



# Concrete Street and Parking Lot Maintenance and Repair

Presented By:  
National Ready Mixed Concrete Association



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  - Civil Design & Pavement
- Brian Killingsworth, P.E.
  - NRMCA Local Paving, Division Head
  - 28 Years in Practice
  - Pavement Design, Materials, Construction, Forensics



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# About the Course

## **Learning Units (LU) or Professional Development Hours (PDH)**

- AIA-CES CSP101: 1.0 LU|Elective (1.0 Hour) | 1.0 PDH for Engineers

- **Learning Objectives:**

- Understand the appropriate maintenance and repair methods for concrete pavements in streets or parking lots.
- Recognize the difference between early preventative maintenance versus more costly repairs at a later date.
- Understand the importance of proper load transfer between concrete slabs.
- Learn the basics of bonded and unbonded concrete overlays.

# Agenda

- Parking Lot & Street Maintenance
  - Parking Lot Cleaning and Restriping
  - Slab Replacement & Stabilization
  - Crack Sealing
  - Pavement Sealers
- Rehabilitation Overview
- Rehabilitation Techniques
  - Partial Depth Repairs
  - Full Depth Repairs & Utility Cuts
  - Dowel Bar Retrofit
- Rehabilitation Techniques (continued)
  - Crack Cross Stitching
  - Diamond Grinding
  - Joint & Crack Sealing
  - Bonded Concrete Overlays
  - Unbonded Concrete Overlays
- Questions & Answers



# What Do We Call It?

It's a Bit Confusing...

Preservation

Refurbish

Resurfacing

Treatment  
Restoration

Renewal

Maintenance

Rehabilitation

Repair

Reconstruct  
Rebuild  
Renovate

Primarily referred to as Maintenance and Rehabilitation (M&R)

# Identifying Concrete Pavement Distress

**GUIDE FOR**

## Concrete Pavement Distress Assessments and Solutions

**IDENTIFICATION, CAUSES, PREVENTION AND REPAIR**



STATE UNIVERSITY  
Institute for Transportation

National Concrete Pavement  
Technology Center



OCTOBER 2018

Table 4.4 Summary of causes and prevention of D-cracking and ASR distress in concrete pavements

Distress in Concrete Pavement	Causes	Prevention: Design	Prevention: Material Selection	Prevention: Construction	Prevention: Maintenance
D-Cracking	Use of coarse aggregates that break down and/or dilate under repeated freeze-thaw cycles when critically saturated	Consider the use of effective joint seals and provision of subsurface drainage to try to reduce moisture in pavement	Certified aggregate sources Avoid using at-risk aggregates Limit the maximum size of coarse aggregates	Certified aggregate sources Consider the use of effective joint seals and provision of subsurface drainage Inspect subdrain systems at the time of construction to ensure their functionality	Keep joints well sealed and maintain drainage systems.
ASR Distress	Chemical reaction between certain siliceous constituents in susceptible aggregates and alkali hydroxides in cement paste that can lead to expansion and cracking	Consider the use of effective joint seals and provision of subsurface drainage to try to reduce moisture in pavement	Certified aggregate sources Use durable, nonreactive aggregates Reduce alkali content of cementitious system Use appropriate type and amounts of SCMs Select material by following guidelines specified in AASHTO PP 65 (now PP R 80) Consider use of lithium-based compounds in mixture	Certified aggregate sources Consider the use of effective joint seals and provision of subsurface drainage Inspect subdrain systems at the time of construction to ensure their functionality	Topical applications of surface sealers

Sources: Van Dam et al. 2002b, Thomas et al. 2013, Taylor 2015, Van Dam 2016



# Understand Maintenance & Rehabilitation Types



Table 2.1. Concrete Pavement Preservation Treatment Types (adapted from Peshkin, et al. [2011])

Treatment Type	Treatment Description
Slab Stabilization	Filling of voids beneath concrete slabs by injecting cement grout, polyurethane, or other suitable materials through drilled holes in the concrete located over the void areas
Slab Jacking	Raising of settled concrete slabs to their original elevation by pressure injecting cement grout or polyurethane materials through drilled holes at carefully patterned locations
Partial-Depth Repair	Removal of small, shallow (top one-third of the slab) areas of deteriorated concrete and subsequent replacement with a cementitious or polymeric repair material
Full-Depth Repair	Cast-in-place or precast concrete repairs that extend through the full thickness of the existing slab, requiring full-depth removal and replacement of full or partial lane-width areas
Retrofitted Edgedrains	Cutting of a trench along the pavement edge and placement of a longitudinal edgedrain system (pipe or geocomposite drain, geotextile lining, bedding, and backfill material) in the trench, along with transverse outlets and headwalls
Dowel Bar Retrofit	Placement of dowel bars across joints or cracks in an existing concrete pavement to restore load transfer
Cross Stitching	Placement of deformed tiebars into holes drilled at an angle through cracks (or, in some cases, joints) in an existing concrete pavement
Diamond Grinding	Removal of a thin layer of concrete (typically 0.12 to 0.25 inches) from the pavement surface, using special equipment fitted with a series of closely spaced, diamond saw blades
Diamond Grooving	Cutting of narrow, discrete grooves into the pavement surface, either in the longitudinal direction (i.e., in the direction of traffic) or the transverse direction (i.e., perpendicular to the direction of traffic)
Joint Resealing	Removal of existing deteriorated transverse and/or longitudinal joint sealant (if present), refacing and pressure cleaning the joint sidewalls, and installing new material (liquid sealant and backer rod or preformed compression seal)
Crack Sealing	Sawing, power cleaning, and sealing cracks (typically transverse, longitudinal, and corner-break cracks wider than 0.125 inch) in concrete pavement using high-quality sealant materials
Concrete Overlay	Placement of a thin concrete layer (typically 3 to 4 inches thick) to a milled or prepared surface



# Understand How to Apply M&R



September 2014

Second Edition

## CONCRETE PAVEMENT PRESERVATION GUIDE



Table 2.2. Primary Capabilities and Functions of Concrete Pavement Preservation Treatments (adapted from Peshkin et al. [2011])

Treatment	Prevention/Delay				Restoration/Improvement			
	Seal/ Waterproof Pavement/ Minimize Pumping	Fill Voids and Restore Support	Remove Moisture Beneath Structure	Prevent Intrusion of Incompressible Materials	Remove/ Control Faulting	Improve Texture for Friction	Improve Profile (Lateral Surface Drainage and Ride)	Improve Texture for Noise
Slab Stabilization		✓			✓			
Slab Jacking		✓					✓	
Partial-Depth Repair	✓			✓			✓	
Full-Depth Repair	✓	✓		✓	✓		✓	
Retrofitted Edgedrains			✓		✓			
Dowel Bar Retrofit					✓		✓	
Cross Stitching					✓		✓	
Diamond Grinding					✓	✓	✓	✓
Diamond Grooving						✓		
Joint Resealing	✓			✓				
Crack Sealing	✓			✓				
Thin Concrete Overlay						✓	✓	✓



An aerial photograph of a large, irregularly shaped parking lot. The lot is paved and contains several small, landscaped islands with trees and light poles. The surrounding area includes a road with a white arrow pointing left and some greenery. The image is overlaid with a semi-transparent white box containing text.

# Parking Lot and Street Maintenance

Typical Maintenance Activities for Parking Lots and Streets

# Typical Concrete Parking Lot & Street Maintenance

- Lot Cleaning and Restriping
- Crack Sealing and Spall Repair
- Slab Replacement or Stabilization
  - Drainage Restoration From Depressions
  - Correct Subsurface Erosion From Pumping
- Surface Restoration (Milling)
- Joint Resealing (if Joints are Sealed)
- Joint Load Transfer Restoration (Heavy Use Settings)



Crack Sealing – An Example of What NOT To Do!

An aerial photograph of a large, irregularly shaped parking lot. The lot is paved and contains several small trees and landscaped areas. It is surrounded by streets and other parking areas. The image is faded to serve as a background for the text.

# Parking Lot and Street Maintenance

Parking Lot Cleaning and Restriping



# Concrete Cleaning (Pressure Washing) and Restriping

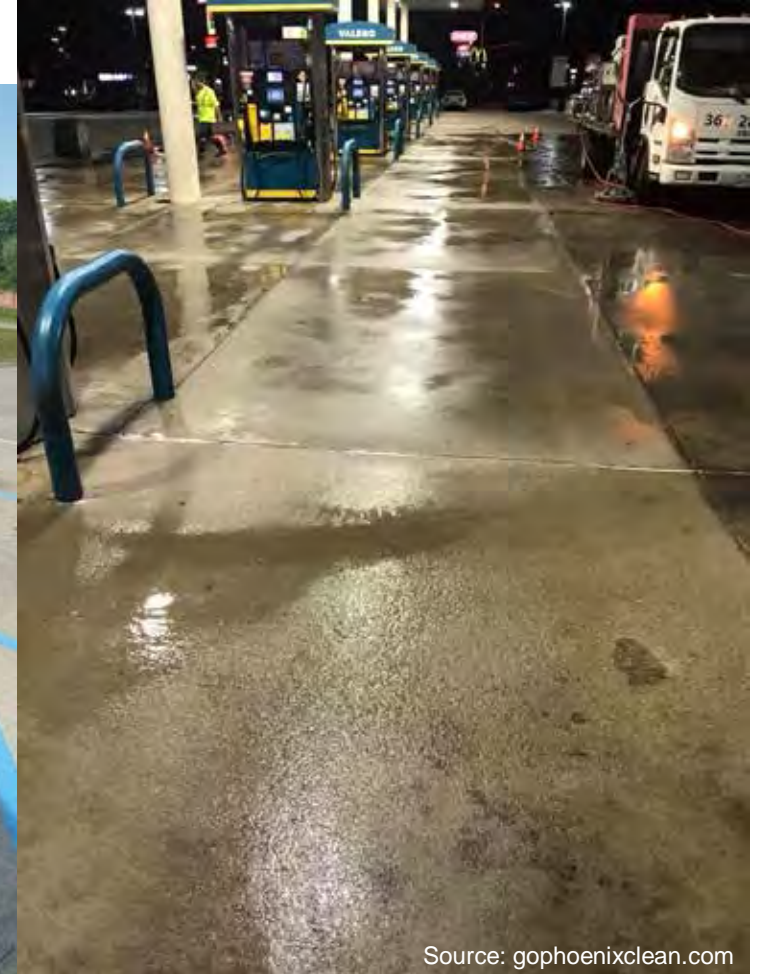
- No Definitive Rules
- Good to Maintain Appearance
- Consider Safety (Lighting, Slip Hazards)
- Removing Oils, Deicers, and Other Assailants Improves Durability



Source: [www.parkinglotstripingorlando.com](http://www.parkinglotstripingorlando.com)



Source: Pressure Washing Corpus Christi



Source: [gophoenixclean.com](http://gophoenixclean.com)

**PAVE AHEAD**  
DURABLE. SUSTAINABLE. CONCRETE.



An aerial photograph of a large, irregularly shaped parking lot. The lot is paved with light-colored asphalt or concrete. Several trees are planted in small landscaped islands within the lot. There are also several light poles. The parking lot is bordered by a road on the left and a building on the right. The overall image is in grayscale, with a green bar at the top.

# Parking Lot and Street Maintenance

Slab Replacements and Slab Stabilization

# Remove and Replace Poorly Performing Areas



# Slab Stabilization: Slab Jacking or “Mudjacking”



Before



After

Residential Slab Stabilization Example

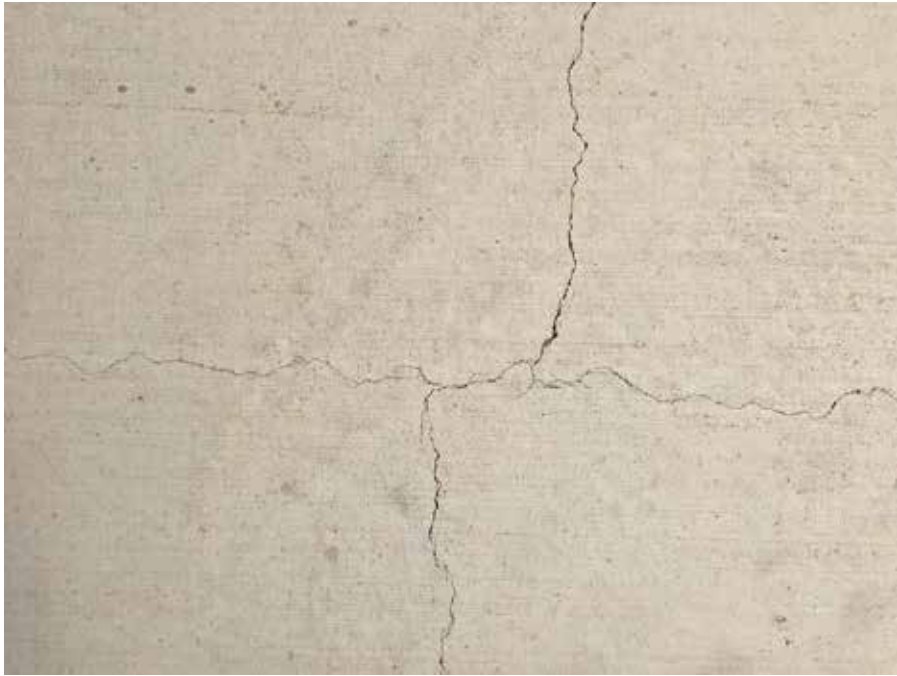
An aerial photograph of a large, irregularly shaped parking lot. The lot is paved and contains several trees and light poles. The image is overlaid with a semi-transparent white box containing text.

# Parking Lot and Street Maintenance

Crack Sealing



# Some Common Types of Cracking



Hairline Cracking



Structural Cracking  
(Widened)



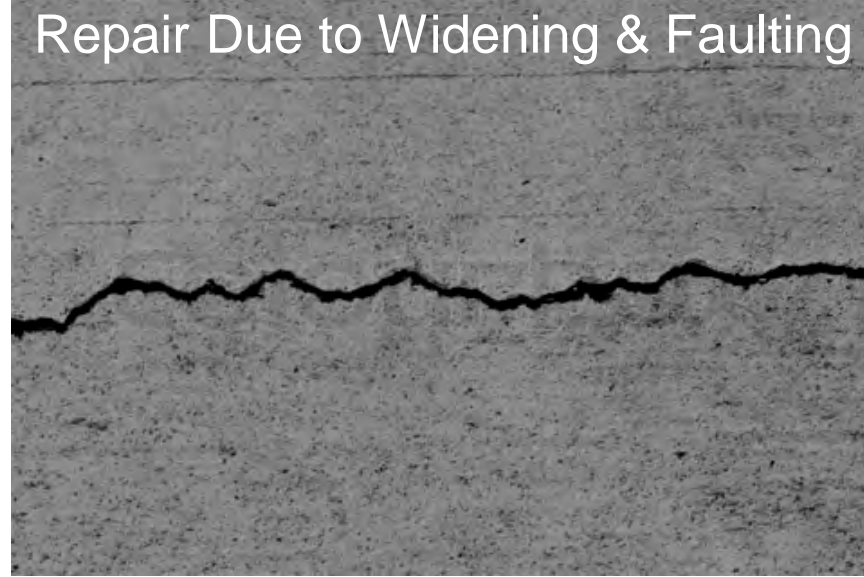
Structural Cracking (Spalled)

# Crack Repair: Determining What to Fix

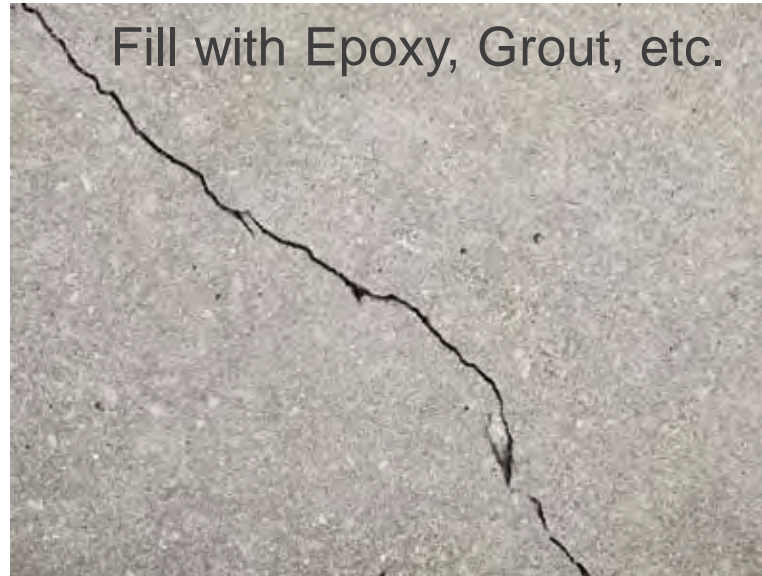
Hairline: Do Not Repair or Seal



Repair Due to Widening & Faulting



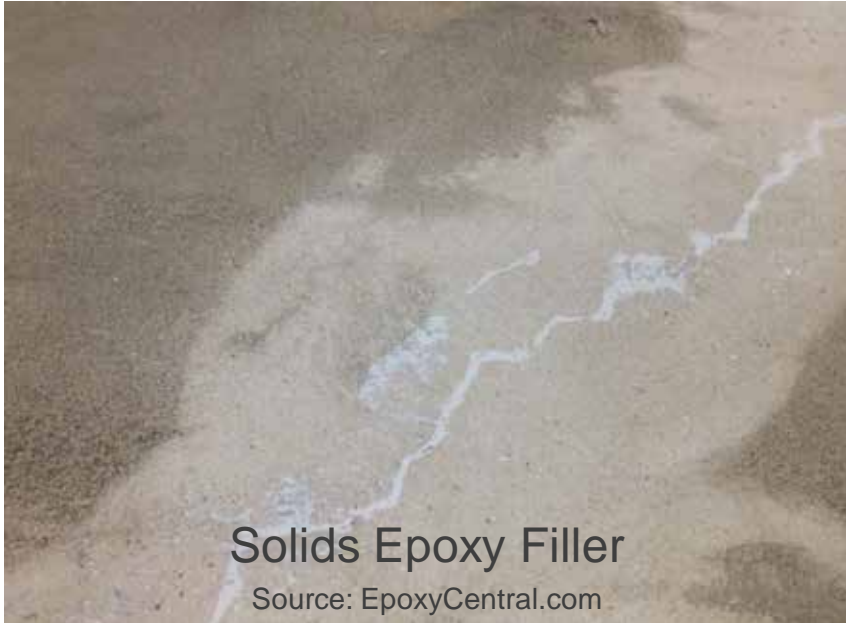
Fill with Epoxy, Grout, etc.





# Crack Sealing or Filling

Always Wear Appropriate PPE!



Solids Epoxy Filler

Source: EpoxyCentral.com



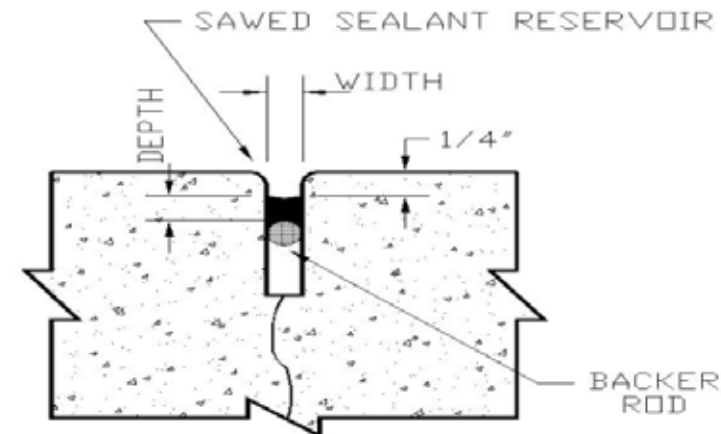
Crack Widening and Filling

Source: masterconstruction.com



Crack Widened and Filled

Source: Sherwin Williams



Detail for One Type of Widened Crack

**PAVE AHEAD**  
DURABLE. SUSTAINABLE. CONCRETE.

# Crack Bonding

- Structural polyurethane, bonds the crack with “micro-doweling.”



Source: Roadware Concrete Mender

An aerial photograph of a large, irregularly shaped parking lot. The lot is paved with light-colored concrete and contains several trees and light poles. The surrounding area includes a road and some buildings.

# Parking Lot and Street Maintenance

Concrete Pavement Sealers



# Concrete Pavement Sealers: Why & What

- Why Use a Sealer?
  - Address moisture intrusion (surface & joints),
  - Reduce deterioration due to freeze-thaw and/or de-icing salts,
  - Provide staining resistance,
  - Slow mold and mildew growth and efflorescence formation.
- What Types of Sealers are Available?
  - Penetrating Sealers (silanes, siloxanes, silicates, siliconates, soy methyl esters, combinations – “hydrophobes”)
  - Surface Sealers (acrylic-resins, epoxies, urethanes)







# Rehabilitation Overview

Concrete Pavement Maintenance and Repair (Rehabilitation)

# *“The Ultimate Question!”*

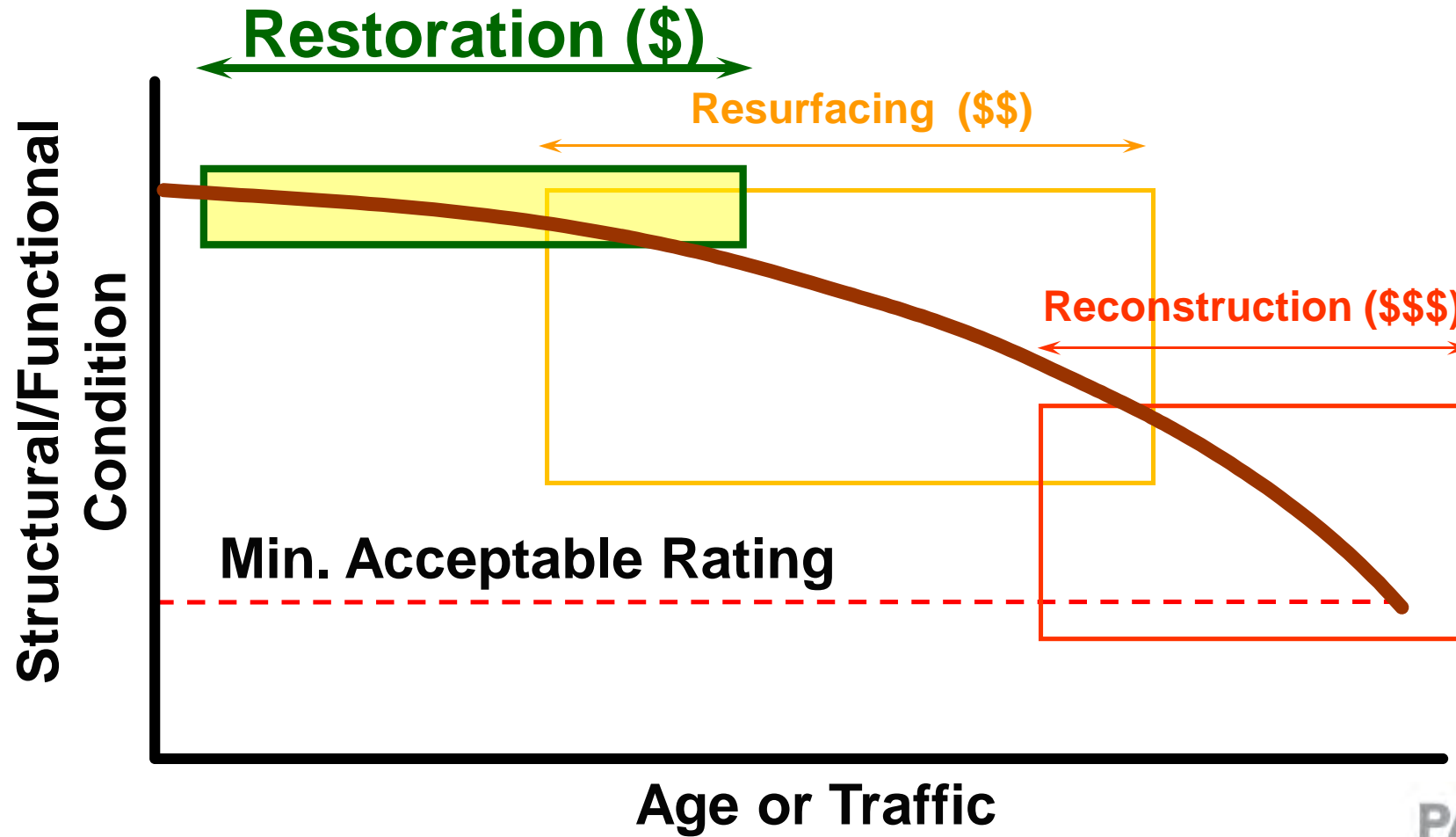
*How do we maintain pavements that have carried traffic loadings many times in excess of their design lives?*



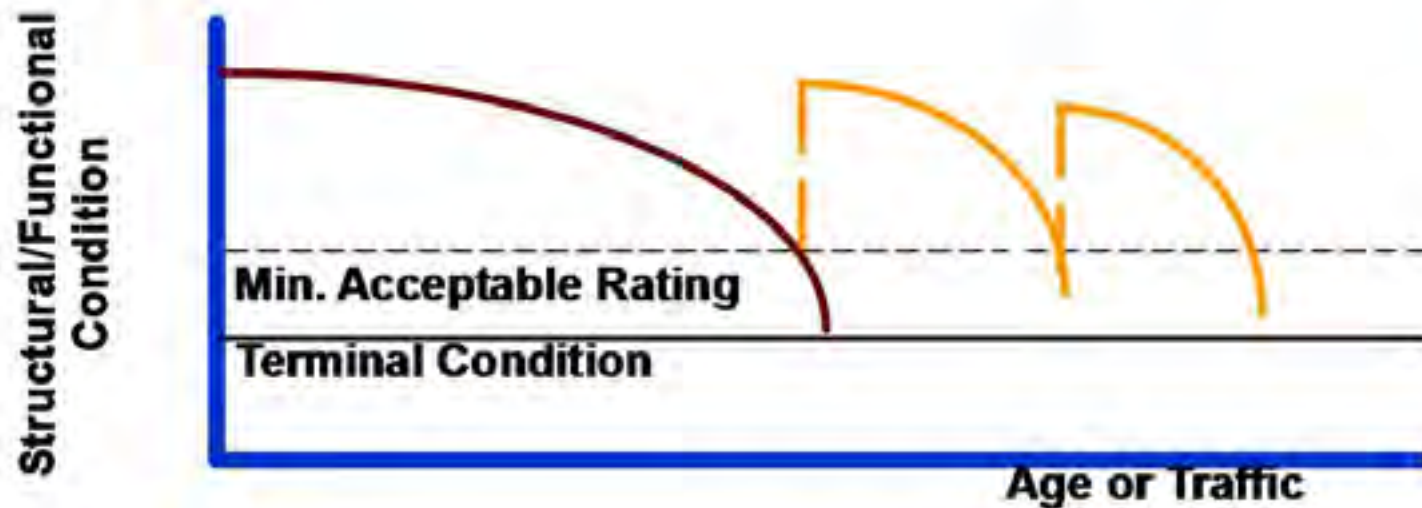
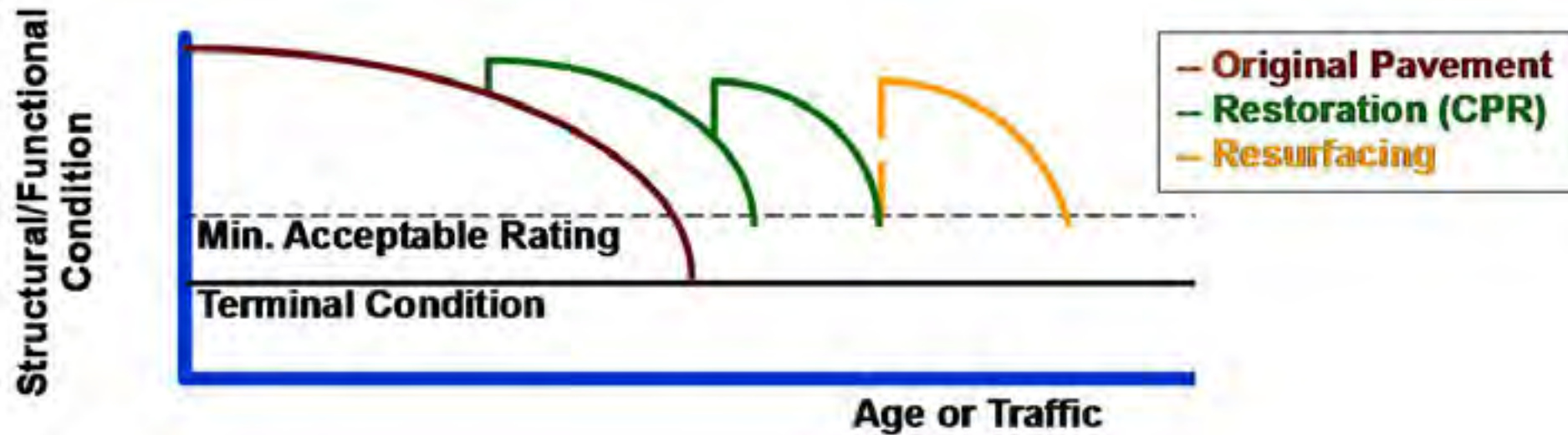
# CPR = Concrete Pavement Restoration

- CPR is first level of response for concrete pavement deterioration
  - Least costly
  - Best return on investment
  - Least service disruption
- Used early when pavement has little deterioration
  - Typically conducted at 10 to 15 years
  - Repairs isolated areas of distress
  - Repairs some construction defects
- Goal is to Manage the Rate of Deterioration

# Rehabilitation Timing



# Pavement Condition





# CPR Techniques

- **Most Common**
  - Partial Depth Patching
  - Full-Depth Patching
  - Dowel Retrofit
- **Other Techniques**
  - Cross Stitching
  - Diamond Grinding
  - Joint Cleaning / Sealing
  - Concrete Overlays

An aerial photograph of a large, irregularly shaped parking lot with several trees and light poles. The image is semi-transparent, allowing the text to be clearly visible over it.

# CPR Techniques

## Partial Depth Patching

# Partial-Depth Patching

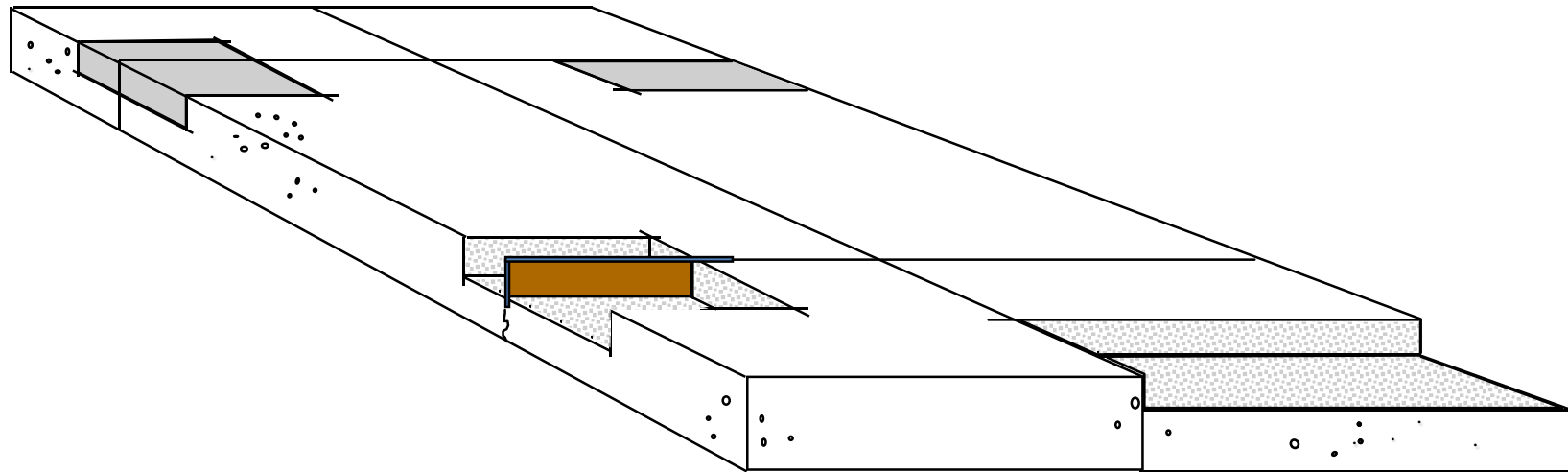
- Purpose
  - Repair surface distresses
  - Reestablish joint reservoir
- Used for:
  - Mid-slab surface spalling
  - Joint spalling
  - Severe scaling





# Partial Depth Repairs

- Repairs deterioration in the top 1/3 of the slab.
- Generally located at joints, but can be placed anywhere surface defects occur.



# Partial Depth Repair Steps

## 1. DETERMINE REPAIR BOUNDARIES

- Find unsound concrete
- Mark area for removal



“Sounding” with hammer or chain



Marking area for removal

# Partial Depth Repair Steps

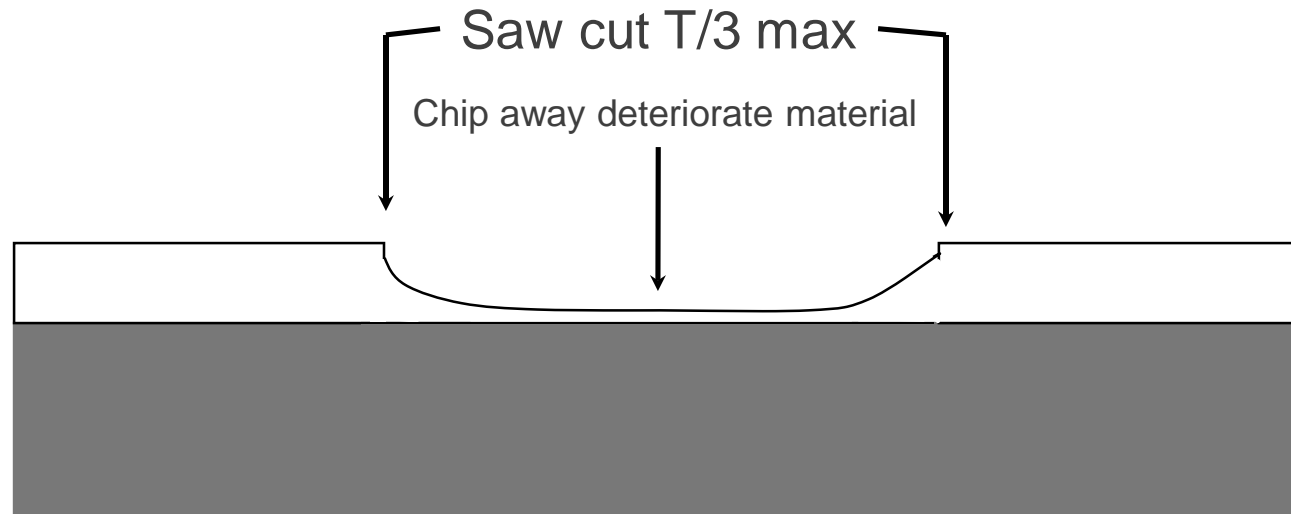
## 2. REMOVAL OF CONCRETE

### a) Sawing and chipping.

- Break concrete using a light pneumatic hammers no heavier than 30 lb.
- Spade bits are preferable to gouge bits for control of chipping.
- Chip the area until sound and clean concrete along the entire bottom of the repair is exposed.
- The depth of the repair should not exceed about one-third the pavement thickness.
- If more chipping is necessary to find sound concrete, or dowel bars are exposed, switch to a full-depth repair.



# Partial Depth Slab Repair



- *To permanently repair localized failures that are limited to and do not extend deeper than 1/3 the thickness of the slab*

# Partial Depth Repair Steps



# Partial Depth Repair Steps

## 2. REMOVAL OF CONCRETE

### b) Carbide milling

- Milling machines with 12 in to 18 in wide cutting heads have proven efficient and economical, particularly when used for large area.
- The milling machine must have a mechanism that will stop penetration of the milling head at a preset depth to protect dowel bars.
- Milling machines can operate either across lanes or parallel to the pavement centerline.
- Milling across lanes is effective for spalling along an entire joint.

# Joint Milling Technique





# Milling a Deteriorated Longitudinal Joint



CPR in 1991



2011

# Partial Depth Repair Steps

## 3. CLEAN REPAIR AREA



Clean repair area by sandblasting or high-pressure water blasting



Air blasting to remove dust and sandblasting residue

# Partial Depth Repair Steps

## 4. PREP REPAIR AREA



A compressible insert reforms the joint or crack and keeps the new repair from bearing on the adjacent concrete.



Apply a bonding agent (cementitious grout) in a thin even coat. The contact time should not exceed 60 minutes.

# Partial Depth Repair Steps

## 5. PLACE, FINISH, CURE CONCRETE

- Place concrete in small batches
  - Shovel into area
  - Vibrate for consolidation
  - Trowel patch OUTWARD towards walls of patch
- Curing important!
  - Apply a liquid membrane-forming curing compound
  - Can place mat/plate over patch
- Seal joints to protect repair





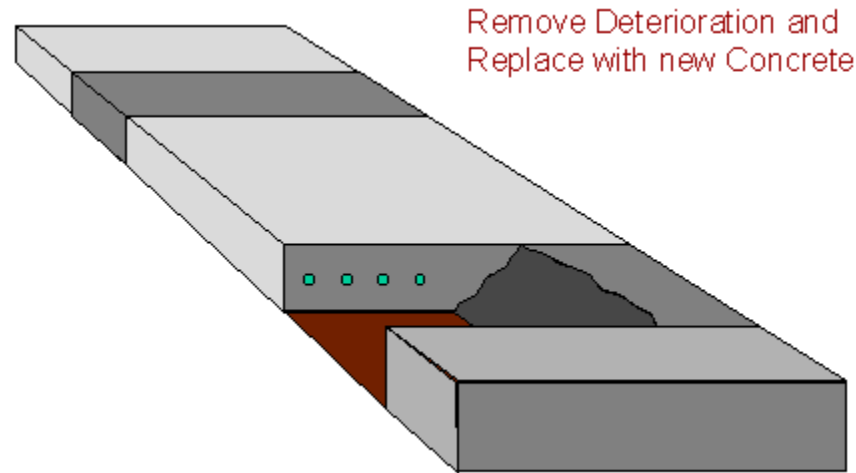
An aerial photograph of a large, irregularly shaped parking lot. The lot is filled with parking spaces, some of which are occupied by cars. There are several trees and landscaped areas within the lot. A faint grid is overlaid on the entire image. The text "CPR Techniques" is centered in the middle of the image.

# CPR Techniques

Full Depth Patching

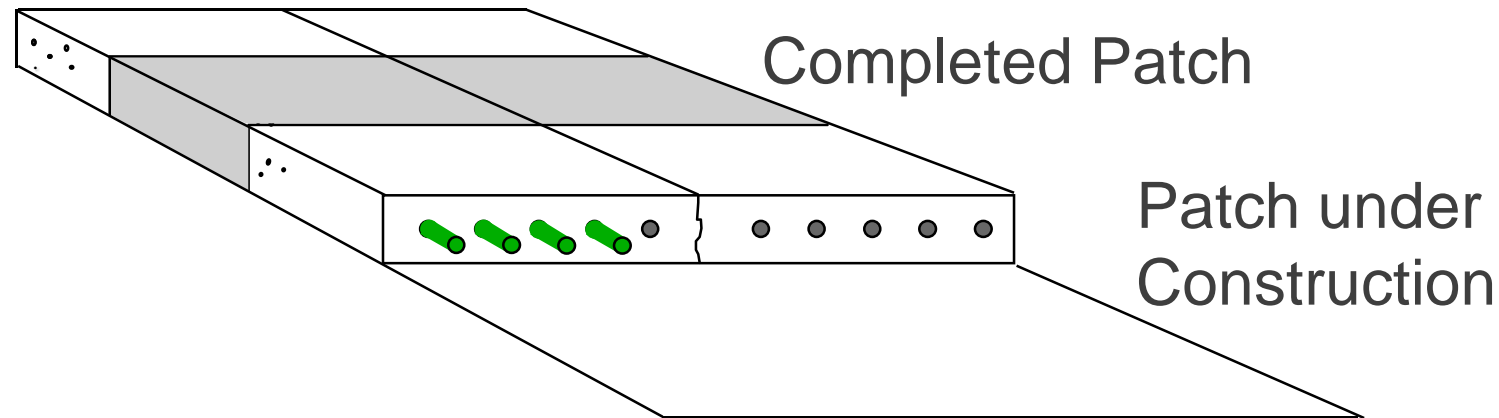
# Full-Depth Patching

- Purpose
  - Restore structure
  - Restore ride
- Used for
  - Joint/crack deterioration
  - Transverse & longitudinal cracking
  - Broken slabs & corner breaks



# Full Depth Repairs

- Repairs distresses greater than 1/3 the slab depth.
- Consists of removing and replacing at least a portion of the existing slab to the bottom of the concrete.



# Selecting Repair Boundaries

- Repair Dimensions

- Minimum dimensions

- Use lane-width repairs
    - Length > 6 ft

- Maximum joint spacing

- 15 ft (plain PCC)
    - 30 ft (reinforced PCC)

- Jointing Guidelines

- Minimum 6 ft between patch joint and original joint
  - Remove minimum 2 ft into adjacent slab to avoid dowels
  - Go beyond deterioration





# Sawing Boundaries

- Use diamond bladed saws
- Saw through the joints so base of blade reaches boundary
- Isolate transverse, longitudinal and shoulder
- Provide pressure-relief cut within patch if saws bind



# Slab Removal

- Lift Out
  - Pin and chain
  - Claw



# Lift-Out Method: No Single Method!



# Preparing Patch Area

- Add and compact new subbase material if necessary
- Use vibratory plate compactors
- Drain rainwater as necessary



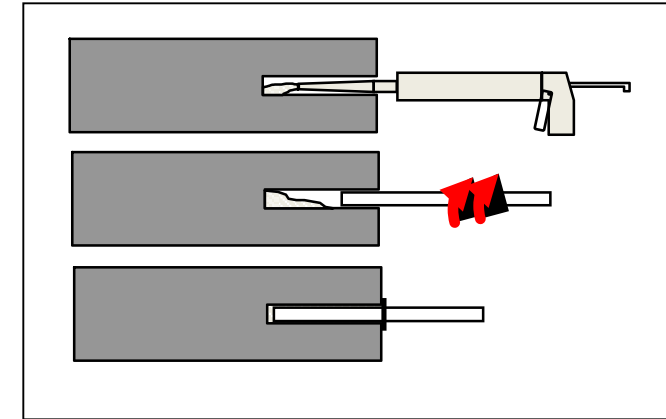


# Doweling Patches

- Drilling Recommendations

- Dowel holes drilled on 12-inch centers across the joint face at mid-depth of the slab
- Dowel holes drilled slightly larger than dowel diameter (1/8 inch larger)
- Use frame-mounted gang drills (no hand drills or drills that rest on base)
- Hole location may be moved by + 1-inch to avoid existing reinforcing steel

- Install Dowels



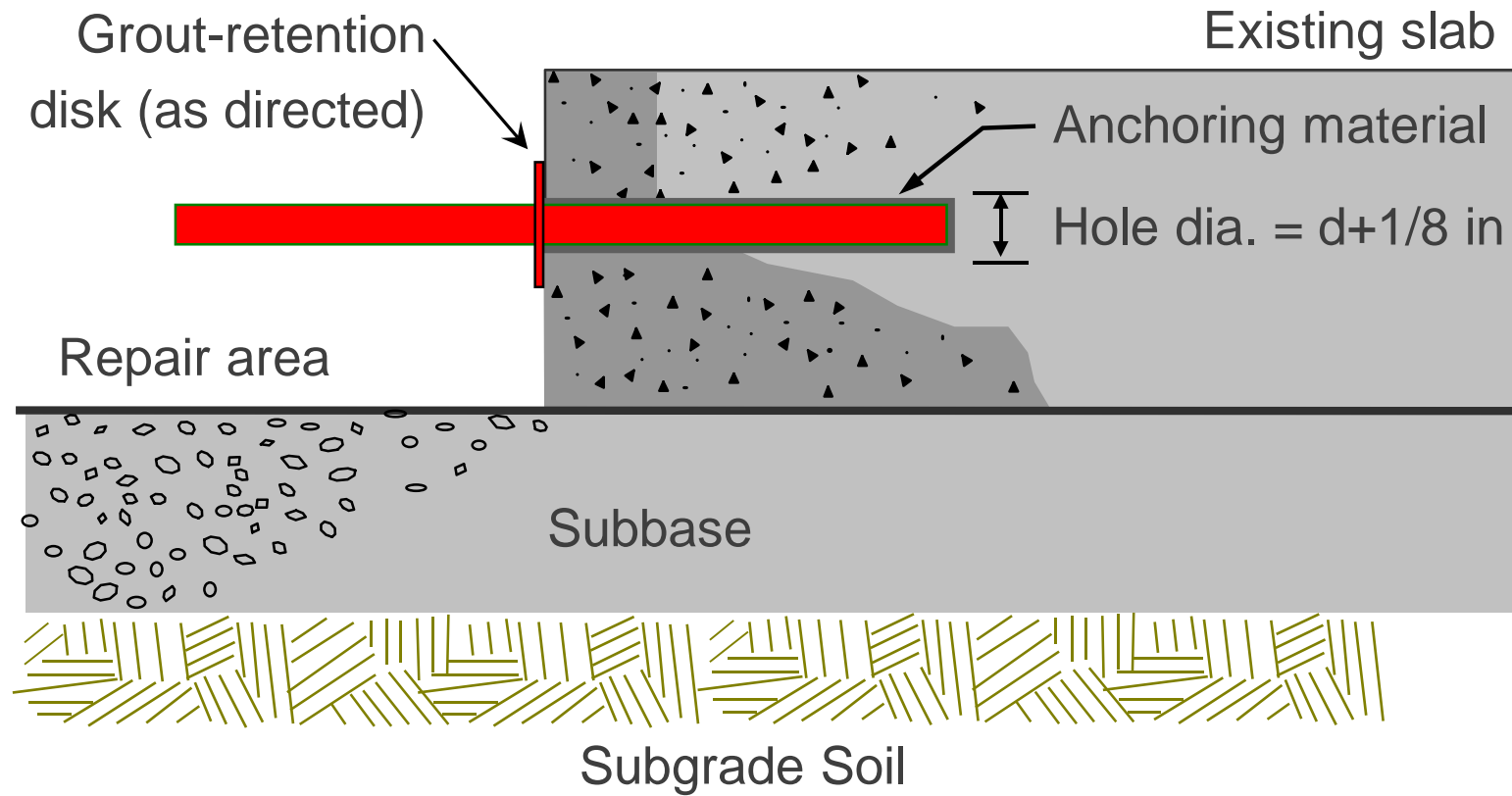
# Dowel Drilling Machine



*Note: Wear your hard hat  
or someone might photoshop  
a pink one on you!*

# Load Transfer Provision

## Dowel Bar Placement



# Preparing Longitudinal Joints

- For long patches
  - > 60 ft long
  - Drill and anchor tie bars or wiggle bolts
- For short patches
  - < 60 ft long
  - Place bond breaking board





# Placing Concrete

- Distribute evenly
- Avoid excessive shoveling
- Vibrate uniformly
  - Use vertical penetrations of vibrator
  - Do not drag!!



# Finishing Patch

- Texture soon after finishing
  - Texture similar to surrounding concrete surface
    - burlap drag or tine (match spacing)
- Do not delay curing
  - Apply curing compound evenly
  - Pigment is helpful to see coverage
  - Insulation mats useful for:
    - Accelerating strength gain
    - Cold temperatures
  - Place polyethylene between patch and insulation



# Precast Panel Option

## Full Depth Repair

- Less Impact on travelling public
  - Reduced user delay costs used to justify increased costs (3x conventional patching)
- Lane closures limited to 8 hour window
  - Interstate-676, Philadelphia (2010)





# CPR Techniques

Special Case of Full Depth Repair: Utility Cuts



# Utility Cuts in Concrete Pavements

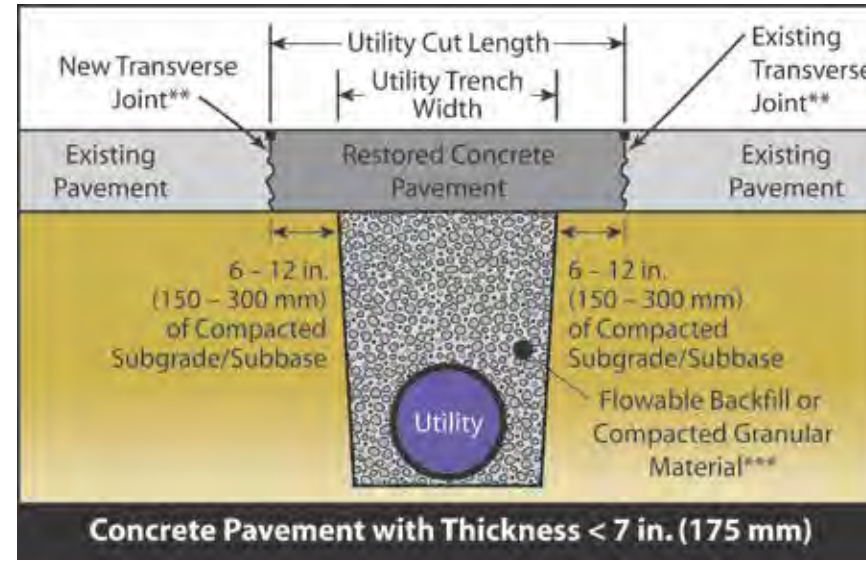
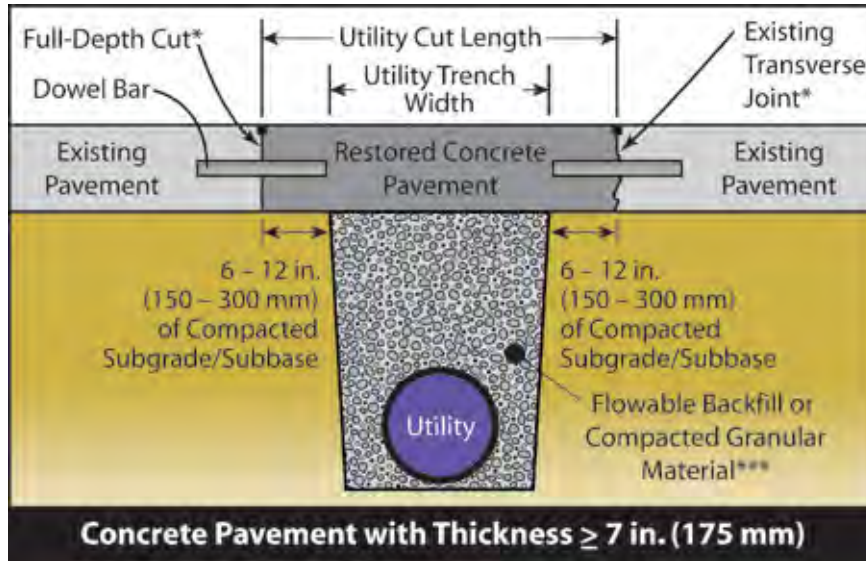
- Sometimes it is necessary to cut trenches in some concrete pavements in order to repair or install utilities.
- Experience has shown that it is best to repair or restore concrete pavements with concrete, similar to a full-depth repair.
- Proper utility cut restorations, constructed even with the surrounding pavement, provide a smooth transition that can withstand traffic loads without future settlement.

# The Steps to a Proper Utility Cut

- Plan the utility cut location, size, and shape.
- Make the necessary cut(s) in the concrete slab.
- Remove the concrete.
- Excavate the subbase and/or subgrade.
- Repair, upgrade, or install the utility.
- Backfill and compact or place flowable backfill.
- Install dowels, if necessary.
- Place, finish, texture, and cure the new concrete surface course (high-early strength may be necessary).
- Place joints and seal (if required).
- Open to traffic after sufficient curing.

# Common Utility Cut Details

[wikipave.org/Utility Cuts](http://wikipave.org/Utility%20Cuts)



\* A full-depth cut should be made at any utility cut boundary that is not an existing joint for thicknesses of 7 inches and greater.

\*\* For pavements thinner than 7 in. utility cut boundaries that are not at an existing joint should be cut to a depth of about one third of the slab thickness and the remainder of the depth removed with a jackhammer.

\*\*\* Some agencies have had success with up to a 2 ft layer of natural soil above the backfill but below the restored concrete pavement surface course.



# CPR Techniques

Dowel Bar Retrofit



# Dowel Bar Retrofit

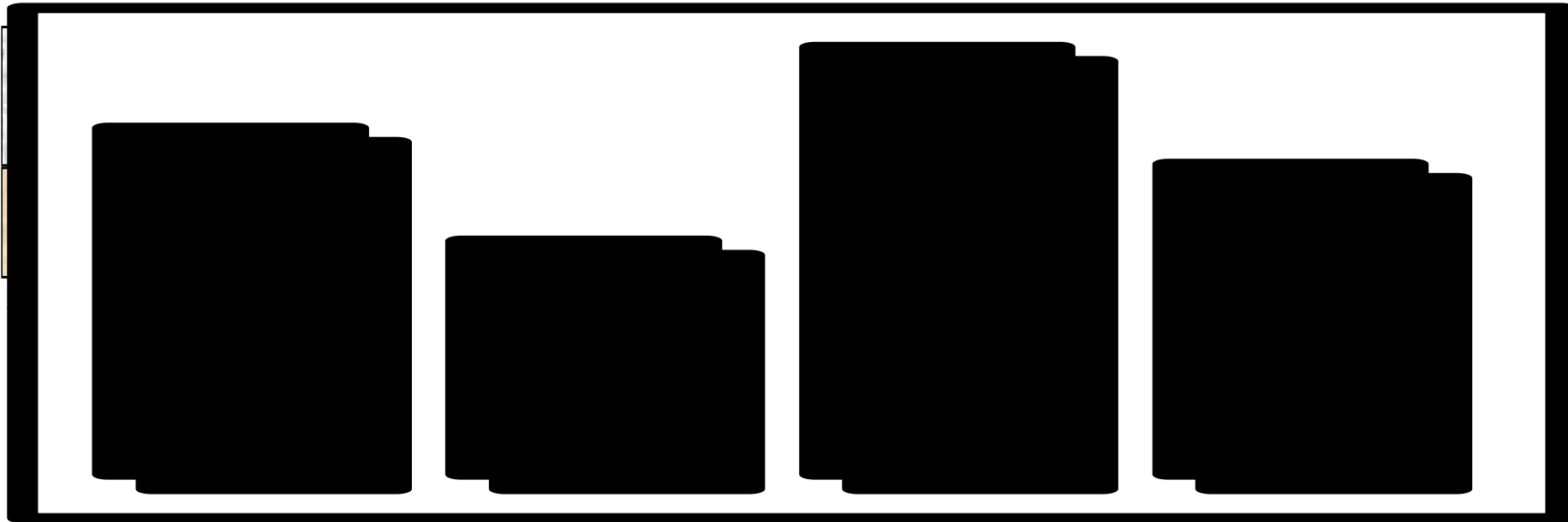


*also known as Load Transfer Restoration*

# Load Transfer

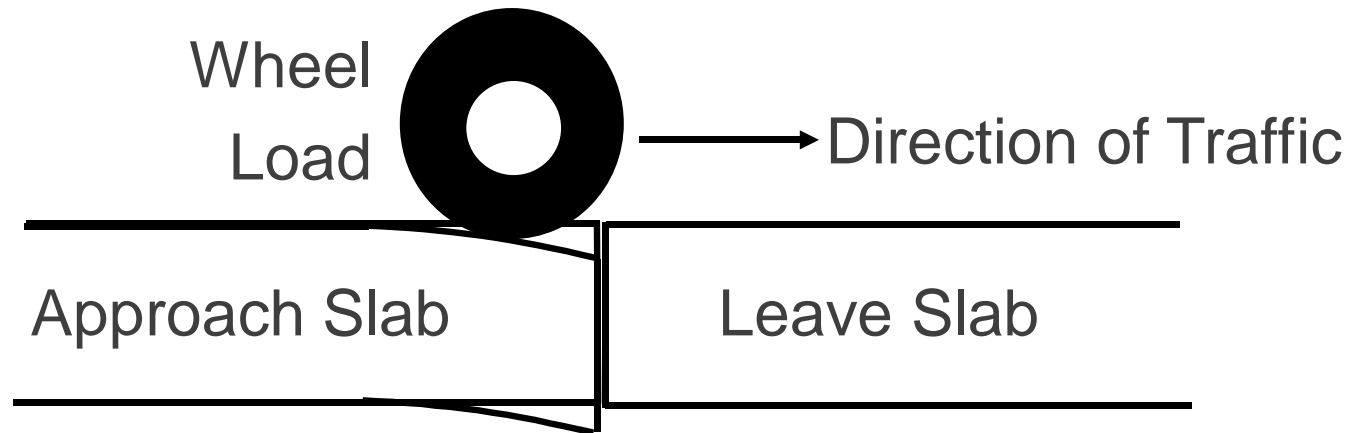
- Ability of a joint or crack to transfer a wheel load from one side to the other
- Accomplished through:
  - Mechanical devices (dowel bars)
  - Aggregate interlock
  - Foundation support
- Load transfer efficiency (LTE)

# Typical Concrete Pavement Cross-Section



# Poor Load Transfer

## *0% Load Transfer*

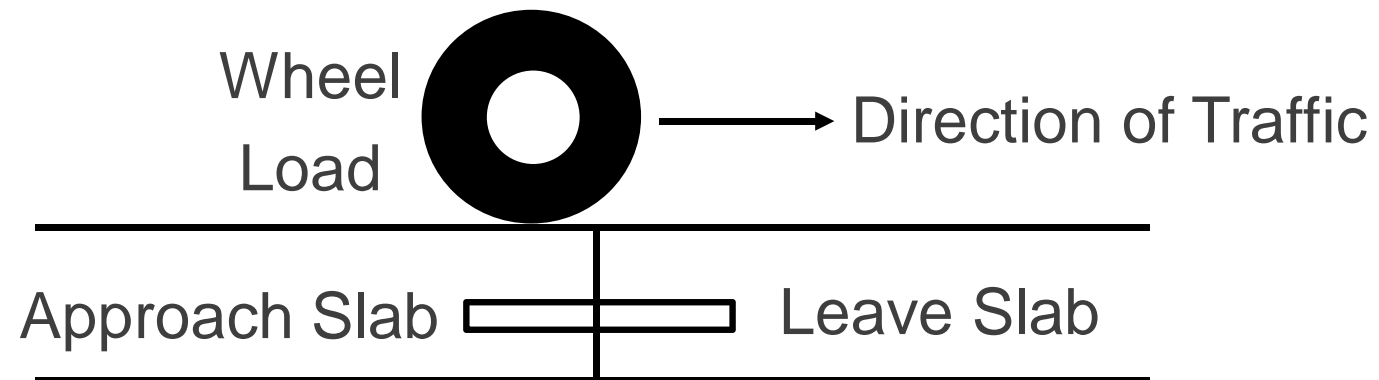


- What distresses are the result of poor load transfer?
  - Pumping
  - Faulting
  - Corner Breaks
  - Mid-panel cracks that develop can break down and deteriorate because of poor load transfer across the crack



# Proper Load Transfer

## ***100% Load Transfer***



# Causes of Poor Load Transfer

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

# Results of Poor Load Transfer

Pumping is caused by poor load transfer, when water infiltrates through joints or cracks and softens the underlying materials. If there is poor load transfer, as traffic loads pass over the joint/crack, the slab depresses, causing the water/fines mixture to be “pumped” up through the joint or crack



# Results of Poor Load Transfer Transverse Joint Faulting





# Results of Poor Load Transfer Corner Breaks



# Results of Poor Load Transfer Deteriorated Mid-Panel Cracking



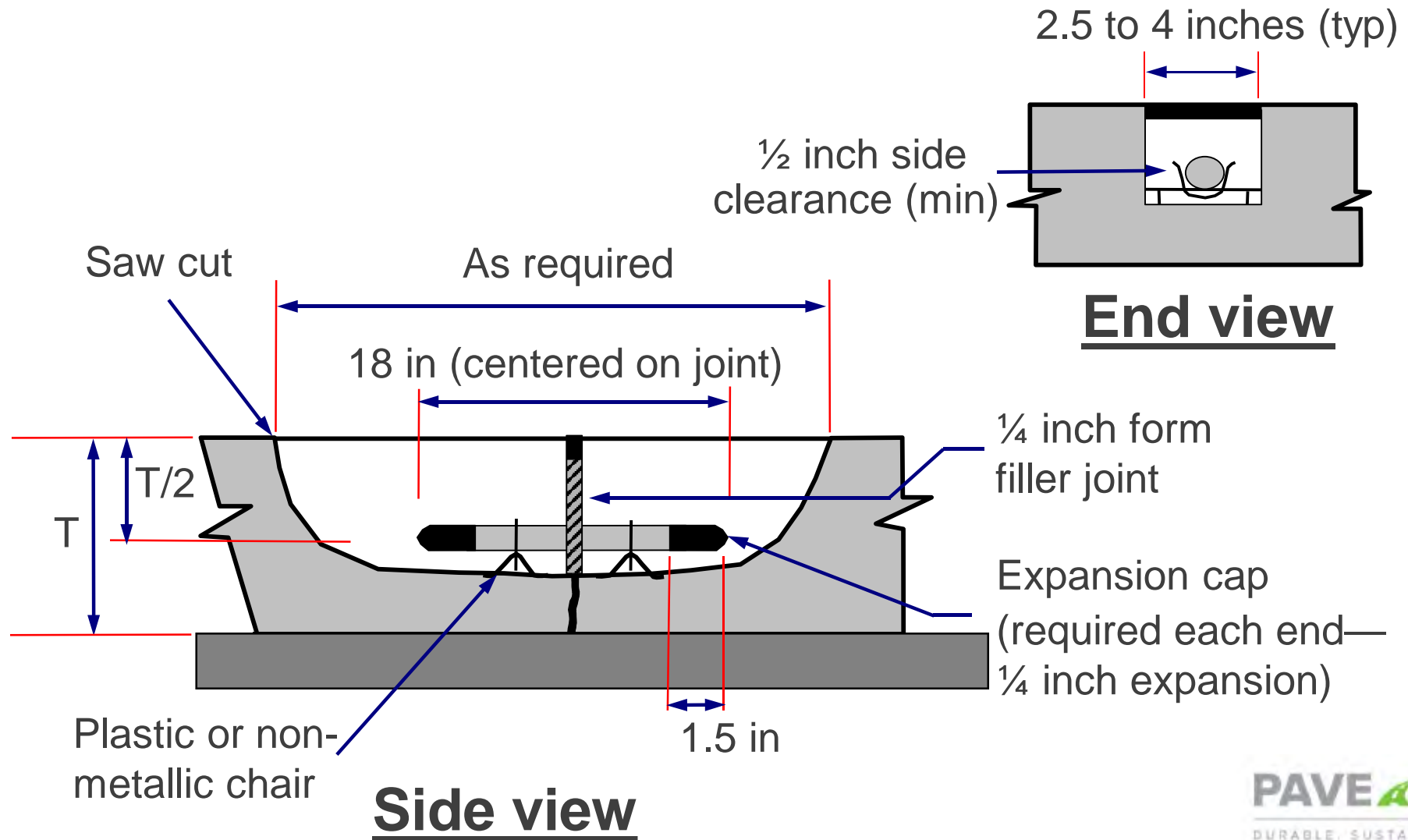
# Load Transfer Restoration

- Definition:

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

- Suitable for transverse joints or cracks
- Should last for the remaining life of the pavement
- Can cost less and create less traffic disruption than a full-depth repair

# Dowel Bar Assembly





# Material Selection

- Load transfer devices
  - Dowel bars - currently recommended by the FHWA
  - Other repairs not as successful (*I-beams, double-vee, figure eight, and plate-and-stud devices*)
- Repair (filler) materials
  - Portland cement concrete (PCC)
  - Rapid-setting proprietary materials
  - Polymer concretes
  - Epoxy-resin adhesives

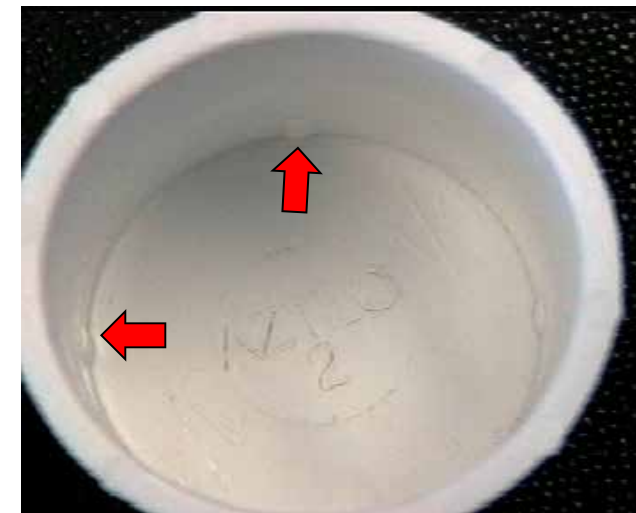
# Load Transfer Devices

## Dowel Bars



Note the chairs, end caps, and joint filler attached to the dowel

The photo on the right shows a close up of an end cap. Note the dimples that prevent the dowel from sitting against the end of the cap (which would prevent movement)

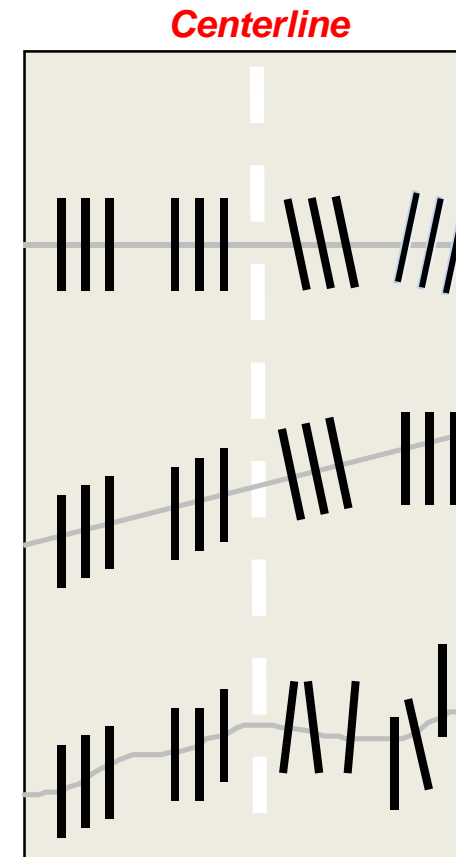


# Dowel Slot Alignment

- Must always be parallel to centerline
- New channels must be cut so at least one-half of dowel can be on each side of the joint or crack

Correctly Aligned  
Dowel Slots

Incorrectly Aligned  
Dowel Slots



# Slot Creation

- Diamond-bladed slot cutting machines
  - Ganged saw blades for multiple cuts
- Slots parallel to pavement centerline
- Slot dimensions
  - Length: Varies, typically 3 ft for 14" dowel bar
  - Width: Typically 2 – 1/2"
  - Depth: 1/2" below dowel

# Slot Creation

## Slot Cutting Machine

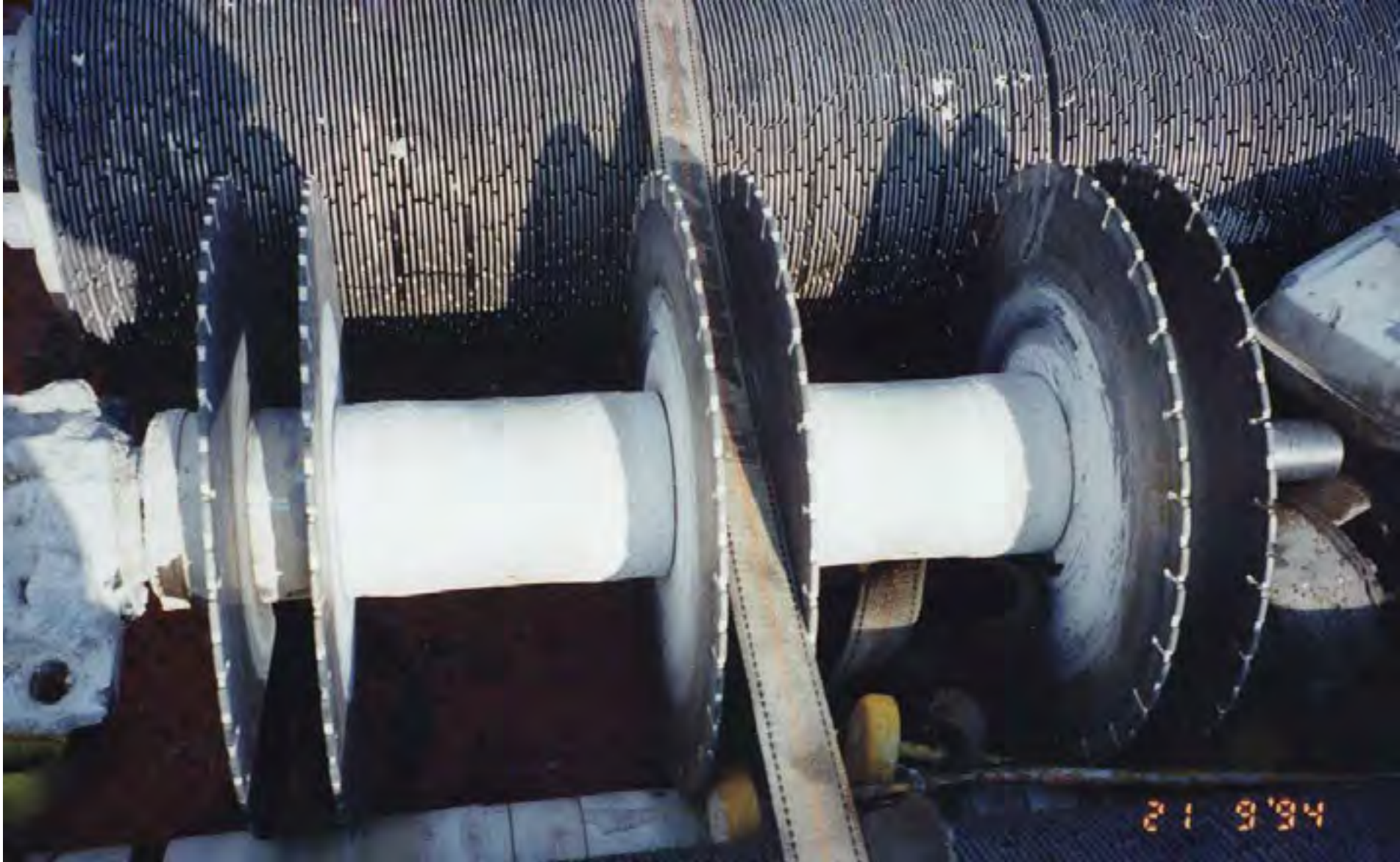


Note the three sets of saw blades on the front of the machine. A production rate of 500 to 2,500 bars per day can be expected with a production saw.



# Slot Creation

## Close-Up of Sawblades



# Slot Creation

## Slot Sawcuts



New slot cutting equipment can make these six sawcuts in about 90 seconds





# Slot Creation

## Slot Cutting with Milling Machine - Not Recommended



For comparison, this photo shows the creation of individual slots with a carbide milling machine. These devices are not recommended because they can not provide a consistent slot width, they are slower, and they spall the sides of the slot.

# Slot Preparation

## Material Removal



- Remove the concrete wedge in pieces
- After removal, flatten the bottom of the slot so the dowel bar can sit in a level plane
- Use a hammerhead mounted on a small jackhammer

# Slot Preparation Material Removal



OR a skilled worker on a large jackhammer



# Slot Preparation



Sandblasting

***THEN***



Airblasting

# Slot Preparation

## Cleaned Slot



# Slot Preparation

## Caulking of the Joint or Crack



- Caulk the joint or crack in the slot to prevent intrusion of any patch material that might cause a compression failure.
- Sealant should not extend  $\frac{1}{2}$ " beyond the joint because excessive sealant will not allow the repair (filler) material to bond to the sides of the slot.



# Dowel Bar Placement





# Dowel Bar Placement



# Repair Material Placement

- Mix material in small quantities
  - Generally 3/8" top size aggregate
  - Do not re-temper mix
- Totally encase dowel bar with material
- Provide effective consolidation
  - Small 1" spud vibrator
  - Do not contact dowel bar

# Repair Material Placement Backfilling



# Repair Material Placement Consolidation and Finishing



Make sure not to overwork the repair



# Final Steps

- Curing
- Re-establish joint reservoir (sawcut)
- Diamond grinding
- Joint sealing



Depending upon the type of repair material, the pavement may be opened to traffic in as little as a few hours.

# Key Factors For Success of Dowel Repair

- Selection of proper candidates
- Proper dowel design and layout
- Cutting of dowel bar slots
- Proper preparation of slots
- Proper placement of dowels
- Selection of appropriate material
- Careful material placement and curing



# CPR Techniques

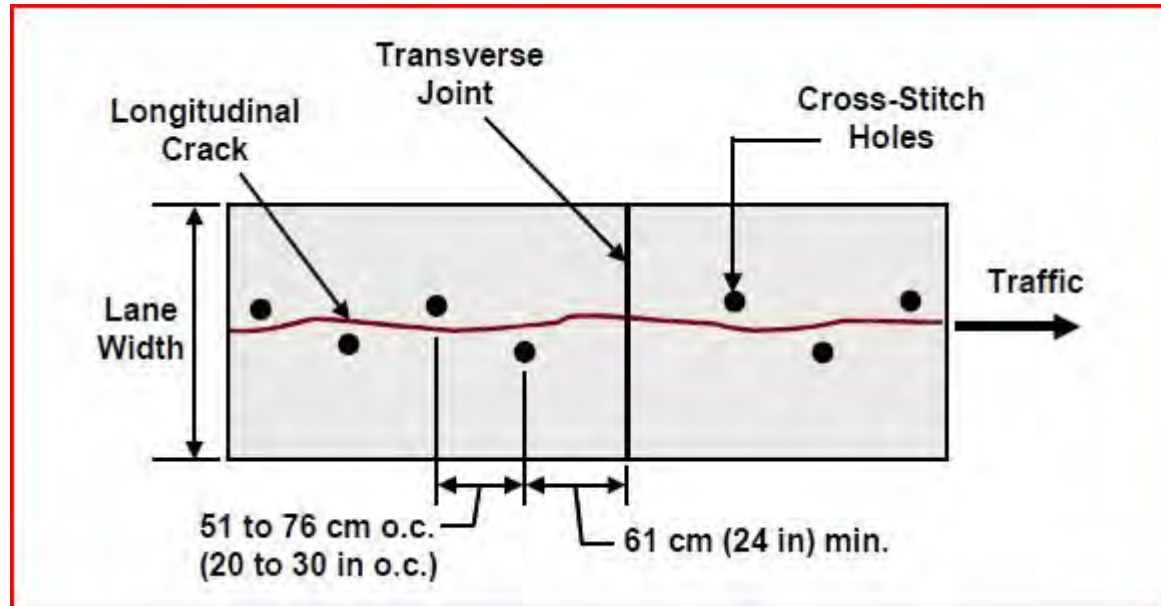
Crack Cross Stitching

# Crack Cross Stitching

- Used for longitudinal cracks only
- Not appropriate for transverse/moving cracks
- Operation comprised of:
  - Drilling holes
  - Inserting tie bars
  - Grouting with low shrink material

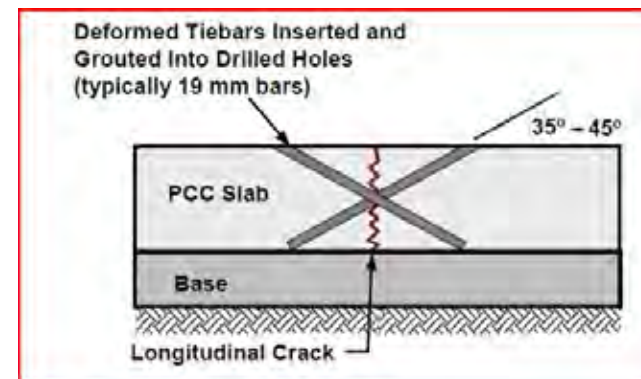


# Crack Cross Stitching



Cross-Stitching Bar Dimensions and Location of Drill Holes

	Slab Thickness (in.)							
	8	9	10	11	12	13	14	15
Distance to Hole (in.)								
35°	5.75	6.50	7.25	7.75	8.50	—	—	—
40°	—	—	—	8.50	7.25	7.75	8.25	—
45°	—	—	—	—	6.00	6.50	7.00	7.50
Length of Bar (in.)								
35°	9.50	11.00	12.50	14.50	16.00	—	—	—
40°	—	—	—	12.50	14.00	16.00	18.50	—
45°	—	—	—	—	12.00	14.00	16.50	18.00
Diameter of Bar (in.)								
	0.75	0.75	0.75	0.75	0.75	1.0	1.0	1.0





# CPR Techniques

Diamond Grinding

# Diamond Grinding

- Removal of thin layer of hardened PCC using closely spaced diamond saw blades



# Diamond Grinding Benefits

- Restores smoothness
- Improves friction
- Improves cross slope
- Reduces noise
- Short closures: re-open lanes as needed
- No equipment encroachment into other lanes (can do just one lane)
- Does not affect overhead clearances





# Diamond Grinding Applications

- Long-term application
  - Concrete pavement with roughness/texture problems
  - Frequently performed with other CPR techniques
    - Full Depth Repairs
    - Dowel Bar Retrofit
    - Cross Stitching
- Short-term application
  - Used alone on structurally deficient pavements as reliable short-term (< 5 yrs) solution to optimize condition of pavement network

# Diamond Grinding Construction Considerations

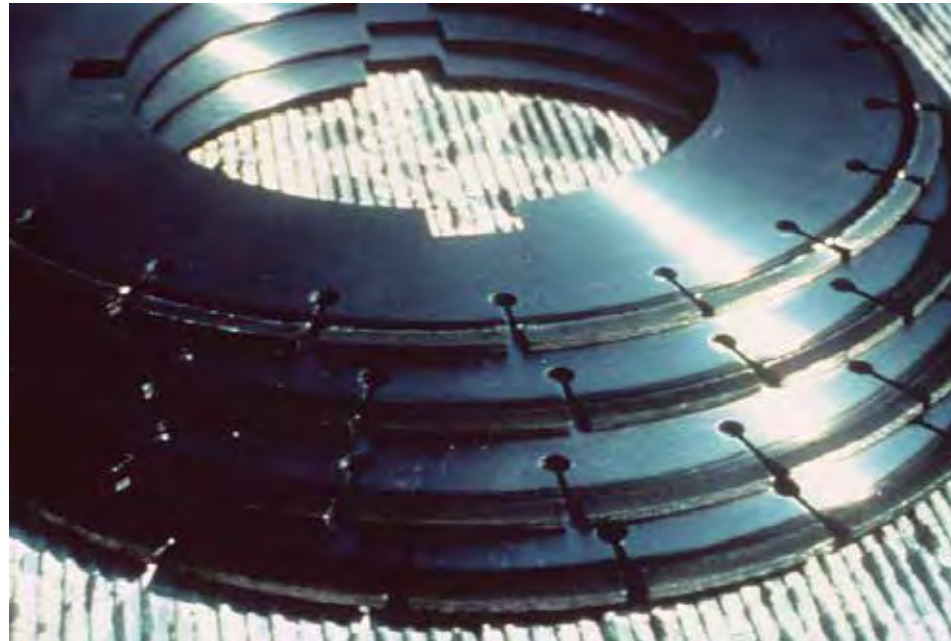
- Mobile single lane closure
- Conduct grinding parallel to centerline
- Multiple passes per lane
  - Maximum overlap of 2 inches
  - Maintain cross slope of adjoining passes
  - Minimize drop-off
- Slurry removal



# Diamond Grinding

## Cutting Head Specifications

- Diamond blades mounted in series on cutting head
- Cutting head width from 48 to 50 inch
- Spacing of 50 to 60 blades per foot





# CPR Techniques

Joint and Crack Sealing



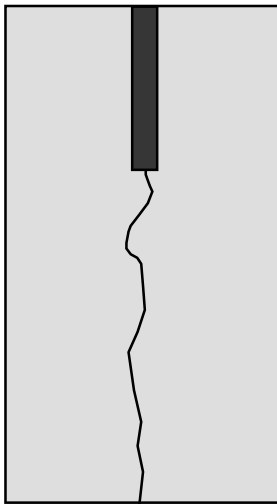
# Joint & Crack Sealing

- Purpose
  - Protect rehabilitated pavement
- Used for:
  - Replace ineffective sealant
  - Minimize moisture infiltration
  - Minimize incompressible infiltration

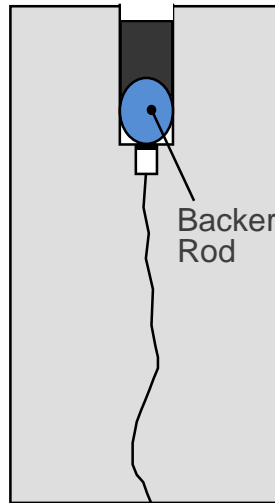


# Joint Sealant Reservoirs

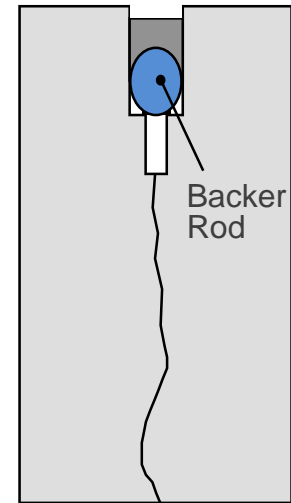
## Three Basic Sealants



**Hot-pour as filler  
(in single saw cut)**



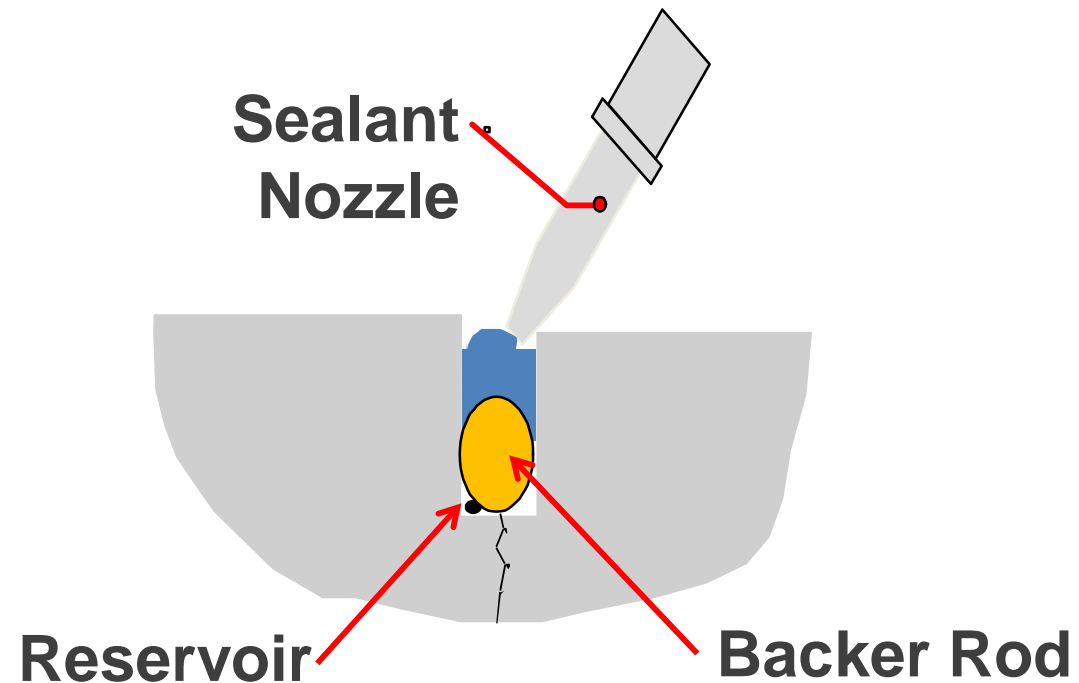
**Hot-pour Sealant  
(in reservoir cut)**



**Silicone Sealant  
(in reservoir cut)**

# Joint and Crack Sealing

- Minimizes water & incompressible materials into pavement system
- Reduces:
  - Subgrade softening
  - Pumping
  - Erosion of fines
  - Spalling



# Five Steps to Resealing

1. Removing the old sealant
2. Shaping the reservoir
3. Cleaning the reservoir



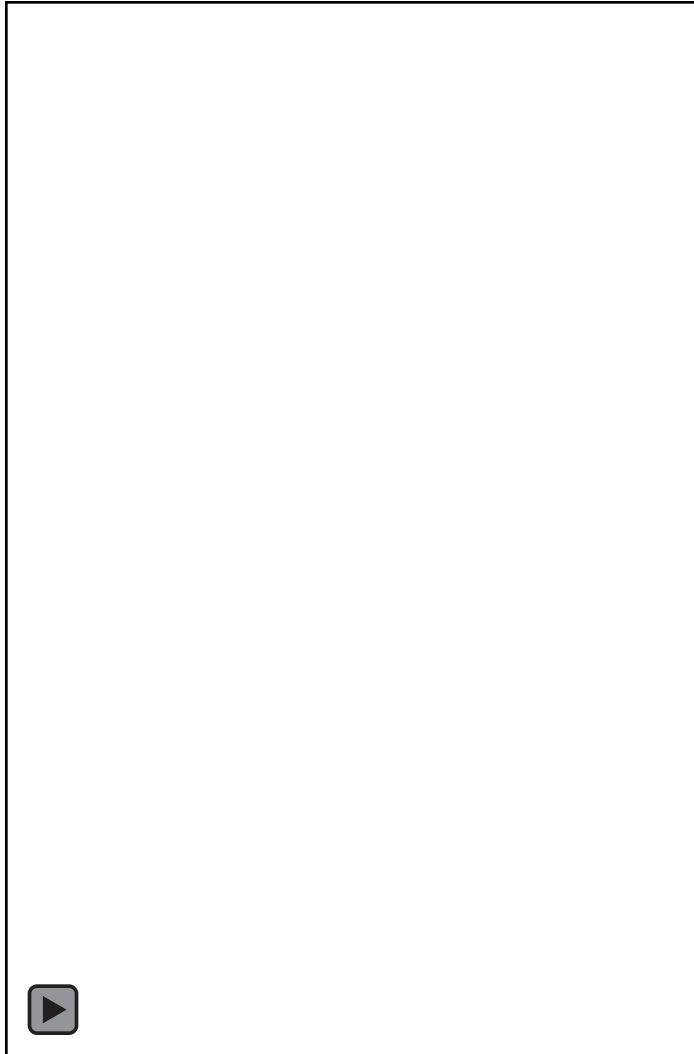


# Five Steps to Resealing

4. Installing the backer rod
5. Installing the sealant



# Nebraska Success Story

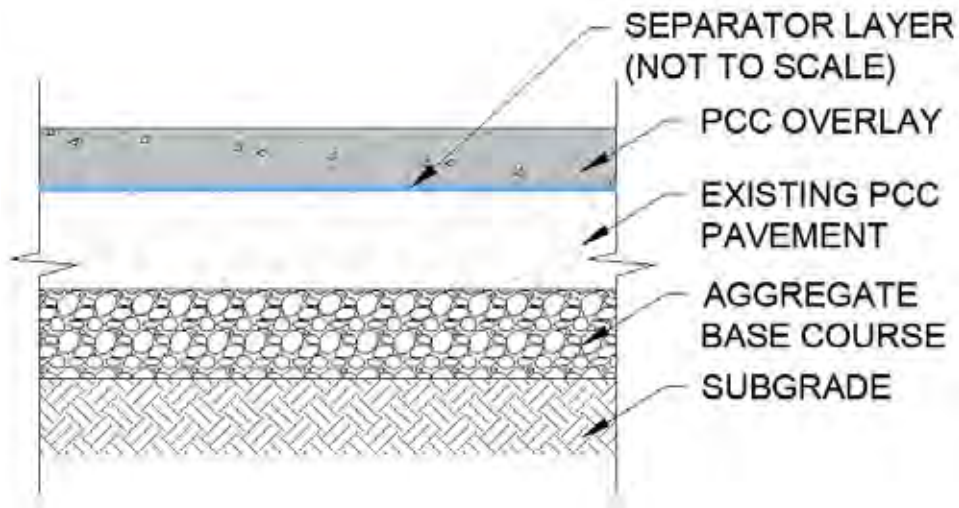
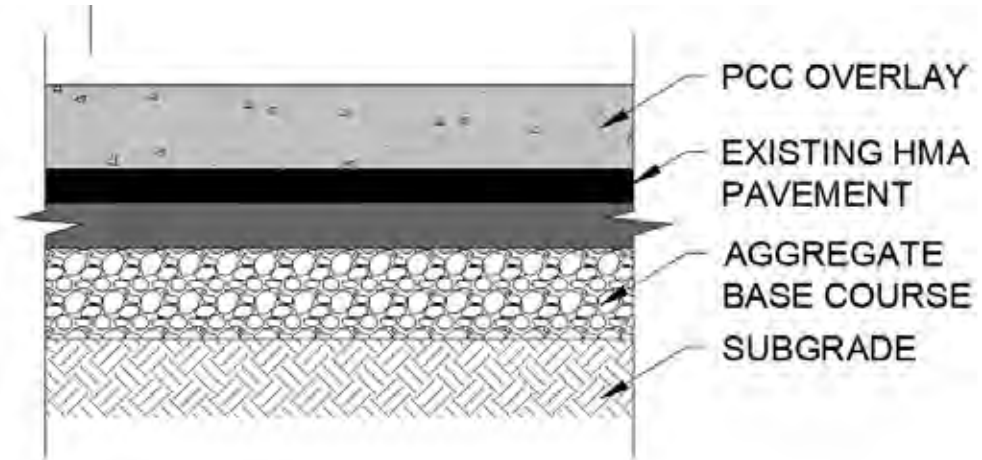




# CPR Techniques

Concrete Overlays

# Concrete Overlays

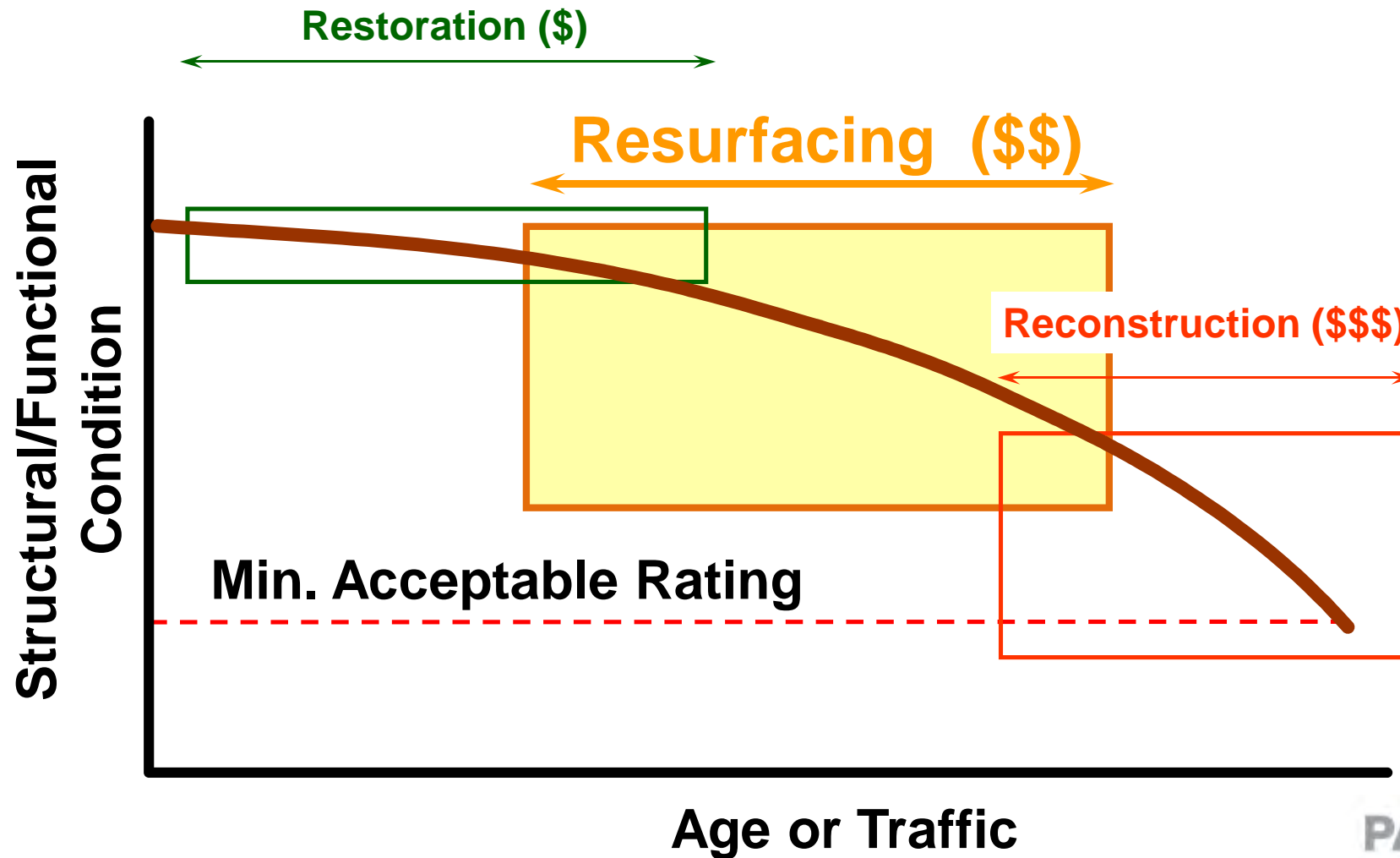


# Concrete Overlays

- Used extensively across the United States to extend pavement service life (8,000,000 square yards in 2013!)
- Can be designed for a service life of 10 to 40 or more years.
- Can be constructed rapidly and with effective construction traffic management.
- A wide variety of concrete overlay applications for a wide range of pavement conditions.



# Rehabilitation Timing



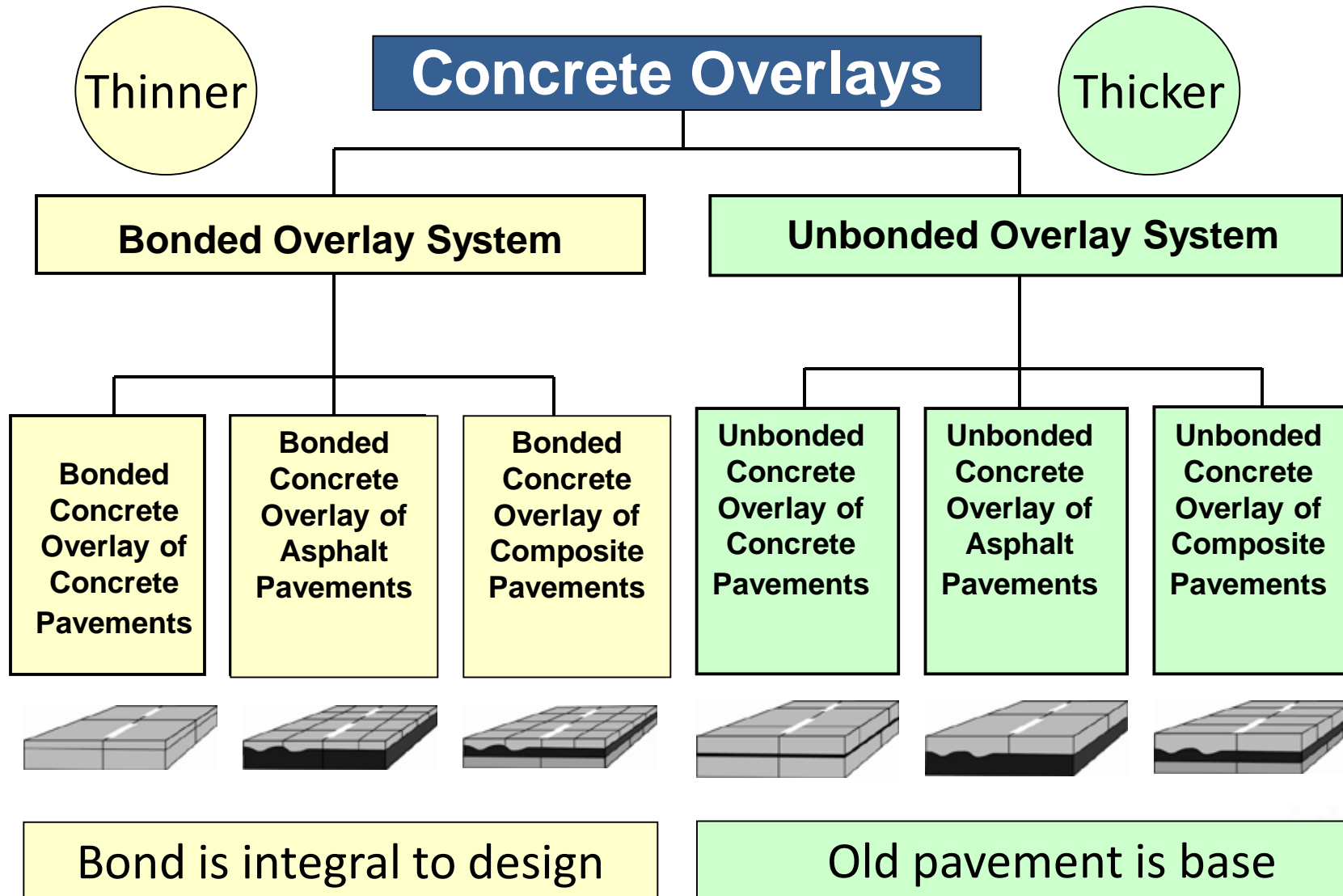
# National Concrete Overlay Database

- Many examples of successful PCC overlay projects.
- Consult the National Overlay Explorer App on the ACPA website.

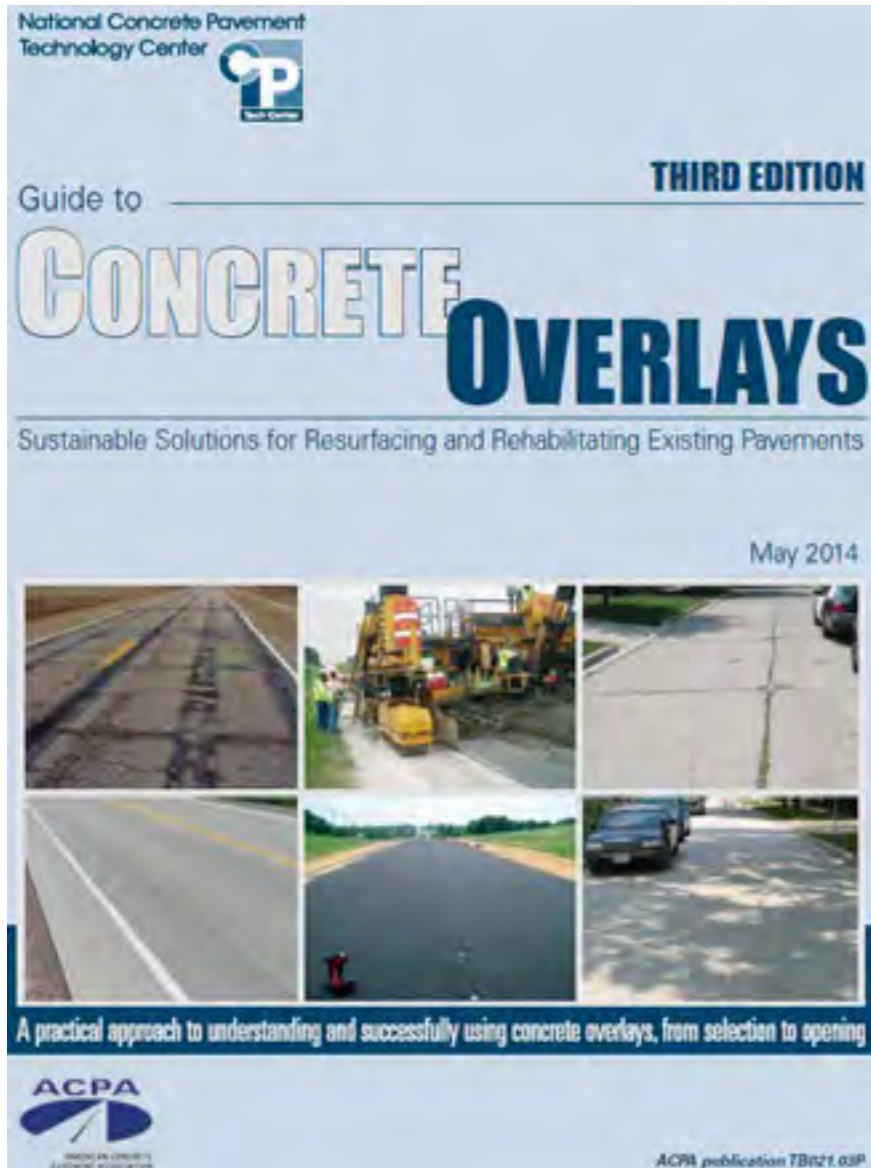


<http://apps.acpa.org/apps/Overlaypass.html>

# System of Concrete Overlays



# Streets & Roads: Guide to Concrete Overlays, 3rd Ed.



*Third Edition May 2014*



- Overview of Overlay Families
- Overlay types and uses
- Evaluations & Selections
- Six Overlay Summaries
- Design Section
- Miscellaneous Design Details
- Overlay Materials Section
- Work Zones Under Traffic
- Key Points for Construction
- Accelerated Construction
- Specification Considerations
- Repairs of Overlays

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# Guide to Concrete Overlays of Asphalt Parking Lots



*Minor Update April 2020*



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Upcoming NRMCA Webinar:

Thursday, May 14, 2 – 3 p.m. Eastern

## Concrete Overlays of Existing Asphalt Surfaced Streets and Parking Lots



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## Welcome to ACPA's Concrete Pavement Wiki

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- Joint Layout
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- Pavement Utility Cuts
- Fast Track Pavements
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#### A Brief Introduction to Concrete Pavements

Concrete pavements utilize cement to create a rigid surface which can be used for numerous applications. The most common applications are highways, streets, roadways, airports, industrial sites, and parking facilities. Due to the concrete's rigidity, concrete pavements distribute applied loads over a wide influence area. The most common types of concrete pavement are jointed plain concrete pavement (JPCP), jointed reinforced concrete pavement (JRCP), and continuously reinforced concrete pavement (CRCP). The main difference that distinguishes between these three systems is the jointing system used to control crack development and transfer load. Additionally, porous concrete pavement and roller-compacted concrete (RCC) pavement have been gaining popularity in recent years. These two types of concrete pavement utilize optimized mixes and construction methods to achieve different properties than the three more traditional types of concrete pavement. These typically behave as undoweled jointed plain concrete pavements which rely on aggregate interlock and subgrade support to transfer the load between slabs.

#### Featured Pages

Must-See Pages:

- Joint Layout
- Utility Cuts
- RCC Materials Selection
- Concrete Pavement Thickness Design

#### Featured Article: Joints

There are numerous types of joints utilized in concrete pavements and all of them serve a specific purpose. All joints are designed in some way or another to help the pavement achieve its design life. Jointed plain concrete pavement (JPCP) is most representative of how concrete pavements utilize joints, but all concrete pavement types, including jointed reinforced (JRCP) and continuously reinforced concrete pavement (CRCP), use joints for a number of reasons. This page looks at the purpose and history of joints as well as their proper design and construction. [To view the rest of this page, click here.](#)



#### Featured Picture: Dowel Bar Insertion



Dowel bars can be vibrated into the concrete pavement as it is being placed. This eliminates the need of dowel baskets. Dowel bars are used to transfer the load at the joints from one slab to the next. Dowels are an important part of the joint mechanics of jointed plain concrete pavement (JPCP).

# NRMCA Resources

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Concrete Parking ▾

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Pervious Concrete ▾

Roller Compacted Concrete ▾





## RESOURCES

Concrete Overlays ▾

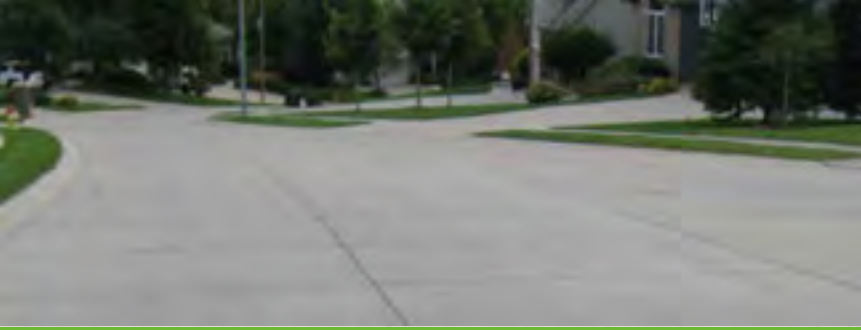
Concrete Parking ▾

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  - Roller compacted concrete
  - Cement slurry for full depth reclamation (FDR)



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- April 09      Designing Concrete Industrial Pavements

- April 16      Soils 101: What to Know for a Successful Paving Project

- April 23      Concrete Pavement Jointing and Details

- April 30      Materials and Construction Specifications for Concrete Pavement Projects

- May 07      Concrete Street and Parking Lot Maintenance and Repair

- May 14      Concrete Overlays of Existing Asphalt Surfaced Streets and Parking Lots

- May 21      Concrete Trail Design

- NRMCA **Concrete Buildings** Webinar Series: [buildwithstrength.com/education/](http://buildwithstrength.com/education/)

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- May 28      Designing Pervious Concrete

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- June 11      Installing Pervious Concrete

- June 18      Maintenance Guidelines for Pervious Concrete

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- **Portland Cement Association** Webinar Series: [www.cement.org/events/pca-infrastructure-webinar-series](http://www.cement.org/events/pca-infrastructure-webinar-series)

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- April 29      Lightweight Cellular Concrete for Geotechnical Applications

- May 6      Roller-Compacted Concrete Pavements

- May 13      Cement Stabilized Subgrade Soils

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# Questions??

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