

Concrete Pavement Preservation & Restoration

*Improved Performance and Customer
Satisfaction Through Timely
Intervention*

Presented by John Roberts, Executive Director IGGA – CPAM 2022

Introduction

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

Introduction

- Al Adamek – Diamond Surface, Inc.
- Gordy Bruhn – MnDOT
- Todd Callahan – PCiRoads, LLC
- Sam Gramling – Interstate Improvement, Inc.

Pavement Management– Circle of Life



Priorities Have Shifted in Recent Years



- Minimal system expansion
- Maintain the present system
- Minimize traffic disruptions
- Increase safety
- Address operator comfort
 - Reduce roughness
 - Reduce noise
- Protect the environment
- Inadequate funding

Pavement Preservation Philosophy



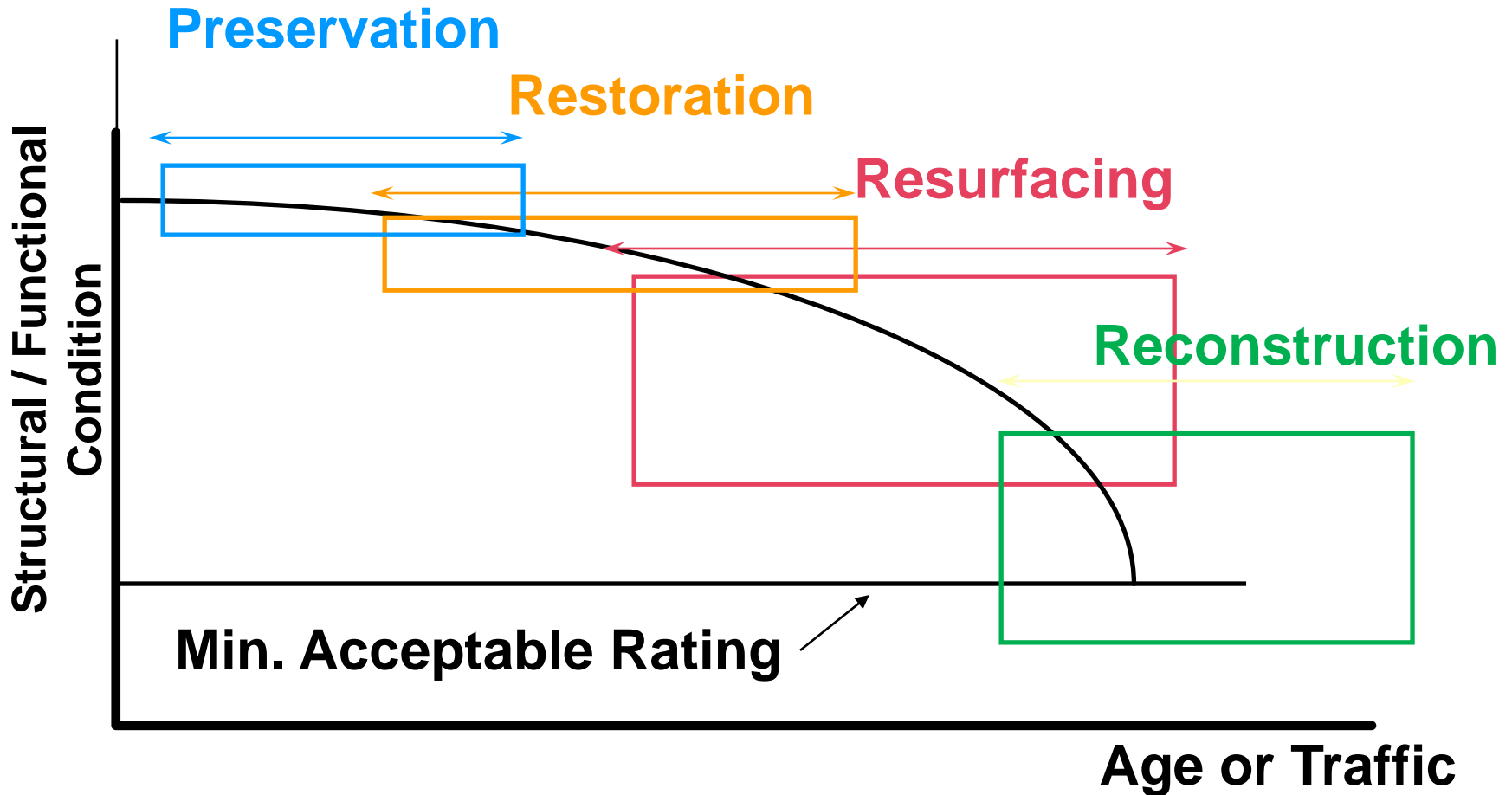
Keeping good roads in Good Condition!

How do *preservation* treatments differ from routine/reactive treatments?



***Same treatments
...different TIMING!***

Rehabilitation Timing



Preservation

- Used early when pavement has little deterioration.
 - Repairs isolated areas of distress.
 - Repairs some construction defects.
 - Remove permanent curl.
 - Manage the rate of deterioration.



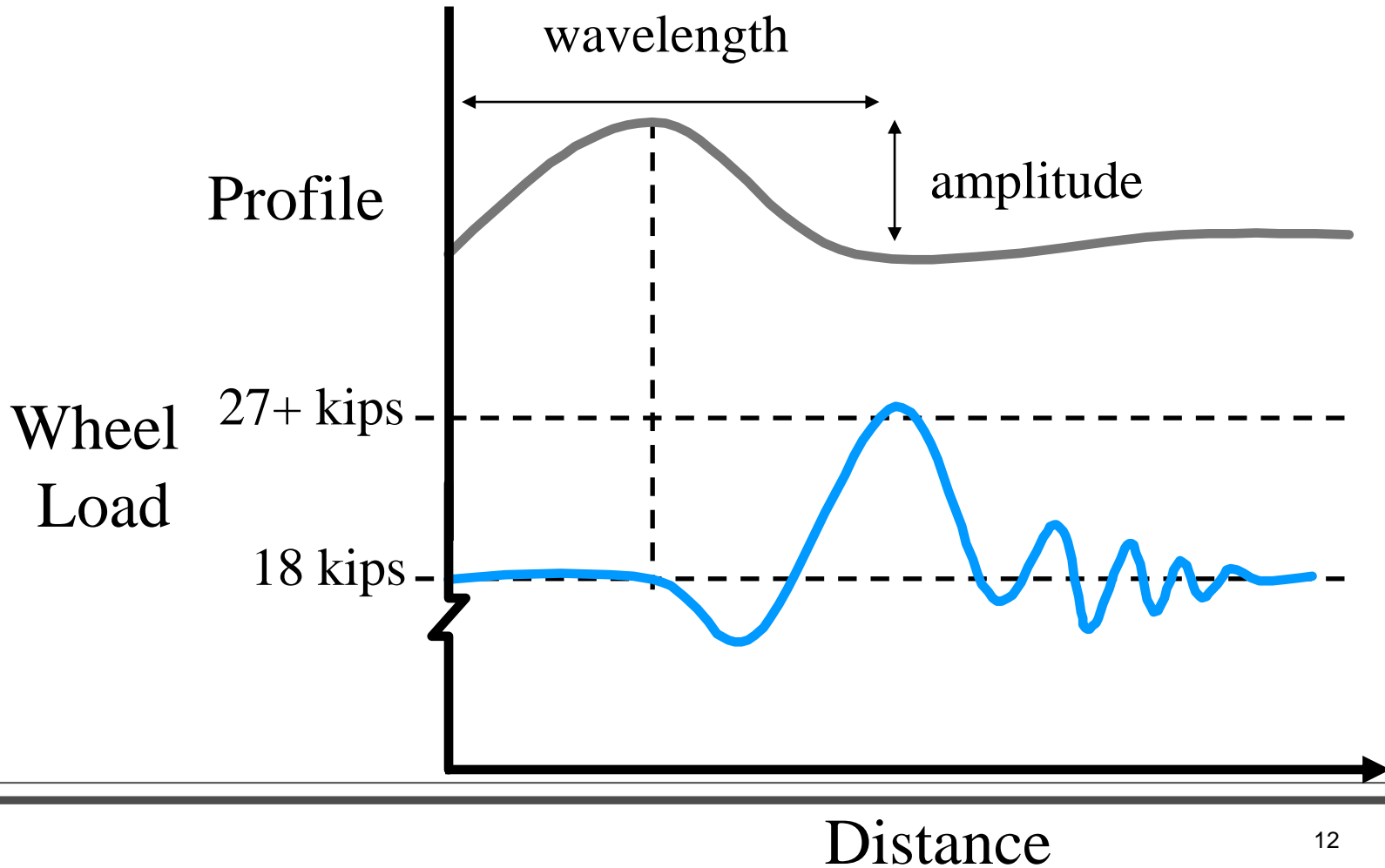
Expected Benefits

- **Preservation of investment**
 - Improved pavement performance
 - Long term cost savings/leveling
- **Maintain a high level of service**
 - Increased safety
 - Greater customer satisfaction

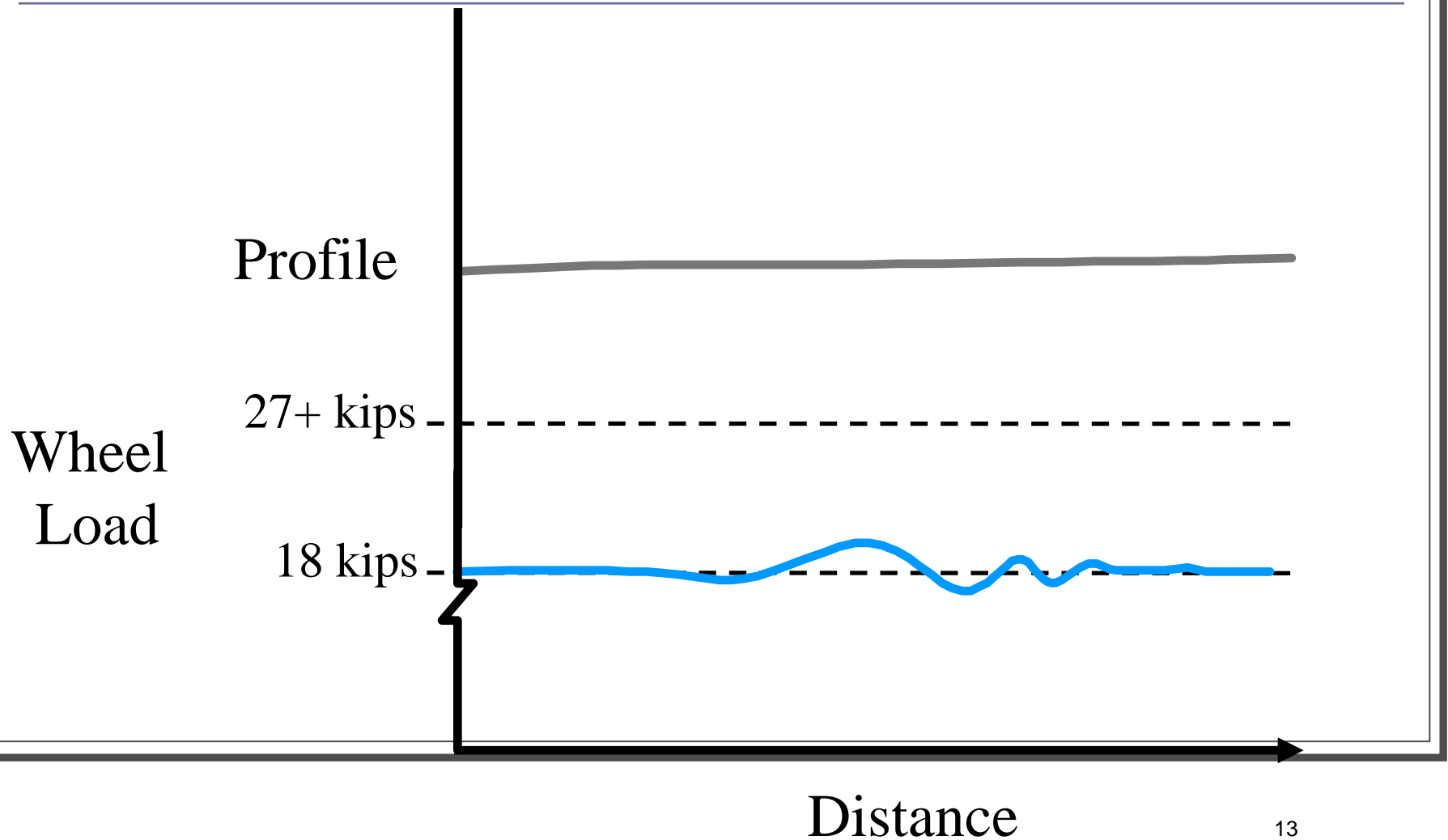
Preserving the Investment

- Keep water out!
- Reduce debris infiltration into joints or cracks
- Minimize dynamic loads
- ***SMOOTH PAVEMENTS LAST LONGER!***

Rough Pavement



Smooth Profile



CPP – Treatments and Techniques



PCCP Preservation Techniques

- Subsurface rehabilitation
- Cross-stitching longitudinal cracks/joints
- Partial-depth repair
- Dowel bar retrofit
- Full-depth repair
- Diamond grinding
- Joint & crack resealing

Pavement Sub-Surface Rehabilitation

- Used for sub-grade repair
- Soil collapse
- Poor compaction
- Helps reduce
 - Pumping
 - Joint faulting
 - Corner breaks



Cross Stitching

- Used for longitudinal cracks that are in good condition
- Not appropriate for transverse cracks – use DBR
- Helps maintain aggregate interlock and provide added reinforcement to crack
- Reduce slab migration
- Prevent longitudinal joint faulting



Partial Depth Repair - PDR

- Partial-depth repairs are used on surface defects and joint spalls.
- Restores ride quality and pavement functionality with minimal traffic interruption.
- Costs less than a full depth repair.



MNDOT PDR Method

- Concrete removal by modified cold-milling.
- Must faster and less expensive than sawing and jack-hammering.
- Since PDR is a bonding operation, irregular shapes are permitted.
- Provides long term performance .



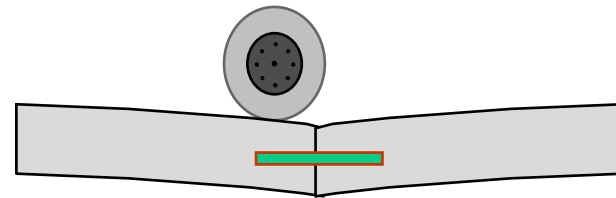
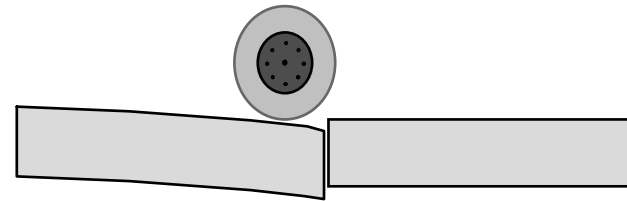
Dowel Bar Retrofit - DBR

- Placement of load transfer devices across transverse joints or cracks of existing pavements.
- Used to limit future faulting.
- First production use of DBR in 1992 by WSDOT. Over 8 million bars retrofitted in the USA since that time adding decades of pavement life.

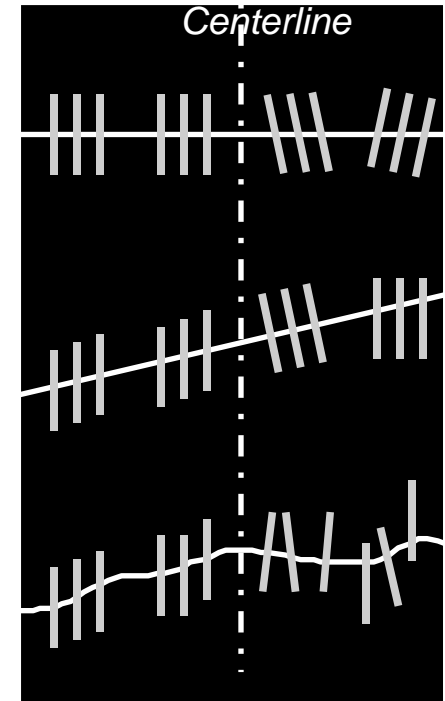


Purpose of Dowel Bar Retrofit

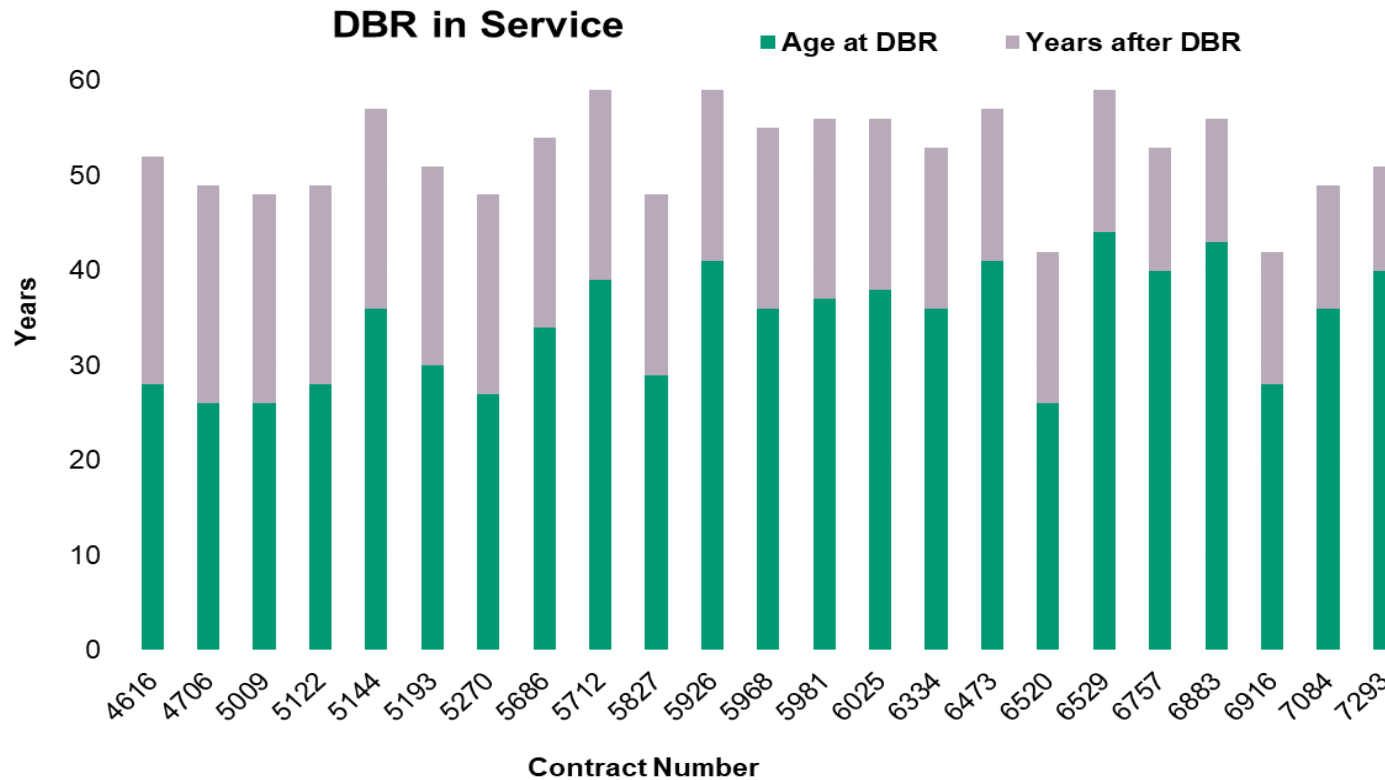
- Reestablish load-transfer across joints or cracks
 - Load-transfer is a slab's ability to transfer part of its load to its neighboring slab
- Used in JRC and JPC pavements to limit future faulting



Dowel Slot Alignment



WSDOT DBR Survival Data



Full-Depth Repair

- Removal and replacement of concrete through entire depth.
- Restores ride quality.
- Fast setting materials minimize traffic disruption.
- Pin/lift-out speeds process



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



Advantages of Diamond Grinding

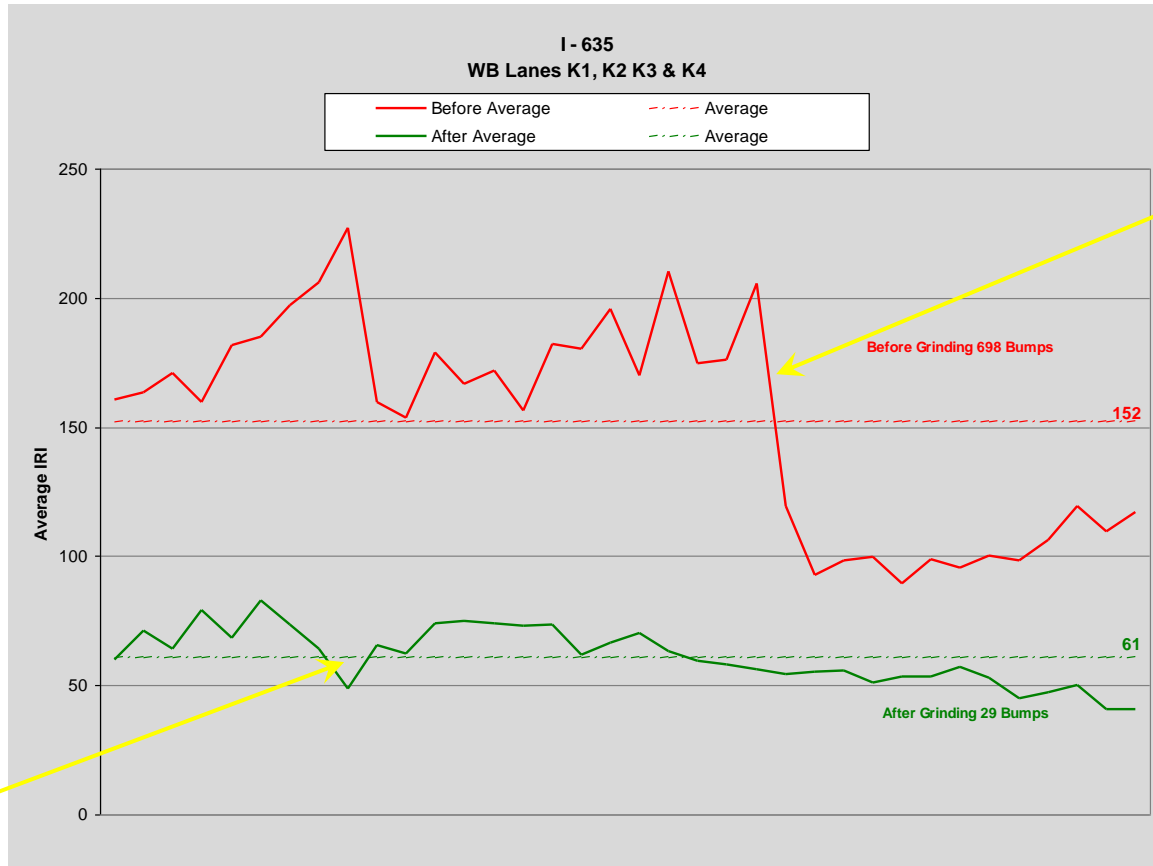
- Can be used on both concrete and asphalt pavements
- Cost competitive
- Enhances surface friction and safety
- Can be accomplished during off-peak hours with short lane closures and without encroaching into adjacent lanes
- Grinding of one lane does not require grinding of the adjacent lane
- Does not affect overhead clearances underneath bridges
- Provides increased fuel economy and lower carbon footprint from the driving public.
- Increases the life of the pavement- Less dynamic loading

Pavement Problems Addressed

- Faulting at joints and cracks
- Built-in or construction roughness
- Polished surface
- Wheel-path rutting
- Permanent upward slab warping
- Inadequate transverse slope
- Unacceptable noise level



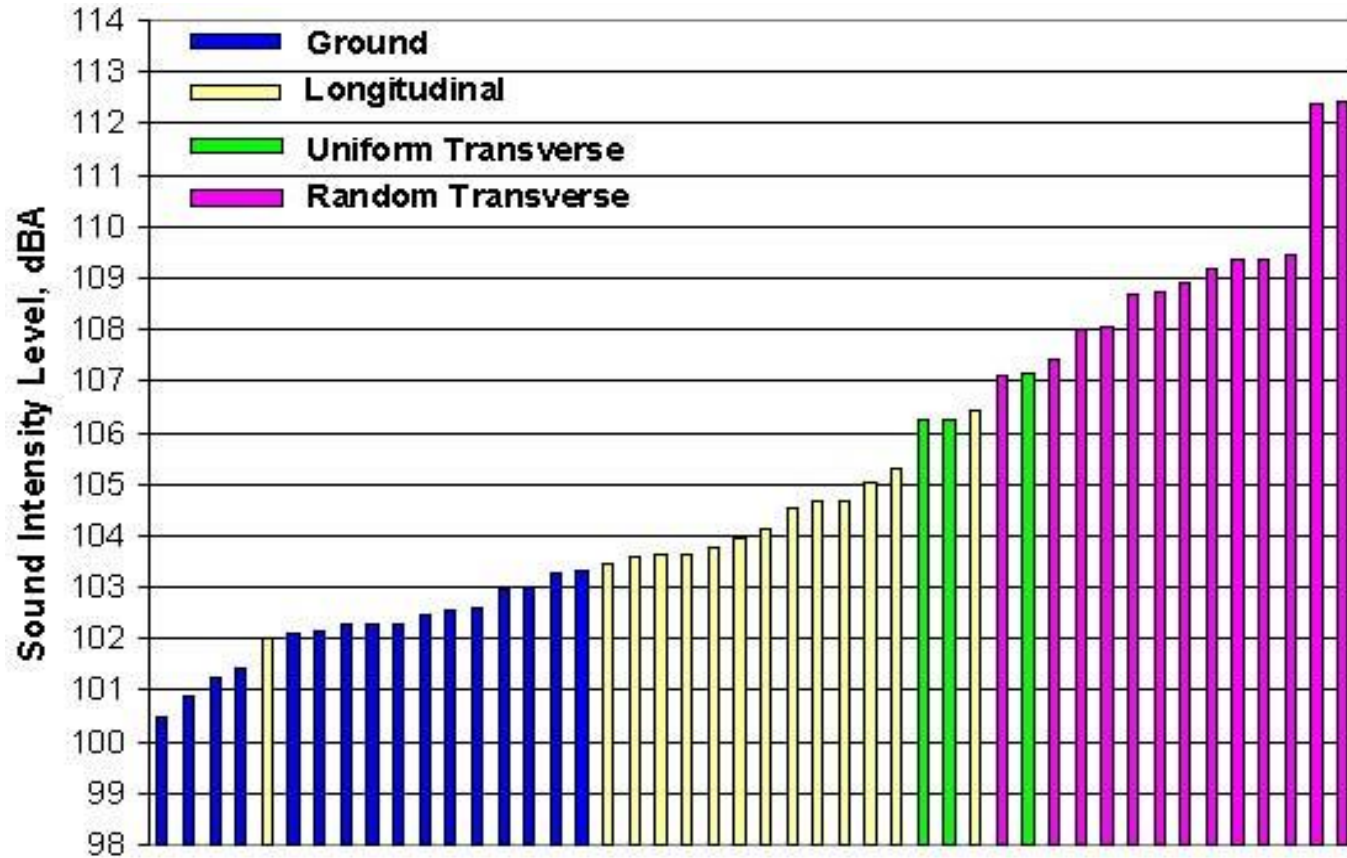
Diamond Grinding can provide a 50% to 70% improvement over the pre-grind profile on average!



Before
Grinding

After
Grinding

CA and AZ PCCP Noise Test Results

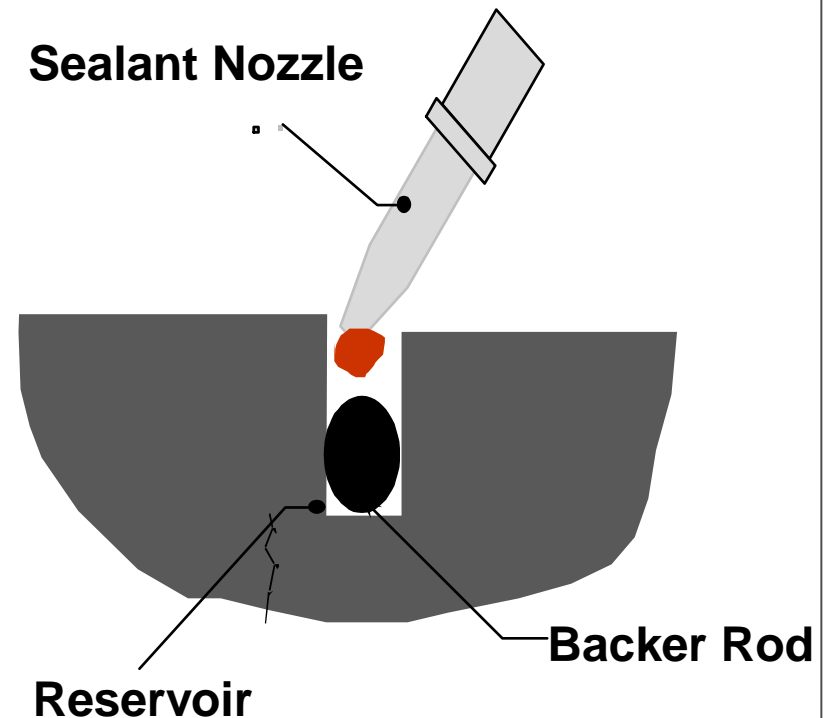


Joint and Crack Resealing

- Minimizes water & incompressibles into pavement system

Reduces:

- Subgrade softening
- Pumping
- Erosion of fines
- Spalling



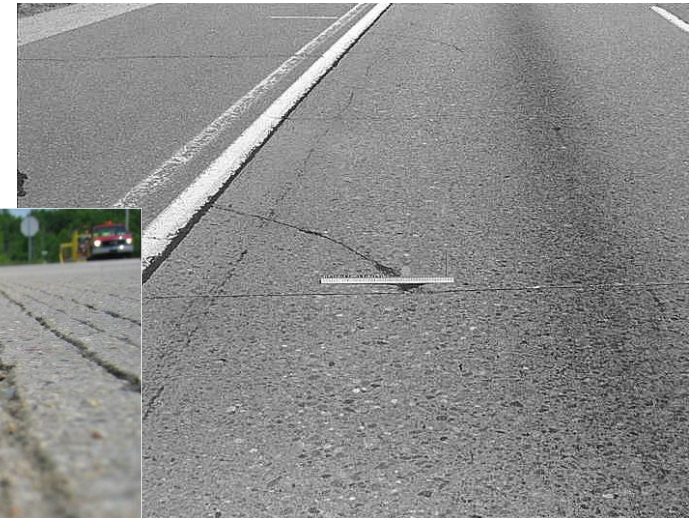
Influence of Moisture Infiltration



Loss of Fines
(Pumping)



Transverse Joint Faulting

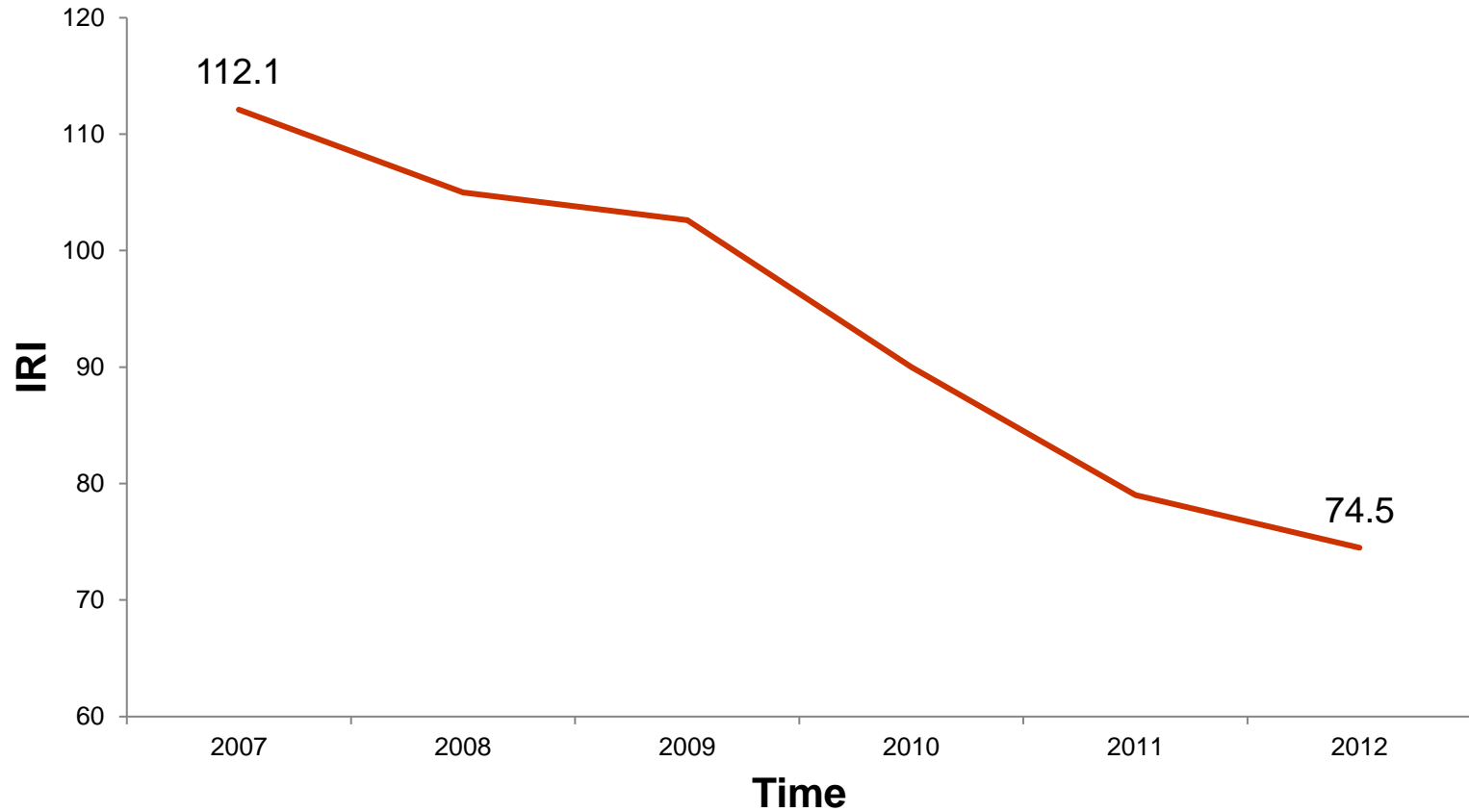


Corner Breaks

So Why Preservation?



IRI of Kentucky Interstate PCCP



Impact of CPP Strategy in KY

- 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
- Reconstruction cost would have been \$1.5 - \$2.5 million/lane mile
- Preservation saved over \$1 Billion

Safety, Surface Texture and Friction

- MoDOT Increased macro-texture of the I-70 surface by diamond grinding to improve profile and drainage of water at tire-pavement interface
- In Wisconsin Marquette University found that, overall accident rates for ground surfaces were 40% less than for un-ground surfaces over a 6-year period, 57% in wet weather conditions




I-70 Missouri

Environmental & Sustainability Considerations



Effectiveness of Diamond Grinding

- CALTRANS has determined that the average life of a diamond ground pavement surface is 16 to 17 years and that a pavement can be ground at least three times without affecting the pavement structurally. See IGGA.net for full report





STATE OF CALIFORNIA
DEPARTMENT of TRANSPORTATION

DIVISION OF
ENGINEERING SERVICES

MATERIALS ENGINEERING
AND TESTING SERVICES

OFFICE OF RIGID PAVEMENT
AND STRUCTURAL CONCRETE

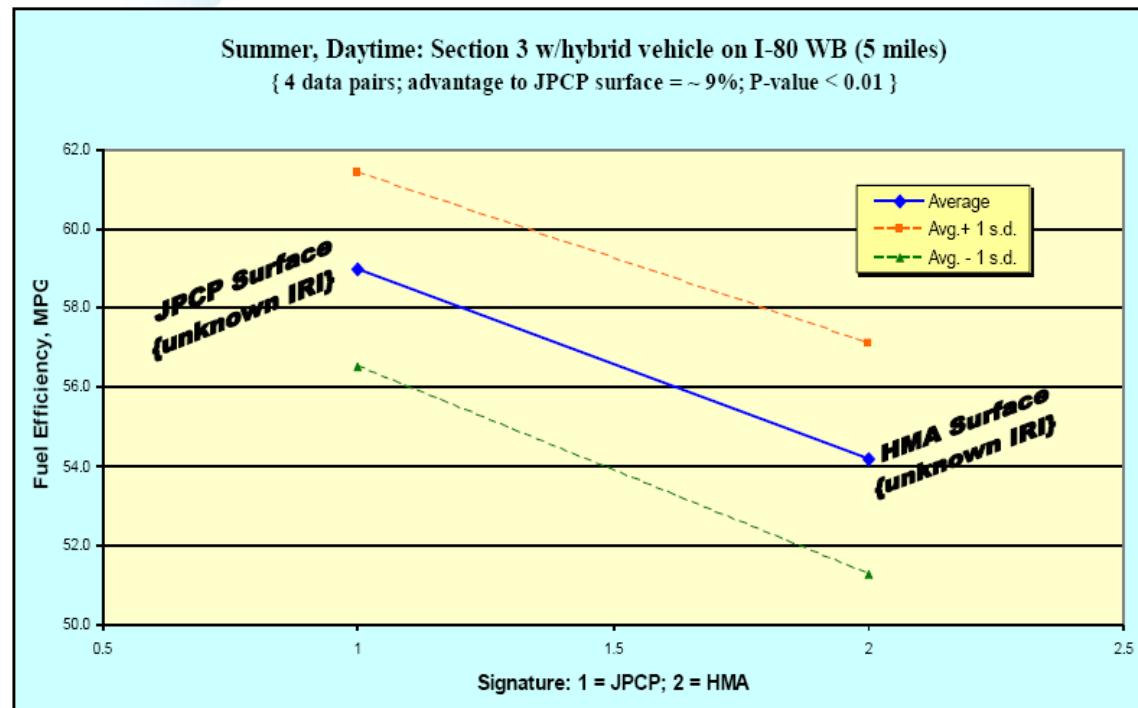
5900 Folsom Boulevard
Sacramento, California 95819



THE EFFECTIVENESS OF DIAMOND GRINDING
CONCRETE PAVEMENTS IN CALIFORNIA

November 2004

CALTRANS Fuel Efficiency Research



Surface Type vs. MPG on I-80 WB w/Hybrid – Section 3

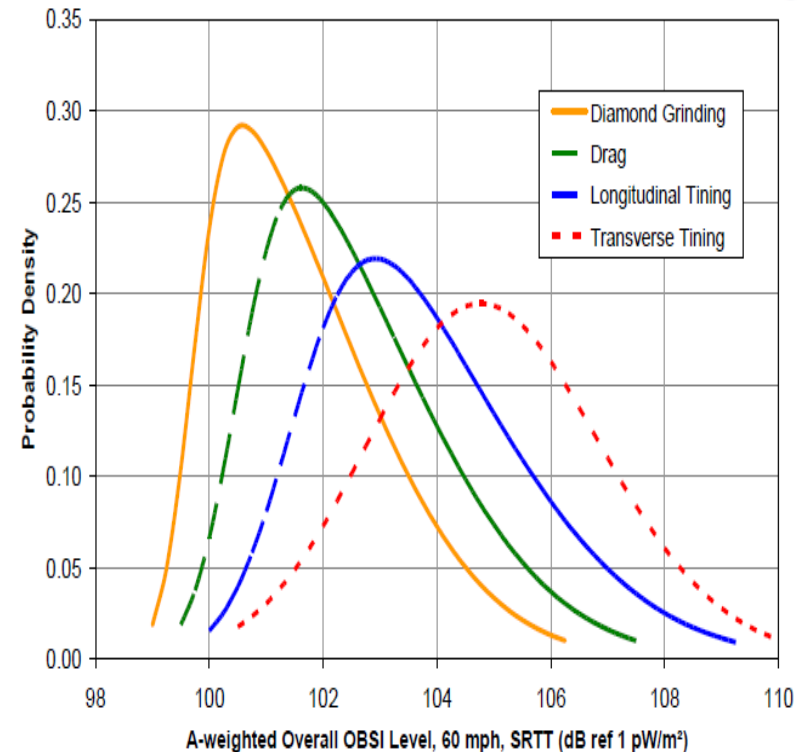
CALTRANS Fuel Efficiency Research

Summary of Fuel Efficiency Test Results

<u>Test Performed</u>		<u>Fuel Savings (approximate)</u>
Effect of tire pressure on PCC		6.5 % (for every 5 mph decrease in speed)
AC vs. PCC	Fuel efficiency van on I-80	1.9 % to 3.2 % (in favor of PCC)
Diamond grinding PCC pavements that result in a significant improvement in IRI		1.8 % to 2.7 % * (for every IRI decrease in IRI of 50 in/mile)
Effect of tire pressure on PCC and AC pavements, respectively		1.0 % to 1.7 % (for every 4 psi increase in tire pressure)
AC vs. PCC	Fuel efficiency van on I-5	-0.1 % to 0.8 % (however no statistically significant differences were noted)

NCPTC Noise Catalogue

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



Fuel Conservation thru Grinding

- Rehabilitation using diamond grinding and joint resealing on a concrete pavement is 3 times more energy efficient than a typical asphalt overlay.

conserving fuel when **rehabilitating** concrete roads

How the choice of road repair methods can save fuel and reduce our dependence on oil imports



WITH MORE ATTENTION THAN EVER being focused on energy conservation, vehicle fuel efficiency and new alternatives such as hybrid cars and bio-diesel, few people realize the significant impact that road rehabilitation methods can have on energy use. The difference is black and white:

Just How Much Fuel is Consumed Rehabilitating Pavements ...

➤➤ **BY DIAMOND GRINDING?**

935 Gallons (fuel use per mile)
BY REMOVING FAULTING, slab warping, studded tire wear and unevenness resulting from patches, diamond grinding creates a smooth, uniform pavement profile. Diamond grinding also reduces road noise by providing a longitudinal texture, which is quieter than transverse textures. The longitudinal texture also enhances macro texture and skid resistance in polished pavements. Further, joint and crack resealing minimizes the infiltration of surface water and incompressible material into the joint system. Minimizing water entering the joint reduces sub-grade softening, slows pumping and erosion of the sub-base fines, and may limit dowel bar corrosion caused by deicing chemicals. Diamond grinding can be completed with a short lane closure for a shorter period of time than the typical asphalt overlay project.

In comparison, asphalt pavements require a large amount of energy to heat materials to 325-degree-Fahrenheit at the production plant. Hot asphalt is delivered by a diesel-powered truck to the construction site where diesel-powered pavers and compaction rollers use even more fossil fuel to place the overlay.

THE RESULT: Diamond grinding and joint resealing a concrete pavement is three times more energy efficient than a typical asphalt overlay.

➤➤ **BY ASPHALT OVERLAY?**

3,215 Gallons (fuel use per mile)

It is also important to consider the life-cycle cost of paving and rehabilitating both types of pavement surfaces. An asphalt surface should be replaced approximately 8 to 15 years into its life with a new layer of asphalt. This reality dramatically increases the fuel usage per mile of road for asphalt roads over the road's life.

Since concrete roads can be rehabilitated by much more cost-effective techniques, life-cycle fuel consumption is dramatically less for concrete pavements. Further, concrete pavements often last 30-40 years before diamond grinding becomes necessary and a road can usually be rehabilitated up to three times using this technique, taking the potential life-cycle for a concrete pavement out to the 50 to 70 year range.

Please visit the ACPA's website at www.pavement.com or the IGGA's website at www.igga.net for more information on the best rehabilitation methods for concrete roads as well as further data on additional environmental advantages to choosing concrete roads!



Visit Us on the Web

**International Grooving and Grinding
Association**

at

www.igga.net

A Successful Project Starts With A Thorough Investigation!



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