

# Diamond Grinding

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*Improved Pavement Performance and  
Customer Satisfaction Using  
Diamond Grinding*

# Looking Back In Time

- In the not so distant past noise, ride quality, and customer comfort (functional considerations) took a back seat to structural considerations.



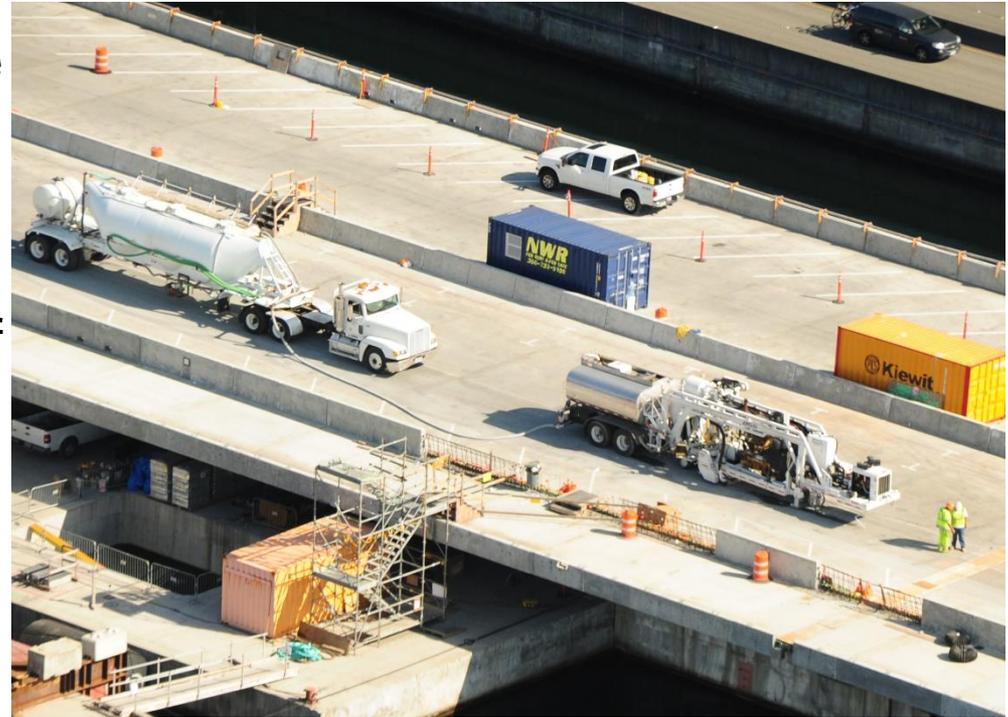
# Transportation Authorities React

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- Today Specifiers place greater emphasis on tire/pavement noise, smoothness and construction delays.
  - Development of tighter smoothness and new noise specifications.
  - Development of low noise surface treatments.
  - Increased use of sound walls.
  - Night work becomes the norm.
  - Safety concerns still paramount!

# Diamond Saw Cut Surface Textures

- Increasingly Specifiers are utilizing diamond saw cut surfaces to reduce roughness, reduce noise and increase the friction of their pavements, bridges, tunnels and runways.
  - Economical
  - Long-lasting
  - Effective
  - Environmentally Friendly



**Evergreen Floating Bridge- Washington**

# What is Diamond Grinding?

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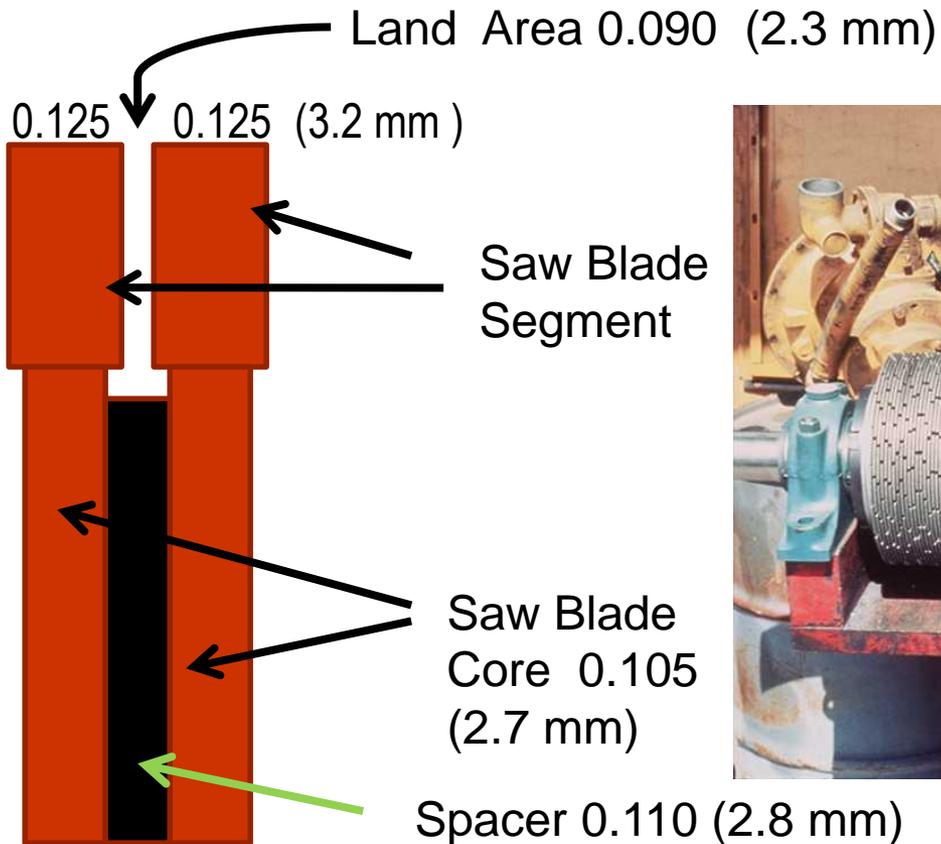
- Removal of thin surface layer of hardened PCC using closely spaced diamond saw blades
- Results in smooth, level pavement surface
- Provides a longitudinal texture with desirable friction and low noise characteristics
- Frequently performed in conjunction with other CPR/CPP techniques, such as full/partial depth repair, undersealing/slabjacking, dowel bar retrofit, and joint resealing

# Blades and Spacers

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# Typical Conventional Diamond Grinding (CDG) Blade Configuration



# Diamond Grinding Equipment



# Diamond Grinding Process

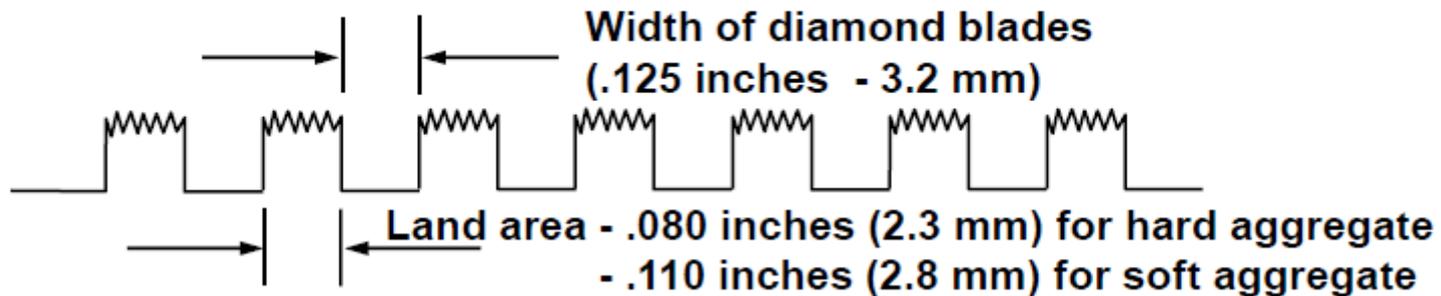
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# Conventional Diamond Ground Surface



## Diamond Grinding



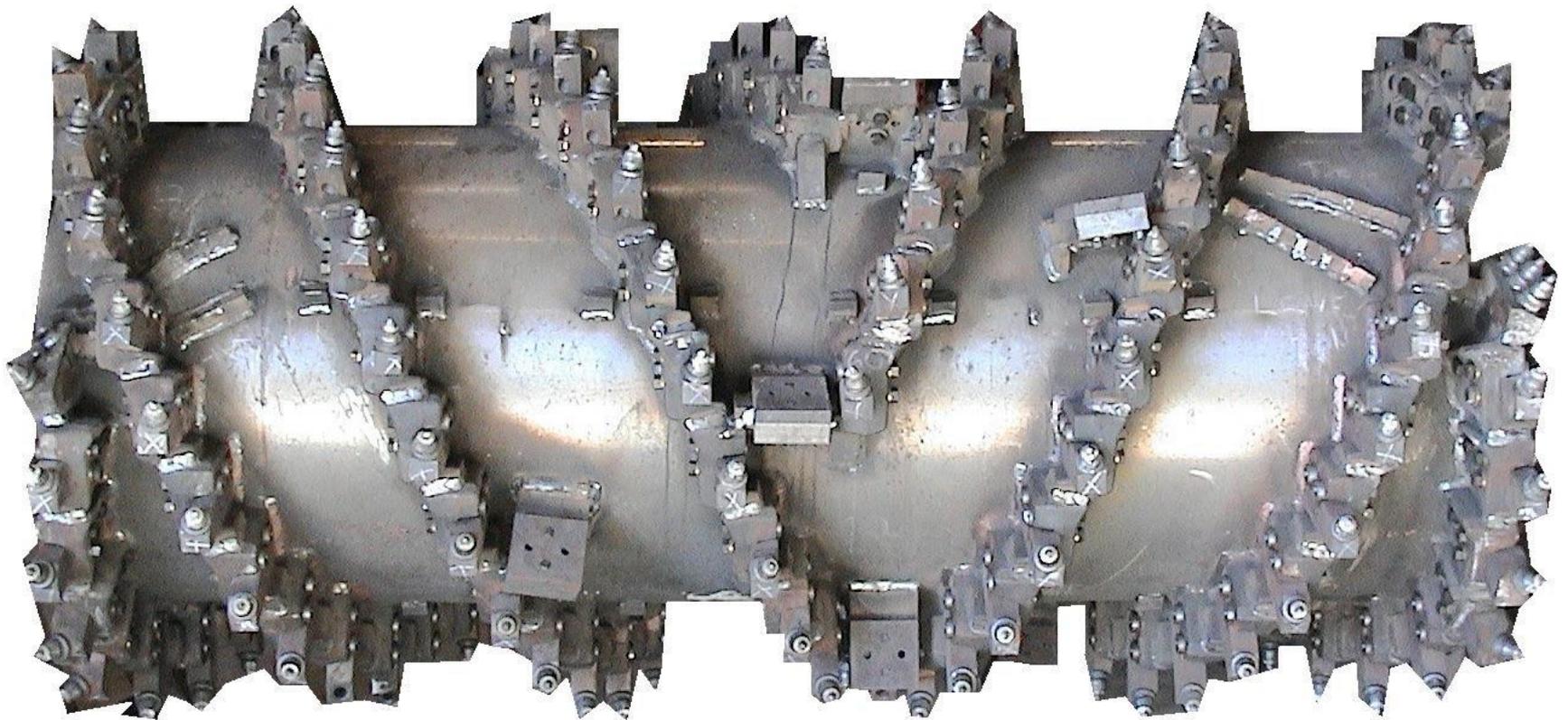
# Milled Surfaces

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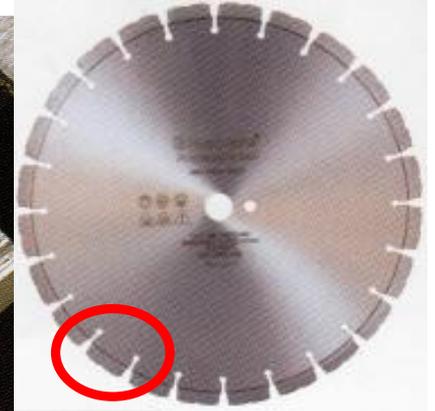
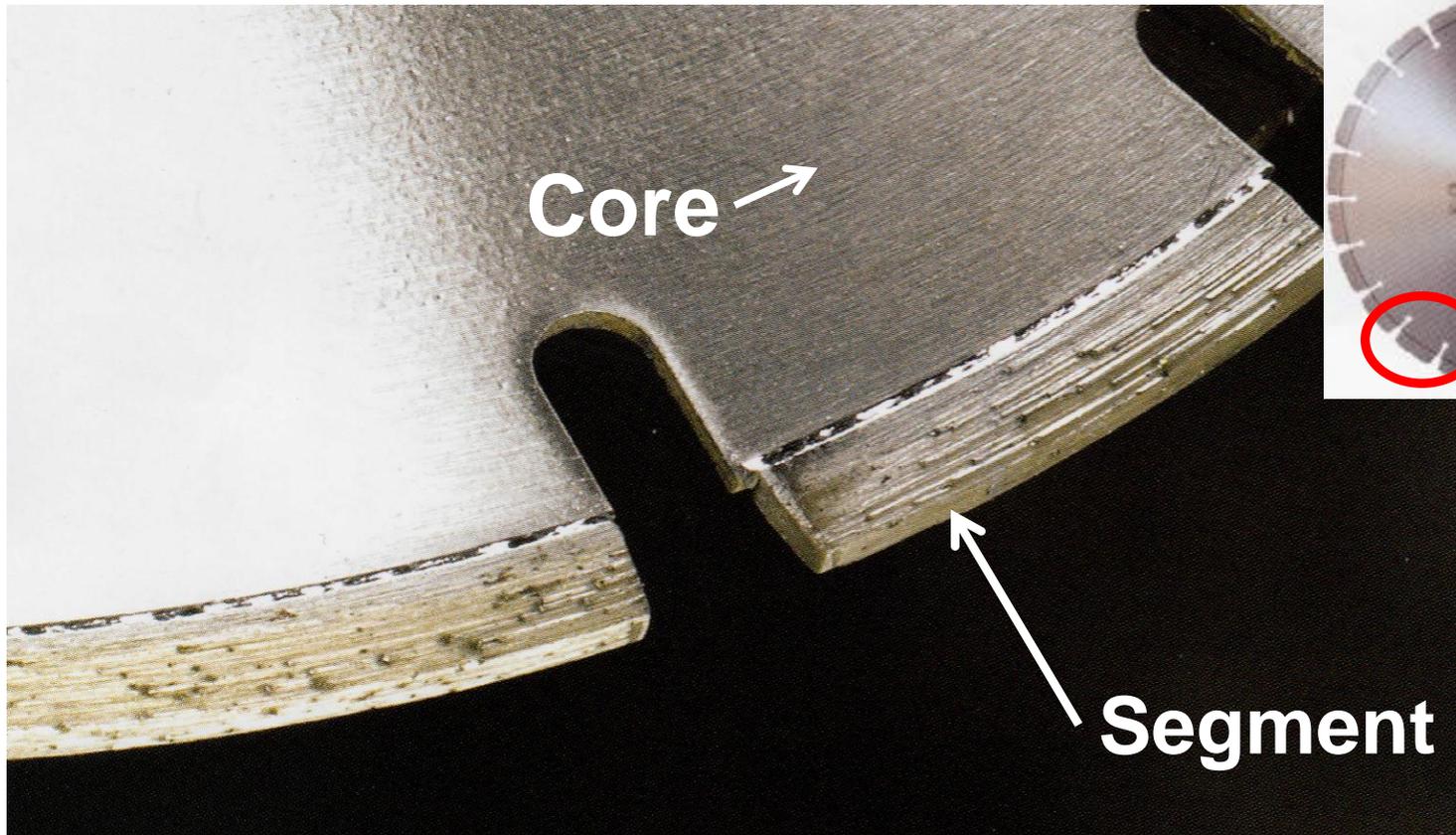


# Milling Drum

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# Impact vs Abrasion

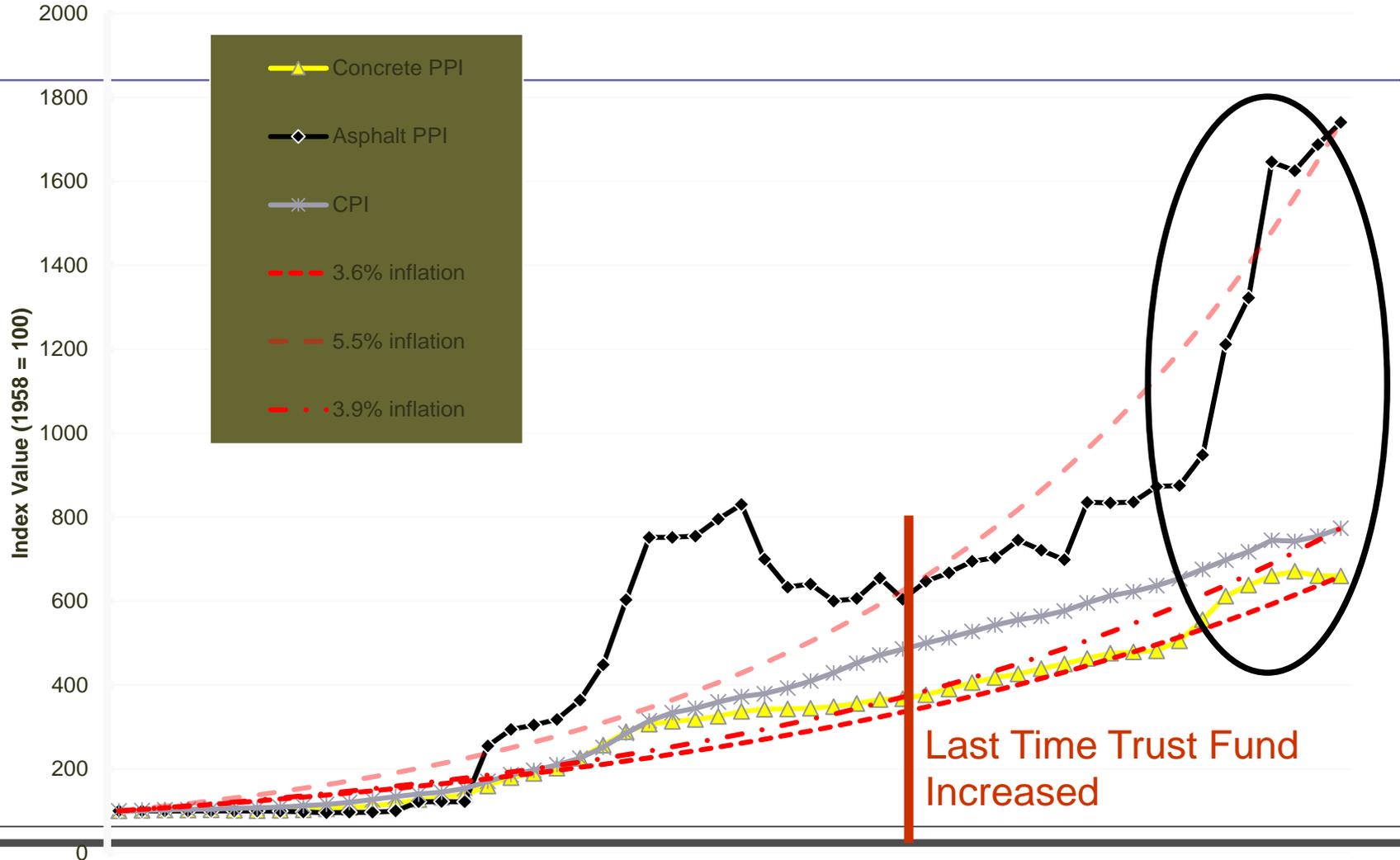


# Advantages of Saw-Cut Textures

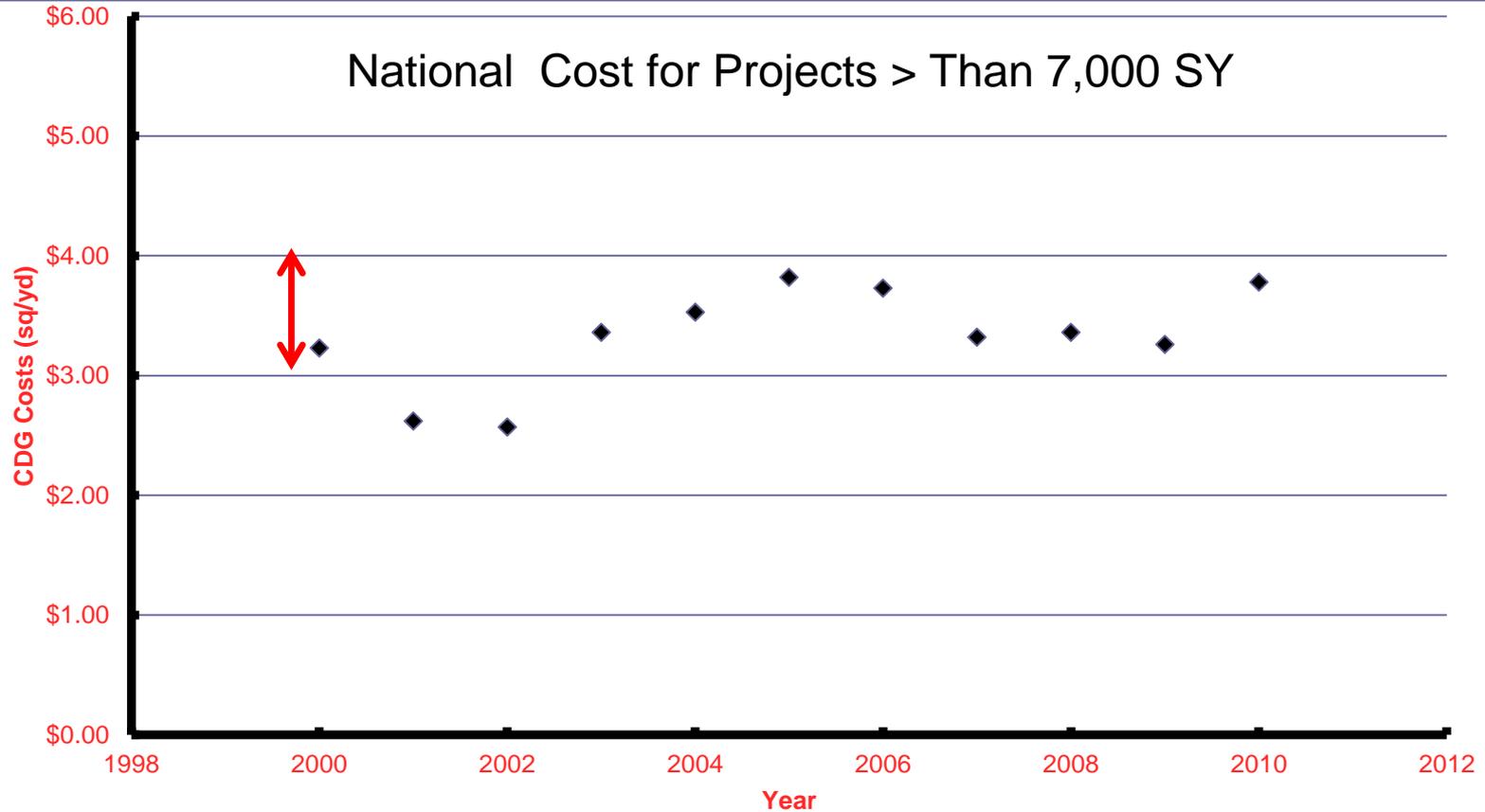
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- Often cost less than AC overlays;
- Enhances smoothness, surface friction and safety
- Can be accomplished during off-peak hours with short lane closures
- Texturing of one lane does not require grinding of the adjacent lane
- Does not affect overhead clearances underneath bridges, signs or tunnels
- Blends patching and other surface irregularities into a consistent, identical surface
- **Environmentally friendly**

# Commodity Price Increases



# DG is Cost Effective and Predictable



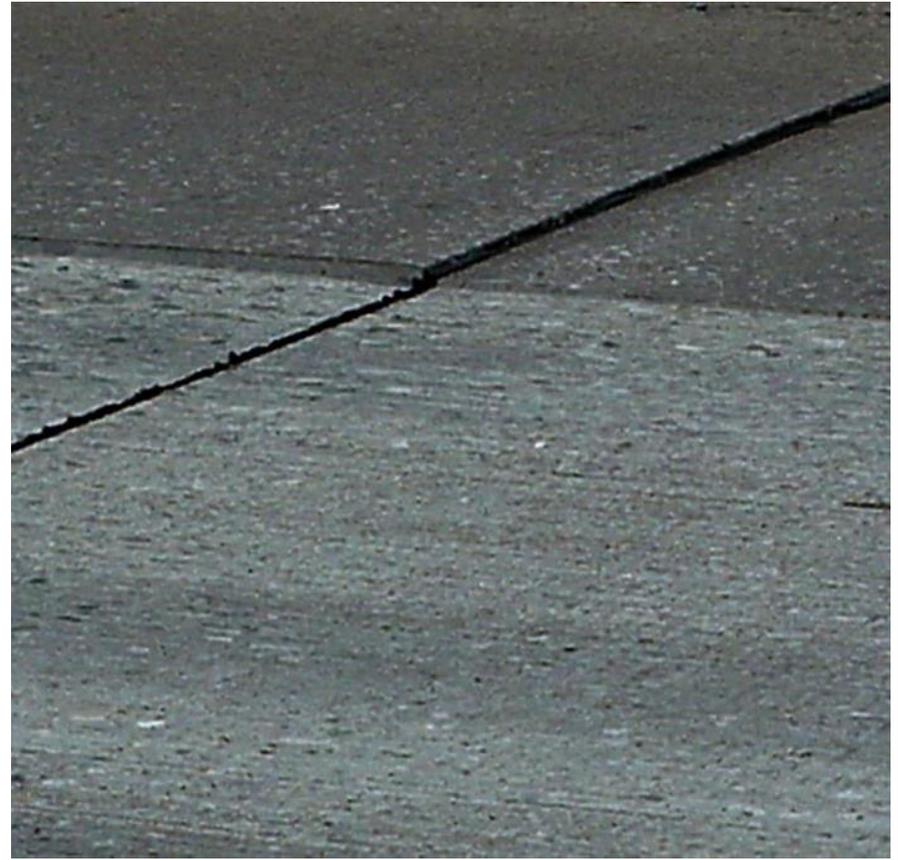
# Pavement Problems Addressed

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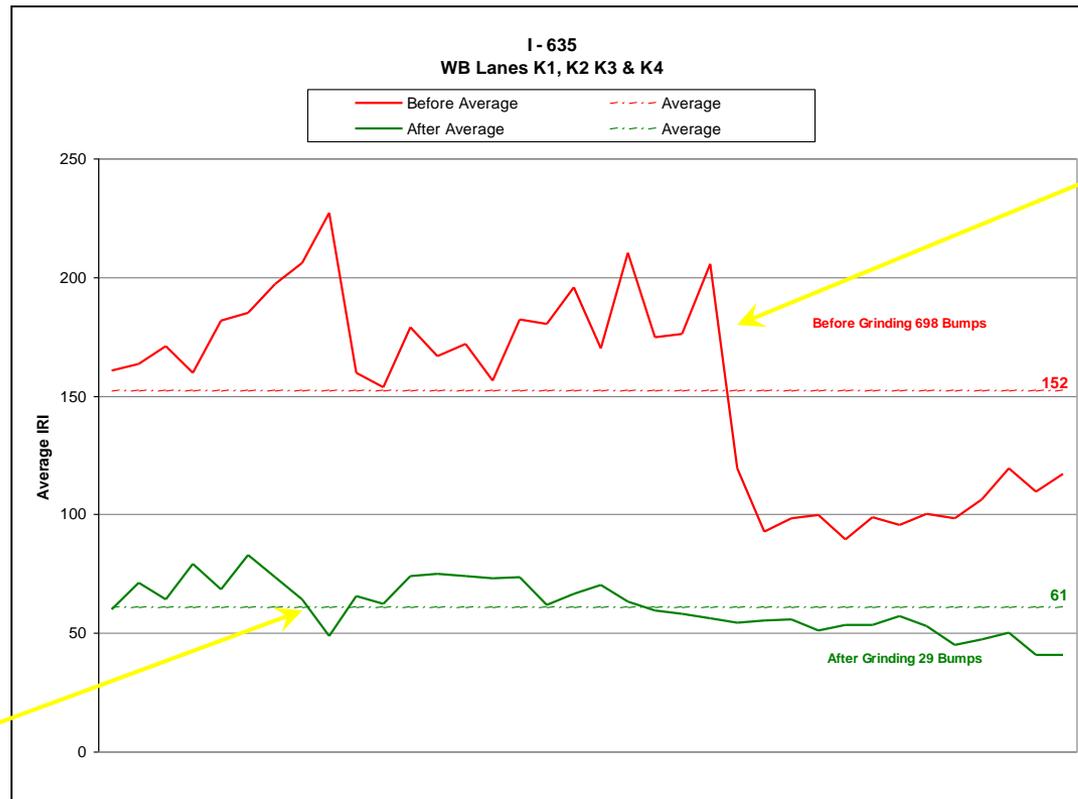
- Faulting at joints and cracks
- Built-in or construction roughness
- Polished concrete surface - Increase friction
- Wheel-path rutting
- Inadequate transverse slope
- Unacceptable noise level

# Joint Faulting

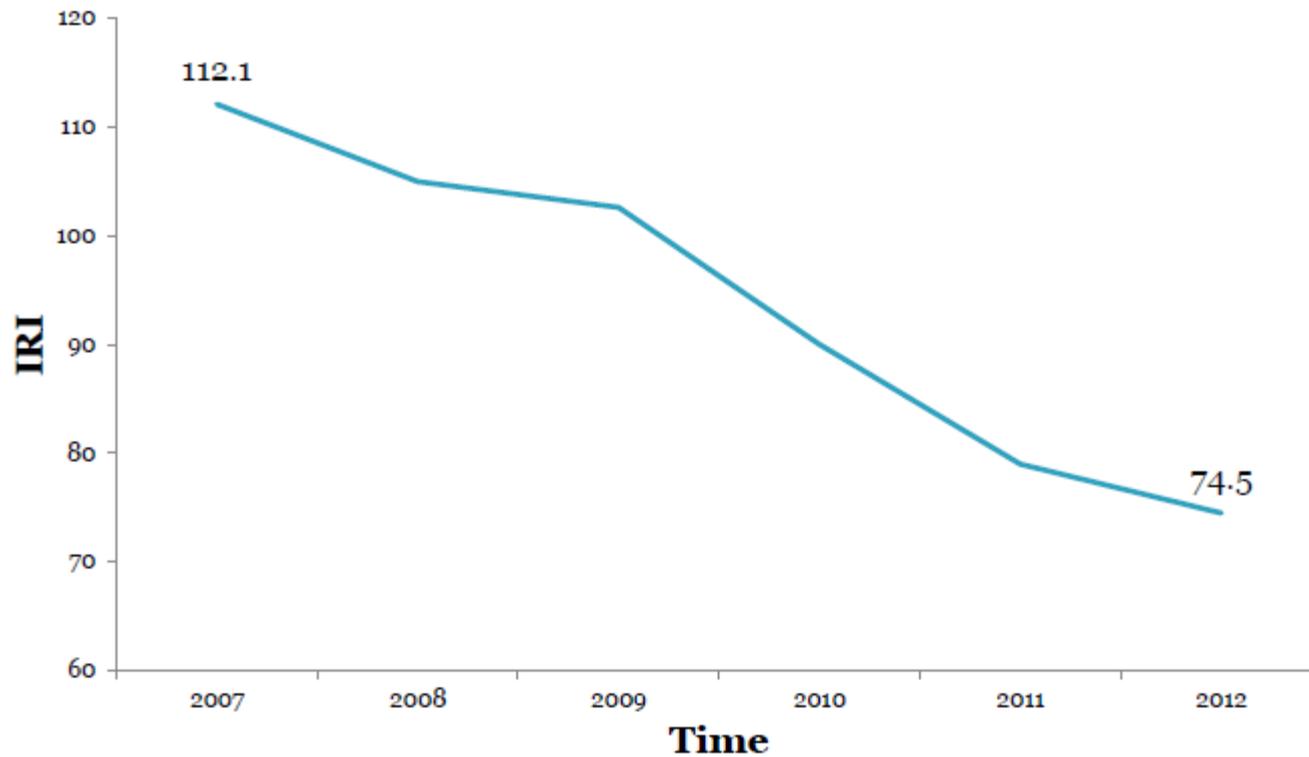
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# Diamond Grinding can provide a significant improvement over the pre-grind profile!



# IRI of KY Interstate Pavements



# KTC Diamond Grinding Experience

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- IRI Improved from 112.1 to 74.5 in 5 years
- Lowest recorded average IRI ever covering 536 lane miles
- \$188,000 per lane mile
- Diamond grinding had an avg. cost of \$2.75 per sq. yd. in KY over a 5-year period
- Provides favorable impacts related to the performance criteria attached to Map-21 and the Fast Act

# Safety, Surface Texture and Friction

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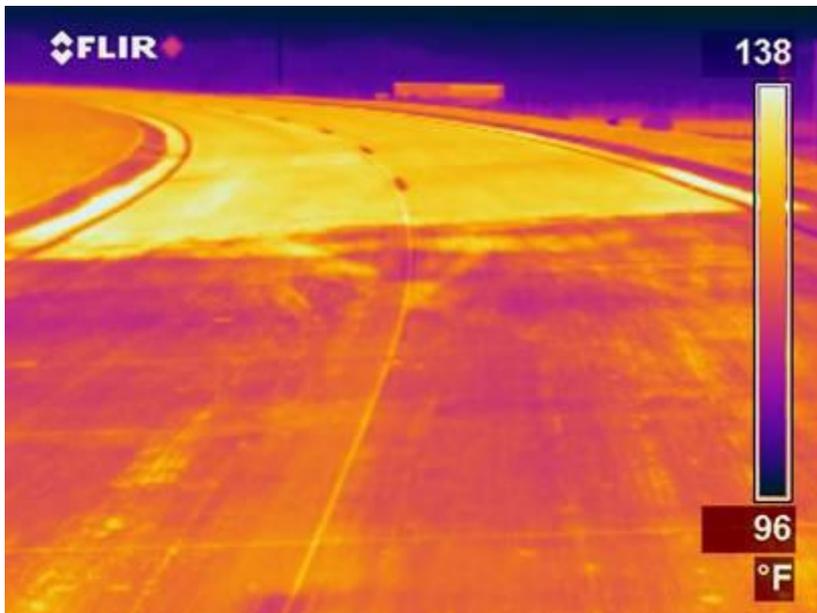
- Increased macro-texture of diamond ground pavement surface provides for improved drainage of water at tire-pavement interface
- Longitudinal texture provides directional stability and reduces hydroplaning (side-force friction). Grooves provide “escape route” for water trapped between tire and pavement surface
- In Wisconsin, **overall accident rates for ground surfaces were 40% less than for un-ground surfaces over a 6-year period, 57% in wet weather conditions**

# Tunnel Pavement Texturing



# Lower Ambient Temperatures and Energy Costs

The light reflective color of PCCP means less energy required for overhead lighting and cooling in urban areas.



# Can be used on asphalt too!

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I-70 Missouri

# Unacceptable Noise Level

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# Transverse Tining

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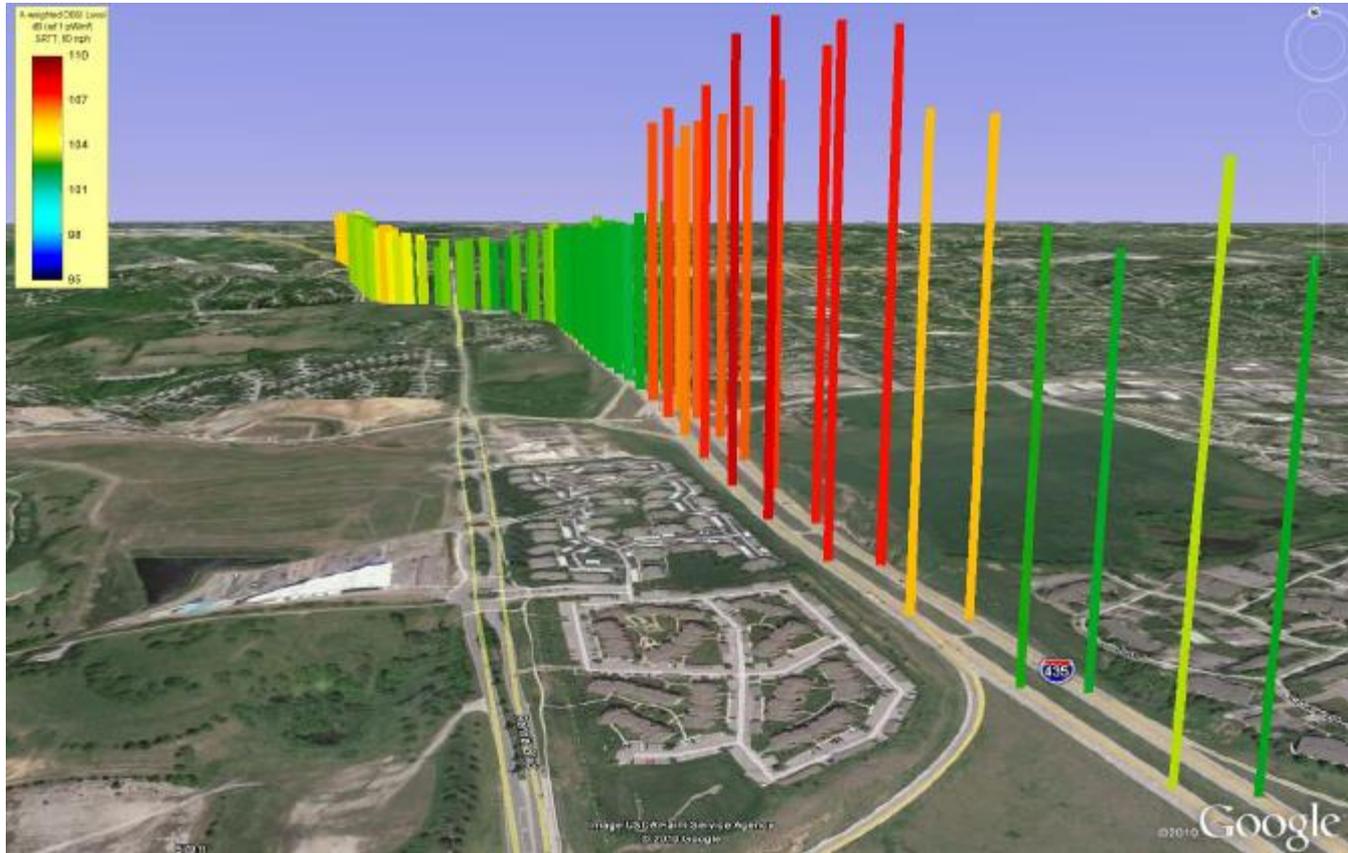
- For many years the use of transverse tining created the perception that all concrete pavement is noisy.

# NCPTC OBSI Testing

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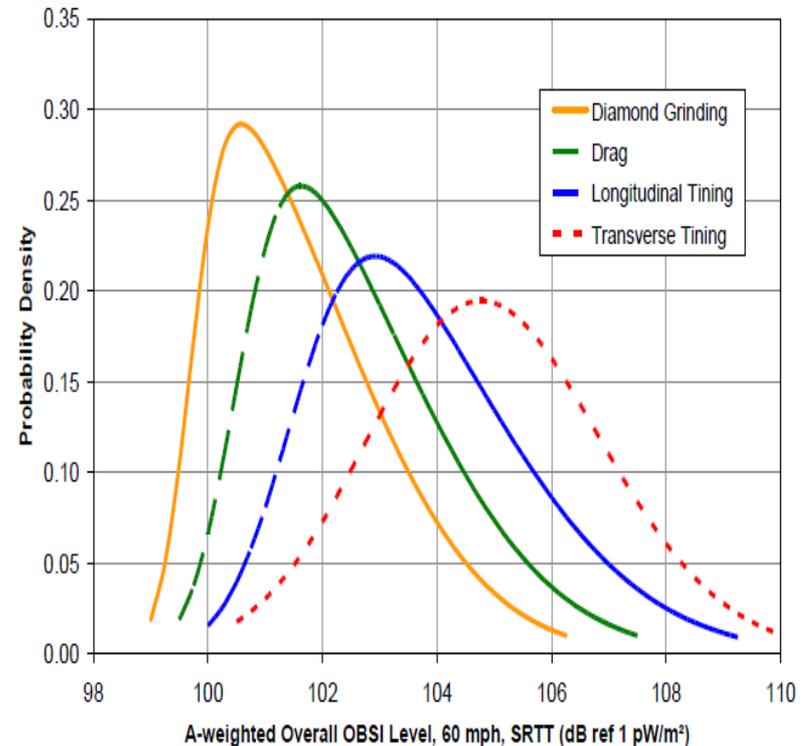
- In 5 years the National Concrete Pavement Technology Center tested over 1500 unique textures
  - Transverse Tining
  - Longitudinal Tining
  - Diamond Ground
  - Diamond Grooved (Longitudinal, Transverse)
  - Shot Peened
  - Exposed Aggregate
  - Pervious Concrete
  - HMA and Surface treatments
- Hundreds of Miles in 20 States and 6 Countries

# NCPTC OBSI Testing

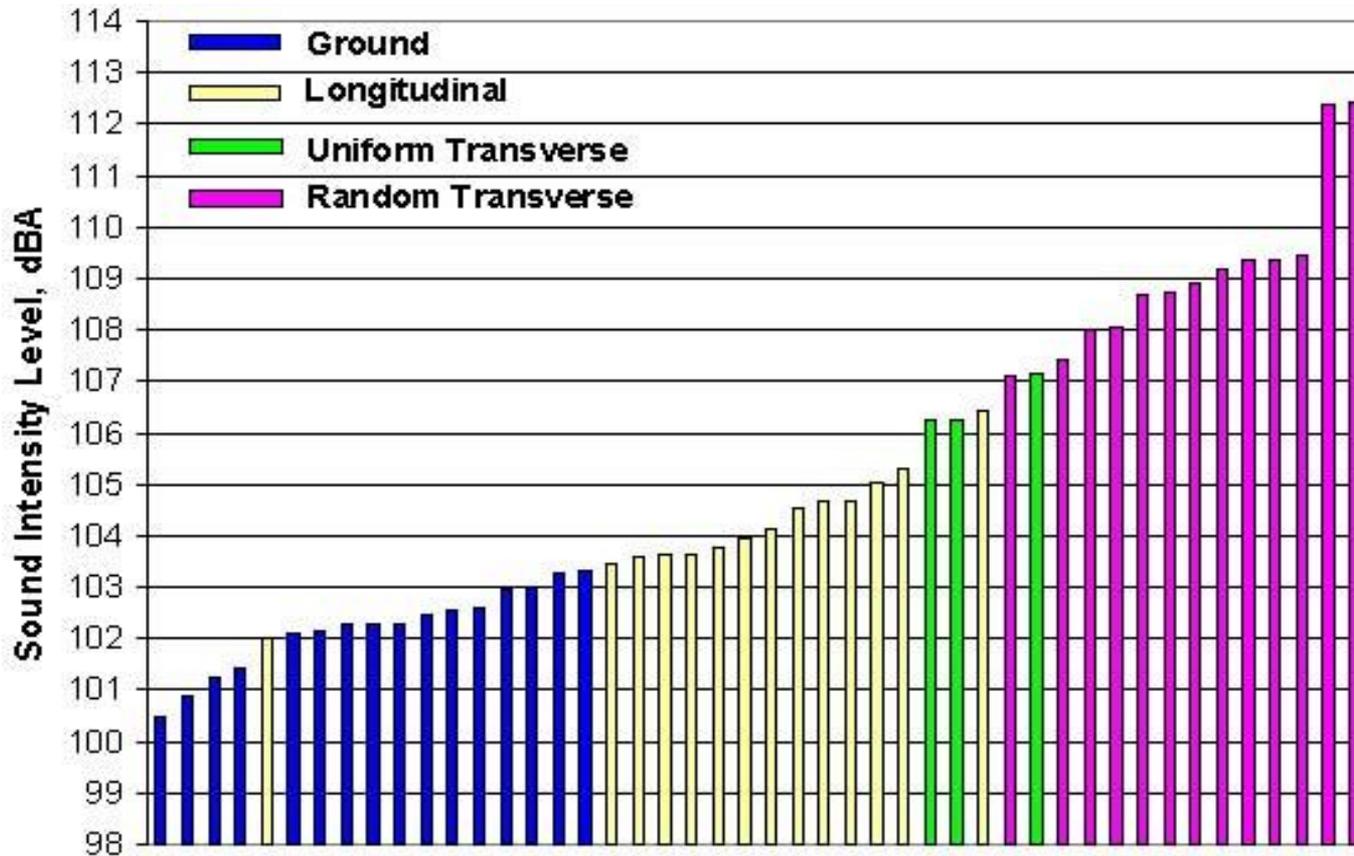


# NCPTC Noise Catalogue

- Research conducted by the National Concrete Pavement Technology Center shows diamond grinding as the most quiet PCCP surface texture commonly used.



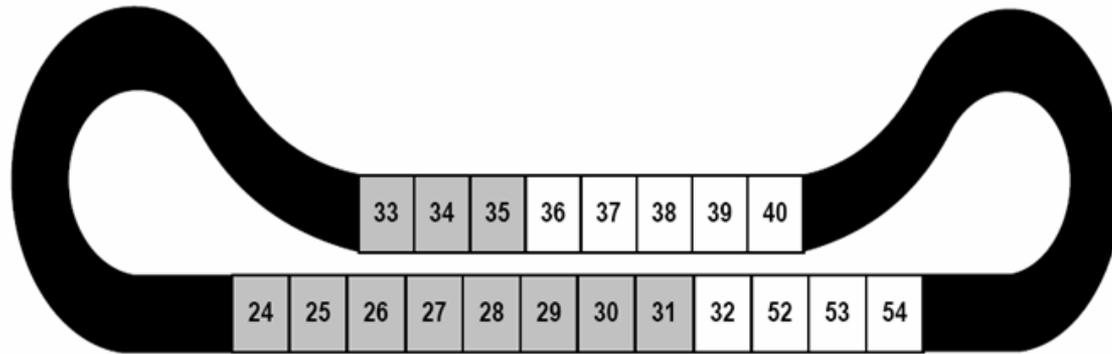
# Caltrans & ADOT Testing



# Purdue-Tire Pavement Testing Apparatus

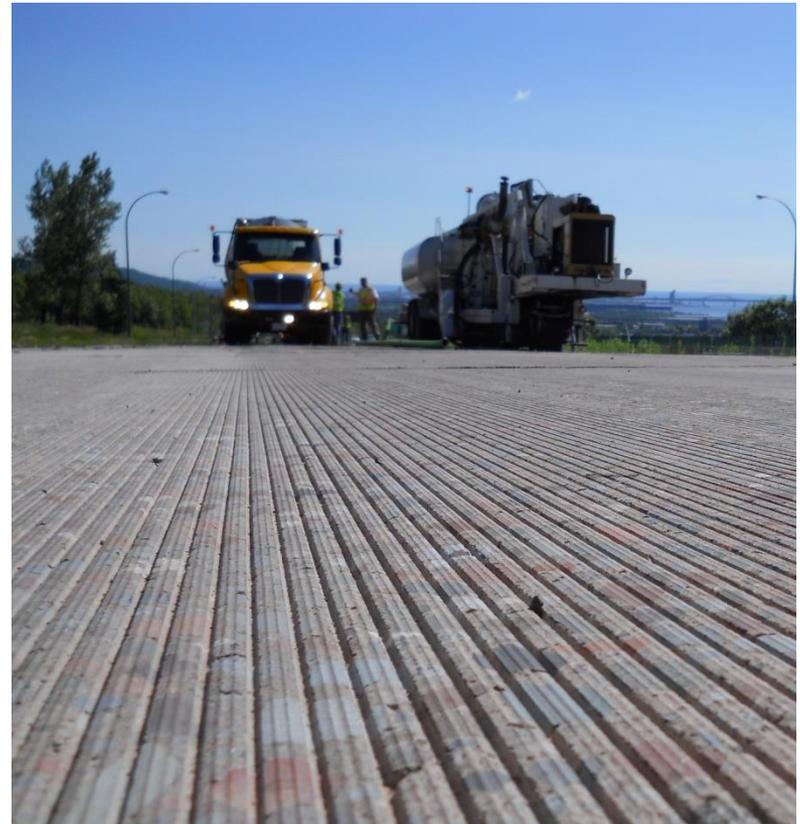


# MNROAD Field Validation of TPTA

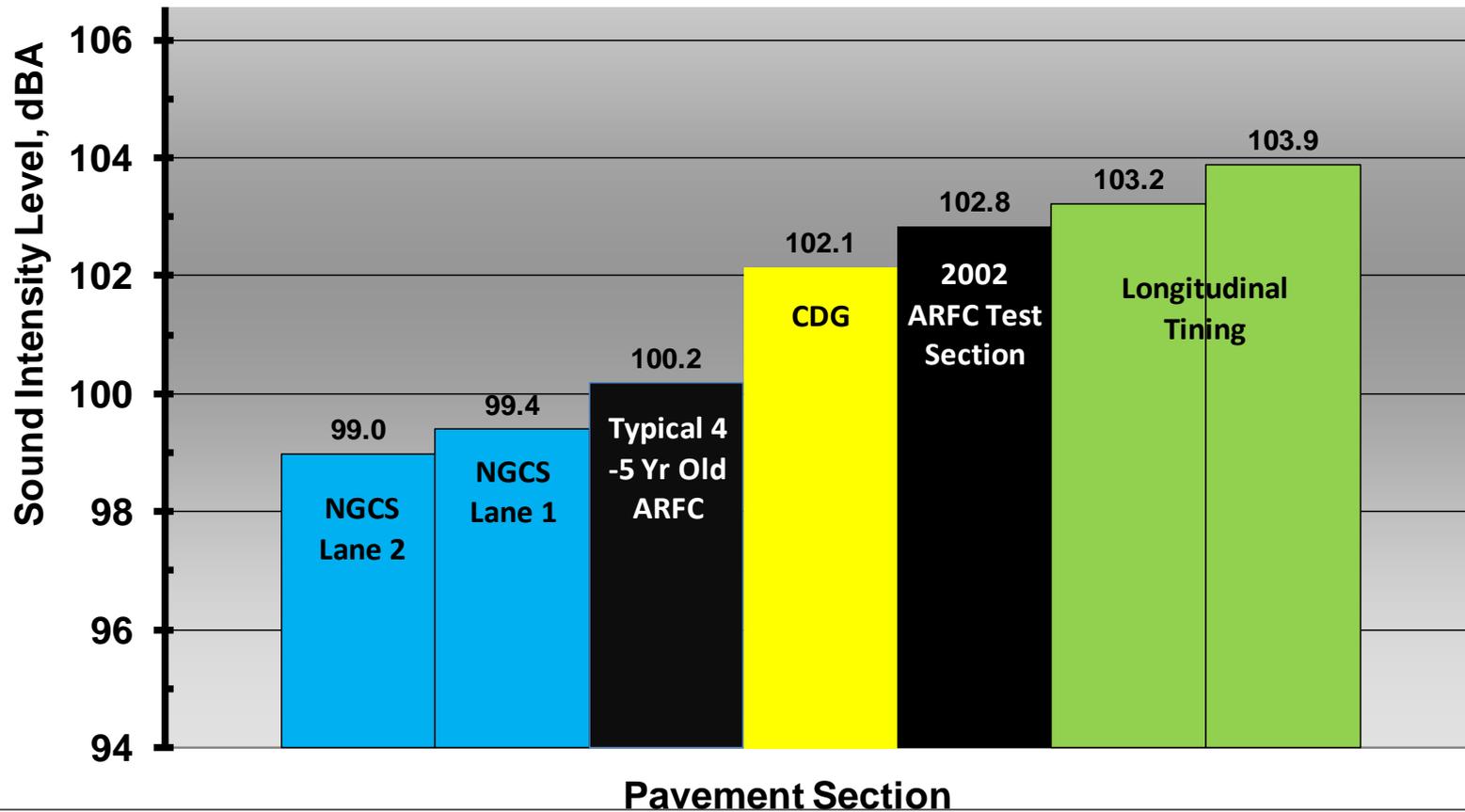


	36	37	38	39	40	32	32	52	53	54	54
Layer Depth (Inches)	6.4" 5" Sand	6.4" 12" Sand	6.4" 5" Clay	6.4" 5" Clay	6.3" 7.6" 5" Clay	6" 6" Clay	5" 1" 6" Clay	7.5" 5" Clay	7.5" 5" Clay	4" 60" Culverts Clay	7.5" 12" Clay
Panel Width	12'	12'	12'	12'	12'	Gravel	12'	13'/14'	13'/14'		12'
Panel Length	15'	12'	15'	20'	15'	Section	10'	15'	15'		15'
Dowel Bar Diameter	1"	none	1"	1"	none	--	none	Varies	none		1"
Subgrade "R" Value	70	70	12	12	12	12	12	12	12	12	12
Construction Date	Jul-93	Jul-93	Jul-93	Jul-93	Jul-93	Sep-98	Jun-00	Jun-00	Jun-00	Oct-00	Oct-04

# Duluth Minnesota NGCS



# Comparison to Other Pavement Surfaces

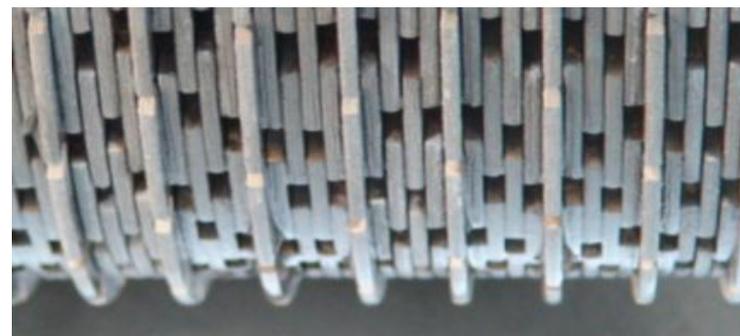
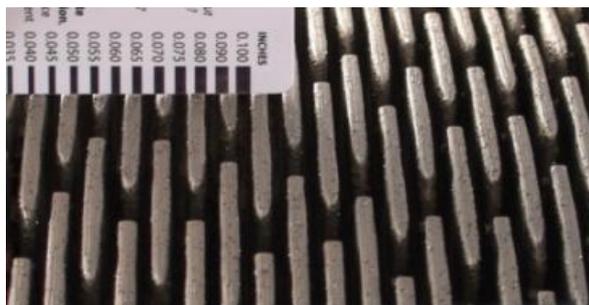


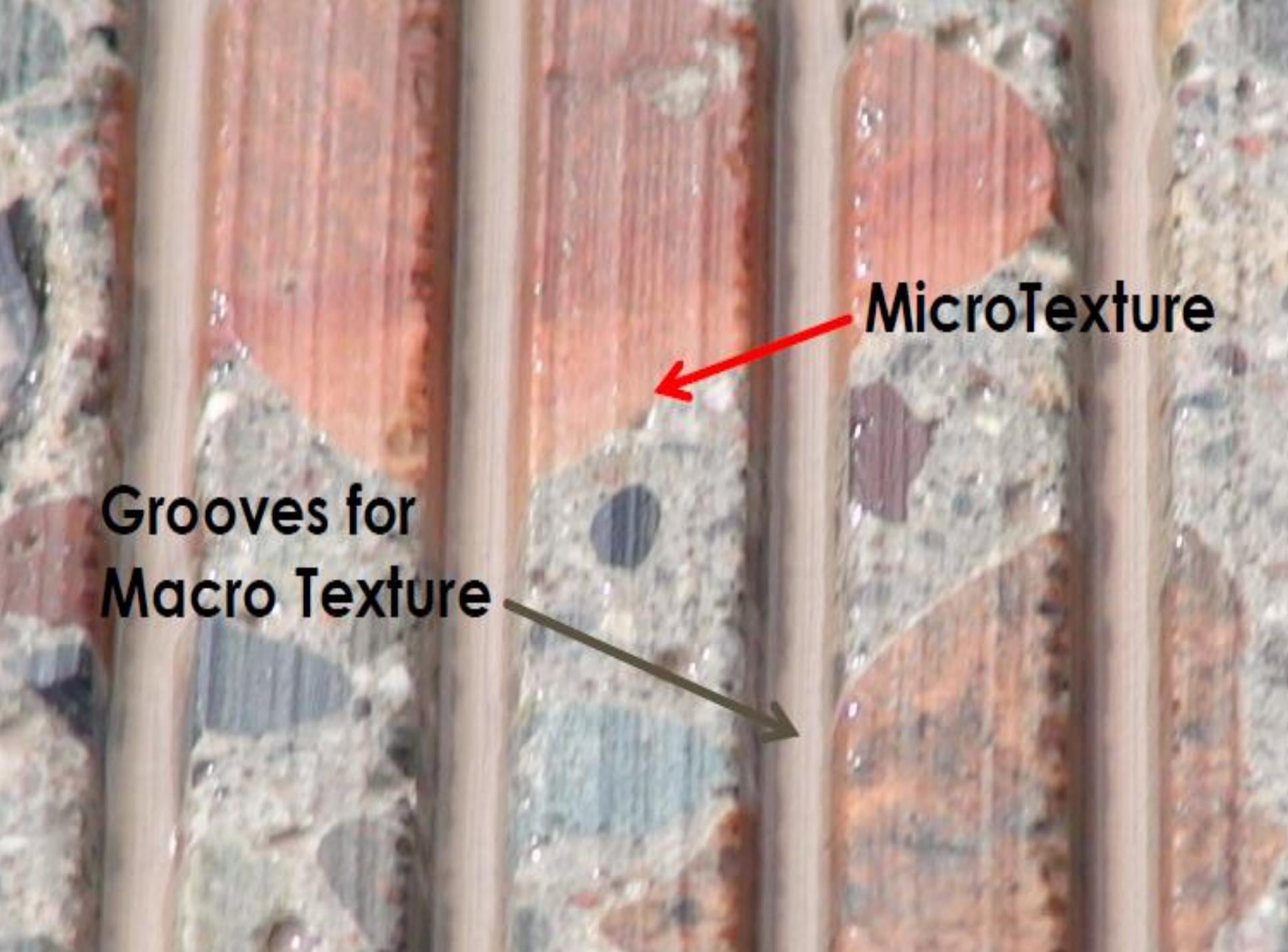
# NGCS is Built Using DG Technologies



**CDG**

**NGCS**





**MicroTexture**

**Grooves for  
Macro Texture**

# Why Grooving?

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- Grooves provide “escape route” for water trapped between tire and pavement surface
- Increases macro-texture of pavement surface.
- **Reduces the potential for hydroplaning**

# Reduced Splash and Spray

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# CALTRANS Grooved Pavement Study

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- Study conducted over a four-year period
- All grooved and un-grooved control sections located on freeways in urban Los Angeles County
- Study includes 322 lane-miles of grooved pavement
- Study includes 750 lane-miles of un-grooved control sections

Technical Report Documentation Page

1. REPORT No.                      2. GOVERNMENT ACCESSION No.                      3. RECIPIENT'S CATALOG No.

4. TITLE AND SUBTITLE  
Study Of The Effect Of Grooving On Motor Vehicle Accidents

5. REPORT DATE  
January 1972

6. PERFORMING ORGANIZATION

7. AUTHOR(S)  
Darryl R. White

8. PERFORMING ORGANIZATION REPORT No.

9. PERFORMING ORGANIZATION NAME AND ADDRESS  
State of California  
Business and Transportation Agency  
Department of Public Works

10. WORK UNIT No.

11. CONTRACT OR GRANT No.

12. SPONSORING AGENCY NAME AND ADDRESS

13. TYPE OF REPORT & PERIOD COVERED

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

Grooving has proved to be one of the most cost-effective safety programs of the Department of Public Works. Grooving has contributed greatly to savings in lives, injuries and dollars for the travelling public. Rainfall is comparatively moderate in California but the accident rate is four times greater on wet pavement than on dry pavement. This is one of the problem areas for which a positive solution has been found.

The Department of Public Works' accident experience reveals that grooving has yielded a:

- 1) 20 percent reduction in total accidents
- 2) 50 percent reduction in fatal accidents
- 3) 70 percent reduction in wet pavement accidents

Motorcycle accident reports were reviewed from both grooved and ungrooved sections. Abstracts of these reports are given in the following pages. They show little evidence that grooves constitute a hazard to the cyclist.

17. KEYWORDS

18. No. OF PAGES:                      19. DRI WEBSITE LINK  
54                      <http://www.dot.ca.gov/hq/research/researchrep>

20. FILE NAME  
72-69.pdf

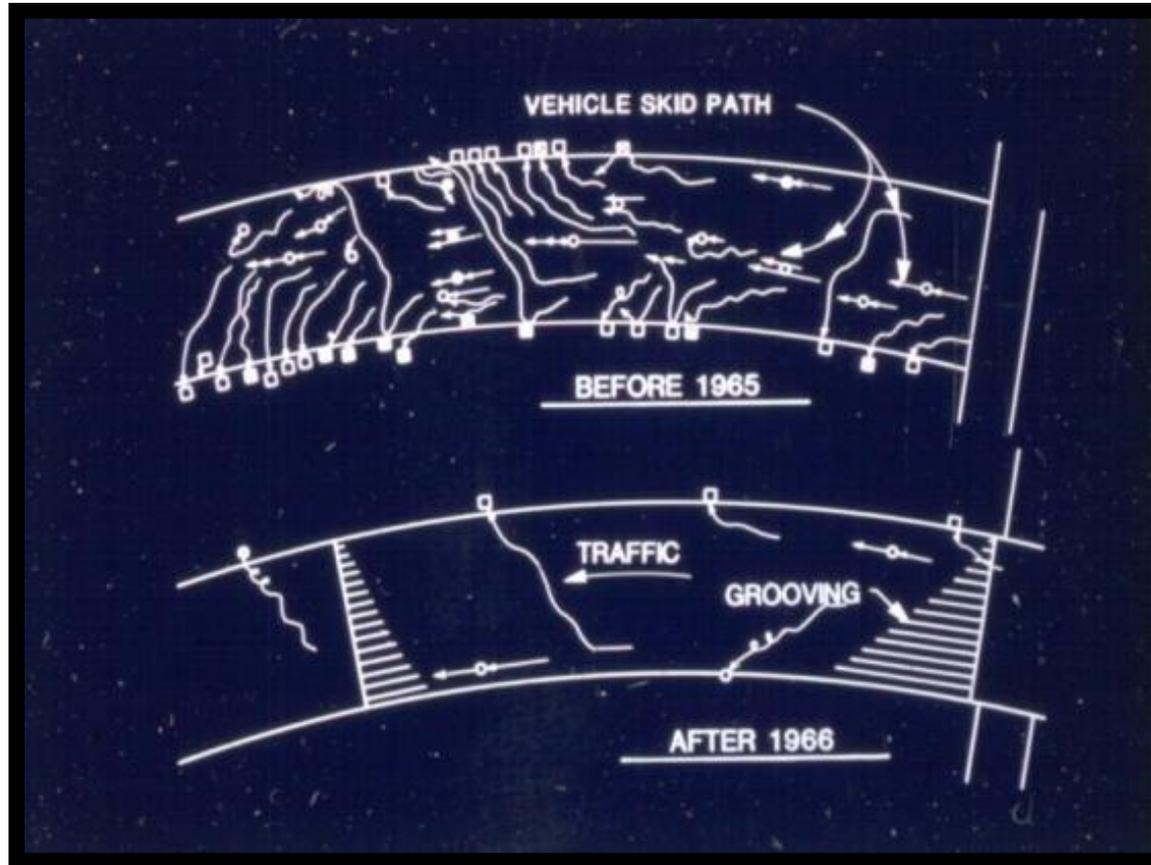
This page was created to provide searchable keywords and abstract text for old  
November 2005, Division of Research and Innovation

# Caltrans Grooving Research

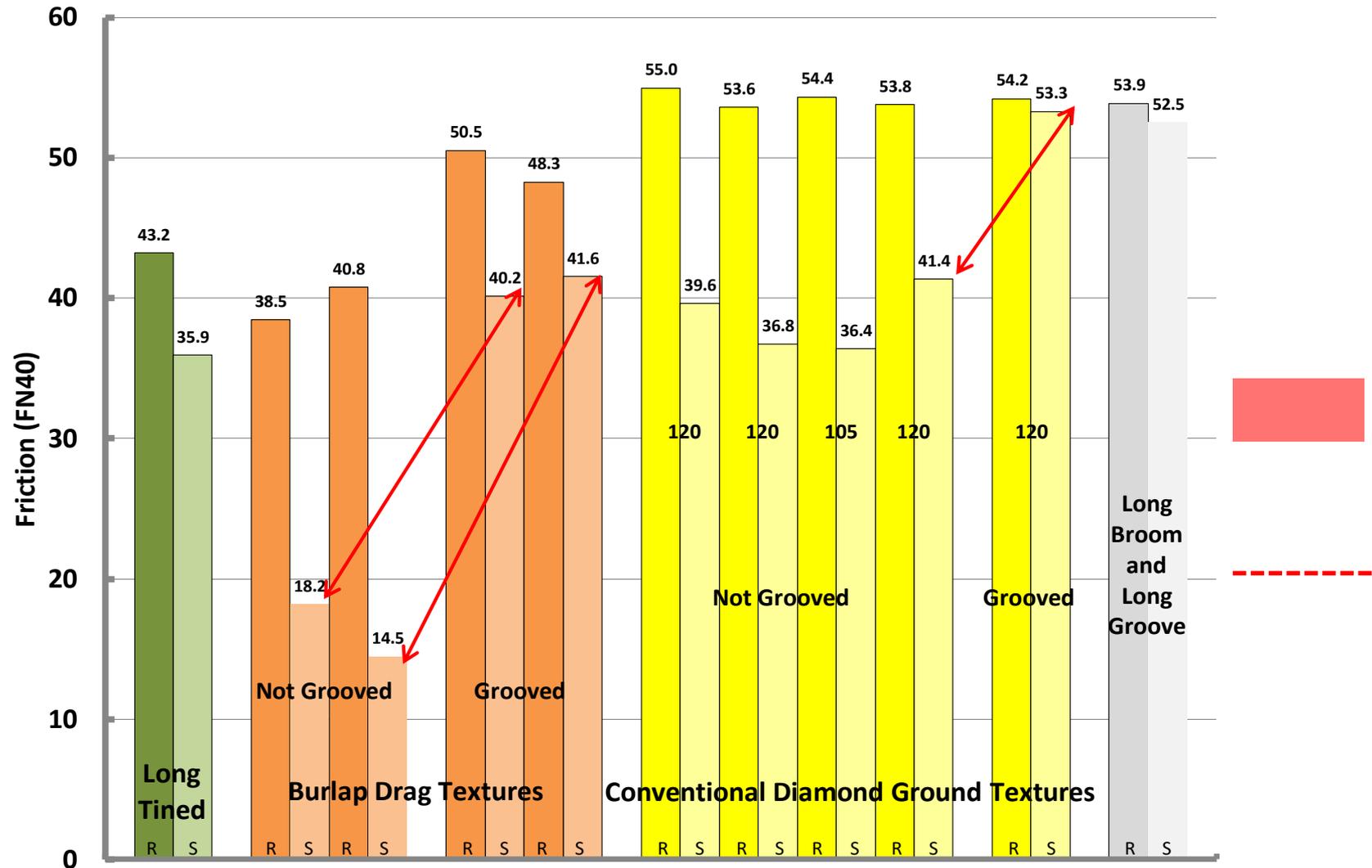
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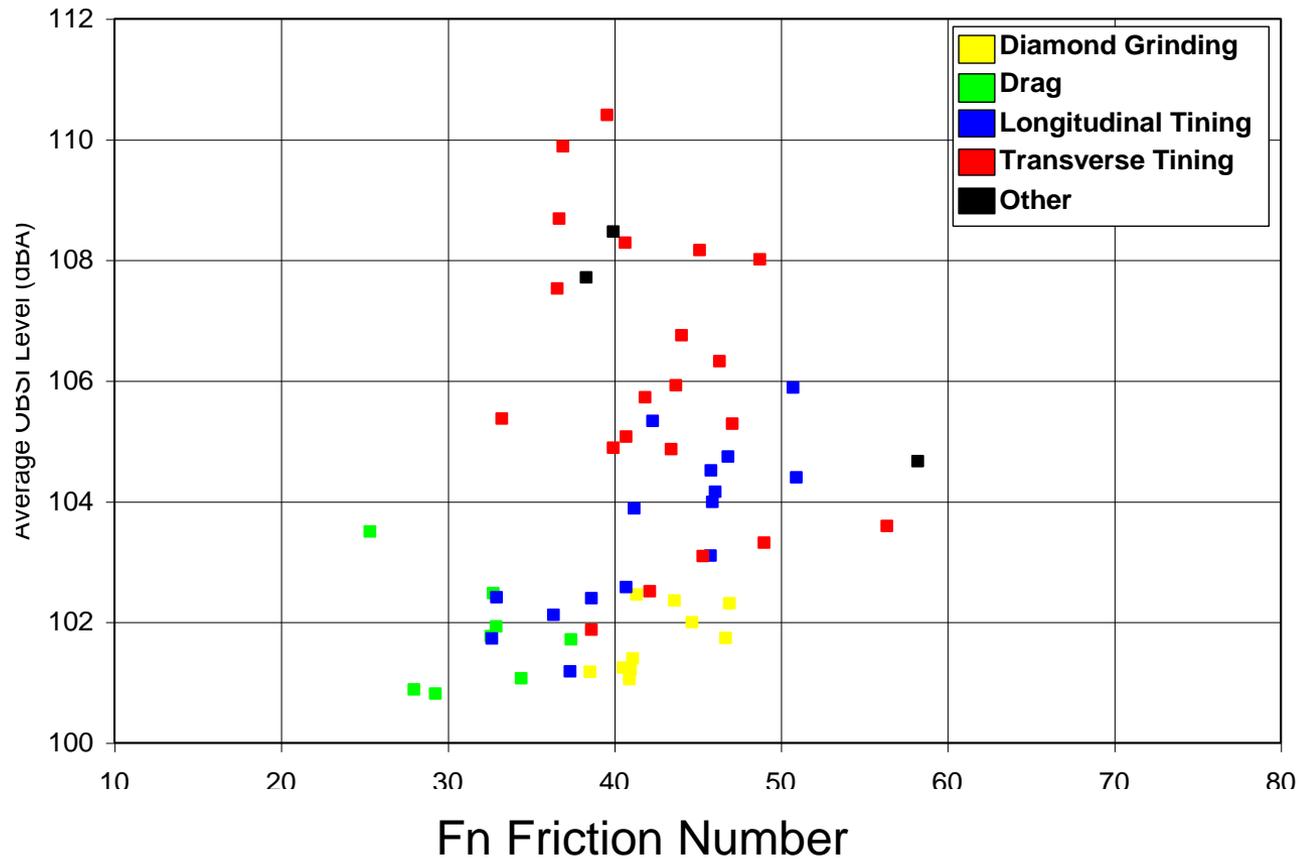
# Effects of Groove Geometry



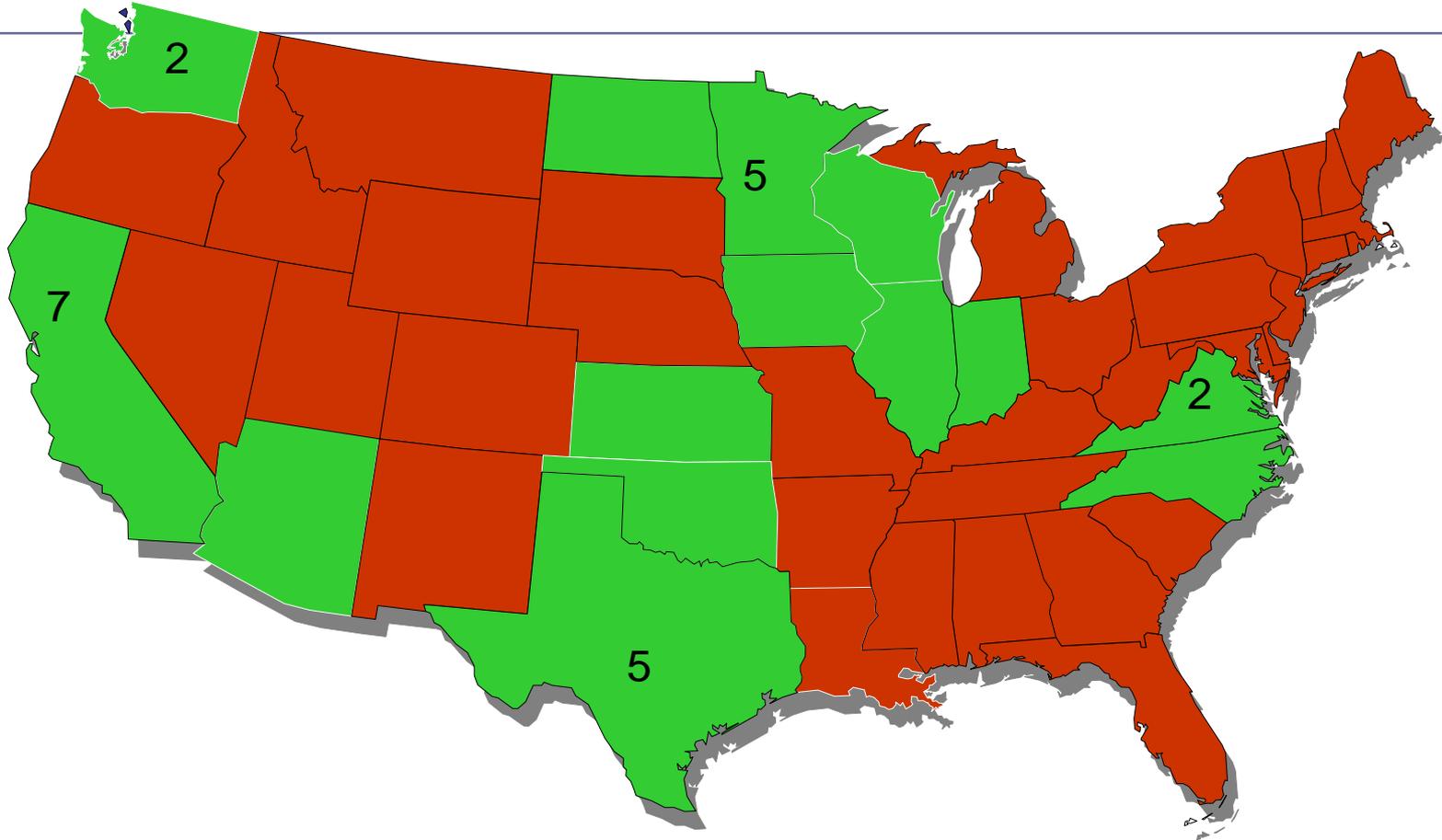
# California SR 58 - 10 Years Old



# Noise vs. Friction

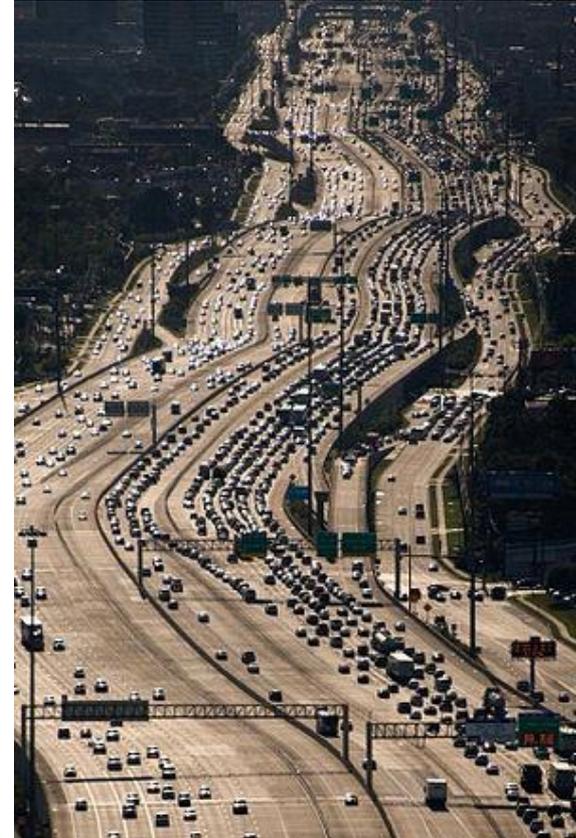


# NGCS Site Locations in The USA



# TXDOT NGCS Usage

- TxDOT - Houston District (the largest DOT district in the state) incorporated NGCS into several major highways, including I-10, Harris County's U.S. 290, and the 610 Loop.
- Houston has constructed approximately 3 million square yards of NGCS as of 2018.



# In Summary

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- Motorists are increasingly demanding safe, smooth, quiet and delay free roadways while funding necessary to meet these needs remains elusive.
- Diamond saw-cut textures are a time proven, cost effective means of providing consistently smooth, quiet and safe textures at a cost often lower than asphalt overlays.
- Diamond saw-cut textures are not as subject to inflationary pressures as asphalt based products.

# In Summary

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- Diamond grinding can provide sustainable benefits such as increased pavement longevity, increased fuel economy, reduced noise and resource conservation
- Diamond grinding can extend pavement life significantly at a competitive cost
- IGGA is ready to assist!

# Visit Us on the Web

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**International Grooving and Grinding  
Association**

**at**

**[igga.net](http://igga.net)**

***THANK YOU!***