Diamond Grinding

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

- 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!
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?

- 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
Typical Conventional Diamond Grinding (CDG) Blade Configuration

- Saw Blade Segment
- Saw Blade Core 0.105 (2.7 mm)
- Spacer 0.110 (2.8 mm)
- Land Area 0.090 (2.3 mm)
- 0.125 (3.2 mm)
Diamond Grinding Equipment
Diamond Grinding Process
Conventional Diamond Ground Surface

Diamond Grinding

- Width of diamond blades: 0.125 inches (3.2 mm)
- Land area: 0.080 inches (2.3 mm) for hard aggregate, 0.110 inches (2.8 mm) for soft aggregate
Milled Surfaces
Milling Drum
Impact vs Abrasion
Advantages of Saw-Cut Textures

- 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

- Concrete PPI
- Asphalt PPI
- CPI

3.6% inflation
5.5% inflation
3.9% inflation

Last Time Trust Fund Increased
DG is Cost Effective and Predictable

National Cost for Projects > Than 7,000 SY

Year

CDG Costs (sq/yd)

$0.00

$1.00

$2.00

$3.00

$4.00

$5.00

$6.00

Pavement Problems Addressed

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

Before Grinding

After Grinding

I - 635
WB Lanes K1, K2 K3 & K4

Average IRI
Before Average
After Average
Before Grinding 698 Bumps
After Grinding 29 Bumps
IRI of KY Interstate Pavements

![Graph showing the decrease in IRI from 2007 to 2012. The IRI values are as follows:
- 2007: 112.1
- 2012: 74.5]
KTC Diamond Grinding Experience

- 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

- 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!

I-70 Missouri
Unacceptable Noise Level
Transverse Tining

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

- 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

International Grooving and Grinding Association
Duluth Minnesota NGCS
Comparison to Other Pavement Surfaces

<table>
<thead>
<tr>
<th>Pavement Section</th>
<th>Sound Intensity Level, dBA</th>
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<tbody>
<tr>
<td>Arizona I - 10 NGCS Test Sections Compared to Other Surfaces</td>
<td>99.0</td>
</tr>
<tr>
<td>CDG Typical 4-5 Yr Old ARFC</td>
<td>99.4</td>
</tr>
<tr>
<td>ARFC Test Section</td>
<td>100.2</td>
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<tr>
<td>CDG</td>
<td>102.1</td>
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<tr>
<td>Longitudinal Tining</td>
<td>103.2</td>
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<tr>
<td>Typical 4-5 Yr Old ARFC</td>
<td>103.9</td>
</tr>
</tbody>
</table>

International Grooving and Grinding Association
NGCS is Built Using DG Technologies
Grooves for Macro Texture

MicroTexture
Why Grooving?

- 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
CALTRANS Grooved Pavement Study

- 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
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
Effects of Groove Geometry
California SR 58 - 10 Years Old

Friction (FN40)

- Long Tined
- Burlap Drag Textures
- Conventional Diamond Ground Textures

Not Grooved
Grooved
Long Broom and Long Groove
Noise vs. Friction

![Graph showing the relationship between friction number (Fn) and average noise level (dB(A)). The graph includes data points for Diamond Grinding, Drag, Longitudinal Tining, Transverse Tining, and Other methods. Different markers and colors are used to distinguish between the methods.](image-url)
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

- 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

- 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

International Grooving and Grinding Association

at

igga.net

THANK YOU!