Surface Texture Restoration Using Diamond Grinding
Introduction

- John H. Roberts
- Executive Director - International Grooving and Grinding Association
- Vice President – American Concrete Pavement Association’s Pavement Restoration Division
What is 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
- Frequently performed in conjunction with other CPP techniques, such as full-depth repair, dowel bar retrofit, and joint resealing
Diamond Grinding Equipment
Diamond Grinding Process
Diamond Grinding Final Surface
Advantages of Diamond Grinding

- Costs substantially less than asphalt 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
- Environmentally friendly
Pavement Problems Addressed

- Faulting at joints and cracks
- Built-in or construction roughness
- Polished concrete surface – friction enhancement
- Wheel-path rutting
- Warp and curling removal
- Inadequate transverse slope
- Unacceptable noise level
Concrete Pavement Preservation Beginnings

- Diamond grinding was developed in California and was first used as part of an engineered system to preserve PCC Pavement in 1965.
Concrete Lane Miles by State DOT

Lane Miles by State:
- Texas
- California
<table>
<thead>
<tr>
<th>State</th>
<th>YDS²</th>
<th>$</th>
<th>State</th>
<th>YDS²</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>11,376,823</td>
<td>$40,778,762</td>
<td>OK</td>
<td>261,976</td>
<td>$650,208</td>
</tr>
<tr>
<td>WA</td>
<td>1,497,968</td>
<td>$10,196,334</td>
<td>TN</td>
<td>242,160</td>
<td>$619,453</td>
</tr>
<tr>
<td>UT</td>
<td>2,024,955</td>
<td>$7,164,921</td>
<td>IA</td>
<td>174,667</td>
<td>$490,743</td>
</tr>
<tr>
<td>MS</td>
<td>983,212</td>
<td>$6,498,776</td>
<td>WI</td>
<td>101,054</td>
<td>$444,496</td>
</tr>
<tr>
<td>KY</td>
<td>1,469,974</td>
<td>$4,024,784</td>
<td>AL</td>
<td>155,336</td>
<td>$401,216</td>
</tr>
<tr>
<td>FL</td>
<td>1,113,615</td>
<td>$2,818,104</td>
<td>GA</td>
<td>110,616</td>
<td>$359,948</td>
</tr>
<tr>
<td>IL</td>
<td>404,637</td>
<td>$2,566,695</td>
<td>IA</td>
<td>174,667</td>
<td>$490,743</td>
</tr>
<tr>
<td>MI</td>
<td>480,507</td>
<td>$2,177,617</td>
<td>ND</td>
<td>144,587</td>
<td>$338,221</td>
</tr>
<tr>
<td>MN</td>
<td>386,950</td>
<td>$1,681,074</td>
<td>MA</td>
<td>46,000</td>
<td>$334,725</td>
</tr>
<tr>
<td>MT</td>
<td>387,991</td>
<td>$1,554,080</td>
<td>VA</td>
<td>97,015</td>
<td>$316,620</td>
</tr>
<tr>
<td>AR</td>
<td>371,284</td>
<td>$1,371,624</td>
<td>DE</td>
<td>44,820</td>
<td>$270,105</td>
</tr>
<tr>
<td>ID</td>
<td>448,540</td>
<td>$1,188,631</td>
<td>NV</td>
<td>26,396</td>
<td>$260,174</td>
</tr>
<tr>
<td>NC</td>
<td>336,491</td>
<td>$815,596</td>
<td>NY</td>
<td>27,130</td>
<td>$194,915</td>
</tr>
<tr>
<td>TX</td>
<td>135,318</td>
<td>$774,875</td>
<td>SC</td>
<td>57,011</td>
<td>$193,395</td>
</tr>
<tr>
<td>CT</td>
<td>114,325</td>
<td>$764,720</td>
<td>AZ</td>
<td>12,141</td>
<td>$158,753</td>
</tr>
<tr>
<td>NE</td>
<td>292,473</td>
<td>$729,374</td>
<td>LA</td>
<td>5,736</td>
<td>$118,338</td>
</tr>
<tr>
<td>NM</td>
<td>303,430</td>
<td>$723,195</td>
<td>CO</td>
<td>2,558</td>
<td>$25,697</td>
</tr>
<tr>
<td>OH</td>
<td>343,646</td>
<td>$722,439</td>
<td>NH</td>
<td>2,400</td>
<td>$18,000</td>
</tr>
<tr>
<td>MO</td>
<td>390,210</td>
<td>$713,594</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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.
IH 635 Dallas County Texas

- CRCP DG in 2004
- Project length – 12 centerline miles
- Diamond Grinding – 492,968 sq yds
- 60% Ride improvement w/o any patching
- Cost < $3.40 /sq yd
- Reduced noise
- Increased friction

Graph showing:
- Average IRI (Before and After Diamond Grinding)
- Comparison between Before and AfterDiamond Grinding
- Before Grinding: 698 Bumps
- After Grinding: 29 Bumps
US 287 Childress District Texas

- 13 inch JPCP Ground and Retrofitted 2004
- Poor soils the cause for poor initial ride

![Graph showing IRI (in/m) before and after DBR & DG from 2000 to 2013.](image)
US 69 Beaumont District Texas

- 12 inch JPCP Ground and Retrofit 2008
- Diamond Ground for $3.25 per square yard
Surface restoration of a 8.2 mile stretch of CRCP in Fort Worth on IH35W in 2011
Pavement age varies from 20 to 40 years
Diamond grinding vs. thin-overlay
- Half the estimated budget
- Bridge clearance issues
- Texture improvement
TXDOT saved $3,000,000
Bid Prices for IH 35W Project in Tarrant County September 2011, CSJ 0014-02-047

<table>
<thead>
<tr>
<th>Bidder</th>
<th>Project ($)</th>
<th>Item 3232 diamond grinding, SY ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate (reference)</td>
<td>3,105,277</td>
<td>3.50</td>
</tr>
<tr>
<td>1</td>
<td>2,503,821</td>
<td>2.60</td>
</tr>
<tr>
<td>2</td>
<td>2,568,561</td>
<td>2.50</td>
</tr>
<tr>
<td>3</td>
<td>2,714,598</td>
<td>2.65</td>
</tr>
<tr>
<td>4</td>
<td>2,744,444</td>
<td>2.95</td>
</tr>
<tr>
<td>5</td>
<td>2,757,406</td>
<td>2.05</td>
</tr>
<tr>
<td>6</td>
<td>2,766,286</td>
<td>2.85</td>
</tr>
<tr>
<td>7</td>
<td>2,908,957</td>
<td>2.79</td>
</tr>
</tbody>
</table>
Research Project Objectives (Project 5-9046-01)

- Effectiveness of diamond grinding (measured pre and post grinding)
  - Texture
  - Skid resistance
  - Noise
  - Roughness
- Long term performance monitoring
- Supporting TXDOT in Quality Assurance
Research Findings To Date

- Effectiveness of diamond grinding
  - Texture: improved by 0.61 mm (SP and CTM)
  - Coefficient of Friction: improved by 0.138 (DFT)
  - Skid number: improved by 13.4
  - Roughness: reduced by 44.4 inch/mile
  - Pavement Noise reduced: 3.2dBA (50% sound pressure reduction)
Lab testing consists of:

- Measuring the initial texture and friction of a concrete slabs using the CTM & DFT.
- Running the slab for a certain amount of cycles on the three-wheel polisher.
- Measuring texture and friction after the slab has been polished.
Bench Scale Grinding Device
TXDOT Saw-cut Texture Research

- Preliminary results very promising
- Saw-cut textures improve surface texture durability in many types of aggregates
- Additional research by TXDOT, University of Texas, and IGGA slated for 2013/2014
Next Generation Concrete Surface (NGCS)
District receives noise complaints adjacent to US 290 corridor

NGCS and DG chosen as noise abating treatments

Specification drafted in 2013

Section to be constructed in 2014
Summary

- This is a challenging time for the transportation industry
- Innovative, cost-effective solutions are needed to meet these challenges
- Saw cut textures provide sustainable benefits for concrete pavement such as increased pavement longevity, increased friction, reduced noise and improved appearance
- Diamond grinding can extend pavement life at a cost significantly less than an asphalt overlay
- IGGA is ready to assist!
Visit Us on the Web

International Grooving and Grinding Association
at
igga.net

THANK YOU!