

TRANSPORTATION RESEARCH BOARD

Preserving Concrete Pavement

August 19, 2020

@NASEMTRB
#TRBwebinar

PDH Certification Information:

- 1.5 Professional Development Hour (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Reggie Gillum at RGillum@nas.edu

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.



REGISTERED CONTINUING EDUCATION PROGRAM

#TRBwebinar

Learning Objectives

1. Define concrete pavement preservation conditions that can be addressed using diamond grinding, partial depth patching, and joint resealing
2. Describe the process for each treatment type
3. Identify key aspects required for a successful application

#TRBwebinar



Diamond Grinding!

Larry Scofield
IGGA and ACPA

Diamond Grinding Beginnings

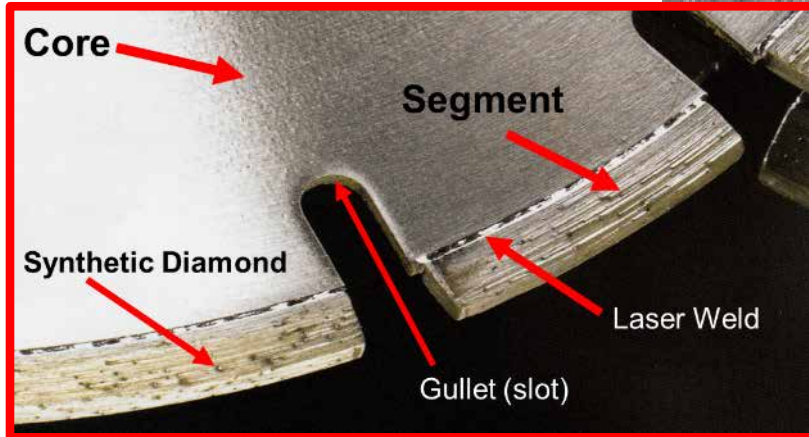
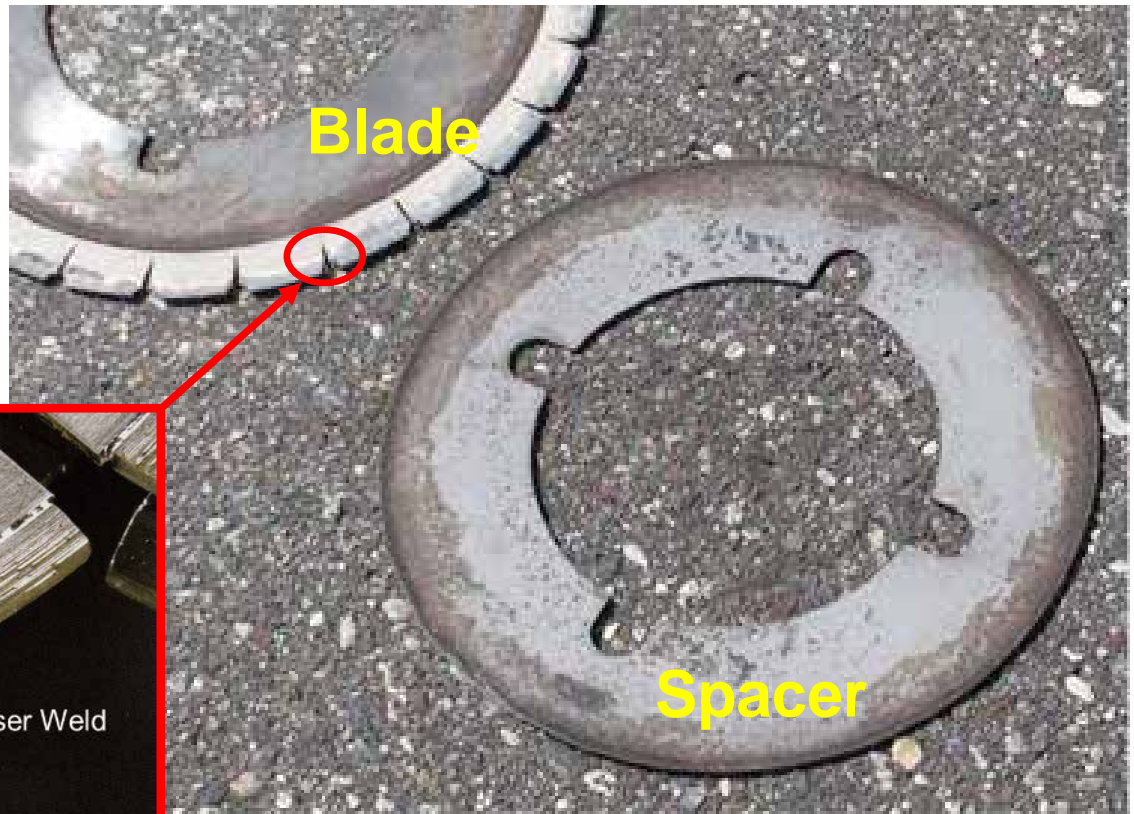
- n Diamond grinding was first used on an airfield in 1958 in Arizona
- n First highway use was I-10 in California in 1965
- n Its been the most common concrete preservation strategy over the last 55 years



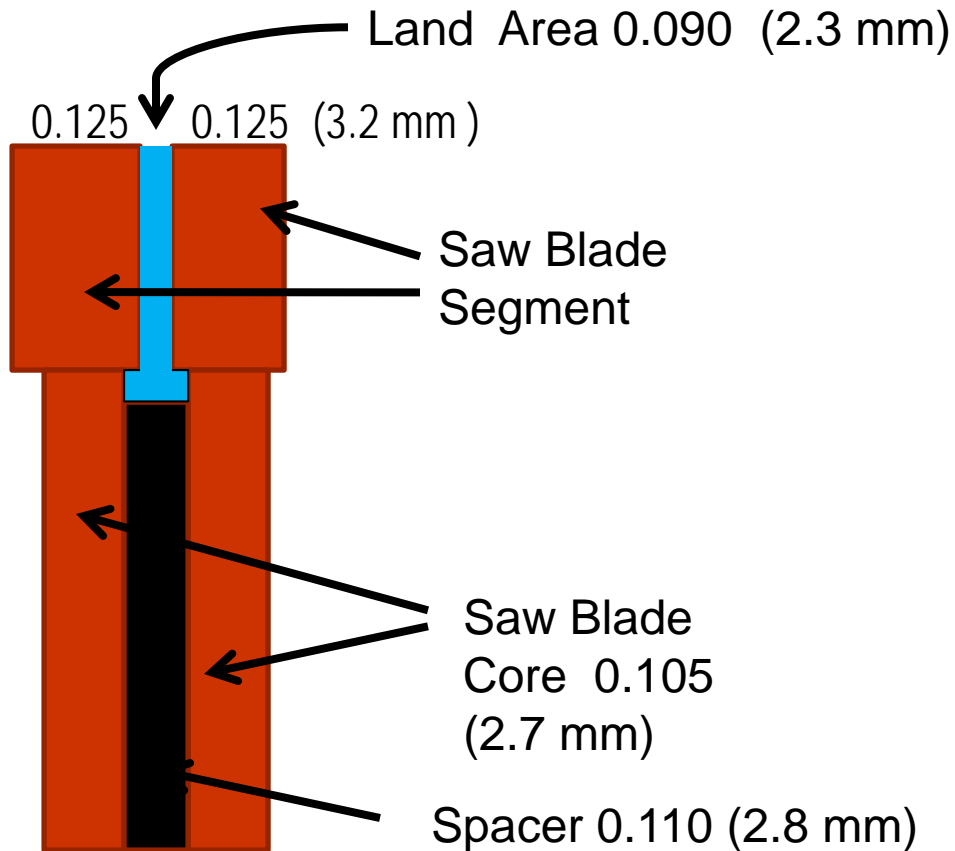
What is Conventional Diamond Grinding?

- ∅ Removal of thin surface layer of hardened PCC using closely spaced diamond saw blades
- ∅ Results in smooth, level pavement surface with desirable friction, and low noise characteristics
- ∅ Frequently performed in conjunction with other concrete preservation techniques to extend pavement life

It all Starts with Blades and Spacers



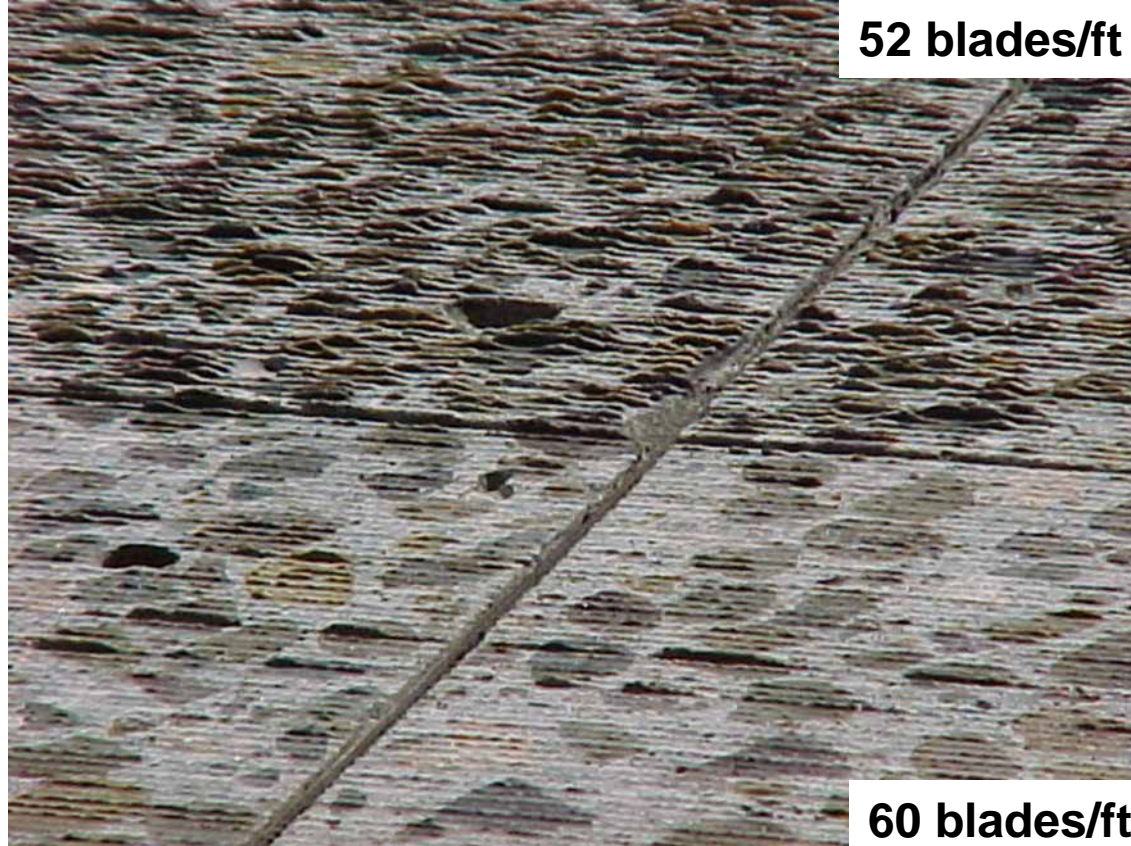
Typical Conventional Diamond Grinding Blade Configuration



The Spacers Create the Ridges (lands) in the Corduroy Texture



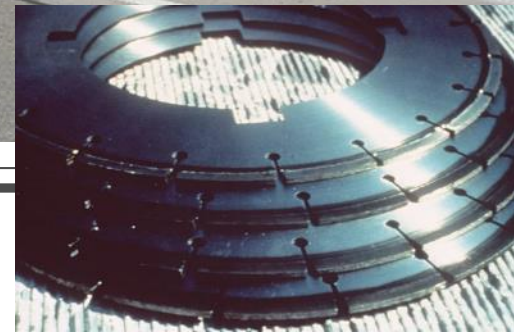
60 Blades vs 52 Blades per Foot



52 blades/ft

60 blades/ft

The Grinding Operation (Rural)



The Grinding Operation (Urban)



New Construction Bump Grinder

- n Wt. 17,000 lbs
- n 260 HP
- n 3 ft. head width
- n Can grind within 12” of a vertical surface
- n Primarily a bump grinder and used in tight places



Full Surface Roadway Grinder

- n 4 ft grinding head
- n 485 – 650 HP
- n Wt. 53,000 – 62,000 lbs
- n Max wt. on head is variable up to 27,000 lbs
- n Production rate variable 2' to 40' per minute

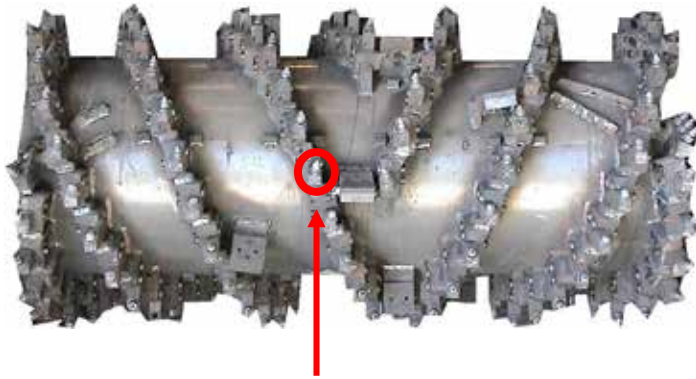


Grinding Close to Vertical Structures



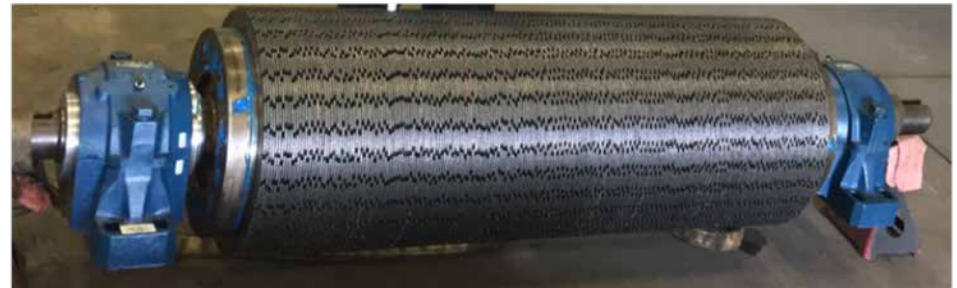
Milling Vs Grinding

Milling Head



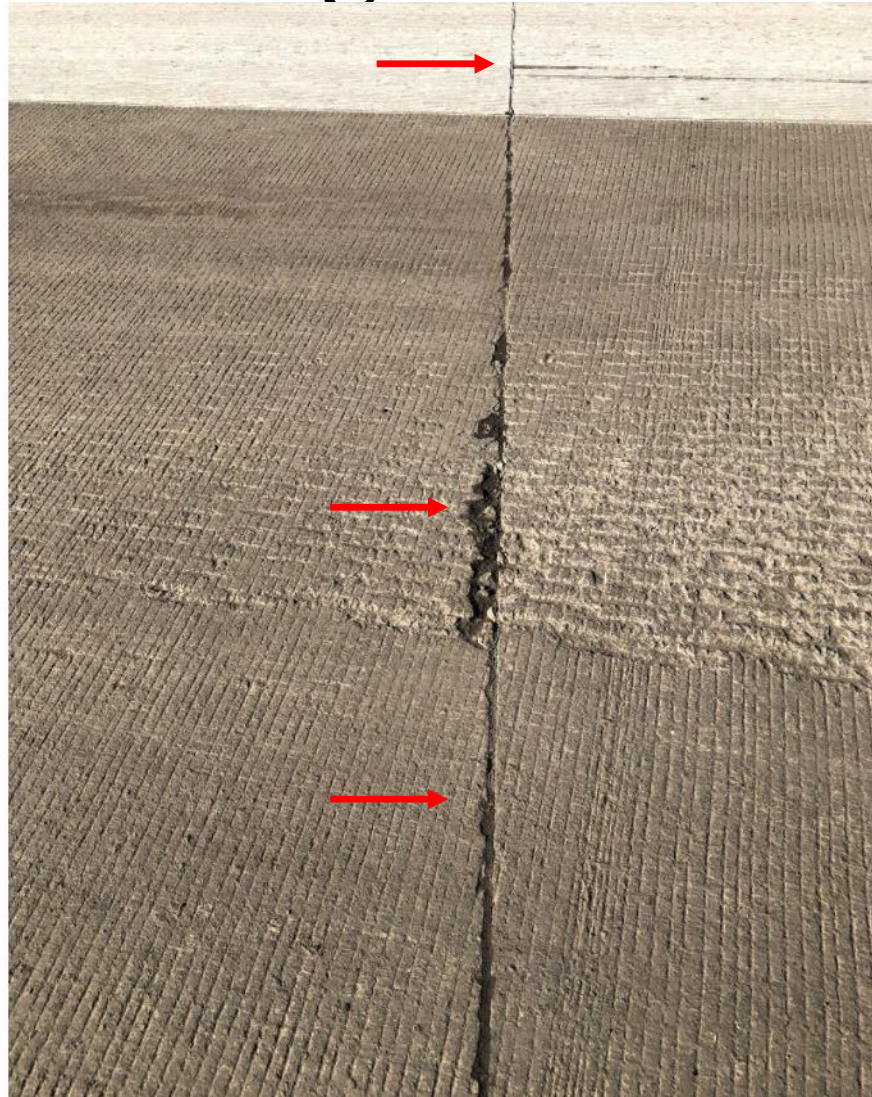
**Uses Carbide Bits to Impact
Concrete**

Diamond Grinding Head



**Uses Diamond Impregnated
Blades to Grind Concrete**

Milling Vs Grinding



Diamond Grinding

**Joint Damage from
Milling Machine**

Original Texture

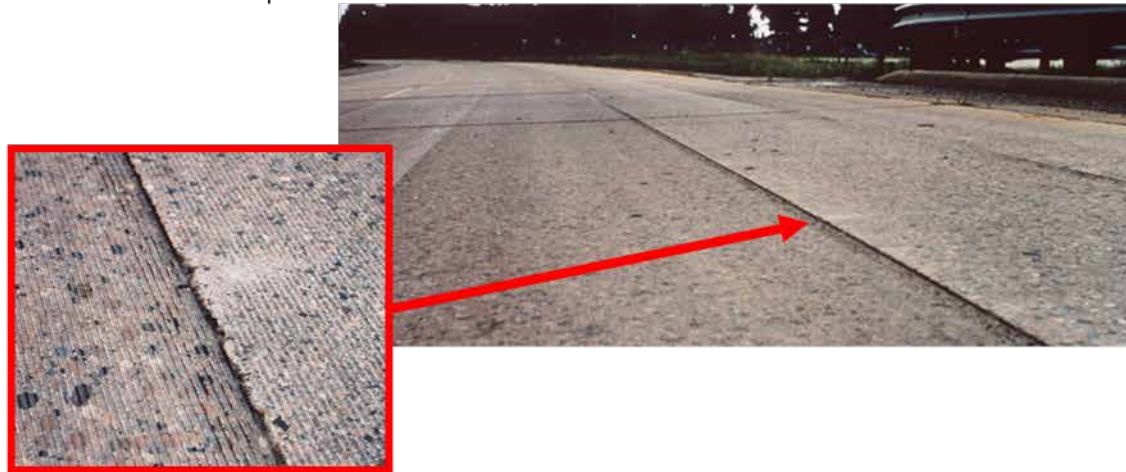
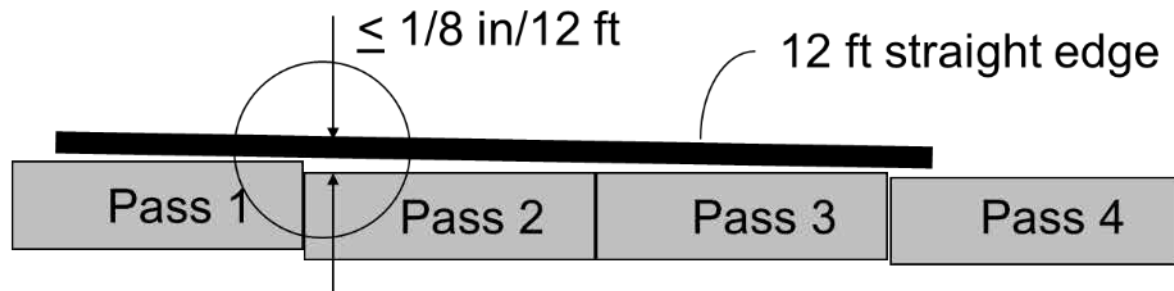
Pavement Problems Addressed Through Diamond Grinding

- ∅ Faulting at joints and cracks
- ∅ Built-in or construction roughness
- ∅ Polished surface
- ∅ Wheel-path rutting
- ∅ Curling and warping
- ∅ Unacceptable noise level

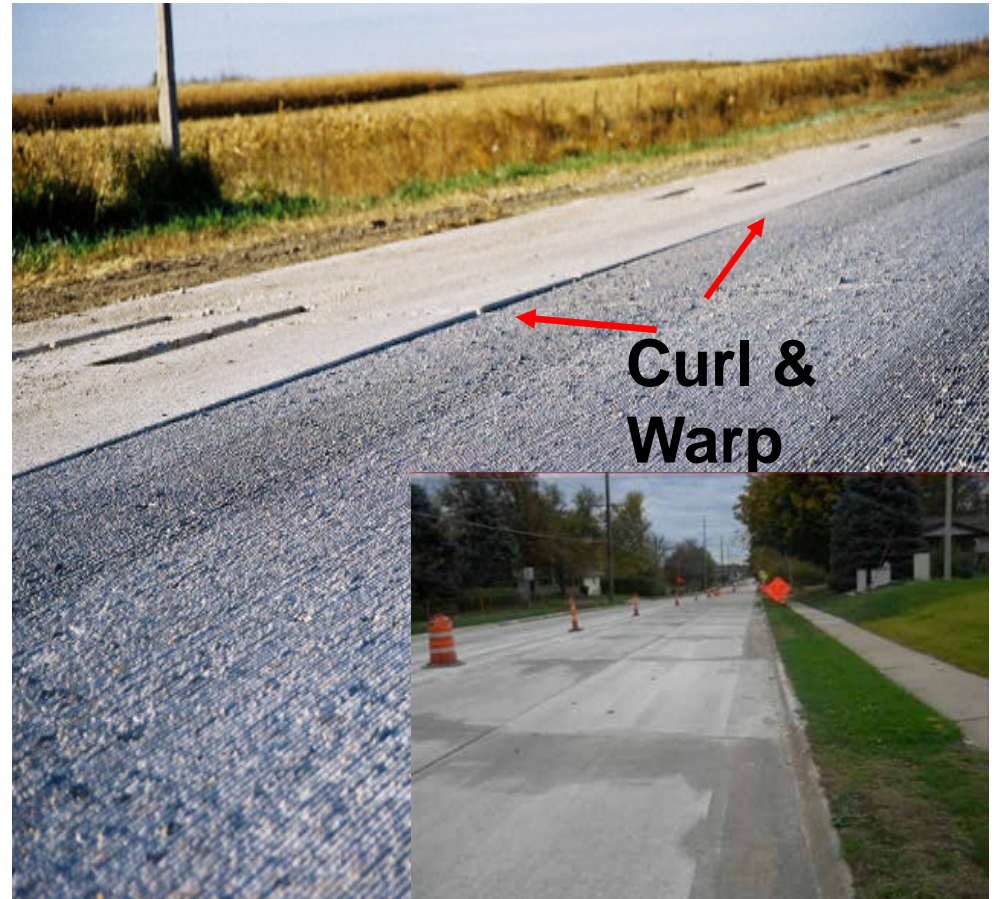


Construction Inspection (Smoothness)

Poor Match Between Passes



Percent Coverage (95%)



Slurry Containment Vacuum

Diamond Grinding Slurry



Slurry Recovery Failure



Proper Slurry Recovery System

Types of Slurry Disposal

Shoulder Disposal



- Most Cost Effective Approach

Settlement Basins



- Consists of Both Temporary and Permanent Basins
- Sometimes Can Be Located on Project Site

Brandt System



- Uses a Shaker, a Centrifuge, and a Vertical Clarifier

Filter Press



- Essentially Squeezes the Water Out to Separate Fines

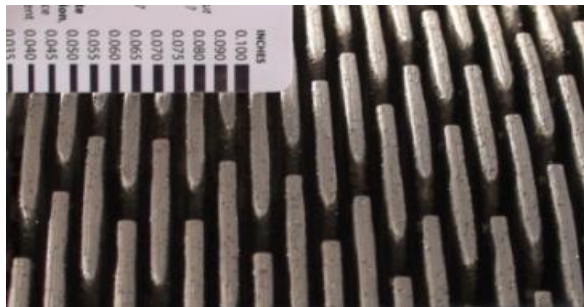
Increasing Costs



What is Next Generation Concrete Surface (NGCS)



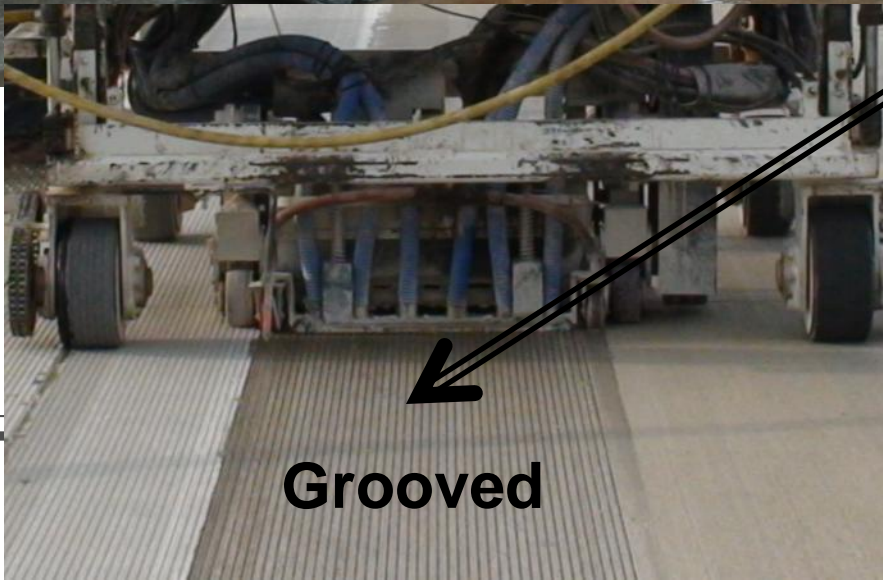
CDG



NGCS



NGCS Construction



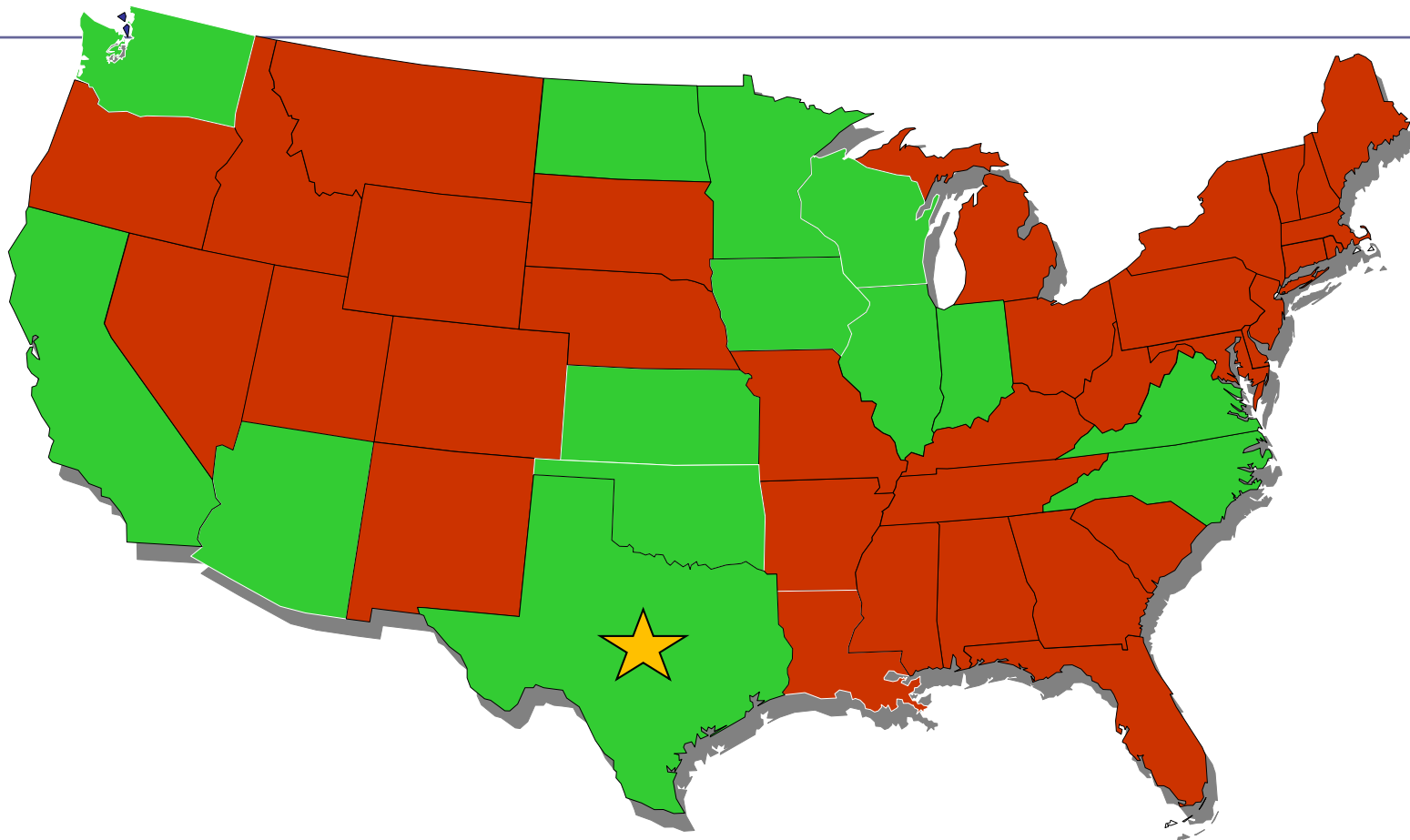
NGCS Compared to CDG



CDG

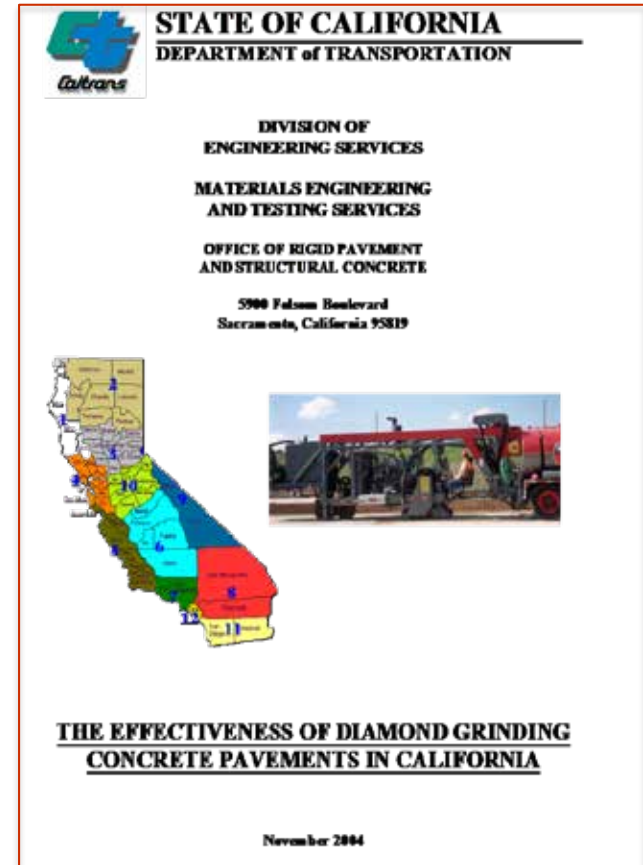
NGCS

NGCS Site Locations in The USA



Effectiveness of Diamond Grinding

- Ø 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.



In Summary

- ∅ **Sustainable:** No New Road Material Used
- ∅ **Efficient:** Can be accomplished during off-peak hours with mobile lane closures; single lane at a time
- ∅ **Compatible:** Does not affect overhead clearances underneath bridges, signs or tunnels
- ∅ **Extends Performance:** Enhances smoothness, surface friction, and safety
- ∅ **Competitive:** Relatively Stable Costs Overtime

Can be used on asphalt too!



I-70 Missouri



Questions?

**Thank
You**



Partial-Depth Repairs in Concrete Pavements

TRB Webinar on Concrete
Pavement Preservation

August 19, 2020

Prashant Ram
Applied Pavement Technology, Inc.



Presentation Outline



Benefits and Suitability of Partial-Depth Repairs (PDRs)



Repair Material Selection



Construction Procedures



Key Success Factors

Partial Depth Repairs (PDR)

- Removal and replacement of small, shallow areas of deteriorated PCC at spalled or distressed joints
- Distress limited to upper 1/3 to 1/2 of slab thickness
- Existing load transfer devices are functional



Image Source: Applied Pavement Technology

Benefits of PDR

- Restores overall pavement integrity
- Improves ride quality
- Extends pavement service life
- Restores a well-defined uniform joint reservoir prior to joint resealing

Good PDR Candidates

- Spalls caused by:
 - » Incompressibles in joints
 - » Localized areas of weak material
- Surface deterioration caused by:
 - » Reinforcing mesh too close to the surface
 - » Poor consolidation, curing, or improper finishing practices



Image Source: Smith et al. (2014)

Poor PDR Candidates

- Spalls due to dowel bar misalignment
- Spalls at working cracks due to shrinkage, fatigue, or vertical movement
- Spalls due to D-cracking or reactive aggregate

PDRs to address durability issues should be approached with caution

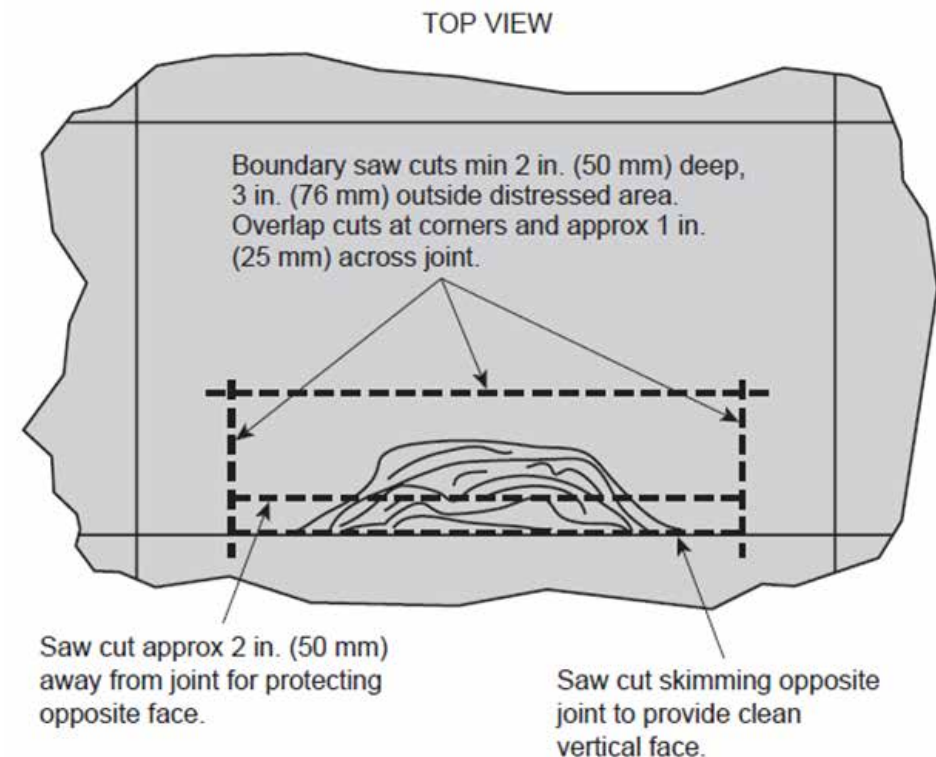


Image Source: FHWA (2015)

PDR Considerations

Sizing Repairs

- 3 inches beyond distressed area
- Combine spalls if closer than 24 inches
- Minimum dimensions for cementitious materials:
 - » 4 inches x 10 inches
 - » 2 inch depth
- Follow manufacturer recommendations for proprietary materials



PDR Considerations

Repair Material Types

- Portland cement concrete
- Modified hydraulic cements
 - » Gypsum-based
 - » Calcium aluminate
- Magnesium phosphate
- Polymeric materials
 - » Epoxy
 - » Polyurethane
- Bituminous
 - » Conventional
 - » Modified (proprietary)

- Use bonding agent to enhances bond between repair material and existing pavement
- Typically required for most cementitious materials

Pay Attention to Repair Size when Using Polymeric Materials!

Image Source: Applied Pavement Technology



PDR Considerations

Material Selection Factors

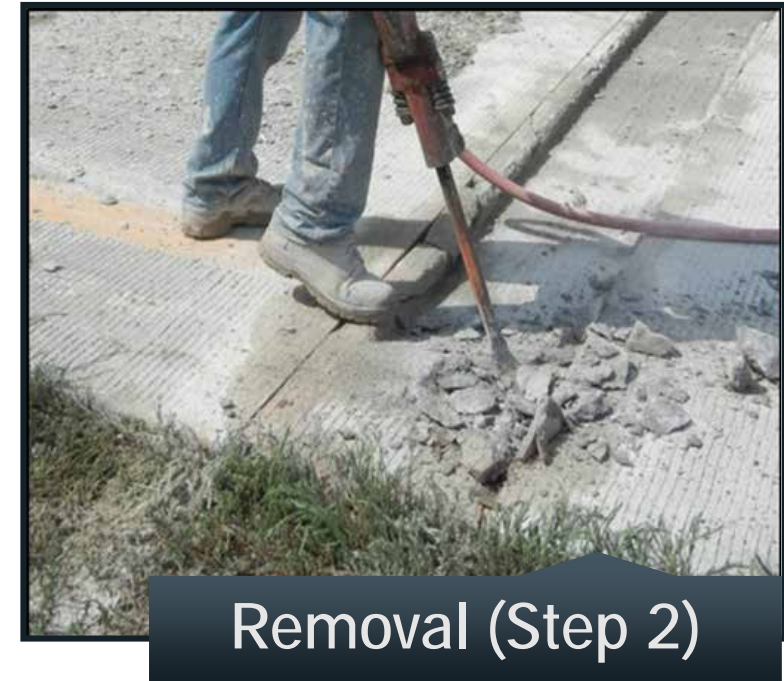
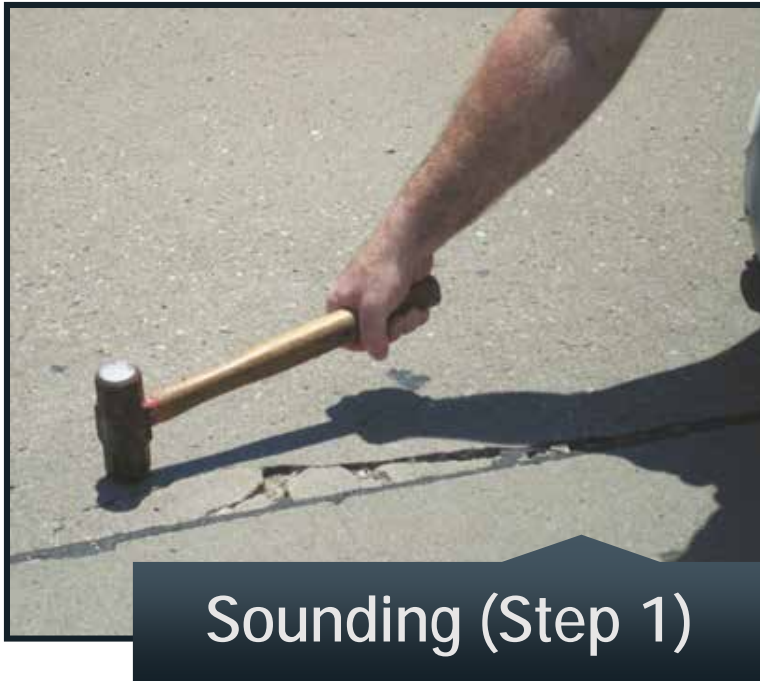
- Available lane closure time
- Ambient temperature and moisture levels
- Material properties (shrinkage, CTE, bond)
- Material and placement cost
- Handling and workability
- Compatibility between repair material and existing pavement
- Size and depth of repair
- Performance capabilities and requirements
- Project size

Construction Steps

1. Repair boundaries determination
2. Concrete removal
3. Repair area preparation
4. Joint preparation
5. Bonding agent application
6. Repair material placement
7. Curing
8. Diamond grinding (optional)
9. Joint resealing

Step 1: Repair Boundaries Determination

Step 2: Concrete Removal



Images: Smith et al. (2014)

Step 3: Repair Area Preparation

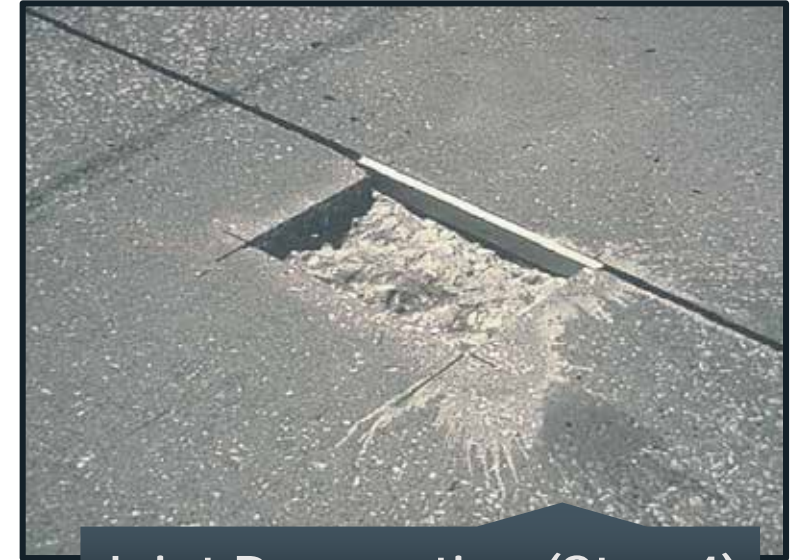
Step 4: Joint Preparation



Sand Blasting (Step 3)



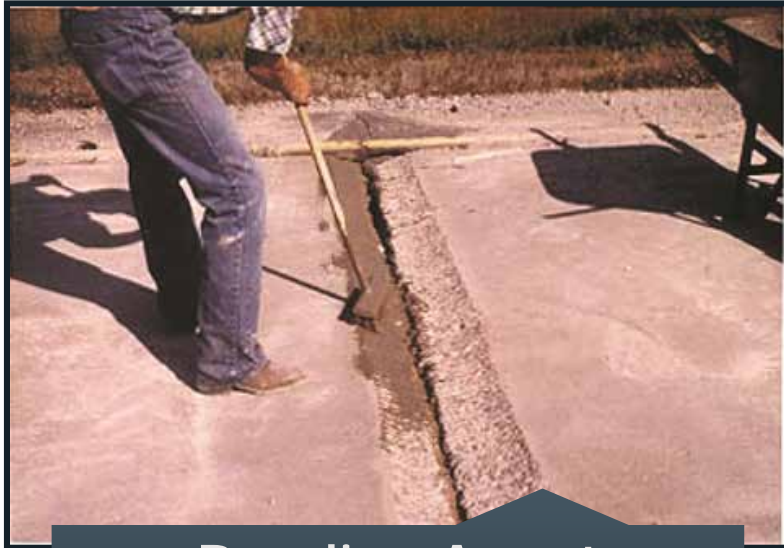
Air Blasting (Step 3)



Joint Preparation (Step 4)

Step 5: Bonding Agent Application

Step 6: Repair Material Placement



Bonding Agent Application (Step 5)



Repair Material Placement (Step 6)



Finishing (Step 6)

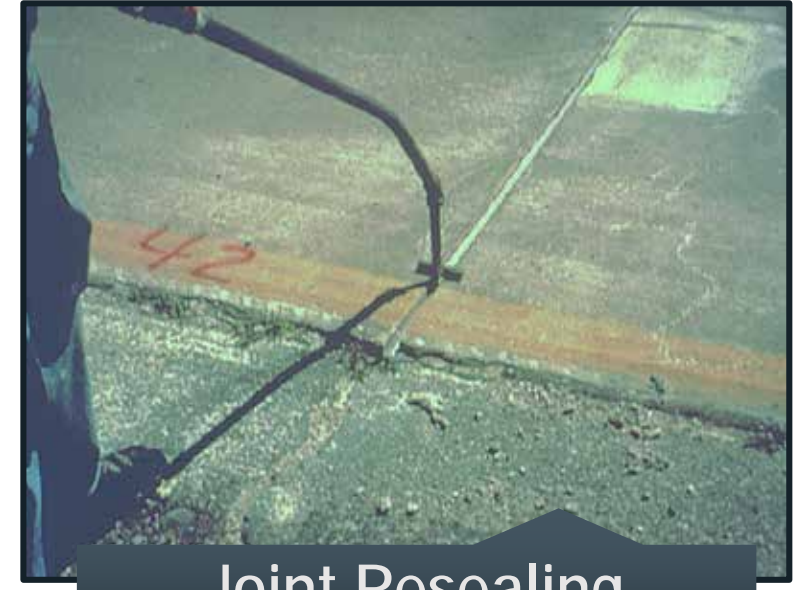
Step 7: Curing | Step 8: Grinding Step 9: Joint Resealing



Curing (Step 7)

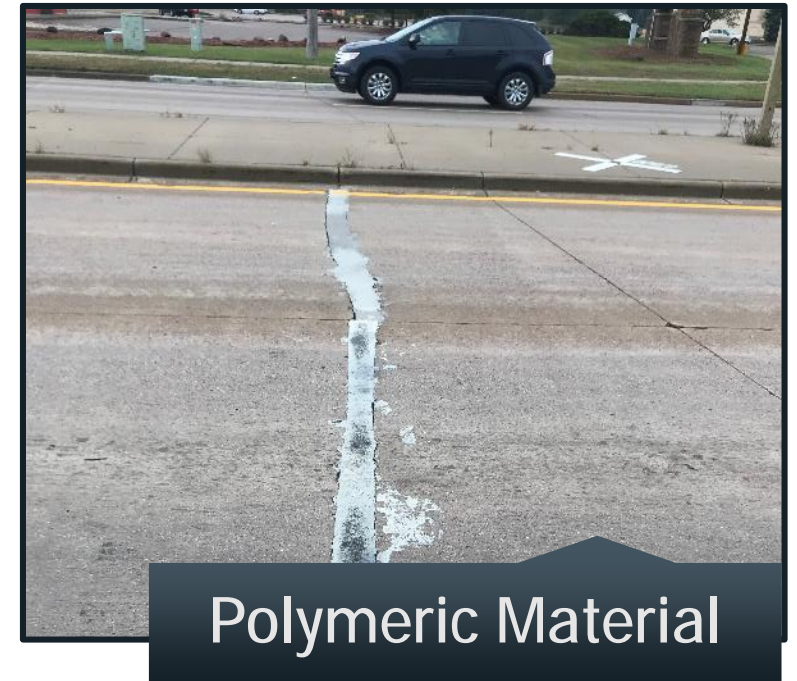
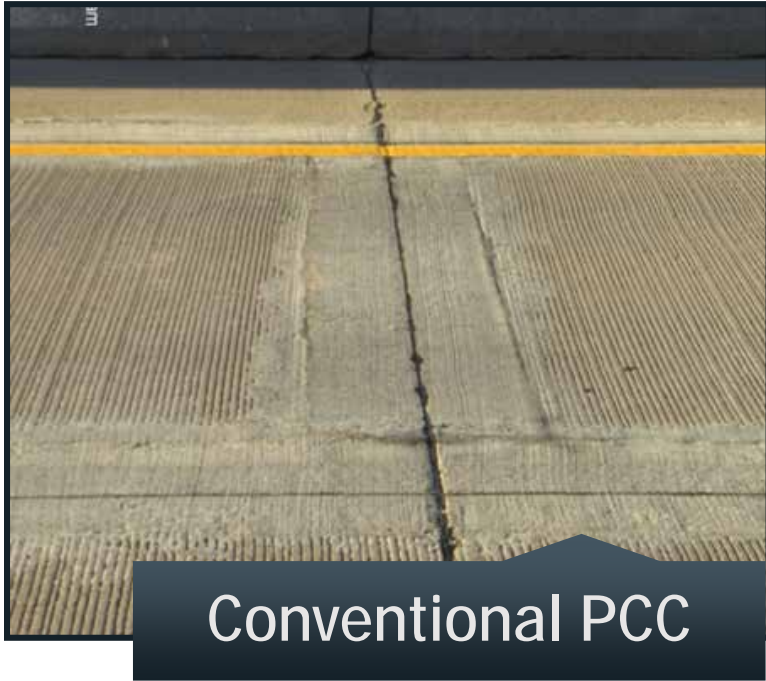


Grinding (Step 8)



Joint Resealing
(Step 9)

Completed Repairs



Images: Applied Pavement Technology

Key Success Factors

- Proper selection of candidate projects
- Proper material selection
- Identification or repair boundaries
- Use of joint/crack reformers
- Achieving good bond
- Proper mixing, placement, and curing

Summary

- PDRs can restore rideability and overall concrete pavement integrity
- Do not select repair materials just based on strength
 - » Consider compatibility with existing substrate concrete
- Take time to properly prepare repair area
- Follow material manufacturer recommendations
- Pay attention to:
 - » Weather conditions during placement
 - » Curing

Resources

- Guide for PDRs (Frentress and Harrington 2012)
 - » https://intrans.iastate.edu/app/uploads/2018/08/PDR_guide_Apr2012.pdf
- Concrete Pavement Preservation Guide (Smith et al. 2014)
 - » <https://www.fhwa.dot.gov/pavement/concrete/pubs/hif14004.pdf>
- FHWA PDR Checklist (FHWA 2019)
 - » <https://www.fhwa.dot.gov/pavement/preservation/2019checklists/hif19048.pdf>

Questions?



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Joint Resealing in Concrete Pavements

TRB Webinar on Concrete
Pavement Preservation

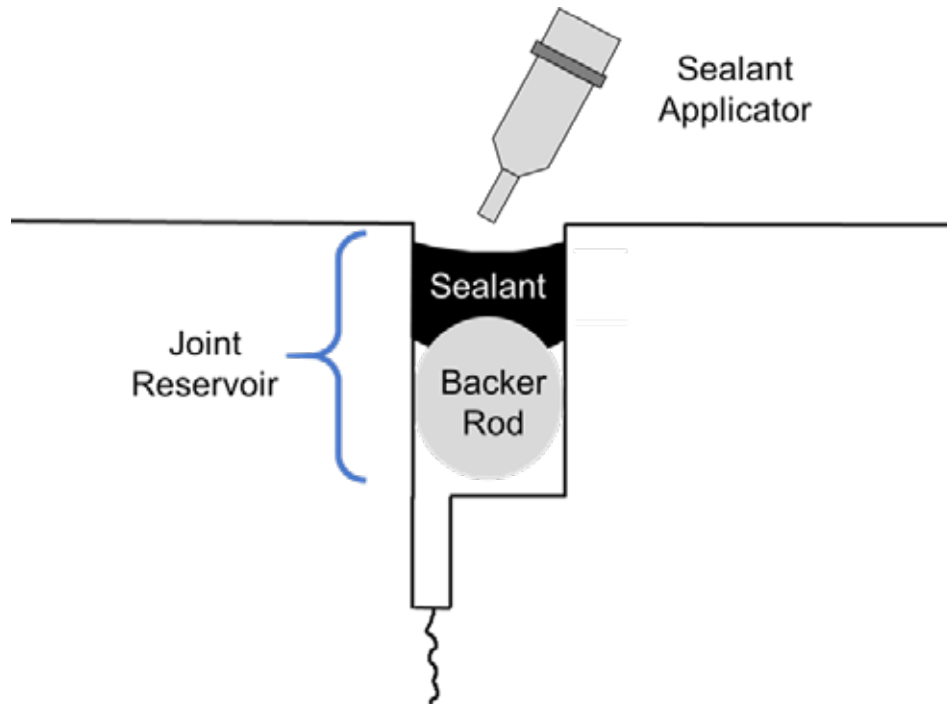
August 19, 2020

Kurt Smith
Applied Pavement Technology, Inc.



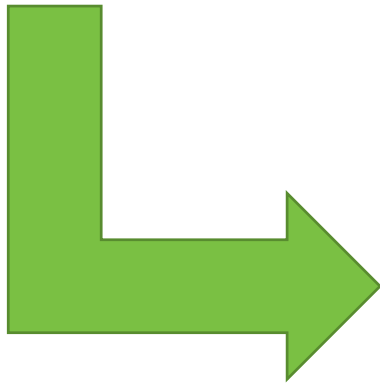
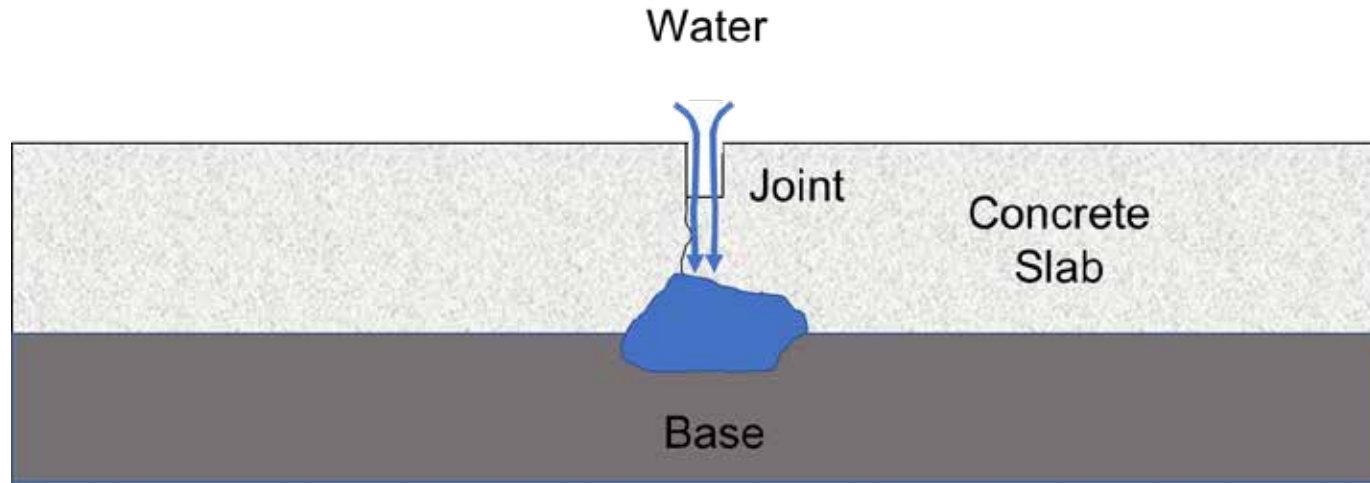
What Is It?

- Placement of an approved sealant material in an existing joint



Why Do We Seal?

1) Minimize moisture infiltration



Why Do We Seal?

1) Minimize moisture infiltration (continued)

Water



Joint

Concrete
Slab

Base



Why Do We Seal?

2) Reduce incompressibles



What Do We Expect?

- 1982 NCHRP Synthesis
 - » Avg. joint sealant life/ resealing frequency = 5 yrs
- 2011 SHRP2 Report
 - » Joint sealant life/resealing frequency = 2 to 8 years
- 2019 FHWA Tech Brief
 - » Hot Poured Sealants: 3 to 8 years
 - » Silicone Sealants: 8 to 10 years
 - » Preformed seals: up to 20 years



So When Do We Reseal?

- Reseal when existing sealant no longer functional
- Pavement not severely deteriorated
- In conjunction with other preservation activities

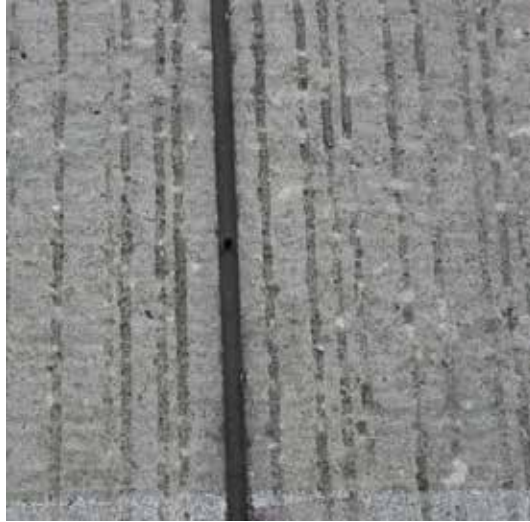
***If joints were originally sealed,
continue to keep those joints sealed***



What Materials Are Commonly Used for Resealing?

- Hot-Poured

- » Standard or Low Modulus
- » ASTM D6690, Types I-IV



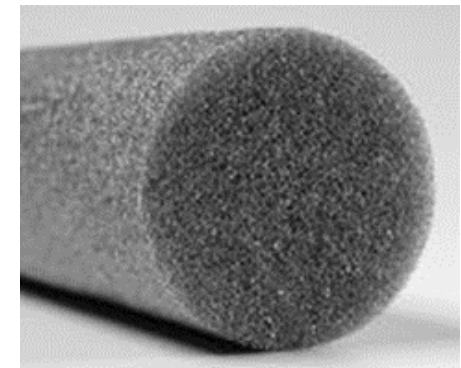
- Silicone

- » Non-Sag or Self Leveling
- » ASTM D5893



- Backer Rod

- » Closed-cell products
- » ASTM D5249



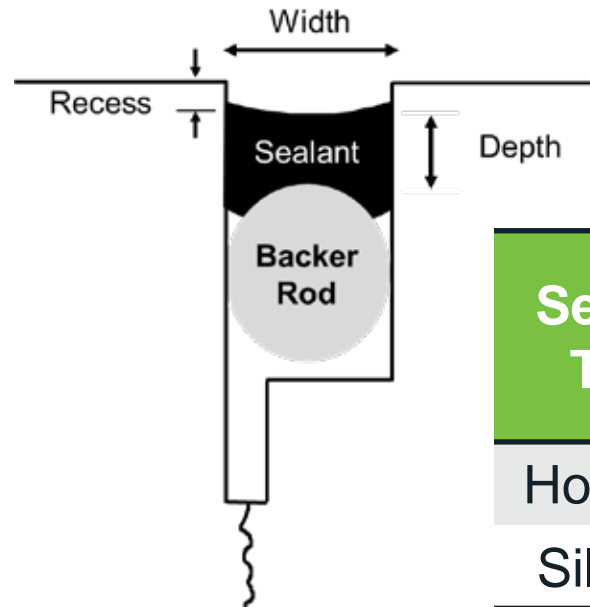
What Influences Sealant Performance?



Slab movements (joint spacing, base type, climate)



Joint preparation (=clean & dry!)



Sealant Type	Recommended Shape Factor (W:D)
Hot-Pour	1:1
Silicone	2:1

Sealant properties and design

What Are the Installation Steps?

1. Removal of Old Sealant
2. Joint Refacing
3. Joint Reservoir Cleaning
4. Backer Rod Installation
5. Sealant Installation



What Was Step 1?

- Removal of Old Sealant



What Was Step 2?

- Joint Refacing



What Was Step 3?

- Joint Reservoir Cleaning



Sandblasting



Airblasting

What Was Step 4?

- Backer Rod Installation



What Was Step 5?

- Sealant Installation



Hot-Poured



Silicone



What Are Some Final Things to Keep In Mind?

- Reseal when existing sealant not longer functional
- Do not overwiden (keep joints as narrow as possible)
- Ensure proper reservoir design and joint shape factor
- Effectively prepare the joint (Clean and Dry!)



So Are We Done?



Kurt Smith

ksmith@appliedpavement.com

Today's Panelists

#TRBWebinar



Moderator: Dingxin Cheng,
*California State University,
Chico*

Larry Scofield, *American Concrete
Pavement Association*

Prashant Ram, *Applied Pavement
Technology*

Kurt Smith, *Applied Pavement
Technology*

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- September 17: [Enhancing Pavement Foundation Resilience through Moisture Measurement](#)

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- Check our [website](#) for more information



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