


Developments in Concrete  
Pavement Surface Textures

8<sup>th</sup> Annual Pennsylvania Concrete Conf.

January 31<sup>st</sup>, 2007



ACPA  
American Concrete  
Pavement Association

Leif Wathne  
Director of Highways

Larry Scofield  
Director of Environmental Technology

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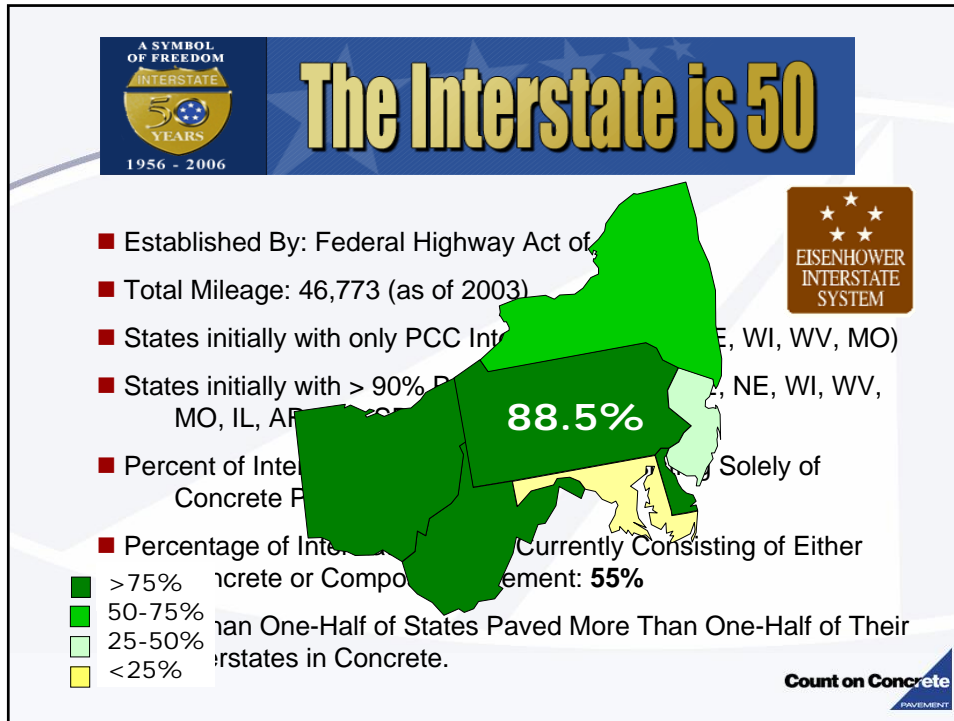


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Mr. Scofield had a "CONFLICT"



## Background

- First PCC Pavement constructed in Bellefontaine, Ohio, 1891
- Two course construction
  - Hard aggregate on top so horseshoes wouldn't wear pavement.
  - Grooved in 4" squares so horses would not slip

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## Reasons For Surface Textures

- Safety
- Durability
- Ride Comfort
- Fuel Efficiency
- Noise



## Burlap Drag

- Standard of
  - 30 US states in 1963
  - 46 US states in 1969
  - Many counties & municipalities currently
- Process:
  - Pull burlap sheets from paver or bridge
  - Slightly moisten



## Burlap Drag Texturing



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## Surface Texture Types

- Burlap Drag (Into the 1970s)
- Transverse and Longitudinal Brooming (Into the 1970s)
- Diamond Grinding/Grooving (1960s)
- Longitudinal & Transverse Tine (1970s)
- Artificial Turf Drag (1980s)
- Random Transverse (1990s)
- Whisper Grind (2003)
- Innovative Textures?????
  - Exposed Aggregate
  - Porous Concrete

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## Broom Textures



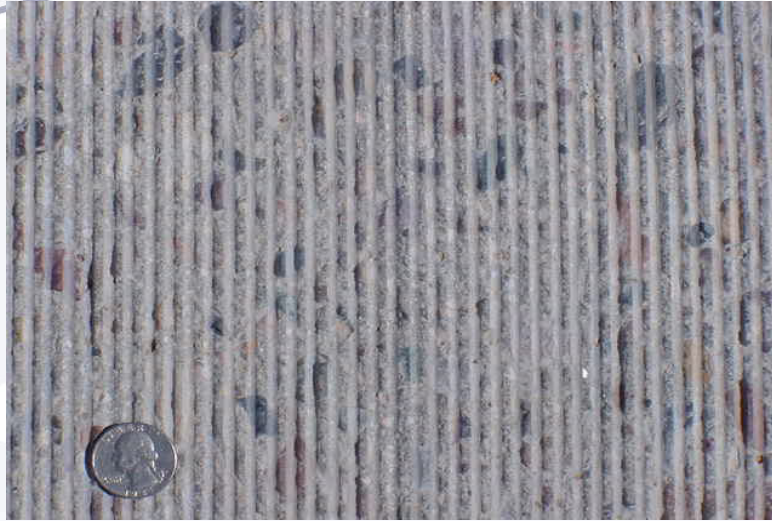
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## Diamond Grooving



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## Diamond Grinding



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## Tined Texture Looking Down on Tines



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## Random Transverse



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## What's Been Tried

- Belt Drag – Sinusoidal
- Dimpled
- Skewed
- Cross Hatched
- Exposed Aggregate
- Porous Concrete

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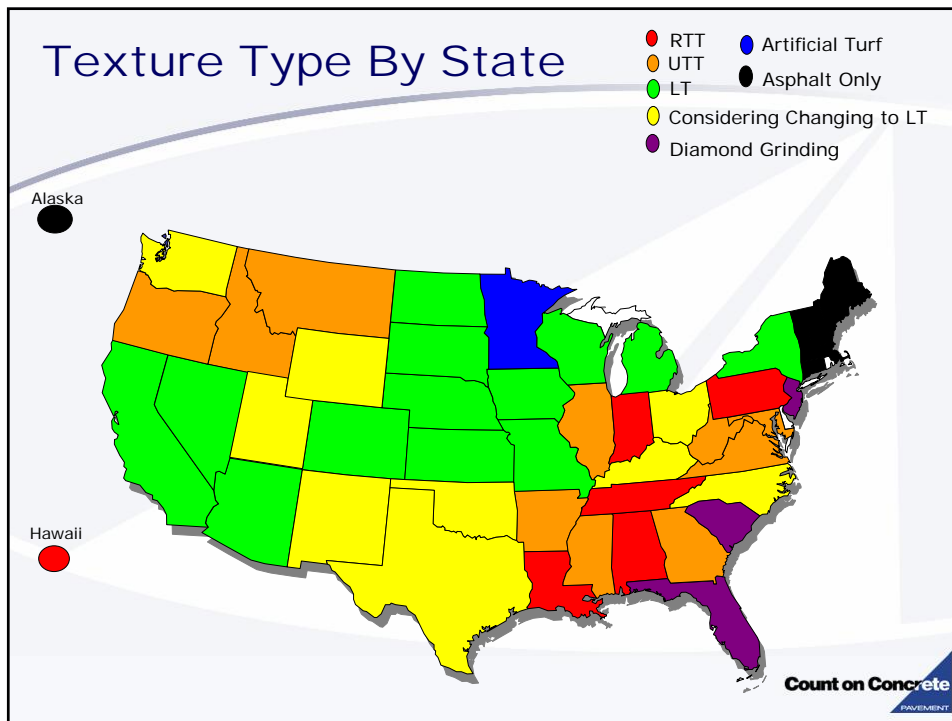
## Current US Research On Surface Characteristics

- Friction—NCHRP 1-43 Friction Guidelines
- Optimizing—NCHRP 10-67
- Near Field Noise Measurement –NCHRP 1-44
- Truck Noise Source Measurement—NCHRP 8-56
- Innovative Texturing Device—FHWA
- Innovative Textures—ACPA/Purdue TPTA
- Surface Characteristics—NCPTC/FHWA/ACPA
- OBSI ACPA testing
- Pooled Fund Studies

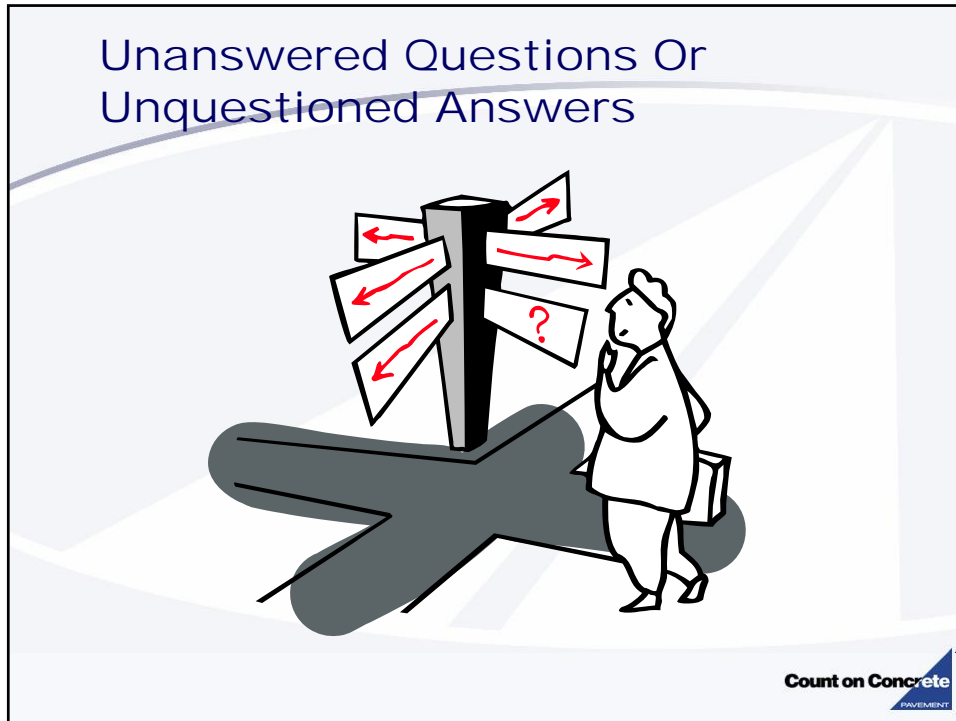
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## Texture Type By State

- RTT
- UTT
- LT
- Considering Changing to LT
- Diamond Grinding
- Artificial Turf
- Asphalt Only



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### Unanswered Questions

- How Smooth is Smooth Enough? IPRF Task 16
- How Quiet is Quiet Enough?
- What are the Necessary Friction Requirements?
- How Best to Measure Splash Spray?
- How to Improve Texture Durability through Mix Characteristics?
- Acoustic Durability Over Time?
- Can Texture be a surrogate for friction/noise?

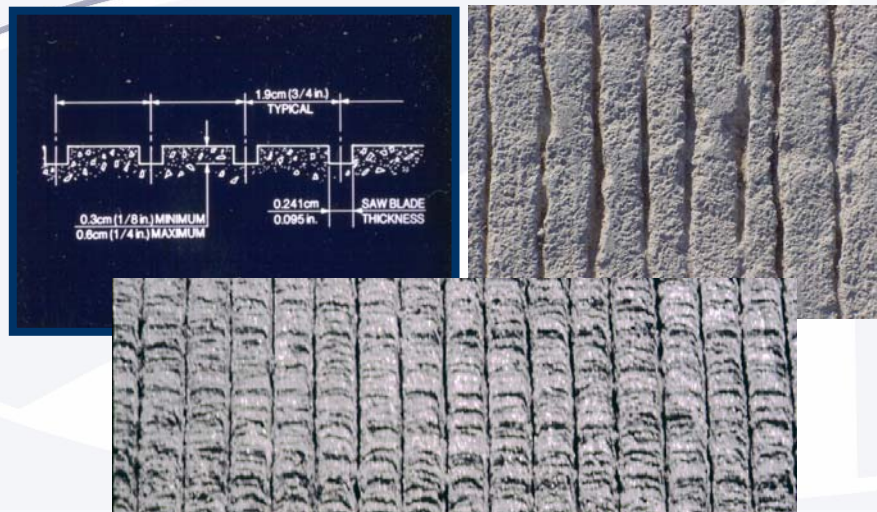
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## Unquestioned Answers

- Random Transverse Tines (really?)...
- Friction is best measure of safety, and skid is best measure of friction... (lateral stability?)
- Best Texture to Maximize Fuel Efficiency
- dB is the Best Noise Annoyance Metric (tonality?)
- Car tires only (truck metrics?)...

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## The Bottom Line: As-Designed vs. As-Built Tining



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## Major Projects Reviewed

- NCPTC/FHWA/ACPA -  
Surface Characteristics Study
- Purdue University –  
Tire Pavement Test Apparatus

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## Test Sections

### To Date: 213 Unique Textures Tested

- 71 Transverse Tining (incl. 6 skewed)
  - 51 Longitudinal Tining (incl. 1 sinusoidal)
  - 1 Cross-Tined (transverse and longitudinal)
- 20 Diamond Ground
- 8 Grooved (2 longitudinal, 6 transverse)
- 30 Drag (Burlap, Turf, Broom, Belt, Carpet)
- 1 Transverse Broom
- 3 Exposed Aggregate
- 3 Shot Peened
- 1 Milled
- 19 HMA
- 5 Surface Treatments

Over 547 unique test sections for a total of over 143,000 ft !

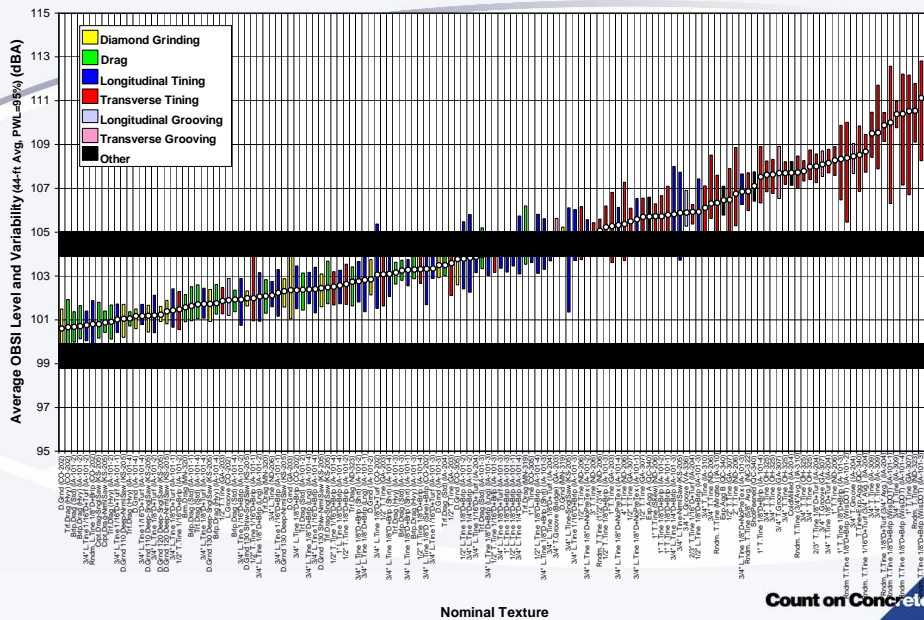
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## Noise Measurement

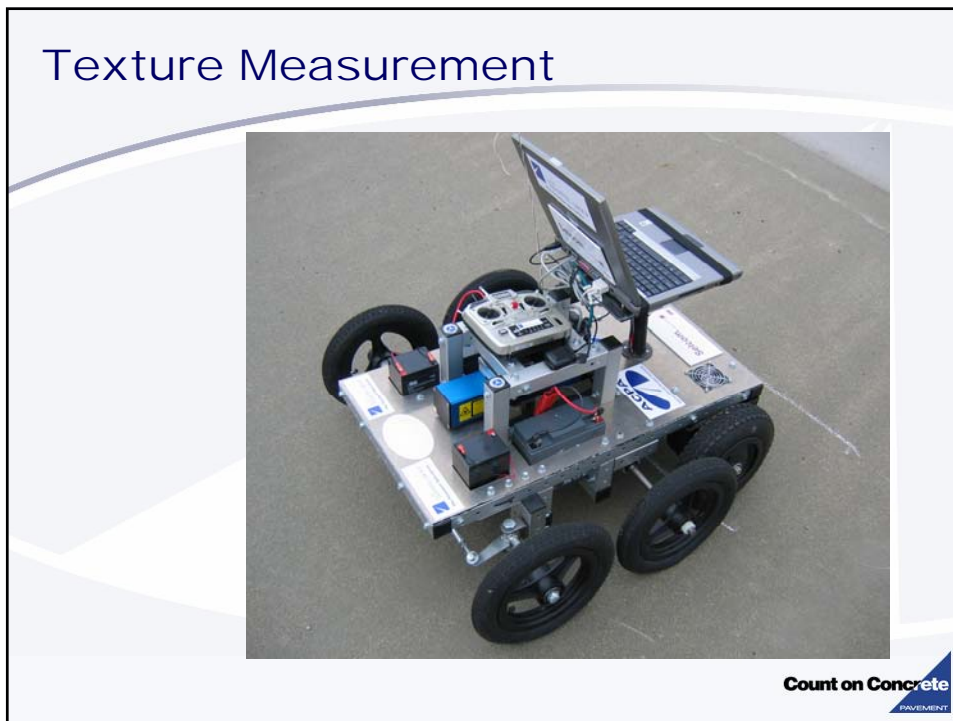
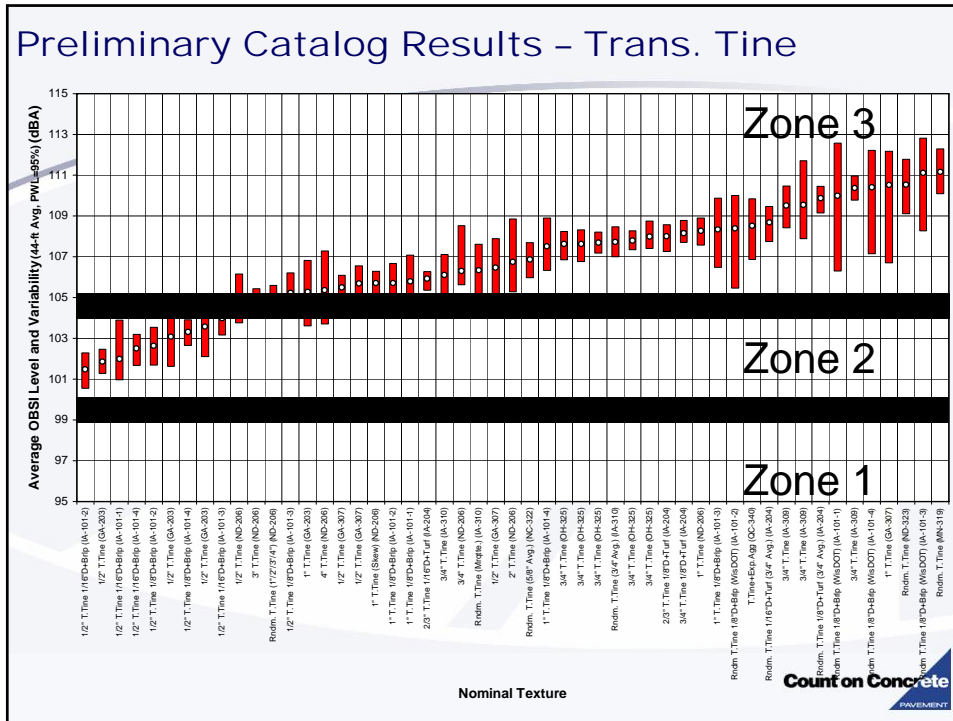


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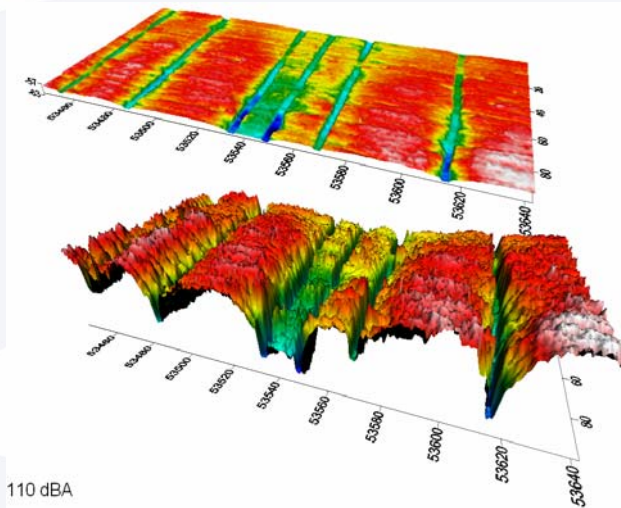
## Noise Results







### US 30 Random Transverse Tined 110 dBA



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### DFT / CTM vs. the Skid Trailer



Friction (Microtexture)

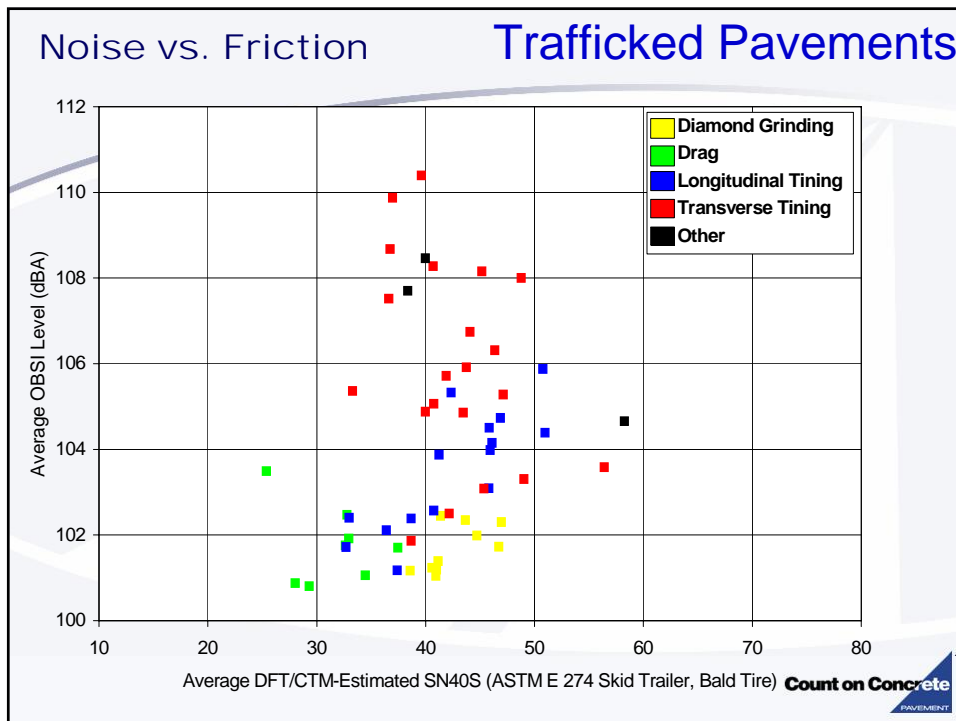
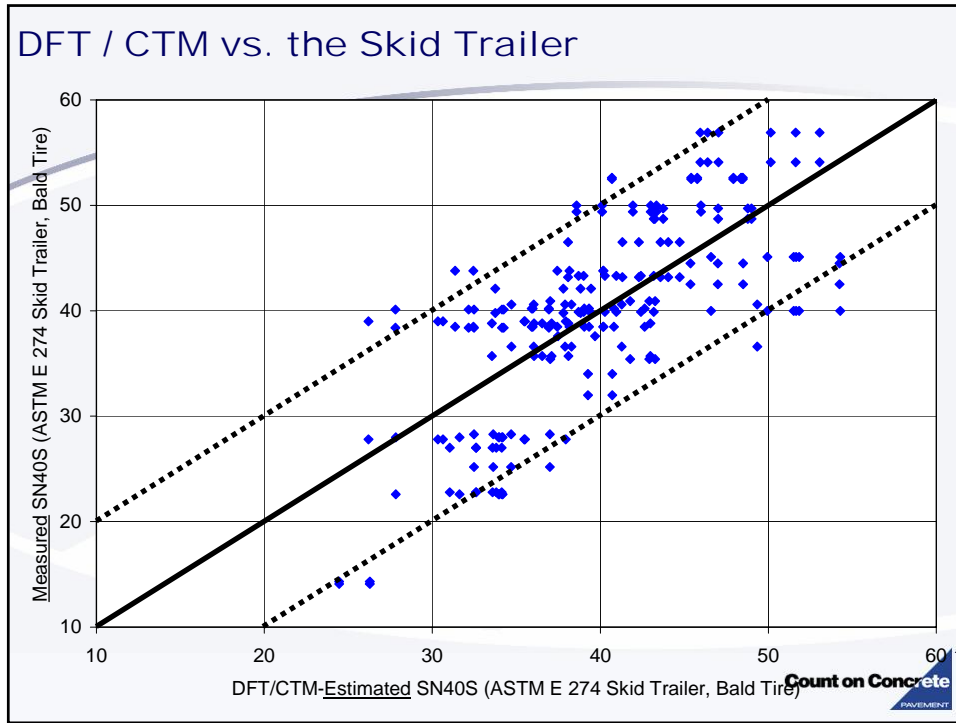


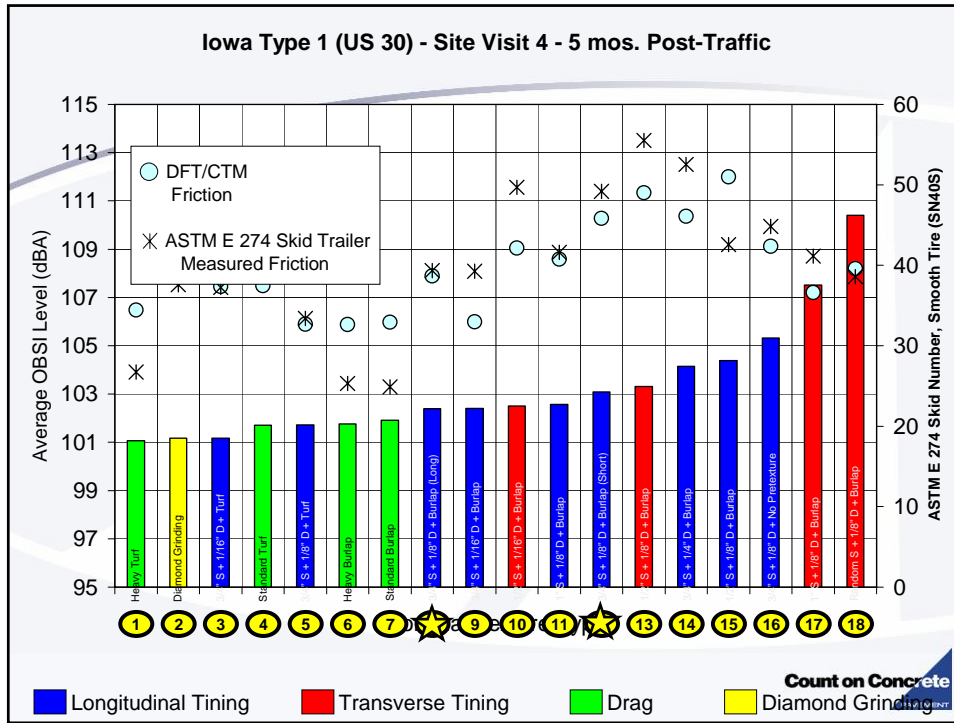
MPD (Macrotexture)

Skid Number (SN40S)





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## Purdue Research (TPTA)

- Optimize grinding
  - Blade Spacing
  - Blade Width
  - Depth
- Joint Effect
  - Joint Opening
  - Joint Faulting
- Innovative Surfaces
  - To be determined and tested

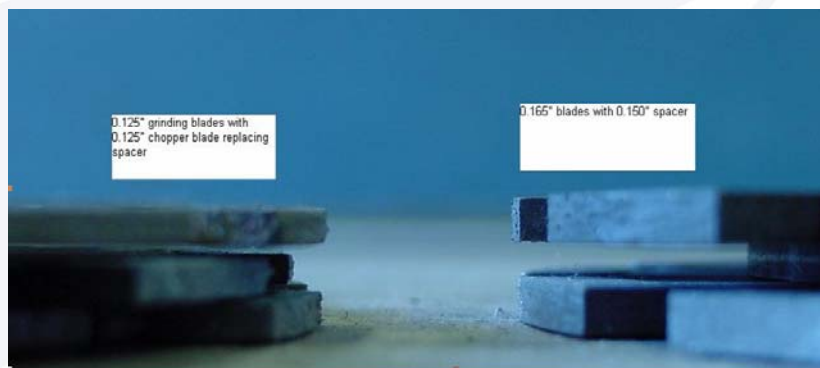
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## Fins Existing After Grinding



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## Chopper Blades vs. Conventional



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## Future TPTA Enhancements

- Friction Measurement
- Rolling Resistance Measurement
- Annoyance Metrics White Paper

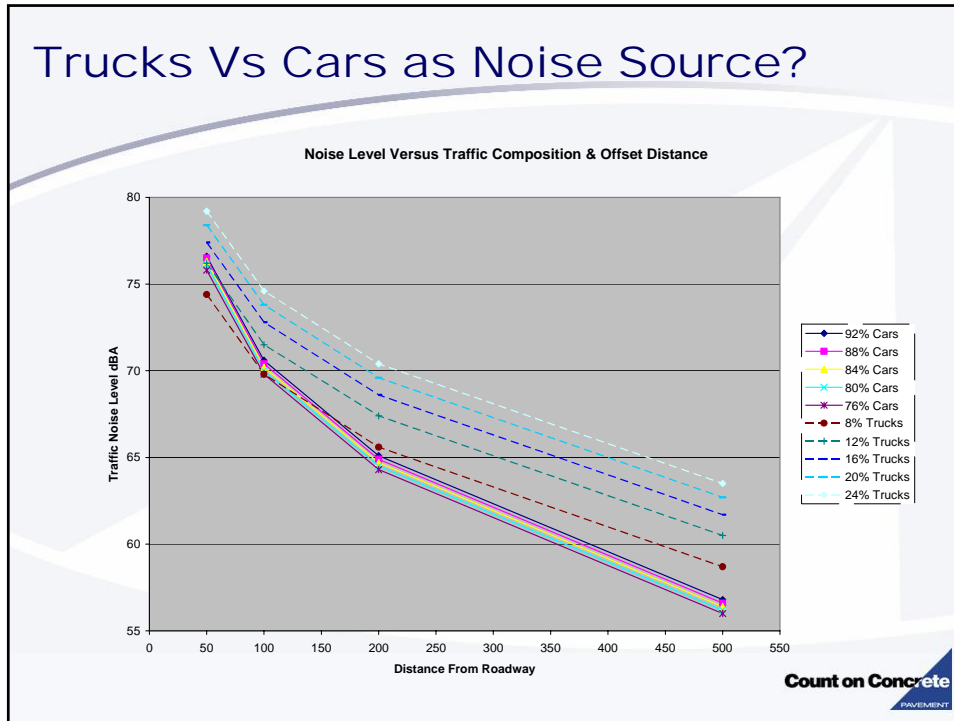
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## Back to the Future



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## Trucks Vs Cars as Noise Source?



## Splash and Spray - ARFC



## Splash and Spray-- Concrete



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## In Summary—Future Texture Directions

- Elimination of Textures with Tonal Issues or Excess Level
- Improvement of Existing Textures
- Development of New Textures Types and Processes
- Texture Consideration for Commercial Vehicles
- Better Means for Assessing Safety
- Optimization of Surface Textures

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The image shows a screenshot of the Pavements4Life.com website. The website layout includes a header with a photo of people in a car and a navigation menu with items like 'Home', 'About Us', 'Contact Us', 'FAQ', 'Privacy Policy', and 'Terms of Service'. Below the header is a main content area with several sections, each featuring a small image and a link to learn more:

- Proven Design**: Proven design that saves lives.
- Spending Wisely**: How to make the most of your investment.
- Spill Sites**: Some great photos about spill sites.
- Environmental Advantage**: Can a pavement actually be better for the environment?
- Cost Savings**: Get out of that traffic jam!
- Take Action**: Let's work together to create something great!

A large, semi-transparent 'Thank You!' message is overlaid on the right side of the website screenshot. At the bottom of the screenshot, the text 'KICK the asphalt habit...' is followed by the 'PAVEMENTS4life.com' logo. In the bottom right corner of the screenshot, there is a logo for 'Count on Concrete PAVEMENT'.