

# Concrete Pavement Preservation: The Key to Long-Life Pavements



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NC Concrete Pavement Conference

# Topics of Discussion

- What is pavement preservation
- The cost benefit of smooth roads
- The pavement preservation tool kit
- The carbon benefit of smooth roads
- Other notable considerations
- IGGA Interactive CPP Tool on the new website

# Shifting Priorities



- Minimal system expansion
- Maintain the present system
- Minimize traffic disruptions
- Increase safety
- Address operator comfort
  - Reduce roughness
  - Reduce noise
- Protect the environment
- Inadequate funding

# Pavement Preservation Philosophy



***Keeping good roads in Good Condition!***

# The Difference Between Preservation Techniques and Routine Repair Techniques?

*Same  
treatments  
...better  
TIMING!*

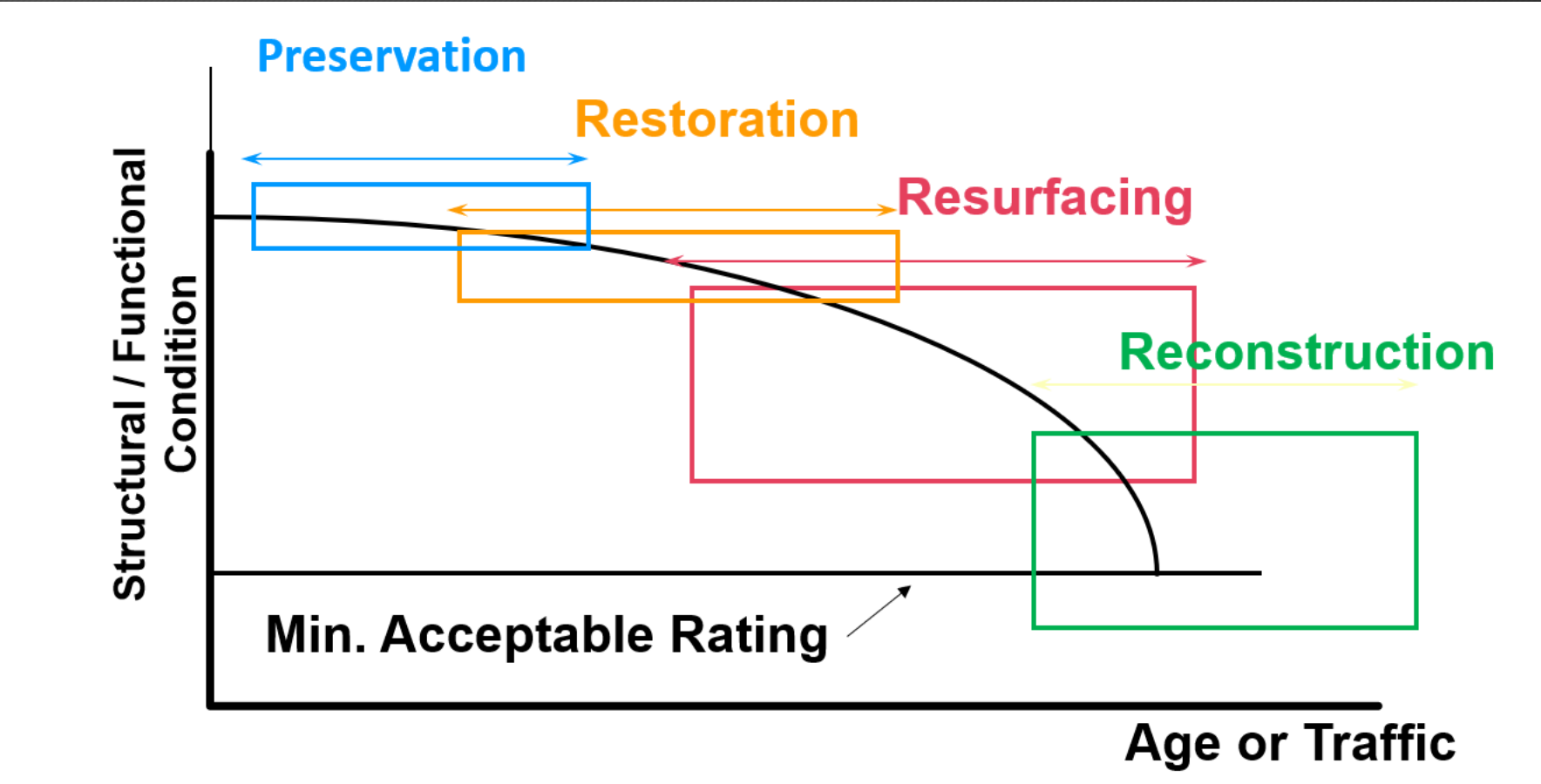


# World Bank's Evaluation

Transport Notes from the World Bank evaluated the relationship between maintenance timing and cost on South African highways.

- It was determined that 3 years of maintenance neglect resulted in 6 times the repair cost.
- 5 years of neglect resulted in up to 18 times the repair cost.

# Rehabilitation Timing



# Expected benefits?



## Preservation of investment

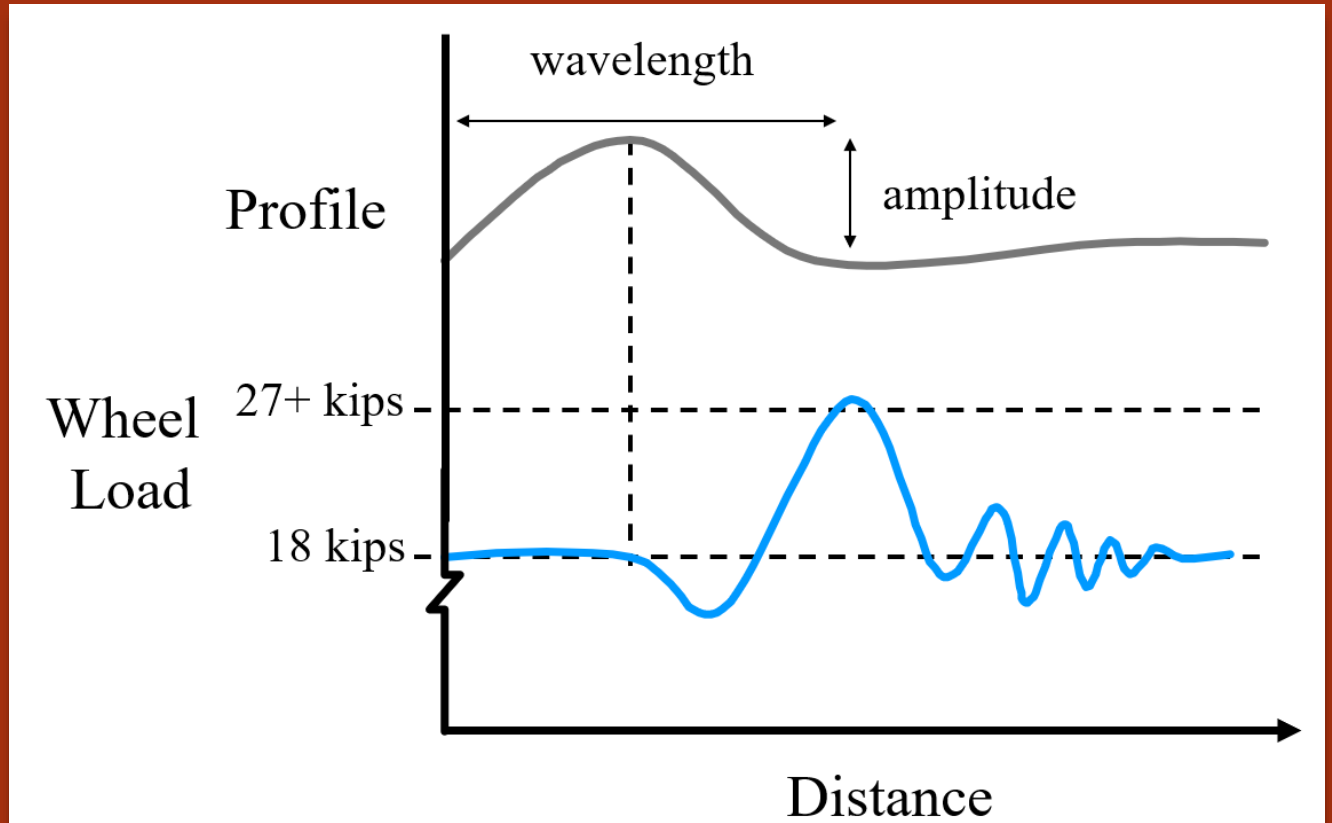
- Improved pavement performance
- Long term cost savings/leveling



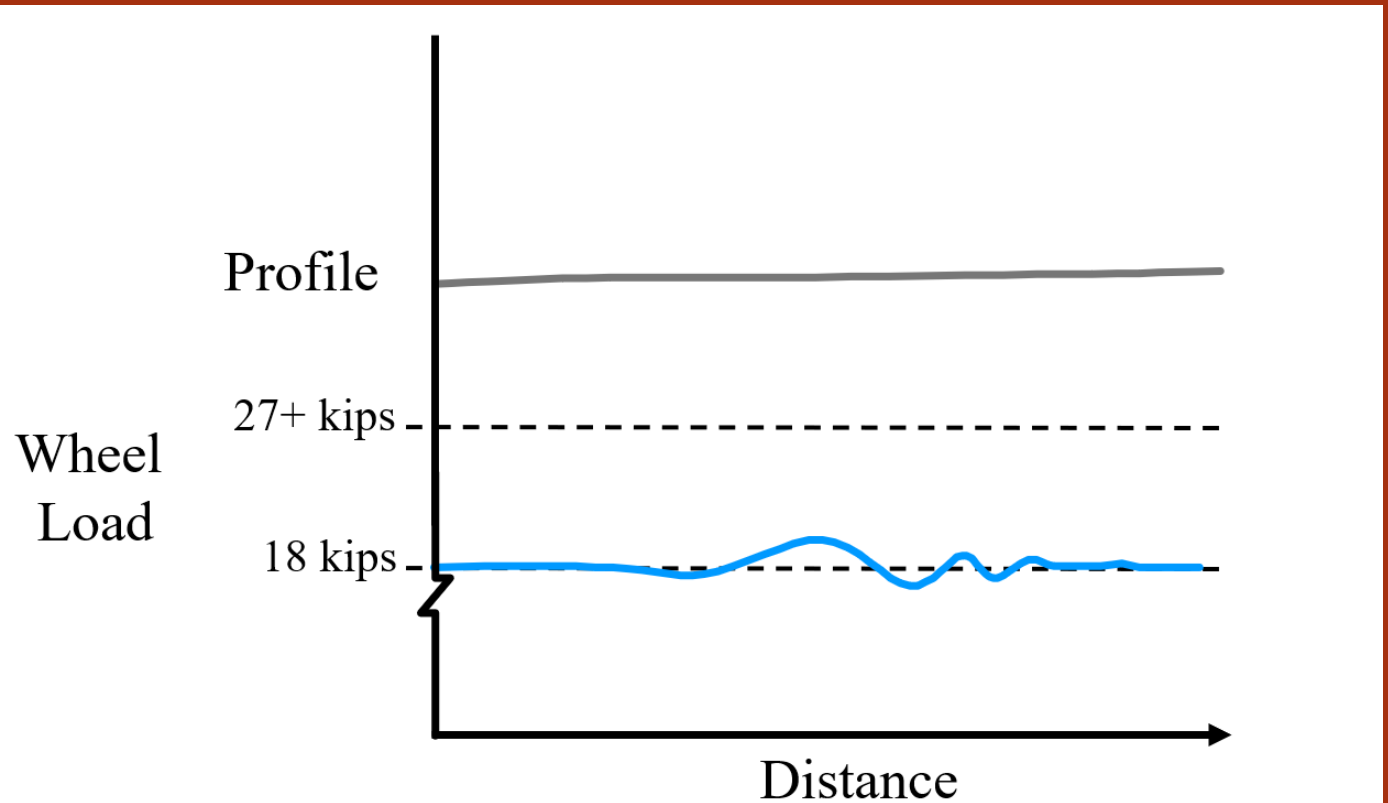
## Maintain a high level of service

- Increased safety
- Greater customer satisfaction
- Increased fuel economy

# Rough Pavement



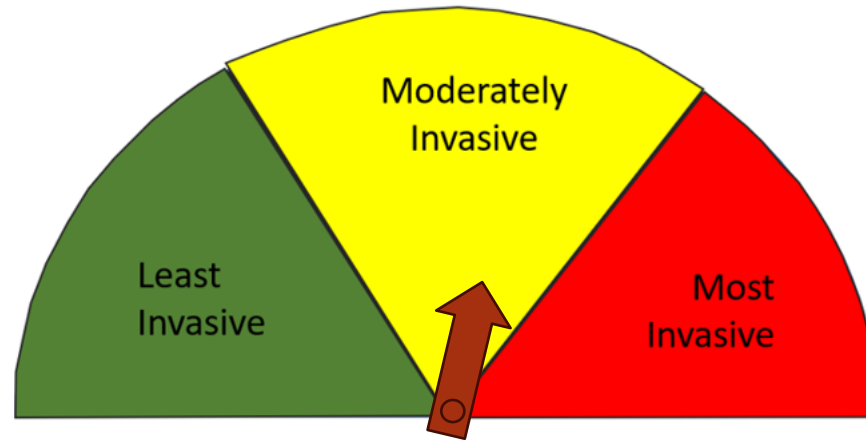
# Smooth Pavement





Why take a beating??

# What is the Cost of Pavement Repairs?



The less invasive a repair procedure is, the more cost effective it is and the less risk it carries.

### Least Invasive

- Joint and crack sealing
  - Prevents subbase degradation
    - Faulting
    - Rocking Slabs
    - Corner breaks
- **Diamond Grinding**
  - Removes Faulting
  - Remediates ride quality
  - Reduces sound
  - Enhances Safety

### Moderately Invasive

- Partial depth repairs
- Dowel Bar retrofits
- Cross stitching
- Slab jacking

### Most Invasive

- Full depth pavement repair

# Repairs Types and Invasiveness



MYTH

Concrete pavement is difficult and expensive to maintain while Asphalt is cheap and easy to maintain

# Benefits of Concrete Pavement



Carbon Sequestration



Urban heat Islands



Rigid Pavements offer improved fuel economy



Long lasting

# I26 in Asheville

## Annual Excess Fuel Consumption Cost Calculation Tool

Data For Analysis			
Analysis Date	October 26, 2023		
Project Length	18 Centerline Miles		
<a href="#">AADT</a>	90000 Vehicles		
<a href="#">HCAADT</a>	5000 Vehicles		
<a href="#">PAADT</a>	85000 Vehicles		
Traffic Growth Rate	1.5% %/Yr		
Analysis Period	50 Years		
<a href="#">MPG Light-Duty</a>	25.0 Miles/Gallon		
<a href="#">MPG Heavy-Duty</a>	6.6 Miles/Gallon		
<a href="#">Gasoline Price</a>	\$3.315 \$/Gallon		
<a href="#">Diesel Fuel Price</a>	\$4.554 \$/Gallon		
Fuel Savings Factor Light-Duty	0.02%		*Calculated by MIT Model
Fuel Savings Factor Heavy-Duty	0.98%		*Calculated by MIT Model
<a href="#">Gasoline CO2</a>	18.74 lbs/gallon		
<a href="#">Diesel Fuel CO2</a>	22.46 lbs/gallon		

# I26 in Ashville

Passenger Excess Cost	\$16,011.35	
Heavy Commercial Excess Cost	\$221,495.46	
	<b>1st Year</b>	<b>Over 50 Years</b>
<b>Excess Cost</b>	<b>\$237,506.81</b>	<b>\$17,500,173.52</b>
	\$13,194.82 /mi	
<i>Annual Excess Carbon Light-Duty = (Project Length) x (Fuel Savings Factor Light-Duty) x 365 x (PAADT) / (MPG Light-Duty) x (Gasoline CO2) / 2000</i> <i>Annual Excess Carbon Heavy-Duty = (Project Length) x (Fuel Savings Factor Heavy-Duty) x 365 x (HCAADT) / (MPG Heavy-Duty) x (Diesel Fuel CO2) / 2000</i> <i>Annual Excess Carbon = (Annual Excess Carbon Light-Duty) + (Annual Excess Carbon Heavy-Duty)</i>		
Annual Excess Carbon Light-Duty	45 tons CO <sub>2</sub> 115 barrels	
Annual Excess Carbon Heavy-Duty	546 tons CO <sub>2</sub> 1158 barrels	
	<b>1st Year</b>	<b>Over 50 Years</b>
<b>Excess Carbon</b>	<b>591 tons CO<sub>2</sub></b>	<b>43580 tons CO<sub>2</sub></b>
	33 tons CO <sub>2</sub> /mi	
	<b>1st Year</b>	<b>Over 50 Years</b>
<b>Excess Barrels Fuel</b>	<b>1,273 barrels</b>	<b>93801 barrels</b>
	71 barrels/mi	

# Joint and crack sawing and sealing



\$15 per linear foot  
\$142,000 per lane mile

# Diamond Grinding

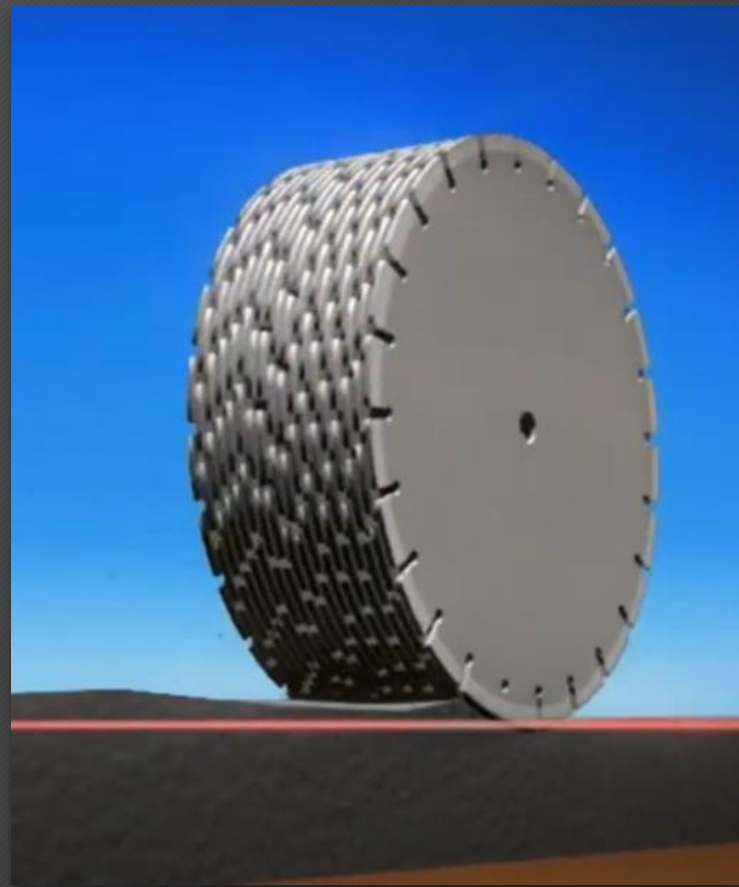


**\$3-5 Per square yard**

**\$28,000 per lane mile**

**Moderately hard stone**

**12 lane mile project (100,000 sqyd)**



What is Diamond Grinding?

# Partial Depth Repairs (PDR)



**\$70-200 Per square foot**

# Additional PDR information



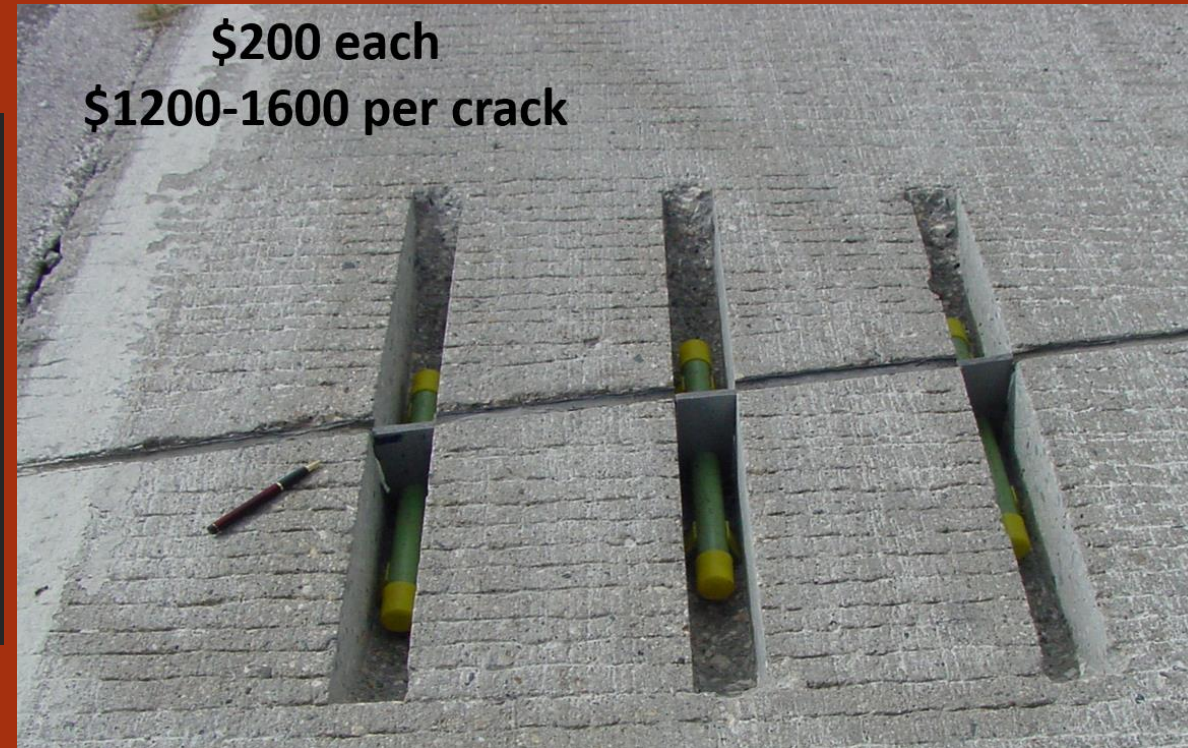
Modified  
Milling for  
fast and  
efficient  
repair prep



When repairs  
are properly  
bonded, odd  
geometries are  
permitted

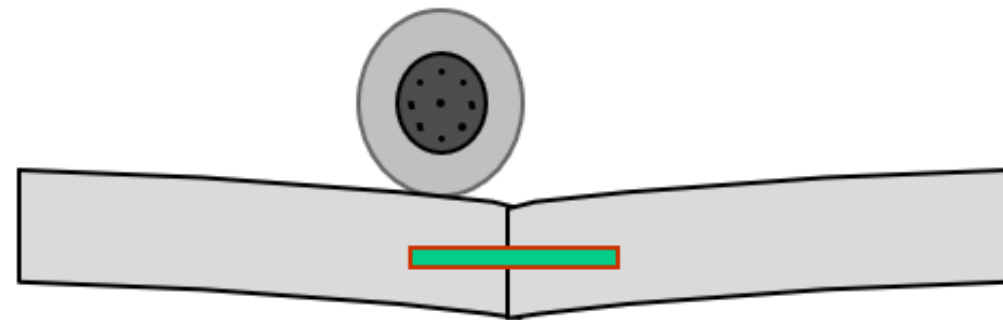
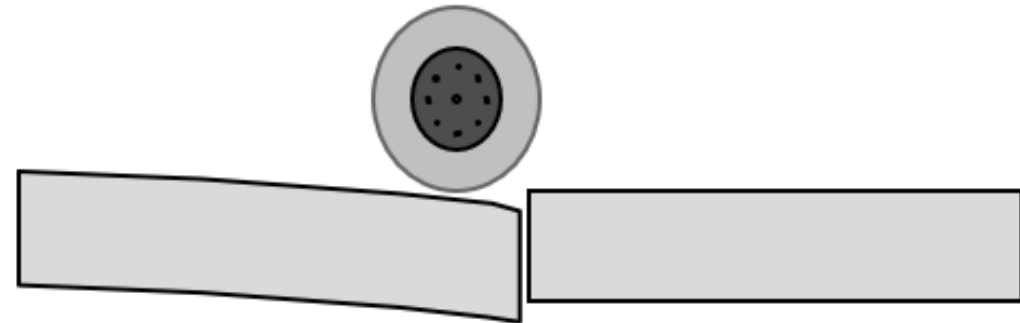


# Dowel Bar Retrofit (DBR)



## Purpose of DBR

- Reestablish load-transfer across joints or cracks
  - Load-transfer is a slab's ability to transfer part of its load to its neighboring slab
- Used in JRC and JPC pavements to limit future faulting

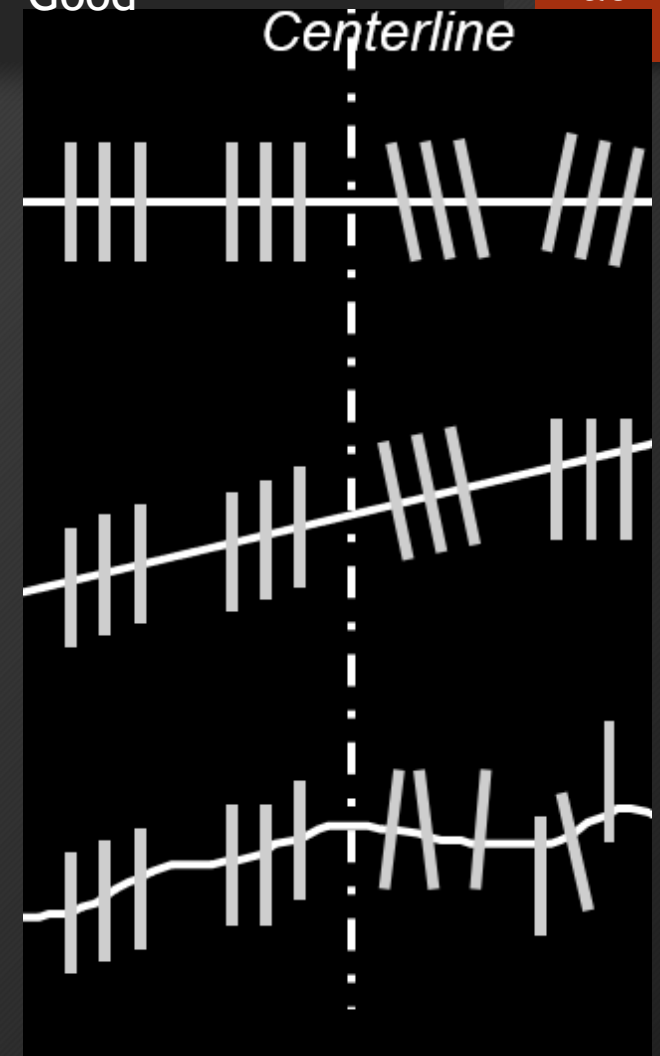


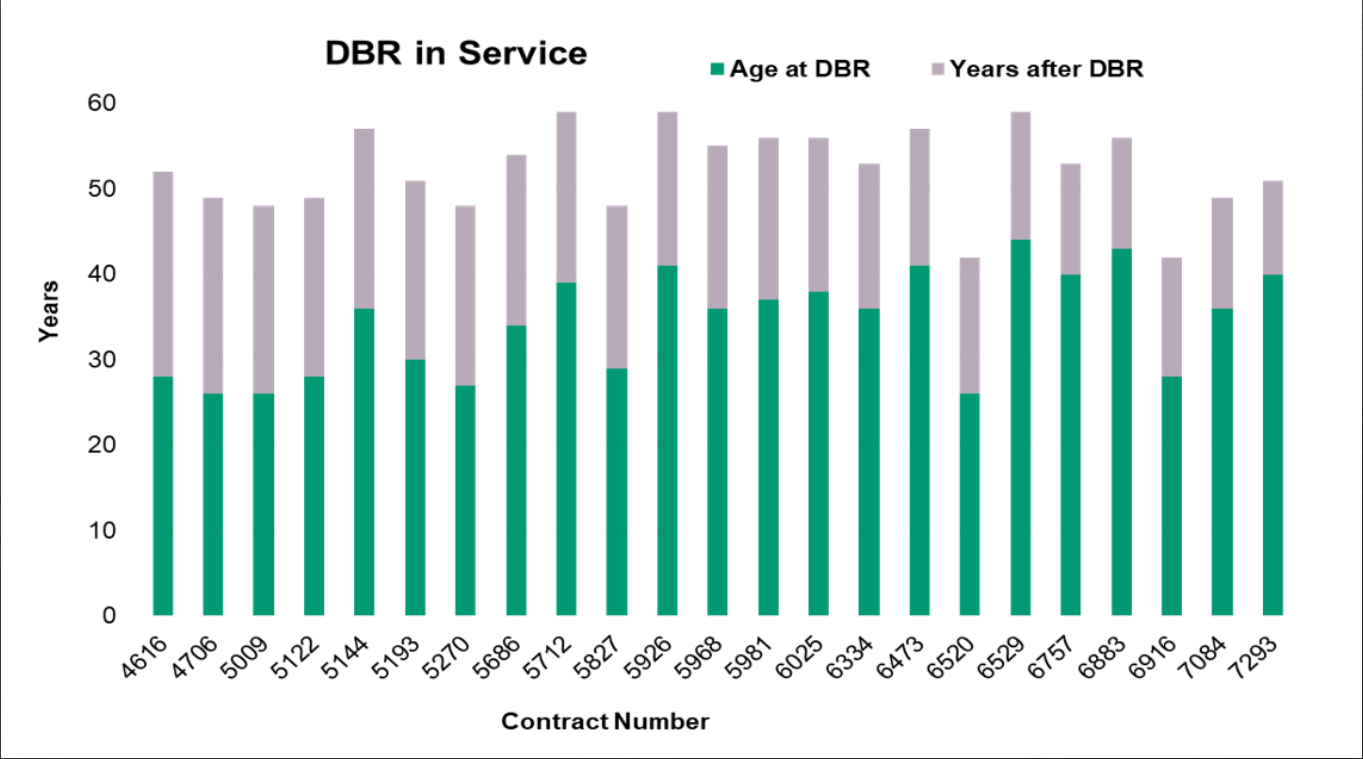
# Key Factors



Good

Bad





# Historical performance of DBR's

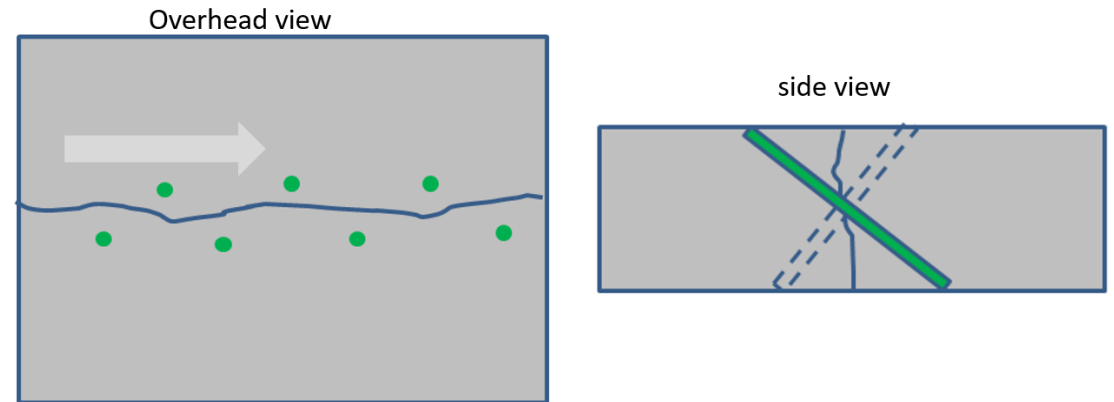
Don't over do it!



# Caution!



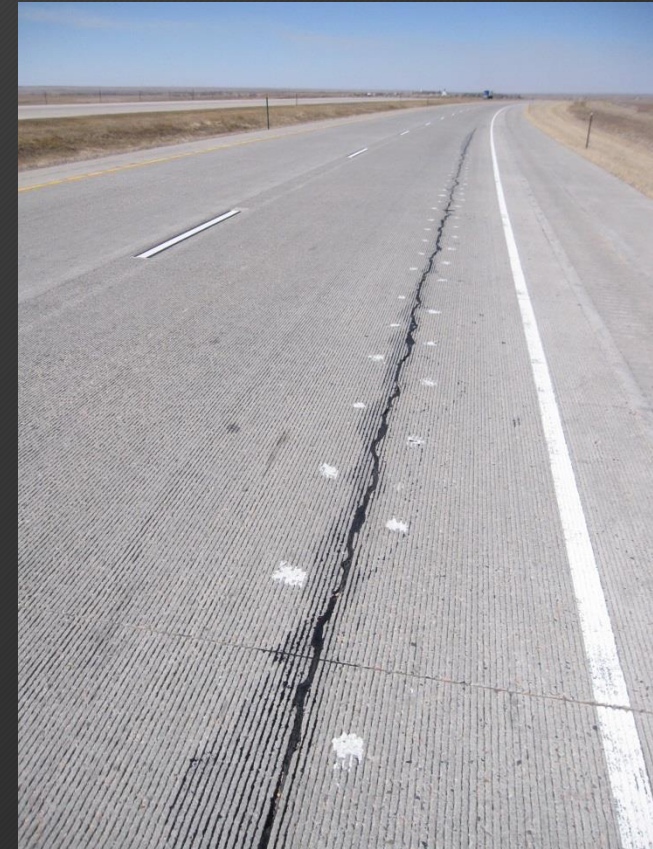
# Cross-stitching



**\$50-100 each**  
**Placed every foot alternating sides**  
**15' slab = \$700-\$1400**

# More on stitching

- Used for longitudinal cracks that are in good condition
- Not appropriate for transverse cracks - use DBR
- Helps maintain aggregate interlock and provide added reinforcement to crack
- Reduce slab migration
- Prevent longitudinal joint faulting



# Pavement Sub-Surface Rehabilitation

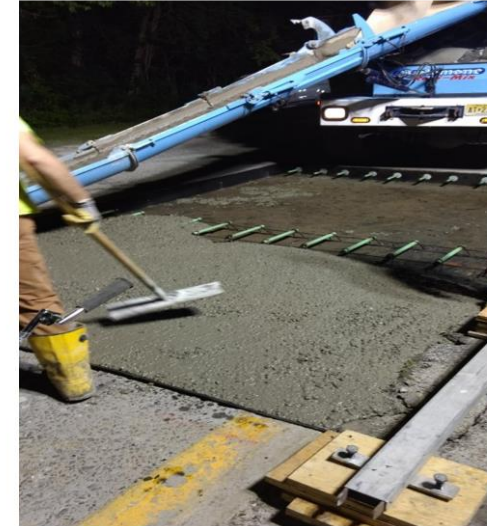
- Used for sub-grade repair
- Soil collapse
- Poor compaction
- Helps reduce
  - Pumping
  - Joint faulting
  - Corner breaks



# Full-Depth Repair

## Multi-pay item process

- PCC lift-out **\$150 per yard**
- Drill and anchor of Dowel bars and longitudinal bars **\$90 each (16 per slab)**
- Placement of new PCC **\$400 per yard**



**Full depth replacement of a 10' x 12' x 9" slab (3.3 CY)  
\$3200 per yard**

Are we forgetting any other pieces of our Highway system?



Bridges!

# Hydro-blast Inlay

- Uses Ultra high-performance Concrete (10,000 PSI Compressive strength in 24 hours)
- Steel fibers instead of aggregate for improved flexural strength
- Chemical bond is greater than the strength of the existing high performance structural concrete



# The steps for UHPC Inlay



# More UHPC



# Interactive CPP Toolkit

- Helps DOT's and Designers select the appropriate repairs for PCC pavement to help optimize repair spending.

Identify your pavement's problem area. Click on the photo that represents your pavement problem:



**Spalled Joints and Cracks**



**Faulted Joints**



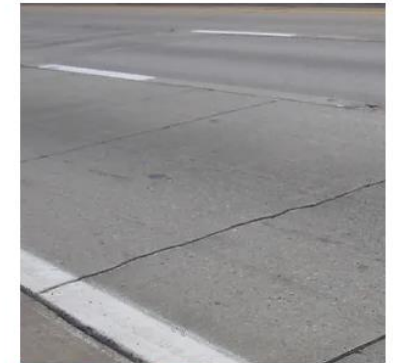
**Subsurface Voids**



**Cracked Slabs**



**Low-Severity Longitudinal Cracks or Joints**



**Low-Severity Transverse Cracks**



**Slab Warping or Unevenness**



**Joint Sealant Failure**



**Hydroplaning on Pavement**

# CRACKED SLABS

## Learn About the Repair

Images, information, and resources on the appropriate repair



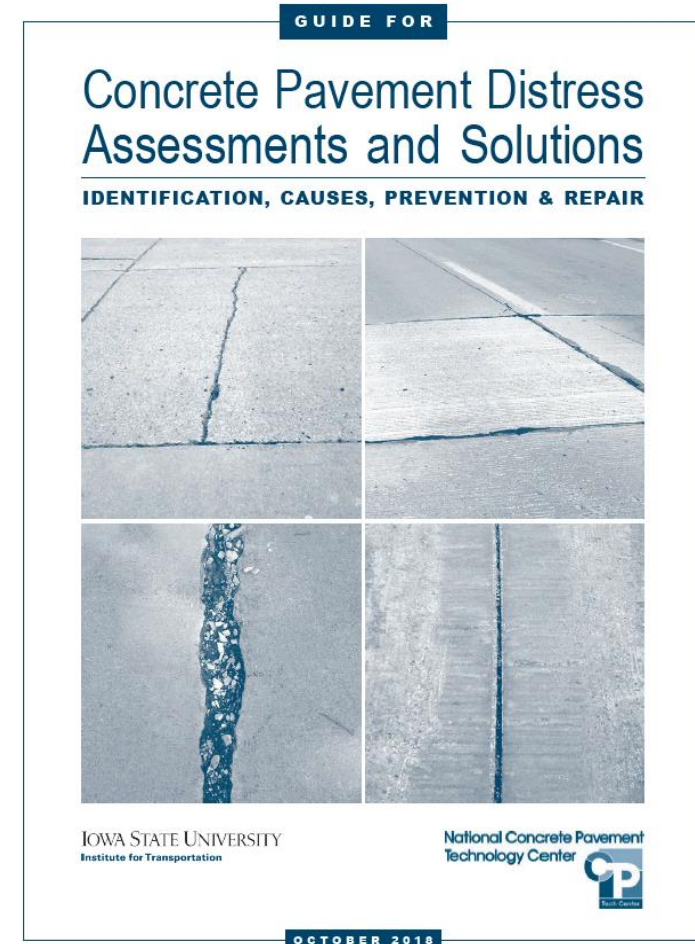
If you have cracked slabs, you need to perform:

### Full-Depth Repairs

Full-depth repair is the removal and replacement of full slab thickness sections of deteriorated pavement. Length can vary based on conditions present. A common minimum patch size is four to six feet long and a full lane width wide. This type of repair can be completed on both jointed and continuously reinforced concrete pavement. On jointed pavement, the transverse construction joints at the patch ends are typically doweled and/or tied to restore load transfer across the joints. Additionally, on longer patch sections, dowel bar assemblies are placed at intervals to coincide with the existing transverse joint pattern present. On continuously reinforced concrete, the reinforcing steel pattern of the existing pavement is removed and replaced with new steel within the repair section. The transverse repair boundaries are first sawed and jackhammered to

# Other resources

Pavement repair guides produced by the  
National Concrete Pavement Technology  
Center (CPTECH Center)



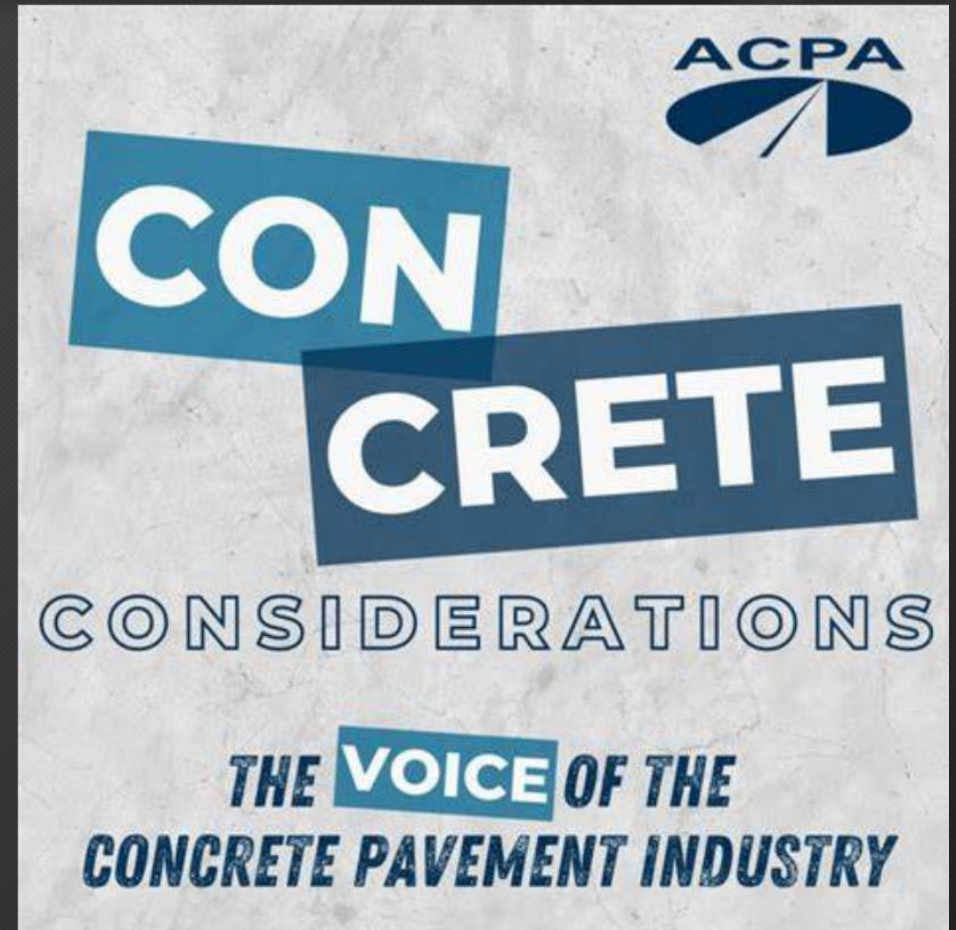
# Total Benefits Smooth Concrete Pavements?

1. Better Fuel Economy
2. Improved safety (40% reduction in accidents, 57% reduction in wet weather accidents for diamond ground pavements)
3. Reduced freight damage
4. Reduce maintenance spending
5. Reduced GHG Emissions for use-phase



# Other resources

American Concrete  
Pavement Associations  
Podcast for general  
industry updates



## Conclusion

Keep your pavements smooth; It's the most affordable option

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# IGGA

International Grooving  
& Grinding Association

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# 2023 Fall Concrete Pavement Conference Attendance Log Day 1 - General Session



Please scan the QR code and sign in so your attendance is documented