

Concrete Pavement Preservation

Integrating Engineering, Economics and the Environment

Mid West Pavement Preservation Partnership Meeting



International Grooving and
Grinding Association

The Challenge in Hand



Sustainability = Preservation

- In the context of pavement systems, sustainable pavements are those that, from design through rehabilitation, use environmentally friendly materials and practices and enhance the public's economic well-being and general quality of life.



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**

The Need

- Cost effective, engineered strategies to preserve and rehabilitate the aging roadway system.
 - Interstate system still serves public utilizing 30 -50 year old PCCP sections.
 - Highway maintenance budgets are shrinking.
 - Traffic volumes and vehicle loads are increasing.



Question



What if?



What if you could.....

- Restore or enhance pavement surface characteristics like smoothness, quiet ride, skid resistance; and reflectivity?
- Reduce wear and tear on vehicles from poor pavement surfaces?
- Rehabilitate pavements for a fraction of the cost of reconstruction?
- Preserve the remaining equity in existing pavements for another 30 to 40 years?
- Reduce “first use” of natural or manufactured materials?
- Reduce frequency and duration of work zones, ultimately reducing vehicle emissions due to work-zone related traffic delays?



Tomorrow's Technologies Here Today

Transportation agencies already have access to a variety of sustainable, concrete-based pavement maintenance and repair solutions. What is needed is not necessarily new technologies or solutions, but a new, proactive mindset toward using them.



What Does Tomorrow's Pavement Look Like?

- Concrete Pavement is durable and long lived.
- Concrete Pavement requires less fuel consumption during materials production, transportation, placement and rehabilitation.
- Concrete mixes incorporate industrial byproducts such as fly ash, slag and tires.
- Concrete pavement is renewable and 100 percent recyclable.



What Does Tomorrows Pavement Look Like?

- Concrete pavements' lighter color and increased reflectivity improve nighttime visibility, reduce the amount of power needed to illuminate roads at night, and can help mitigate urban heat islands and smog generation.
- Optimized concrete pavement surface textures produce quieter pavements over longer periods of time, reducing noise pollution.
- Properly constructed and textured concrete pavements have reduced pavement deflection, which results in less vehicle drag and thus reduced vehicle fuel consumption.



California I-10



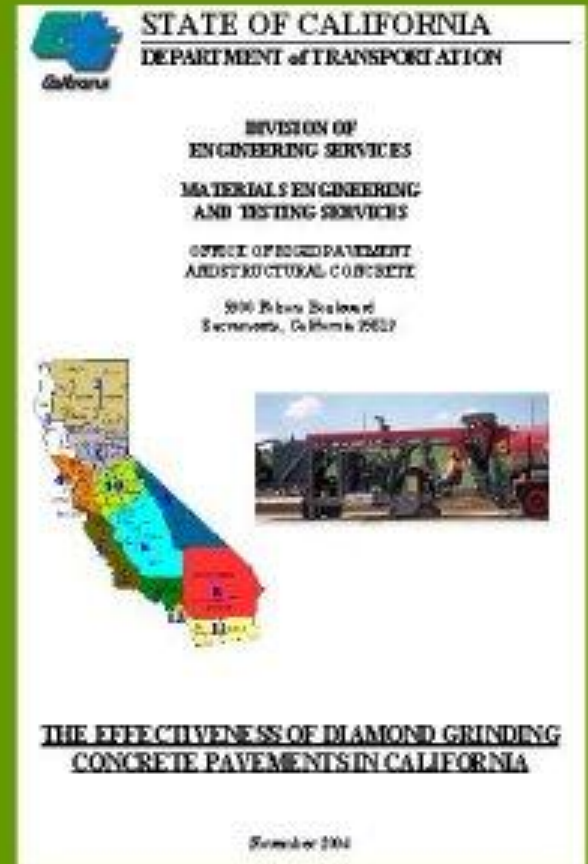
Diamond Grinding Was Invented in California

- Diamond grinding was first used in California in 1965 on a 19-year old section of I-10 to eliminate significant faulting (Neal and Woodstrom 1976).
- In 1983, CPR was conducted on this same pavement section, including the use of additional grinding to restore the rideability and skid resistance of the surface. In 1997, the process was repeated.
- Since its first use in 1965, the use of diamond grinding has grown to become a major element of PCC pavement preservation.



Effectiveness of Diamond Grinding - CALTRANS

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



Some Things Last Forever



And others need a little TLC



Preservation and Restoration

- First level of response for deteriorating concrete pavements should always be Preservation/Restoration
 - Least cost – Cheaper than reconstruction
 - Least service disruption
 - Increases safety
 - Environmentally sound
 - Addresses operator comfort



Purpose of CPP

- Used early when pavement has little deterioration.
 - Repairs isolated areas of distress.
 - Repairs some construction defects.
 - Manages the rate of deterioration.





PCCP Preservation Techniques

- Slab stabilization/jacking
- Partial-depth repair
- Cross-stitching longitudinal cracks/joints
- Retrofitting dowels
- Full-depth repair
- Diamond grinding
- Joint & crack resealing



Undersealing/Slab Jacking



Slab Jacking

Used for Sub Grade Repair of

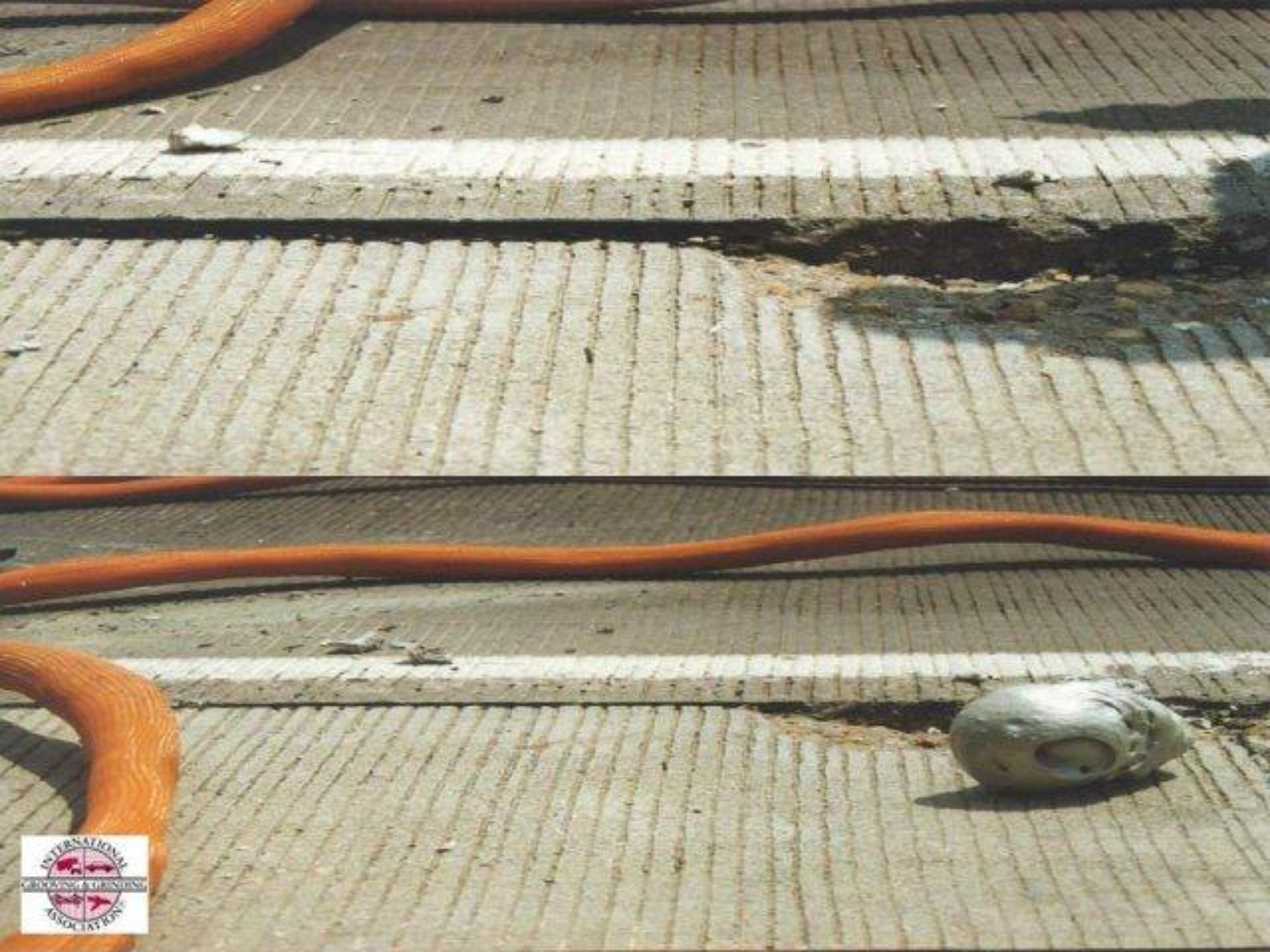
- o Soil collapse
- o Poor Compaction



Faulted - Longitudinal



- Deep consolidation or Poor compaction
- Flooding or Erosion
- Overloading
- Loss of Fines Pumping





Performance

- Short- and long-term reductions in pavement deflections
- Most effective on pavements with little structural damage
- Cost effective alternative to remove and replace when slabs are in good condition

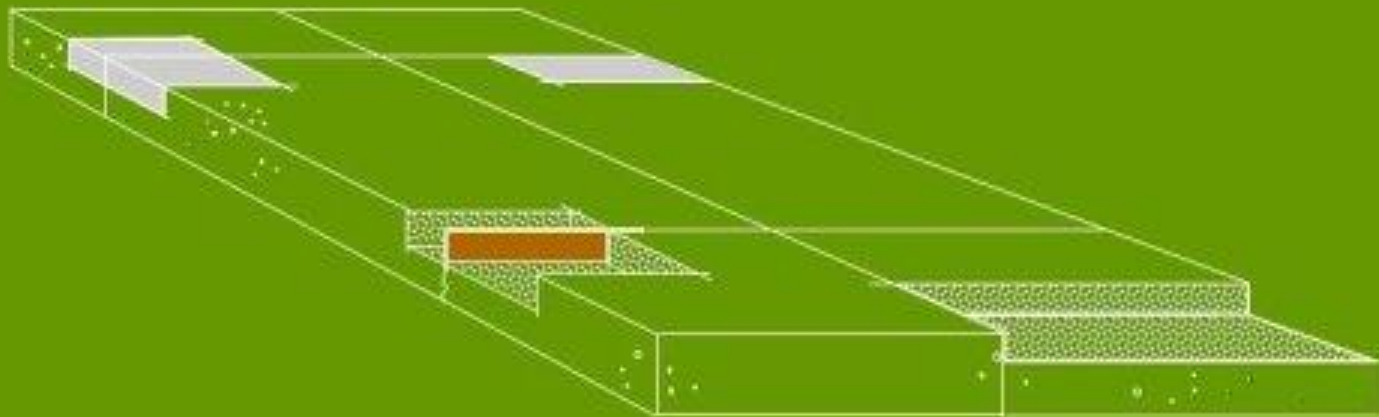


Partial-Depth Patching



Partial Depth Repairs

- Repairs deterioration in the top 1/3 of the slab.
- Generally located at joints, but can be placed anywhere surface defects occur.















Trunk Highway 53 Ramp Duluth, MN - 1994

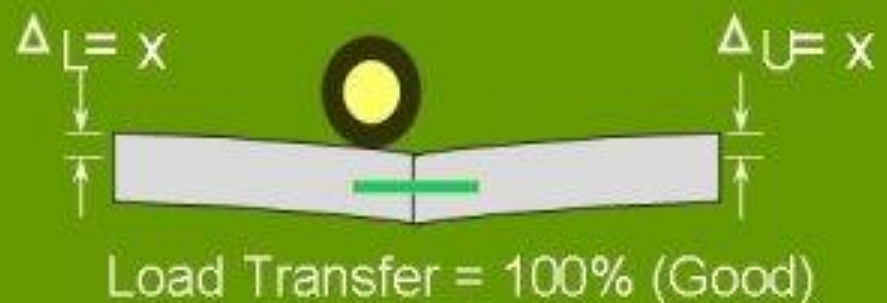


Load Transfer Restoration – Dowel Bar Retrofit



Purpose of Load Transfer Restoration

- 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



Load Transfer Restoration

- Placement of load transfer devices across joints or cracks of existing pavements
- Candidate projects
 - Poor load transfer (< 70 %)
 - Pumping
 - Faulting
 - Corner breaks





***Illinois Calibrated Cow
Static Deflection Testing Device***



Performance of DBR Concrete Pavement Under HVS Loading

by CALTRANS, UC Davis and UC Berkeley

- Tested two retrofitted PCCPs under a Heavy Vehicle Simulator (HVS) aka accelerated loading frame
- HVS results demonstrated large improvement in LTE and decrease in vertical deflections
- DBR sections not damaged by HVS loading, unlike control section
- DBR less sensitive to temp changes than control section
- Total of 11,000,000 ESALS applied to DBR sections without failure occurring



Ten-Year Performance of DBR Application -WASHDOT

- First production DBR project completed in Washington in 1992
- WASHDOT has retrofitted 225 miles since 1992
- Subject DBR sections still maintain average LTE of 70% to 90%
- Determined that carbide roto-milling is NOT a viable alternative for diamond grinding
- Based on 10 yr results, DBR is considered a successful alternative for rehabilitation of aging PCCPs in WS



Full-Depth Patching Operations



Full-Depth Repair

- Purpose
 - Restore structure
 - Restore ride
- Used for:
 - Joint deterioration
 - Transverse cracking
 - Longitudinal cracking
 - Broken slabs & corner breaks



Pre-cast Pavement Panels



In Situ Full Depth Repair



Sizing a Patch

- Go beyond deterioration
- Remember to check for below-surface spalling
- Minimum length 6 feet
- Adjust as necessary
- Combine closely spaced patches



Combine Patches!!





Load Transfer

- 1.5 inch dowels
- At least 6 inches of embedment on either side
- Minimum of 3 dowels in each wheelpath
- Corrosion resistance necessary if deicing chemicals will be used



Performance of Full-Depth Repairs

- Can provide 20 or more years of service when properly designed and constructed
- High-early strength materials allow early opening to traffic and limited lane closures



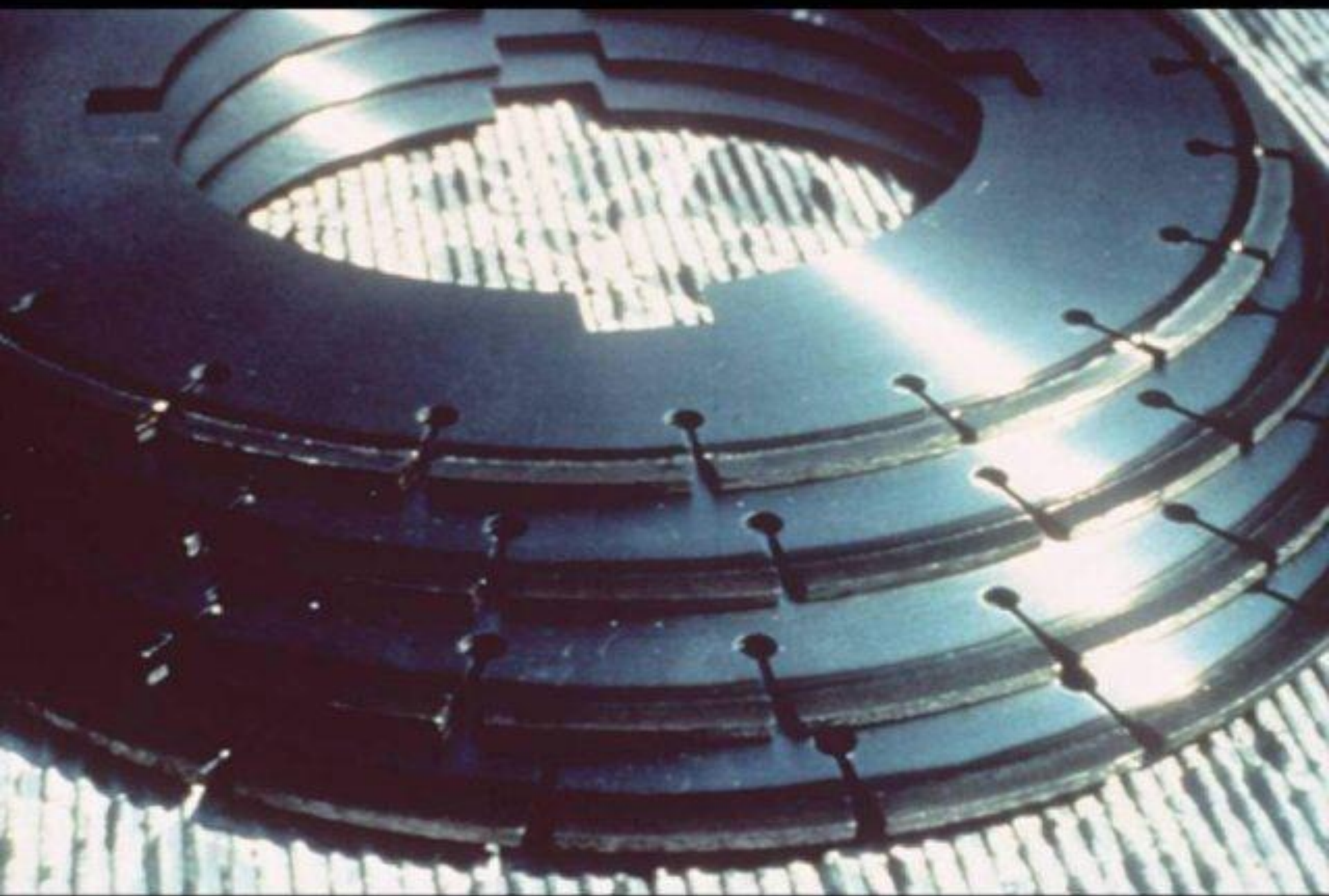
Diamond Grinding



What is Diamond Grinding?

- Removal of thin surface layer of hardened PCC using closely spaced diamond saw blades;
- Results in smooth, level pavement surface;
- Longitudinal texture with desirable friction and low noise characteristics;
- Frequently performed in conjunction with other CPR techniques, such as full-depth repair, dowel bar retrofit, and joint resealing.
- Comprehensive part of any PCC Pavement Preservation program;



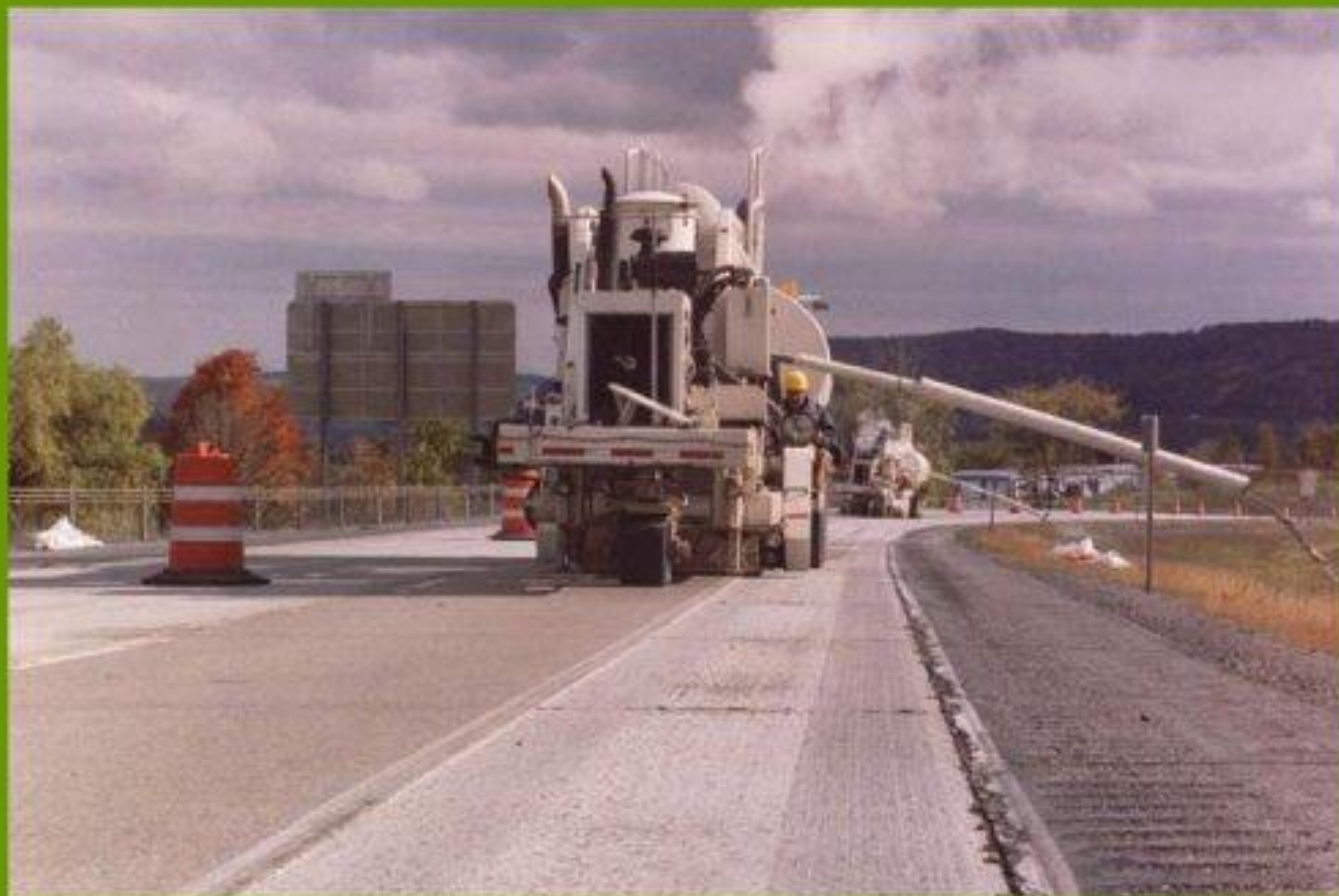


Diamond Grinding



Diamond Grinding

Grinding Process



Diamond Grinding

Finished Product



Diamond Grinding



Advantages of Diamond Grinding

- 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;
- Blends patching and other surface irregularities into a consistent, identical surface;
- Provides a low noise surface texture!



MODOT- Safer, Smoother, Sooner

- MODOT initiates Safer, Smoother, Sooner program in 2005 – 2007
- The initiative invests \$400 million on 2,200 miles
- Improve customer satisfaction through
 - Safer pavements
 - Smoother ride quality
 - Quiet ride quality
- Approx 25,000,000 sq yds let since 1st Qtr 2005
- See IGGA.Net for MODOT's BMP on diamond grinding new PCCP



Summary

- Many available rehabilitation treatments for PCC pavements
- Each has advantages and limitations
- Performance and cost vary with given conditions
- Applying the right treatment to the right pavement *at the right time*
- No universal method available
- Take advantage of local contractor experience
- IGGA & ACPA are ready to assist



We all need to start pulling together to help keep our environment healthy

