

# Innovative Textures

R26 Workshop  
September 3, 2014  
Minneapolis, MN

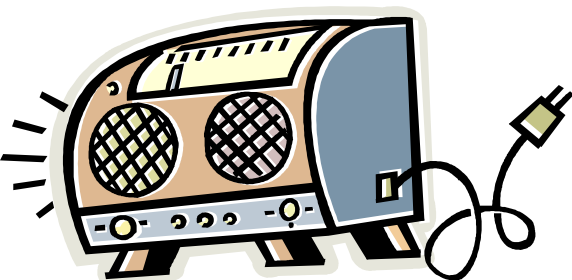
Terry Kraemer

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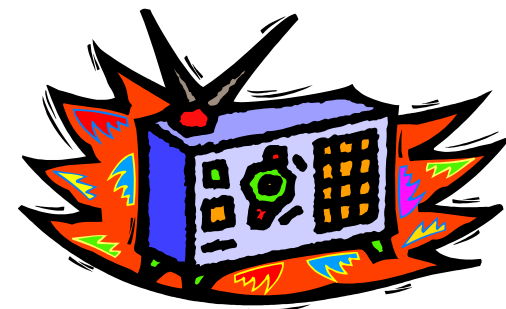
# Presentation Outline

- A Few Noise Basics
- What Did the Purdue Research Change
  - Existing Pavement Noise Reduction
  - New Pavement Noise Reduction
  - Joint Slap Prediction
- NGCS LITE—Renewable Texture
- Friction and Hydroplaning
- California and Virginia Quiet Pavement Programs

# Transverse Tining Most Widely Used Texture– FHWA Tech Advisory



**Volume  
(Too Loud)**



**Frequency  
(Off Station)**

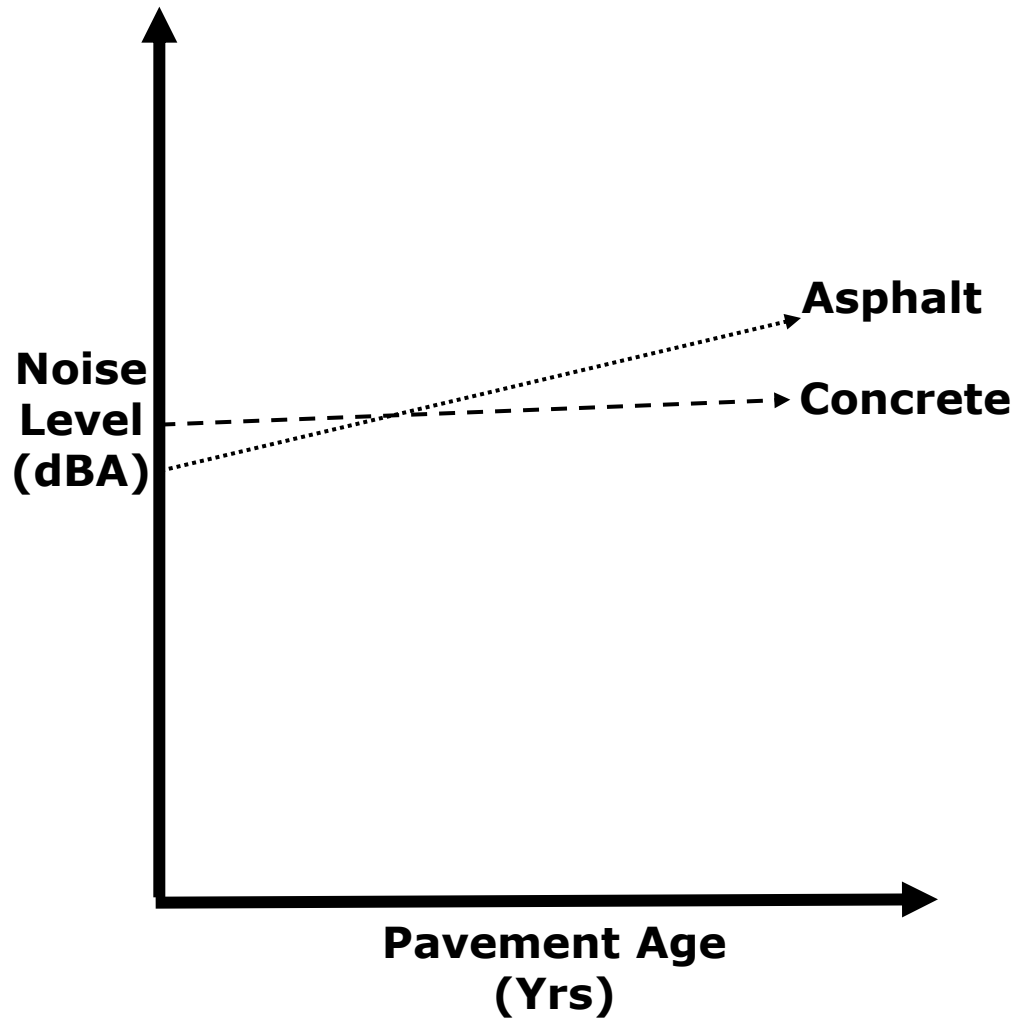
# William Tell Overture (@50mph in a Honda Civic)



# Growing Old Or "Acoustic Durability"



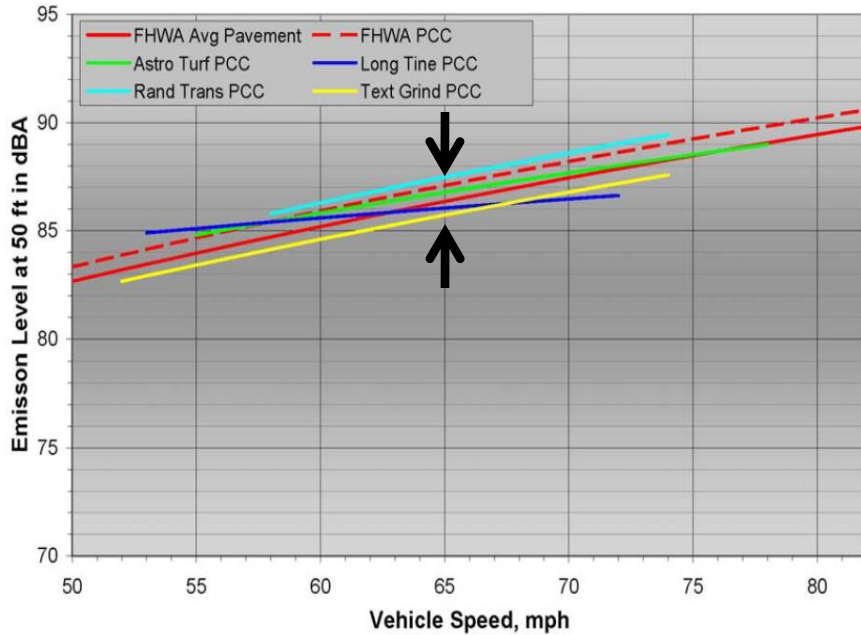
**Changing  
Performance Over  
Time**



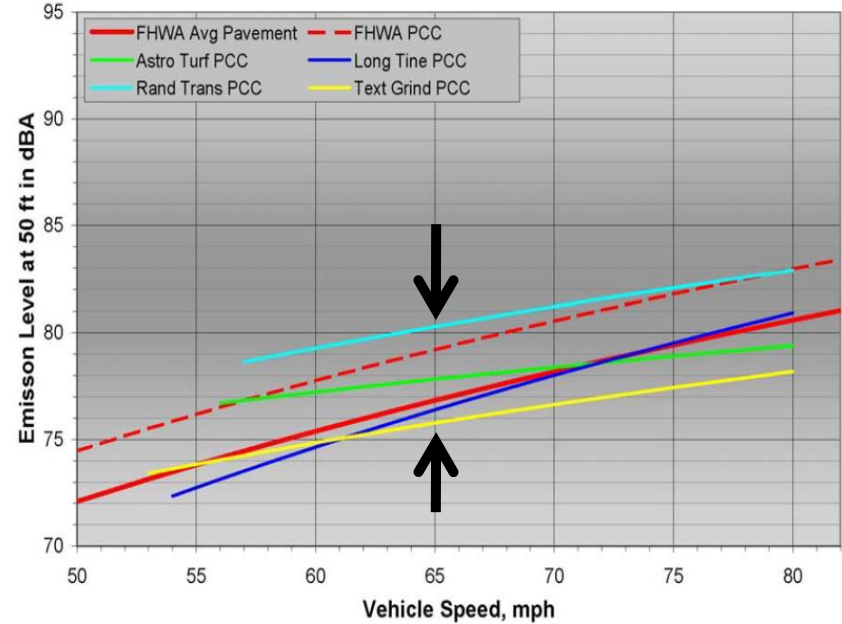
# TNM RESULTS (Noise Mitigation)



FHWA vs. Specific PCC Pavement for Heavy Trucks



FHWA vs. Specific PCC Pavement for Light Vehicles



# What Did the Purdue Noise Research Evaluate

- Diamond Grinding of Existing Roadways
- Evaluation of Joint Slap Effect
- Evaluation of Geometric Patterns for New Construction
- Evaluation of Friction and Rolling Resistance
- Annoyance

# Purdue Research-- Tire Pavement Test Apparatus (TPTA)





# Purdue Defines New Grinding Texture

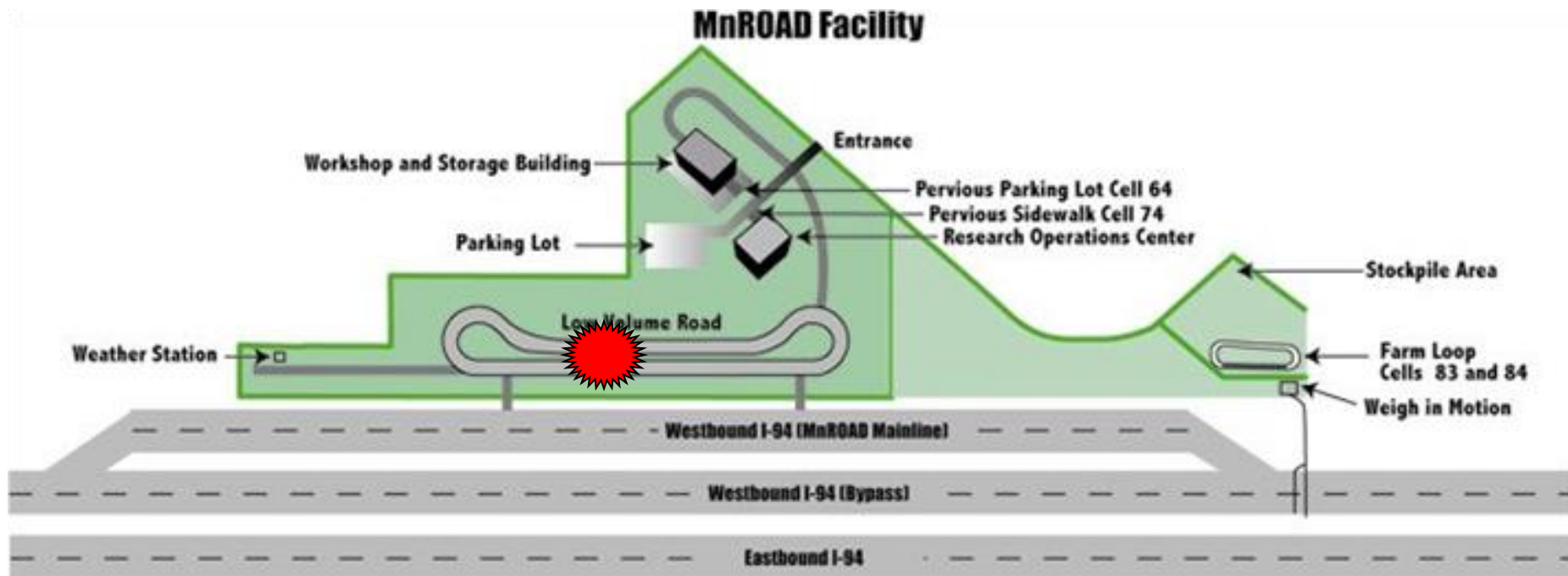
- Texture Consists of Flush Grinding Plus Longitudinal Grooves
- Evaluates Both Single Pass and Two Pass Construction Techniques
- Evaluates Groove Width and Depth Effects
- Grinding Performed on 6 ft Long Samples Using a Portable Grinding Device
- Proof of Concept Necessary on Real Pavement Using Real Grinding Equipment

# Industry Consideration

Terry  
Kraemer



# Proof of Concept Testing Conducted at MnROAD Low Volume Road Facility



# Special Grinder Used for Proof of Concept



# Proof of Concept Test Strips



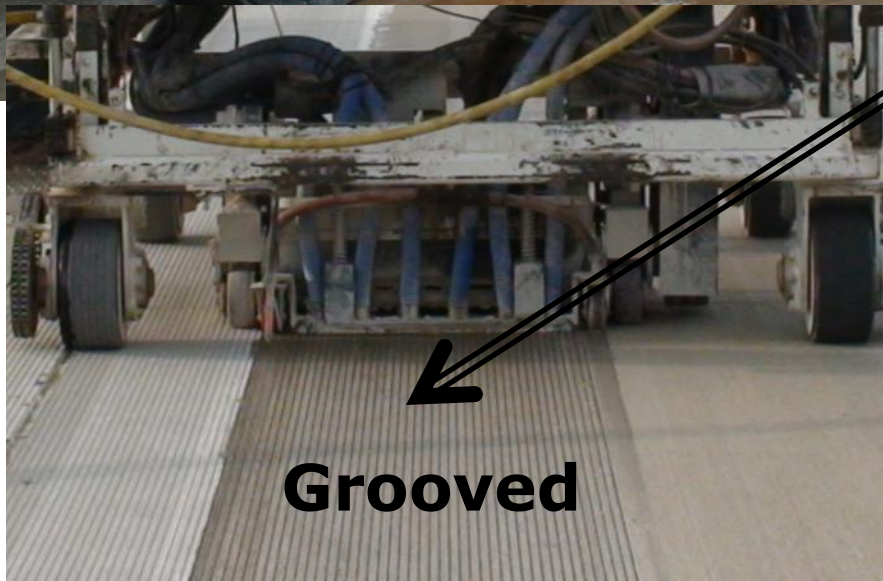
# Proof of Concept Work Validated Purdue Research

- Proof of Concept Conducted at MnROAD Low Volume Road Facility in 2007
- First New Construction and First Highway Installation on Chicago Tollway I-355 in 2007
- First Existing Highway and First Two Lane Installation I-94 In Minneapolis in 2007

# NGCS Construction

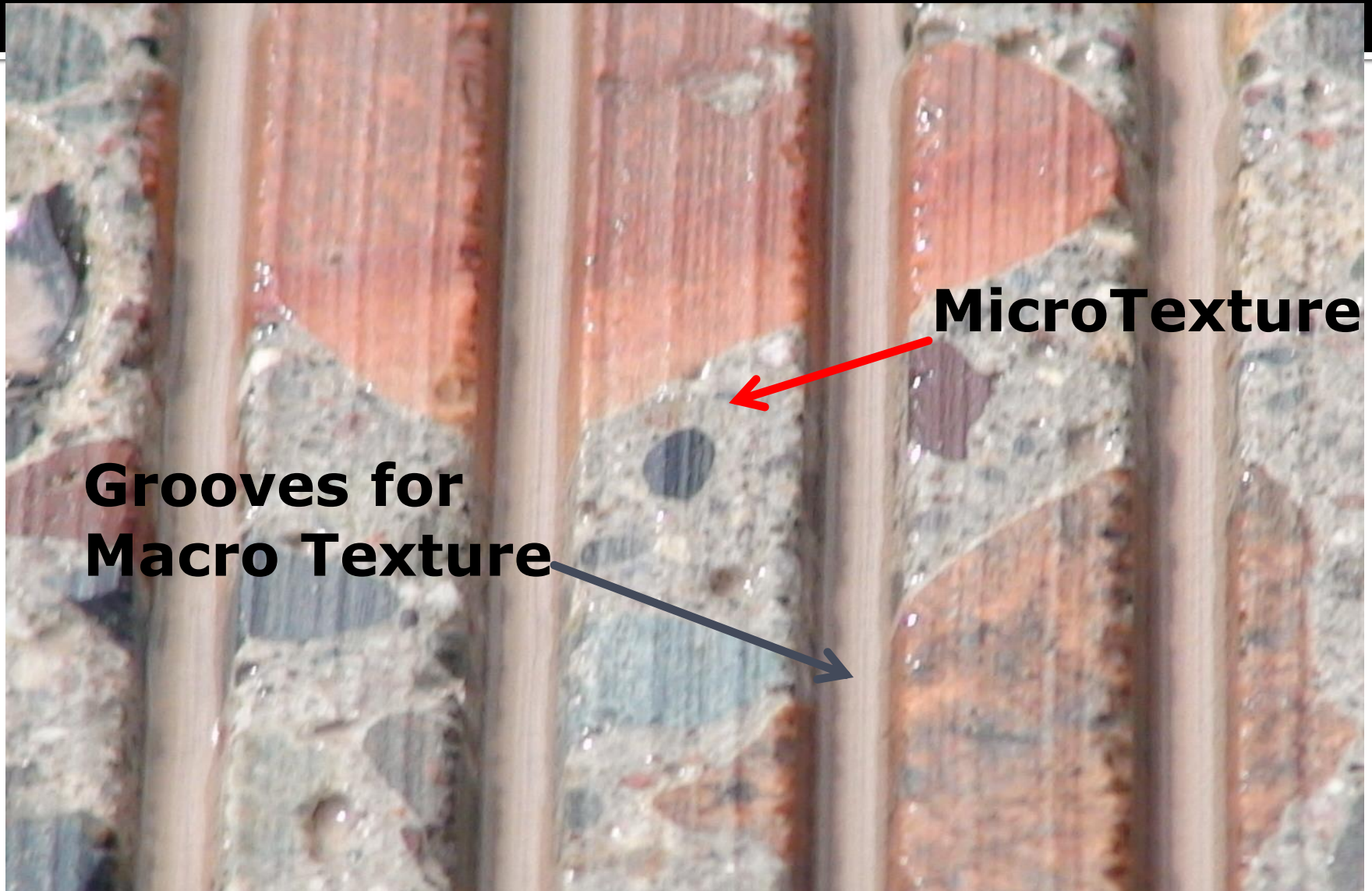


**Positive Texture  
Removal**



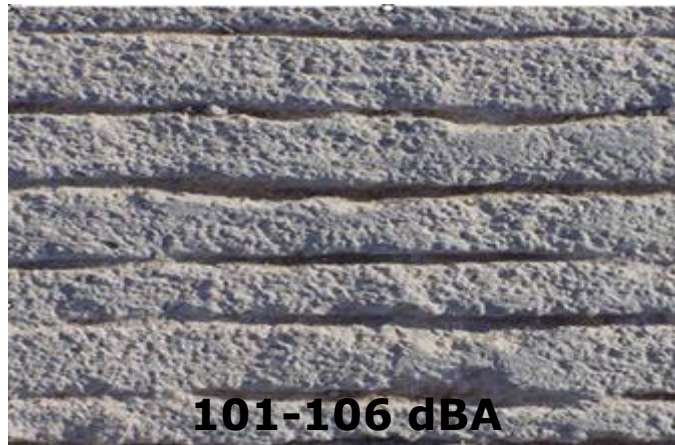
**Grooved**

# NGCS Surface



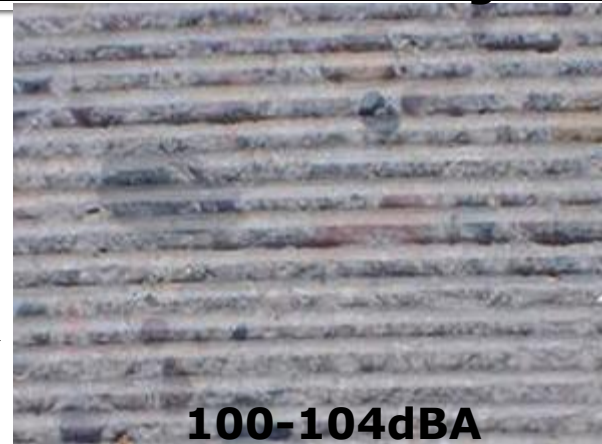


# Concrete Texture Types and Typical Levels

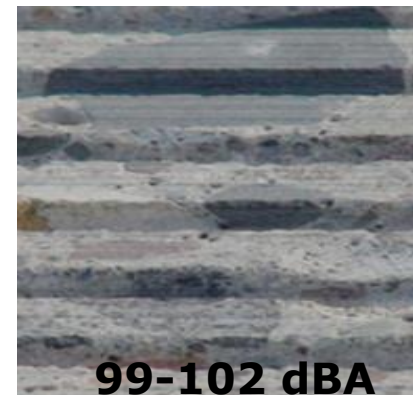


**Longitudinal Tine**

Twice  
as  
Loud



Traffic



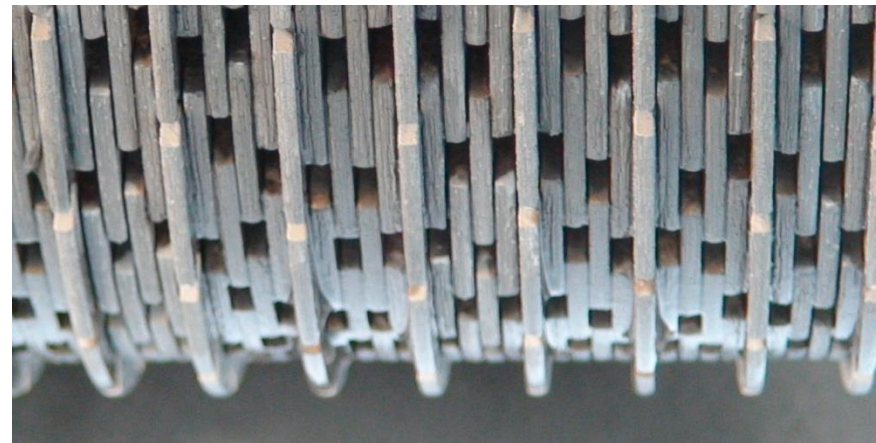
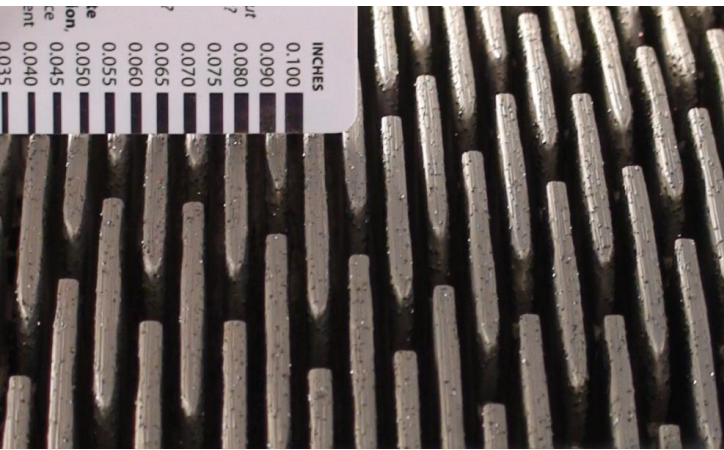
**Next Generation  
Concrete Surface**

# NGCS is a Diamond Grinding Procedure

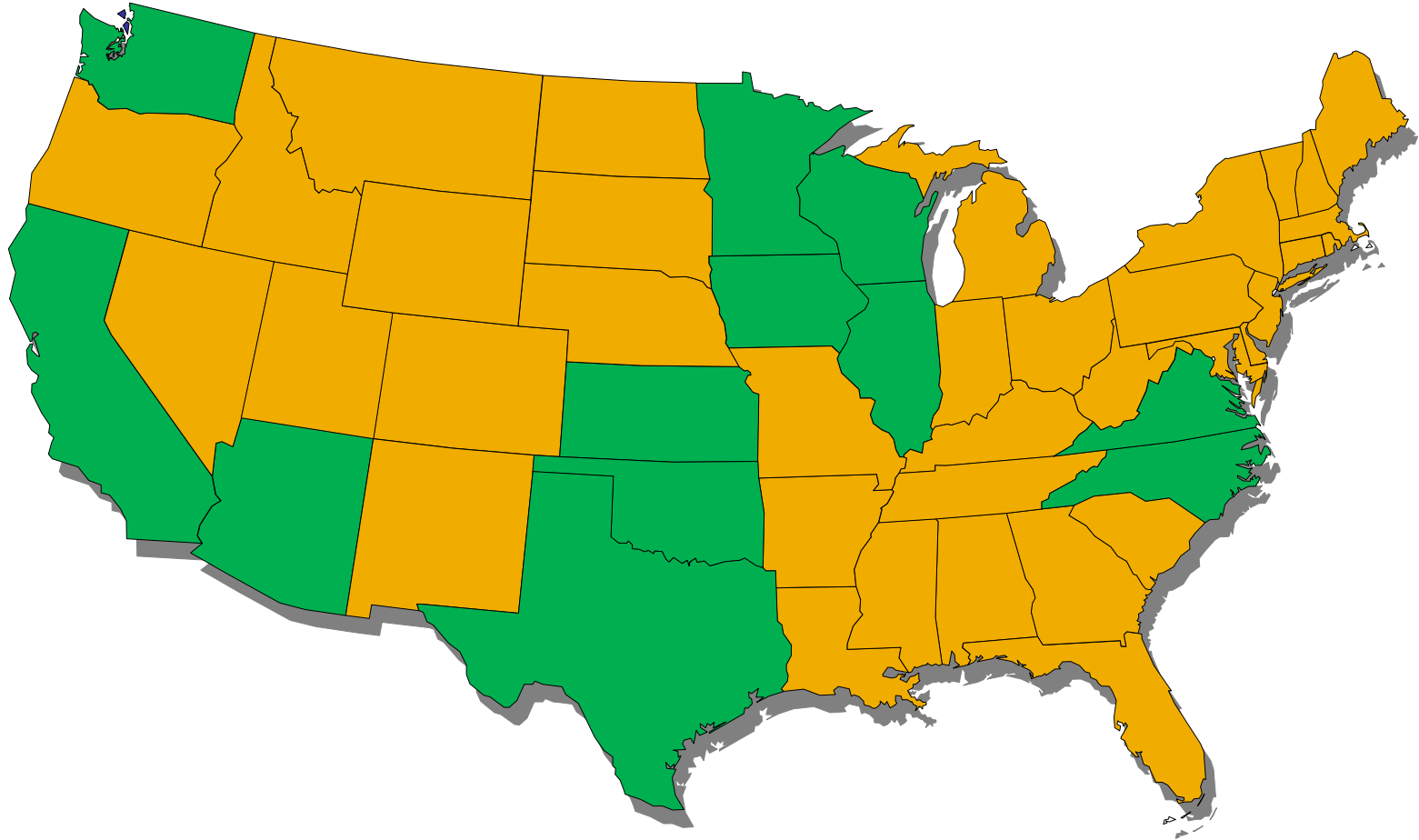


CDG

NGCS



# States with NGCS Surfaces



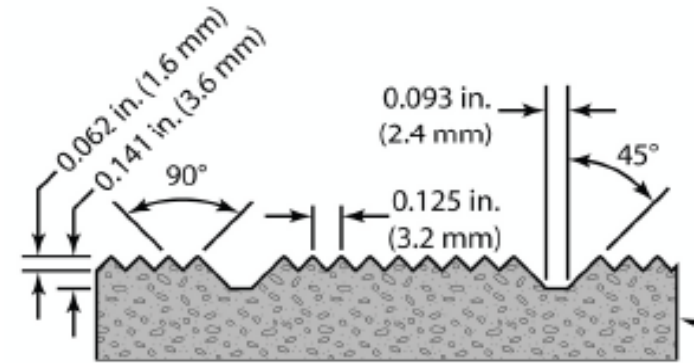
# Current Deployment of NGCS Surfaces

- California has more NGCS construction than all other states combined
- Texas has bid the largest NGCS project to date

# Development of a Renewable Texture

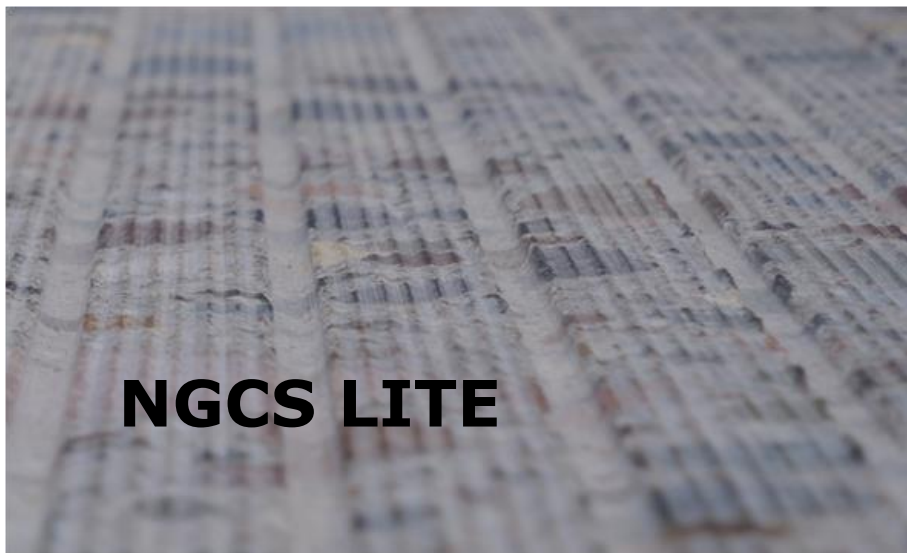
- First Attempted in 2008 on MnROAD Cell 9 on I-94--- Not Successful
- Successfully Demonstrated on MnROAD Low Volume Road Cell 37 in 2010
- First Highway Installation on I-35 in Duluth, MN
- Second Highway Installation on I-80 In California
- First City Street Installation at Neenah, Wisconsin

# Renewable Texture Concept

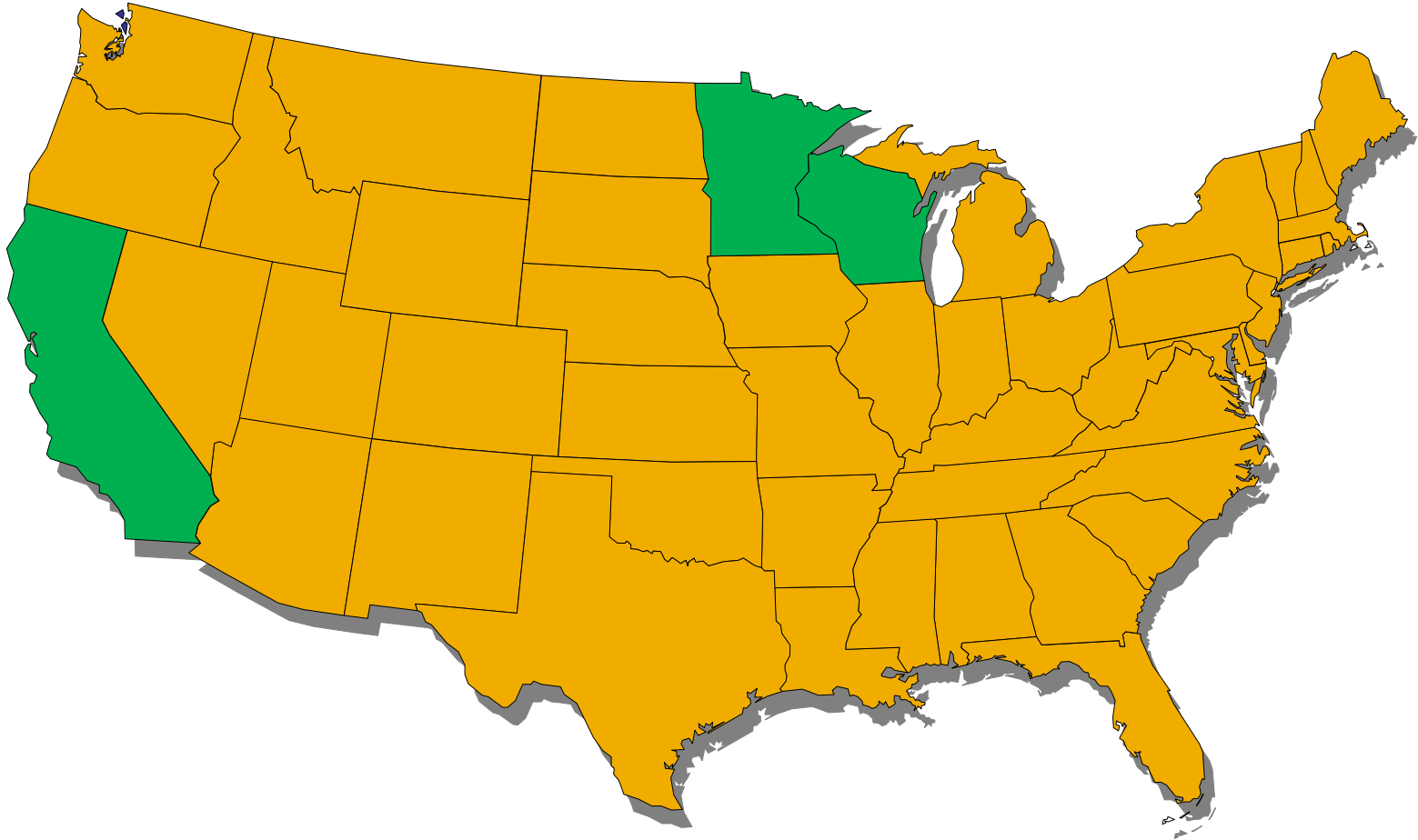


**Style 15 Christensen Diamond Grooving Pattern**

**1960's  
California  
Texture**



# States with NGCS LITE/OTCS

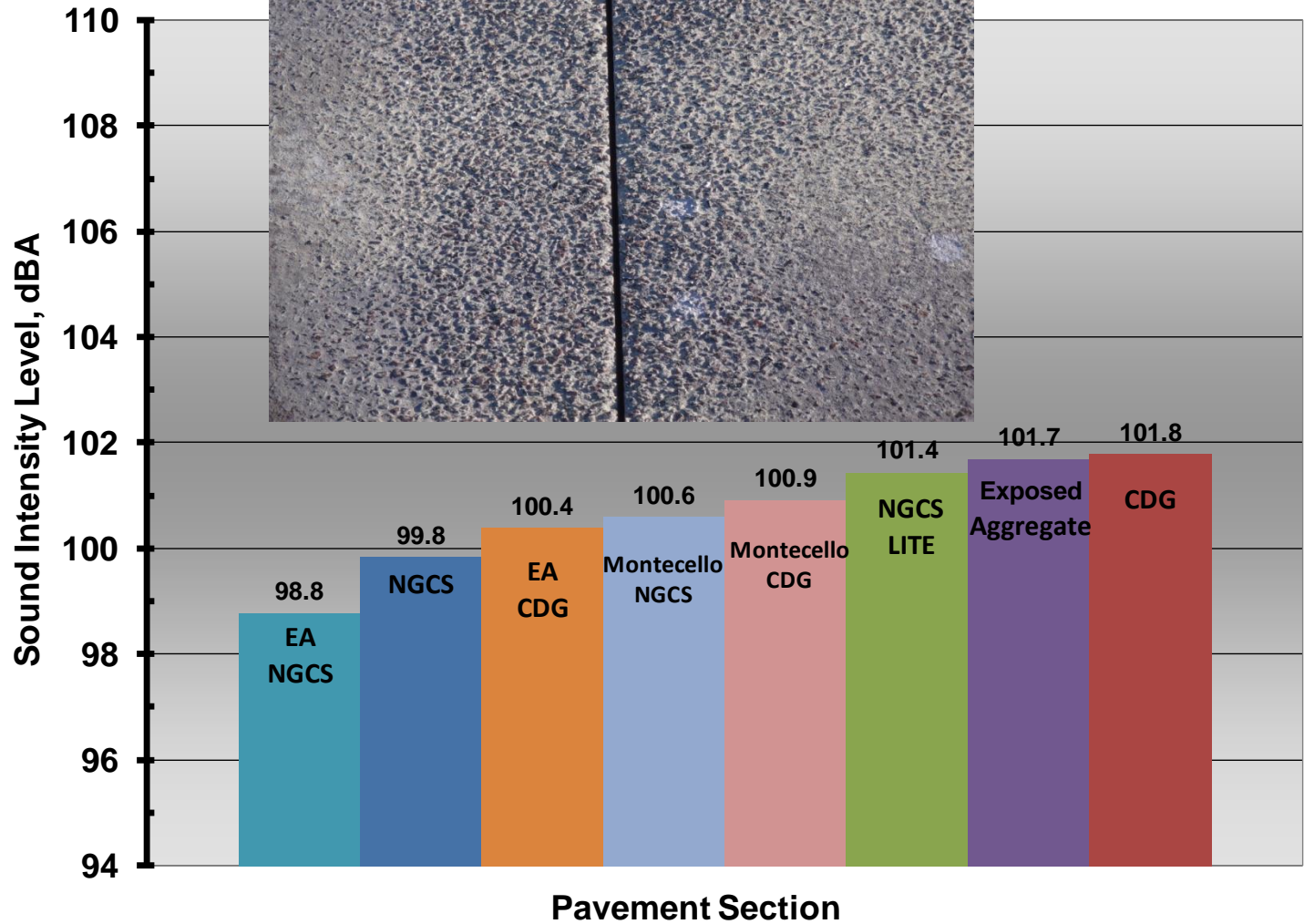


# Noise Results (OBSI)

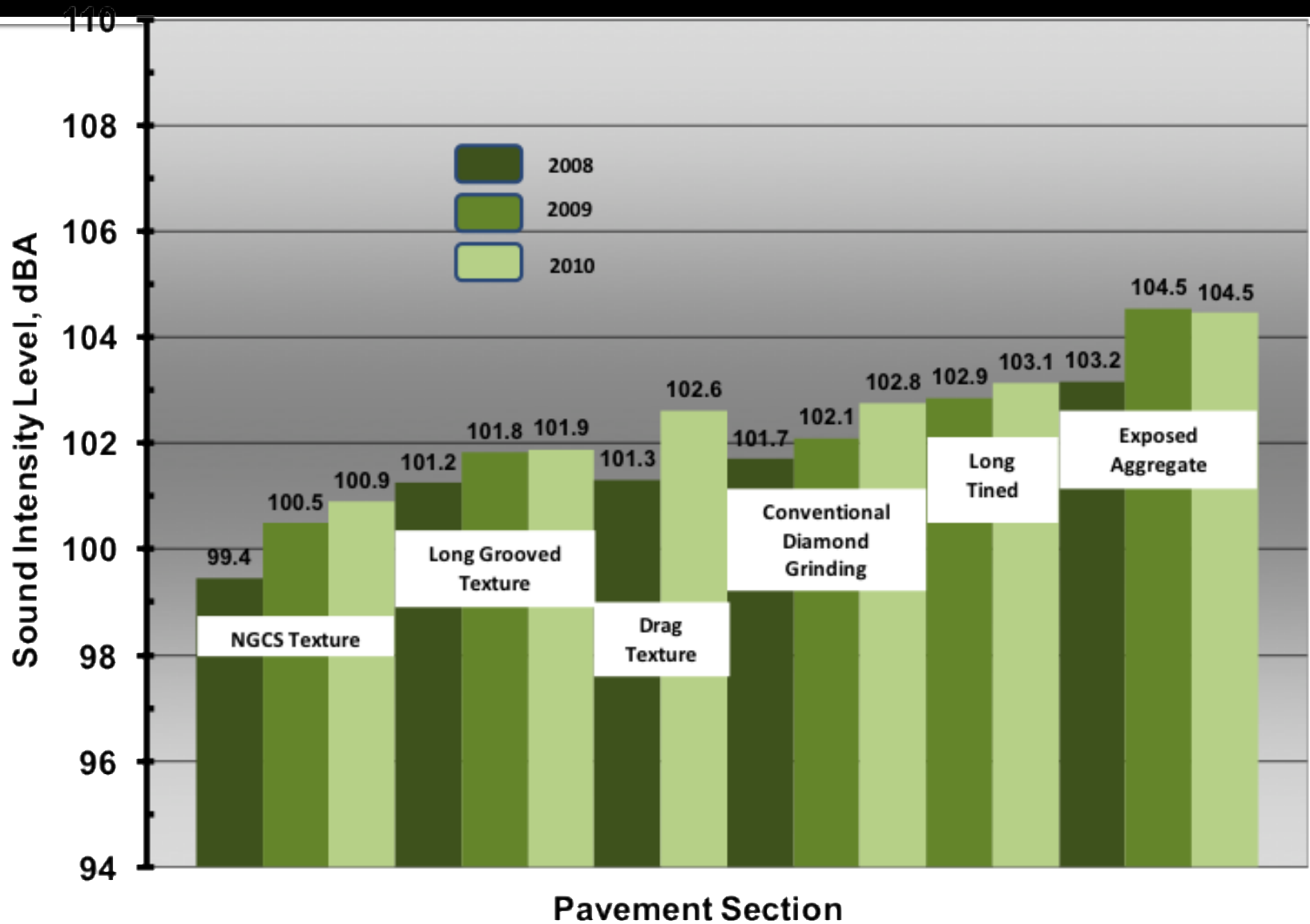




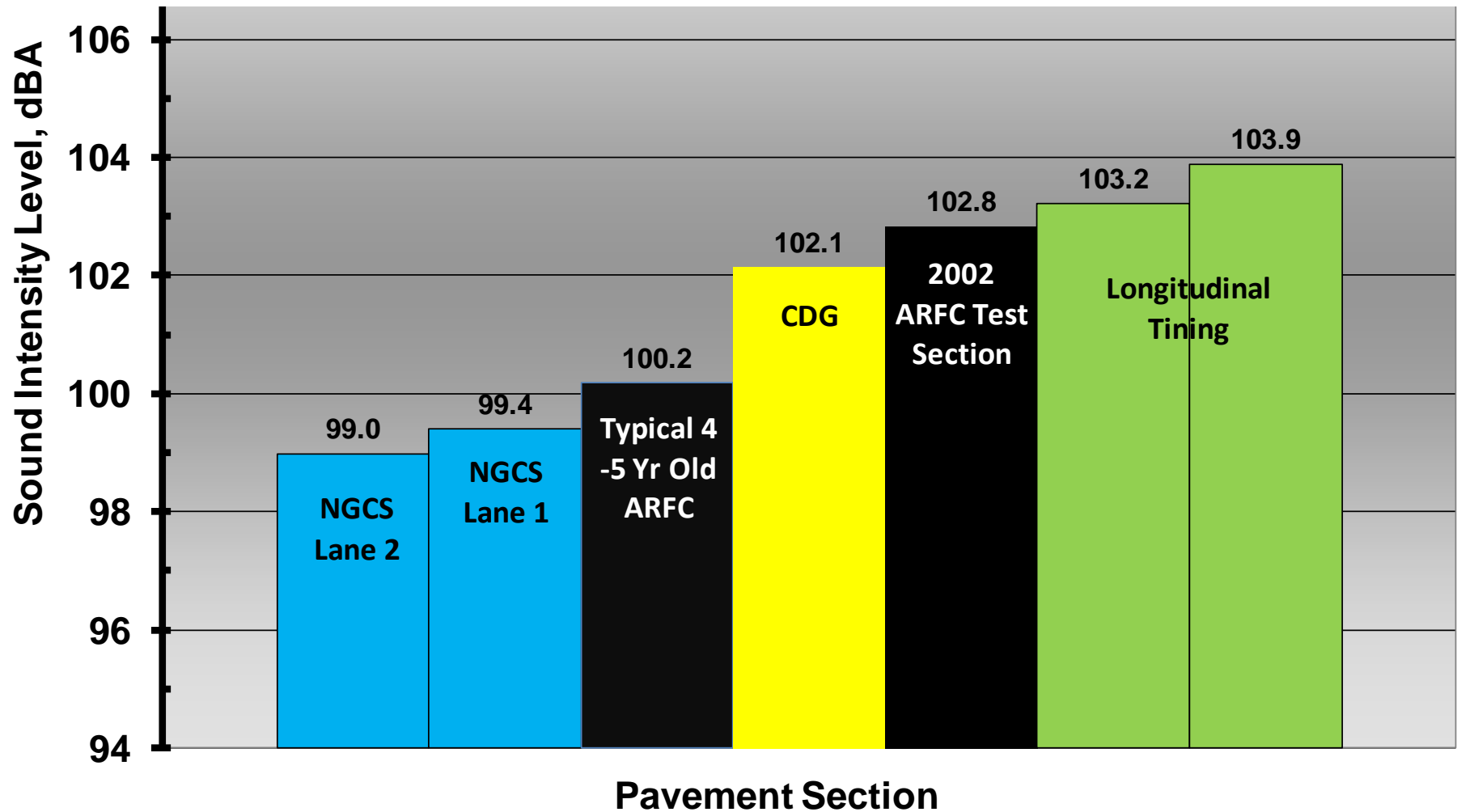
# MnROADs Test Sections



# Kansas I-70 Results



# Arizona NGCS Test Section



# What Did the Purdue Noise Research Change

- Diamond Grinding of Existing Roadways
- Evaluation of Joint Slap Effect
- Evaluation of Geometric Patterns for New Construction
- Evaluation of Friction and Rolling Resistance
- Annoyance

# Joint Slap Effects

- Joint Opening Width
- Sealant Level
- Faulting



# Joint Noise Estimator

The screenshot shows a software application interface with a central menu of construction-related tools. The menu is organized into vertical categories on the left and right sides. The central area contains ten application tiles, each with a representative image and a title. A red arrow points to the 'Joint Noise Estimator' tile in the second row, first column.

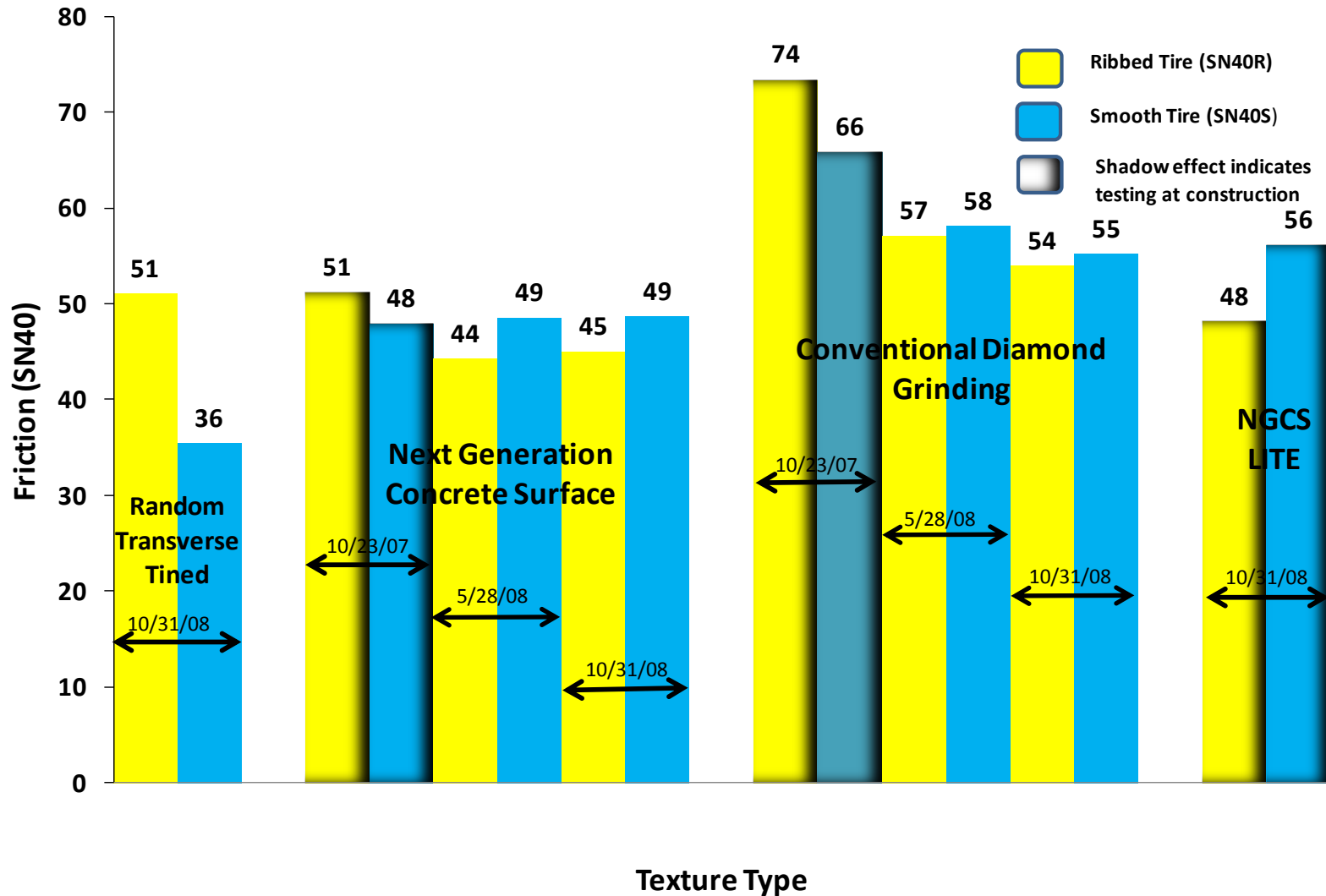
Category	Application Name	Status
CONSTRUCTION/ANALYSIS APPS	Concrete Temp Calculator	COMING SOON
	Total ESAL Calculator	COMING SOON
	Evaporation Rate Calculator	COMING SOON
	Gradation Analyzer	COMING SOON
	Joint Movement Estimator	COMING SOON
	Joint Noise Estimator	COMING SOON
	Maximum Joint Spacing Calculator	COMING SOON
	Strength Converter	COMING SOON
	Strength Analyzer	COMING SOON
	HIPERPAV®	COMING SOON

# Safety: Friction and Hydroplaning



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# MnDOT ASTM Locked Wheel Skid Testing of NGCS

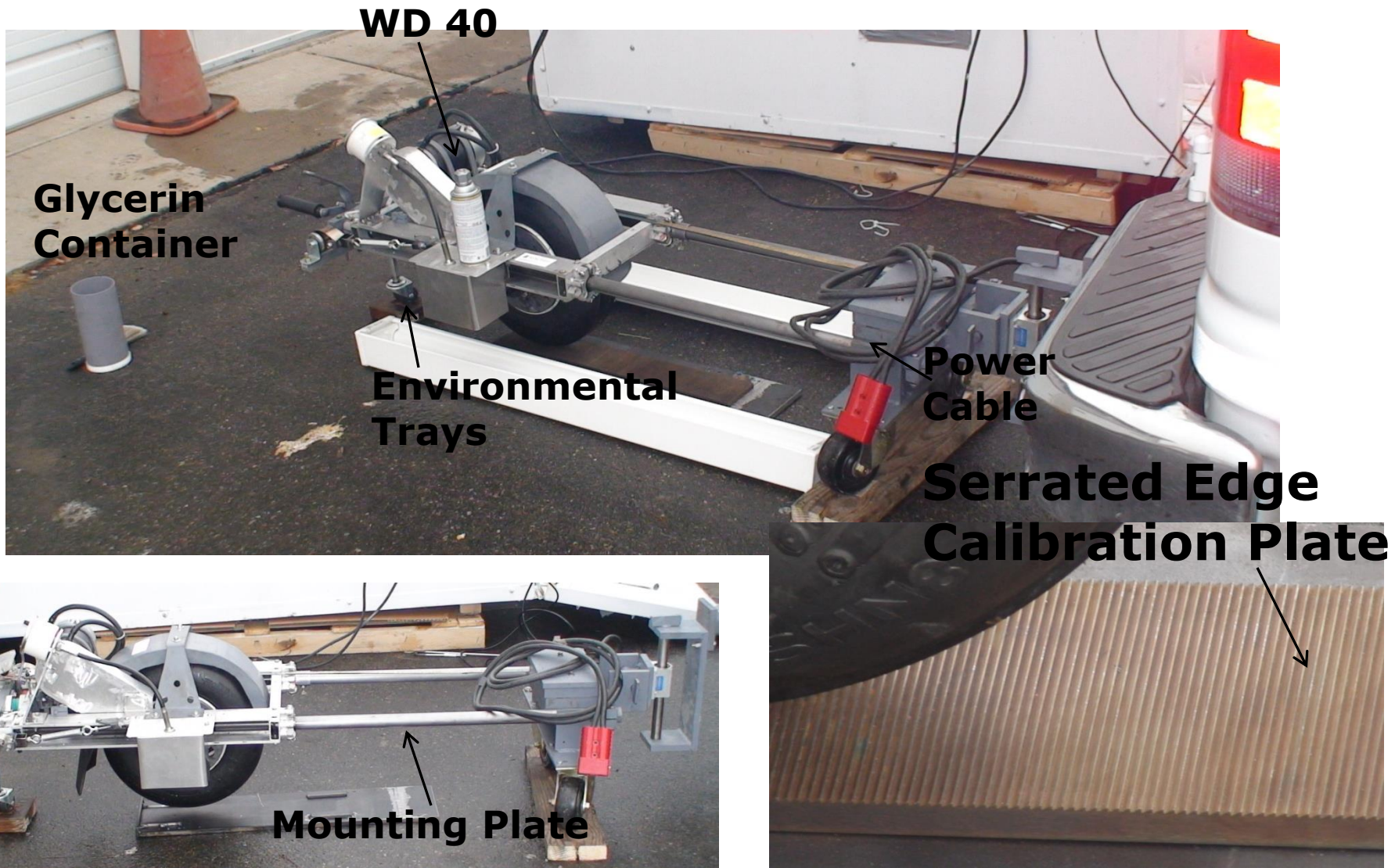




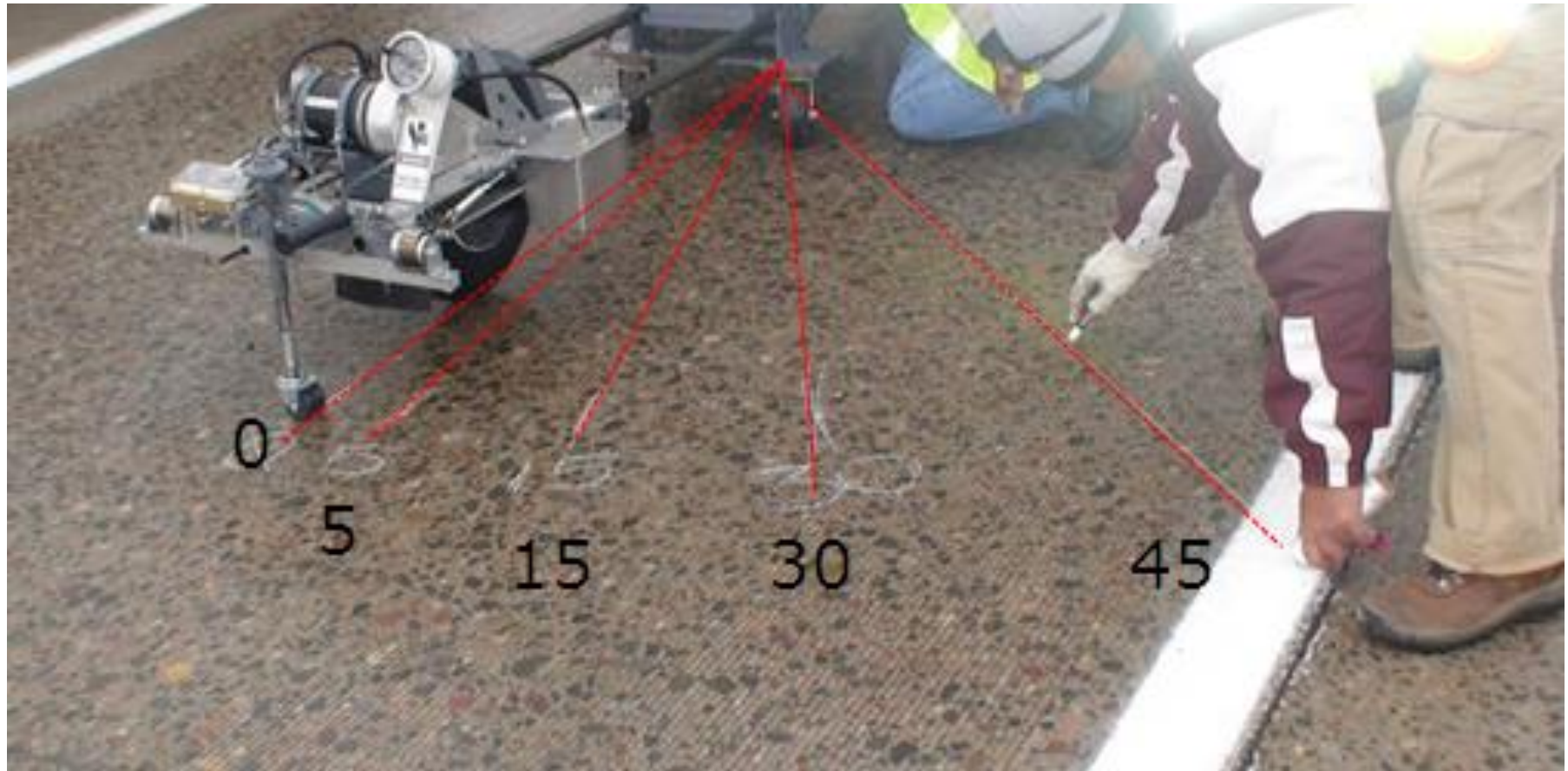
# Anisotropic Friction Evaluation

- Does Frictional Resistance Change as a Function of Direction of Skidding-- Yes

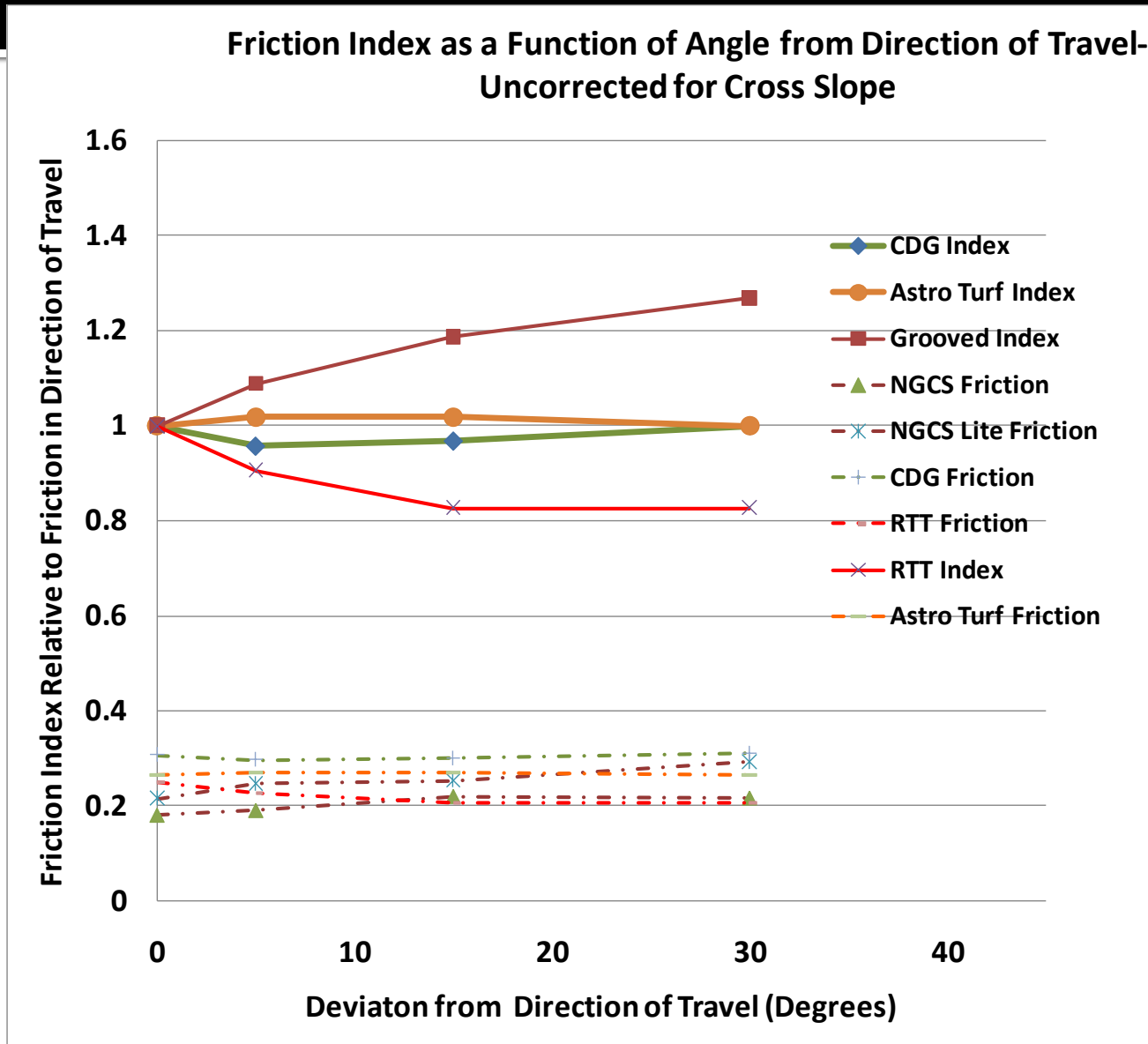
# Calibration of the Equipment



# Operation of CT-342 for Determining Effect of Test Angle on Friction Value



# Friction as a Function of Test Angle



# Splash and Spray Durability

**ARFC**

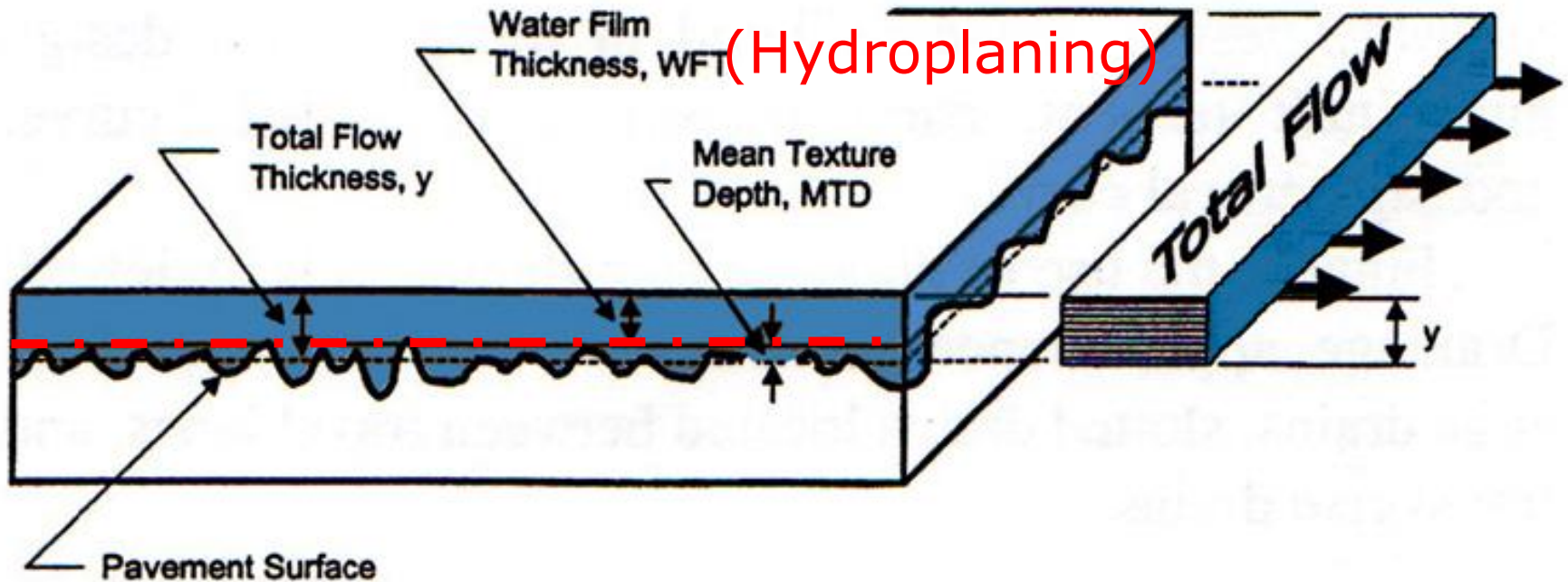


**Longitudinally Grooved PCCP**

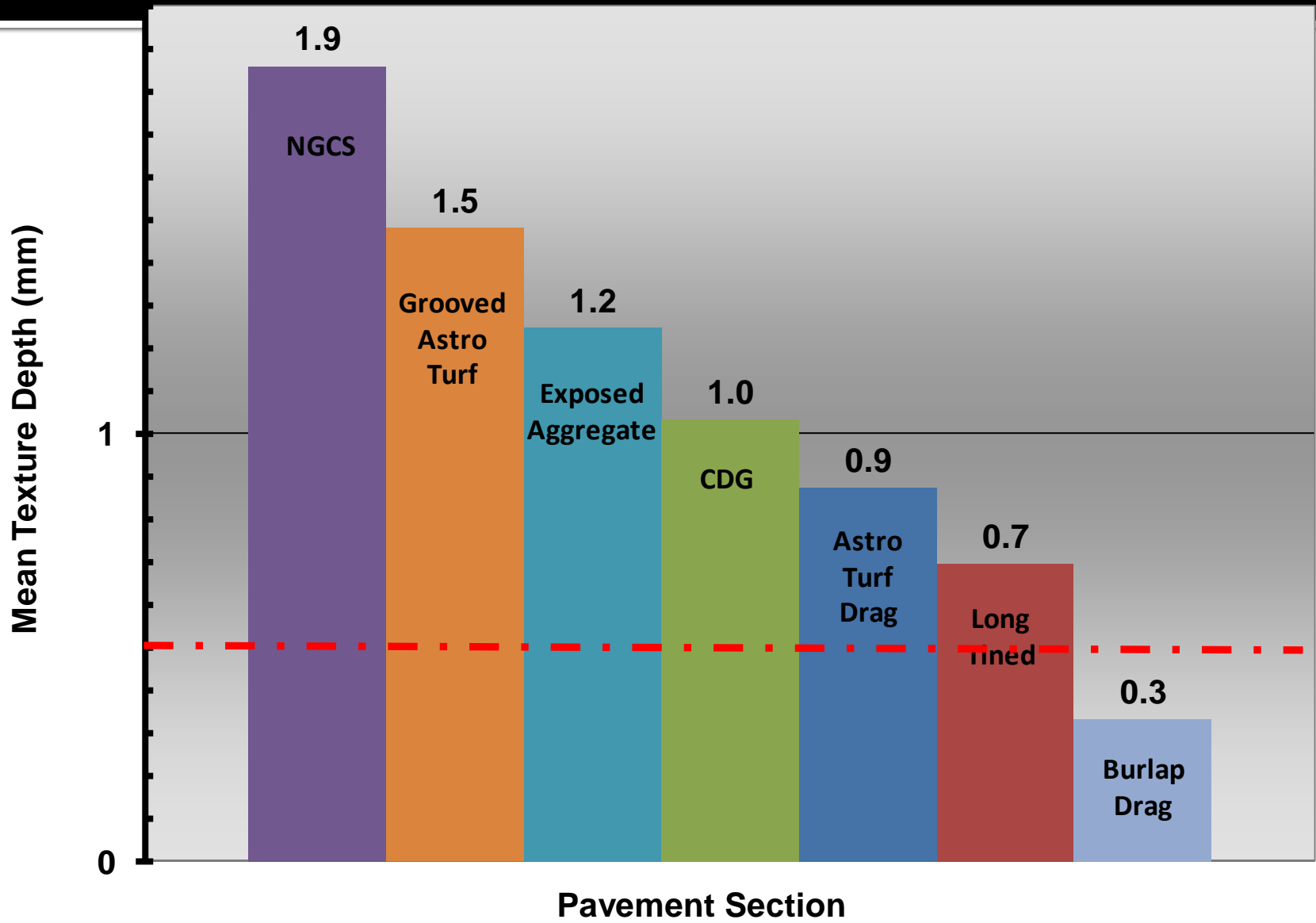


**March 2006 after 143 Days w/o Rain**

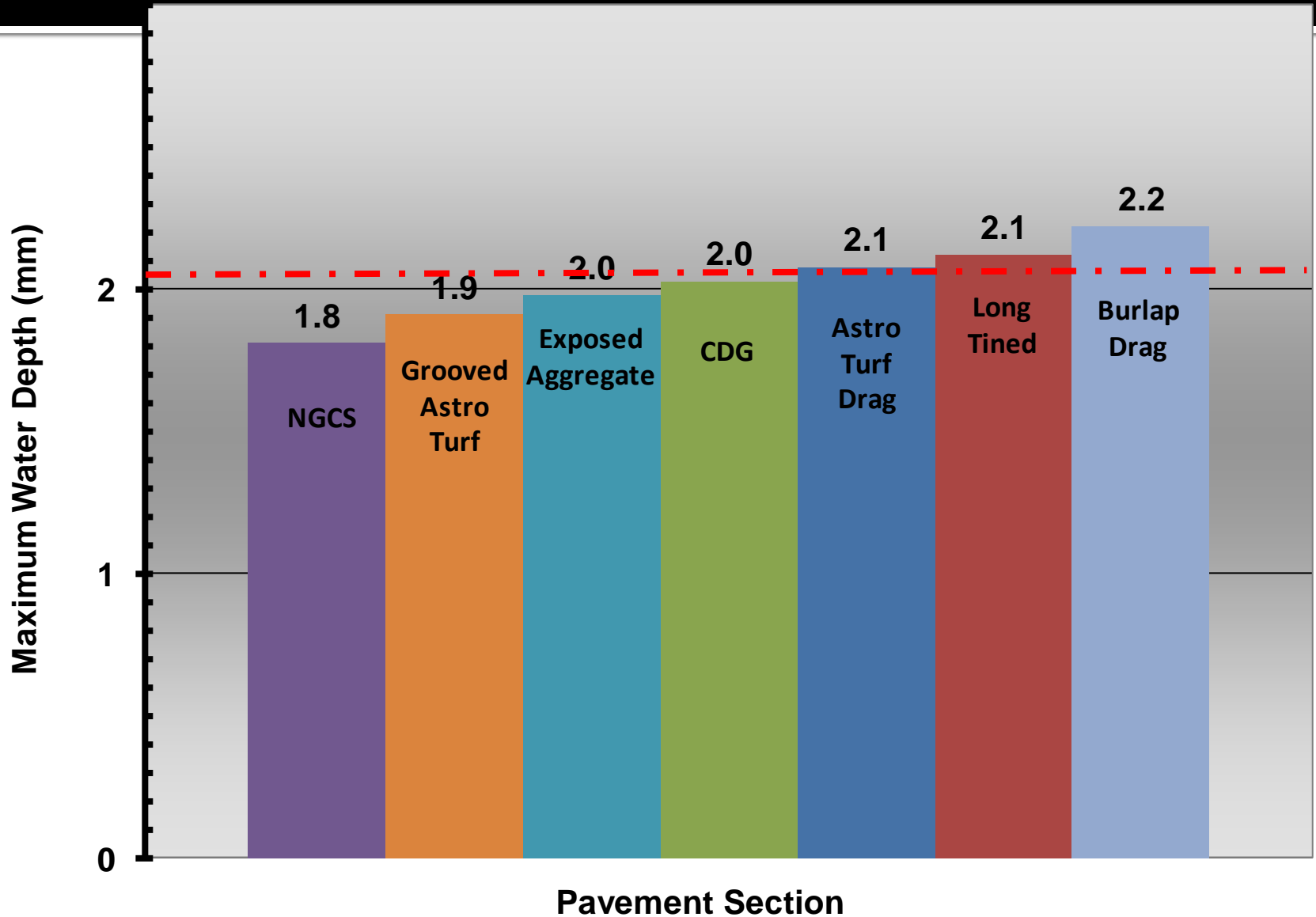
# Texture and Why Do We Need It?



# Mean Texture Depth



# Water Depth For Hydroplaning





# Virginia NGCS Test Sections

“...a measurable and noticeable decrease of more than 5 dB(A) for the NGCS. The NGCS is therefore a significantly better technology for concrete projects designed to decrease noise. Another advantage is that the NGCS seems to be the most reliable in terms of noise variability between different locations. Given the potential for improved lateral stability and the better hydroplaning resistance benefits of the NGCS, it is reasonable to conclude that this technology represents an attractive option as a quiet surface for concrete pavement projects.”

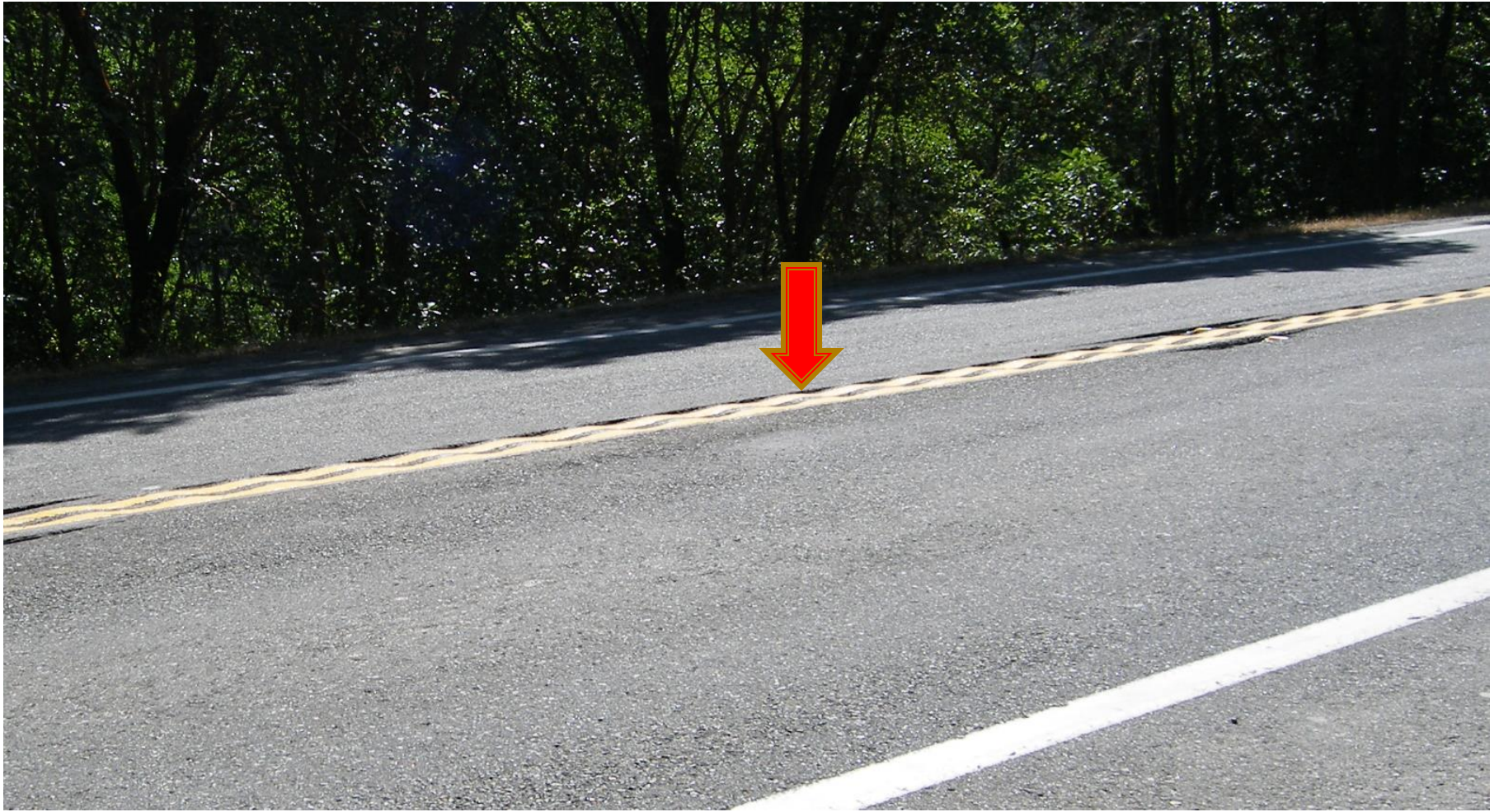
# California NGCS Projects

The GnG surface texture was found to be quieter than the CDG, with lane average OBSI values on the GnG texture ranging from 99.5 dBA to 101.7 dBA, with an average of 100.8 dBA, compared with a range of 100.6 dBA to 104.7 dBA, and an average of 102.8 dBA measured on the CDG surface texture. The average OBSI level for all GnG sections was 100.8 dBA compared with an average of 102.8 for all CDG sections."

**Questions?**

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# Rumble Strip Developments



# Mumble Strips



# Rumble Strip Developments



# Rumble Strip Developments



**Questions?**

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