PUT SAFETY FIRST

DIAMOND SAW-CUT TEXTURES DECREASE ACCIDENTS & SAVES LIVES
Introduction

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Wet Weather Accidents

Driving in rain, snow or ice is known to increase the risk of accidents and the loss of life.

The reason? A loss of friction between the tire and pavement surface.
What is hydroplaning

Hydroplaning is when the tire is not in contact with the pavement due to standing water on the pavement surface.
Back to the future

- The first Portland Cement Concrete Pavement (PCCP) constructed in US was located in Bellefontaine, Ohio, 1891
- Used two lift construction
  - Hard aggregate on surface so horseshoes wouldn’t wear pavement.
  - Surface texture was grooved in 4” squares so horses would not slip
Remove water to improve traction

Extensive research and applications across the world’s pavements show that removing water from a road surface improves friction and decreases accidents during inclement weather.
Increasingly Specifiers are utilizing diamond saw cut surfaces to reduce roughness, minimize noise and increase the friction of their pavements, bridges and runways.

- Economical
- Long-lasting
- Effective
- Environmentally Sustainable
Performance matters!

- Bristol Motor Speedway 2012
Advantages of saw-cut textures

- Costs substantially less than AC overlays
- Enhances surface friction and safety
- Saw-cut surfacing can be accomplished during off-peak hours with short lane closures
- Diamond saw-cut 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 and sustainable
Diamond saw-cut texture variations

- Conventional Diamond Grinding
- Longitudinal Safety Grooving
- Transverse Grooving
- Next Generation Concrete Surface
Blades and spacers
Grinding (CDG) blade configuration

Land Area 0.090 (2.3 mm)

Saw Blade Segment

Saw Blade Core 0.105 (2.7 mm)

Spacer 0.110 (2.8 mm)
Diamond grinding equipment
Diamond grinding process
Conventional diamond ground surface (CDG)

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
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
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.

- Over 20 million square yards of PCCP are diamond ground in the US every year.
Can be used on asphalt too!

I-70 Missouri
CDG is cost effective and predictable

National CDG Cost for Projects > Than 7,000 SY
Pavement grooving, which is both easy and economical, is effective for increasing traction, reducing hydroplaning and minimizing splash and spray.
Diamond Grinding

Width of diamond blades (.125 inches)

Land area - .08 inches for hard aggregate
- .110 inches for soft aggregate

Diamond Grooving

Saw blade thickness (.125 in – 3.2mm)

75 in – 19 mm

.125 in – 3.2 mm
Grooving head

.75 inch (19 mm) Spacing
How is pavement grooved?

- Grooves are saw-cut using machines equipped with circular diamond-tipped blades.
- Blades are mounted and spaced on a horizontal shaft and are cooled constantly by water pumped from a tanker. (Water is recovered by an on-board vacuum system.)
- Grooving can be constructed on concrete and asphalt surfaces.
- Grooves are typically 1/8-inch to 3/16-inch deep and 1/8-inch wide. Spacing is typically ¾-inch center-to-center.
Why use grooving?

- Reduce the number of wet pavement accidents
- The wet pavement accident occurs when the vehicle pavement friction demand exceeds the ability of the pavement-tire contact to produce the required amount of friction
Improved internal water drainage

- Grooves provide “escape route” for water trapped between tire and pavement surface
- Increases macro-texture of pavement surface
- Minimizes splash and spray
- **Reduces the potential for hydroplaning**
California longitudinal grooving research studies

- California DOT conducted several safety grooving studies from 1963 through 1975
  - RPT No. CA-DOT-TL-3126-10-75-07 – Portland Cement Concrete Pavement Texture Quality Investigation
California longitudinal grooving research study

- Studies 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 longitudinally grooved pavement
- Study includes 750 lane-miles of un-grooved control sections
California longitudinal grooving research study
ASTM locked wheel friction tester
Tests conducted with 2 tire types

Simulates dry weather conditions

Simulates Wet Weather Conditions
California SR 58 - 10 years old

Friction (FN40)

- Long Tined
- Not Grooved
- Grooved
- Burlap Drag Textures
- Conventional Diamond Ground Textures
- Long Broom and Long Groove
Grooving for safety in Ohio – interstate and state routes

- Ohio DOT grooved highways in three counties where wet-road crashes were occurring at a higher-than-expected rate.
- Wet weather accidents decreased in all locations.
- Skid numbers improved 50-70% across the three locations.
Ohio DOT SR 76 - 1 year old
KDOT Surface Characteristics TS, Kansas I-70 EB

Friction (FN40)

- Longitudinally Tined 6 Yrs: 43.0
- CDG 6 Yrs: 56.5
- NGCS 6 Yrs: 50.7
- Exposed Aggregate 6 Yrs: 52.3, 51.7
- Longitudinally Grooved 6 Yrs: 60.4
- Drag Texture 6 Yrs: 28.4
CALTRANS friction test devices
Anisotropic friction
Anisotropic friction behavior

The graph shows the friction index relative to friction in the direction of travel for different surfaces as a function of deviation from the direction of travel (in degrees). The surfaces include CDG, Random Transverse Tined, Astro Turf, and Grooved. The x-axis represents the deviation from the direction of travel, while the y-axis represents the friction index relative to friction in the direction of travel.
Longitudinal grooving summary

- Reduces splash/spray, hydroplaning and wet weather accidents by up to 70% (CALTRANS)
- Reduces fatal accidents by up to 50% (CALTRANS)
- Enhances tire/pavement interlock and lateral stability
- Increases smooth tire (wet friction) skid values dramatically
- Longitudinal textures are quieter than transverse textures
- Will last the life of the pavement
- Longitudinally Based Textures Increase in Friction as Vehicles Get out of Control
- Can be used on both concrete and asphalt pavement
Grooving for Safety in Illinois – I-55

- IDOT grooved 1.92 miles of pavement on I-55 along three separate curved highway segments.
- Longitudinal grooving was the most economical means of addressing friction, compared to asphalt overlays costing >4 times the cost of grooving.
Grooving for Safety in Illinois – Dan Ryan Expressway

- Tight curves (totaling 61,555 sq. yds. pavement) on the Dan Ryan Expressway in Chicago were grooved in order to enhance traction and wet-weather safety.

- The concrete had been transversely tined 8-10 years previously.
Grooving for Safety in New York City—FDR Drive

- New York City’s FDR Drive suffered distorted, shoved asphalt pavement as a result of heavy truck traffic. The Manhattan Transit Authority specified milling, paving and grooving, with diamond saw cut surface textures enhancing safety, especially in wet weather.
Many DOTs specify grooving for bridge decks, which are particularly prone to standing water and freeze faster than roadways.

Measurements collected at the Virginia Smart Road research facility showed that safety grooving can increase macrotexture by 2-5 times that of an original, tined pavement.
Next Generation Concrete Surface - NGCS
Next generation concrete surface - NGCS

- Industry searches for a durable, safe, low-noise concrete surface circa 2001
- Working with Purdue and MNDOT NGCS is developed... a ultra-smooth, high friction surface with acoustically durable properties, that will out perform asphalt based surfaces acoustically over time
- The NGCS texture has performed consistently for over a decade and typically is constructed at an OBSI level of 99 dBA
- Hundreds of miles of NGCS have been constructed dozens of times in 14 states and 4 countries and is **THE** sustainable low-noise concrete surface texture to be used in noise sensitive areas
NGCS is built using DG technologies.
NGCS cross section

First pass 3.2 mm blades with 0.9 mm spacers

Second pass 3.2 mm blades 3 – 5 mm depth
Grooves for Macro Texture

MicroTexture
Mean texture depths – KDOT I-70

Mean Texture Depth (mm)

- NGCS: 1.9
- Grooved Astro Turf: 1.5
- Exposed Aggregate: 1.2
- CDG: 1.0
- Astro Turf Drag: 0.9
- Long Tined Drag: 0.7
- Burlap Drag: 0.3

Pavement Section
NGCS site locations in the USA
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 fraction of the cost of asphalt overlays.

- Diamond saw-cut textures are not as subject to inflationary pressures as other pavement improvement alternatives.
Contact the IGGA today to learn more.