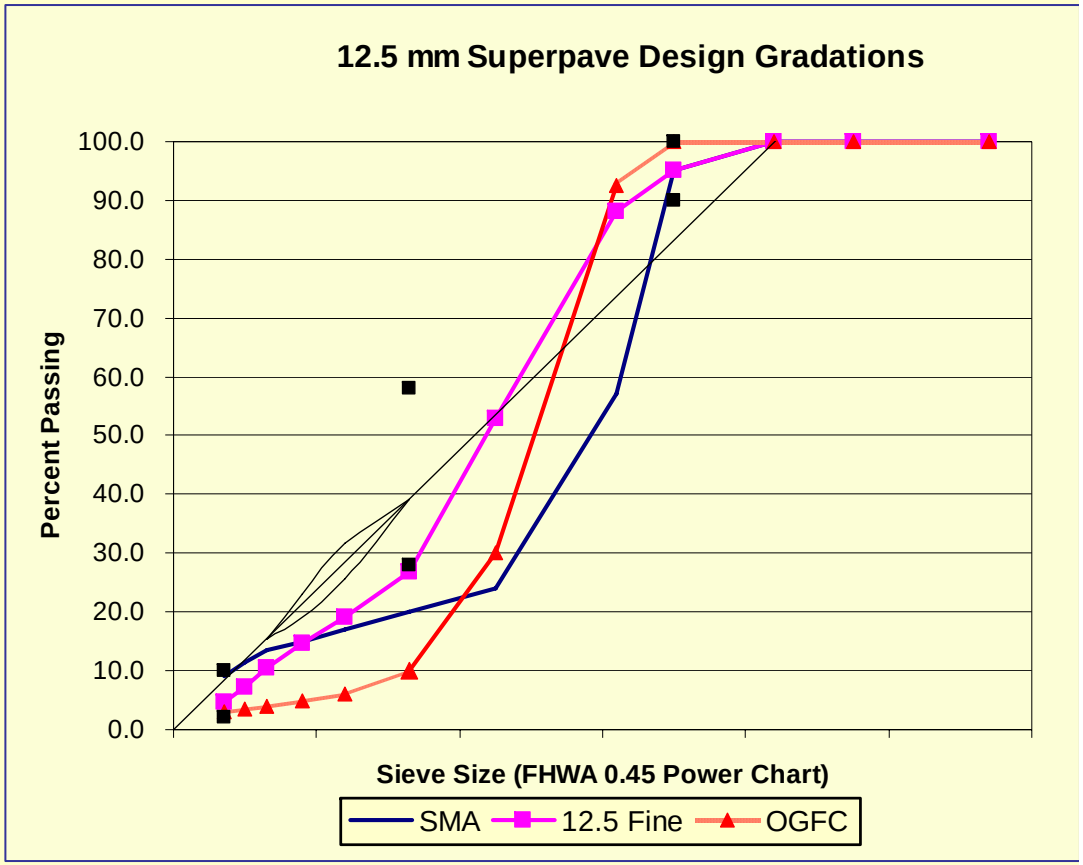
Pavement Technologies

- Asphalt technologies
  - Fine Superpave mixes
  - Stone Matrix Asphalt (SMA)
  - Porous Friction Course

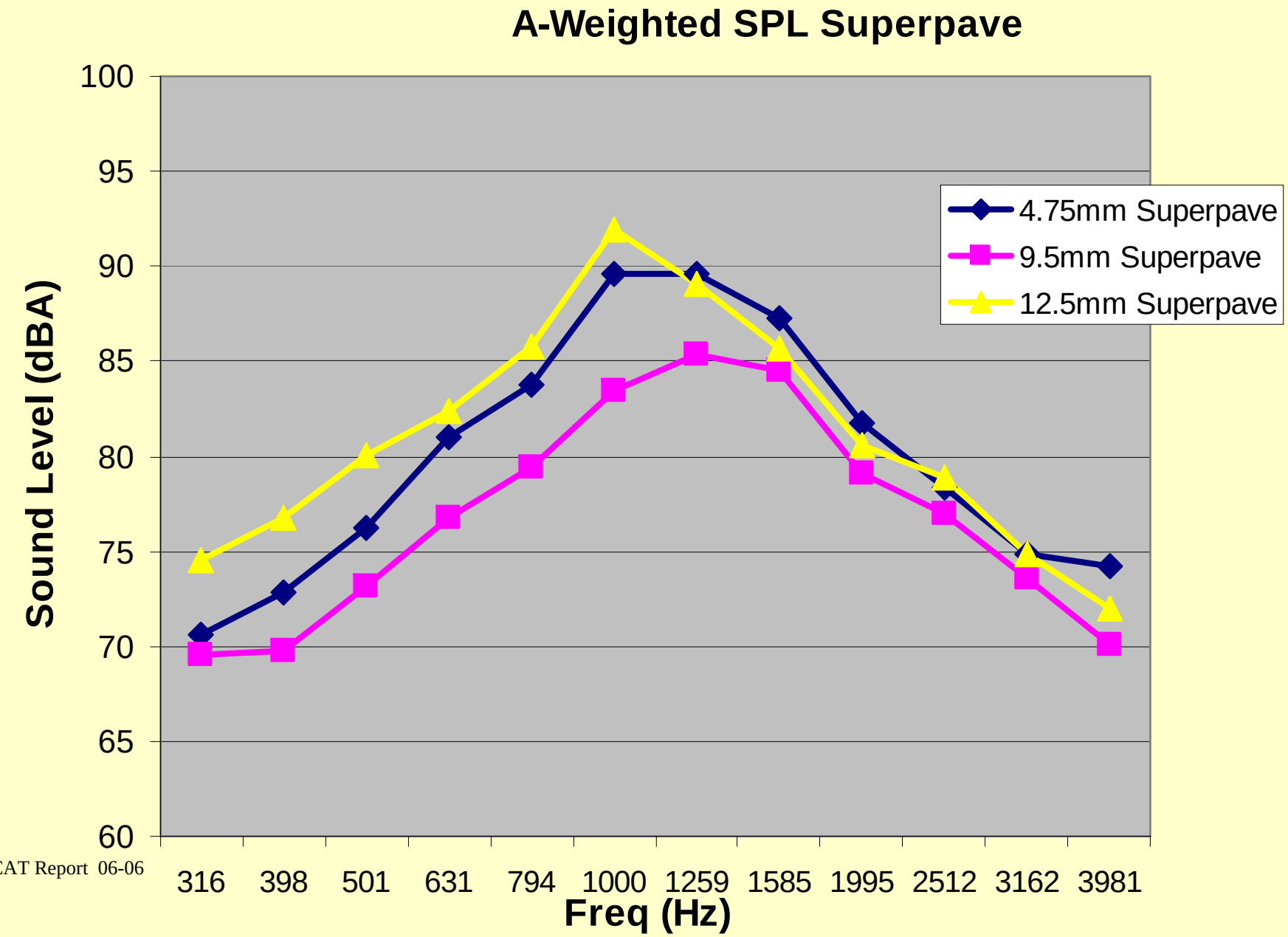
Fine Superpave Mixes

Fine Superpave Mixes

- Small aggregate size
- Fine gradation
- Dense graded
- Pooled fund



Noise Level vs. Aggregate Size



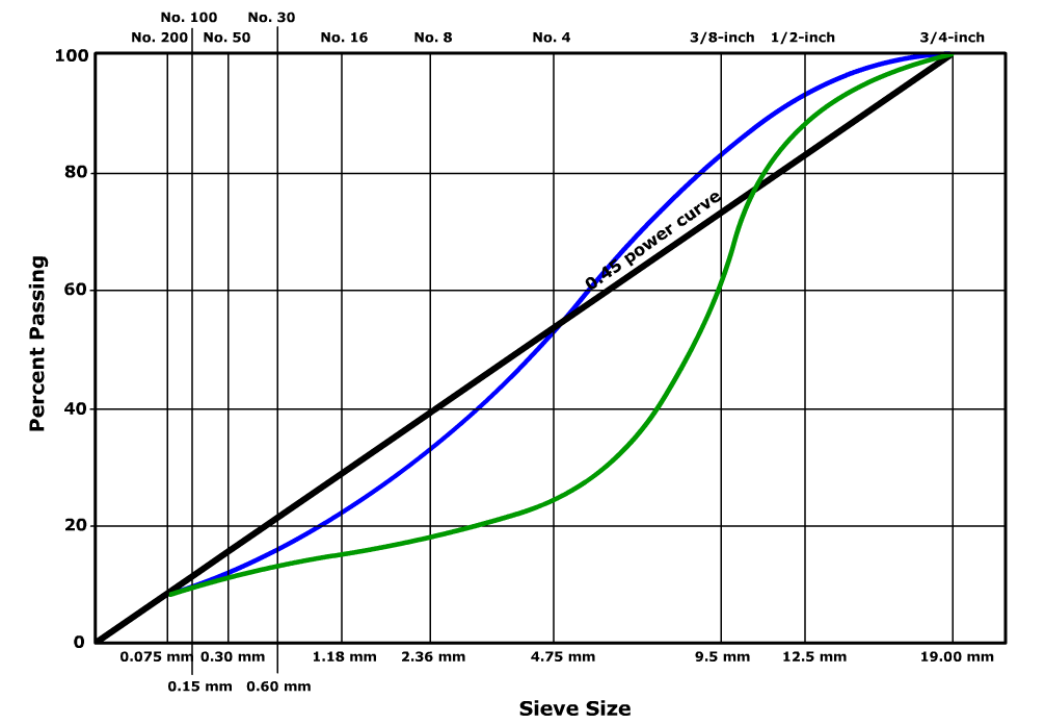
NCAT Report 06-06

Stone Matrix Asphalt

Source: Univ. of Washington

Stone Matrix Asphalt

- Small aggregate size
- Gap-graded aggregate (usually from coarse aggregate
- Manufactured sands and mineral filler
- Asphalt binder typically modified

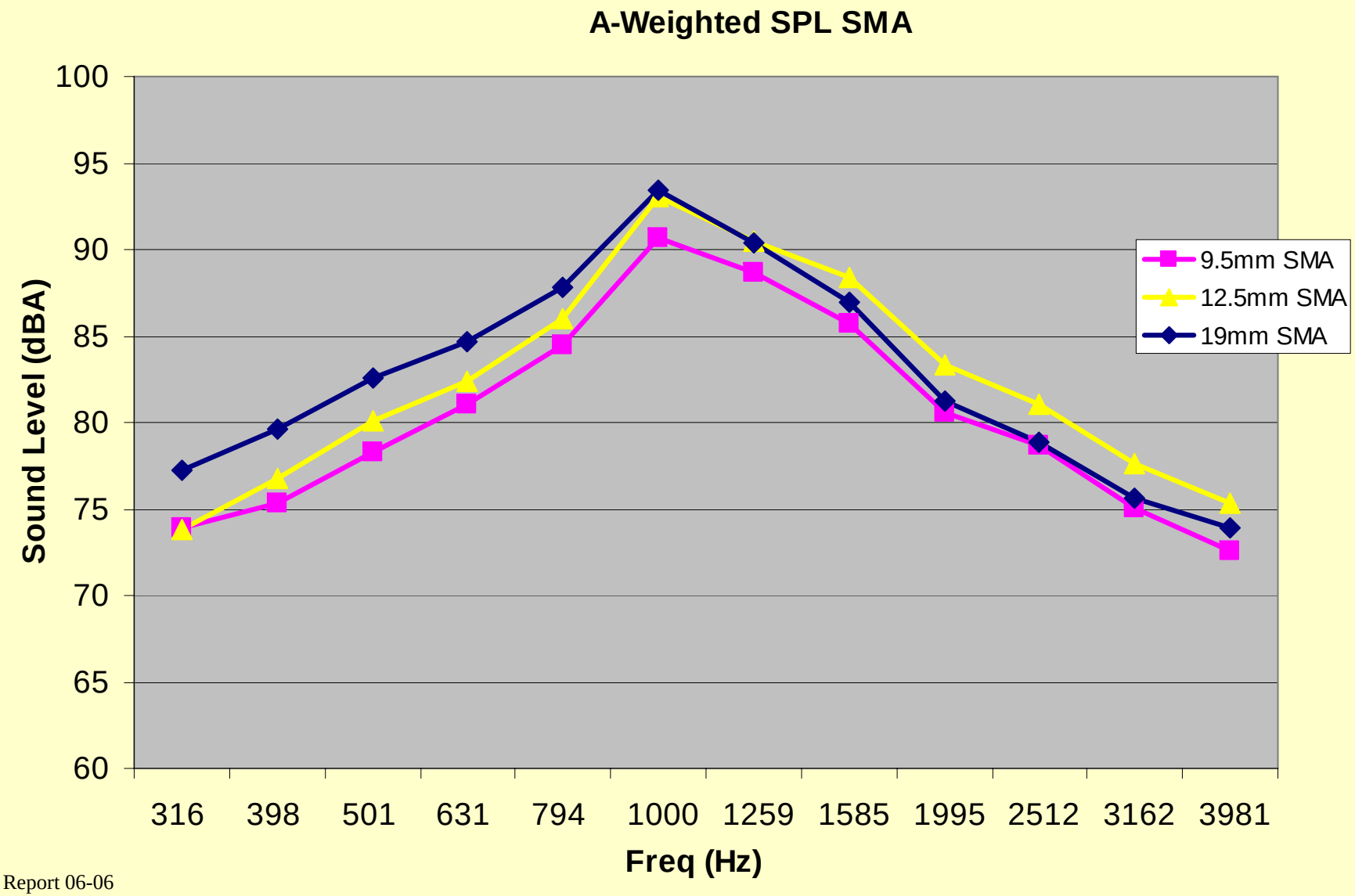


Source: Univ. of Washington

Stone Matrix Asphalt

Source: Univ. of Washington, Mark Swanlund

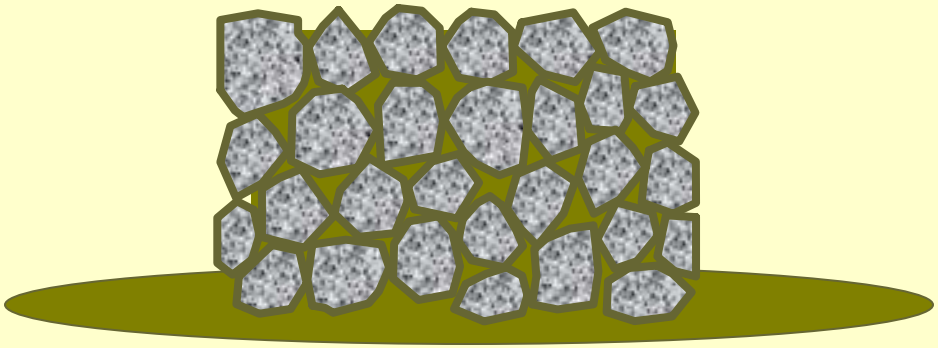
Noise Level vs. Aggregate Size

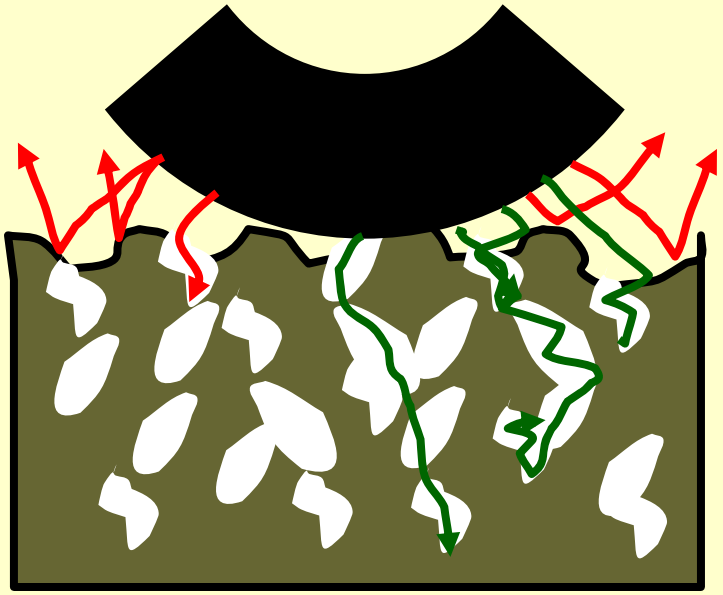


Porous Friction Course

Courtesy of Doug Hanson

Porous Friction Course





- Small aggregate size
- Open-graded aggregate
  - High volume of voids
    ≥ 20% air voids, in place
- Thick asphalt binder coating
- Array of tortuous pores
- Dissipates energy through friction
- Reduce surface area and slip-stick or slap
- Reduces horn effect
- Modified binders may increase elasticity

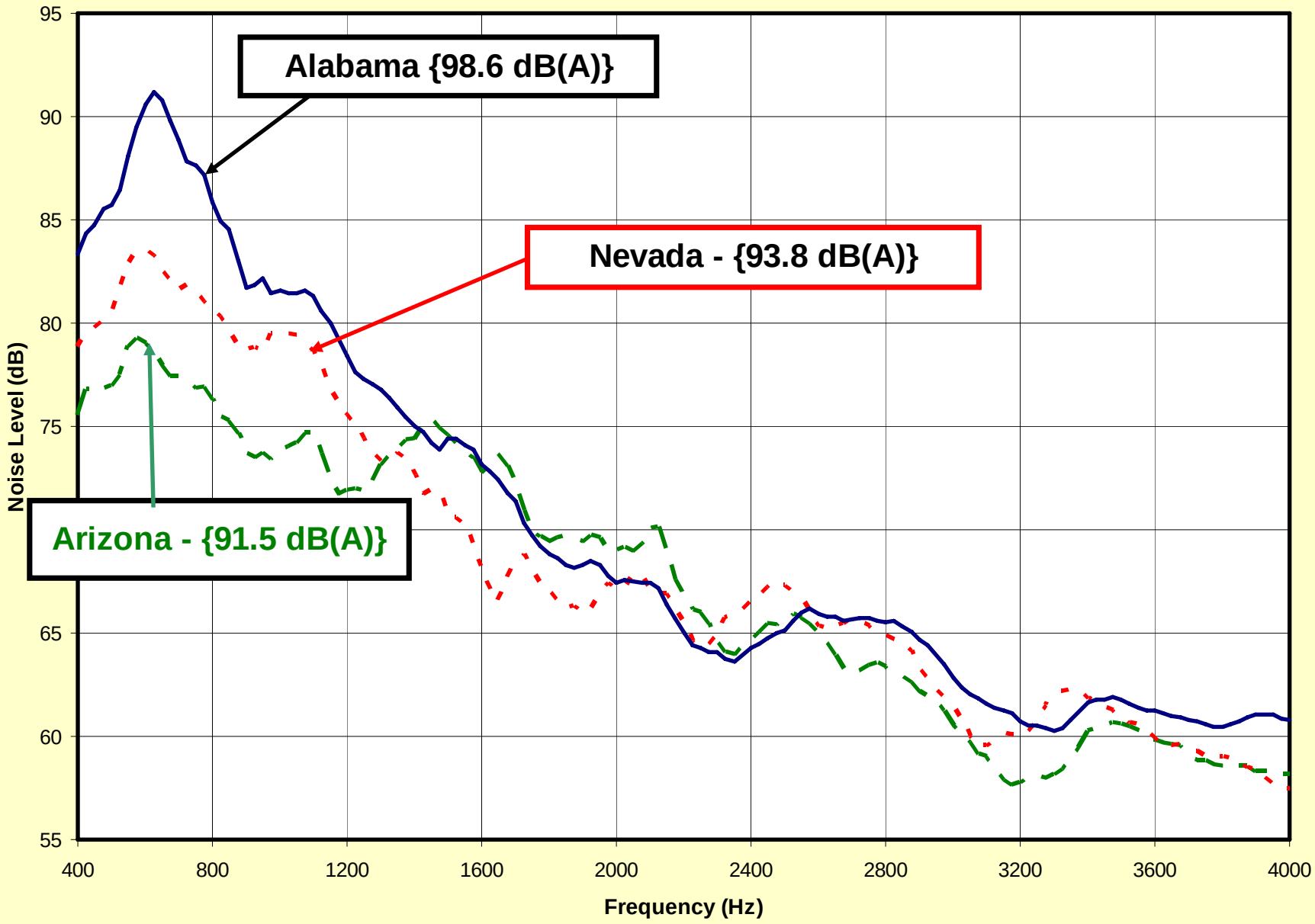
Porous Friction Course

Source: Mark Swanlund

OGFC GRADATIONS

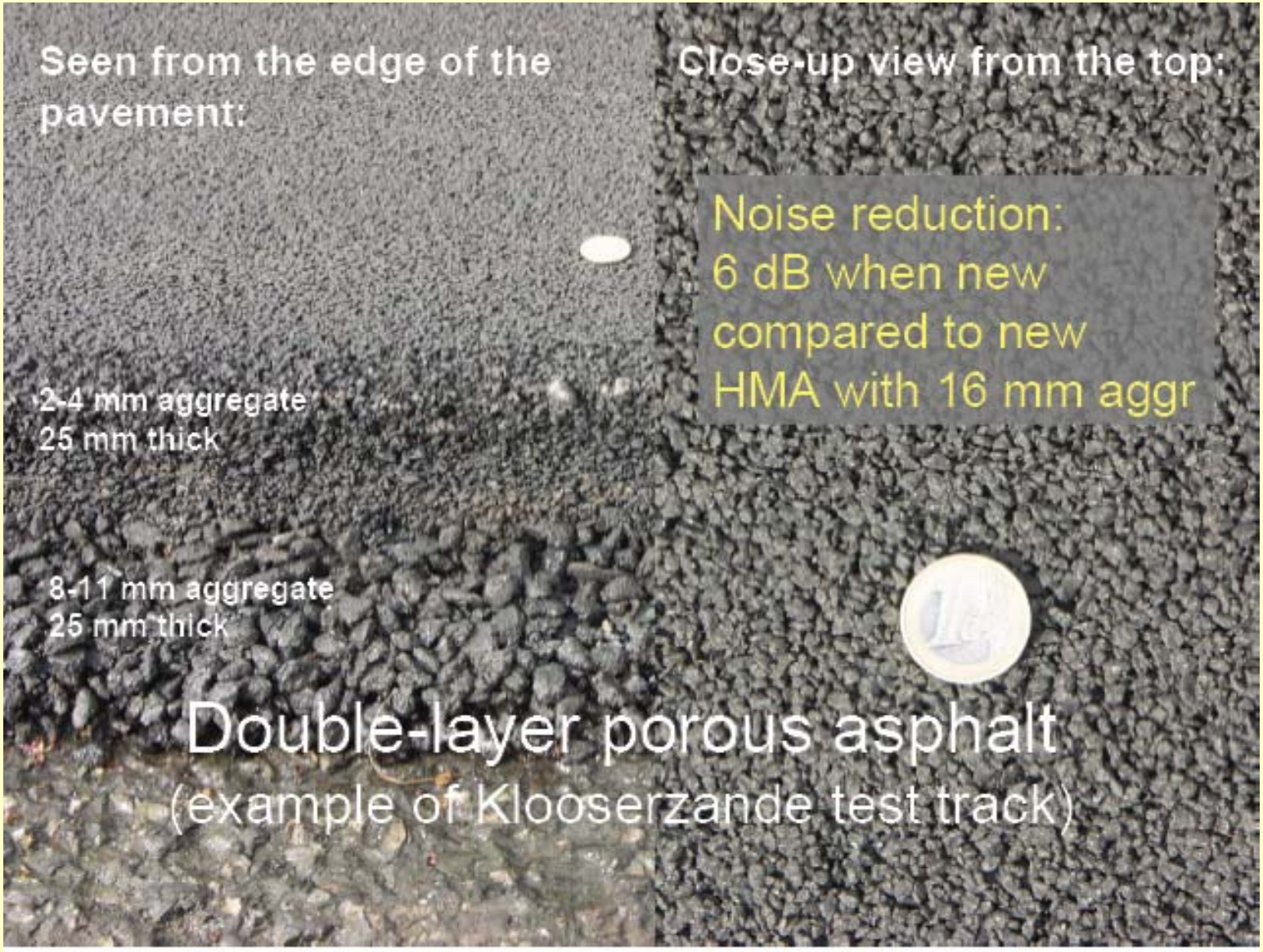
Gradation	Arizona[1]	Nevada[1]	AL 1 – 7[2]
Nominal Max Size	4.75 mm	9.5 mm	12.5 mm
¾ inch	-	-	100
½ inch	-	100	89
3/8 inch	100	95	56
No. 4	38	45	14
No. 8	6	-	9
No. 16	-	11	-
No. 200	1.2	2	3.2
Fineness Modulus	5.42	5.00	6.14
Air Voids	-	-	17 %
Noise Level	**91.5**	**93.8**	**98.6**

Courtesy of Doug Hanson



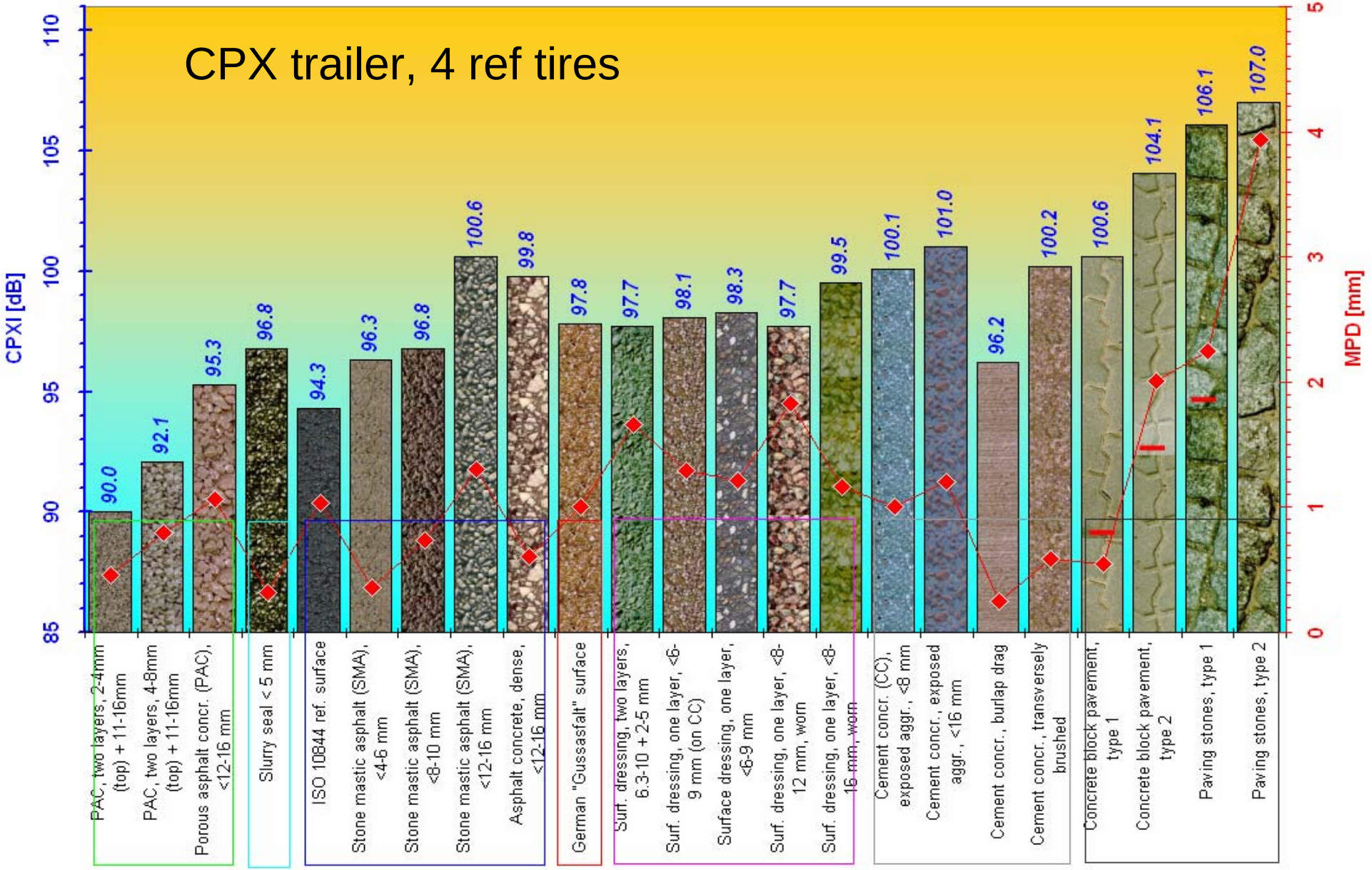
Courtesy of Doug Hanson

Porous Friction Course



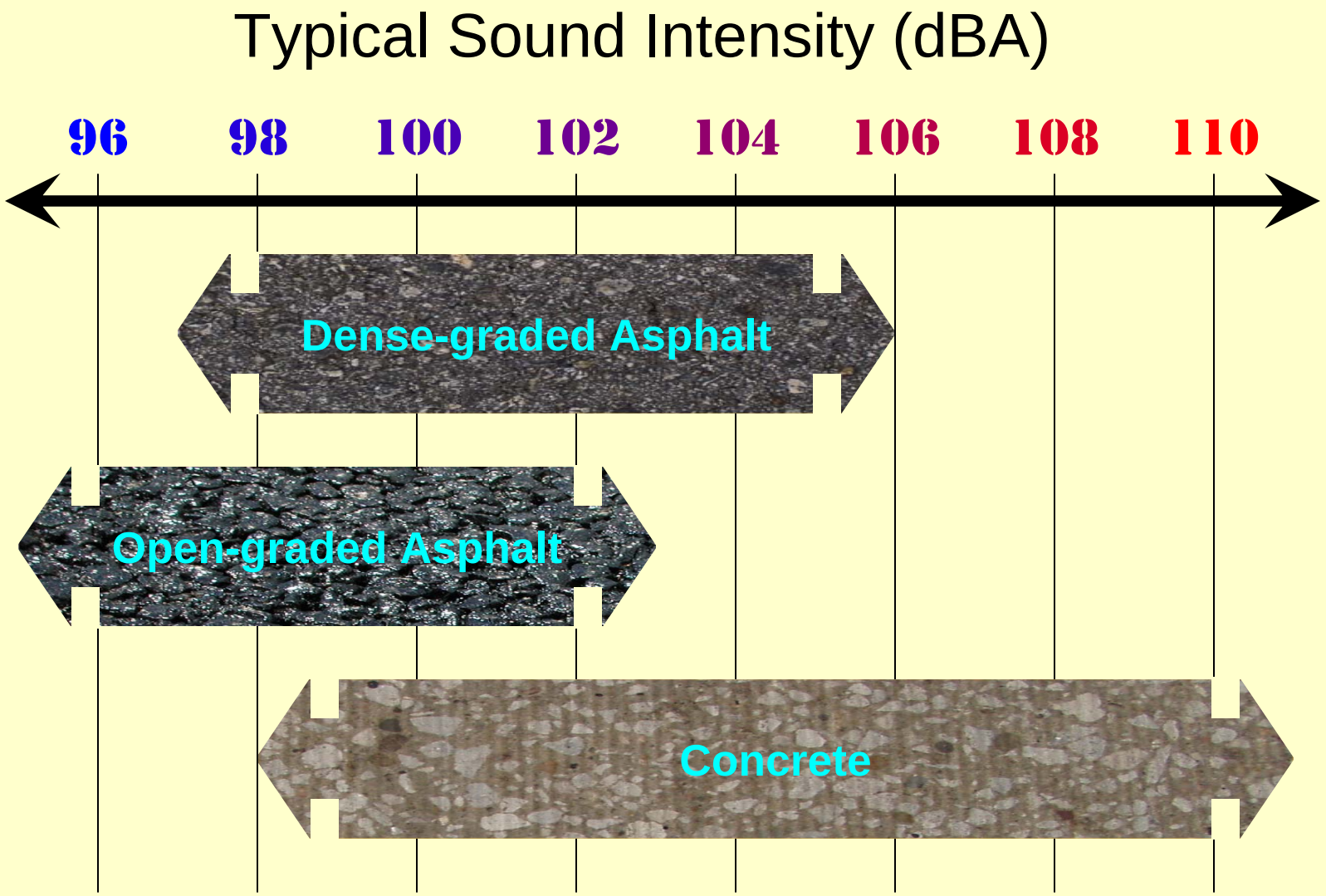
Source: Ulf Sandberg

Pavement Performance



Source: Ulf Sandberg

Pavement Performance

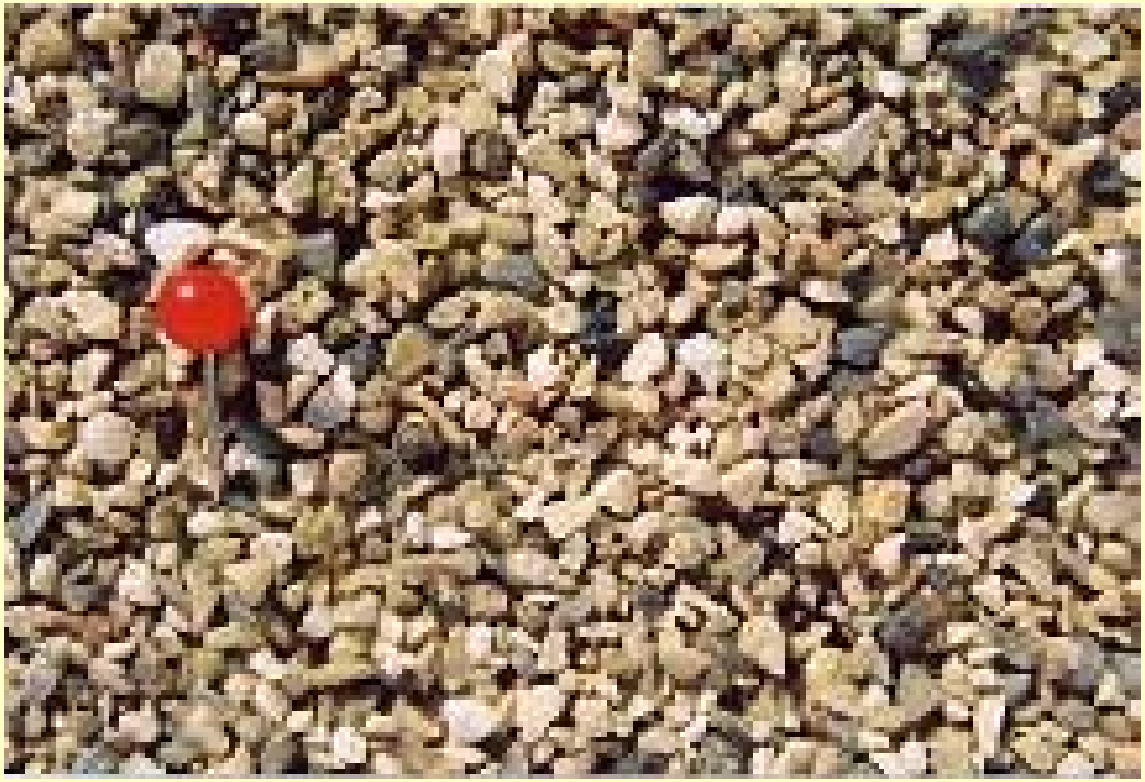


Source: Transtec CPSC

POP QUIZ

Quiet or Loud?

Calcined Bauxite, 1-3mm



10 mm

Zebragrip, Calcined
Bauxite, 1-3mm

10 mm

Dense graded HMA, 20M ESALs, 19mm

20 mm

Superpave, 9.5mm, 20M
ESALS, 0.8mm MTD

10 mm

Milled Asphalt

20 mm

Hot Rolled Asphalt 20mm

20 mm

OGFC, 20M ESALs,

NMS 12.5mm, MTD 1.6mm

20 mm

Ongoing Research

- NCAT and Purdue University
  - development & evaluation of low noise pavements
- Poroelastic Road Surface (PERS)

NCAT and Purdue Quiet Pavement Development

- Develop and evaluate quiet pavement technology
  - Double layer porous
  - Thin, gap-graded asphalt layers

AU 4-C2 Sections

North Tangent

	N 5	N 6	N 7	N 8	N 9
Layer 1 (1 ¼ inches)	AZ OGFC	AZ OGFC	AZ OGFC	PEM	PEM
Layer 2 (1 ¼ inches)	Track	AZ OGFC	PEM	PEM	Track

South Tangent

	S 4	S 5	S 6	S 7	S 8
Layer 1 (1¼ inches)	< 4.75 SMA	4.75 SMA	9.5 SMA	4.75 DGA	9.5 DGA
Layer 2	Track				

Courtesy of Doug Hanson

AZ OGFC and Georgia PEM

20 mm

AU 4-C2 Sections

North Tangent

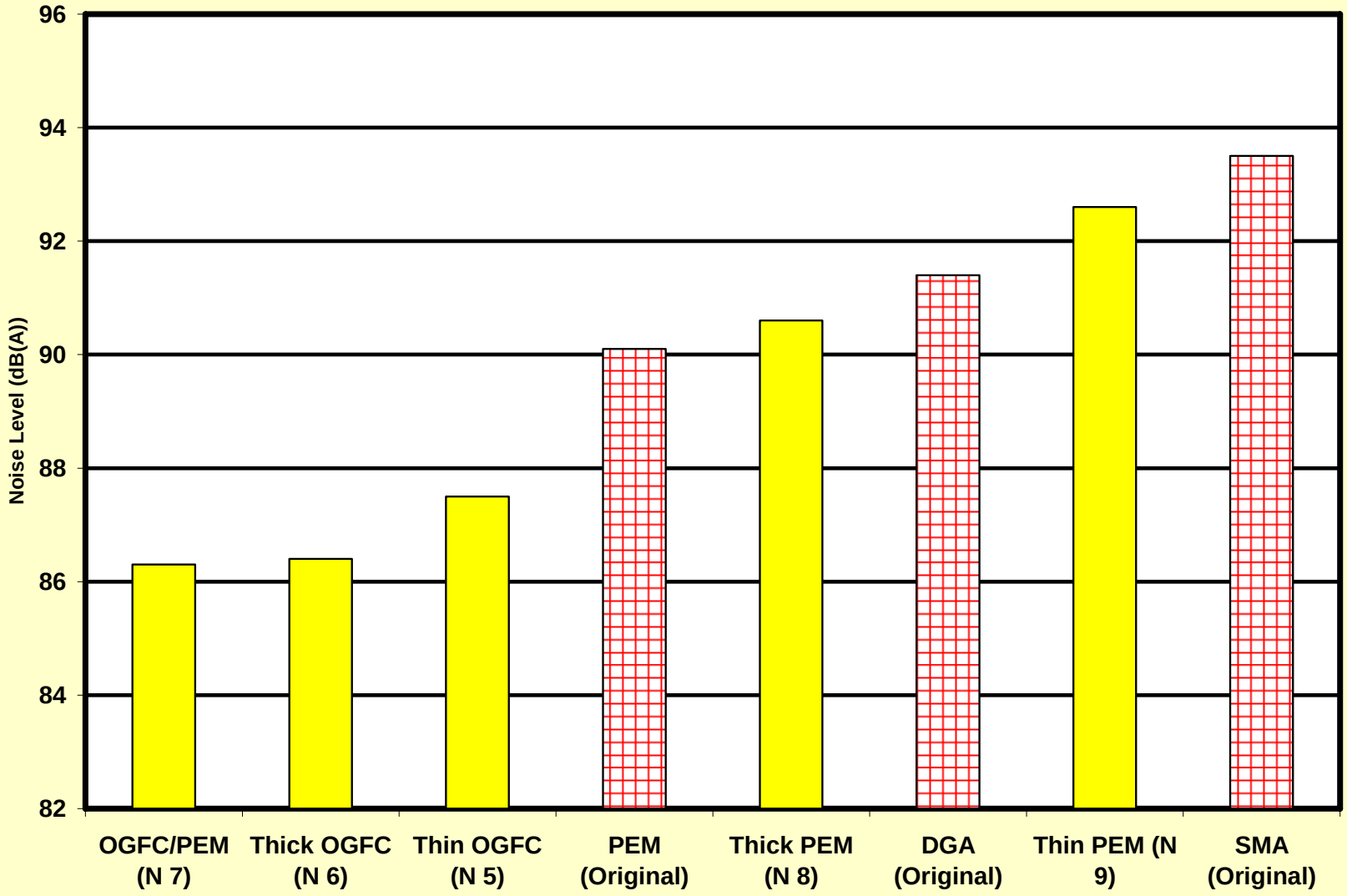
	N 5	N 6	N 7	N 8	N 9
Layer 1 (1 ¼ inches)	AZ OGFC	AZ OGFC	AZ OGFC	PEM	PEM
Layer 2 (1 ¼ inches)	Track	AZ OGFC	PEM	PEM	Track

South Tangent

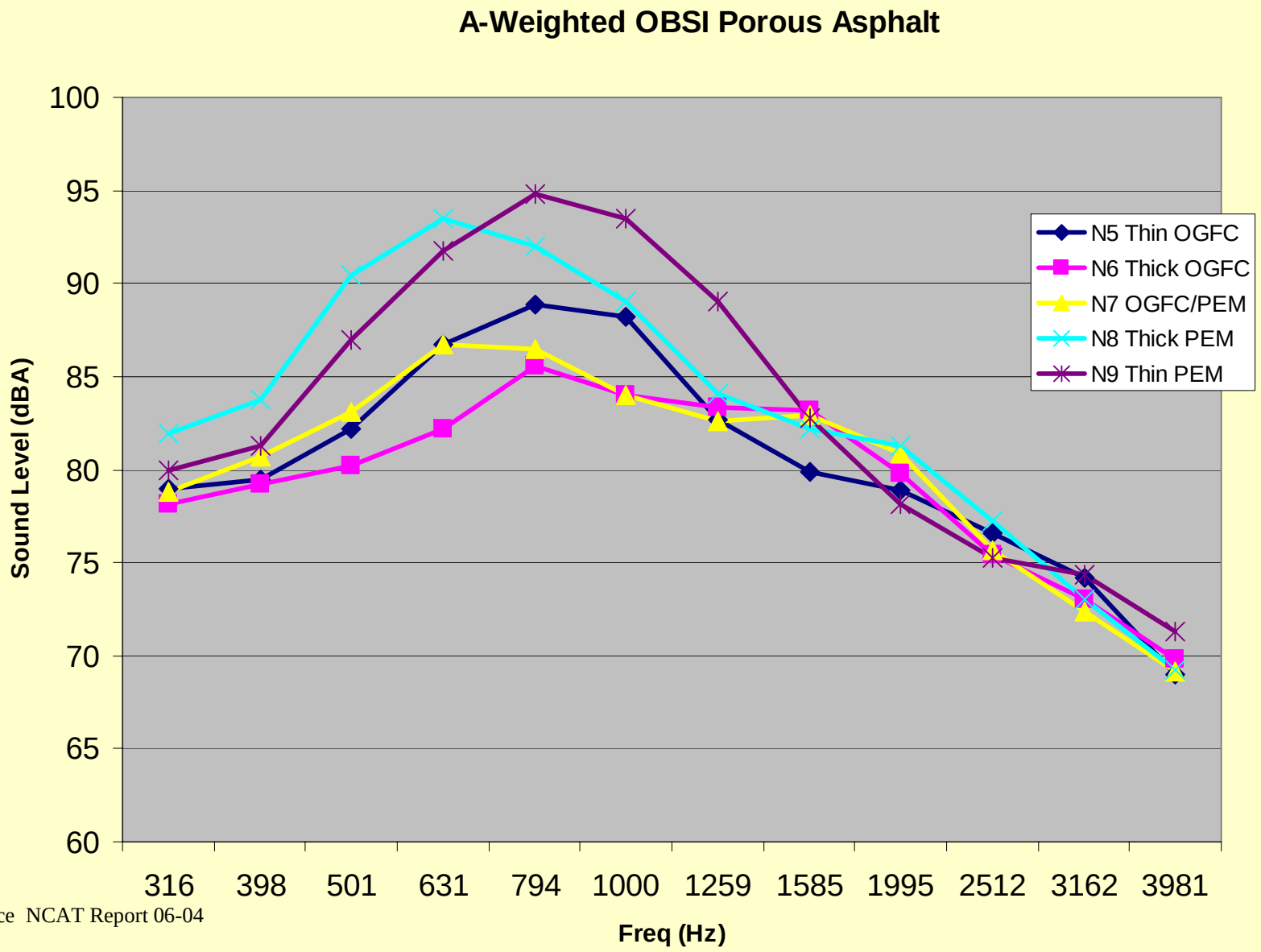
	S 4	S 5	S 6	S 7	S 8
Layer 1 (1¼ inches)	< 4.75 SMA	4.75 SMA	9.5 SMA	4.75 DGA	9.5 DGA
Layer 2	Track				

Courtesy of Doug Hanson

AU 4-C2 Sections



OBSI Spectra @60 MPH, GDYR

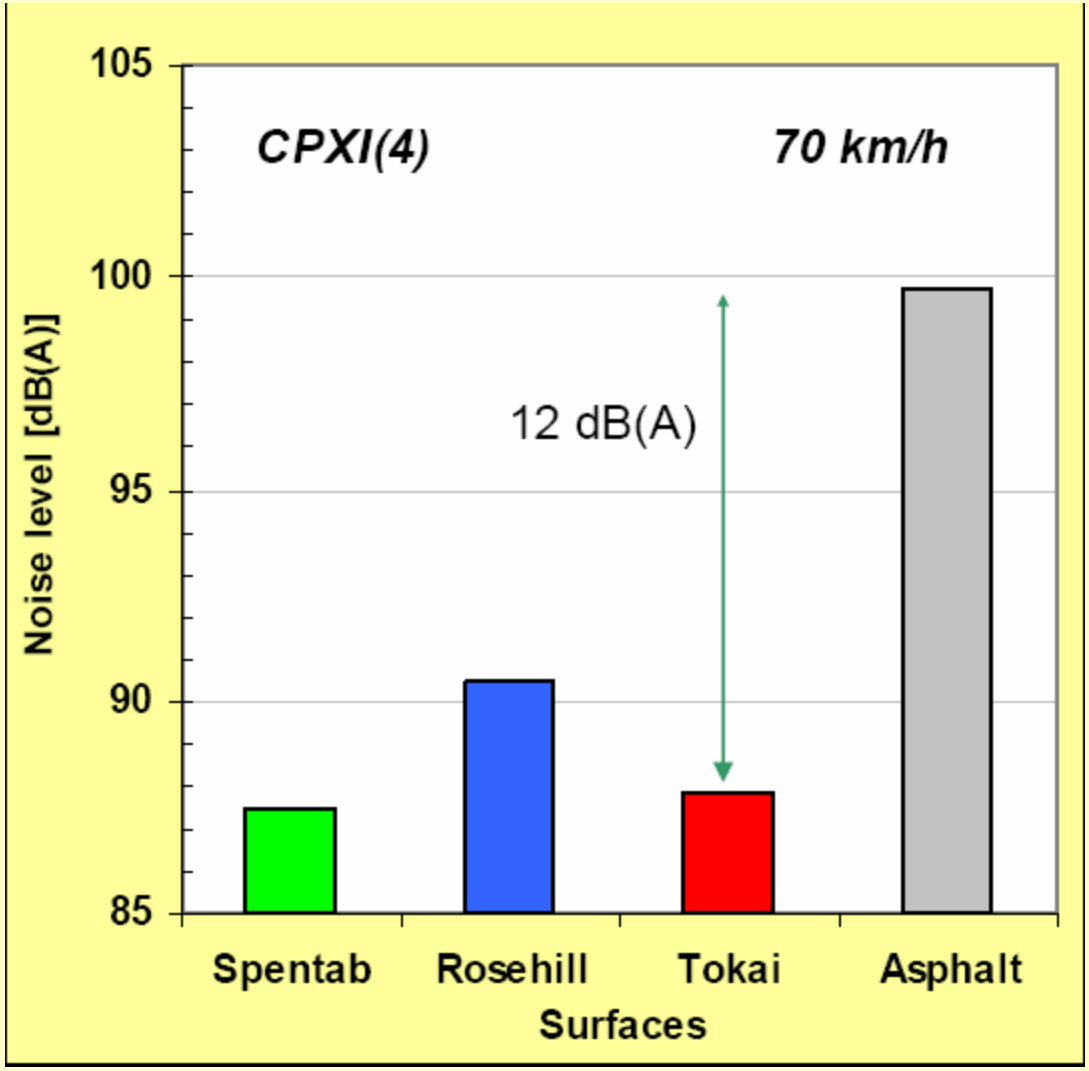


Source NCAT Report 06-04

Poroelastic Road Surface (PERS)

Source: Ulf Sandberg

Poroelastic Road Surface (PERS)



Source: Ulf Sandberg

Poroelastic Road Surface (PERS)

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Thank You

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