

Concrete Pavement Road Map Surface Characteristics Track and the Concrete Pavement Surface Characteristics Program

21st Annual Road Profilers Users' Group
Atlanta, Georgia
9 December 2009

National Concrete Pavement
Technology Center



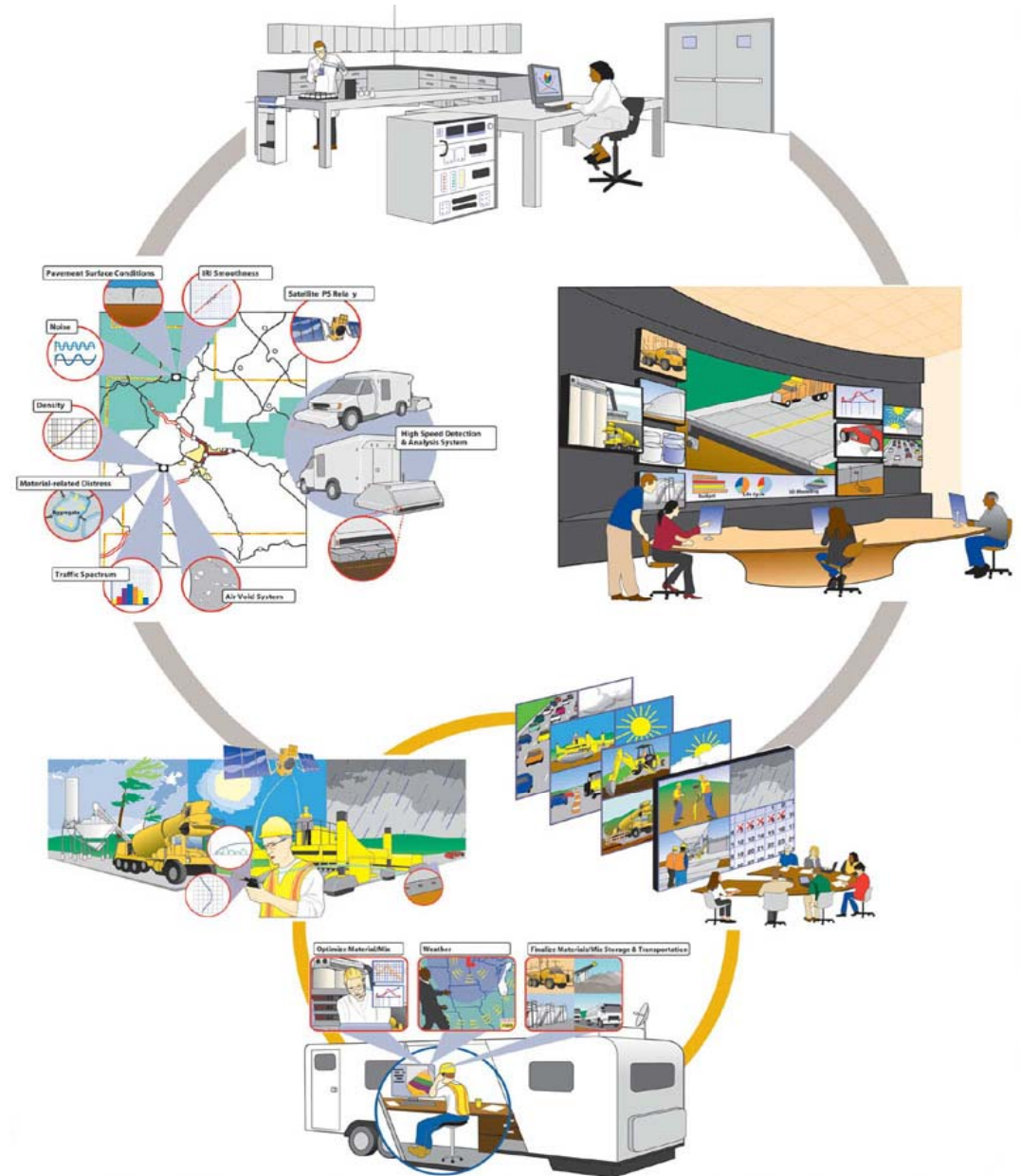
Robert Otto Rasmussen, PhD, INCE, PE (TX)
The Transtec Group, Inc.

CP Road Map

Surface Characteristics Track

CP Road Map

- ❑ 12 tracks
- ❑ 250 problem statements
- ❑ \$250M
- ❑ 10 years



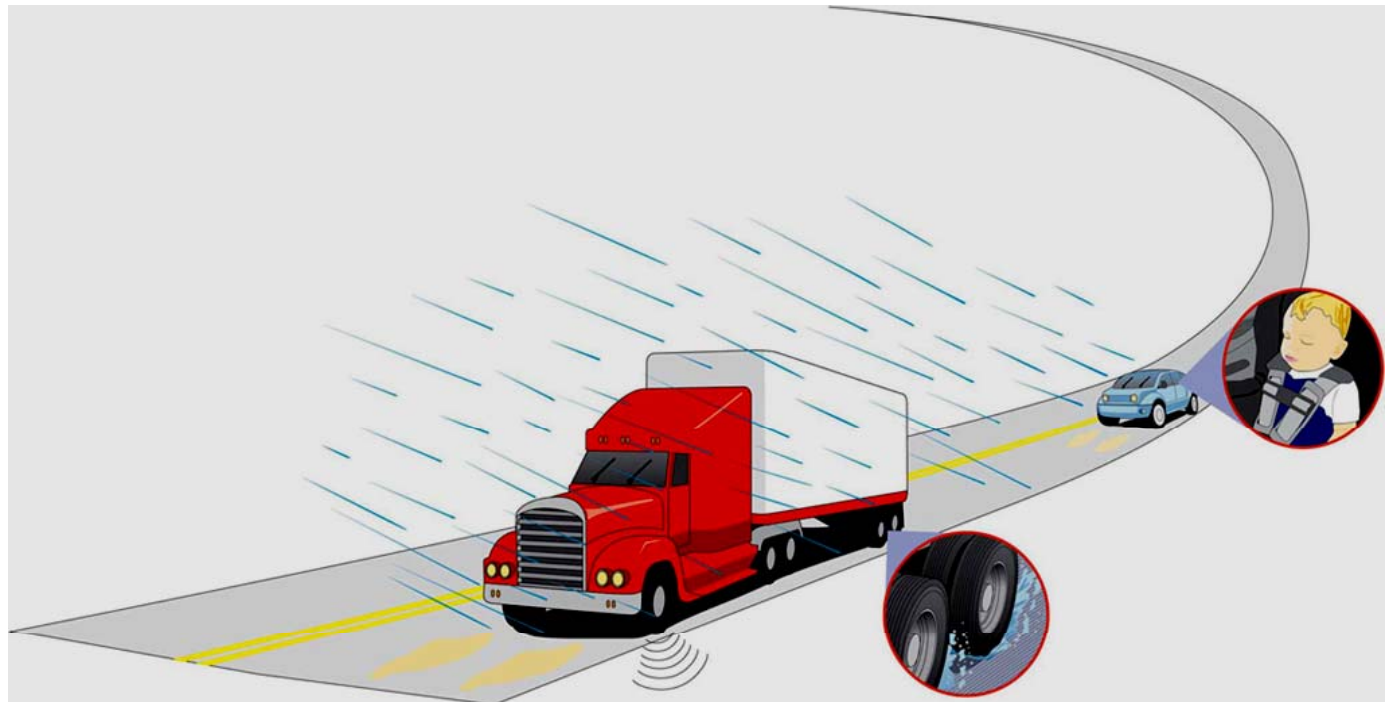
CP Road Map

- ❑ Track 4: Surface Characteristics
- ❑ Optimize nominal pavement textures used today to meet site-specific needs

CP ROAD MAP
shaping the future of concrete pavement



it's your move!



SC Track Goal #1

To fulfill the needs and desires of society by designing, building, and maintaining concrete pavement surfaces that are safer, more comfortable, durable, and cost effective.

CP ROAD MAP
shaping the future of concrete pavement



it's your move!

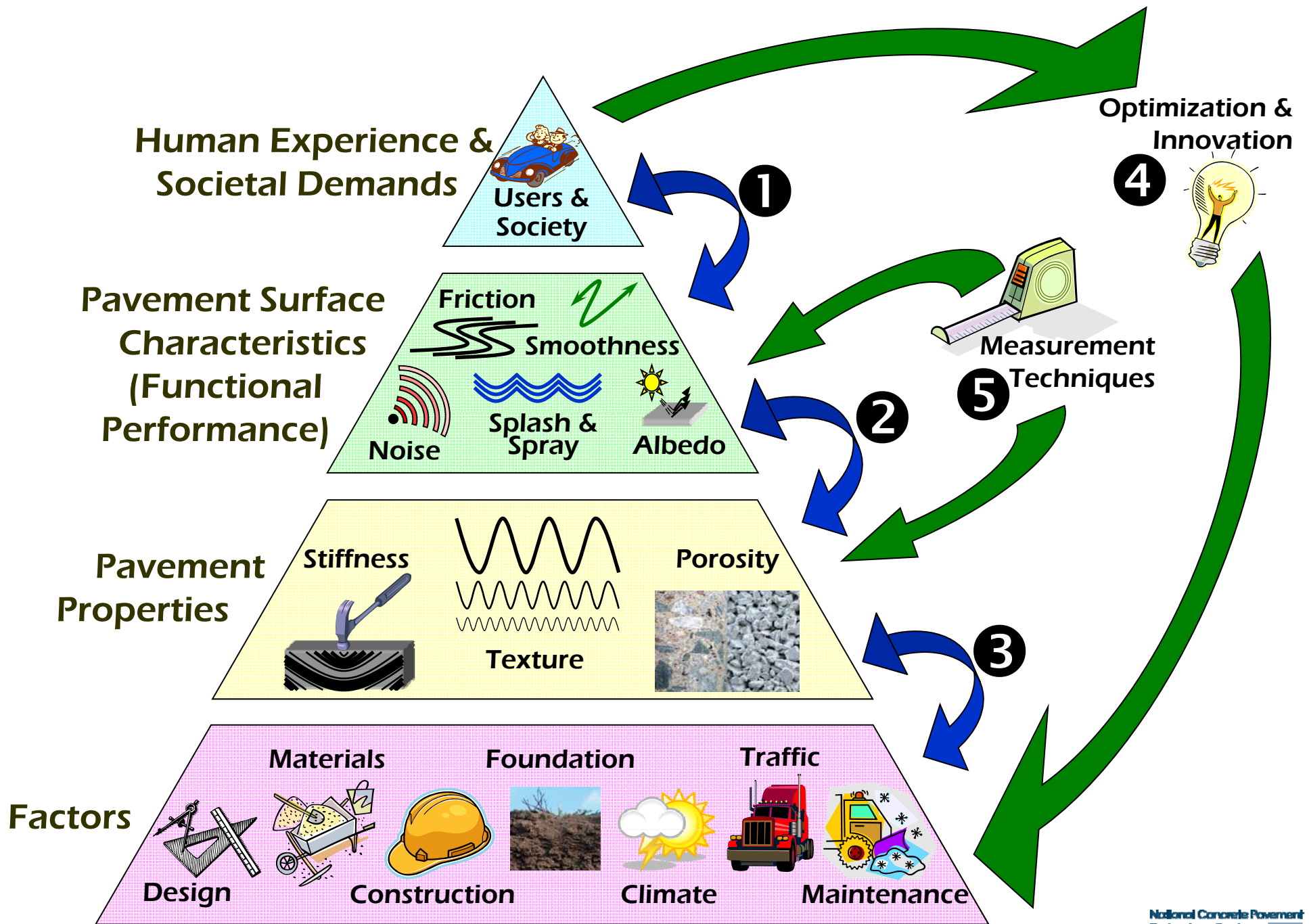
SC Track Goal #2

To develop an integrated unified model that links concrete pavement surface characteristics to the human element, pavement properties, and the factors that affect these all.

CP ROAD MAP
shaping the future of concrete pavement



it's your move!



Concrete Pavement Surface Characteristics Program (CPSCP)

Concrete Pavement Surface Characteristics Program

- ❑ 6 Years (2005-2010)
- ❑ 3 Parts
- ❑ 11 Partners



U.S. Department
of Transportation

**Federal Highway
Administration**



National Concrete Pavement
Technology Center



Uniting agencies, industry, and researchers
to advance concrete pavement technology



CPSCP Working Plan

□ 3 Major Areas of Research and Analysis

1. Measurement & Analysis Techniques – Improvements, Adjustments, Corrections

- OBSI
- Texture & Friction
- Wayside Noise

2. Guidance for Texture Type Selection – Understanding Averages and Variability

- Link Texture to Noise
- Fill Gaps
- Functional Durability
- Non-Traditional Functional Performance Indicators
- Innovative Textures and Techniques

3. Construction Techniques & Control (Average and Variability)

- Construction Equipment and Techniques
- Control of Texturing Operation
- Better Practices and Model Specifications

Three Key Products:

- 1. Design and Construction Guidelines**
- 2. Model Texture Specifications**
- 3. Selecting the Right Texture for the Job**

**What have we
learned these last
few years?**

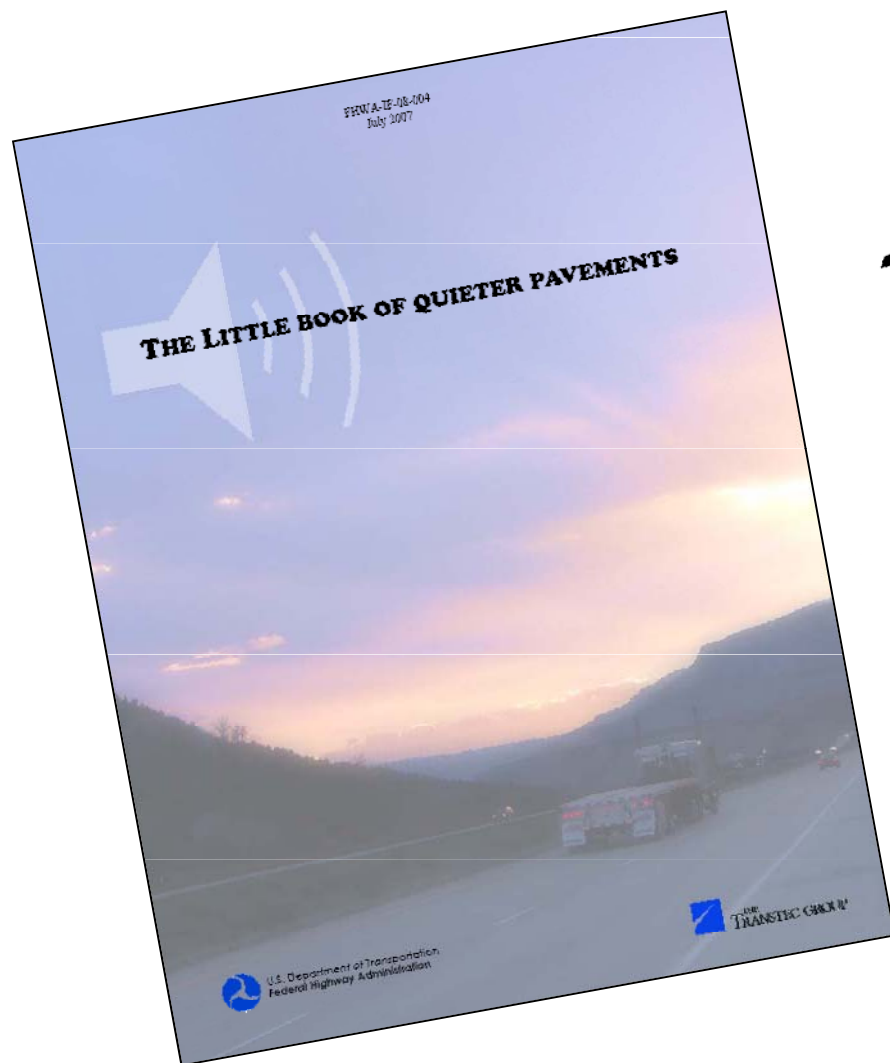
Key Concept #1

Better practices to
improve surface properties
are really about establishing a
higher order of control
over the texture and other surface
properties.

Key Concept #2

It is not about designing or building
“innovative” surfaces,
but rather the control of
conventional texturing techniques.

Fundamentals must come first!



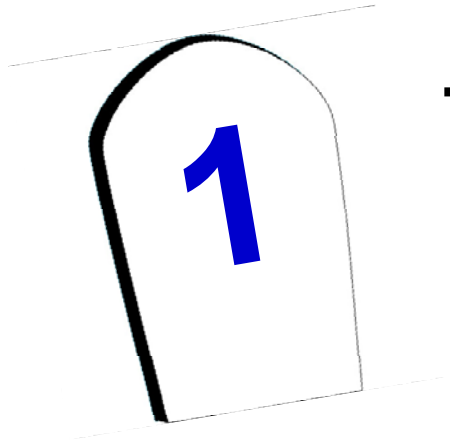
*Tire-Pavement
Noise*
101 

Download from

www.TCPSC.com/LittleBookQuieterPavements.pdf



...for a Quieter Pavement



Thou shalt have Texture...

be it small and negative!

Bad

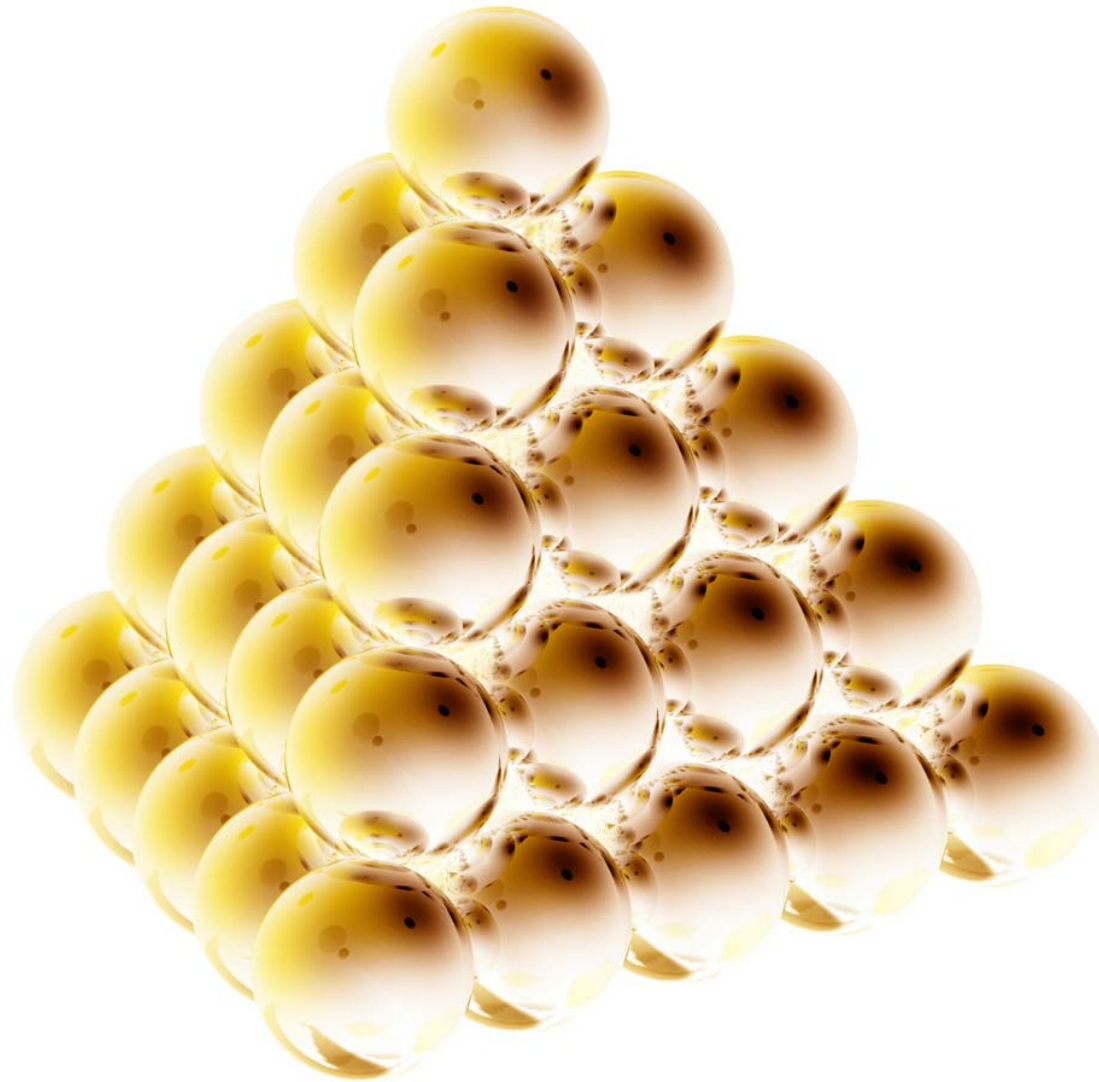


Good



2

Thou shalt have High Porosity!



3

Thou shalt have Low Stiffness!



Pavement Texture

Roughness



Megatexture



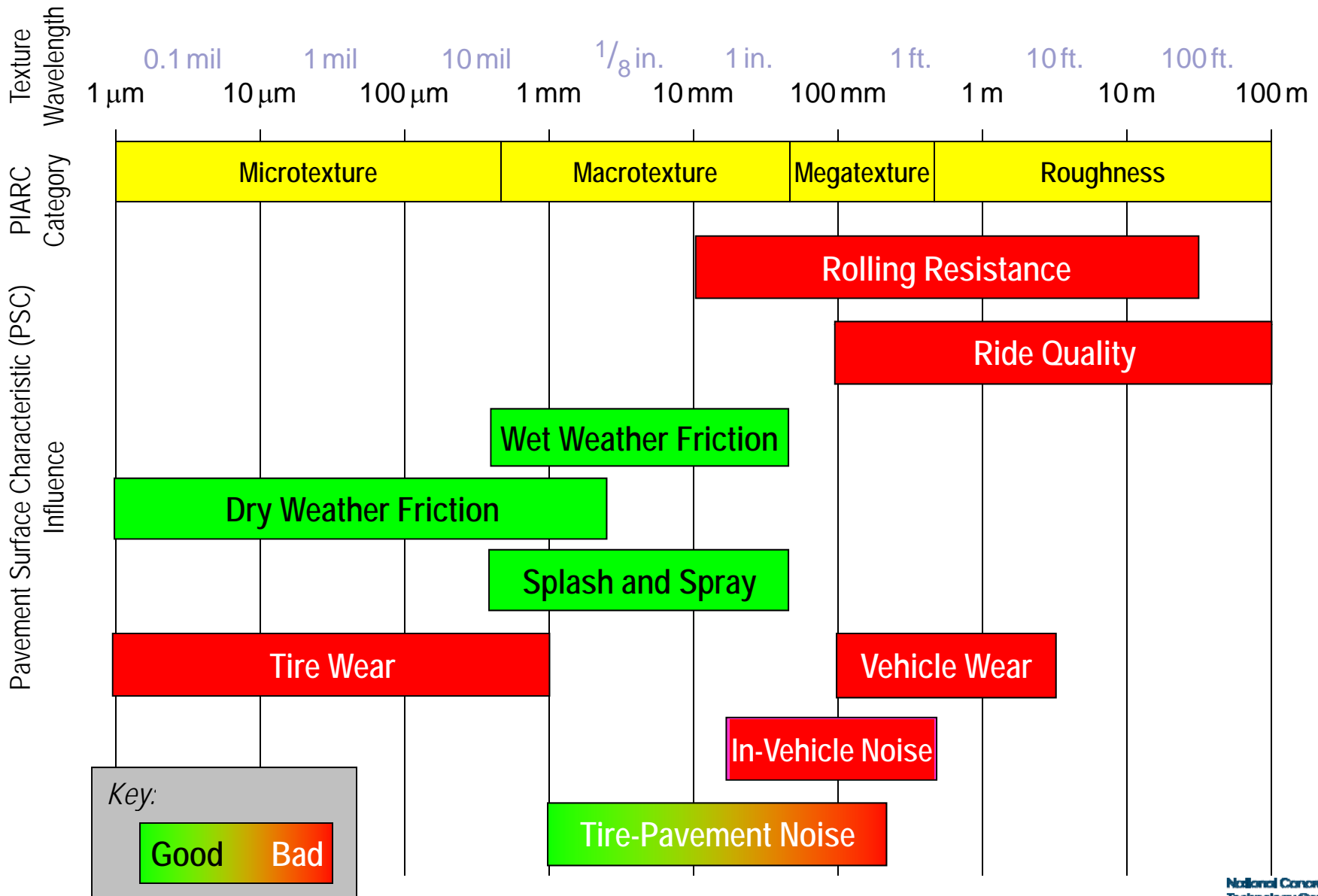
Macrotexture



Microtexture

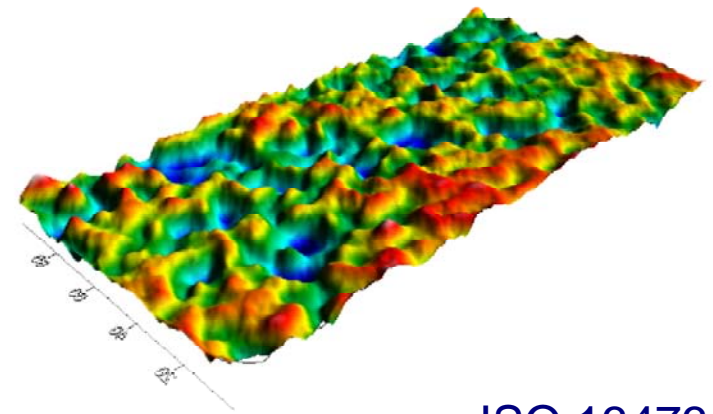
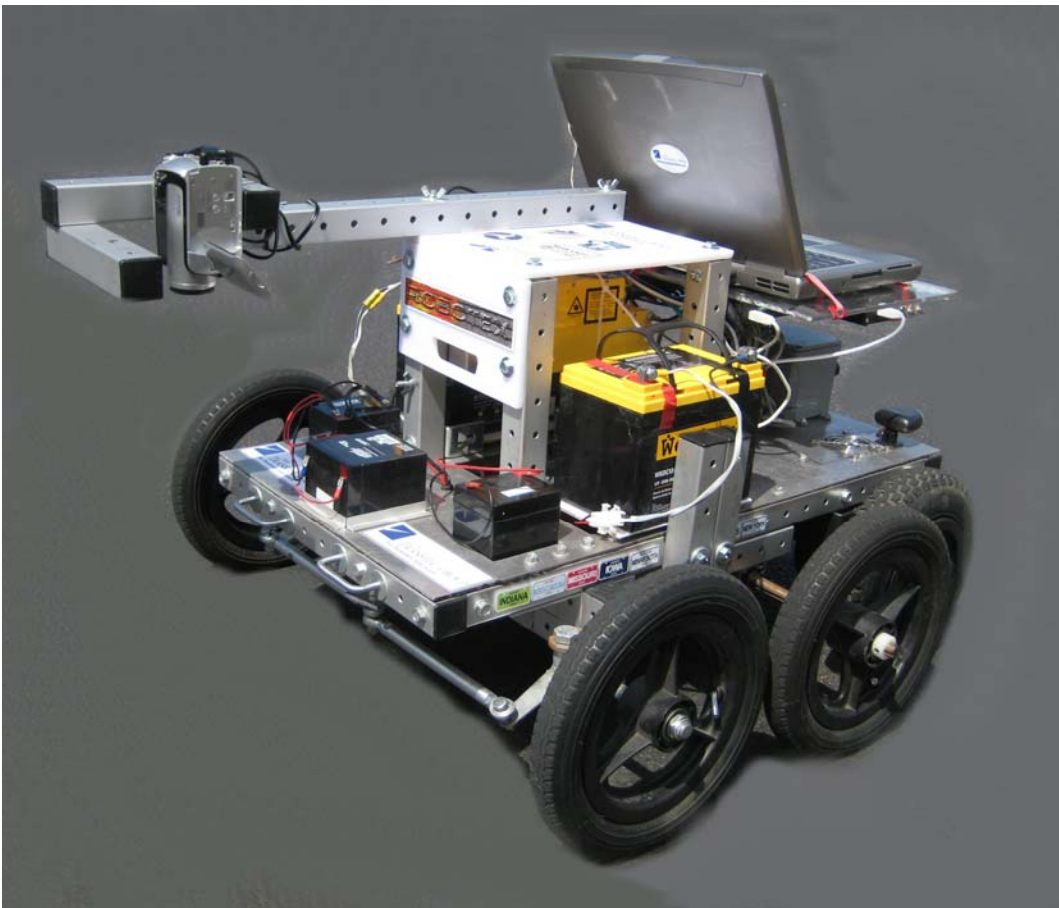


Texture and Pavement Surface Characteristics

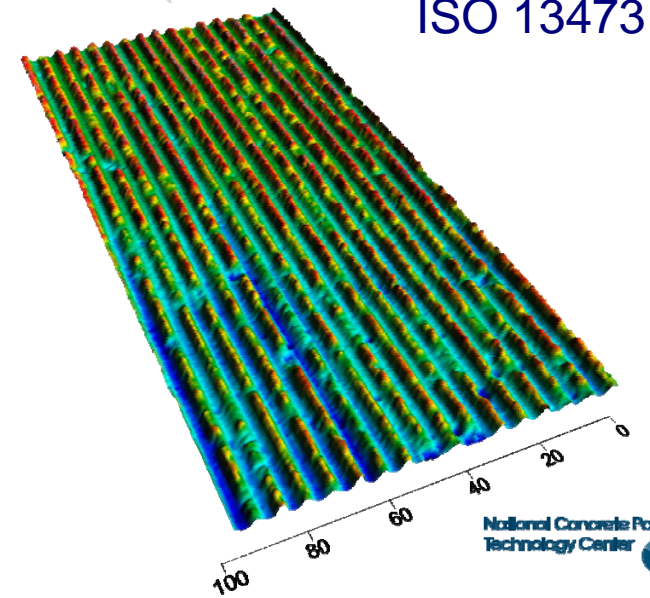


Texture Testing: RoboTex 2.0

- ❑ Built around LMI-Selcom RoLine Sensor
- ❑ Laser height sensor, inertial referencing
- ❑ GPS, DMI encoder, video log



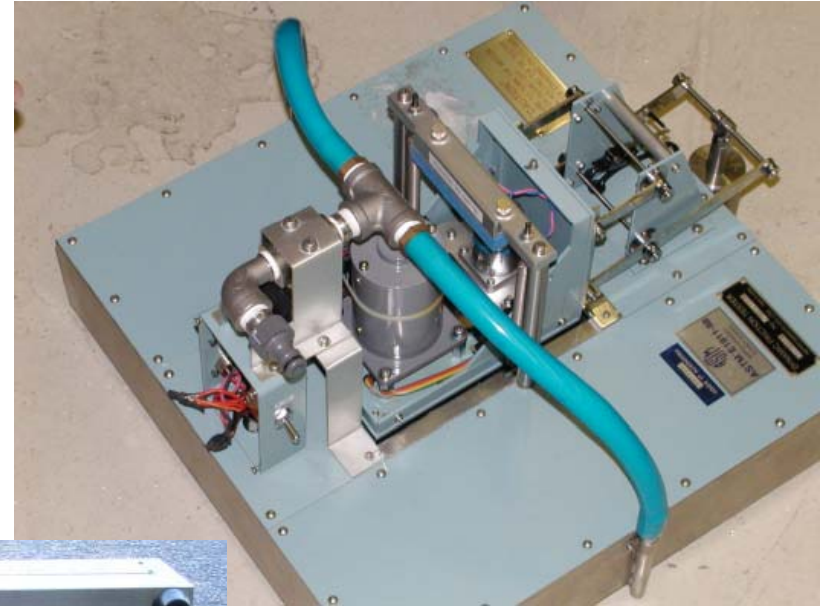
ISO 13473



Friction Testing: DFT and Skid Trailer



ASTM E 274



ASTM E 1911

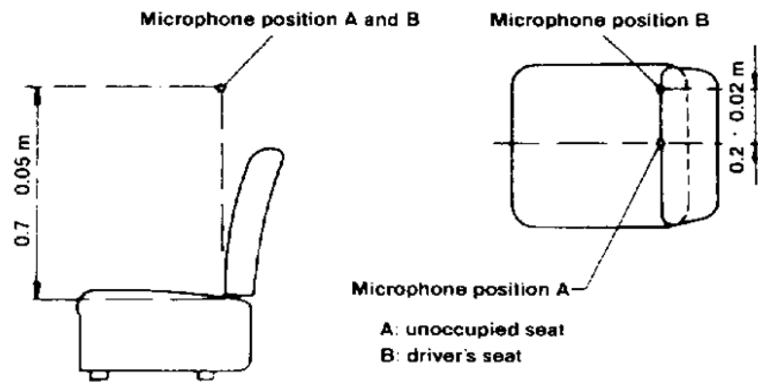
Noise Testing: Wayside

- Controlled pass-by (CPB) measures noise “roadside” using test vehicle under controlled conditions



Noise Testing: In Vehicle

SAE J1477 and ISO 5128



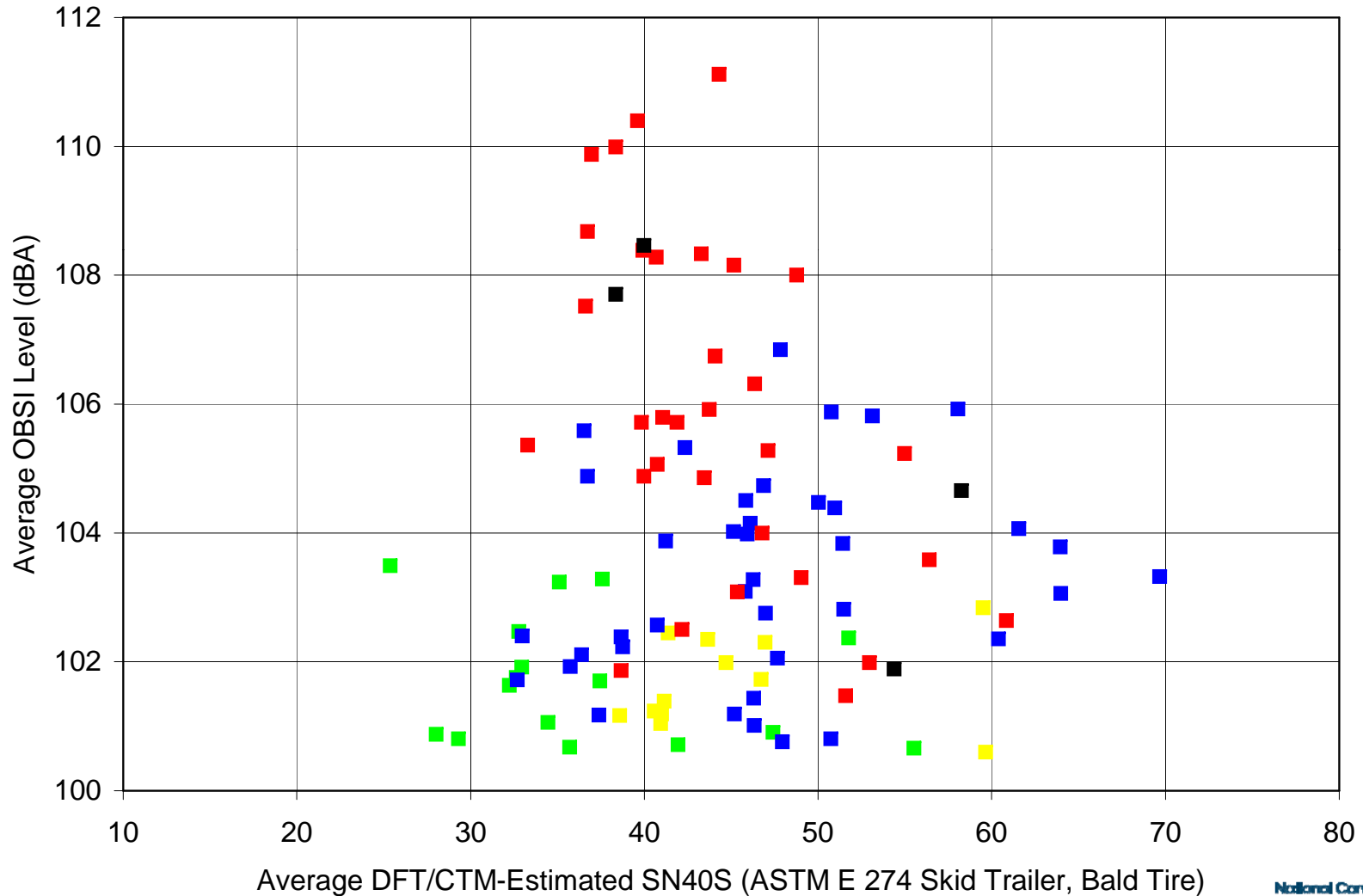
Noise Testing: OBSI



AASHTO TP 76

Friction vs. Noise

Do Friction and Noise Relate?



CP Tech Center Test Sections

- ❑ In 3½ years, Over 1000 Unique Textures Tested
 - ❑ Transverse Tining (incl. skewed and cross-tined)
 - ❑ Longitudinal Tining (incl. sinusoidal)
 - ❑ Diamond Ground
 - ❑ Grooved (longitudinal, transverse)
 - ❑ Drag (Burlap, Turf, Broom, Belt, Carpet)
 - ❑ Shot Peened
 - ❑ Exposed Aggregate
 - ❑ Porous (Pervious) Concrete
 - ❑ Milled
 - ❑ HMA and Surface Treatments

- ❑ 150 miles of test surface in 20 States and 6 Countries

What we've learned

There is a lot of:

VARIABILITY

Variability from project to project, and
variability within a given project.

Texture: Diamond Grinding



Diamond Grinding

98 dBA
Kansas

98 dBA
Colorado



101 dBA
Minnesota

104 dBA
New York



Texture: Drag



Drag

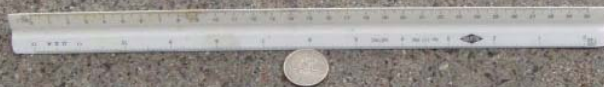
99 dBA
Iowa

99 dBA
Kansas



103 dBA
Minnesota

103 dBA
New York



Texture: Longitudinal Tining



Long. Tining

99 dBA
Colorado

99 dBA
Iowa



105 dBA
New York

104 dBA
Iowa



Texture: Transverse Tining



Trans. Tining

99 dBA
Iowa

100 dBA
Georgia

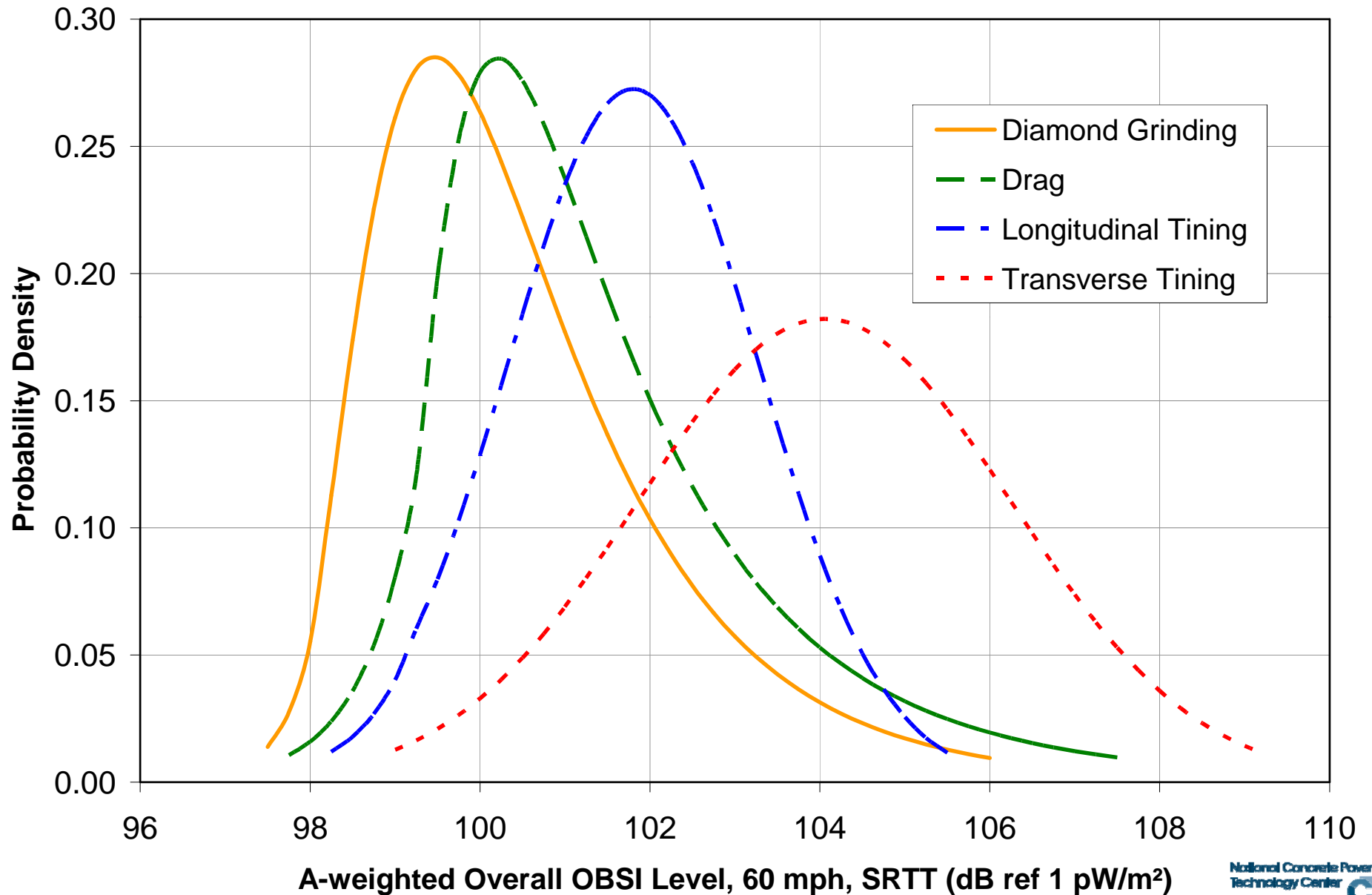


108 dBA
Georgia

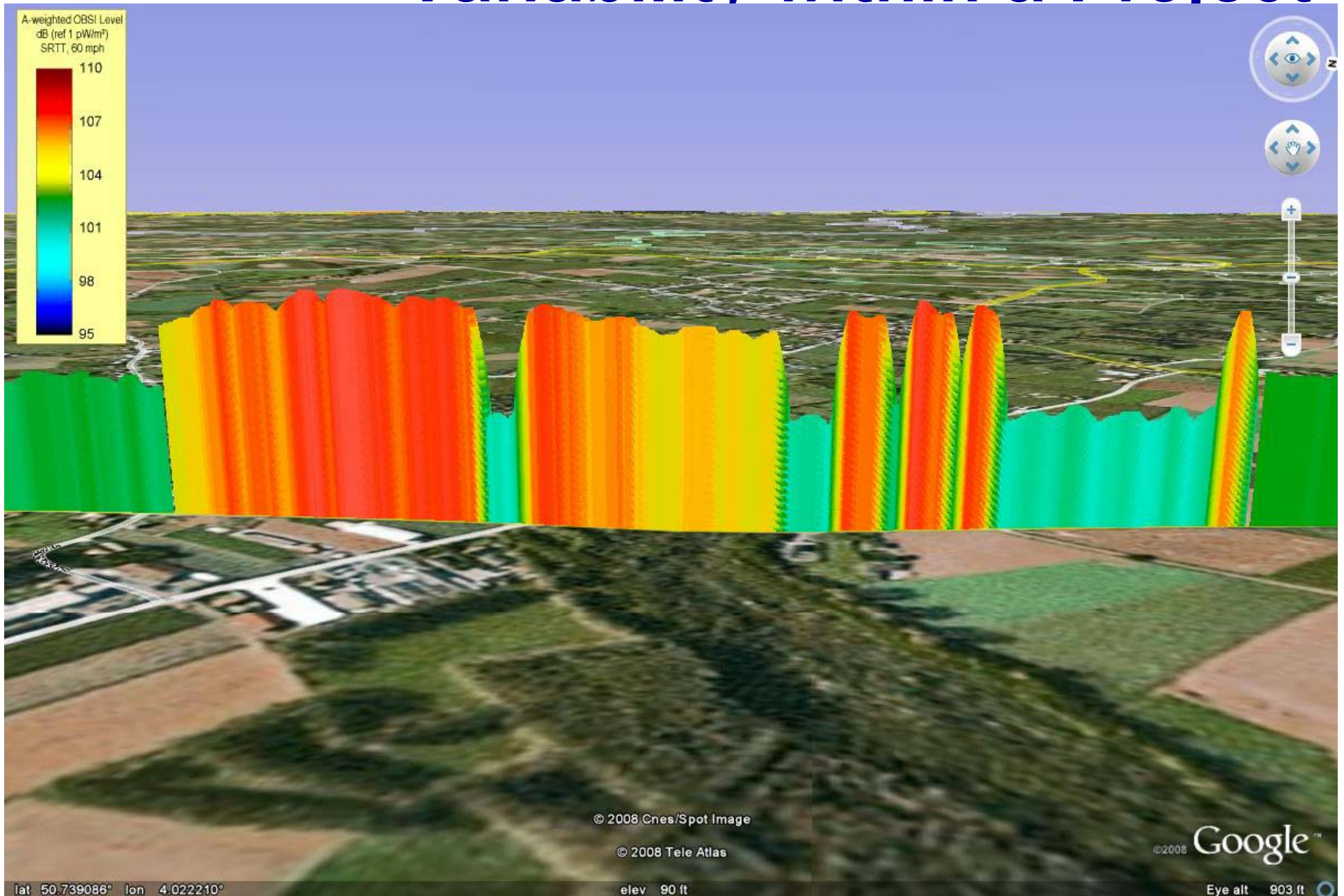
108 dBA
North Dakota



CP Tech Center OBSI Noise Catalog

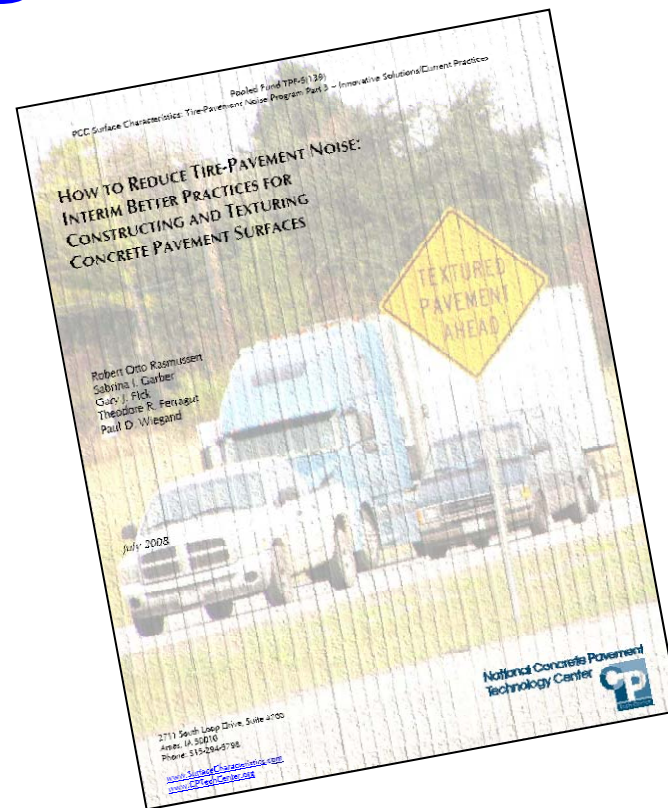


Variability within a Project



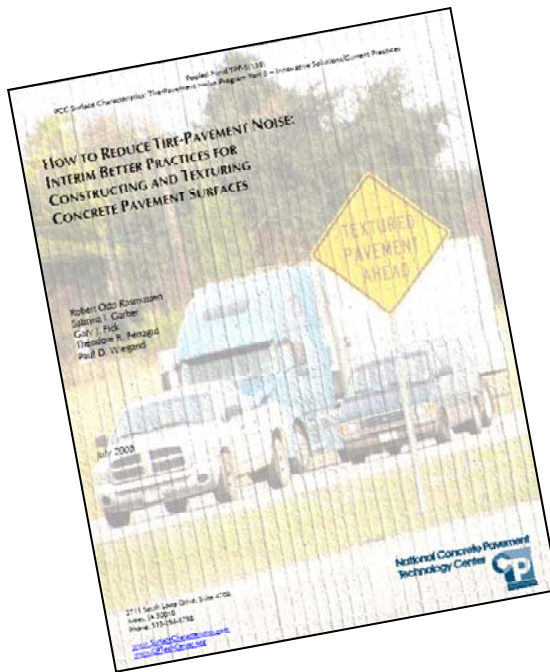
**What has been
done with this
knowledge?**

Better Design and Construction Practices for Texturing Concrete Pavement



Texturing Guidelines

- ❑ A “how to” guide for designing and constructing quieter concrete pavements
- ❑ Addresses all conventional concrete pavement textures
- ❑ Simple and practical guidance



Download from www.CPTechCenter.org

Properties of a Quieter Pavement

Surface Texture

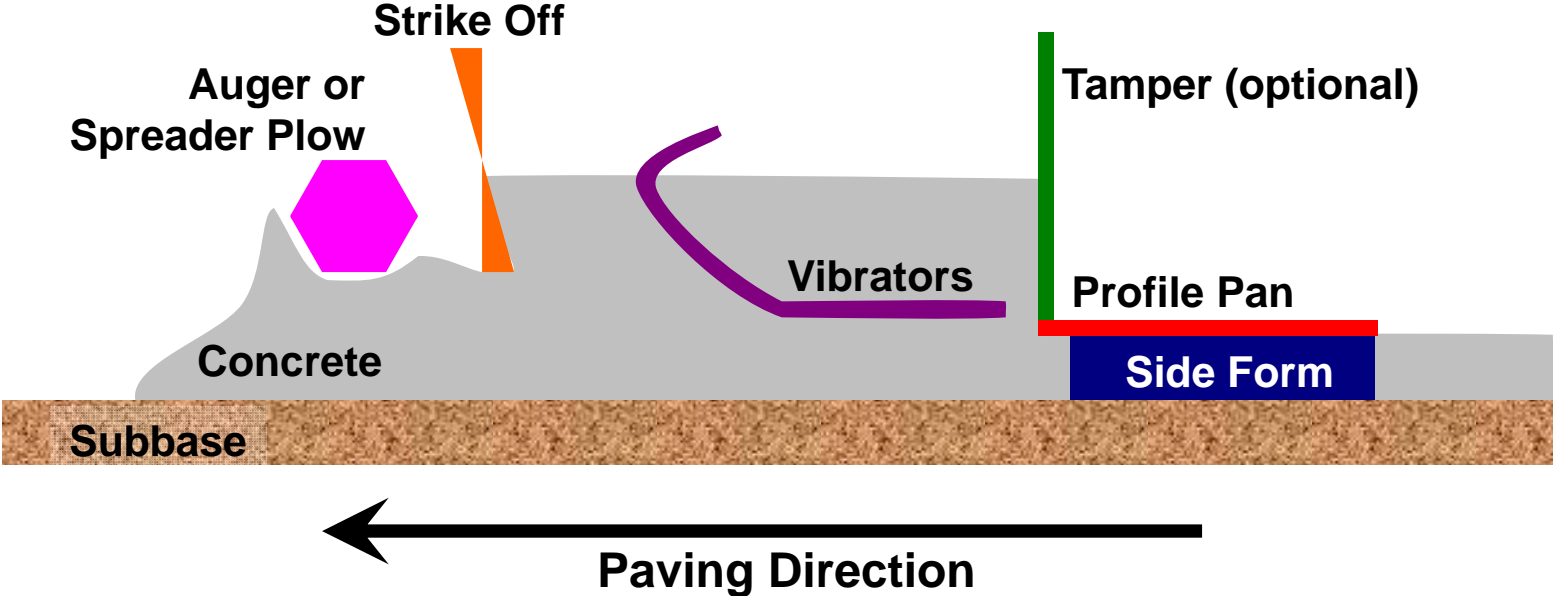
- ❑ Avoid (flatten) texture at intervals > 1 inch
- ❑ Avoid smooth (floated or polished) surfaces
 - ❑ Some fine texture (< 0.25 inch) required
- ❑ Texture should be negative
 - ❑ Point down (grooves), not up (fins)
- ❑ Texture should be oriented longitudinally
- ❑ If transverse, texture should be closely spaced and randomized

Properties of a Quieter Pavement

Concrete

- ❑ Strong and durable mortar
 - ❑ Mix optimized for placement, finishing, curing
- ❑ Siliceous sands for durability and friction
- ❑ For diamond grinding: hard, durable, and polish resistant coarse aggregate is ideal
- ❑ For tined and drag textures: adequate and consistent depth of mortar near the surface

Better Practices For Texturing



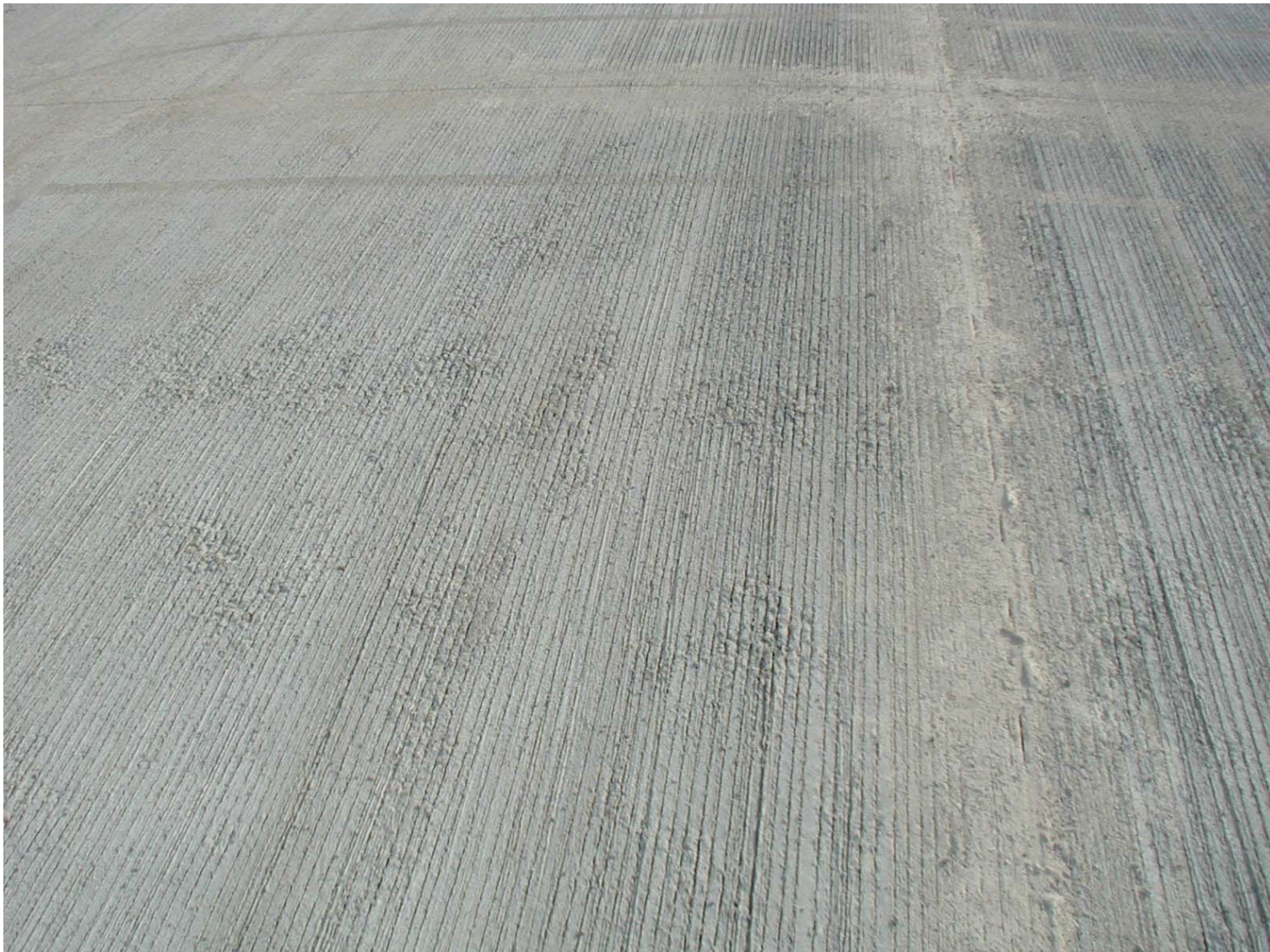
Better Practices For Texturing

Paving Equipment



Better Practices For Texturing

Concrete Materials Selection and Proportioning



Louder – 106 dBA



Quieter – 100 dBA



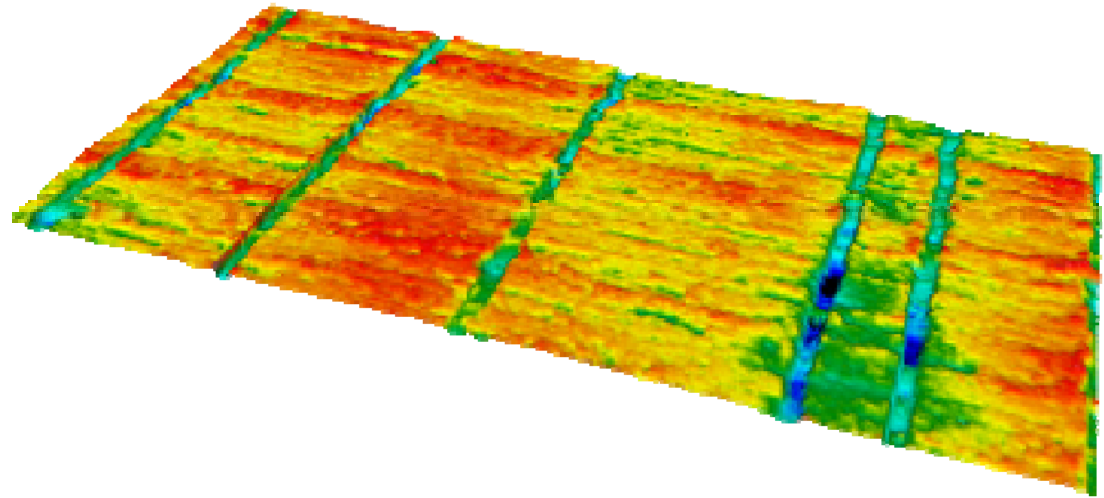
Louder – 111 dBA



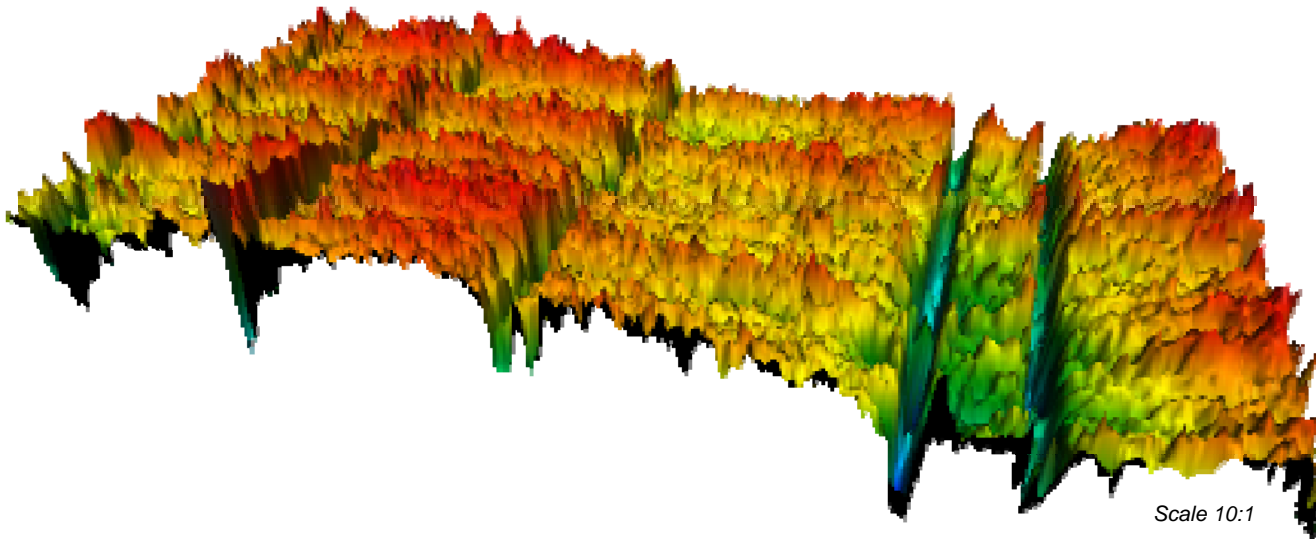
Quieter – 103 dBA



Tined Concrete



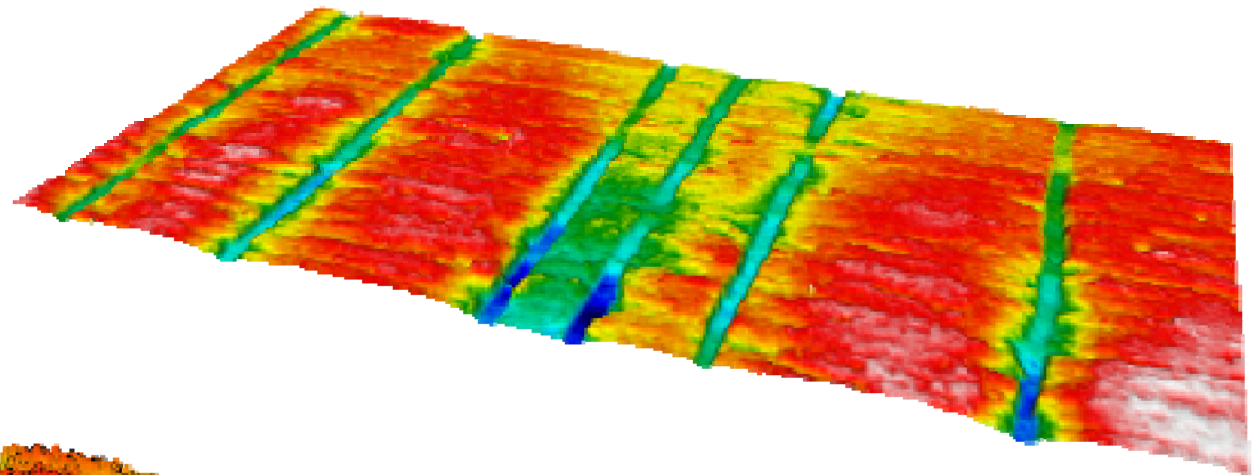
Scale 1:1



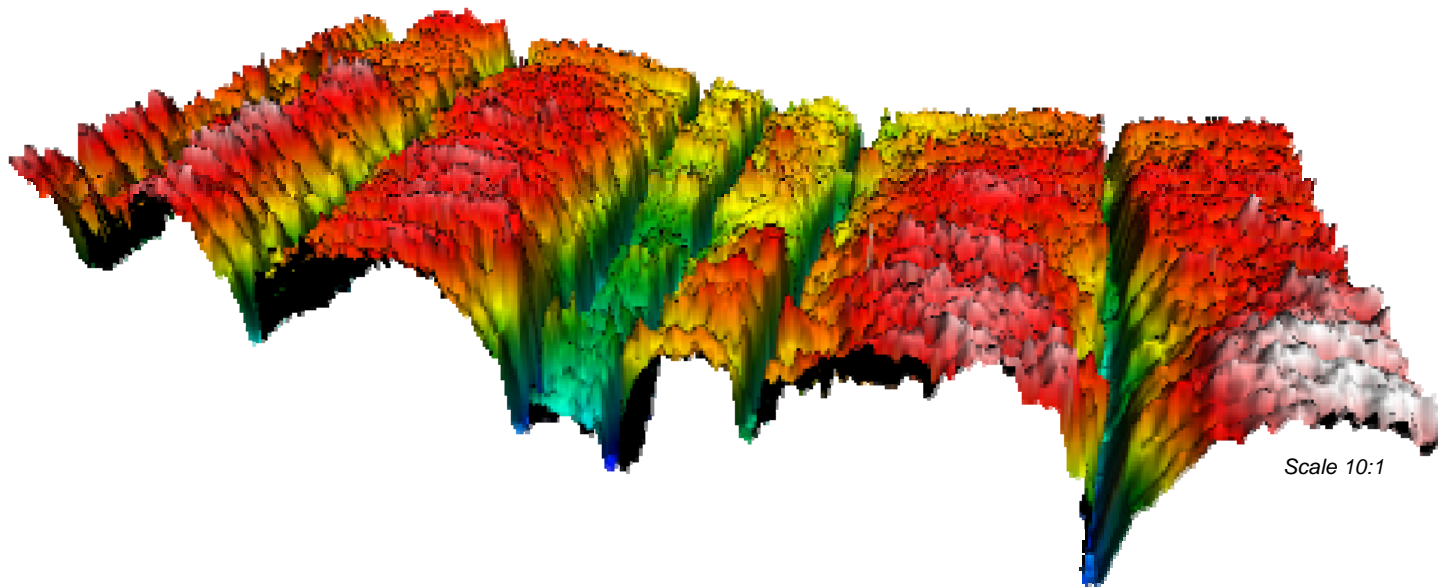
Scale 10:1

Quieter – 103 dBA

Tined Concrete



Scale 1:1



Scale 10:1

Louder – 111 dBA

Better Practices For Texturing

Texture-Cure Equipment



Louder – 103 dBA

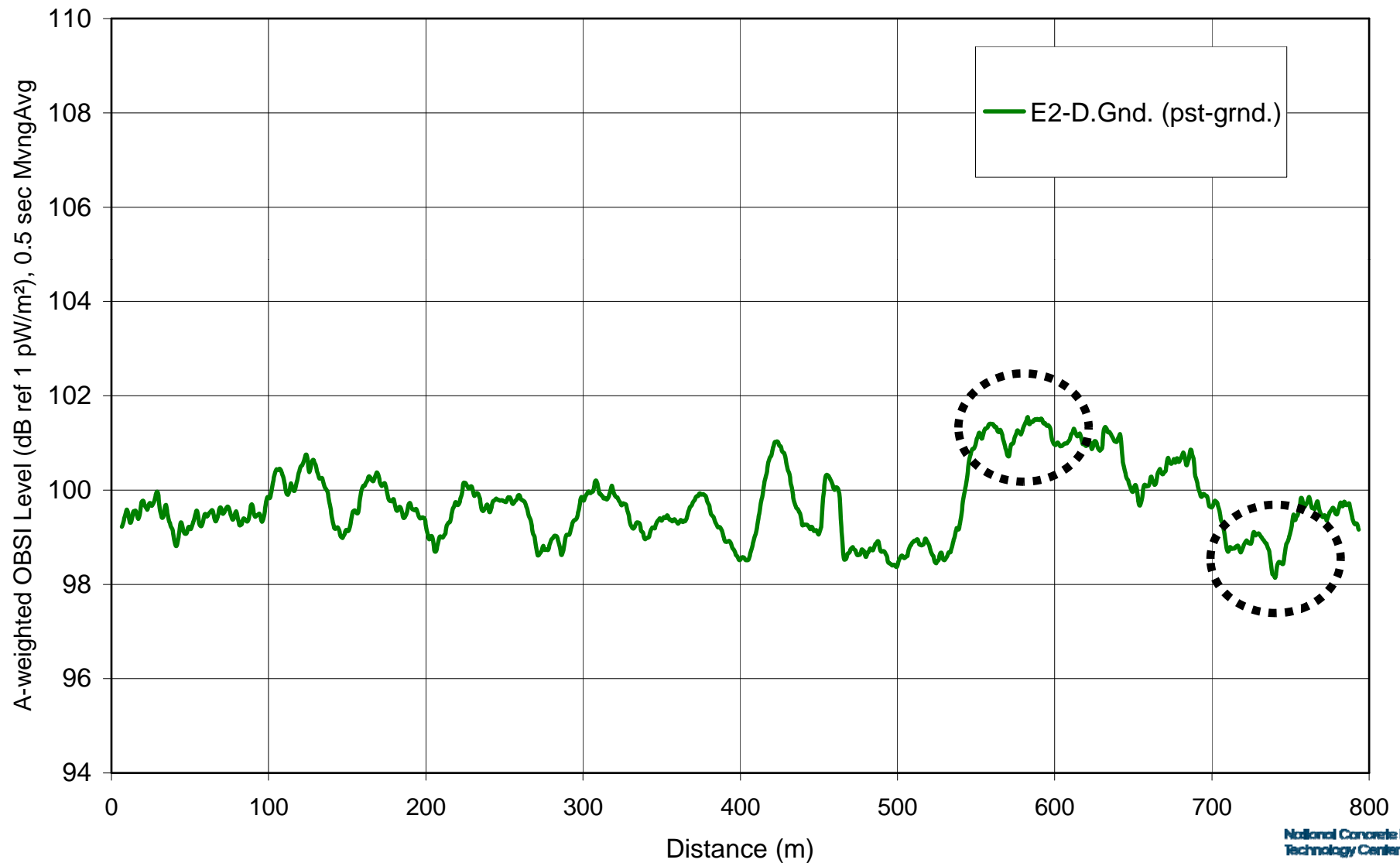


Quieter – 99 dBA



Diamond Ground Concrete

Spatial Variability of OBSI Levels

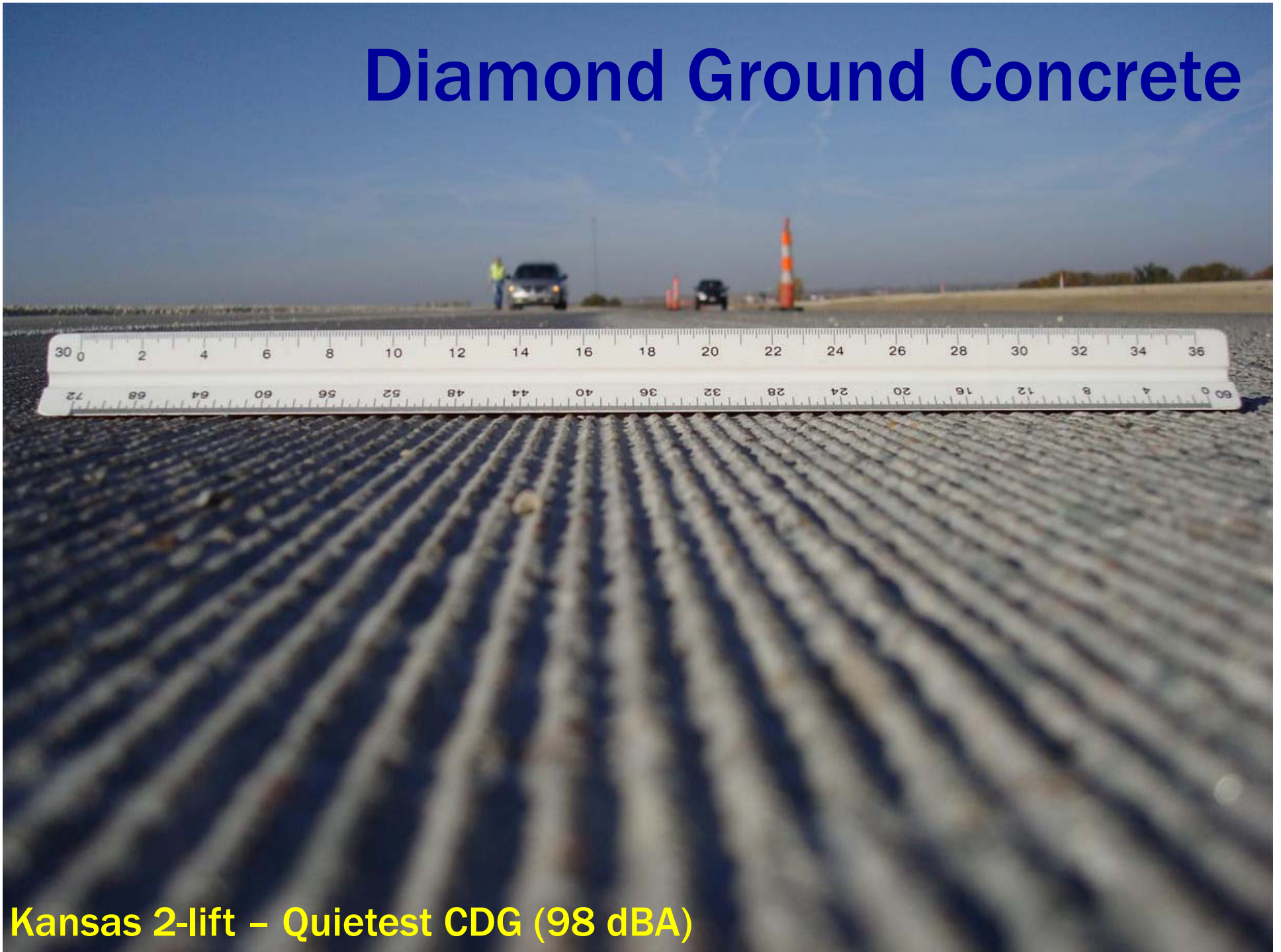


Diamond Ground Concrete

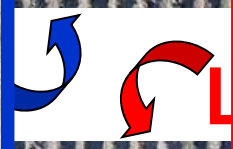


Kansas 2-lift – Loudest CDG (102 dBA)

Diamond Ground Concrete



Kansas 2-lift – Quietest CDG (98 dBA)



So what now?

Monitor Construction Operations

- ❑ Upcoming Type 1 Project
- ❑ Spring 2010
- ❑ Focusing on subtle construction variants of longitudinal tining and/or diamond grinding
- ❑ “Light” and “heavy” drag
- ❑ “Light” and “heavy” tining
- ❑ Varying grinding controls/equipment mods

Monitor Construction Operations

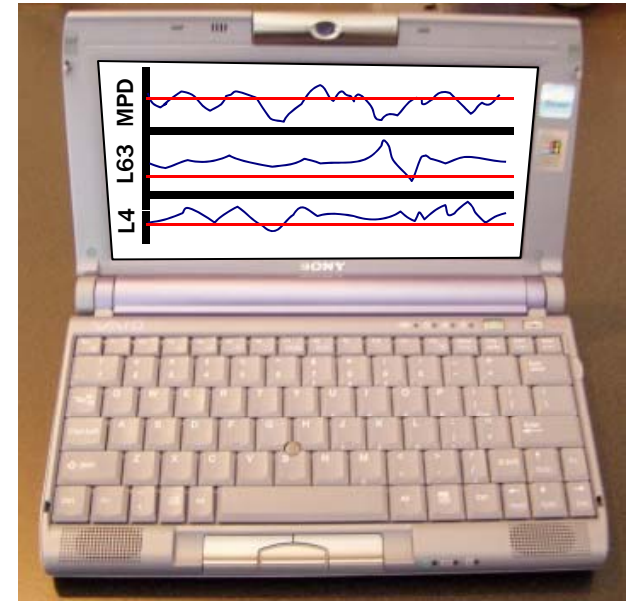
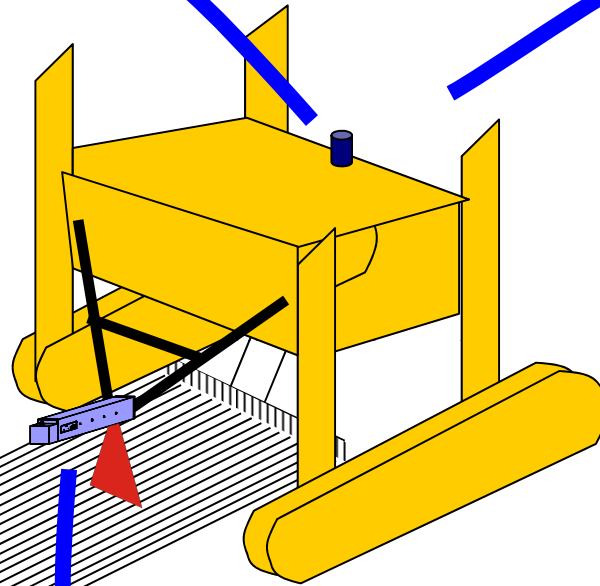


Monitor Construction Operations

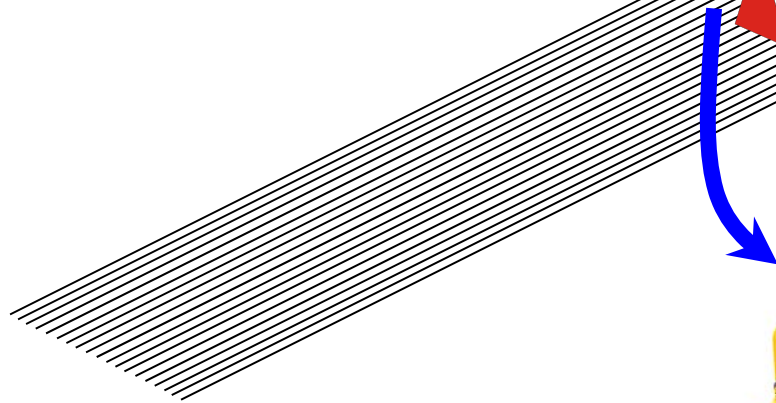
Accelerometers



Texture Machine and Paver

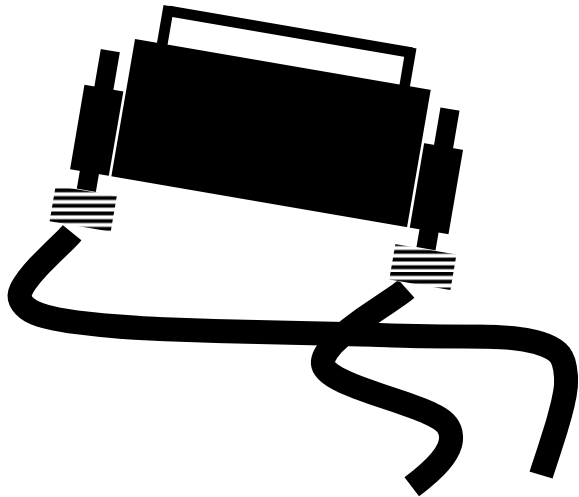


Texture and Vibration Feedback



LMI-Selcom
RoLine
Line Laser

NOTICE



**HEAVY DRINKING
MAY AFFECT
PAVEMENT
QUALITY CONTROL**