

Diamond Saw-Cut Textures

**Integrating Engineering,
Economics and the Environment
2014**

Introduction

- John H. Roberts
- Executive Director - International Grooving and Grinding Association
- Vice President – American Concrete Pavement Association's Concrete Pavement Preservation Partnership

IGGA

- Founded in 1972
- Originally represented grooving and grinding contractors
- In 1995 the group affiliated with ACPA to become the Concrete Pavement Preservation Partnership (CP3)
- IGGA serves as the technical resource and industry leader in the marketing of optimized pavement surfaces, concrete pavement restoration and pavement preservation around the world.

IGGA's Role

- Marketplace advocacy
- Specification development
- Research
- Legislative assistance
- Promotion and marketing
- Communications

IGGA Current Status

- Offices located near Albany, NY
- Staffing:
 - Executive Director
 - Office Manager
 - Director of Engineering and Research
 - Consultant Promoter
 - Constructive Communications Inc.
 - Shared Staff with ACPA

Strategic Partnerships

- American Concrete Pavement Association
- Affiliated Chapter/State Paving Associations (21)
- National Concrete Pavement Technology Center
- Portland Cement Association

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.



Performance Matters!

➤ Bristol Motor Speedway 2012



Transportation Authorities React

- 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!

Surface Characteristics Matter!



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



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 and runways.
 - Economical
 - Long-lasting
 - Effective
 - Environmentally Friendly



Case Studies

- MNDOT
- CALTRANS
- ODOT (Bridge Specification)
- NSW Australian RMS
- BASt Germany

Duluth Minnesota NGCS



Next Generation Concrete Surface NGCS



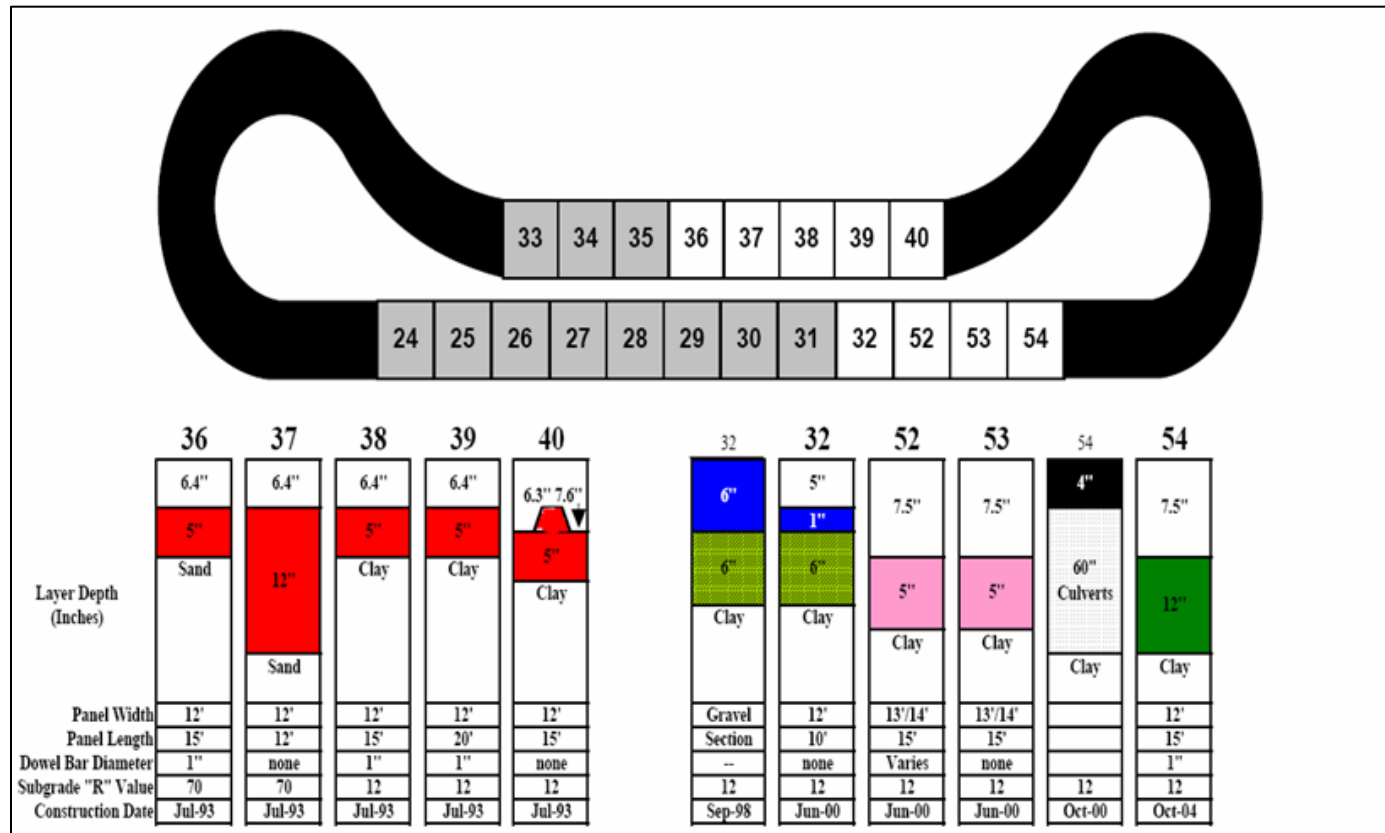
What is the Next Generation Concrete Surface?

- NGCS is a term used to describe a category of textures that have or will evolve through current research. The term applies to textures meant for both new construction and rehabilitation of existing surfaces. The desirable characteristics of such textures will be a very smooth profile coupled with good micro texture and excellent macro texture.

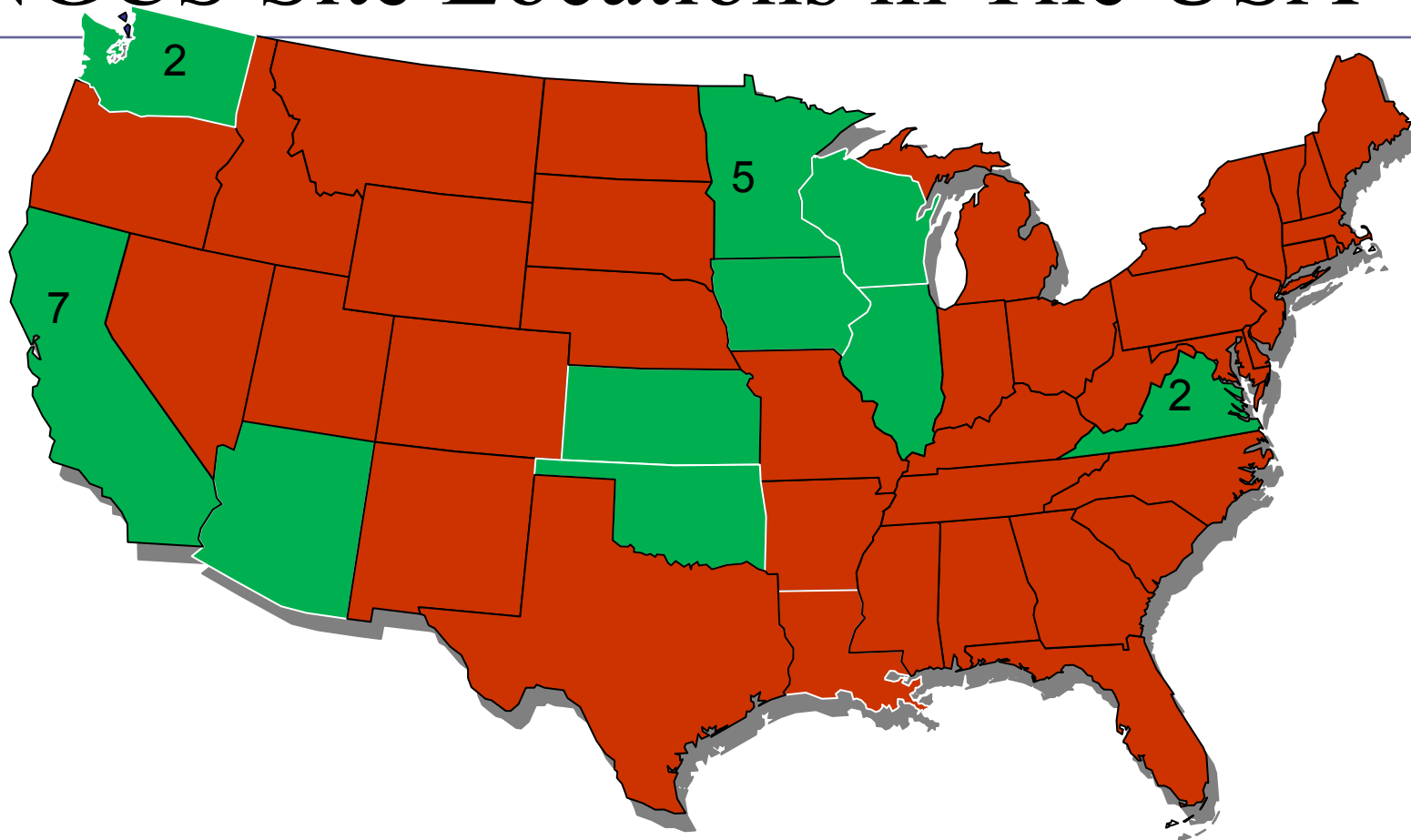
Purdue-Tire Pavement Testing Apparatus



MNROAD Field Validation of TPTA



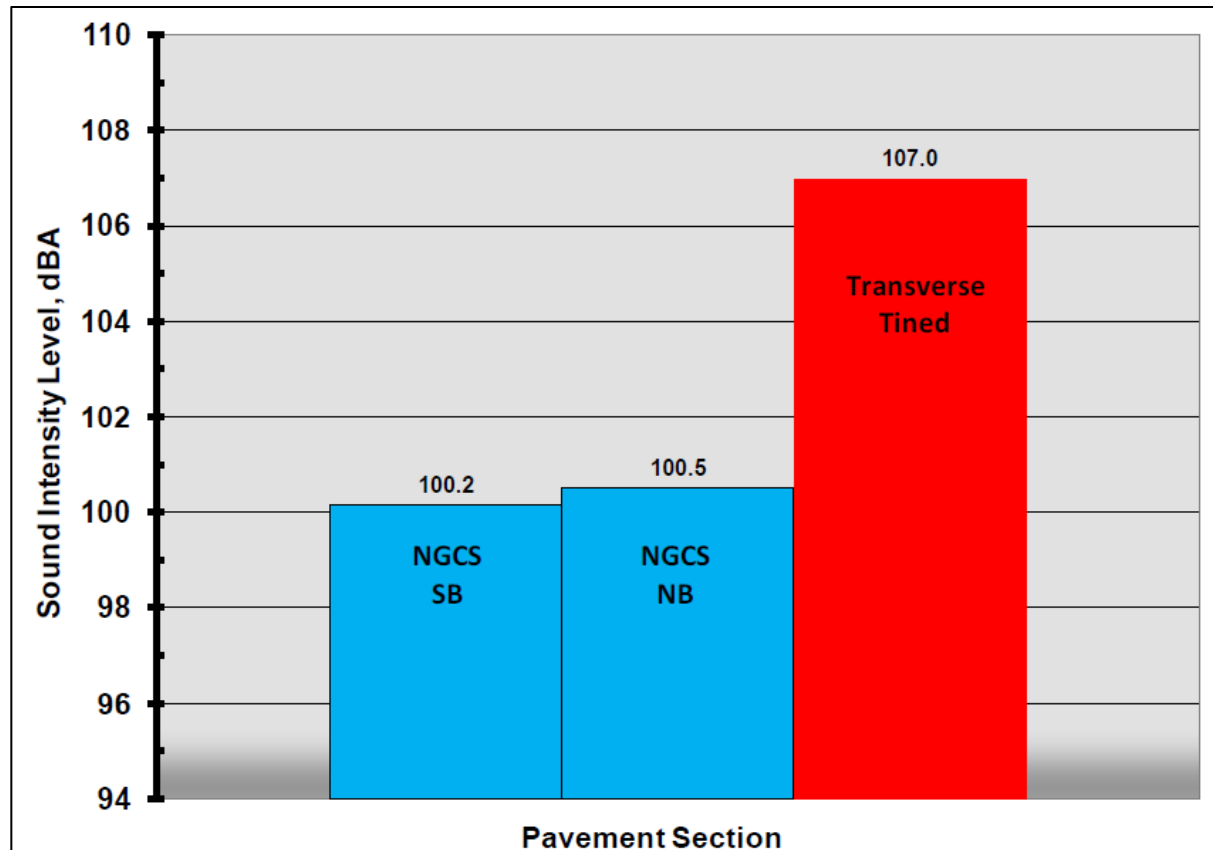
NGCS Site Locations in The USA



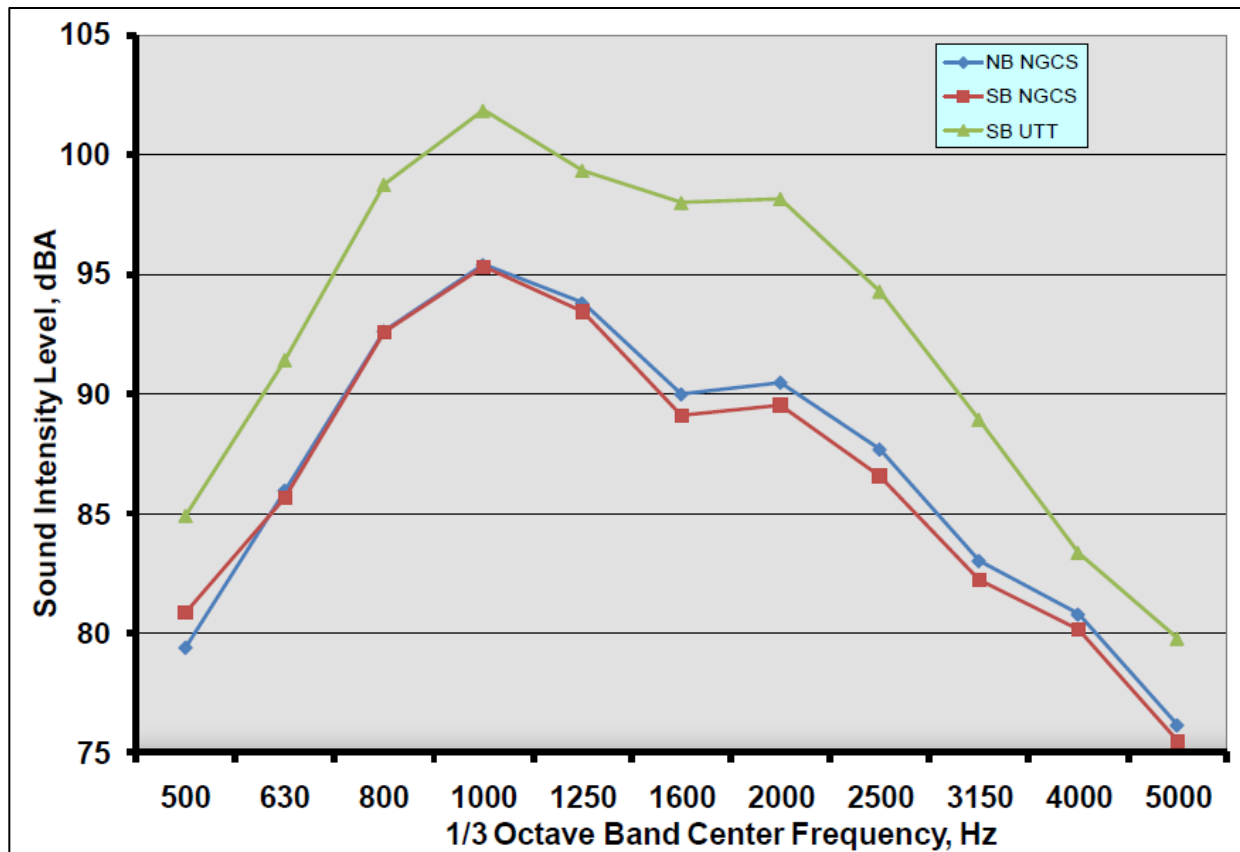
Duluth Minnesota NGCS

- Facility consists of two JPCP approximately 20 and 45 years old
- NGCS constructed during September 2010
- Approximately 125,764 sq yds
- 1/8 inch wide grooves were spaced on approximately 5/8" centers
- Less than 30 in/mile IRI

Duluth Minnesota NGCS

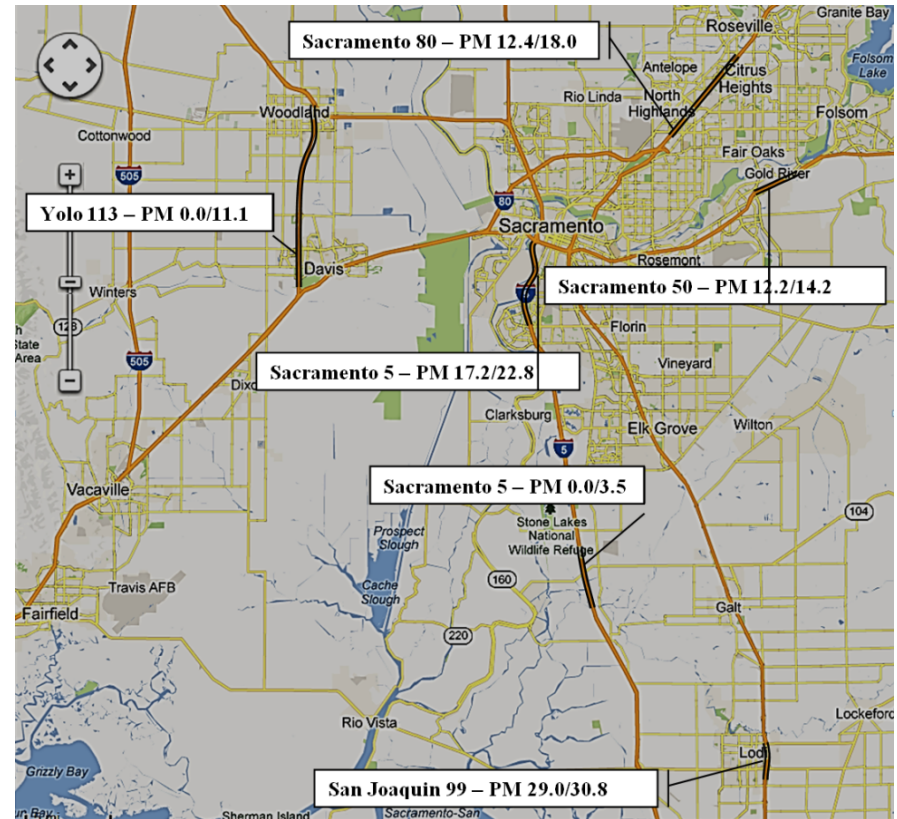


Duluth Minnesota NGCS



CALTRANS

- Second state to initiate a Quiet Pavement Program
- Currently has 7 NGCS locations in Sacramento and San Diego areas
- Developed NGCS Standard Spec in 2013 (Copy Provided)



Ohio DOT Bridge Deck Design Approach

- Overarching Goal – Develop a holistic approach from cradle to grave to improve initial and long-term bridge performance.
- Brian Schleppi, manager, Infrastructure Management Section, Office of Technical Services for the ODOT, led a team including researchers from Iowa State University to develop a design approach that would improve bridge rideability.

2001: ODOT Bridge Rideability

- Bridges 2 ½ X rougher than pavements by IRI
- Bridges increase system IRI by 7.5%
 - Bridges are less than 4% of system by length
- Smoothness specs on decks & pavement
 - 1/8" in 10' rolling straightedge on deck and approach slabs
 - CA profilograph on pavement & a few decks
 - No specs on pavement/approach slabs or approach slab/deck transitions

Impacts of Poor Bridge Ride

User Costs

- ▼ User Satisfaction
- ▲ Vehicle Wear/Damage
- ▲ Cargo Damage
- ▲ Freight Costs
- ▼ Safety

Agency Costs

- ▼ Pavement Life
- ▼ Bridge Life
- ▲ Maintenance Costs
- ▼ Snow/Ice Removal
- ▼ efficiency
- ▲ costs

New Procedure Adopted

- Specifications will cover transitions between pavement to approach slab to deck.
- International Roughness Index (IRI) specs will be used for entire bridge encounter rather than straight-edge or California Profilograph.
- Special requirements will be enforced when backfilling approach areas.
- All facets of process including materials, design, construction and maintenance will be involved.

Diamond Grinding As A Solution

- Bridge encounters longer than 265' must meet 130 in/mi MRI or less.
- If not met surfaces must be corrected to 100 in/mi MRI using diamond grinding.

Moving Forward

- ODOT is the first state DOT to implement such a specification.
- NCDOT has developed a pilot project based on ODOT's template.
- Other states considering doing the same.

Australia Pursues Better Pavement

- In New South Wales concrete pavements have conclusively proven themselves to be the lowest “whole of life cost”.
- The Roads And Maritime Services Agency (RMS) of NSW becomes interested in diamond saw-cut textures in 2000.

Australia Pursues Better Pavement

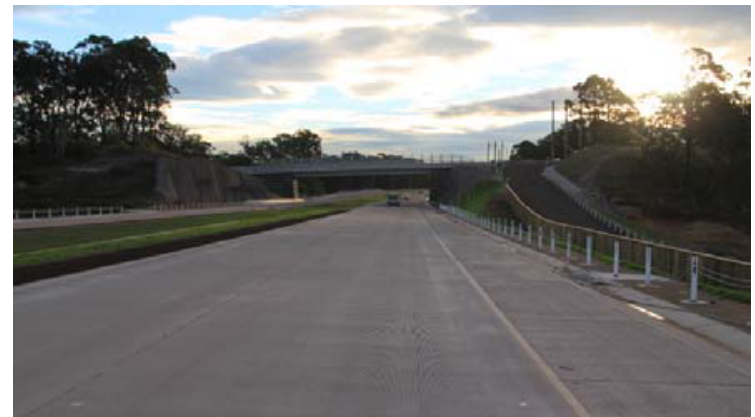
- Increasing urbanization and new noise legislation has lead to use of expensive asphalt pavements in noise sensitive areas.
- The RMS standard pavement section for high-traffic dual carriageways is Continuously Reinforced Concrete Pavement with Stone Matrix Asphalt (SMA) overlay for noise abatement. Expensive and requires regular maintenance.

NGCS Draws Interest

- The quest to adopt NGCS on concrete pavements is motivated by a desire for achieving the combination of concrete's cost effectiveness, low maintenance and newly developed low noise characteristics.
- Three trial sections are constructed in 2012/2013 with multiple treatments and blade configurations considered.

RMS Adopts LNDG

- RMS develops a modified NGCS and names it “Low Noise Diamond Grinding” (LNDG).
- Couples turf drag and modified grooving techniques.
- Not as quiet as NGCS but meets RMS needs.



RMS Conclusions

- Noise produced by LNDG is 3 dBA less than dense graded asphalt (Benchmark).
- The skid resistance measured by SCRIM is in line with transverse tining measurements.
- The texture depth of LNDG is in the order of 1.1 to 1.6 mm giving confidence that this pavement provides a appropriate margin of safety against aquaplaning.

RMS Conclusions

- The consistency of profile achieved provides confidence that these results are repeatable and likely to continue with a narrower band of deviation than other pavement surfaces.
- The savings on new highway construction of dual carriageways utilizing LNDG on JPCP instead of SMA on CRCP (current practice for low-noise highways) is estimated at \$720,000 per kilometer.

BASt NGCS Research Activities

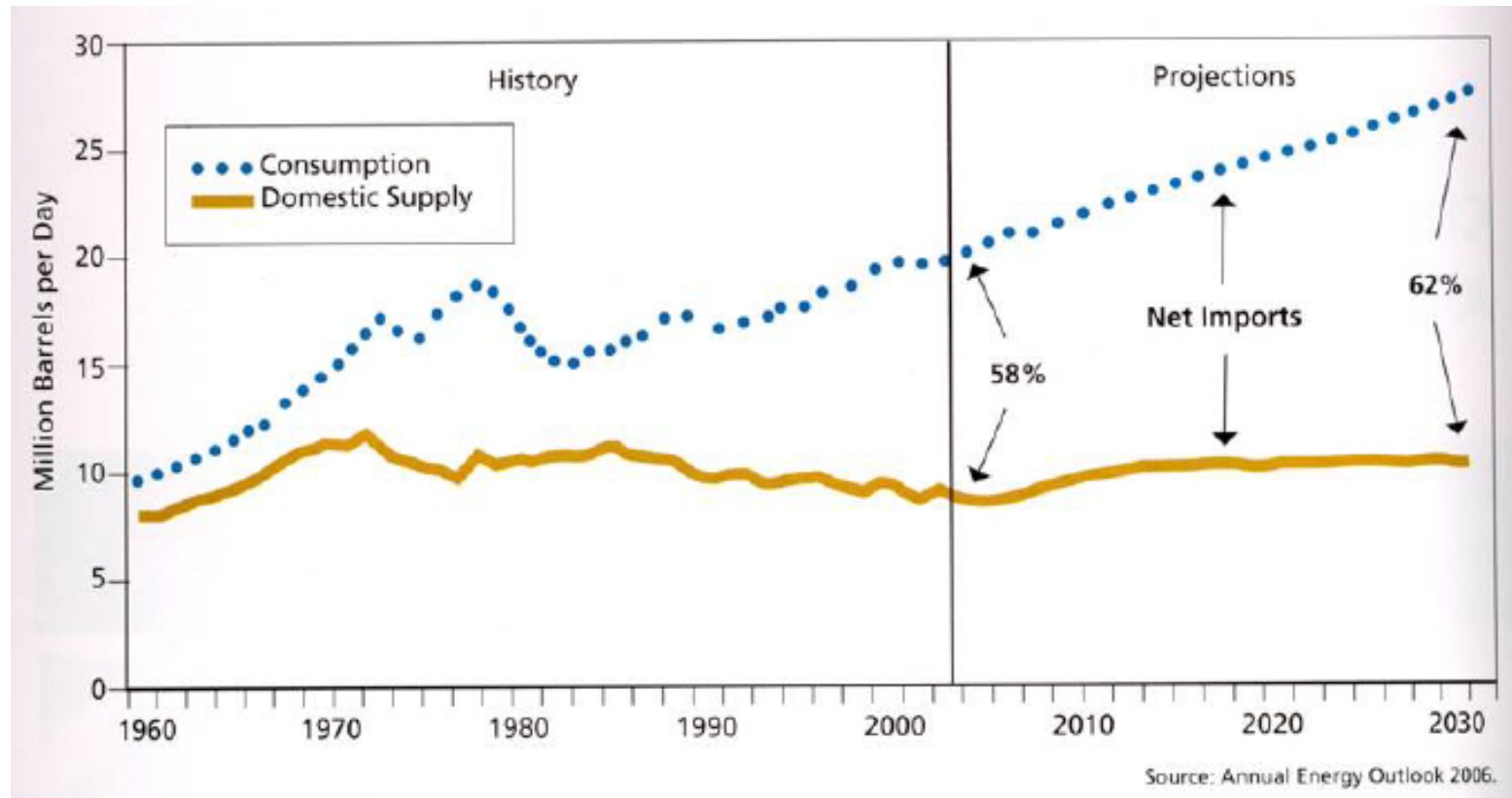
- BASt is Germany's equivalent to the US Federal Highway Administration.
- BASt has desired to improve surface characteristics and reduce costs related to their concrete pavements.
- BASt first hears of NGCS at international conference on concrete roads in Seville Spain in 2010.

BASt Research Efforts

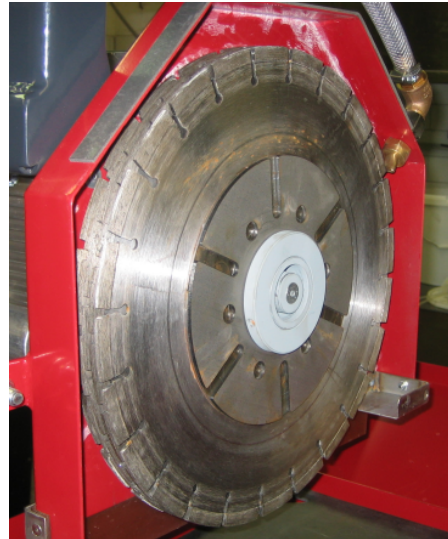
- Reduce tire/pavement noise.
- Increase friction.
- Maintain longevity.
- Hedge against increasing asphalt costs and declining product quality.



Oil Consumption vs. Supply

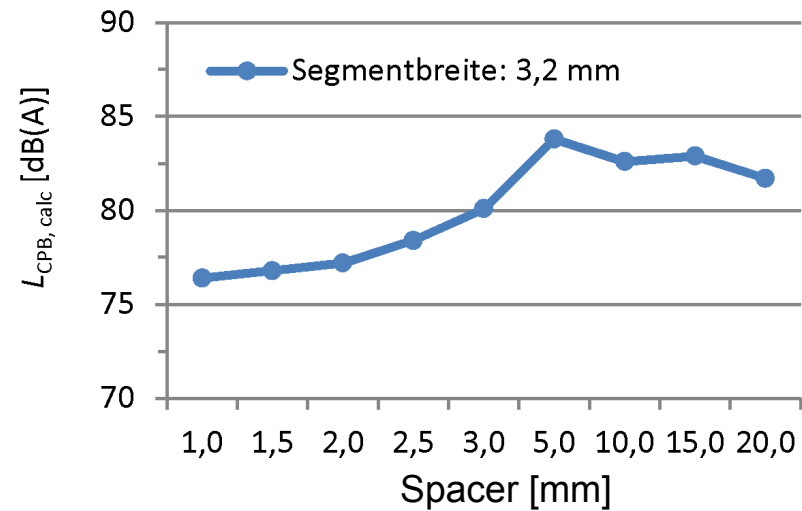
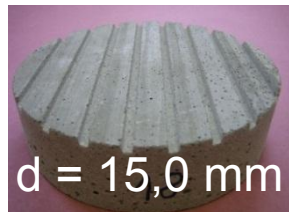
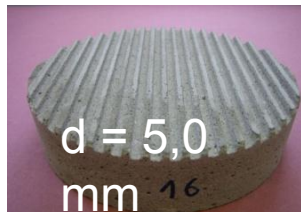


Laboratory Grinding



| Blade | Spacer [mm] | | | | | | | | |
|--------|-------------|-----|-----|-----|-----|-----|------|------|------|
| | 1,0 | 1,5 | 2,0 | 2,5 | 3,0 | 5,0 | 10,0 | 15,0 | 20,0 |
| 3,2 mm | X | X | X | X | X | X | X | X | X |
| 3,0 mm | X | X | X | X | X | - | - | - | - |
| 2,8 mm | X | X | X | X | X | - | - | - | - |

Laboratory Grinding



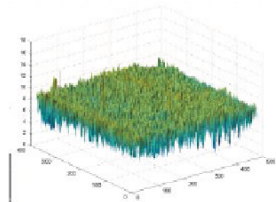
Texture and Air Flow Resistance



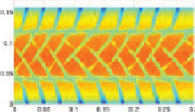
Software Development-Prediction of Noise Emission

Eingabedaten

Fahrbahntextur
(Messwerte)



Reifendaten
(aus Datenbank)

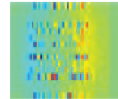


Geschwindigkeit

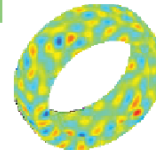
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Computersimulation SPERoN

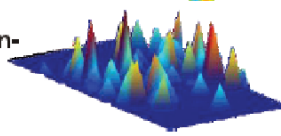
Air-Pumping



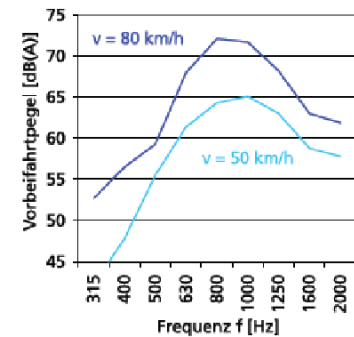
Reifenschwingungen



Reifen-Fahrbahn-
Kontaktkräfte



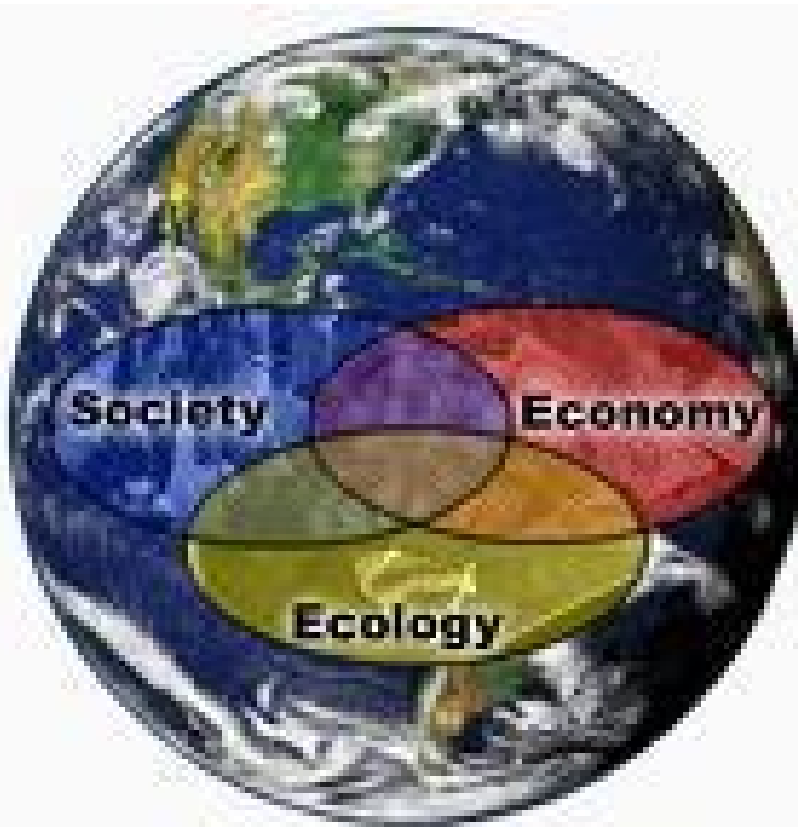
Ergebnis



BASt Research Efforts

- Well funded multi-year effort.
- Involves numerous partnering entities including government, academia and industry with strengths in design, materials, acoustics, software development and construction.
- Results from efforts expected over the course of the next few years.

Priorities Have Shifted



- Minimal system expansion
- Maintain the present system
- Minimize traffic disruptions
- Increase safety
- Address operator comfort
 - Reduce Roughness
 - Reduce Noise
- Save money
- Protect the Environment

Summary

- It is a challenging time for the transportation industry.
- 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.

Summary

- Transportation Specifiers worldwide are recognizing diamond saw cut textures such as conventional diamond grinding, NGCS and safety grooving as environmentally friendly, cost competitive surface treatments necessary to meet the needs of the driving public in these challenging times facing the industry.

Visit Us on the Web

**International Grooving and Grinding
Association
at
igga.net**
