

Chapter 6

Dowel Bar Retrofit

From... Maintenance Technical
Advisory Guide (MTAG)

Load Transfer Restoration Through Dowel Bar Retrofit



Learning Objectives

1. List benefits of load transfer restoration
2. Describe recommended materials and mixtures
3. Describe recommended construction procedures
4. List important quality control activities
5. Describe potential construction and performance problems
6. Identify associated solutions

Presentation Outline

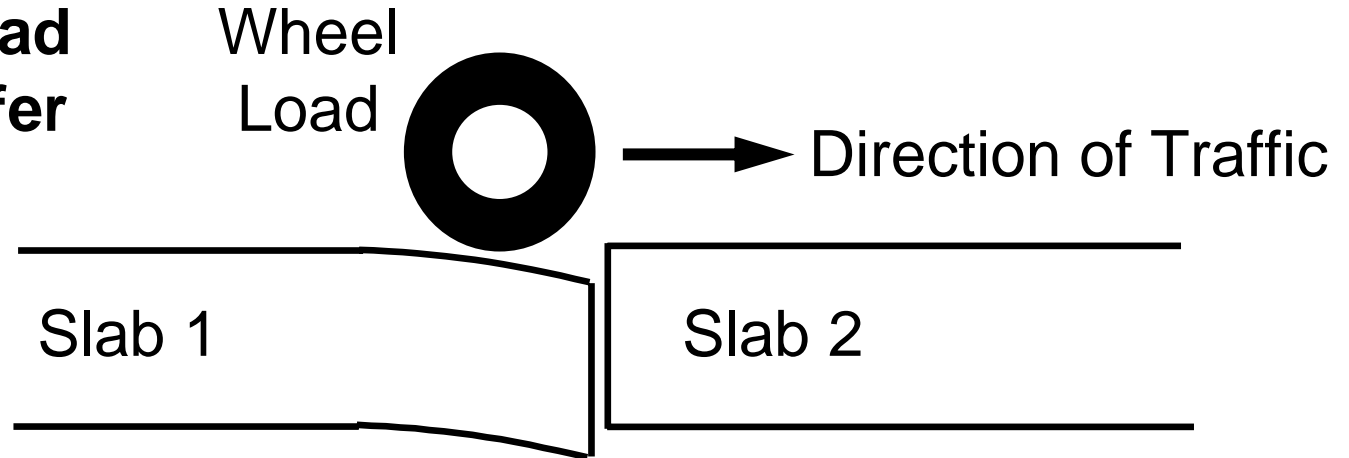
- Introduction
- Material selection
- Construction
- Quality control
- Troubleshooting

Load Transfer

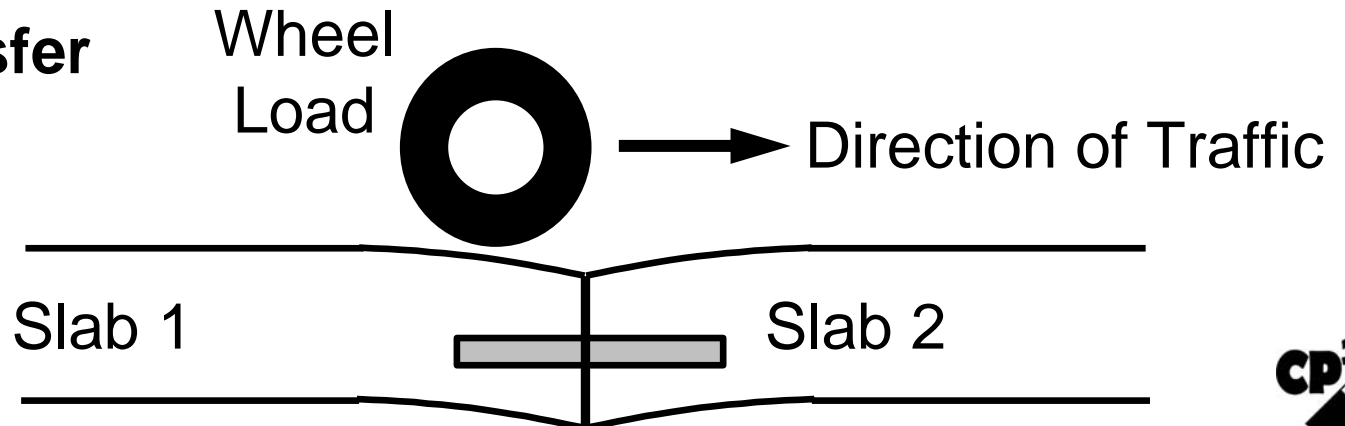
- Definition
 - Mechanism of transferring wheel loads across a joint or crack
- Accomplished through:
 - Mechanical devices (dowel bars)
 - Aggregate interlock
 - Foundation support
- Load transfer efficiency (LTE)

Load Transfer (continued)

0% Load Transfer



100% Load Transfer



Causes of Poor Load Transfer

- Absence of load transfer devices
- Failed load transfer device
- Excessive crack/joint opening
- Poor pavement drainage
- Eroded base

Results of Poor Load Transfer Pumping



Results of Poor Load Transfer Transverse Joint Faulting



Results of Poor Load Transfer Corner Breaks



Results of Poor Load Transfer Deteriorated Mid-Panel Cracking



Load Transfer Restoration

- Definition

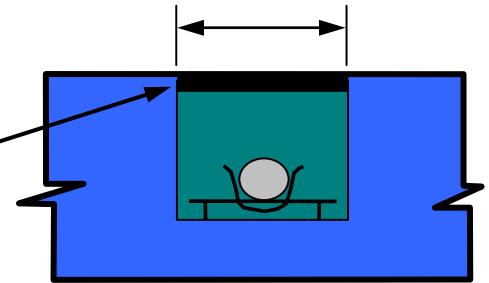
Installation of mechanical devices in an existing pavement to restore load transfer

- Suitable for transverse joints or cracks

Retrofitted Dowel Bar

2.5 in min.
6 in max.

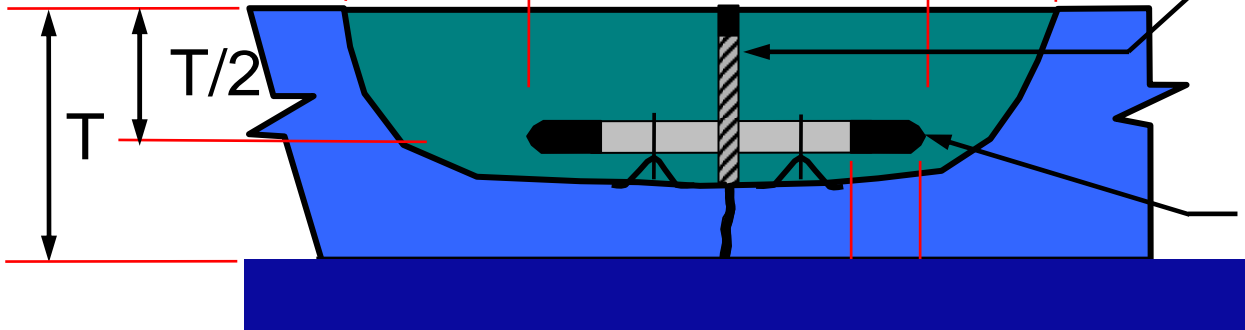
Temporary joint insert for sealant reservoir



End view

As required

18 in \pm 0.2 in



Full depth joint forming medium & dowel support

Dowel bar cap (at least one side)
0.25 in expansion

*18 in max.

1.5 in

Side view

Load Transfer Restoration Benefits

- Reduced probability of pumping, faulting, and corner breaks
- Improved long-term rideability
- Increased service life

Good Candidate Projects

- Relatively good condition but with:
 - Poor load transfer
 - Faulting between 0.125 and 0.5 in
 - <10% slabs with multiple cracks
- Medium to heavy truck traffic

Example Item Codes

Item Code	Description
074017	Prepare water pollution control program
074019	Prepare storm water pollution prevention plan
074020	Water pollution control
074042	Temporary concrete washout (portable)
120090	Construction area signs
120100	Traffic control system
128650	Portable changeable message sign
406100	Dowel bar retrofit
413111	Repair spalled joints
414101	Seal transverse joint
420201	Grind existing concrete pavement

Module 6-1

Design, Materials & Specifications

From... Maintenance Technical
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Presentation Outline

- Introduction
- Material selection
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Material Selection

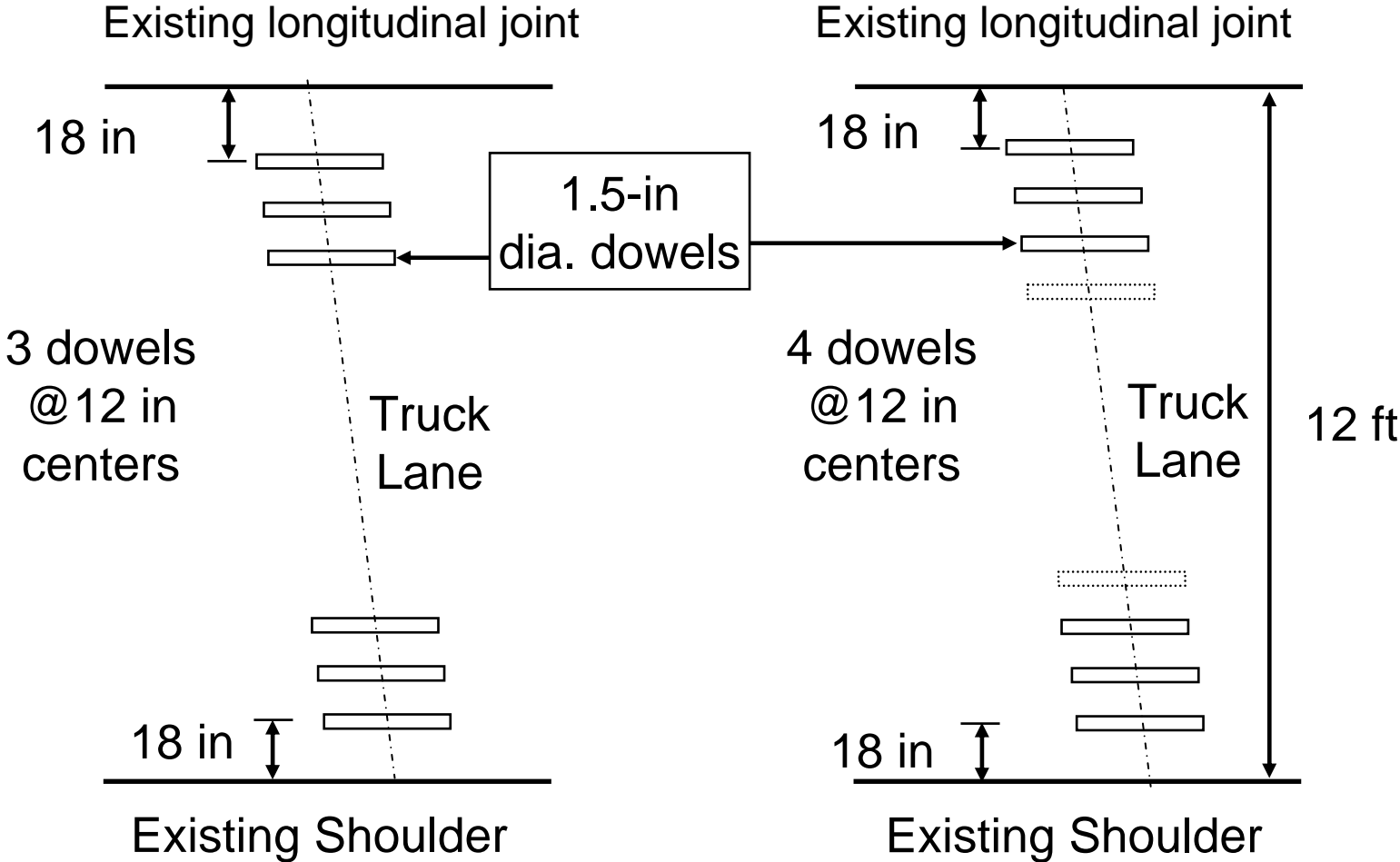
- Load transfer devices
 - Retrofitted dowel bars
 - Other devices not recommended
- Repair (filler) materials
 - Portland cement concrete (PCC)
 - Rapid strength materials
 - Polymer concretes
 - Epoxy-resin adhesives

Load-Transfer Devices

Dowel Bars



Dowel Design and Layout



Repair Material Requirements

- Little or no shrinkage
- Good ultimate strength
- Thermal compatibility
- Freeze-thaw durability
- Good bond to existing concrete
- Non shrink

Selecting Repair Materials

- Partial-depth repair materials work well
- Required time until opening to traffic
- Laboratory testing

Module 6-2

Construction and Inspection

From... Maintenance Technical
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Presentation Outline

- Introduction
- Material selection
- Construction
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Construction

1. Slot construction
2. Slot preparation
3. Dowel bar placement
4. Repair material placement
5. Material consolidation and finishing

Slot Construction

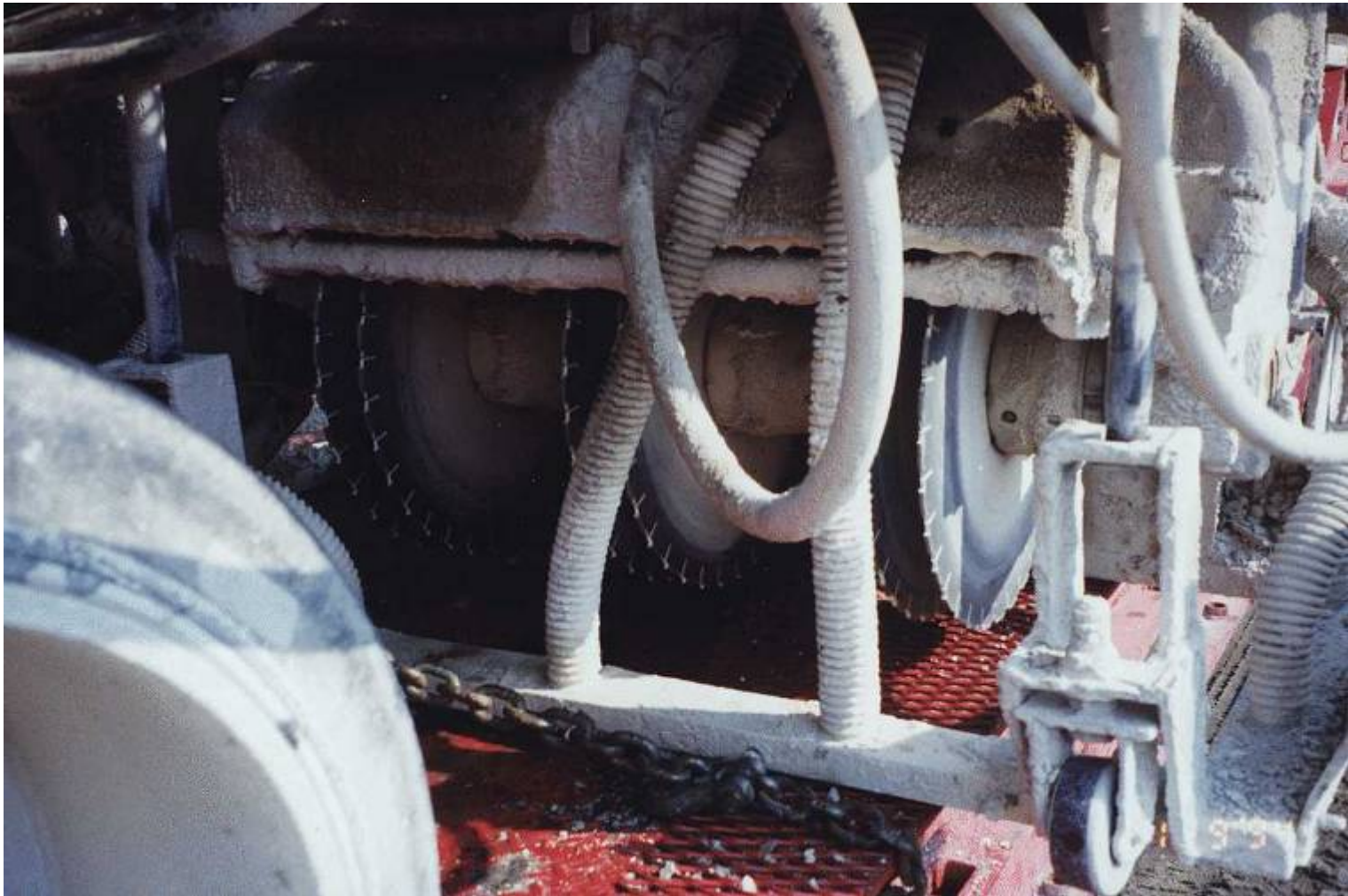
- Parallel to longitudinal joints
- Diamond saw cutters vs. modified milling machines
- Slot dimensions
 - Length: 3 ft on surface
 - Width: 2.5 and 4 in
 - Depth: 0.5 in below dowel (mid-panel depth + half diameter of dowel + 0.5 inch)

Slot Construction Slot Cutting Machine



Slot Construction

Close-Up of Sawblades



Slot Construction

Slot Cutting with Milling Machine



Slot Construction

Milled Slots



Slot Preparation Material Removal



Slot Preparation Material Removal



Slot Preparation Material Removal



Slot Preparation

Sandblasting Slots



Slot Preparation

Cleaning Slots after Sandblasting



Slot Preparation

Caulking of the Joint or Crack



Dowel Bar Placement

- Apply bondbreaker to dowels
- Attach expansion caps
- Place dowel on chair at slab mid-depth
- Filler board placed at mid-point of dowel bar to maintain joint
- Proper alignment is critical

Dowel Bar Placement



Dowel Bar Placement



Repair Material Placement

- Mix material in small quantities
- Generally 3/8 in top size aggregate
- Totally encase dowel bar
- Consolidate with small 1 in pencil vibrator
- Apply curing compound

Repair Material Placement Backfilling



Repair Material Placement Consolidation and Finishing



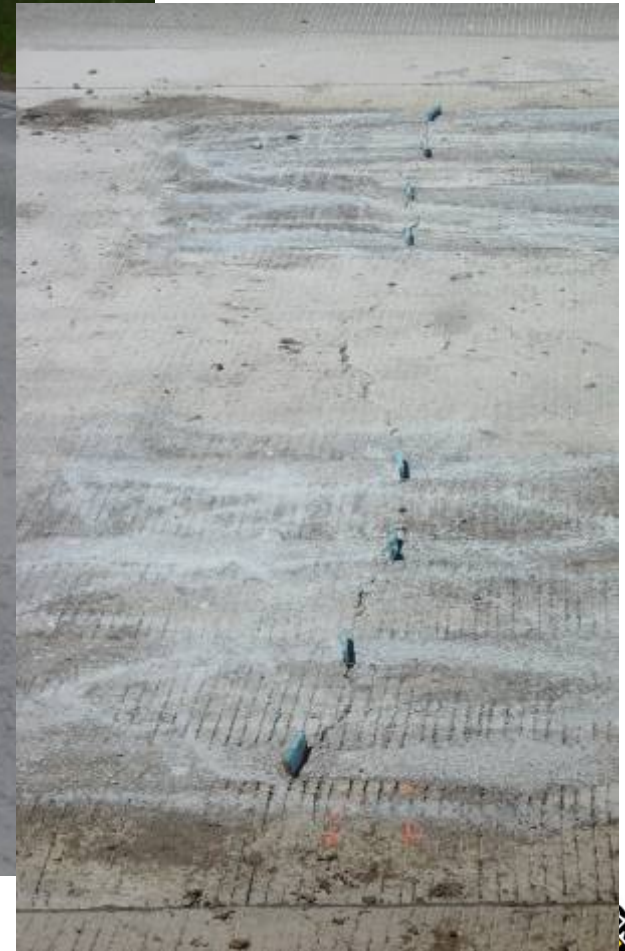
Diamond Grinding after LTR



Retrofitted Dowel Project



Retrofitted Dowels at Cracks



Presentation Outline

- Introduction
- Material selection
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- Troubleshooting

Quality Control

- Preliminary responsibilities
- Inspection of equipment
- Weather requirements
- Traffic control
- Construction inspection

Presentation Outline

- Introduction
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Project Checklist

- Preliminary Responsibilities
 - Project Review
 - Document Review
- Materials Checks
 - Cementing grout
 - Dowel bars
 - Joint/crack materials
 - Other materials
 - General

Project Checklist

- Equipment Inspections
 - Slot Cutting Equipment
 - Slot Cleaning and Preparation
 - Mixing and Testing Equipment
 - Other Equipment
- Others
 - Weather Requirements
 - Traffic Control

Project Checklist

- Project Inspection Responsibilities
 - Slot Cutting and Removal
 - Slot Cleaning and Preparation
 - Placement of Dowel Bars
 - Mixing, Placing, Finishing,
and Curing Backfill Material
 - Cleanup
 - Diamond Grinding
 - Resealing Joints and Cracks

Troubleshooting

- Construction and performance problems
- Approach:



Troubleshooting

What is wrong here?

Misaligned joint forming material



Troubleshooting

Construction Problems

- Problem
 - Sawcuts are not cut parallel to the longitudinal joints*
- Solution?

Troubleshooting

Construction Problems

- Problem
 - Dowel bar slots are cut too shallow*
- Solution?

Troubleshooting

Construction Problems

- Problem
 - Dowel bar slots are cut too deep*
- Solution?

Troubleshooting

Construction Problems

- Problem
 - Concrete fin is not easily removed*
- Solution?

Troubleshooting

Construction Problems

- Problem
 - Jackhammer punching through slot*
- Solution?

Troubleshooting

Performance Problems

- Problem
 - Cracking of in-place patch material*
- Causes?

Troubleshooting

Performance Problems

- Problem
 - Patch material pops out*
- Causes?

Troubleshooting

Performance Problems

- Problem
 - Wearing off of patch material*
- Causes?

Troubleshooting Guide – Causes and Solutions

- Slots are not parallel to pavement edge or longitudinal joint
- Dowel bar slots are too shallow
- Dowel bar slots are too deep
- Concrete fin not easily removed
- Jackhammer punches through bottom of slot
- Epoxy coating on dowel bar is chipped or missing

Troubleshooting Guide – Causes and Solutions

- Joint/crack sealant does not fully seal joint/crack along entire length expose in slot
- Joint/crack sealant extends more than 0.5 in. into slot
- Backfill material cracks in place
- Backfill material pops out of slot
- Backfill material wears faster than adjacent pavement

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Thank You

Questions?