National Concrete Pavement Technology Center

Concrete Overlay Technology

TTCC/NC2 Meeting
Savannah, Georgia
April 6-8, 2010

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US 131 Unbonded Overlay

US 131 (4 lane north and southbound freeway) between Grand Rapids and Kalamazoo, Michigan.

Existing Pavement

- 5 mile long freeway design built in 1959
- JRCP 9 “ PCC with wire mesh
- 99 ft joint spacing’s
- 4’ inside and 10’ outside asphalt shoulders
- Foundation: 14” sand (day lighted to shoulder), 4” gravel subbase.
- Transverse cracks appeared at about 18 ft. intervals).

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US 131 Unbonded Overlay

Overlay:

- Unbonded overlay -1998 construction, no patching done.
- 7.5 “ concrete overlay with 1” asphalt interlayer (non porous surface mix)
- Pours- one 22’ pass and one 16’ ft. pass
- Traffic: 50,000 VPD with 10 to 15 % trucks.

Post Overlay:

- One patch in 2006
- 8 to 9 small patches in 2008

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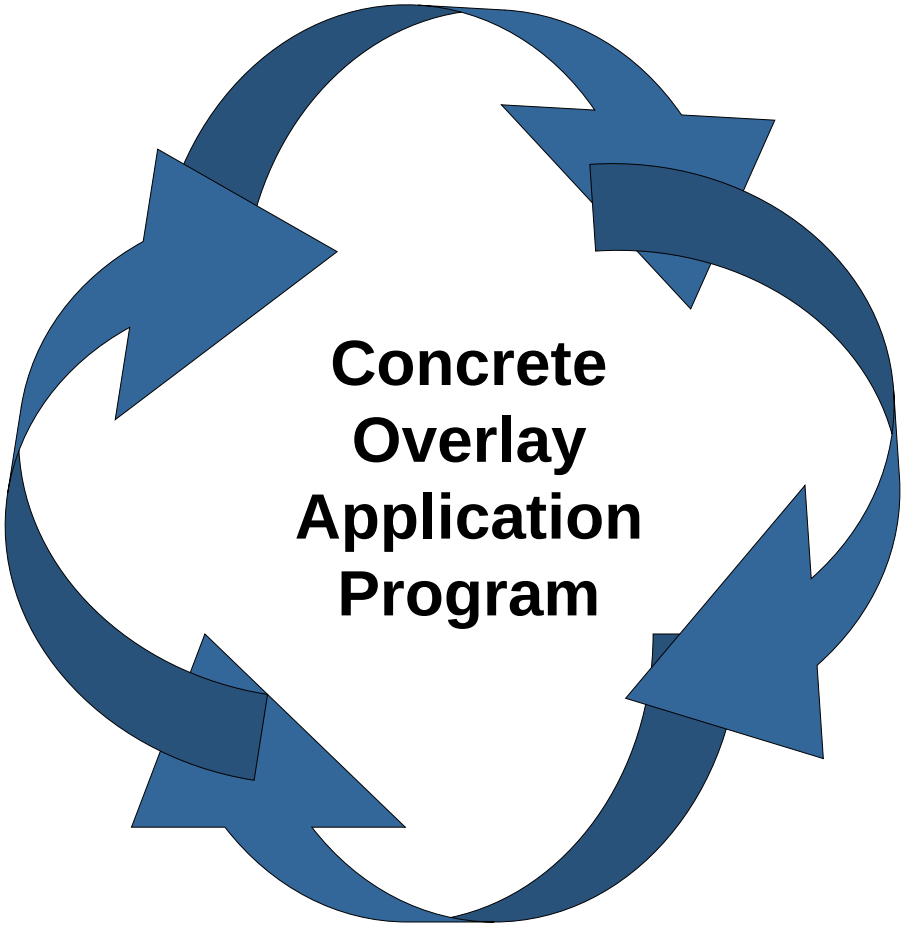
Shortcut (2) to CD Drive.lnk

Need to Move Concrete Overlays Forward

Overlay Guide (what do we know!)

Field Research (What we don't know & how to solve a problem)



Field Application Program (We can build it!)

Simpler Design Explanation of Current Programs

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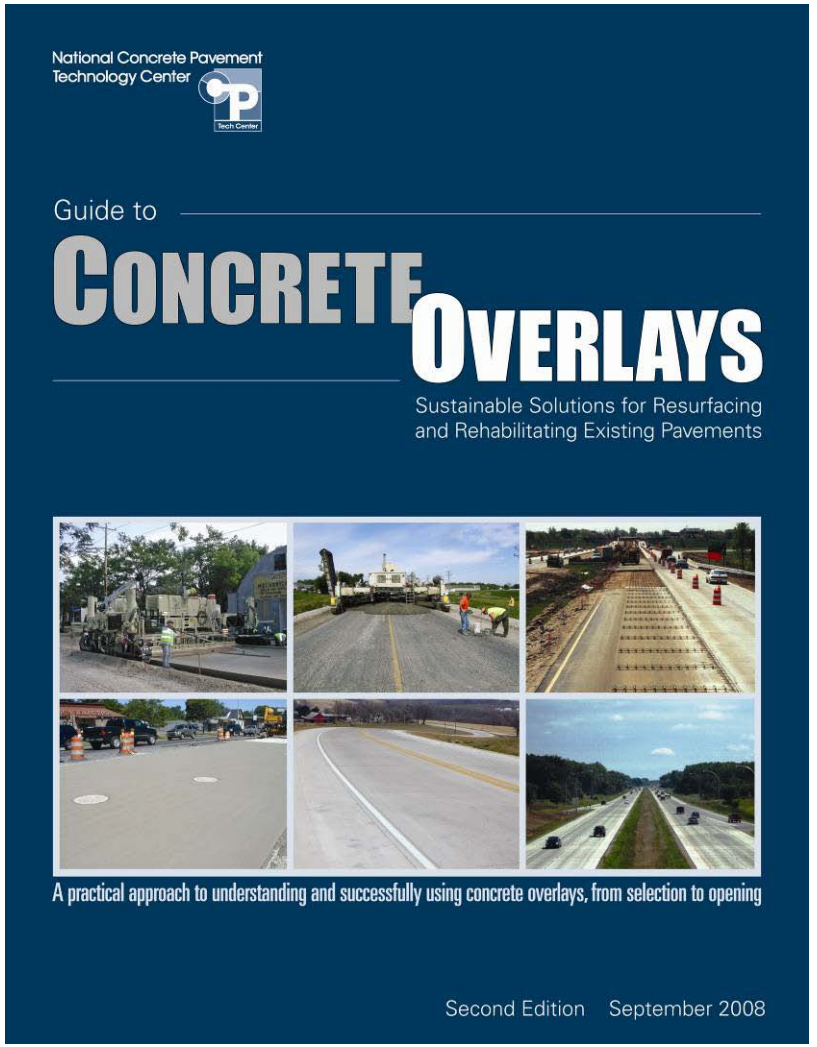
Concrete Overlay Guide second edition

Contents



Second Edition September 2008

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Concrete Overlay Field Application Program

The overall objective of the program is to increase the awareness, knowledge and strengthen confidence in concrete overlay applications among state DOTs, cities, counties, contractors, and engineering consultants

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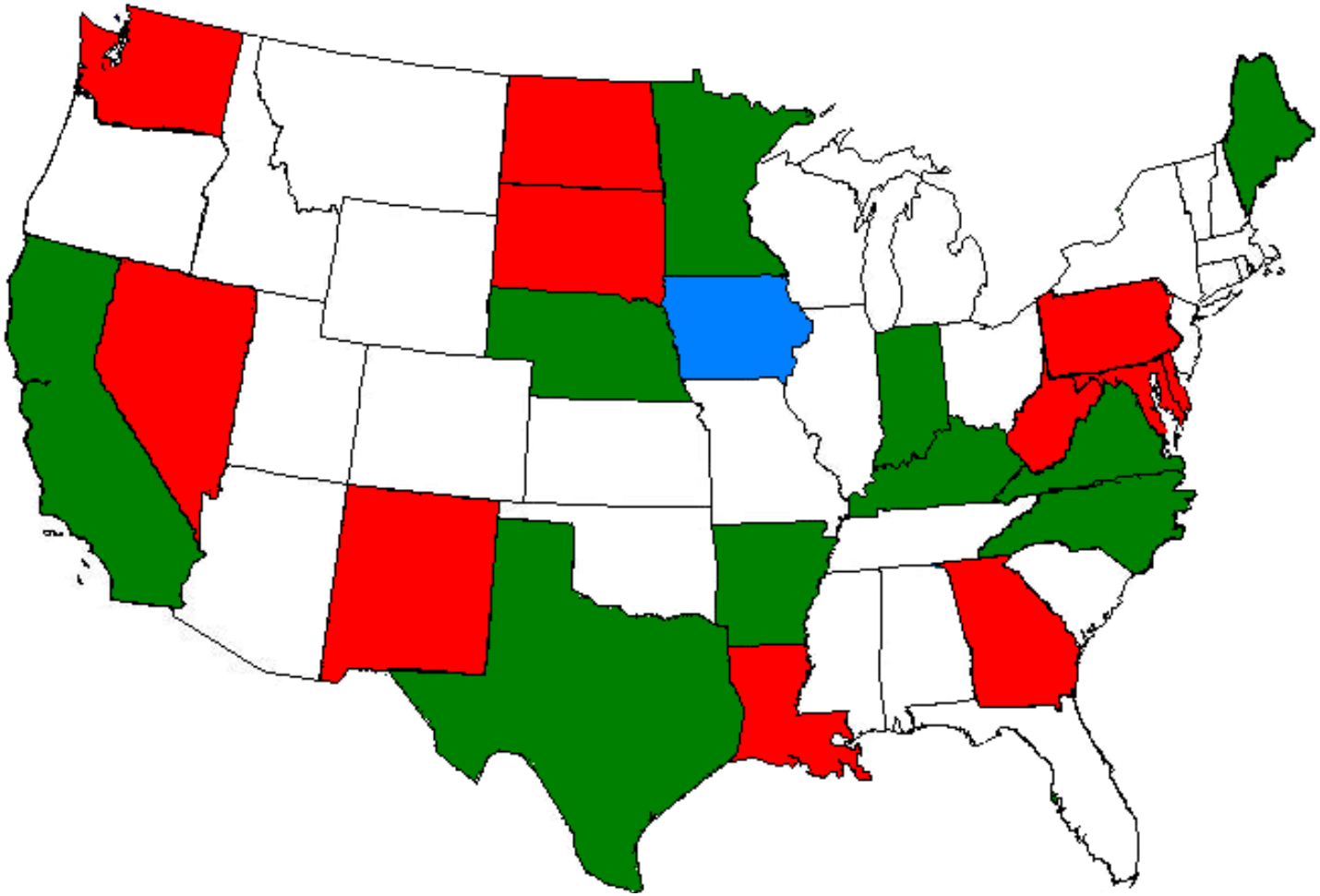
Concrete Overlay Field Application States



Joined the Program

1. Delaware
2. Georgia
3. Louisiana
4. Maryland
5. Nevada
6. New Mexico
7. North Dakota
8. Pennsylvania
9. South Dakota
10. Washington
11. West Virginia

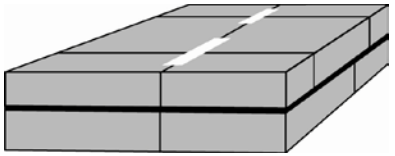
Interested States

1. Arkansas
2. California
3. Indiana
4. Kentucky
5. Maine
6. Minnesota
7. Nebraska
8. North Carolina
9. Texas
10. Virginia

6 States – 6” Bonded Overlays over HMA (6’x6’ joints)
4 States – 6” Unbonded Overlays over Concrete (6’x6’ joints)
1 State – 7” Bonded CRCP over Plain Jointed Concrete

Iowa – 2009-2010 Field Application Research Projects

Concrete Overlay Field Application Program



- Conduct initial field site review
- Walk through the evaluation process
- Walk through the design phase
- Attend pre-pour, pre-bid or pre-construction conference
- Attend during construction & may use mobile lab

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Concrete Material and Pavement Testing Mobile Laboratory

- With the concurrence of each State DOT, the CP Tech Center's Mobile Concrete Lab will be on-site during construction of the overlay demonstration projects
- Will perform comprehensive concrete testing (for each type of overlay) as well as offer technical support to the State DOT.

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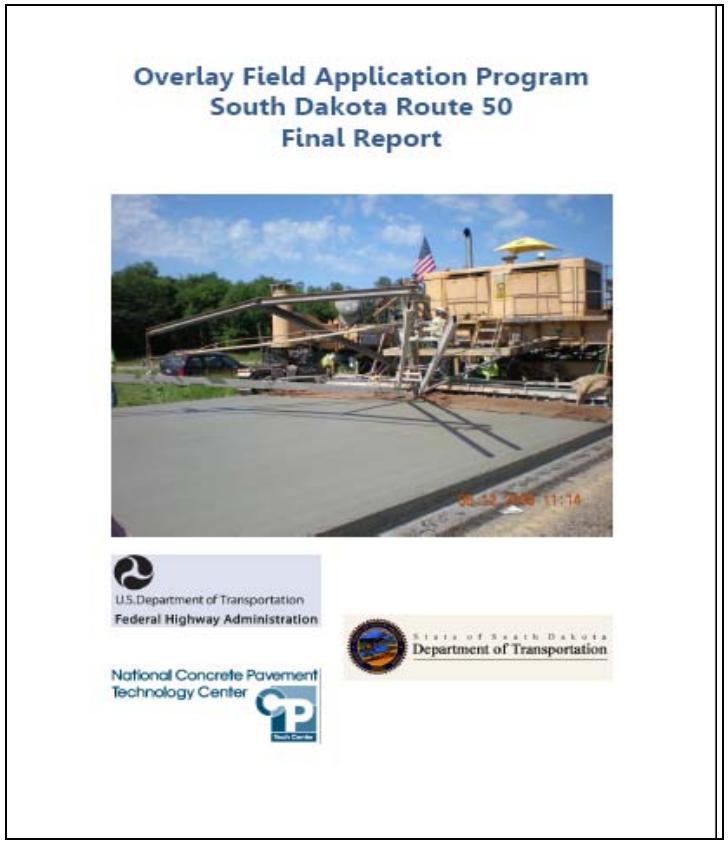
Project Reports

- For each state a project report will be developed that includes the mobile lab report
  - Site selection
  - Overlay type and design
  - Construction issues
  - Benefits and drawbacks
  - Recommendations
  - Lessons learned
- All State reports will be completed and also compiled into one report



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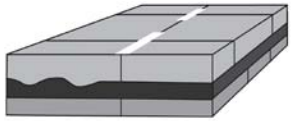
Technical Working Group (TWG) Meetings



- Exchange of lessons learned between participating State DOT's
- Held first TWG conference call May 18, 2009 with nine states participating; Next call April 29, 2010
  - Review uses & benefits
  - States share evaluation criteria and overlay selection process
  - States share their issues, solutions and lessons learned
  - Suggestions on update of Overlay Guide
  - Overall information sharing among states

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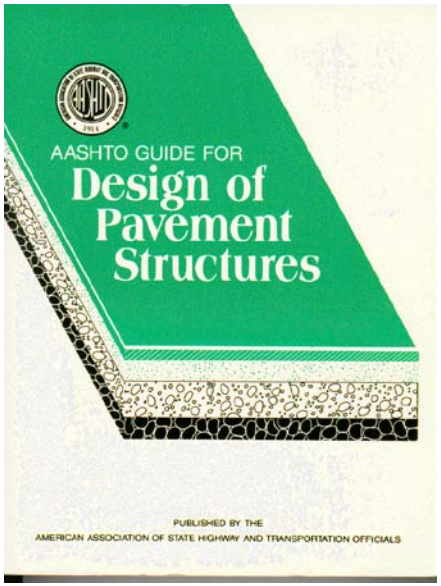
Guide for Existing Concrete Overlay Design Methodology

- Design programs are not always user friendly
- Programs take a significant amount of input
- What is needed is straightforward and simple guidance for concrete overlay design
- More specifically, guidance is needed in how to use the AASHTO and other design procedures that are most commonly used today
- With guidance, DOT's can rest assured that their concrete overlay designs are based on sound engineering fundamentals, and validated by field performance.



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Concrete Overlay Design Project

- Develop Guide for Existing Concrete Overlay Design Methodology in the next 12 months
  - ETG selected and held first meeting
  - Evaluate 4 to 5 software programs, choose one to two for each type of Overlays carry forward and develop a number of examples.
  - Guide will be 40± pages
  - Tech brief near completion summarizing software programs

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Iowa Highway Research Board / CP Tech Center/FHWA on Overlay Research

- There is a need to improve upon the construction techniques for the construction of overlays to improve concrete overlay durability
- Tested ways of project development, site preparation, construction methods and traffic control work for overlays
- To meet the public needs for mobility and access

CP Tech Center/FHWA on Overlay Research

The research elements are:

- Establish profile grades & machine control before or immediately after letting
- Determine ways to guide longitudinal joint forming operation to match the underlying joint alignment
- Determine the appropriate opening strength for depths of concrete of 6 inches or less
- Determine ways of handling traffic control for construction of single lane overlays as part of a two lane or multilane overlay
- Determine the best way to establish the level of need and timing of milling for existing asphalt surface preparation
- Minimizing pavement train width
- Use of innovative materials, such as geotextile layers, for use as bond separator layers

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Global positioning system (GPS) controls will likely be able to eliminate the need for a string line in the future

GPS Receiver

GPS Controller and Laser Height Gages

Laser Senor

High Resolution Laser

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Robotic Total Stations and Prisms

Leica Machine Control Command Center

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Matching Centerline Joints by Satellite

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Overlay Costs

National Concrete Consortium
TTCC
April 6, 2010
Savannah, Georgia

Gary Fick
Representing
The National Concrete Pavement Technology Center

Overlay Cost Tech Brief

- Developed to address common questions we have received during our implementation efforts

TECH BRIEF March 2010

Concrete Overlay Field Application Program
Concrete Overlay Cost Frequently Asked Questions

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National Concrete Pavement Technology Center

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Introduction

The need for engineered preservation and rehabilitation strategies for maintaining the nation's highway pavements has never been greater. To advance the use of concrete overlays as cost-effective solutions for a wide variety of pavement conditions, the Federal Highway Administration (FHWA) and the National Concrete Pavement Technology Center (CP Tech Center) are implementing the Concrete Overlay Field Application Program. The overall objective of this program is to increase awareness and knowledge and strengthen confidence in concrete overlay applications among state departments of transportation (DOTs), cities, counties, contractors, and engineering consultants.

Types of concrete overlays

Concrete overlays are categorized as either bonded or unbonded, depending on how the existing pavement is considered in the thickness design procedure (see Figure 1). Both types of concrete overlays take advantage of the equity investment in the existing pavement structure. Comprehensive guidance on the selection, design, and construction of concrete overlays is provided in the *Guide to Concrete Overlays, 2nd Edition*, which is available from the National CP Tech Center.

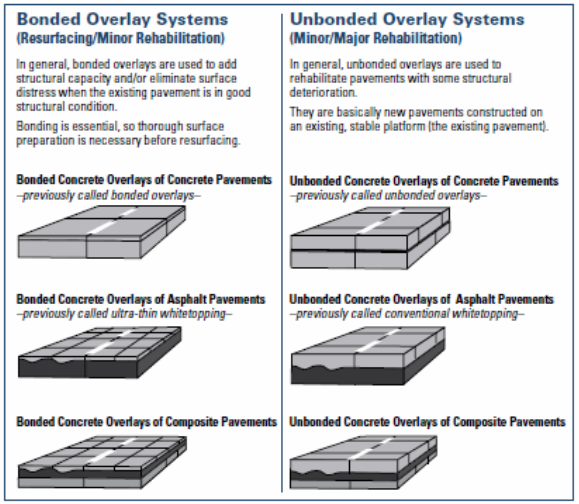
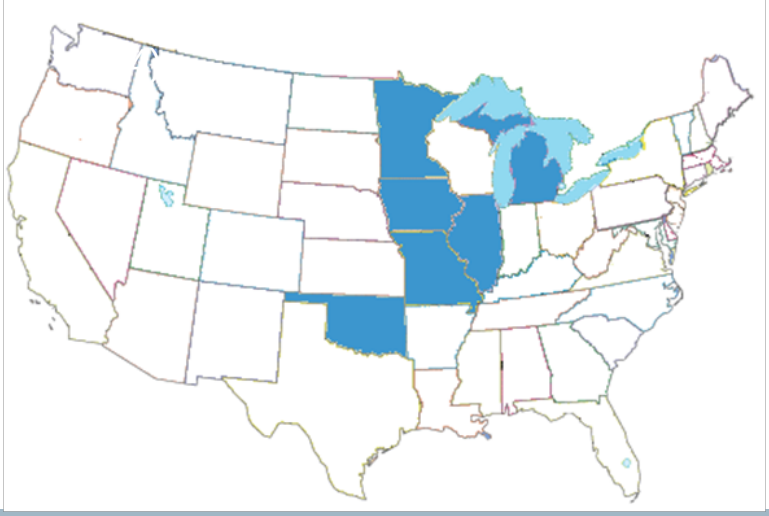


Figure 1. Type of concrete overlays (from Guide to Concrete Overlays, 2nd Edition)

Overlay Cost Tech Brief

- Cost information is derived from representative bid tabulations
  - 6 states
  - 33 projects
  - All types of overlays
  - Overlay costs are inclusive of furnishing concrete, placing the overlay and all costs associated with joints
  - Costs exclude: pre-overlay repairs and separation layer for unbonded overlays



Overlay Type	Range of Nominal Thickness (in.)	Range of Project Size (SY)	Number of Projects
Bonded	5 to 7	40,759 to 117,952	4
Unbonded	4 to 11	21,155 to 279,940	29

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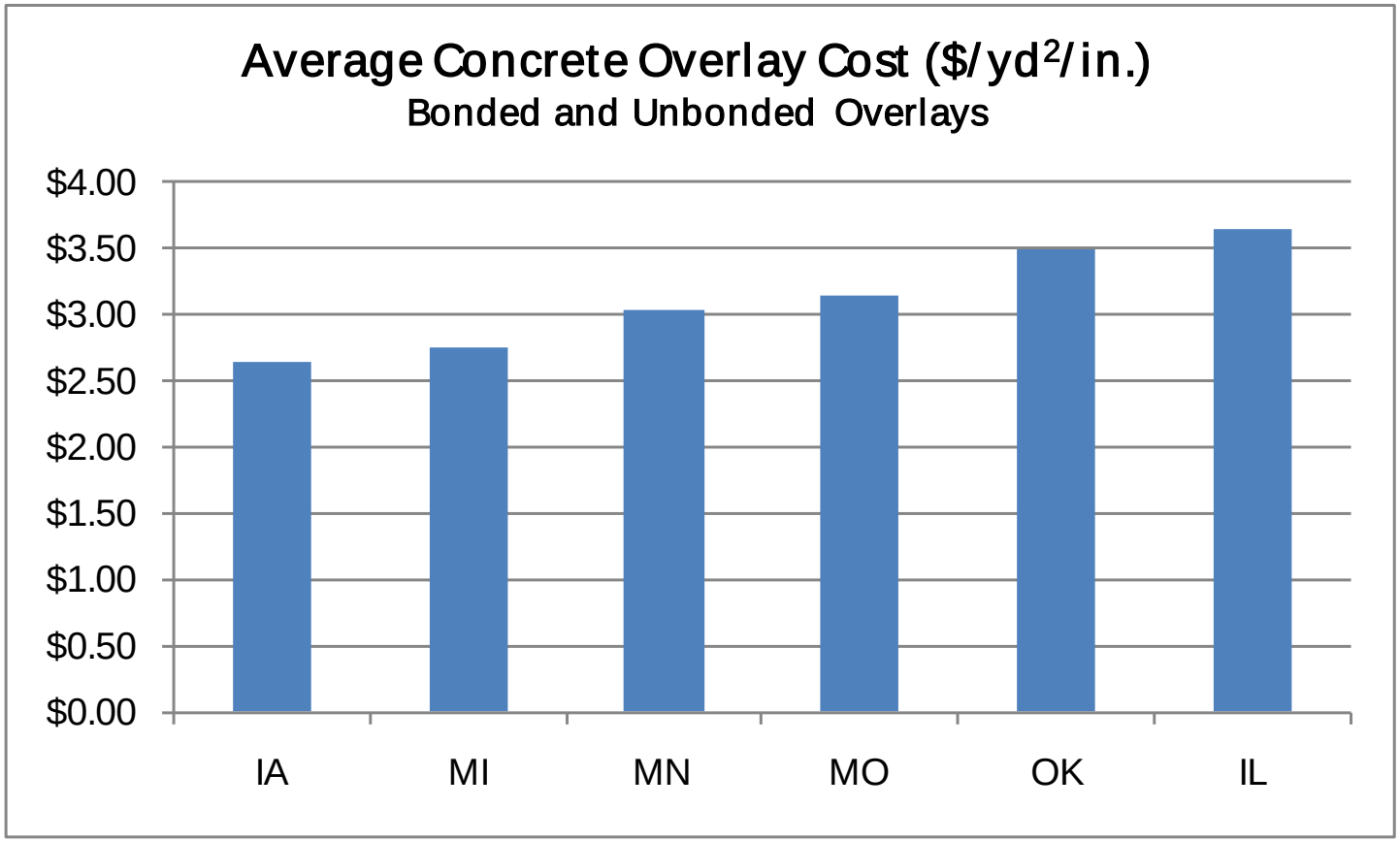
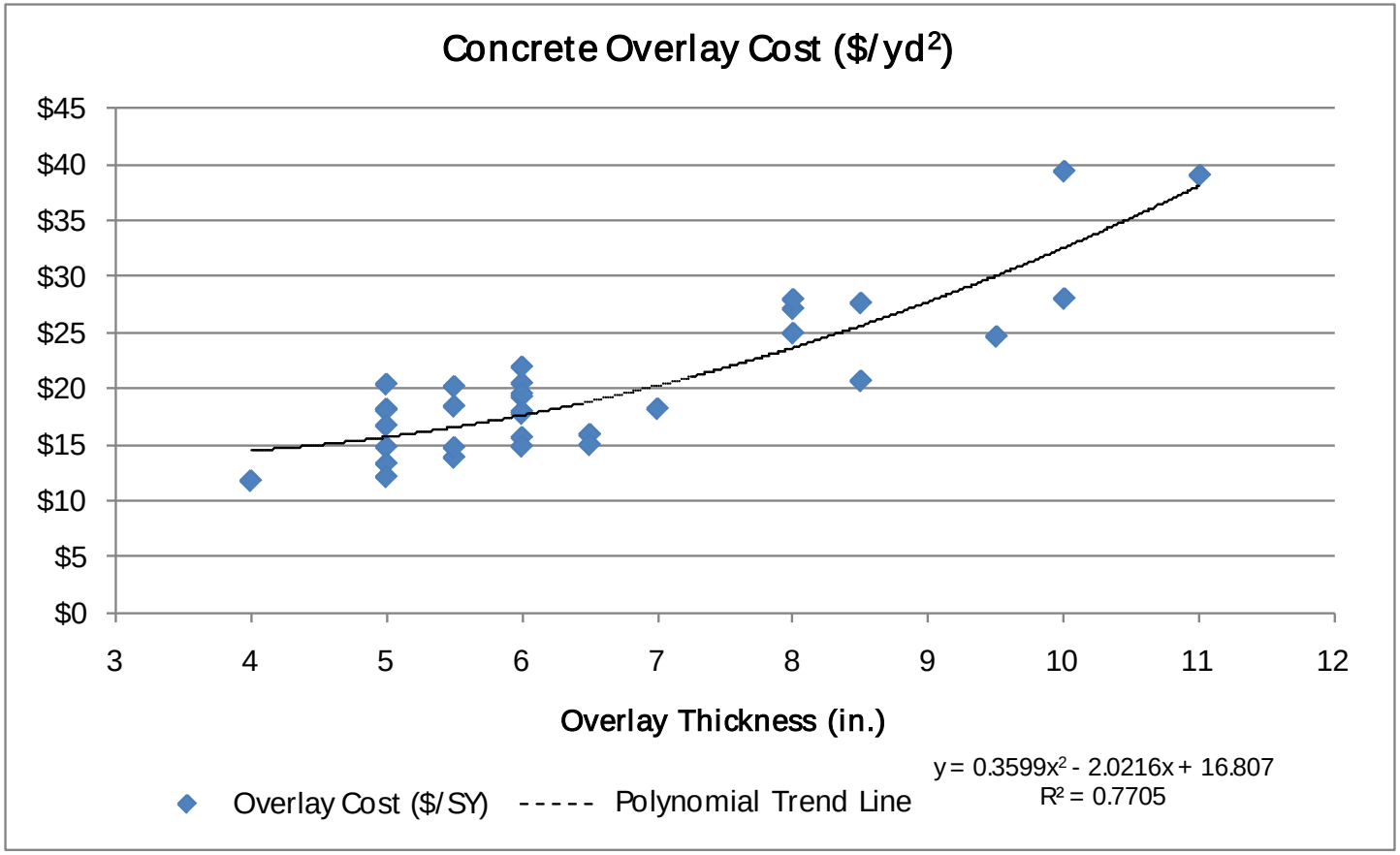
Overlay Cost Tech Brief

- **How much does a concrete overlay cost?**



Overlay Cost Tech Brief



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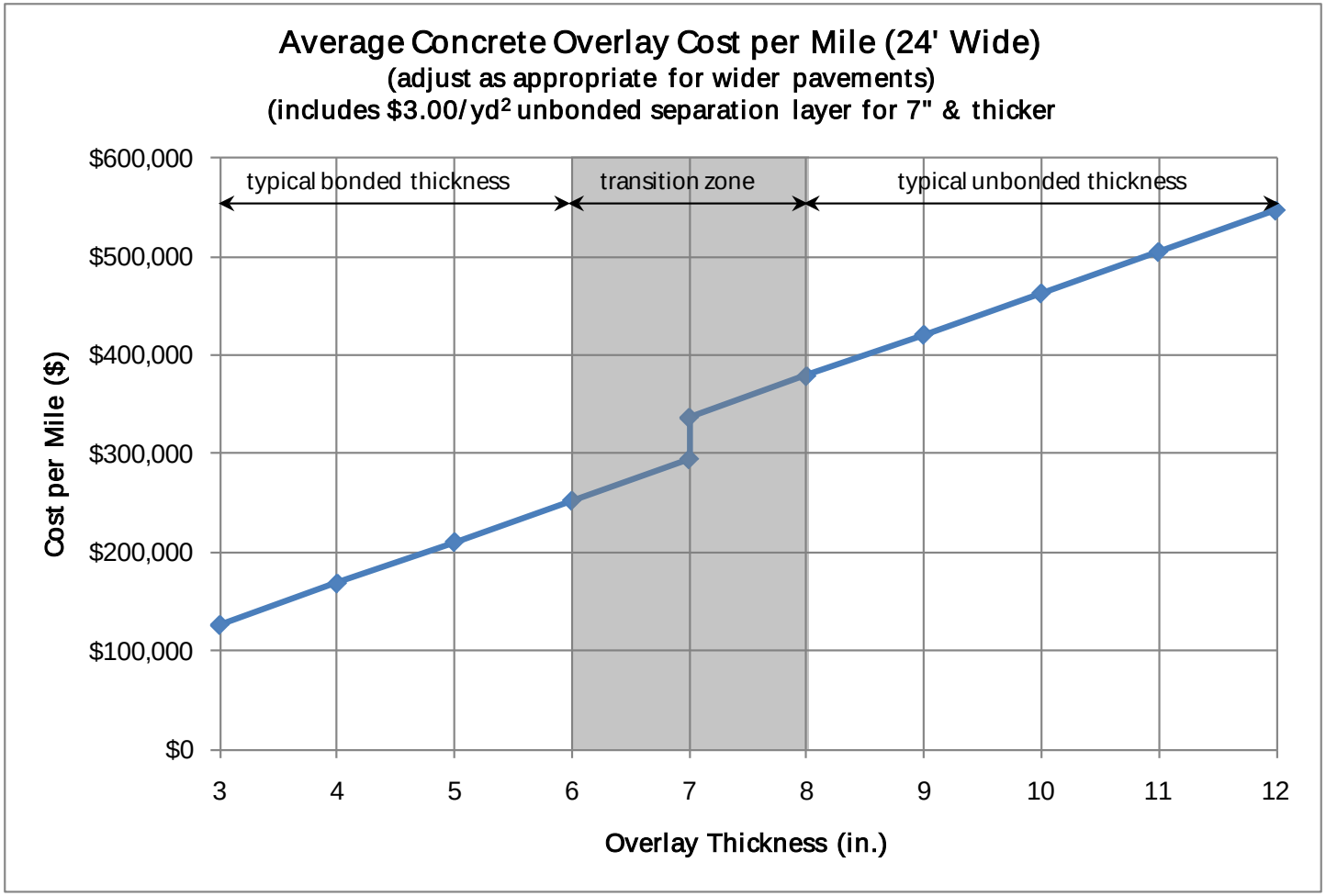
Overlay Cost Tech Brief



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Overlay Cost Tech Brief

- How does the cost of concrete overlays compare to the cost of asphalt?
  - Assume asphalt has an in-place density of 112 lb/yd^2/in
  - Convert the average concrete overlay cost to a per ton equivalent ⇨$54.54 per ton
  - As a comparison, IADOT's average price for an asphalt surface course during the same time frame was $57.32 per ton

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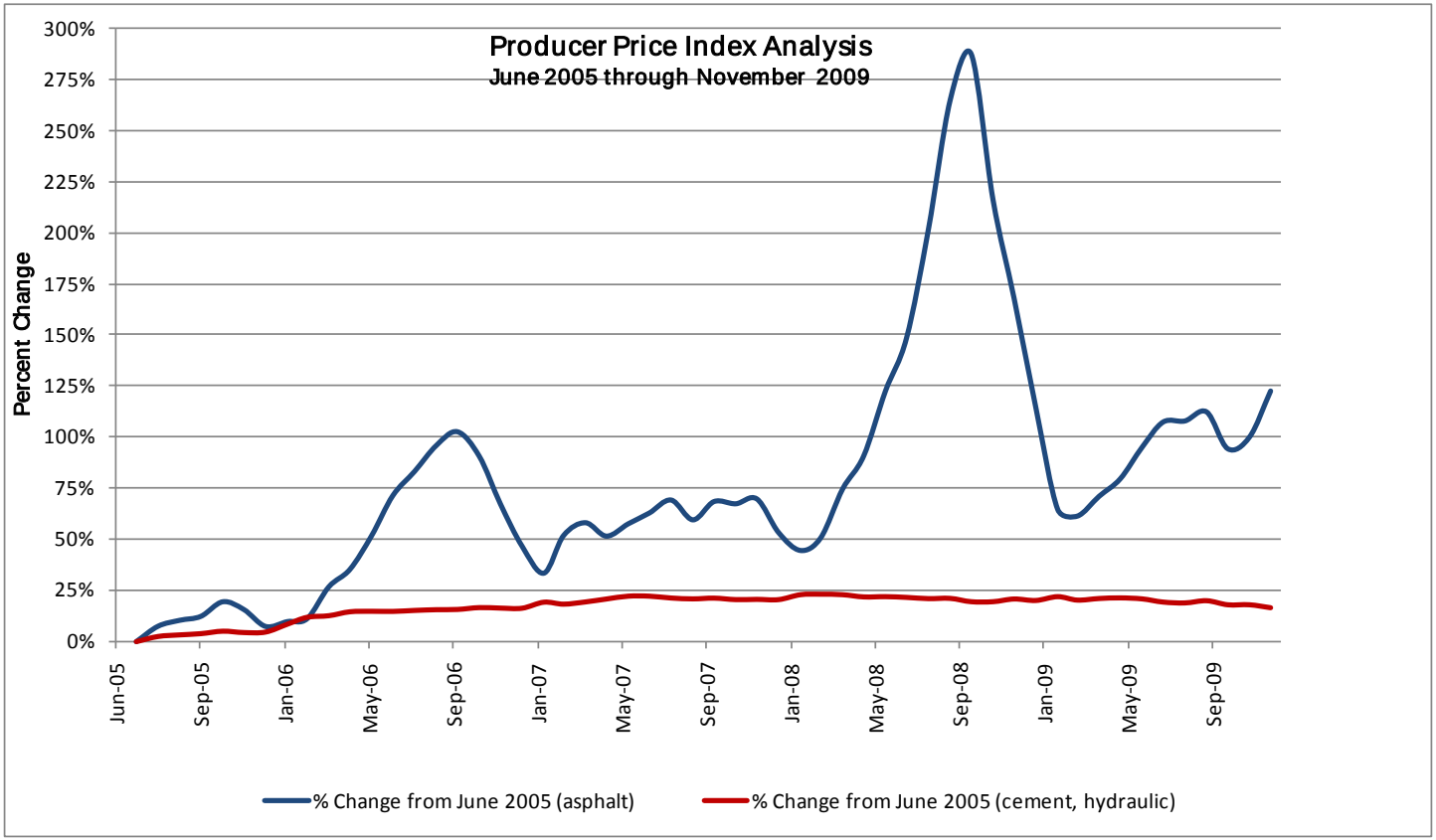
Overlay Cost Tech Brief

- **Have concrete prices increased at the same rate as asphalt prices?**



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Overlay Cost Tech Brief

- Introduction of overlay types
- Brief discussions of cost variables – materials, labor handwork, etc.
- Explanation of measurement and payment by square yard **and** cubic yard

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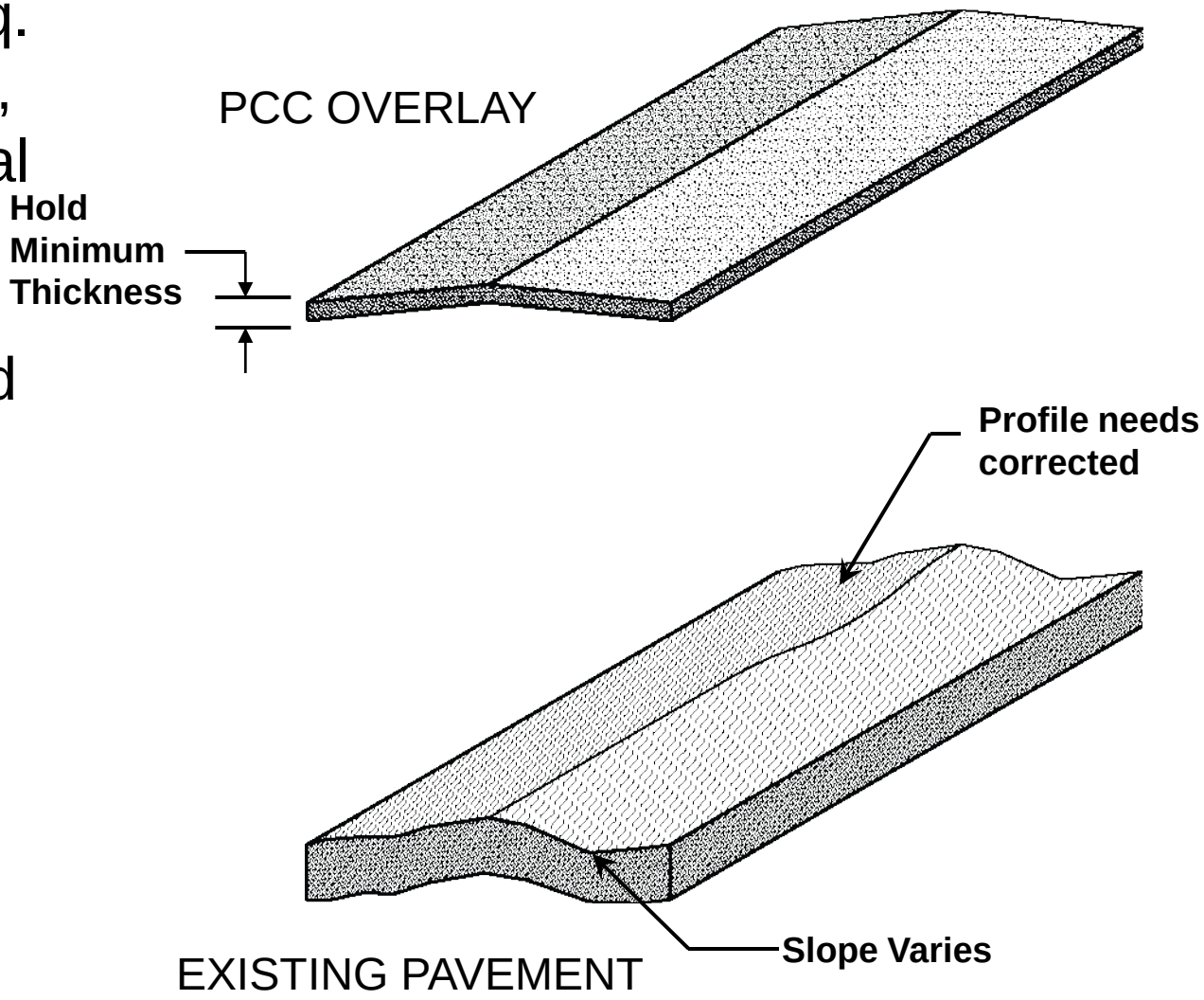
Concrete Overlay Quantities -REALITY SITUATION-

- Concrete is bid in sq. yards for placement, cu. yards for material
- Profile is not perfect and needs corrected
- Cross slope needs correction



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Quantity Estimates

- Estimating plan quantity
  - Overlay cubic yard pay item is to adjust the theoretical volume by an appropriate factor that accounts for the non-uniformity of the existing surface

Concrete Overlay Thickness	½" Placement Tolerance as a % of Design Thickness	Additional % Adjustment for Gross Surface Irregularities in the Existing Surface	Total Adjustment Factor to be Applied to Theoretical Volume
4"	12.5%	5%	17.5%
6"	8.3%	5%	13.3%
8"	6.3%	5%	11.3%
10"	5.0%	5%	10.0%
12"	4.2%	5%	9.2%

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Cross Section or Grade Corrections with Interlayer

- Tendency to utilize the asphalt separation layer as the medium for correcting cross slope & profile
  - Results in variable asphalt thickness and can lead to very thin asphalt sections (less than 1”)
  - When compacted creates variable roll down
  - The result being a non-uniform surface which still must be corrected
- Most effective way to make corrections is by utilizing a nominal thickness of asphalt (typically 1”) as a separation layer
- Make cross-slope and smoothness adjustments in the concrete overlay

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Cross Section or Grade Correction by Milling

- Milling should be minimized to reducing structural support of the milled pavement.
- Purpose of Milling:
  - Remove distortions 2” or more
  - Reduce significant high spots
  - Increase bond of overlay
  - Meet vertical elevation requirements
- It is preferable to mill to a depth that will minimize the potential for delamination between lifts
- Grade corrections should be made in the thickness of the concrete overlay

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Minnesota Department of Transportation (MnDOT) Pay Method

- Set an initial plan quantity based on the theoretical cubic yards
- This quantity is used only for the purposes of bidding and awarding the contract
- After the separation layer has been placed or any milling has been performed, a physical survey is performed
- For a 24’ wide crowned pavement section, lines of survey are taken at the crown point and both edges at 25’ or 50’ centers
- Using this survey information along with the proposed profile grade and design cross-slope(s), a revised cubic yard plan quantity is calculated
- Payment for cubic yards of concrete is then capped by specification at 102% of this revised plan quantity

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Engineering Survey

- Construction Survey
  1. Establish horizontal alignment control from the existing pavement edge, centerline, median drainage structures.
  2. Set two control stringlines at a uniform height (typically 2').
  3. Measure down to the surface of the existing pavement at multiple points to identify high points in the existing pavement.
  4. Adjust the two control stringlines so that the identified high point in the exiting pavement measures a uniform height (typically 2').
  5. Adjust the two control stringlines for smoothness between the high points by eyeballing. Periodically double check with a transverse string.

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Bonded Concrete Overlays of Asphalt Pavements

—previously called ultra-thin whitetopping—

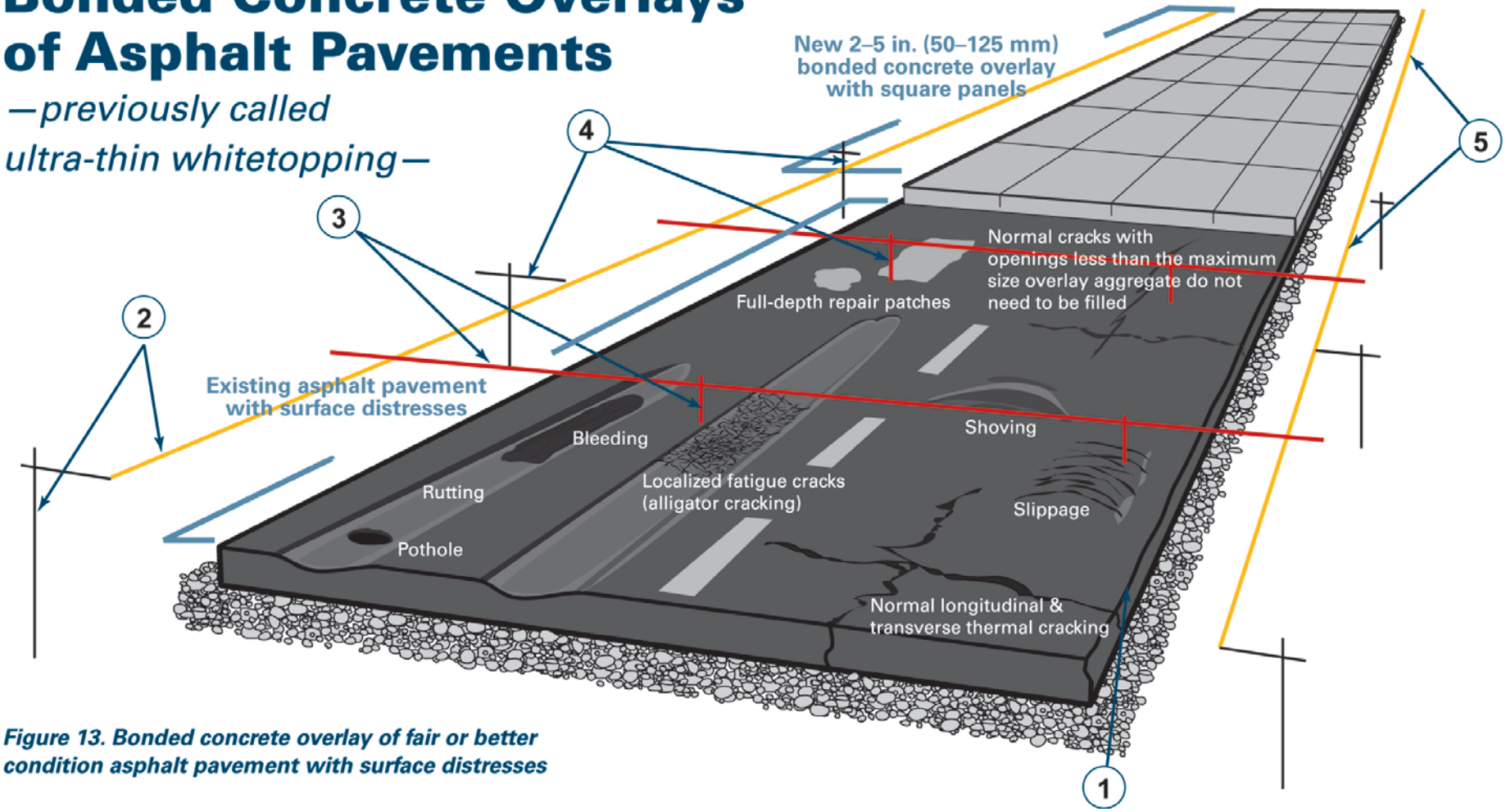

Figure 13. Bonded concrete overlay of fair or better condition asphalt pavement with surface distresses

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Overlay Cost Tech Brief

Questions?

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