Diamond Grinding

Increased Pavement Performance and Customer Satisfaction Using Diamond Grinding

THE ULTIMATE QUESTION!

- How do I make limited budget dollars stretch and provide a highway system that offers a high level of service?

1986-93 Rigid Pavement Design Equation

SMOOTH PAVEMENTS LAST LONGER!
Rough Pavement

- Profile
- Wheel Load
  - 27+ kips
  - 18 kips
- Distance
- Wavelength
- Amplitude

Smooth Profile

- Profile
- Wheel Load
  - 27+ kips
  - 18 kips
- Distance

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;
- Comprehensive part of any PCC Pavement Preservation program;
- Frequently performed in conjunction with other CPR techniques, such as full-depth repair, dowel bar retrofit, and joint resealing.

Diamond Grinding Cutting Head
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.
- 9,500,000 sq yds diamond ground in 1999

MODOT - Safer, Smoother, Sooner

- MODOT initiates Safer, Smoother, Sooner program in 2005 – To be completed December 2007
- The initiative invests $400 million in 2,200 miles of Missouri’s roads that carry 60 percent of the traffic and are within 10 miles of where 86 percent of Missouri’s residents live.
- Improve customer satisfaction through
  - Safer pavements
  - Smoother ride quality
  - Quiet ride quality
- Approx 8,000,000 sq yds let in 1st Qtr 2005 alone
Advantages of Diamond Grinding

- Costs substantially less than AC overlays;
- 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;

Pavement Problems Addressed

- Faulting at joints and cracks
- Built-in or construction roughness
- Polished concrete surface
- Wheelpath rutting
- Inadequate transverse slope
- Unacceptable noise level

Faulted Joints

Diamond grinding will significantly increase smoothness over the pre-grind profile!
Safety, Surface Texture and Friction

- Improvement in friction number and skid resistance due to increase in pavement macrotexture
- Longitudinal texture provides directional stability and reduces hydroplaning (side-force friction)
- 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 (Drakopoulos et al. 1998)
So what is all this noise about diamond grinding in Arizona?!?

Diamond Grinding
Benefits Reported by Arizona DOT - 2003

- Restored smoothness
- Improved friction
- Improved cross slope
- Reduction in noise

Diamond Grinding
Effect on Roughness - ADOT

58 Percent decrease in IRI

<table>
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<th>Test Area</th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
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<td>59%</td>
<td>56%</td>
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<td>2</td>
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<td>NA</td>
<td>53%</td>
</tr>
<tr>
<td>3</td>
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</tr>
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<td>4</td>
<td>NA</td>
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NA = Not applicable
Diamond Grinding
Effect on Friction - ADOT

27 Percent increase in friction

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</thead>
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</tr>
<tr>
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<td>41%</td>
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NA = Not applicable

Diamond Grinding
Effect on Tire/Pavement Noise - ADOT

Arizona PCCP Noise Generation (Near Field)

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<tr>
<td>4</td>
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<td>NA</td>
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</tbody>
</table>

NA = Not applicable

Typical ARFC Noise Research Results - ADOT

- "The results shown represent the average of twenty projects. The projects were located on I-8, and I-10, and ranged in age from three years to twelve years. The regression indicates approximately a 5 dBA increase in noise generation in a ten year period. The current data further indicates that AR-ACFCs typically range from 94 to 99 dBA throughout their life."

THE ULTIMATE QUESTION!

How do I make limited budget dollars stretch and provide a highway system that offers a high level of service?

Diamond Grinding Study
By ERES

Research Data Sources

- 1986 FHWA Database created for the study of CPR
  - 133 Diamond Ground sections at 76 sites
- LTPP SPS-6 CPR database
- In total 177 sections available for analysis
Preventive Maintenance 2
Session 2

AASHTO Design Model Prediction vs. Actual Traffic

Cost Comparisons
CPR in NC and dowel bar retrofit followed by diamond grinding

Diamond Grinding Study
By ERES

- Extends service life
- Initial smoothness comparable to new pavement or overlay
- Average life of 32 years
- May be reground 3 to 4 times

Summary

- Diamond grinding can extend pavement life significantly at a competitive cost.
- Diamond grinding is a key Preventive Maintenance tool.
- Diamond grinding will increase customer satisfaction, increase friction, reduce noise and reduce life cycle costs.
- Performance and cost vary with given conditions. Roughness will return if causes are not addressed. Consider dowel bar retrofit if significant faulting is present.
- Timing is everything.
- NE ACPA and IGGA are ready to assist!

Web sites

International Grooving and Grinding Association
- igga.net

American Concrete Pavement Association
- pavement.com

North East Chapter – ACPA
- ne.pavement.com

LET'S HAVE ONE MORE AND THEN WE'LL GO!!