

Retexturing Concrete Pavements: Traditional Techniques and Next Generation Concrete Surface

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Presentation Outline

- Introduction
- Traditional Retexturing Methods
 - Diamond Grinding
 - Shot Blasting
 - Water Blasting
 - Micro Milling
- Next Generation Concrete Surface (NGCS)
 - Application Process
 - Capabilities
 - Limitations
- Local Case Study
 - Loop 610, Harris County
- Resources



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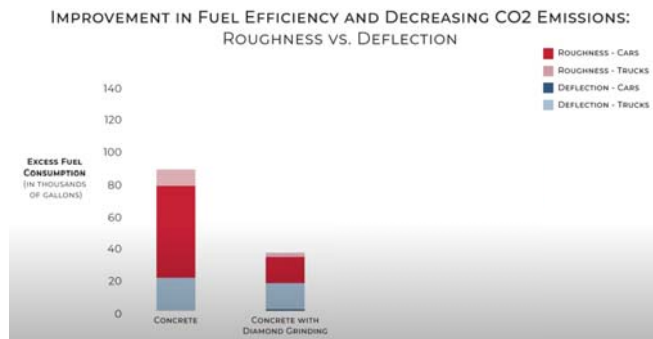
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Introduction

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Retexturing Concrete Pavements

- Pavement needs to be maintained in a smooth condition over its lifetime
 - Durability
 - Quietness
 - Skid resistance
- Can help improve fuel efficiency and decrease CO2 emissions.



Retrieved from the International Grooving and Grinding Association (IGGA)

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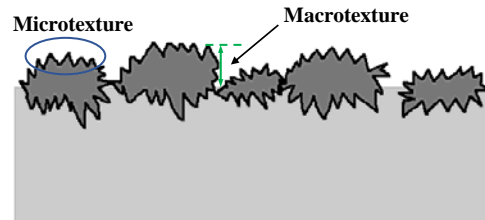
Characterization of Surface Texture

➤ Microtexture

- Small scale texture 0.0004 to 0.02 in. (1 μm to 0.5 mm)
- Surface irregularities on individual aggregates
- Provides adequate friction at mid speeds (under 50 mi/hr)
- Primarily function is for skid resistance
- Does not impact noise or splash and spray

➤ Macrottexture

- Large scale texture of 0.02 to 2 in. (0.5 to 50 mm)
- Provides adequate friction at high speeds
- Primarily function is to prevent hydroplaning
- Strong impact on noise and splash and spray



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Characterization of Surface Texture (cont.)

➤ Megattexture

- Large scale texture of 2 to 20 in. (50 to 500 mm)
- Typically results from poor construction practices, localized settlement or surface deterioration.
- Little impact on pavement friction
- May result in some external and in-vehicle noise
- Reduces ride quality and increases wear

➤ Unevenness (Roughness)

- Irregular texture greater than 20 in. (500 mm)
- Generally attributed to environmental effects, construction practices and localized settlement
- Little impact on noise and friction
- Affect ride quality and surface drainage
- Increases rolling resistance
- Increase dynamic loading



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When to Consider Retexturing

- Improve Skid Resistance/Reduce Accidents
- Reduce Noise
- Eliminate Ghost Striping
- Improve Ride
- Reduce Glare
- Enhance Bond or Penetration
- Reduce Steering Affects
- Remove Striping or Rubber
- Reduce thickness or level pavement surface



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Traditional Retexturing Methods

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Diamond Grinding – Capabilities

- Reduce pavement thickness or level the surface (3/4-in. max in one pass)
- Improve ride
- Reduce noise
- Improves micro and macro texture (skid resistance)
- Blends patching with adjacent surface
- Eliminate striping



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Diamond Grinding – Limitations

- Will have to clean and reseal joints
- Will leave holidays at dips
- May have to grind shoulders for drainage
- Will have to be shot blasted to use sealers or hardeners
- May cause steering issues with light vehicles
- Cannot be used over armored joints
- May cause glare



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Shot Blasting – Capabilities

- Improves macro and micro texture (skid resistance)
- Does not harm joint or crack seals
- Can be used over armored joints
- Can be used to restore drainage in porous pavements
- Will eliminate ghost striping
- Will significantly reduce glare
- Can be used to remove striping



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Shot Blasting – Capabilities (cont.)

- Will improve the penetration of hardeners and sealers
- Will improve the bond of concrete overlays & high friction surface treatments
- Blends patching with adjacent surface
- Existing striping can be left in place without affecting drainage
- Can reduce noise by reducing positive texture



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Shot Blasting – Capabilities (cont.)

- Can be used to complement diamond grinding by:
 - Providing texture in the holidays
 - Reducing the steering affects on light vehicle
 - Improving the penetration of sealers and hardeners
- Can be used to complement micro milling by removing loose materials and improving bond for an overlay



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Shot Blasting – Limitations

- Should not be used to improve ride
- Should not be used to reduce pavement thickness or level the pavement surface



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Water Blasting – Capabilities

- Can be used to remove striping and rubber
- Can be used to provide macro texture
- Can be used to clean surface
- Can be used to clean out joints and cracks



Water Blasting – Limitations

- May need to clean and reseal joints and cracks
- Does not provide micro texture

Micro Milling – Capabilities

- Can be used to reduce pavement thickness as part of a rehab strategy
- Can be used to level up an existing pavement surface prior to an overlay, however shot blasting may be necessary to remove broken/loose aggregate and provide a surface that enhances the bond of the overlay



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Micro Milling – Limitations

- Does not improve micro texture
- Cannot be used over armored joints
- Joints and cracks will have to be cleaned and resealed
- May cause spalling at joints and cracks, making it hard to provide a good seal



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Next Generation Concrete Surface (NGCS)

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NGCS - Introduction

- Developed by Perdue Univ. in 2007 through a Tire Pavement Test Apparatus (TPTA)
- NGCS has been in service for almost 13 years and has been constructed in 15 states.
- In Texas, the Houston District takes the lead with over 3 million square yards.



Retrieved from the International Grooving and Grinding Association (IGGA)



Retrieved from American Concrete Pavement Association (ACPA)



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What is NGCS?

- Longitudinal texture treatment
- Can be used for new construction and rehabilitation of existing surfaces
- NGCS has demonstrated quieter than Conventional Diamond Grinding (CDG)

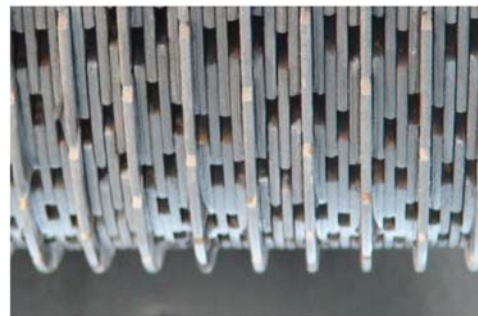


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NGCS Single Pass Application Process

- Grinding/Grooving Configuration
 - Smaller diameter blades between taller blades
 - Taller blades are approx. 0.08 in. larger in radius



Retrieved from American Concrete Pavement Association (ACPA)



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NGCS Two Pass (2-Step) Application Process

- Created by first diamond grinding the surface
 - A flush grind eliminates positive texture elements
 - Different blade set-up than CDG (smaller blades)
- Grooves are then saw cut into the pavement
 - Using taller blades with spacers between them to create approx. ½ in. on centers
 - Create negative or downward facing texture
 - Provide an escape route for water trapped between the tire and the pavement
 - Increases macrotexture
 - Minimizing the potential for hydroplaning



Retrieved from American Concrete Pavement Association (ACPA)



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NGCS Multi Pass Application Process

- Conventional Diamond Grinding
 - Used to remove existing/temporary tining that is too deep
 - Can open traffic after CDG
 - temporary striping
- NGCS Diamond Grinding
- NGCS Grooving

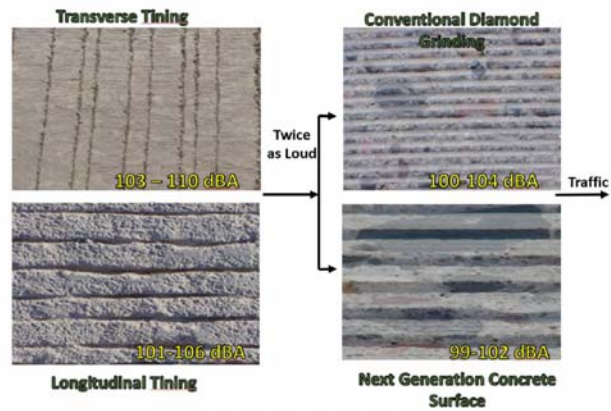


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NGCS – Capabilities

- Similar capabilities to CDG except
 - Significantly decreases tire/pavement noise

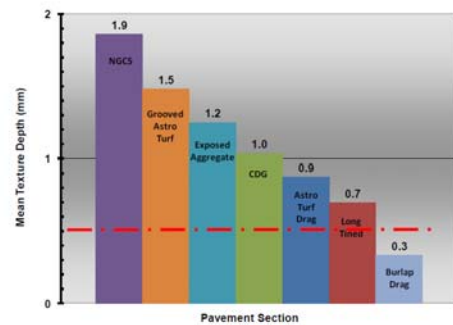


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NGCS – Capabilities (cont.)

- Smoother
 - The grooving used in NGCS enhances hydroplaning resistance
 - Provides similar ribbed and smooth tire test results, which are used to determine good frictional resistance



Retrieved from American Concrete Pavement Association (ACPA)



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NGCS – Limitations

- It is a new technology
 - Still much to learn
 - Acceptance/Concerns
 - Training

➤ Glare

➤ Striping

➤ Pulling Effect?

**Shot blasting to improve
on glare, remove striping
and to reduce pulling
effects**



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Texas Loop 610 Study

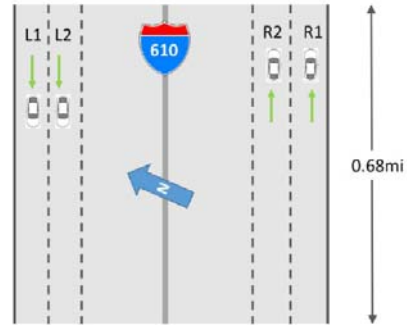
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Loop 610 Harris County, TX Test Section

➤ Developed by UT San Antonio to evaluate the performance of NGCS

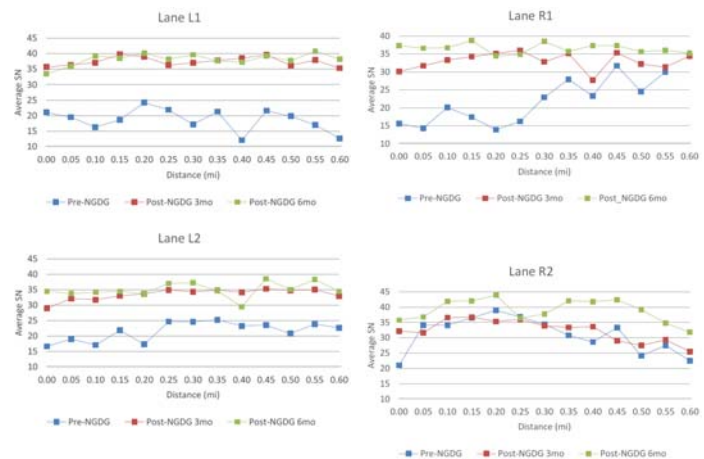
- Skid resistance
- Ride quality
- Macrotexture
- Sound

Data Collected:
Pre-NGCS
3-mo Post-NGCS
6-mo Post-NGCS



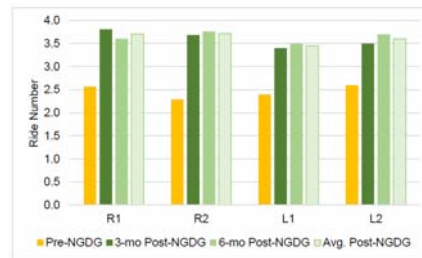
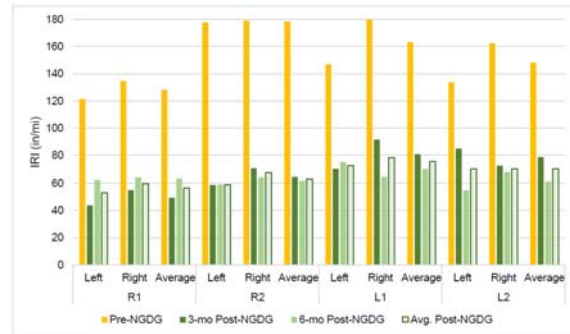
Skid Resistance

- Overall improvement was observed
- Average SN improvement: 59.5%
- Overall percent slip improvement: 35%



Ride Quality

- NGCS caused significant improvement on both ride quality indices, IRI and RN.
- Overall improvement
 - IRI: 91-202%
 - RN: 35-64%



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Macrotexture

- Consisted of mean profile depth (MPD) measurements at every 2ft
- NGCS caused a small but significant increase in MPD for lanes R1, R2 and L2 and no change in L1.
- Between Pre and 3-mo Post-NGCS
 - MPD improved 24.7%
- 6-mo Post-NGCS MPD results were inconsistent
 - Still indicated positive effects

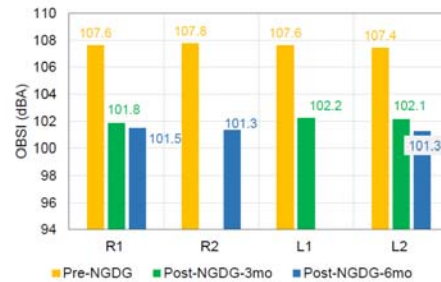


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Noise Reduction

- The observed sound intensity reductions result in percent decreases in noise ranging from 67.9% to 79.1%
- At a 5% annual traffic growth rate, this means it would take from 23 to 32 years for the post-NGCS pavement to cause the same noise as the pre-NGCS pavement with today's traffic



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Other U.S. Studies

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Studies on the Performance of NGCS

- California
- Virginia
- Kansas
- Indiana
- Washington State
- Arizona



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Retexturing Cost

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Is Retexturing Cost Effective?

- NGCS \$5 - \$8 per SY
- Diamond Grinding \$2.5 - \$5 per SY
- Shot Blasting \$1.80 - \$2.25 per SY
- Micro Milling \$2.00 - \$3 per SY/inch
- Water Blasting \$1 - \$2 per SY
- HMAC \$3 - \$8 per SY/inch



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Retexturing Advantages vs Overlays

- Faster
- Less Expensive
- More Sustainable
- Renewable



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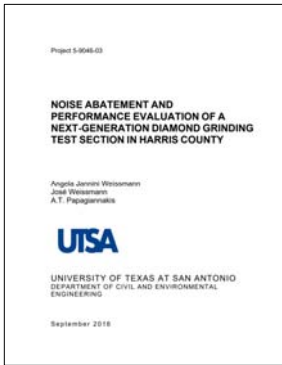
Resources



<http://www.acpa.org/wp-content/uploads/2017/08/NGCS-Development-and-Implementation-6-7-16.pdf>

<https://www.fhwa.dot.gov/pavement/pubs/hif17011.pdf>





<https://library.ctr.utexas.edu/hostedpdfs/utsa/5-9046-03.pdf>



Questions?



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