Pavement Preservation with Thin Lift Concrete Overlays

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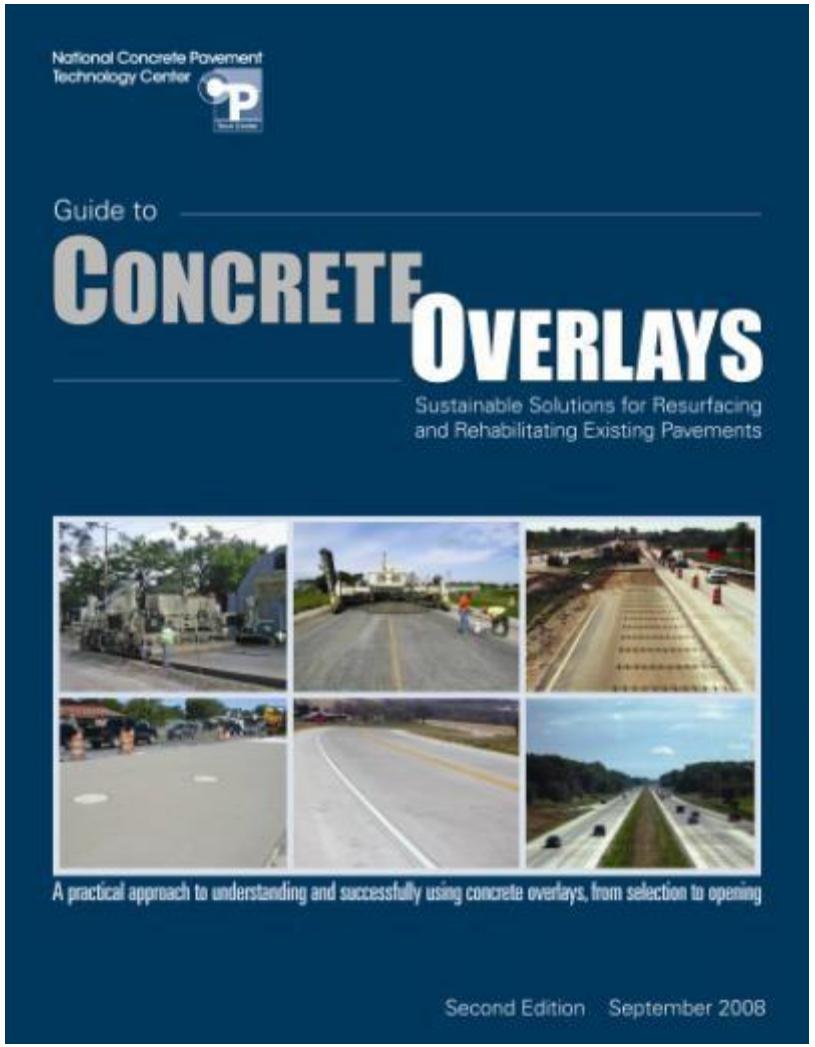
Concrete Overlay Guide second edition

Contents

1. Overview of Overlay Families
2. Overlay types and uses
3. Evaluations & Selections
4. Six Overlay Summaries (11”x17 “sheets)
5. Design Section
6. Miscellaneous Design Details
7. Overlay Materials Section
8. Work Zones under Traffic
9. Key Points for Overlay Construction
10. Accelerated Construction
11. Specification Considerations
12. Repairs of Overlays



Second Edition September 2008

System of Concrete Overlays

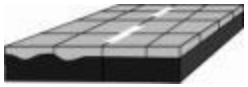
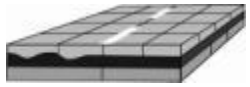
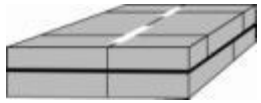
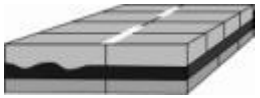
Thinner

Concrete Overlays

Thicker

Bonded Overlay System

Unbonded Overlay System

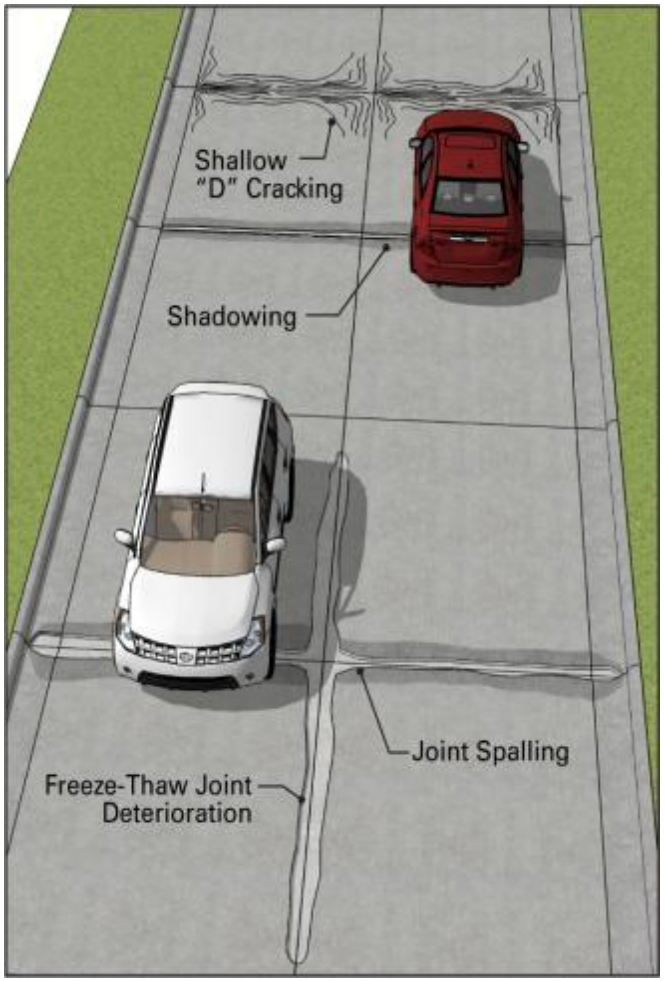
Bonded Concrete Overlay of Concrete Pavements	Bonded Concrete Overlay of Asphalt Pavements	Bonded Concrete Overlay of Composite Pavements	Unbonded Concrete Overlay of Concrete Pavements	Unbonded Concrete Overlay of Asphalt Pavements	Unbonded Concrete Overlay of Composite Pavements
					

Bond is integral to design

Old pavement is base

Bonded Overlays of Concrete Pavements

- Existing pavement is considered a structural component
- Pavement needs to be in good condition, or restored to a good condition



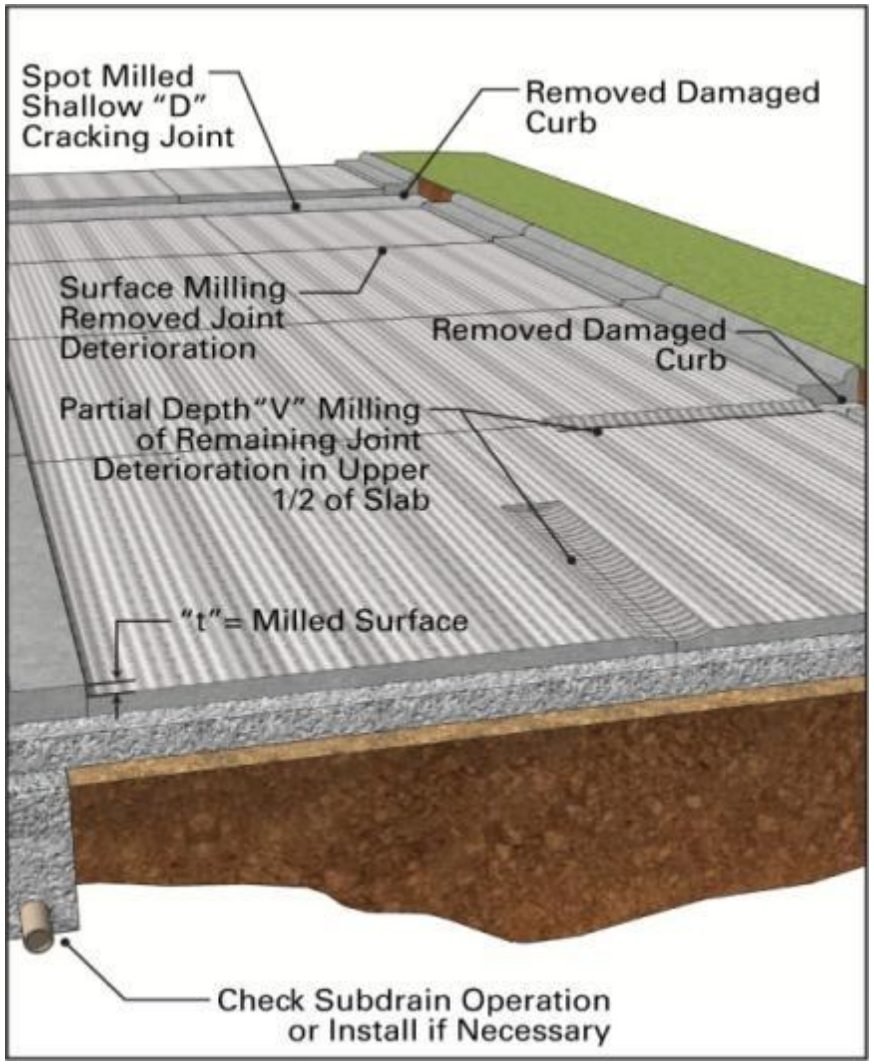
Surface Preparation for Bonded Overlay Bonding is Critical

- Shotblasting

- Milling

Bonded Overlays of Concrete Pavements

- No heavy repairs because the milling can remove the majority of unsound concrete
- Milling to a depth that provides a sound concrete structure
- Small areas of deteriorated concrete after milling to be repaired by either partial or full depth patching
- If large remaining patching after milling then not a good candidate



Bonded Overlays of Concrete Pavements

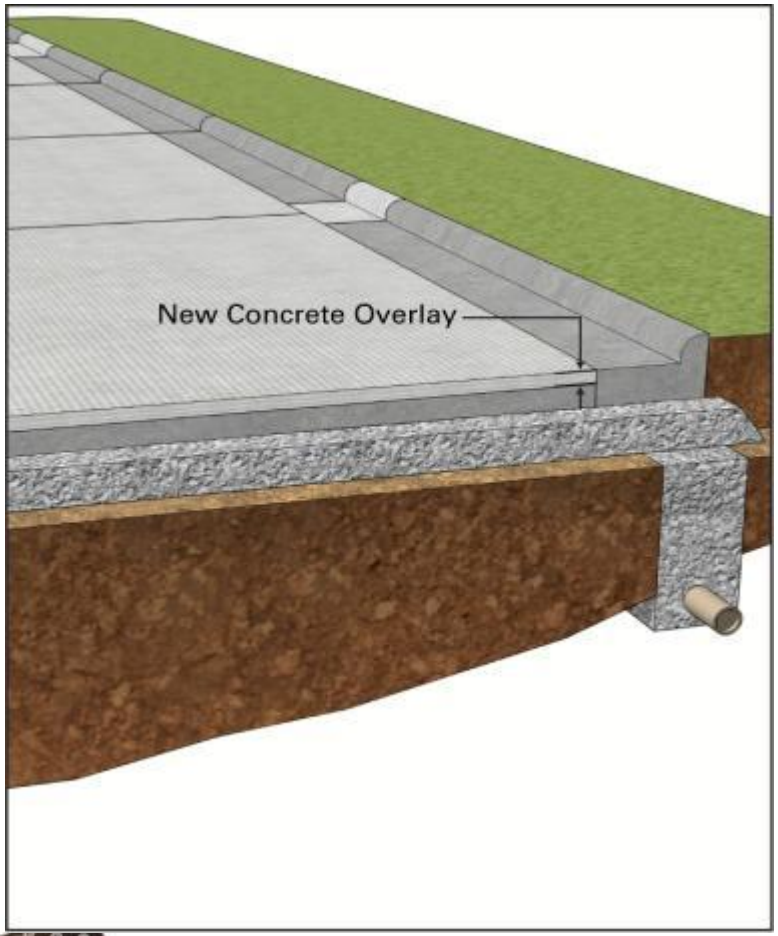
- Perform additional partial and full depth repairs on areas where joint deterioration is excessive.

Cleaning the Surface to Prepare for Bonding

- Sweeping surface followed by compressed air cleaning in front of the paver.
- Air blasting or water blasting is only necessary to remove material that cannot removed any other way.
- Water or moisture should not be on the surface prior to paving or de-bonding can occur.

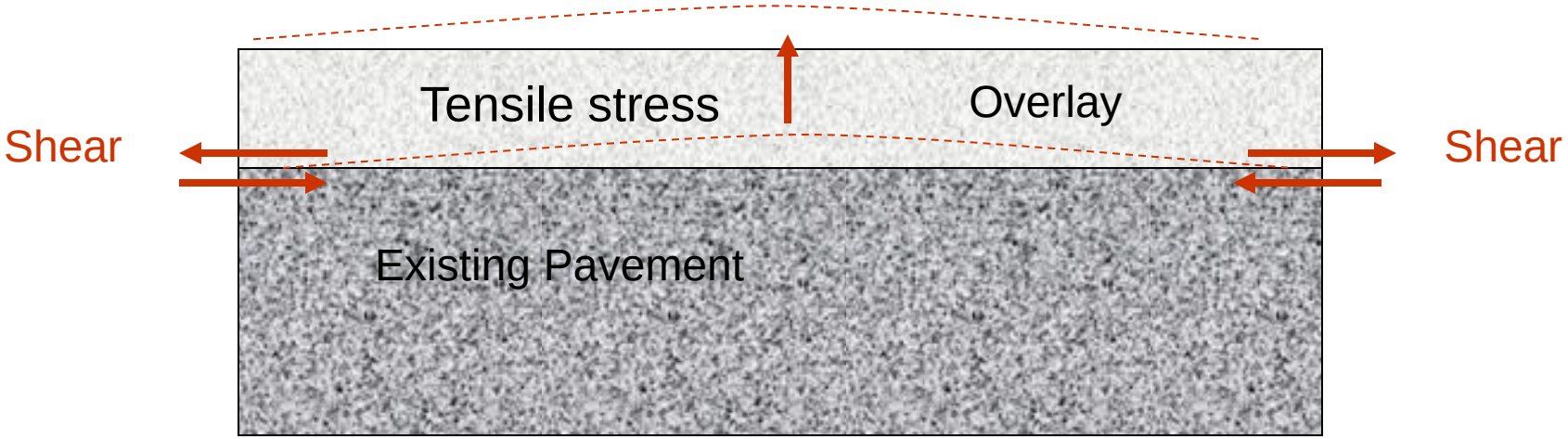
Bonded Overlays of Concrete Pavements

- Construct a bonded overlay



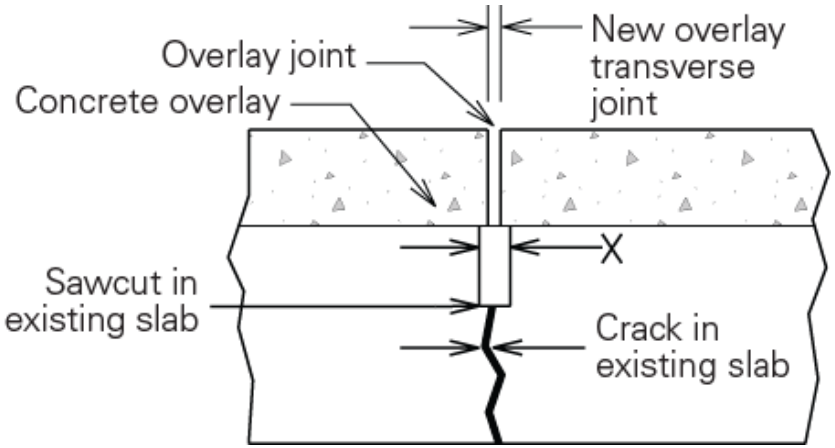
Coefficient of Thermal Expansion (CTE)

- Overlay CTE should be similar to underlining pavement
- If not near the same at least overlay CTE should be lower than existing pavement



Joint Design and Layout

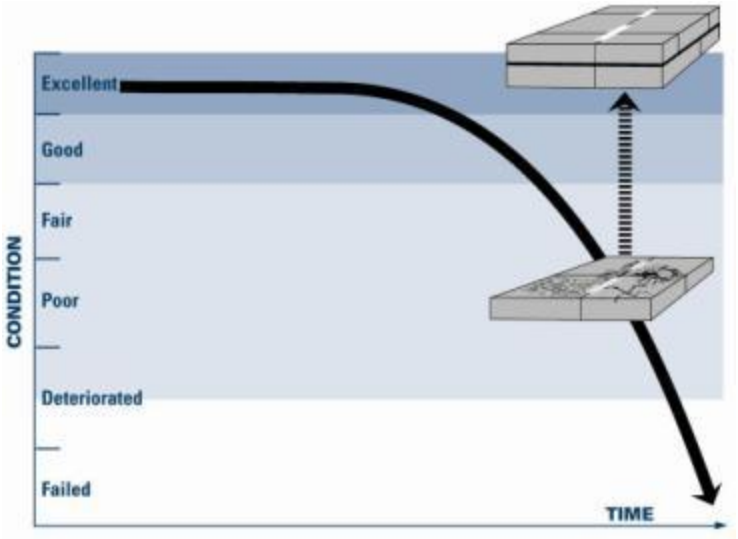
- All overlay joints must match those in underlying pavement
- No additional load transfer devices
- Transverse joint sawing
  - Through entire overlay thickness + ½ inch of **as-constructed overlay**, not planned overlay



Case Study – 2.5” to 4.5” Bonded Concrete Overlay in Plano, Texas (2007)

Case Study – 2” Bonded Concrete Overlay in Northwood, IA (2002)

Uses and Advantages - Unbonded Overlay of Concrete Pavements



4” - 11” thickness

- Use when existing pavement is in poor condition or better.
- Use to restore structural capacity of the existing pavement and increase pavement life equivalent to full-depth pavement.
- Results in improved surface friction, noise and ride.

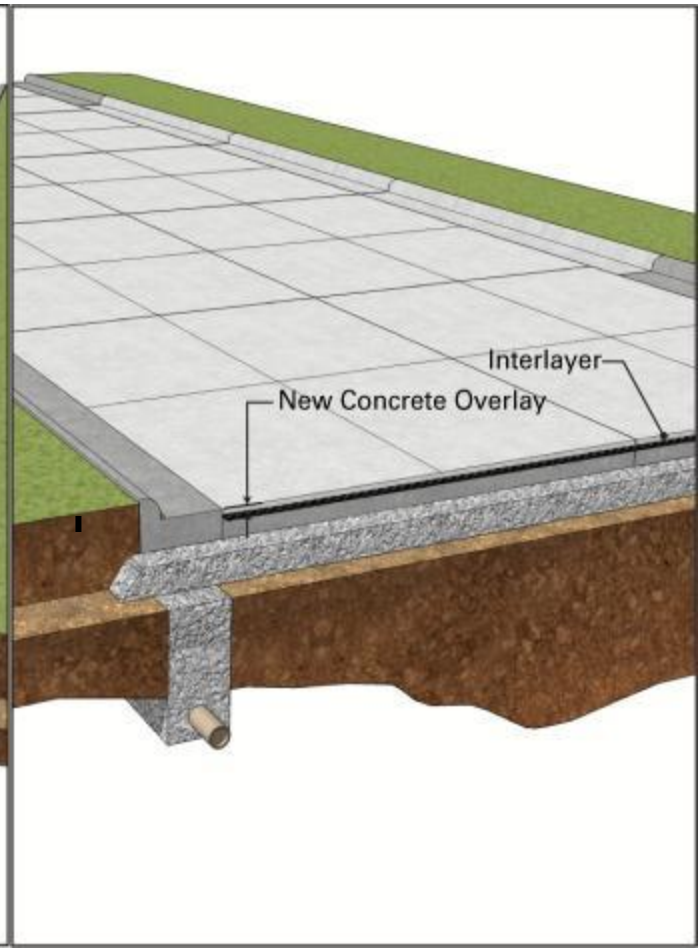
- Overlays 6” or greater have been used successfully on ASR when underlying pavement and subbase are stable.

- Overlays on “D” crack pavements have had mixed results depending on the amount of localized distress.

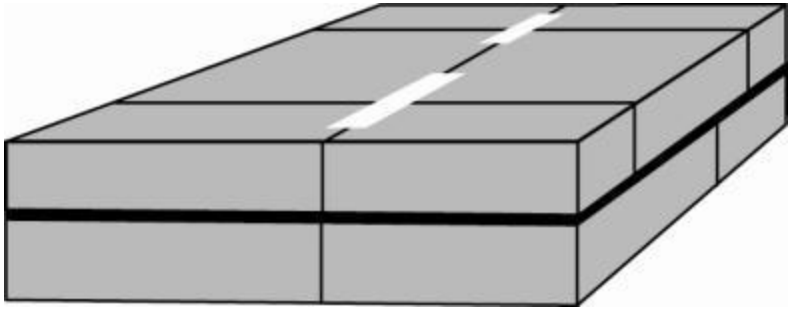
Pages 5, 18-19

Unbonded Overlays of Concrete Pavements

- Placement of a separation layer (HMA or geotextile)
- Construction of an unbonded overlay



Unbonded Overlay of Concrete Pavements
Keys to Success



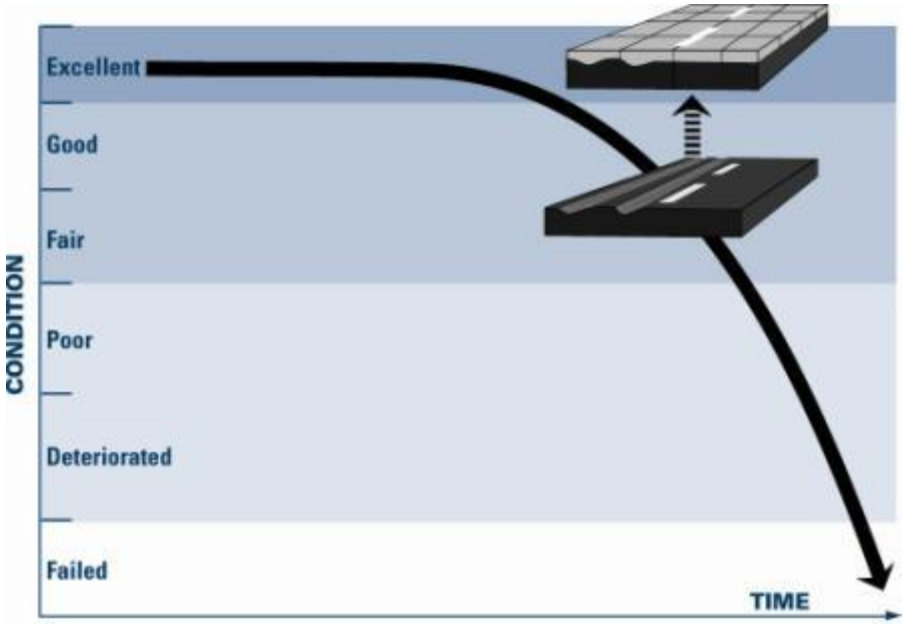
- Full-depth repairs are required only where structural integrity is lost at isolated spots.
- Separator layer (normally 1” asphalt) is important to isolate unbonded overlay from underlying pavement and minimize reflective cracking.
- With heavy truck traffic, adequate drainage design may be important to reduce pore pressure in asphalt separation layer.
- Some states are experimenting with geotextile materials for separation layer.
- Faulting of 3/8 in. or less in the existing concrete pavement is not a concern when asphalt separation layer is 1 in. or more.
- Shorter joint spacing helps minimize curling and warping stresses. Transverse joints at 1.5 times thickness for <5” and 2 times thickness 5” or greater up to 15’.
- No need to match joints with those of the underlying concrete pavement.

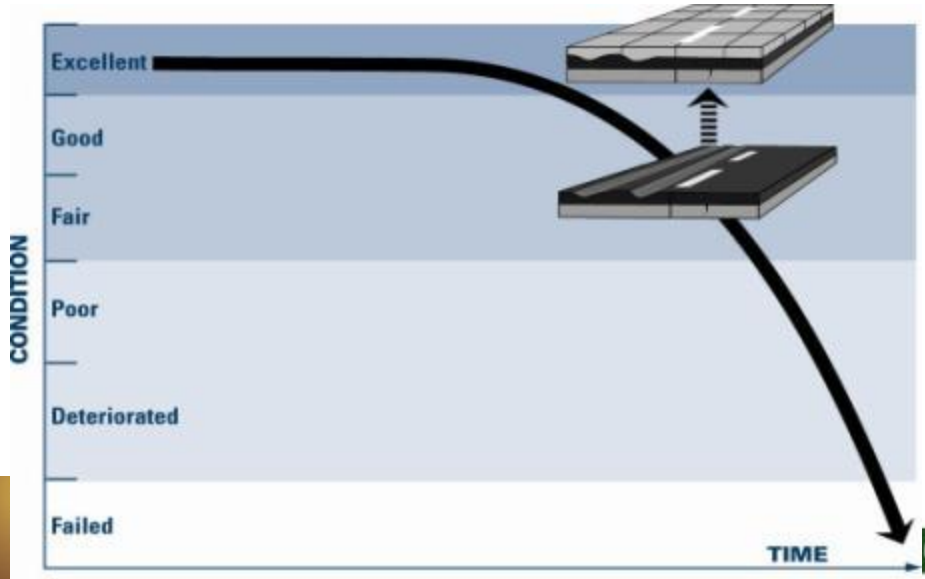
Case Study St. Clair Shores

- Partial and full depth repairs were considered
- Continued deterioration was a concern
- Complete R/R was too costly and the lower 5” of the pavement was sound (determined by previous City study)
- Microscopic testing found some ASR gel around the fine-aggregate and low air in the top 1/3 of the pavement
- Decide on 4” Unbonded Overlay
- 20,000 ADT w/5% trucks

- Contractor started by milling all 4” at once
- Milled surface prior to sweeping
- Contractor kept millings
- After milling place interlayer

Uses and Advantages- Bonded Overlay of Asphalt or Composite Pavements





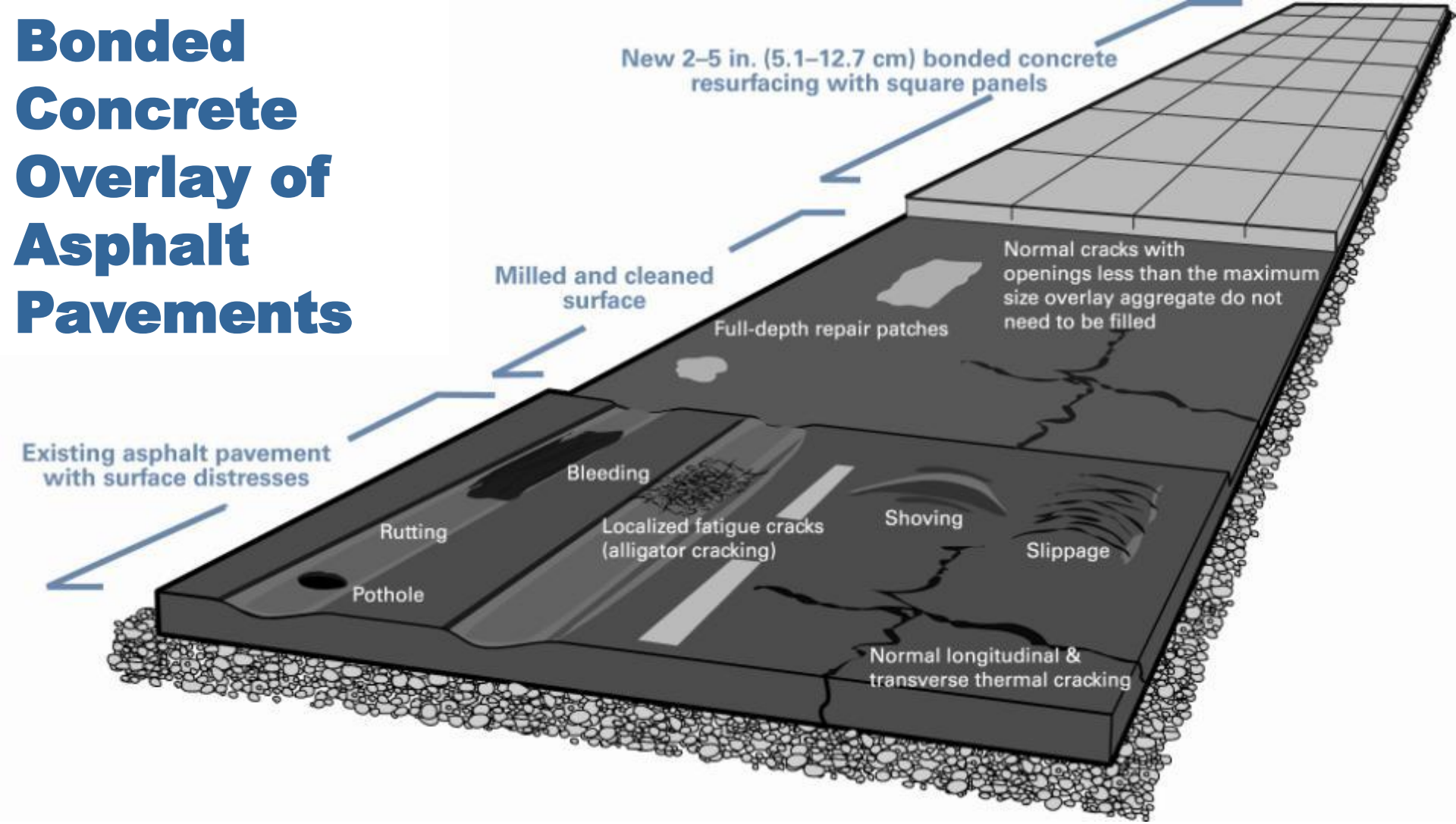
2”–5” thickness

- Use when existing pavement is in fair or better structural condition with surface distress.
- Use to eliminate any surface defects; increase structural capacity; and improve surface friction, noise, and ride.
- Where increased traffic requires more structural capacity like intersections.

Feasibility

- HMA pavements with some structural integrity
  - Limited structural (fatigue) cracking
  - No stripping/raveling in HMA layers
  - HMA thickness after milling > 3 in to 4 in.
- Rutting in HMA layers ok
- Non-load associated cracking ok

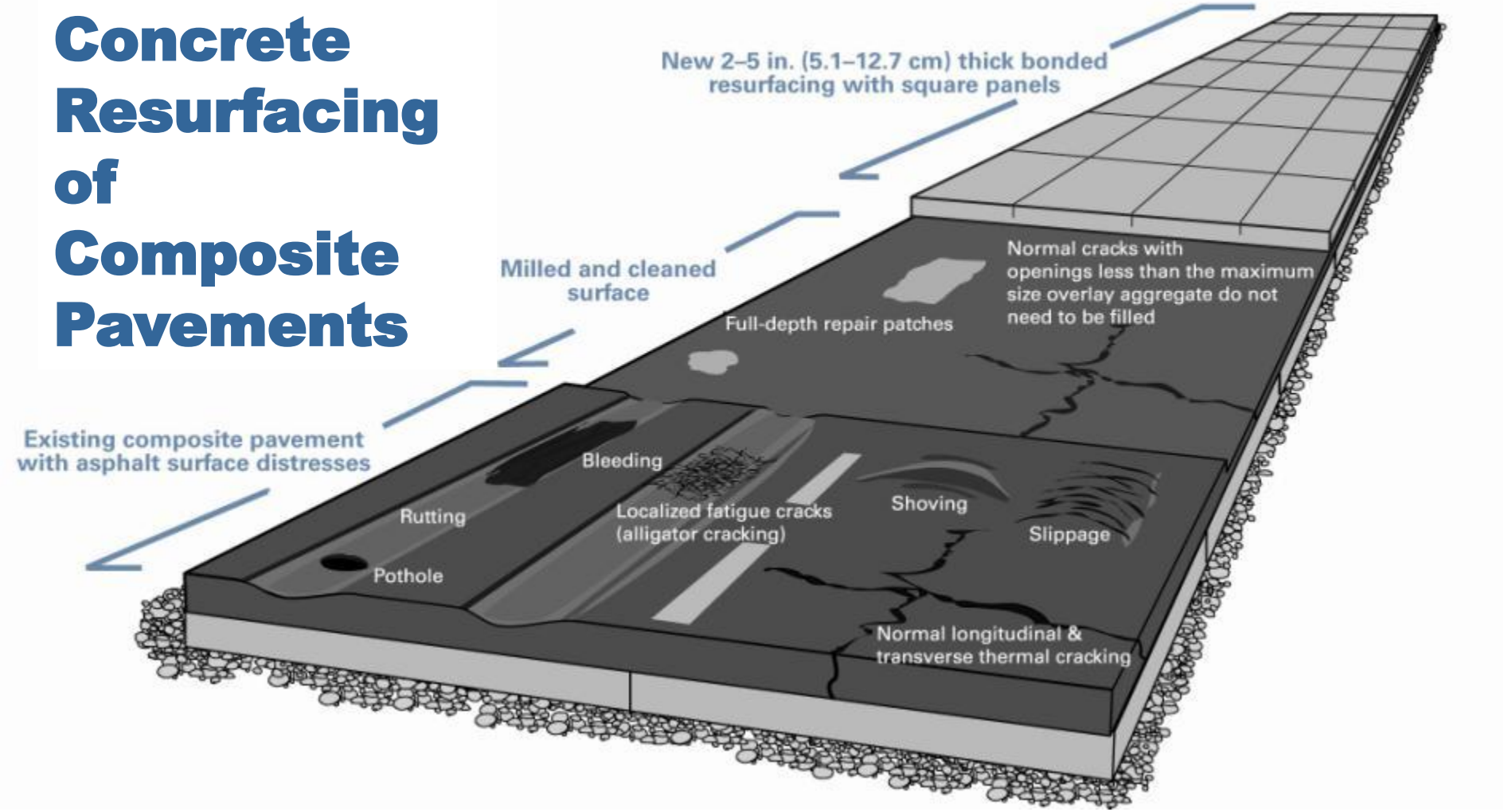
Bonded Concrete Overlay of Asphalt Pavements



- Spots of distress that aren't visible can be determined through evaluation such as the stiffness of the asphalt pavement and subgrade support conditions.

- Localized areas of weakness can be strengthen through patching. Milling can remove a number of asphalt surface distresses.

Bonded Concrete Resurfacing of Composite Pavements

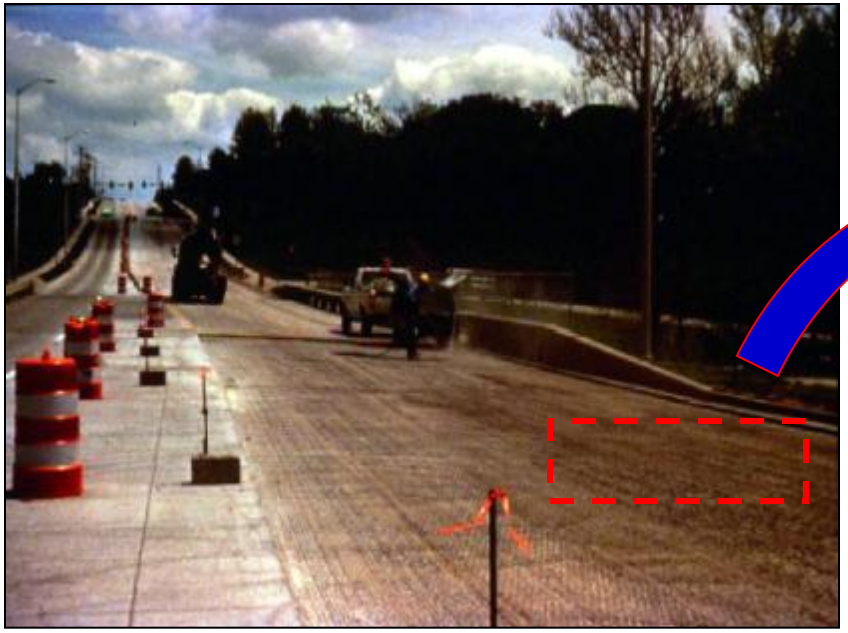


- A review of the existing profile grade line should be conducted and areas of significant deviation investigated through analysis of core samples in the laboratory.

Thickness Design

- 1993 AASHTO slab thickness design procedures do not account for bonding with HMA
- Interim procedures available that account for key design inputs
  - ACPA (BCOA)
  - M-E Guide
- Procedures provide guidance on suitable thickness and joint spacing combinations

Milled Surface



Over Milling Existing HMA

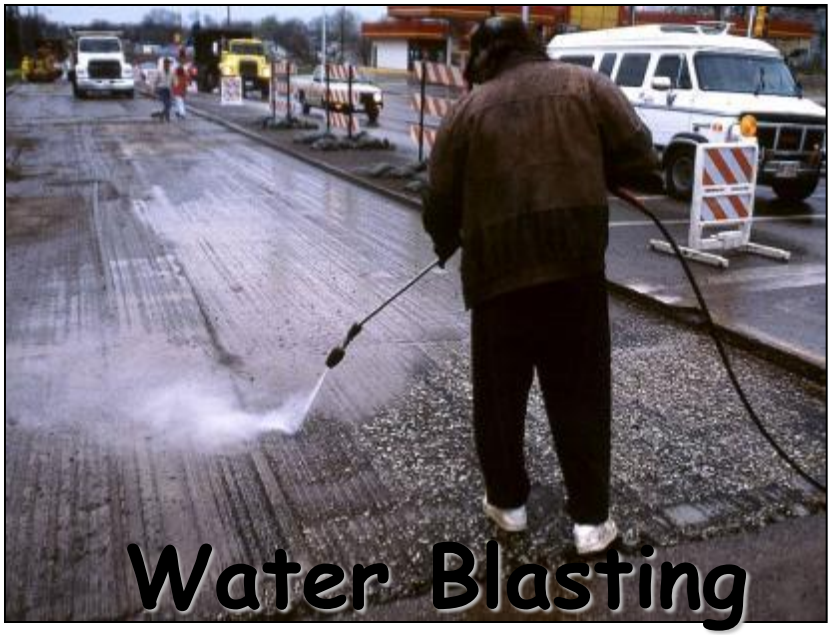
Removed 6 in of existing 9-in HMA Pavement

Remaining HMA severely damaged from trucks hauling away millings

Surface Cleaning

Power Sweeping

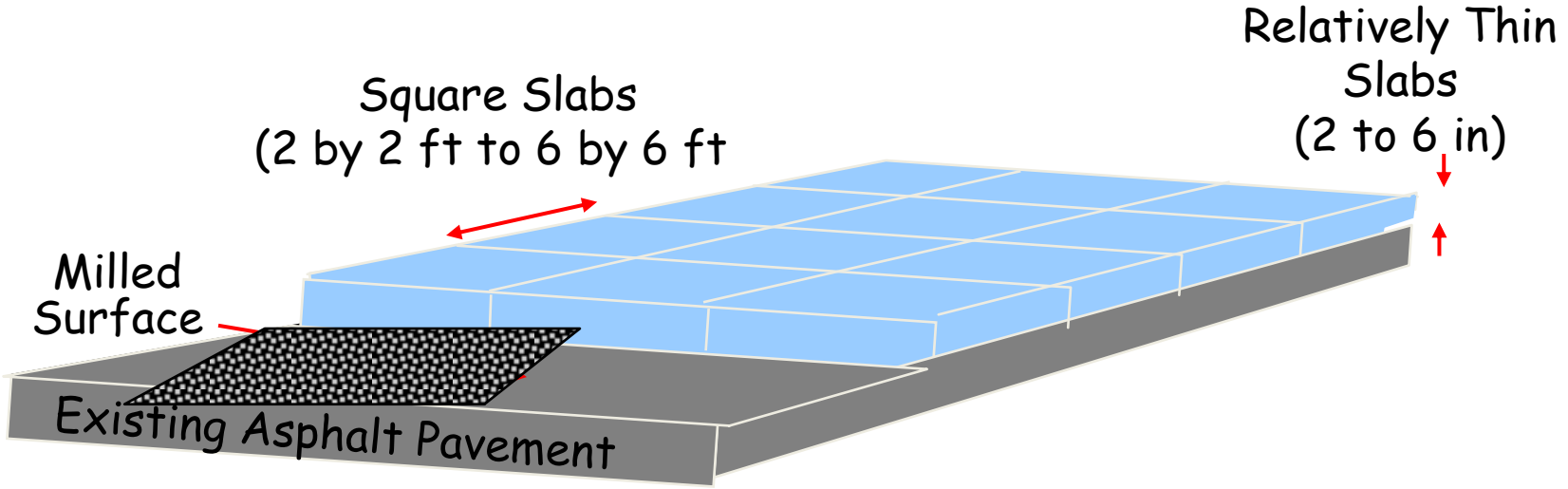
Air Blasting



Water Blasting

Thin Bonded Overlays

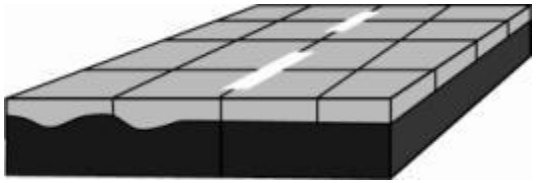
Limit 1.0 to 1.5 times thickness in feet.

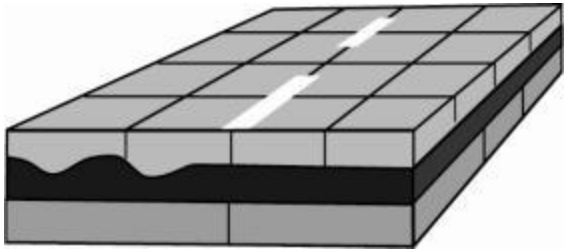


PCC Joint Sawing

Effective curing is critical
Timely joint sawing is critical

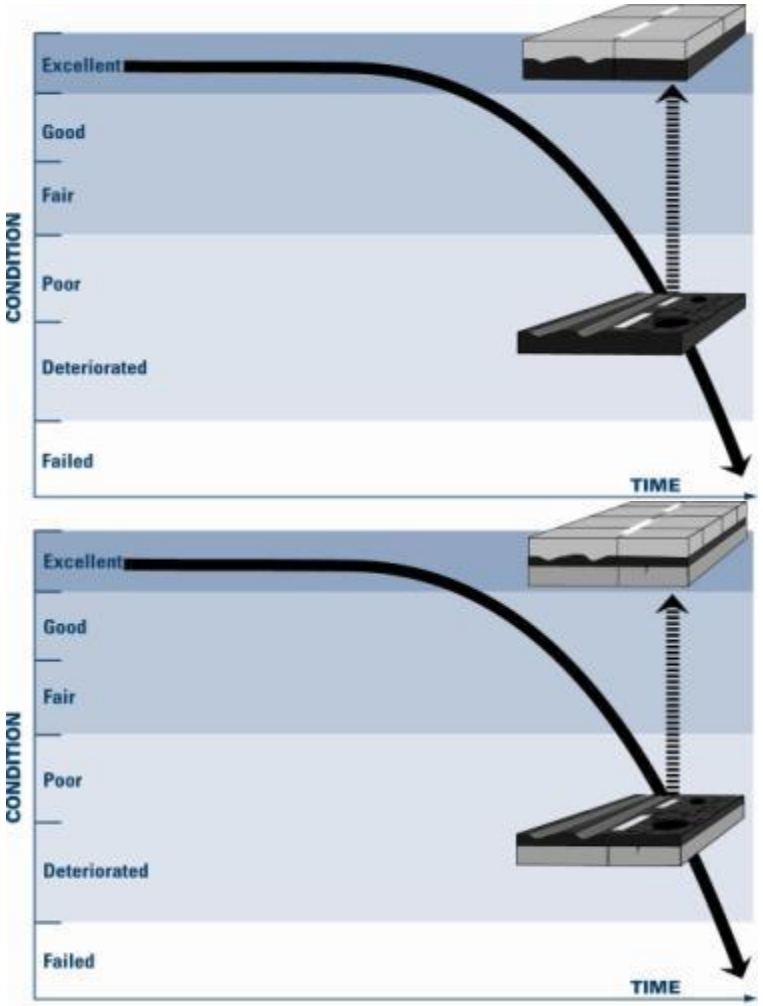
Bonded over Asphalt/Composite Keys to Success





- Bonding is critical
- Small square panels reduce curling, warping, & shear stresses in bond (1.5 times thickness).
- Mill if necessary to correct crown, remove surface distresses, improve bonding. Be sure to leave 3” of HMA after milling.
- HMA surface temperature below 120 F before paving.
- Transverse joints must be sawed T/3
- Joints in the overlay should not be placed in wheel paths, if possible
- Application of curing compound or curing methods must be timely and thorough

Uses and Advantages - Unbonded Concrete Overlay of Asphalt or Composite Pavements

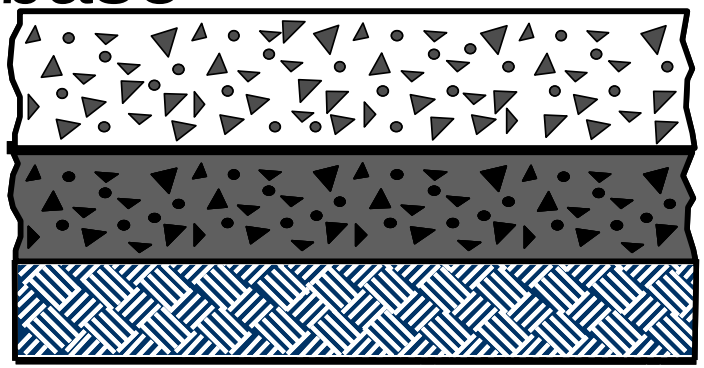


4” - 11” thickness

- Restores or enhance pavement structural capacity, resulting in improved friction, reliability, and noise reduction
- Eliminates deteriorated pavement condition
  - severe rutting,
  - potholes,
  - cracking,
  - shoving, and pumping
  - when composites indicate past D-cracking and ASR,
- Used when underlying pavements and subbase are stable and uniform except for isolated areas that can be repaired.

Unbonded Overlays of Existing Asphalt or Composite Pavement

- Slabs ≥ typically 5 in thick or greater
- Placed directly on AC pavement (little pre-overlay repair)
- Designed as a new concrete pavement over AC base

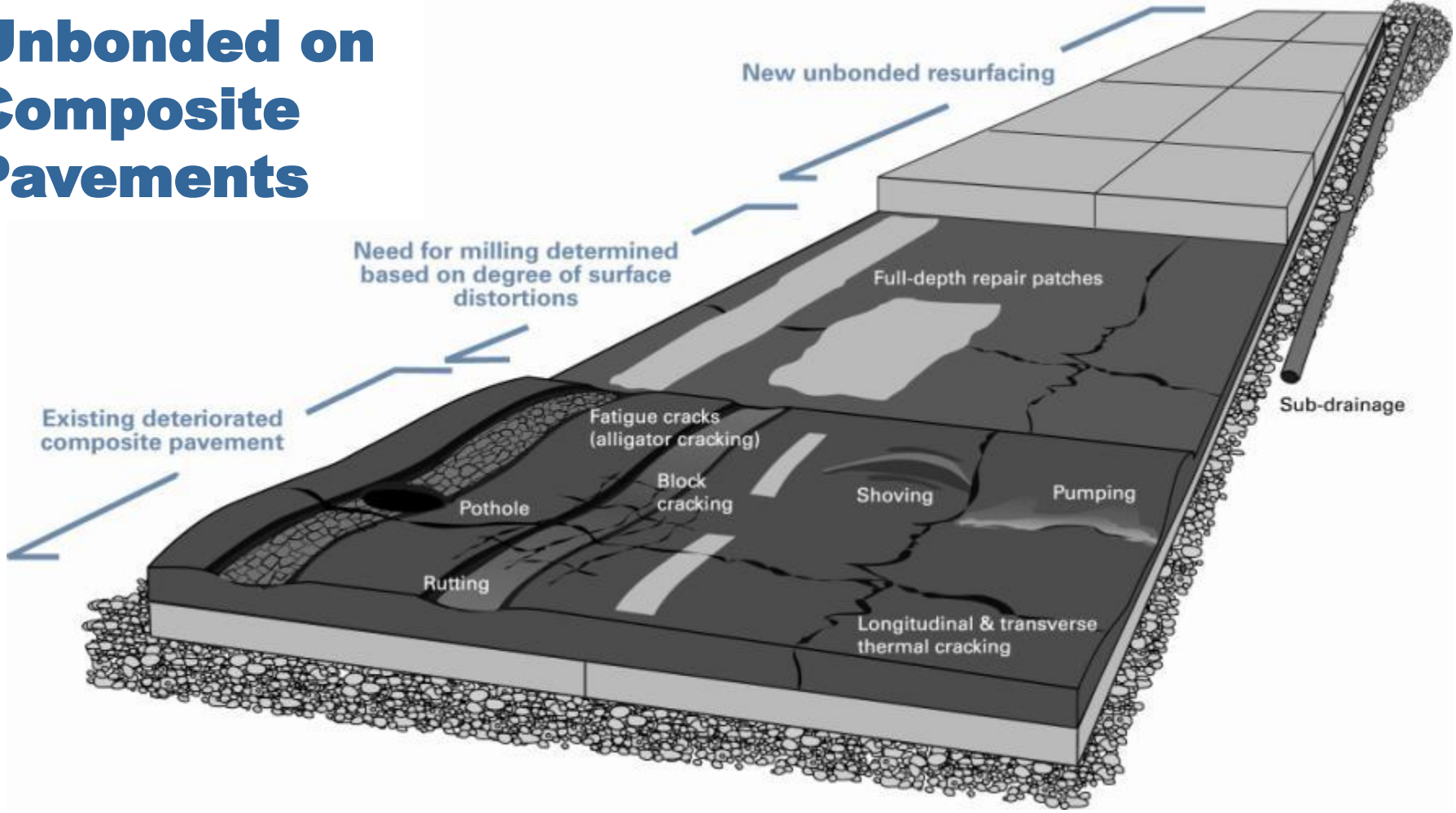


PCC Overlay

Existing HMA

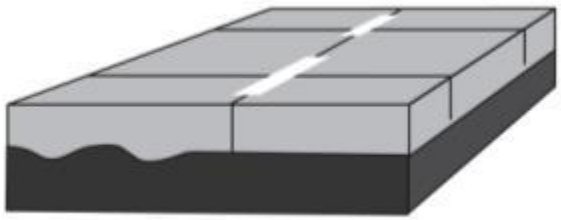
Existing concrete or Subbase

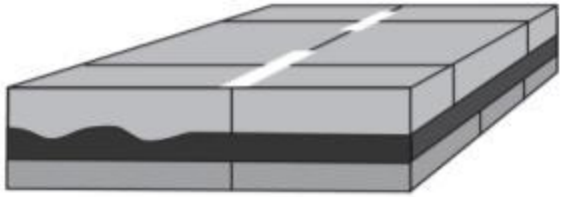
Unbonded on Composite Pavements



- Tented panels with significant movement can be repaired to relieve the pressure and provide uniform support before construction of an overlay.
- Faulted panels that do not exhibit continuing movement have proven to provide adequate support for concrete overlays.
- Edge drains have also been successfully used to reduce the progression of faulting.

Unbonded Over Asphalt/Composite Keys to Success





- Milling may be required to eliminate surface distortions of 2 in. (5.1 cm) or more
- Complete repairs at isolated spots where structural integrity needs restoring
- Concrete patches in the existing pavement should be separated from the overlay
  - with a thin layer of fabric or other bond breaker;
  - or joints should be sawed in the overlay around the concrete patch perimeter
- Surface temperature of existing asphalt pavement should be maintained below 120ºF (48.9ºC) when placing overlay
- Partial bonding between the overlay and the existing asphalt pavement is acceptable and may even improve load-carrying capacity

Overlay Mix Design

Air Void Parameter	Specimen #1			Specimen #2		
	Chords <0.5 mm	Chords <1.0 mm	All Chords	Chords <0.5 mm	Chords <1.0 mm	All Chords
Air Content (%)	3.16	3.89	5.10	1.71	2.36	3.41
Average Chord Length (mm)	0.098	0.117	0.151	0.083	0.109	0.154
Specific Surface (mm^{-1})	40.64	34.09	26.49	48.18	36.61	26.02
Spacing Factor (mm)	0.135	0.147	0.167	0.156	0.177	0.212

- Shilstone gradation was used on the project
- Used an aggregate blend of:
  - ¾” (large)
  - 3/8” (medium)
  - Sand (fine)

THANK YOU!

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