Chapter 5
Diamond Grinding and Grooving

From… Maintenance Technical Advisory Guide (MTAG)
Learning Objectives

1. List benefits of diamond grinding and grooving
2. Describe recommended diamond grinding/grooving dimensions
3. Describe recommended construction procedures
4. List important quality control activities
5. Describe potential construction and performance problems
6. Identify troubleshooting solutions

Chapter 5 – Diamond Grinding and Grooving
Chapter 5 – Diamond Grinding and Grooving
Diamond Grinding
Diamond Grinding

Benefits

- Restored smoothness
- Improved friction
- Improved cross slope
- Reduction in noise
- Improved cross slope for reducing splash and spray
## Diamond Grinding

### Effect on Roughness

Percent decrease in IRI

<table>
<thead>
<tr>
<th>Test Area</th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>59%</td>
<td>56%</td>
<td>NA</td>
</tr>
<tr>
<td>2</td>
<td>NA</td>
<td>NA</td>
<td>53%</td>
</tr>
<tr>
<td>3</td>
<td>64%</td>
<td>60%</td>
<td>NA</td>
</tr>
<tr>
<td>4</td>
<td>NA</td>
<td>NA</td>
<td>55%</td>
</tr>
</tbody>
</table>

NA = Not applicable

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**Chapter 5 – Diamond Grinding and Grooving**
Diamond Grinding
Effect on Friction

Percent increase in friction

<table>
<thead>
<tr>
<th>Test Area</th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25%</td>
<td>15%</td>
<td>NA</td>
</tr>
<tr>
<td>2</td>
<td>NA</td>
<td>NA</td>
<td>18%</td>
</tr>
<tr>
<td>3</td>
<td>41%</td>
<td>35%</td>
<td>NA</td>
</tr>
<tr>
<td>4</td>
<td>NA</td>
<td>NA</td>
<td>26%</td>
</tr>
</tbody>
</table>

NA = Not applicable

Chapter 5 – Diamond Grinding and Grooving
Diamond Grinding

Project Selection

- Consider effectiveness and limitations
- IGGA and ACPA recommendations
  - Present serviceability index (PSI) range of 3.8 to 4.0
  - Before critical faulting level
- Used with other CPR activities

Chapter 5 – Diamond Grinding and Grooving
# Diamond Grinding

## Project Selection

<table>
<thead>
<tr>
<th>Measure</th>
<th>Traffic, ADT</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>&gt;10,000</td>
</tr>
<tr>
<td>IRI, m/km (in/mi)</td>
<td>1.0 (63)</td>
</tr>
<tr>
<td>PSR</td>
<td>3.8</td>
</tr>
<tr>
<td>CA Profilograph, m/km (in/mi)</td>
<td>12</td>
</tr>
</tbody>
</table>

Chapter 5 – Diamond Grinding and Grooving
## Diamond Grinding

### Project Selection

<table>
<thead>
<tr>
<th>Ave. Faulting, mm (in)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8 (1/32)</td>
<td>No roughness</td>
</tr>
<tr>
<td>1.6 (1/16)</td>
<td>Minor Faulting</td>
</tr>
<tr>
<td>2.4 (3/32)</td>
<td>Grinding Project</td>
</tr>
<tr>
<td>3.2 (1/8)</td>
<td>Expedite Project</td>
</tr>
<tr>
<td>4.8 (3/16)</td>
<td>Discomfort Begins</td>
</tr>
<tr>
<td>6.4 (1/4)</td>
<td>Grind Immediately</td>
</tr>
</tbody>
</table>

Chapter 5 – Diamond Grinding and Grooving
Diamond Grinding

Limitations

- Does not address structural or durability problems
- Hardness of aggregate affects costs
- Roughness will return if causes are not addressed
- Allowable work hours for the job can affect the cost
Diamond Grinding
Following Load Transfer Restoration
Diamond Grooving
Diamond Grooving

- Cutting parallel grooves into the pavement using diamond saw blades
- Longitudinal vs. transverse
- Benefits
  - Improved wet weather friction
  - Reduction in splash and spray

Chapter 5 – Diamond Grinding and Grooving
Diamond Grooving
Project Selection

- Historical crash rate, friction number, or macrotexture depth data
- Potential locations for wet weather crashes
- Pavements should be structurally and functionally sound
Diamond Grooving
Longitudinal Grooving

● Advantages
  • Restored surface friction
  • Decreased hydroplaning potential
  • Improved curve tracking
  • Easier to conduct under traffic

● Disadvantages
  • Perception poor handling for motorcycles and light cars

Chapter 5 – Diamond Grinding and Grooving
Transverse Diamond Grooving
Diamond Grooving
Transverse Grooving

● Advantages
  • Most direct channel for water drainage
  • Introduces a surface that provides significant braking traction

● Disadvantages
  • Maintaining adjacent traffic
  • Excessive noise
  • Productivity

Chapter 5 – Diamond Grinding and Grooving
Diamond Grooving
Effect on Friction

YEARS OF OPERATION

WET PCCP ACCIDENT RATE (ACC/MVK)

MILLION VEHICLE PASSAGES/LANE
Module 5-1

Design, Materials & Specifications

From… Maintenance Technical Advisory Guide (MTAG)
Presentation Outline

☑ Introduction
☐ Design considerations
☐ Construction
☐ Quality control
☐ Troubleshooting

Chapter 5 – Diamond Grinding and Grooving
Diamond Grinding
Design Considerations

- Degree of faulting
- Review past corrective efforts
- Design specifications
  - Concurrent preservation techniques
  - Blade spacing
  - Transverse slope
  - Grinding limits and transitions
Diamond Grinding

Dimensions

Width of diamond blades
(2.5 mm - 3.3 mm)

Land area - varies depending on aggregate hardness
- 2.0 mm typical for hard aggregate
- 2.8 mm in typical for soft aggregate

Chapter 5 – Diamond Grinding and Grooving
Diamond Grooving
Design Considerations

- Groove entire lane area
- Allowances for small areas with surface irregularities
- Use recommended blade spacing
Diamond Grooving

Dimensions

Saw blade thickness
2.5 mm

3.2 mm min
6.4 mm max

19 mm

Chapter 5 – Diamond Grinding and Grooving
## Typical Item Codes

<table>
<thead>
<tr>
<th>Item Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>066145</td>
<td>Remove pavement markers</td>
</tr>
<tr>
<td>074017</td>
<td>Prepare water pollution control program</td>
</tr>
<tr>
<td>074020</td>
<td>Water pollution control</td>
</tr>
<tr>
<td>074042</td>
<td>Temporary concrete washout (portable)</td>
</tr>
<tr>
<td>120090</td>
<td>Construction area signs</td>
</tr>
<tr>
<td>120100</td>
<td>Traffic control system</td>
</tr>
<tr>
<td>128650</td>
<td>Portable changeable message sign</td>
</tr>
<tr>
<td>413111</td>
<td>Repair spalled joints</td>
</tr>
<tr>
<td>420201</td>
<td>Grind existing concrete pavement</td>
</tr>
<tr>
<td>420102</td>
<td>Groove existing concrete pavement</td>
</tr>
<tr>
<td>413114</td>
<td>Replace joint seal (existing concrete pavement)</td>
</tr>
</tbody>
</table>

[http://i80.dot.ca.gov/hq/esc/oe/awards/#item_code](http://i80.dot.ca.gov/hq/esc/oe/awards/#item_code)
Module 5-2

Construction and Inspection

From… Maintenance Technical Advisory Guide (MTAG)
Presentation Outline

☑ Introduction
☑ Design considerations
☐ Construction
☐ Quality control
☐ Troubleshooting

Chapter 5 – Diamond Grinding and Grooving
Diamond Grinding
Construction Considerations

- Grinding sequence and pattern
- Continuous operation
- Begin and end perpendicular to centerline
- Maximum overlap of 50 mm (2 in)
- Disposal of slurry
Diamond Grinding
Cutting Head Specifications

- Diamond blades mounted in series on cutting head
- Cutting head width from 48 to 50 in
- Spacing of 56 to 61 blades per ft
Diamond Grinding
Cutting Head
Diamond Grinding

Construction Procedures

- Single lane closure
- Conduct grinding parallel to centerline
- Multiple passes per lane
- Slurry removal
Diamond Grinding
Grinding Machine
Diamond Grinding
Grinding Machine
Diamond Grinding
Trucks Collecting Slurry
Diamond Grinding
Grinding Process
Diamond Grinding
Front of Grinding Head
Diamond Grinding

Behind the Grinding Head
Diamond Grinding
After First Pass of Grinding Machine
Diamond Grinding
Finished Product
Diamond Grooving
Construction Considerations

- Groove dimensions
- Direction of grooving
- Disposal of slurry
- Procedures similar to diamond grinding
Diamond Grooving

Equipment

- Head width: 1 to 6 ft
- Longitudinal blade spacing of 3/4 inch
- Vacuum system employed to collect slurry
Presentation Outline

☑ Introduction
☑ Design considerations
☐ Construction
☐ Quality control
☐ Troubleshooting

Chapter 5 – Diamond Grinding and Grooving
Diamond Grinding

Quality Control

- **Profile**
  - Pavement roughness
  - Need acceptance standards

- **Skid resistance**
  - Standard smooth tire
  - Improvement may be temporary if aggregate is susceptible to polishing
Diamond Grooving
Quality Control

- Quality assessed through friction
- Values prior to grooving compared with post-grooving values
- Direct measurement of surface texture can also be used

Chapter 5 – Diamond Grinding and Grooving
Project Checklist

- Preliminary Responsibilities
  - Document Review
  - Project Review
- Equipment Inspections
  - Diamond-Grinding Machine
  - Profilograph or Profiler
- Others
  - Weather Requirements
  - Traffic Control

Chapter 5 – Diamond Grinding and Grooving
Project Checklist

- Project Inspection Responsibilities
  - Alignment
  - Texture
  - Residues
Troubleshooting

- Construction quality and performance problems

- Approach:
  
  Identify Problem → Determine Cause → Identify Solution

Chapter 5 – Diamond Grinding and Grooving
Troubleshooting—Grinding
Possible Construction Problems

Lack of horizontal overlap (dogtails)
Troubleshooting—Grinding
What is wrong here?

Unground areas (holidays)
Troubleshooting—Grinding

What is wrong here?

Poor vertical match between passes
Troubleshooting—Grinding
Possible Construction Problems

● Problem: *Uneven material removal due to spalled or broken pavement*

● Potential causes?
Troubleshooting—Grinding
Possible Construction Problems

- Problem: Remaining fins do not break easily
- Potential causes?
Troubleshooting—Grooving
Possible Construction Problems

- Problem: *Unground areas from low spots*
- Potential causes?
Troubleshooting—Grooving
Possible Construction Problems

- Problem:
  *Non-uniform groove depths*

- Potential causes?
Troubleshooting Guide – Causes and Solution

- “Dogtails”
- “Holidays”
- Poor vertical match between passes.
- The fins that remain after grinding do not quickly break free.
- Large amounts of slurry on the pavement during grinding.

Chapter 5 – Diamond Grinding and Grooving
Troubleshooting Guide – Causes and Solution

- Lack of horizontal overlap.
- Isolated areas with inconsistent groove depth.
- Inconsistent groove depth near joints.
- Large amounts of slurry on the pavement during grooving.
- Light vehicles and motorcycles experience vehicle tracking.
Presentation Outline

- Introduction
- Design considerations
- Construction
- Quality control
- Troubleshooting

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Chapter 5 – Diamond Grinding and Grooving
Thank You

Questions?