



Concrete Overlay Solutions Workshop

Module 1 – Welcome and Introductions



Image source: FHWA

Workshop Goals

The overall goal of this workshop is to provide practical technical instructions for the planning, design, and construction of concrete overlays.

Answer your questions about concrete overlays

Provide starting point to develop competitive alternatives for your RSRF 30 rehabilitation program

Host/Presenters



Jerod Gross

Snyder & Associates, Inc.

jgross@snyder-associates.com

515-669-7644



Jerry Voigt

Square One Pavement Consulting

gvoigt63@gmail.com

847-867-3943

Host/Presenters

- Tirupan Mandal, WisDOT

Tirupan.mandal@dot.wi.gov

(608) 246-5320

- Kevin McMullen, Wisconsin Concrete Pavement Association

kmcmullen@wisconcrete.org

(608) 240-1020

CP Tech Center

- Missions:
 - Advance innovative concrete pavement technologies
 - Lead implementation of best practices
 - Educate the concrete pavement community
 - Find solutions to strategic problems
 - Provide independent technical expertise



National Concrete Pavement
Technology Center

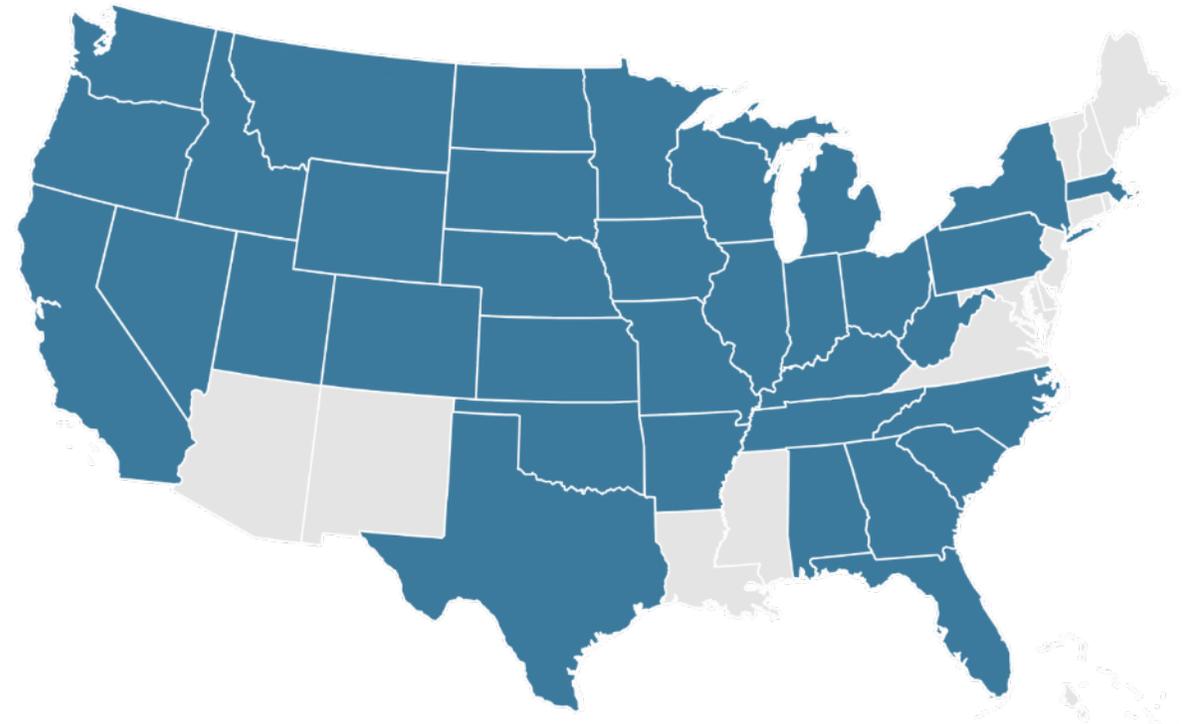


www.cptechcenter.org

TTCC – National Concrete Consortium

- National forum for concrete pavement research and technology transfer initiatives
- Consists of 35 state DOTs & the Illinois Tollway
- The CP Tech Center helps organize training workshops for participating agencies through the pooled fund

TTCC Pooled Fund States



Wisconsin Workshop Agenda - Morning

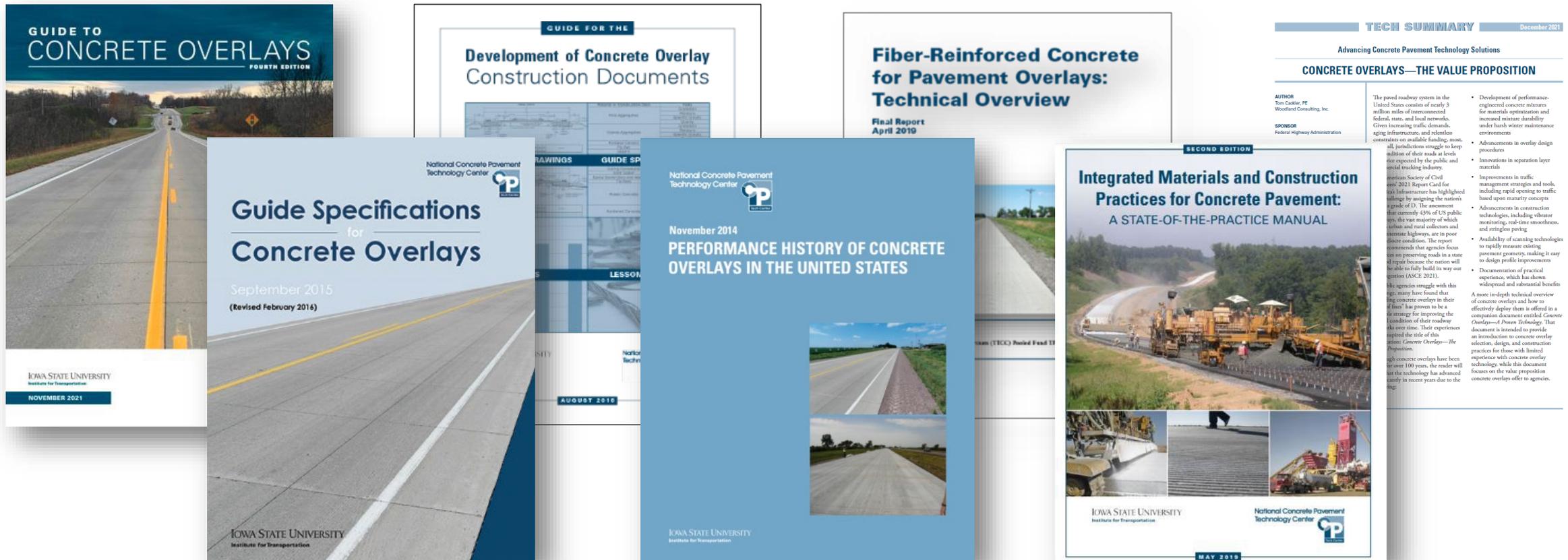
| Schedule | Topic |
|-------------|--|
| 8:00 | Sign-in and Networking |
| 8:30 | Welcome and Introductions |
| 8:50 | History & Perspective on WI Concrete Overlays |
| 9:15 | Benefit and Cost Considerations |
| 9:45 | Overlay Types & How to Select Them |
| 10:30 | BREAK |
| 10:45 | Special Considerations for Concrete Materials, Interlayer, Jointing & Plan Details |
| 12:00-12:45 | LUNCH |

Wisconsin Workshop Agenda - Afternoon

| Schedule | Topic |
|----------|--|
| 12:45 | Successful Construction Practices and MOT Strategies |
| 1:45 | BREAK |
| 2:00 | Thickness Design Case Studies (Computer Demo & Discussion) |
| 4:00 | How to Integrate This Solution into WisDOT Practice |
| 4:30 | Final Open Discussion |
| 5:00 | ADJOURN |

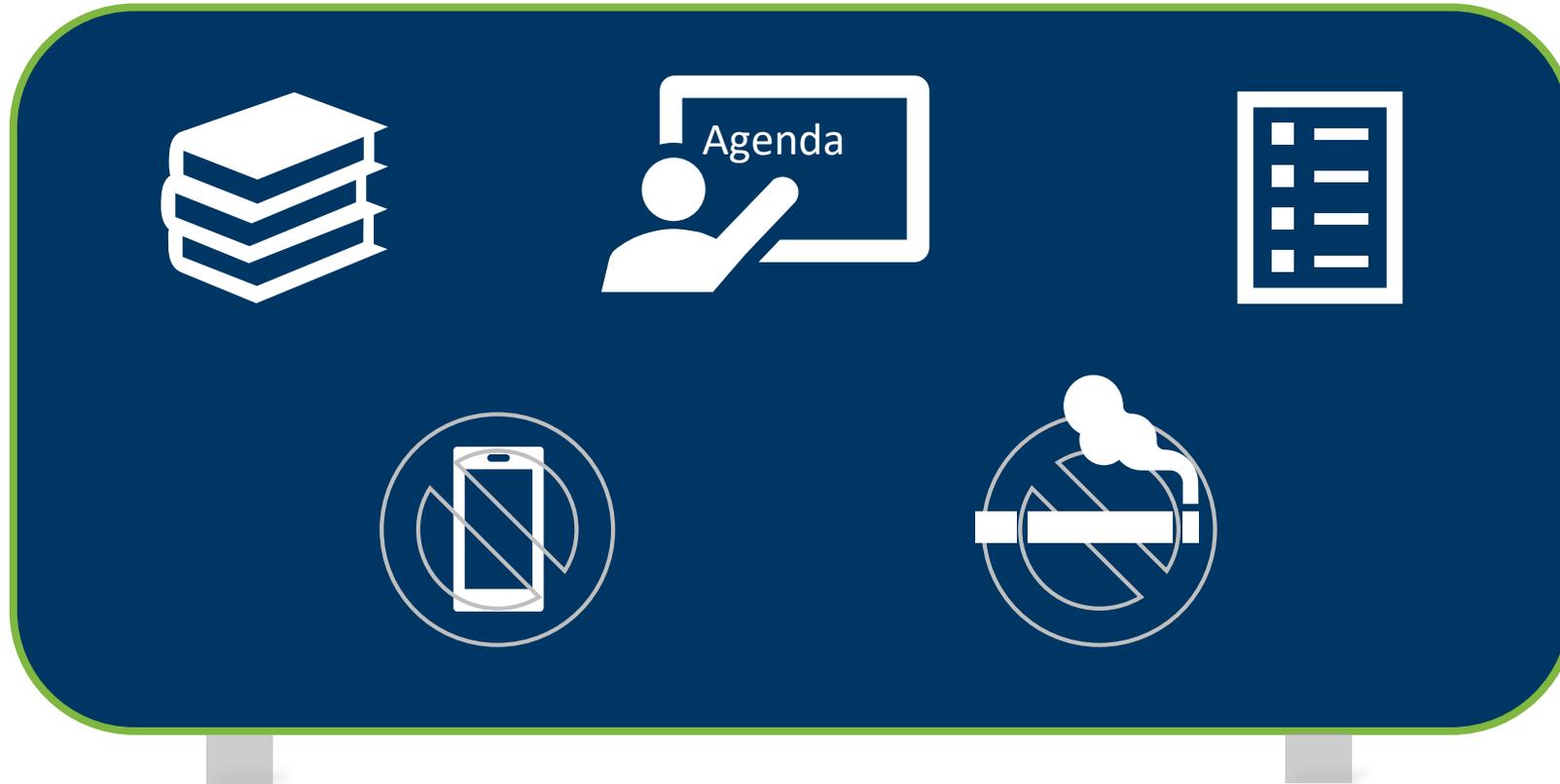
Please Ask Questions Along the Way...Our Goal is That You Leave Here With Answers!

Technical Resources Available to You!



Use the QR Codes you'll see later to retrieve all of these from the web

Housekeeping and Communication



Getting to Know You

To Help Our Instructors Know You Better Please Help Describe...



What disciplines/offices of WisDOT or other organizations are represented here today?



What are you hoping to learn from this workshop?



Concrete Overlay Solutions Workshop

Module 2 – Benefit and Cost
Considerations



Overview

- The Pavement System Challenge
- The Concrete Overlay Value Proposition

The Challenge to Pavement Owners

- Deterioration of the Existing Pavement
 - Environment
 - Traffic
- Increasing Demands
 - Traffic
 - Ride quality
 - Continuous access
- Decreasing Funding
 - Possible imbalance between maintenance costs and agency revenue

Addressing Existing Pavements

- Reconstruction: remove and replace the existing pavement

Benefits

Longer life

Limitations

Challenging disposal management

Slow process causes traffic delays

Lose equity of existing system

Higher construction costs



Addressing Existing Pavements

- Repair: patch the existing pavement

Benefits

- Limited use of material
- Limited energy usage
- Low traffic impact
- Lower construction costs

Limitations

- Shorter life



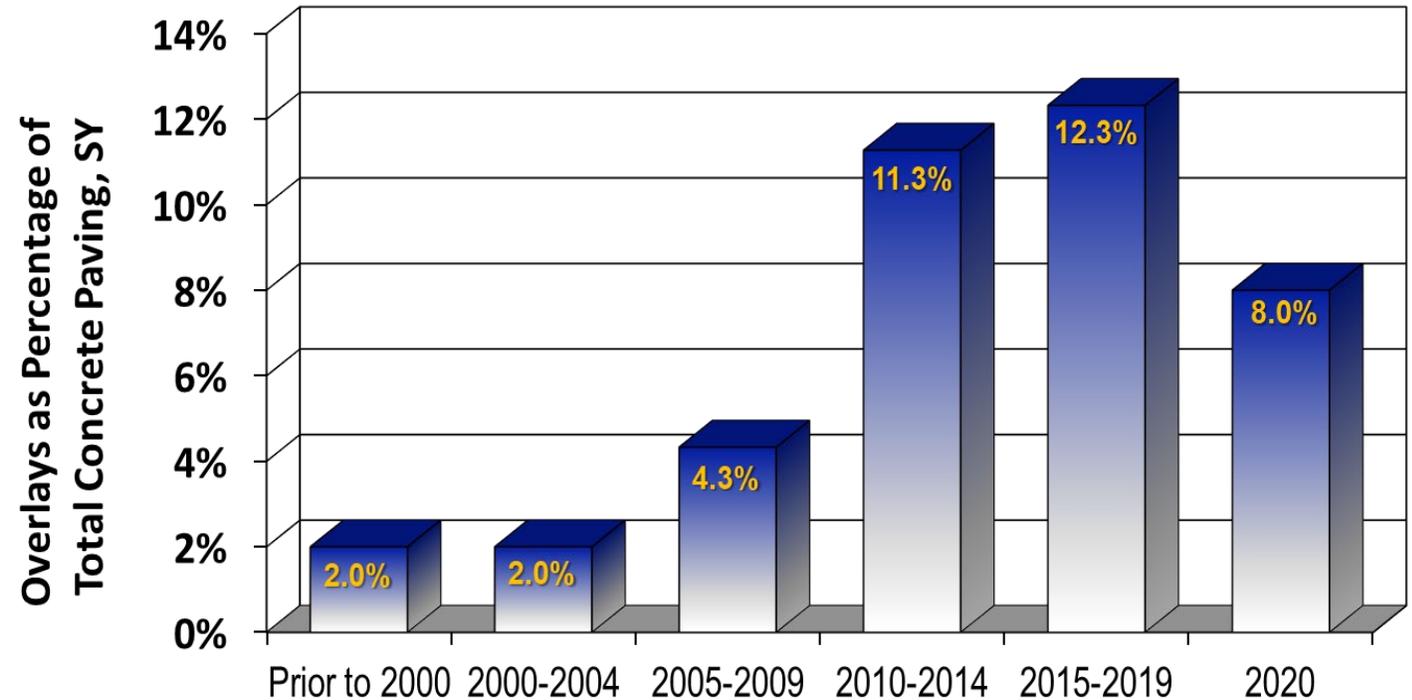
An Alternate Solution

- Concrete Overlays: Concrete placed over an existing surface
 - Extends pavement life
 - Restores ride quality
 - Increases safety and capacity
 - Long-term (life cycle) cost-effective solution



Concrete Overlay Value Proposition

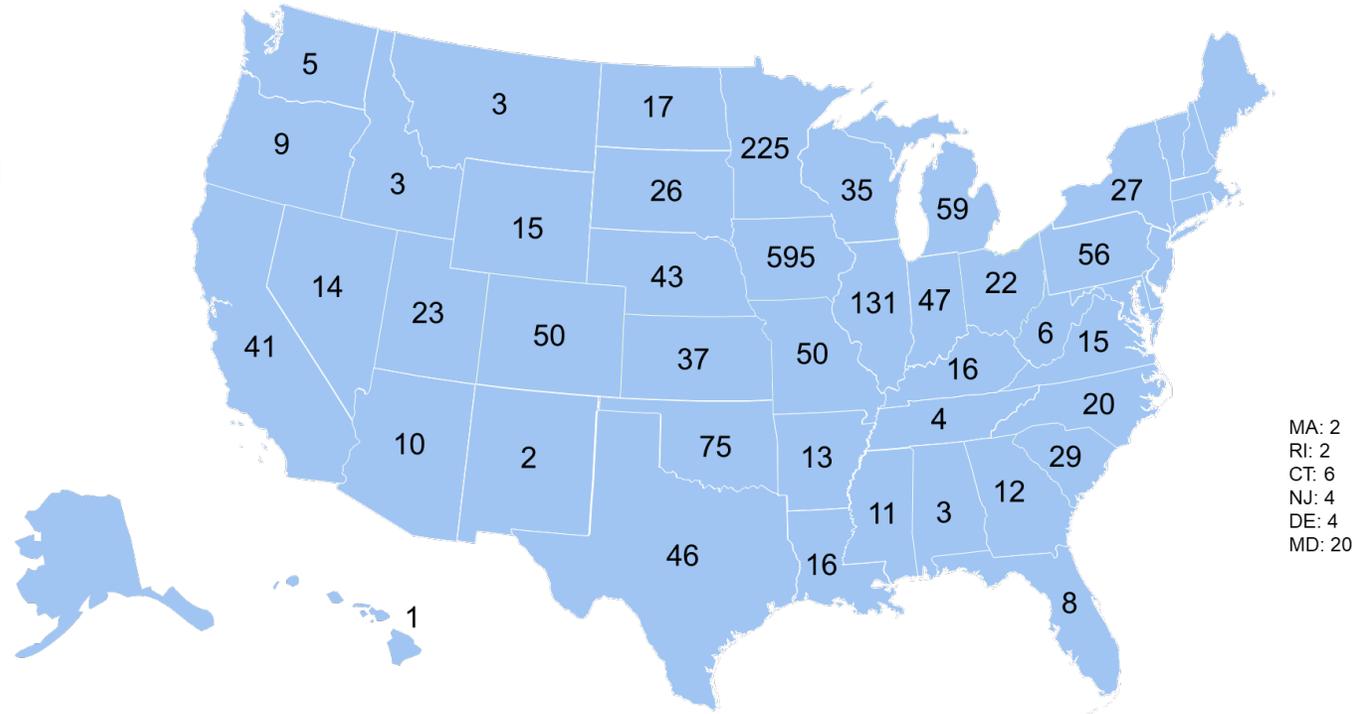
- Costs
- Performance
- Environmental impacts
- Resiliency
- Effectiveness



Source: ACPA

Low Maintenance Service Life Achievable

- Since experimental inception over 2200 overlays built
- Proven technology - much has been learned
- 20-year overlay life common
- Some serve 30-40 years
- Most experience is with: COC-U, COA-U and COA-B



46 States

Image source: Iowa State University

Costs

Improved pavement asset management

- Optimizing the overall cost of pavement network by including concrete overlays as part of an agency's "mix of fixes"

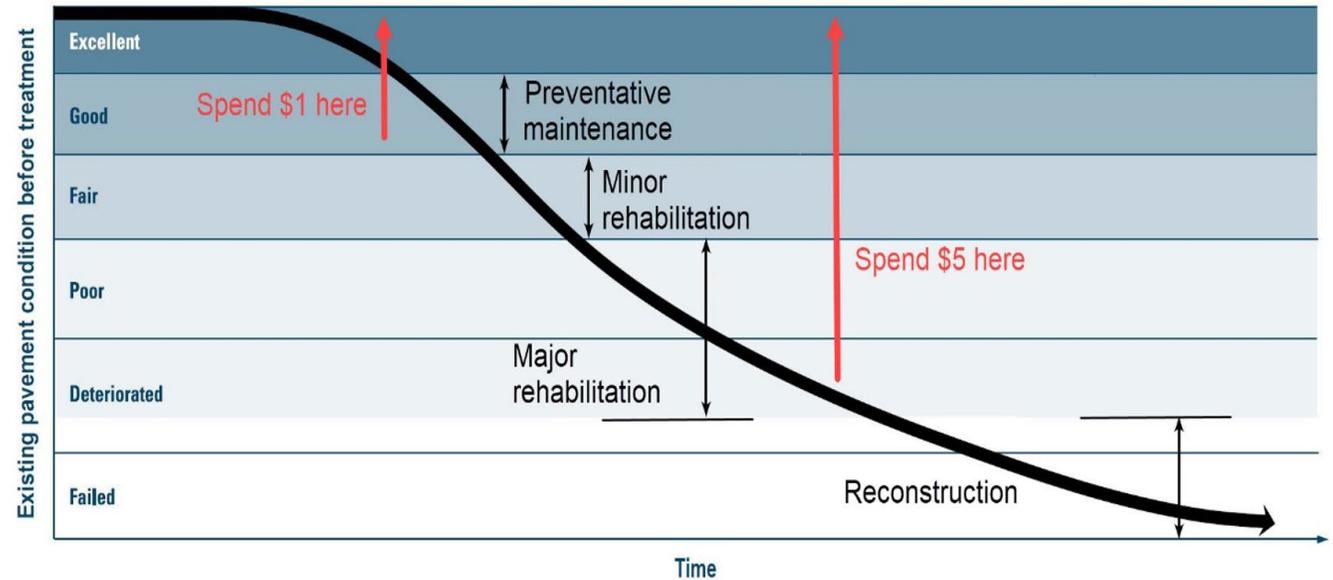
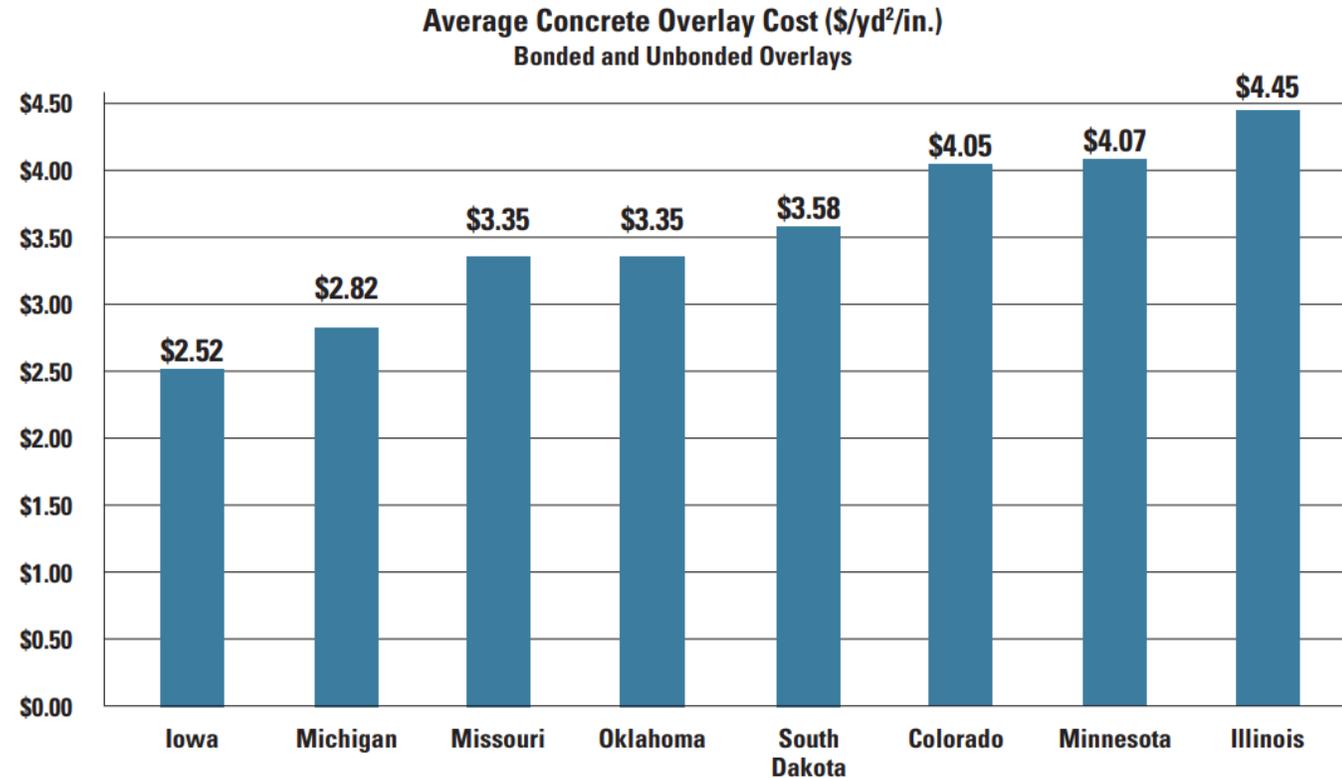


Figure 2 – Pavement Condition Curve

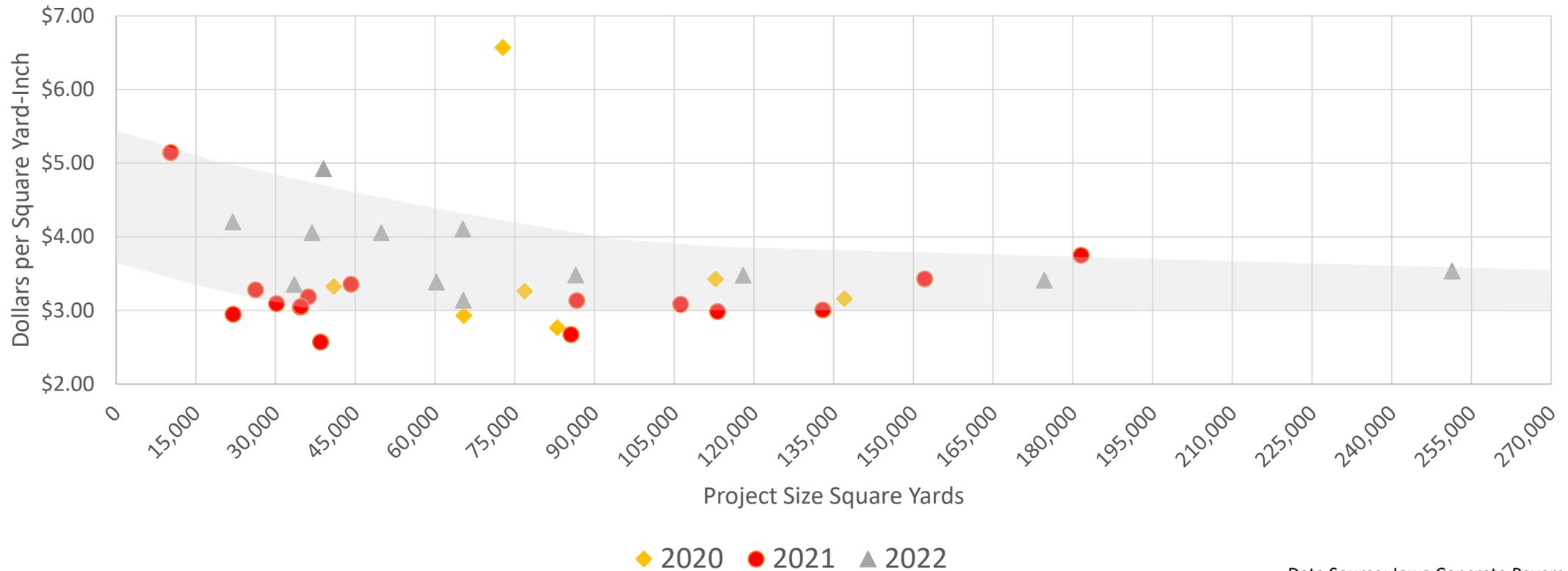
Costs

- Low initial construction cost
- Low annual ownership cost
 - Incorporating LCCA into the decision-making process for an agency's maintenance and resurfacing program, instead of focusing primarily on initial cost



Cost Data From Public Bid Tabulations

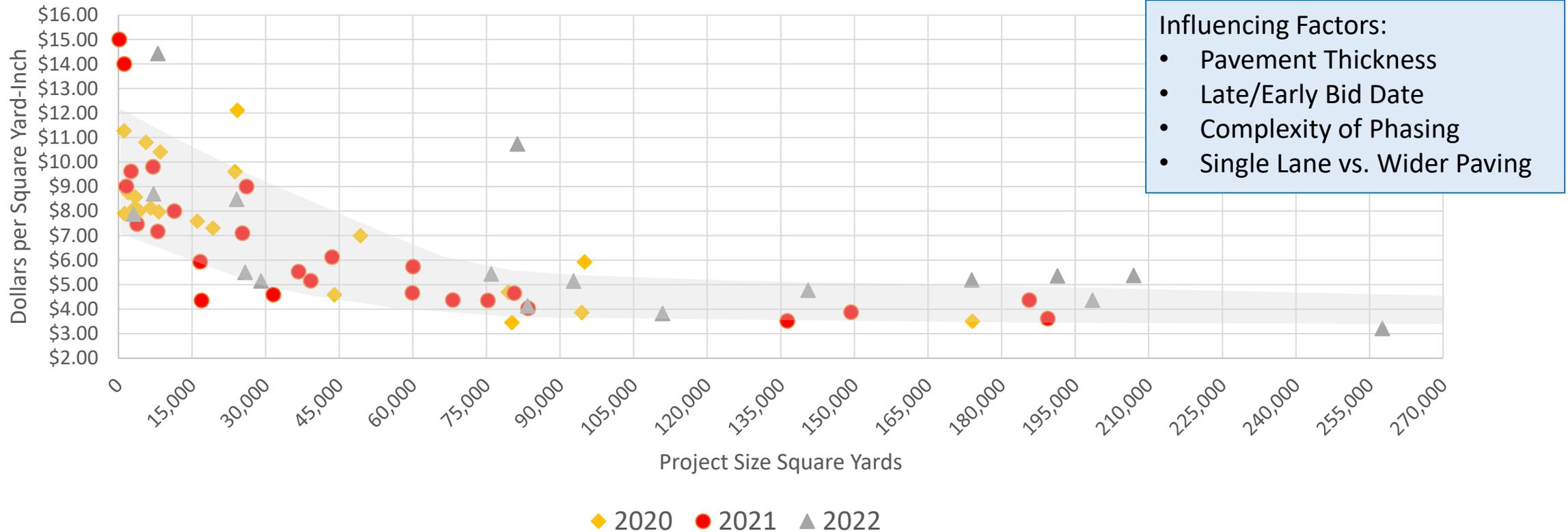
Iowa Concrete Overlay Data – Dollars per Square Yard-Inch



Data Source: Iowa Concrete Pavement Association

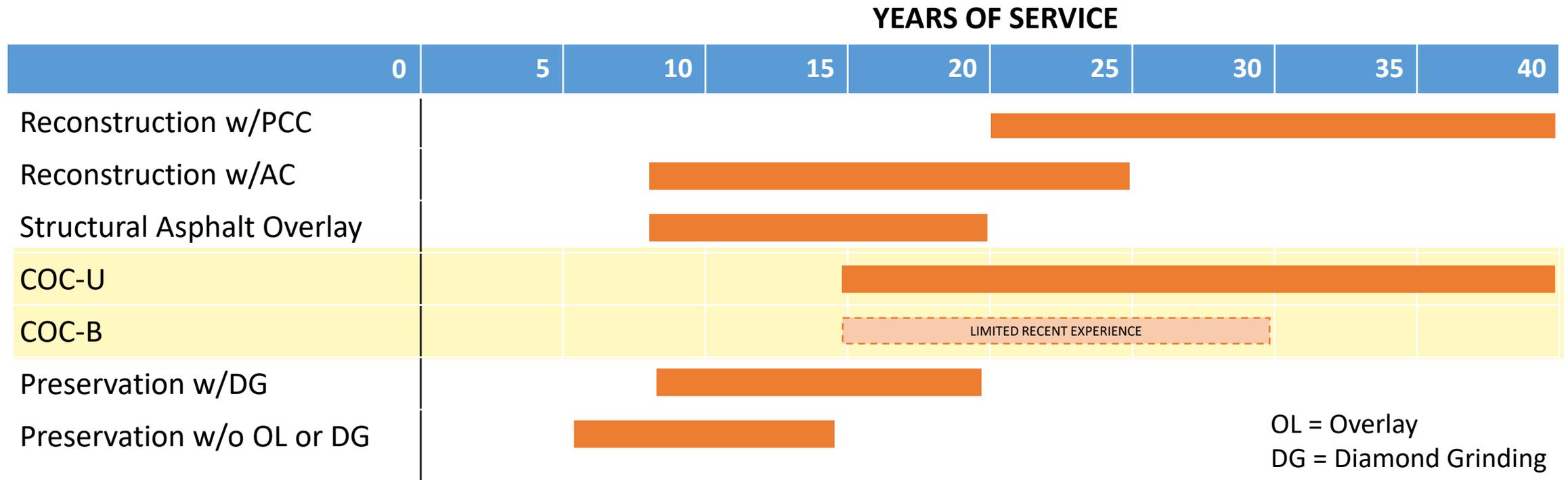
Cost Data From Public Bid Tabulations

Minnesota Concrete Overlay Data – Dollars per Square Yard-Inch



Data Source: Concrete Paving Association of Minnesota

Life-Cycles for Rehab of Existing Concrete Roads



Source: Adapted from ACPA, “Life-Cycle Cost Analysis: A Tool for Better Pavement Investment and Engineering Decisions” Table 2-8; Engineering Bulletin EB011, 2012

An Asset Management Strategy

- Concrete Overlays
 - Extend pavement life
 - Improve safety
 - Meet motorist demands
-All without reconstruction



Image source FHWA

- Fits FHWA Sustainable Pavement Program priorities

Sustainability Value

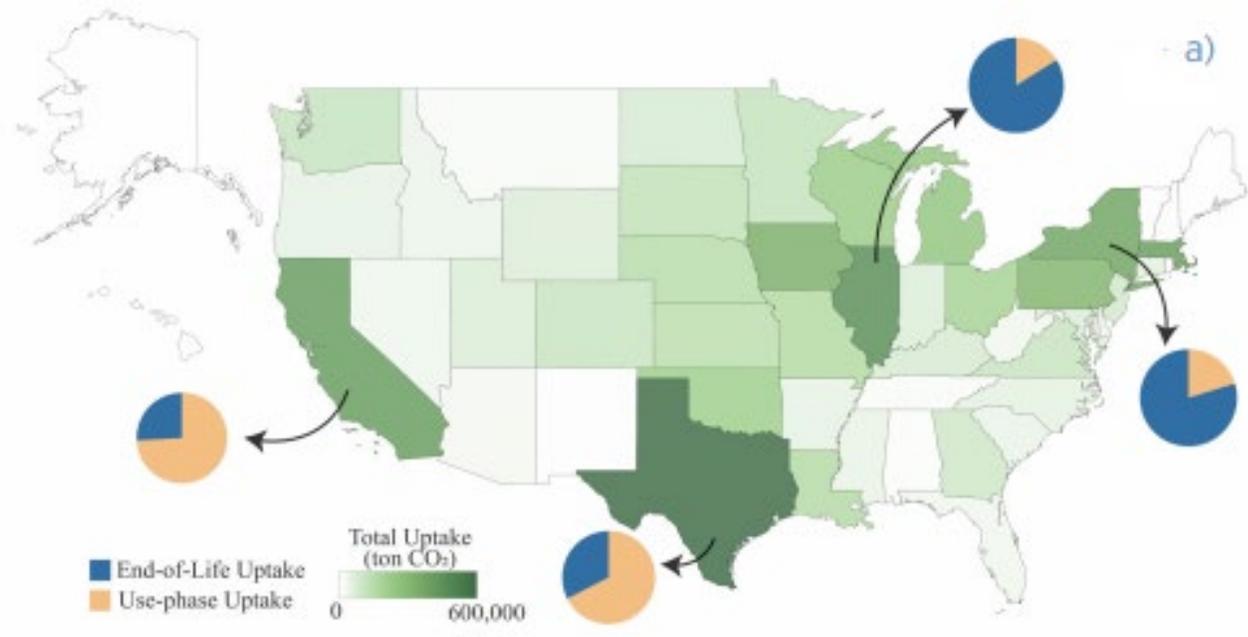
- Preserve equity of investment in the roadway
- Provide long-life solution
- Enhances the pavement system surface (for resiliency)



Image source FHWA

Sustainability Value

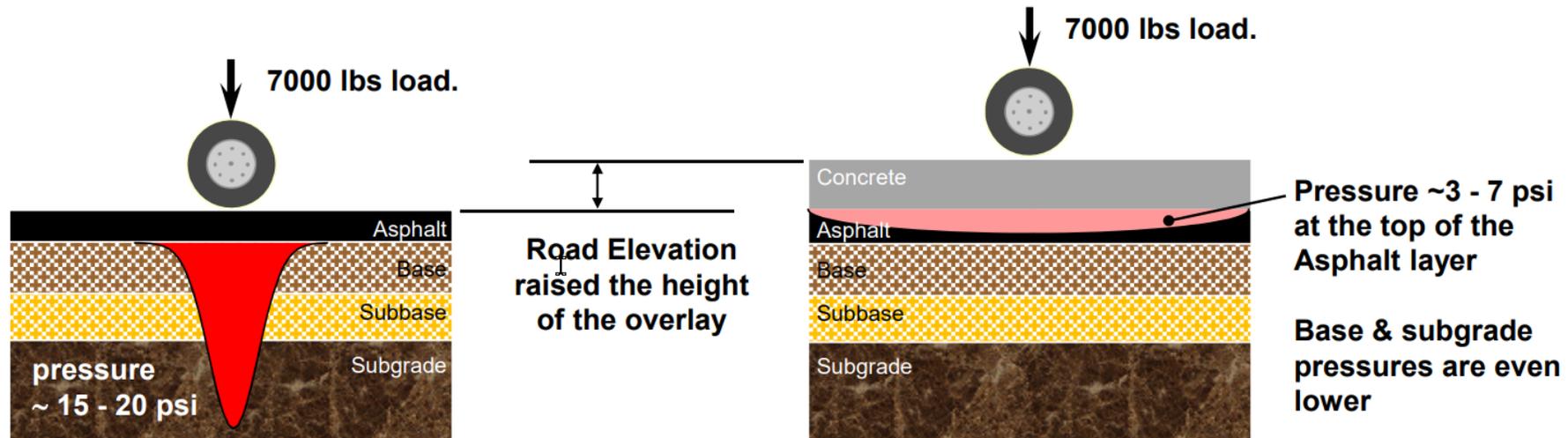
- Long lifespans and low maintenance requirements
- 100% recyclable
- May absorb CO₂



Source: MIT CSHub

Resiliency Value - Strength

- Concrete overlays armor the roadbed, reducing damage caused to underlying foundation by pavement flooding during extreme weather events.
- Enhances resistance to degradation of existing asphalt pavements in anticipation of extreme weather (for COA-U/B)



Resiliency Value - Inundation

- Subgrade resilient modulus reduced 30% 6 months after flooding event (FWD)
 - Gundla, et al., TRB 2020
- Effects of inundation on flexible pavements equivalent to reducing HMA thickness by 2”
- No significant damage or loss of strength for rigid pavements
 - Gaspard, et al., 2007
 - Zhang, et al., 2008



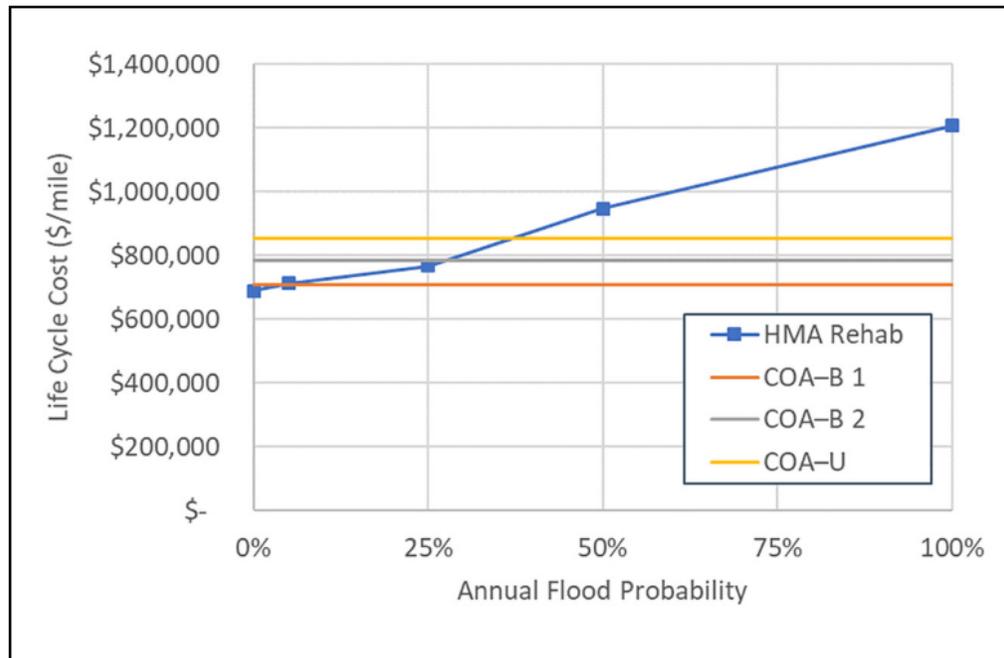
Resiliency Value

- Fatigue
 - Inundation can reduce fatigue life by 5% - 17% (New Hampshire) (Knott, et al., TRB 2017)
- Roughness
 - Increase in roughness for flexible pavements accelerated after Katrina and Rita in 2005, no change in roughness for rigid pavements (Chen & Zhang, 2014)
 - Similar findings in Australia (Khan, et al., 2017)
- Concrete Overlays (COA)
 - California testing with HVS & FWD exhibited excellent performance (Mateos, et al., 2021)



Resiliency Value

- Concrete Overlay Strategies for Improving Pavement Resilience (King and Taylor, 2023)
 - LCCA approach for maintaining vulnerable pavements



Check for updates

TRR
Transportation Research Record
2023, Vol. 2677(6) 259-269
© National Academy of Sciences
Transportation Research Board 2023
Article reuse guidelines:
sagepub.com/journalsPermissions
DOI: 10.1177/03611981231156570
journals.sagepub.com/home/trr
SAGE

Research Article

Concrete Overlay Strategies for Improving Pavement Resilience

Daniel King¹ and Peter Taylor¹

Abstract
Increases in flooding events and rising groundwater levels caused by climate change threaten to weaken pavement foundations, which can have a major impact on flexible pavement service life. Rigid pavements are not as sensitive to the strength of underlying layers, so one potential method to improve the resilience of existing asphalt pavements is to construct concrete overlays. In this analysis, typical asphalt pavement sections on collector and arterial streets under low climatic and soil conditions are identified and evaluated under a variety of theoretical flooding scenarios to determine the impact of inundation on service life. Three types of concrete overlay designs are developed for these typical asphalt pavement sections under the same conditions. A life cycle cost analysis (LCCA) is performed to compare the costs and performance of the concrete overlay strategies to a conventional flexible pavement rehabilitation strategy under the theoretical flooding scenarios. The results of the LCCA indicate that a variety of concrete overlay designs can provide more cost-effective performance when pavement foundation layers become inundated, depending on the roadway functional class and frequency of flooding. These findings indicate that concrete overlays can be a useful method for improving resilience of existing flexible pavements and mitigating the costs of flood damage.

Keywords
infrastructure, pavements, design and rehabilitation of concrete pavements, concrete overlays, pavement design, sustainable and resilient pavements, LCCA, resilient pavements

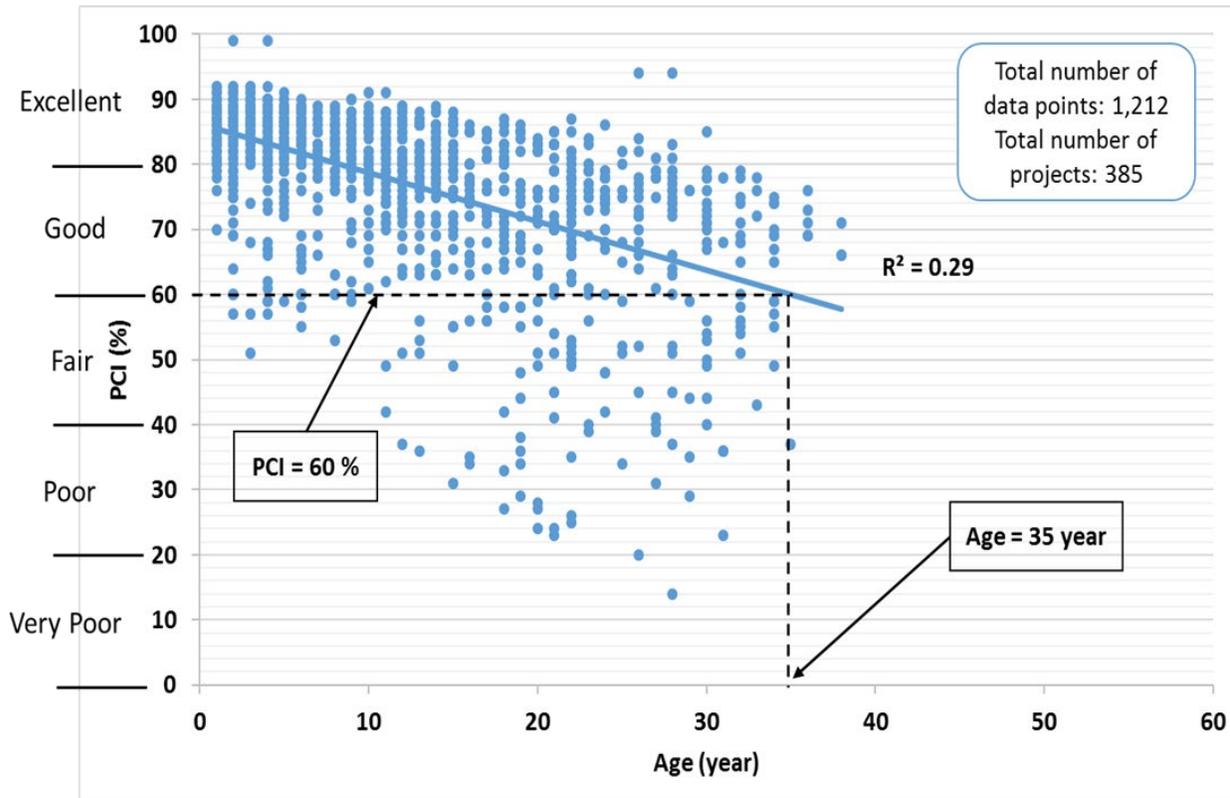
Introduction
Climate change poses a great number of challenges to the transportation infrastructure of the United States, including pavements. Sources of vulnerability for pavements include rising temperatures, heat waves, wildfires, changes to freeze-thaw cycles, and flooding (1, 2). Instances of temporary and permanent flooding of pavements are increasing due to several factors, such as sea level rise, storm surge, severe weather events, and changing precipitation patterns (3). Flooding is disruptive when it renders roads impassable, and in extreme cases it can wash out the pavement structure, requiring immediate repairs (3, 4). Even when a pavement remains intact during a flood, studies have shown that inundation reduces the strength of underlying foundation layers (3-8). The impacts of a single flooding event on the strength of pavement foundations have been found to persist for months after flooding events (5, 6, 8). Meanwhile, as sea levels rise, the groundwater table in coastal regions also rises, threatening to continuously saturate and weaken pavement foundations even when the surface does not flood (1, 9). Given the key role that roadways and airfields play in disaster recovery as well as everyday life, it is inevitable that pavements that experience flooding will be reopened to traffic before their foundation layers have fully recovered from inundation. In coastal areas, pavements will remain in service while their foundations are continuously saturated by the rising groundwater table. Studies have found that loading of inundated pavement structures may harm pavement performance and cause significant reductions in pavement service life (9-12). Pavements vulnerable to inundation become less

¹National Concrete Pavement Technology Center, Institute for Transportation, Iowa State University, Ames, IA

Corresponding Author:
Daniel King, dking@iastate.edu

Concrete Overlay Performance

2017 study found good performance, with an average concrete overlay service life of about 35 years



Concrete Overlay Performance on Iowa's Roadways
Field Data Report
July 2017

National Concrete Pavement Technology Center 



IOWA STATE UNIVERSITY
Institute for Transportation

Sponsored by
Iowa Highway Research Board
(IHRB Project TR-698)
Iowa Department of Transportation
(InTrans Project 15-539)

Concrete Overlay Performance

- A number of national- and state-level studies have been published in recent years about concrete overlay performance:

PERFORMANCE HISTORY OF CONCRETE OVERLAYS IN THE UNITED STATES

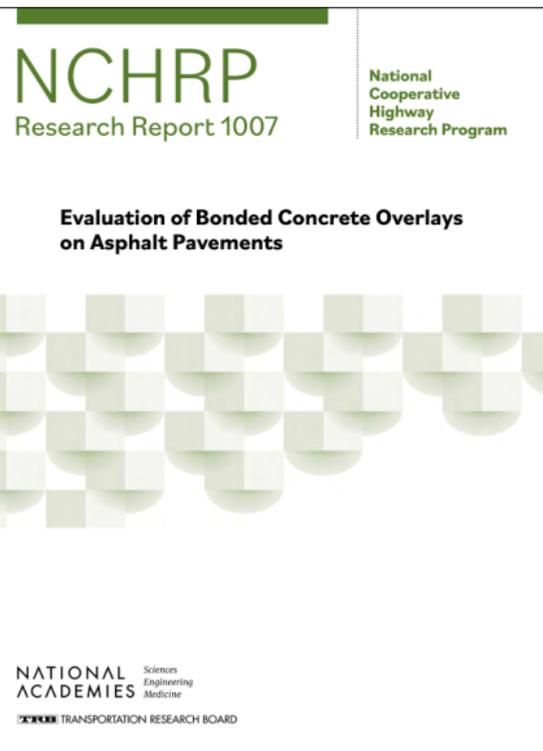


IOWA STATE UNIVERSITY
Institute for Transportation

National Concrete Pavement
Technology Center



JUNE 2023



EVALUATING PERFORMANCE OF CONCRETE OVERLAYS FOR PAVEMENT REHABILITATION



November 2020
Final Report

Project number TR202003
MoDOT Research Report number cmr 20-012

PREPARED BY:

Max Grogg
Arturo Espinoza-Luque
Kurt Smith
Monty Wade
Julie Vandenbossche

PREPARED FOR:

Missouri Department of Transportation
Construction and Materials Division, Research Section

m DEPARTMENT OF
TRANSPORTATION

Development of Performance Curves for Whitetopping in Minnesota

Thomas Burnham, Principal Investigator
Office of Materials and Road Research
Minnesota Department of Transportation

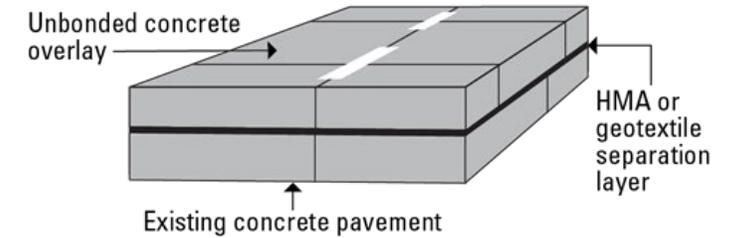
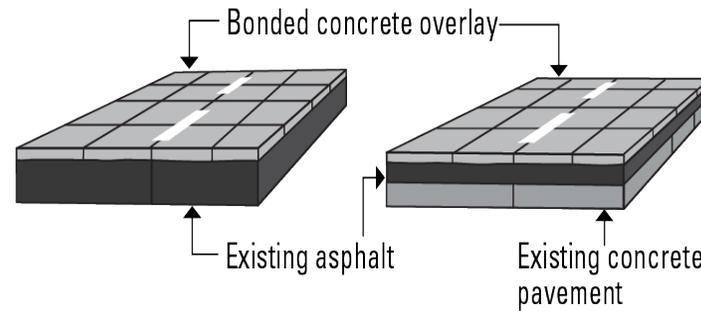
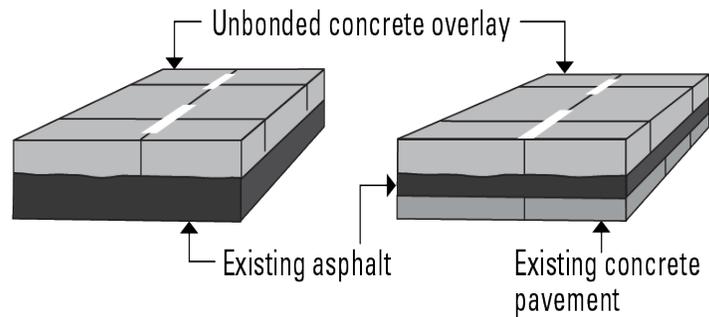
APRIL 2019

Research Project
Final Report 2019-16

MnROAD

RESEARCH SERVICES & LIBRARY • mndot.gov/research

Current Service-Life Examples



US-287; CO – 2001
10 ½ inch



SH 13; IA – 2002
4 inch



Route D; MO – 2008
5 inch



Image sources: Iowa State University

Example: Overlay on Severe Distress

Route D, Cass County, Missouri, 2008

- Concrete on Concrete
- Unbonded interlayer (first U.S. use of non-woven geotextile)
- 3.7 mi, 5" thick, 6' x 6' panels, 9,300 ADT



a) Route D before overlay placement



b) Route D after overlay placement (2008)

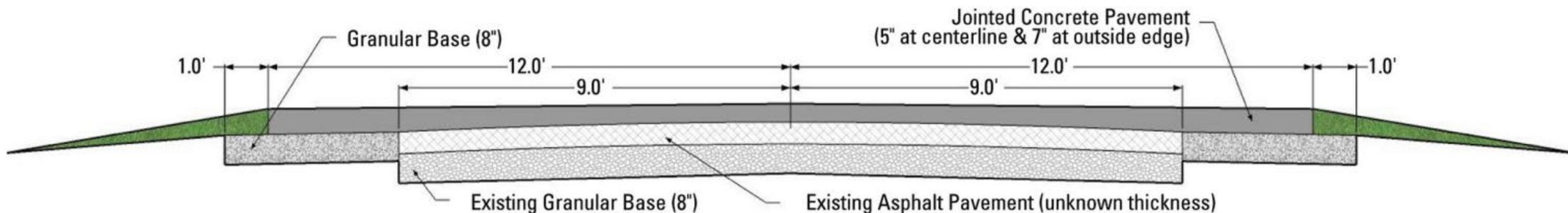


c) Route D current pavement condition (2017)

Example: Overlay on Low Traffic Road

County Route 56, LaSalle County, IL

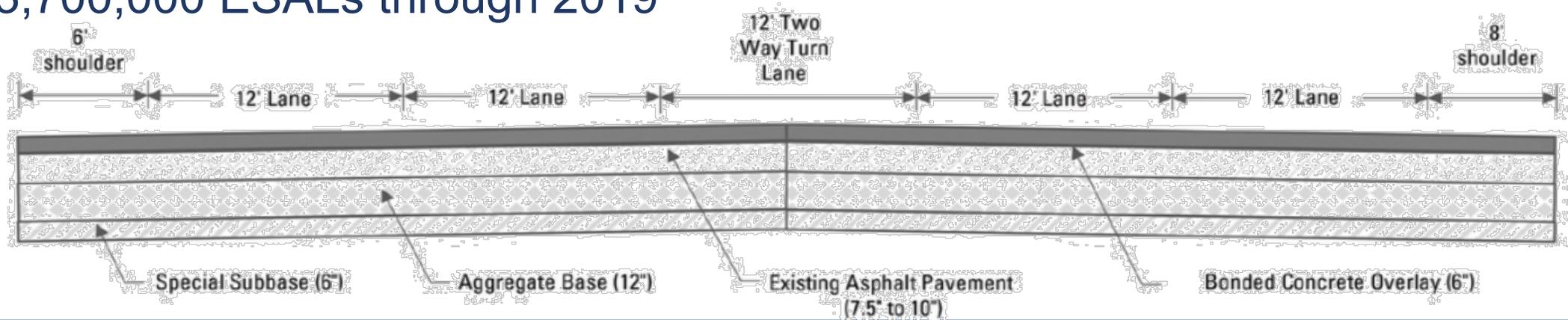
- Concrete on Asphalt
- 2.8 miles; 5–7" thick
- Unbonded interlayer
- 1974 construction (49 years old)
- 2012 ADT 3,850
- 12,500,000 ESALs through 2020
- 30% trucks



Example: Overlay on Med. Traffic Route

SR-119, Uniontown, PA

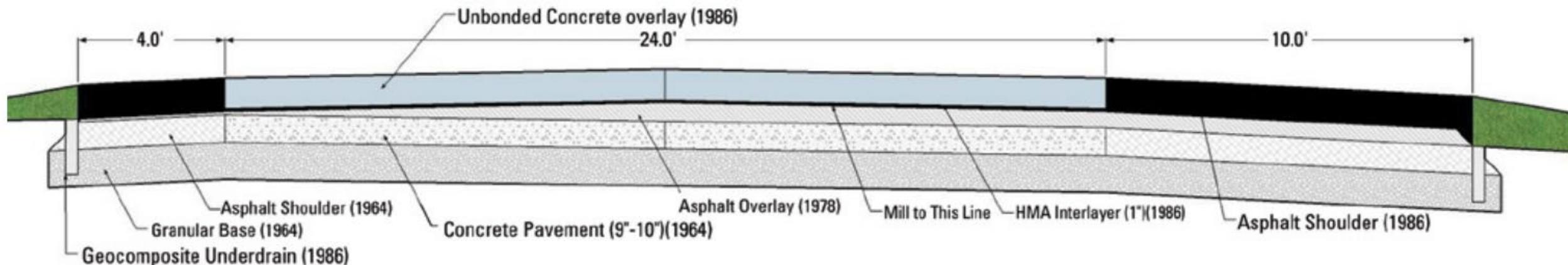
- Concrete on Asphalt
- Bonded interlayer
- 3.9 miles; 6" thick
- 2010 construction (13 years old)
- 2009 ADT 9,983, 7% Trucks
- 3,700,000 ESALs through 2019



Example: Overlay on Heavy Traffic Hwy.

I-69, Grant County, IN

- Concrete on Asphalt
- Unbonded interlayer
- 4.6 miles; 11" thick
- 1986 construction (37 years old)
- 2013 ADT 26,000, 42% Trucks
- 70,500,000 ESALs through 2020



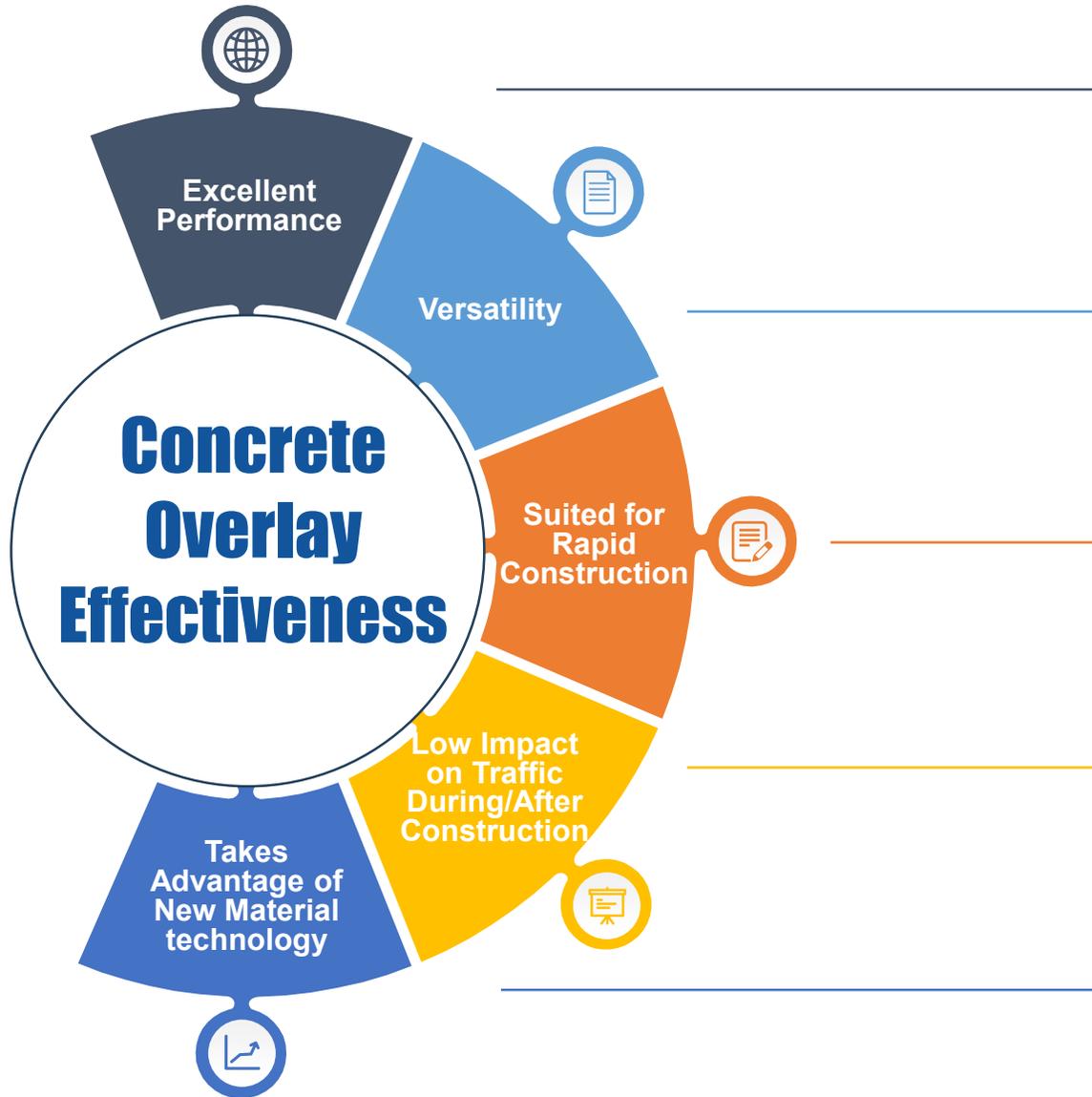
Example: Accelerated Overlay Construction

Highway 3, Plymouth County, IA

- Concrete on Asphalt
- Bonded interlayer
- Approx. 9 miles; 6" thick
- 10" existing asphalt pavement
- 2022 3,940 ADT
- 6' x 6' panels
- 36' wide paving
- Opening flex. strength 325 psi (16 hrs)
- Completed in 25 days
- IRI 50 inches / mile



Ice cream capital of the world!



1

Life can Exceed 35 years with proper project selection, design & construction.

2

Can be used on existing concrete or asphalt in various stages of deterioration.

3

Requires about one-quarter of build time needed for full reconstruction project.

4

Can be built under traffic; opened quickly and long life reduces future rehab closures.

5

No limitations on new technologies, including Performance Engineered Mixtures.

Discussion...





Concrete Overlay Solutions Workshop

Module 3 – Overlay Types and How to
Select Them

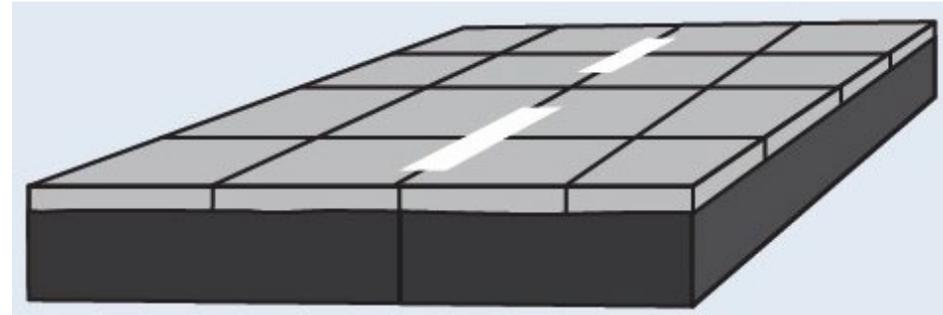


Overview

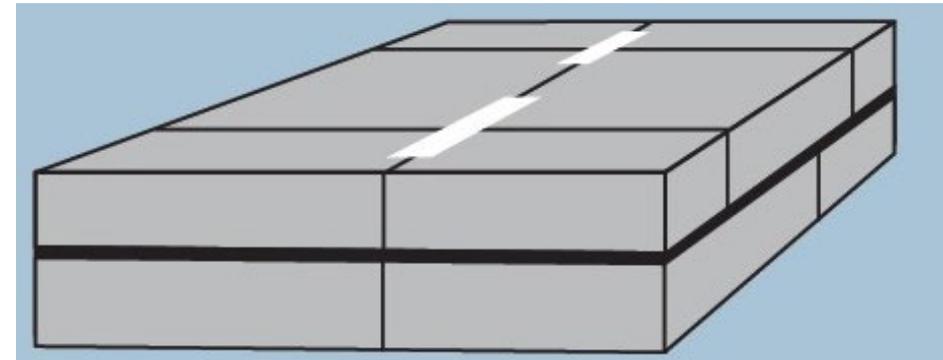
- Types of concrete overlays
- Concrete overlay candidates
- Selecting a proper overlay
 - Existing pavement type and condition
 - Existing typical section layers
 - On-site review and evaluation
 - Milling & Profile Grade Adjustments
 - Validate Existing Pavement Condition
 - Feasibility

Types of Concrete Overlays

- Concrete on asphalt (COA)



- Concrete on concrete (COC)

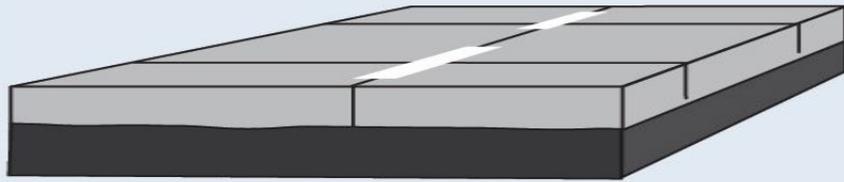


Source: CPTech Center

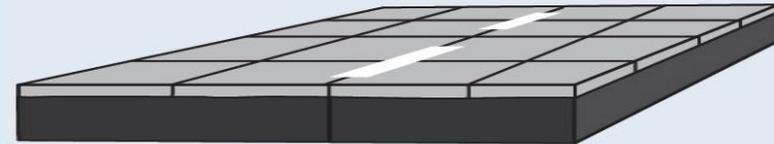
Sub-Types of Concrete Overlays

Concrete on Asphalt

Unbonded (COA-U)

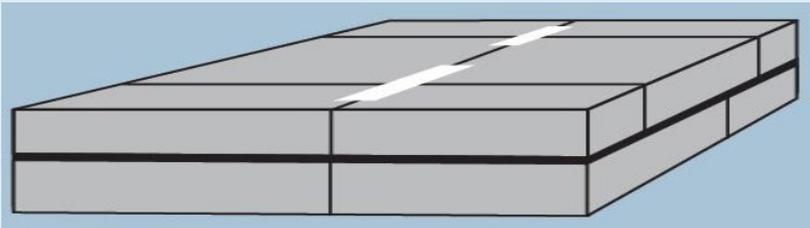


Bonded (COA-B)

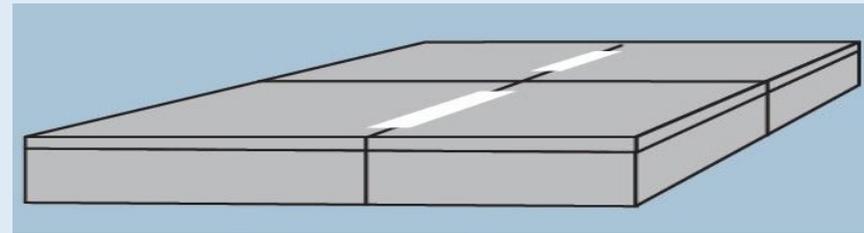


Concrete on Concrete

Unbonded (COC-U)



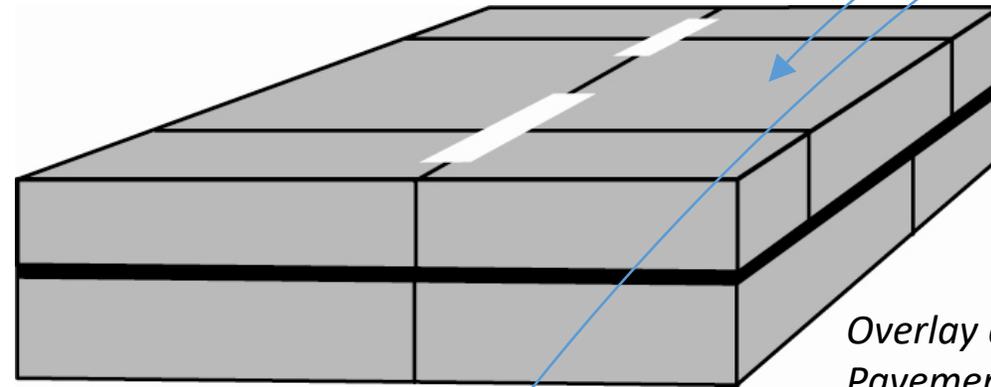
Bonded (COC-B)



Source: CPTech Center

The Basic Engineering

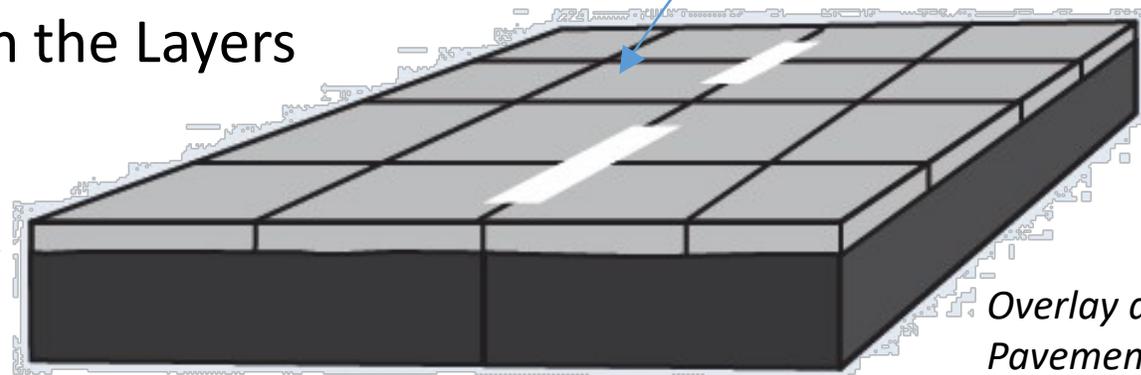
U Counts on Separating the Layers



Jointing Systems May Be Different

Overlay and Existing Pavement Are Not Monolithic

B Counts on Bond Between the Layers

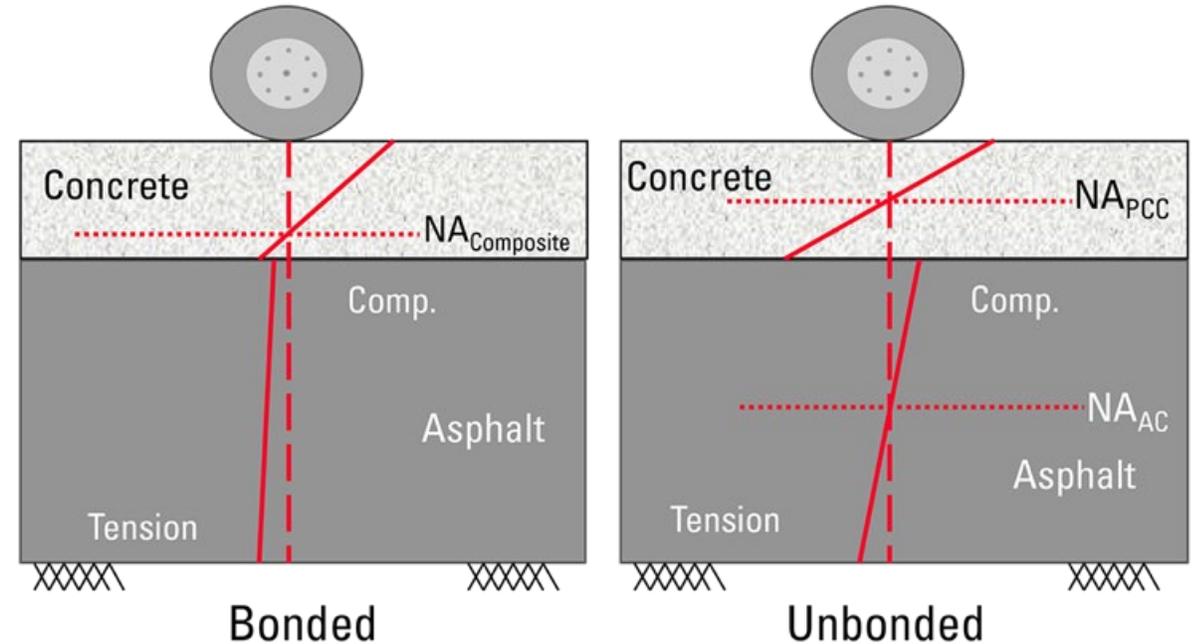


Overlay and Existing Pavement Are Monolithic

Images source: Iowa State University

The Basic Engineering

- B = Bonded
 - New layer and existing surface layer act together to form structural section (monolithic)
- U = Unbonded
 - New layer and existing surface layer separated to act independently from each other
 - Under loading



Source: CPTech Center

Applicability



Jointed
Pavement



Continuously
Reinforced
Pavement



Composite
Pavement



HMA or
WMA
Pavement



Composite
Pavement

Existing Concrete

Existing Asphalt

Wide Range of Applicability

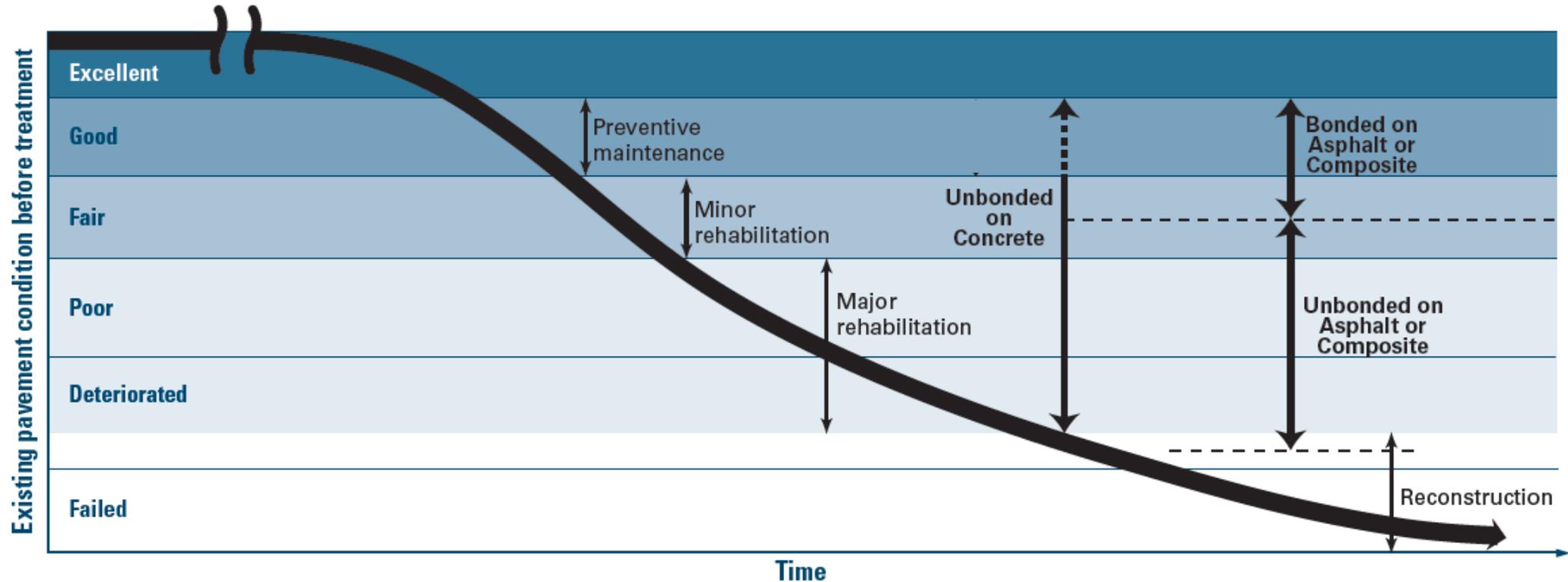
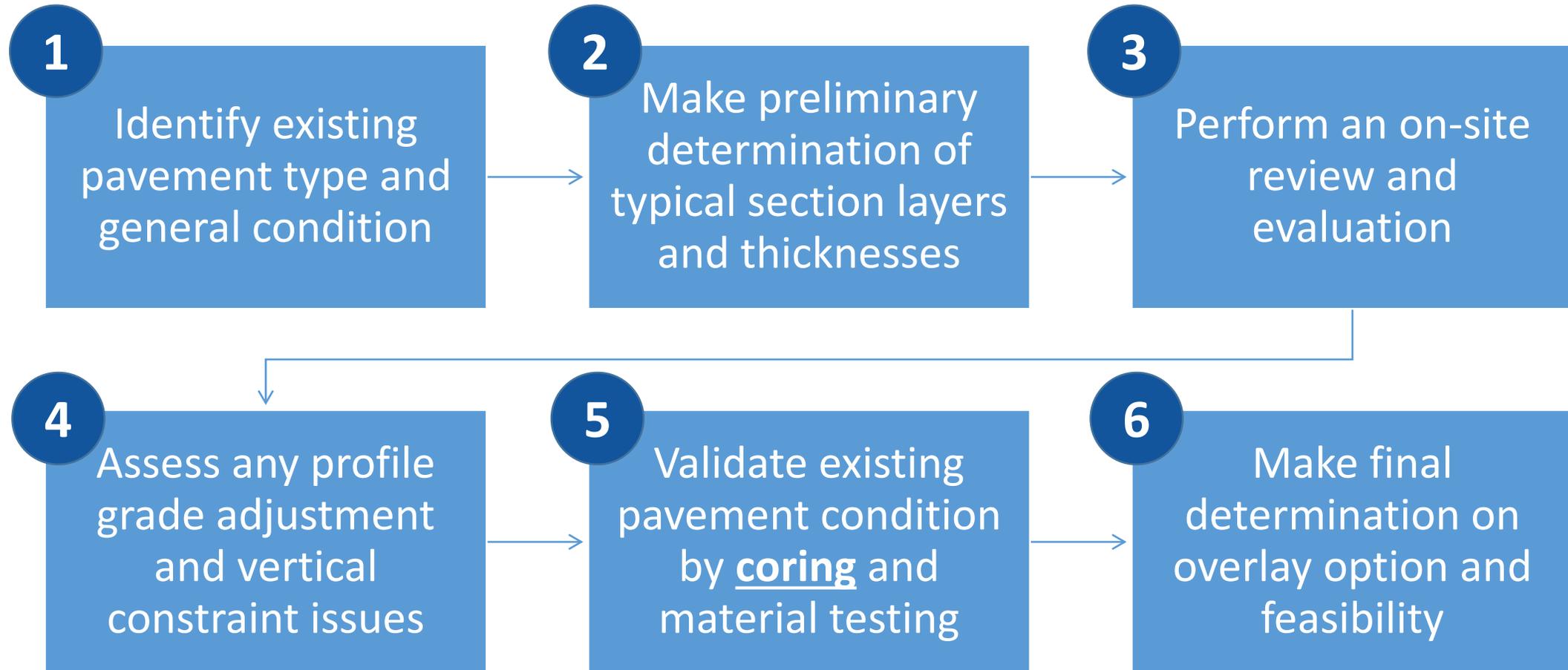


Image source: Iowa State University

Evaluation Process Steps



1. Existing Pavement Type and Condition



- Asphalt or composite?
- Concrete? -- JPCP? -- CRCP?

1. Existing Pavement Type and Condition

- Review construction and maintenance records
- Review visual distress survey using digital imagery to identify areas that need to be carefully examined during a field visit

| NORTH CAROLINA STATE HIGHWAY CONSTRUCTION AND INVENTORY DIAGRAM | | COUNTY YADEN - SURRY | | ROUTE 177 | | SHEET 6 OF 7 | |
|---|--|----------------------|--|-----------|--|--------------|--|
| CONSTRUCTION RECORD | | | | | | | |
| PLAN VIEW | | | | | | | |
| PROFILE VIEW | | | | | | | |
| ROLLING | | | | | | | |
| FULL CONTROL OF ACCESS | | | | | | | |
| NORTH CAROLINA STATE HIGHWAY COMMISSION | | | | | | | |
| PLANNING DEPARTMENT | | | | | | | |



1. Existing Pavement Type and Condition

GOOD

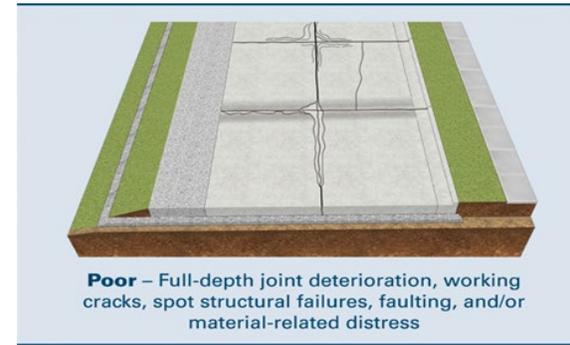
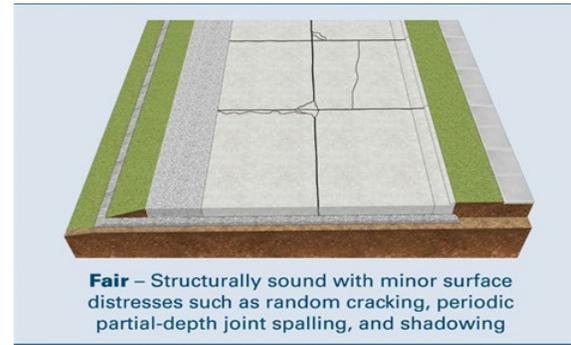
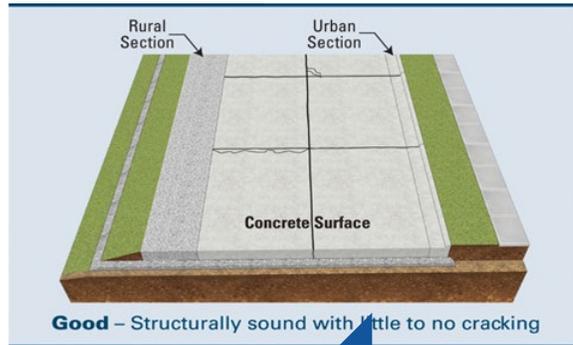
FAIR

POOR

POOR

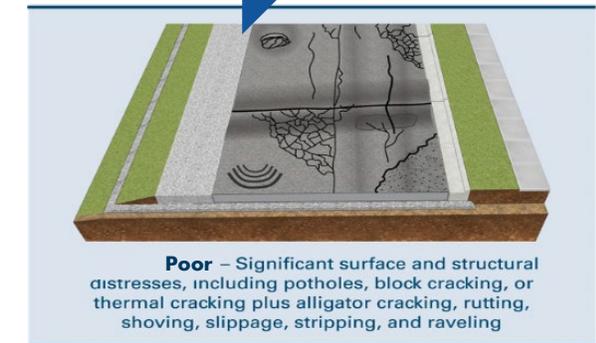
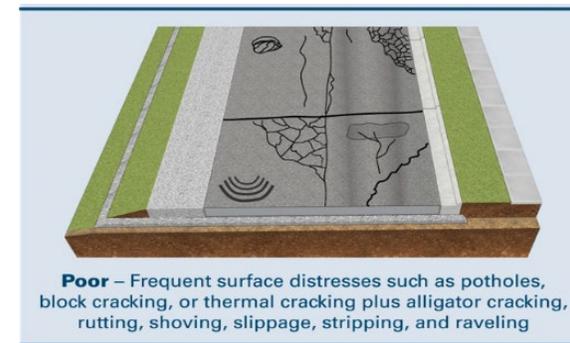
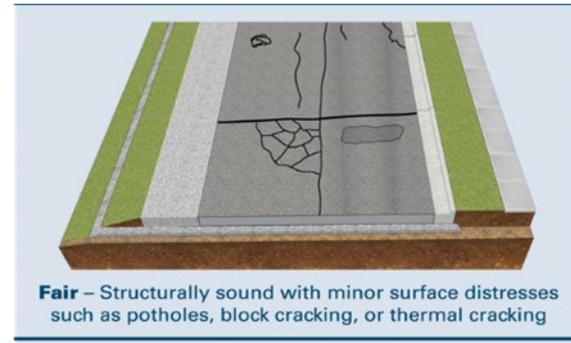
(w/Significant MRD)

CONCRETE



← Assess by Engineering Judgment →

ASPHALT

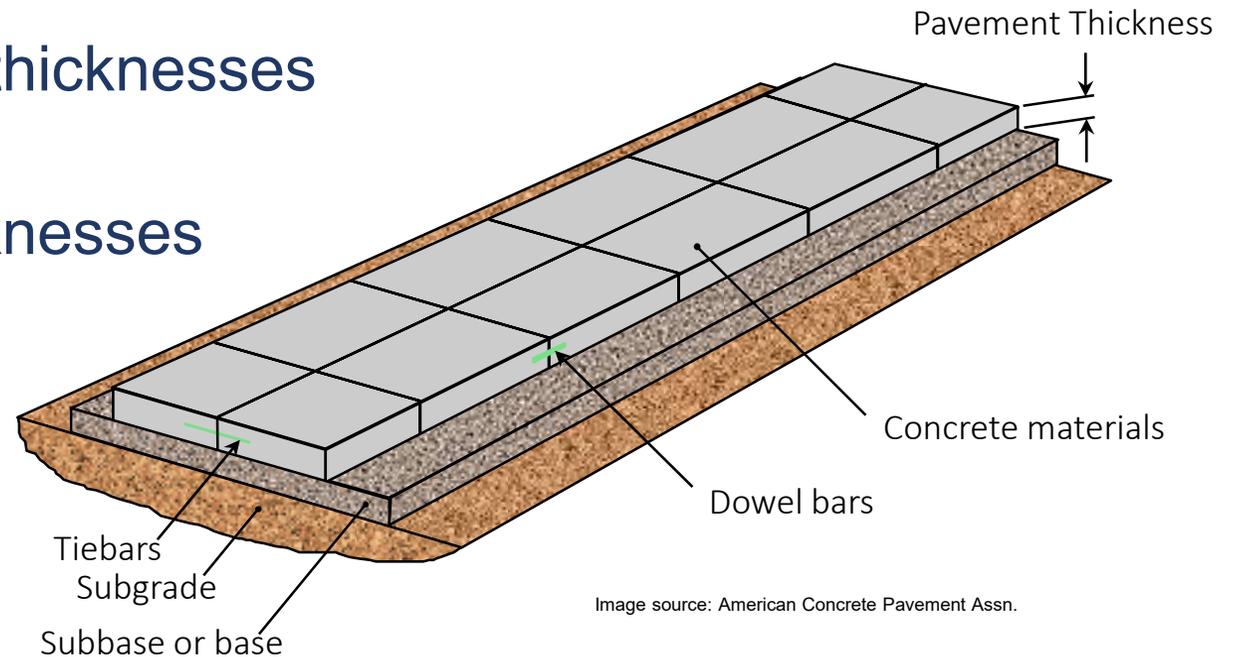


Images: Adapted from Iowa State University

2. Existing Pavement Typical Section

(Preliminary Determination)

- Review historical documents, as-built plans, construction data.
- Check for:
 - Surface pavement layers and thicknesses
 - Dowel & tie bars
 - Base/subbase layers and thicknesses
 - Subgrade soil type



2. Existing Pavement Typical Section

(Preliminary Determination)

- Review historical documents, as-built plans, PMS data:

| Lane | Begin MP | End MP | Length (mi) | Year | Description |
|------|----------|--------|-------------|------|--|
| EB | 343.1 | 354.7 | 11.6 | 1964 | 9" JPCP on 3" sand base |
| | | | | 1979 | Sand seal |
| | | | | 1984 | Joint repair |
| | | | | 1991 | Crack and seat with 3" HMA overlay (mainline) and 1 ½" HMA overlay (shoulders) |
| | | | | 1995 | Chip seal |
| | | | | 1996 | |
| | | | | 2006 | 2 ½" HMA overlay |
| | | | | 2008 | Slurry seal |

3. On-Site Review and Evaluation

- On-site visual survey with the local maintenance engineer to discuss the persistent pavement maintenance issues
 - Pavement Distresses
 - Support Conditions
 - Vertical Constraints
 - Existing Shoulders and Widened Sections

3. On-Site Review and Evaluation

Qualify the Pavement Distresses

- Identify type, quantity and severity of distresses
- Refine the pavement condition assessment initiated in Steps 1 & 2
- Identify locations for pavement coring for further investigation of distresses
- Estimate the extent of any needed pre-overlay repairs.

3. On-Site Review and Evaluation

Identify and rate pavement distresses...



Faulting (M-H Severity?)



Pumping (M-H Severity?)



Reflective Cracking of
Composite Pavement
(L-M Severity?)

3. On-Site Review and Evaluation

Begin to define extent of any necessary pre-overlay repairs...



Major pre-overlay repair needed



Only Minimum surface repair needed

3. On-Site Review and Evaluation

Assess extent of any support issues...



Existing pavement needs repair, but still carries traffic every day



Virgin base course – how long would it last if opened to traffic?

3. On-Site Review and Evaluation

Assess the Drainage Conditions...

- Review the profile grade for extreme bumps and dips indicative of subgrade and/or drainage issues.
- Identify any moisture-related distresses
- Assess the condition of edge drains, if present
- Note any drainage-related structural failures.

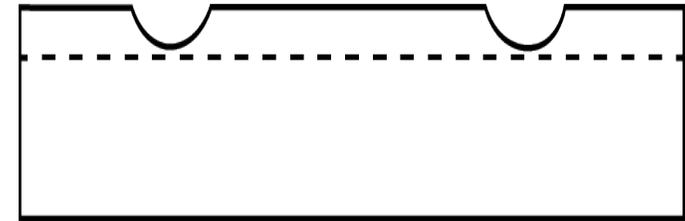
3. On-Site Review and Evaluation

Identify Vertical Constraints...

- Bridges
- Guardrails, parapet walls, cable barriers, and median barriers
- Curb and gutter sections
- Storm sewer inlets
- Intersecting roadways and access drives
- Drainage conduits and culverts
- Safety slopes and ditches

4. Assess Milling & Profile Grade Adjustments

- Plan ahead that an iterative milling process may be needed for a COC-B or COA-B overlay
- Purpose:
 1. Remove nonstructural surface distresses such as potholes, block cracking, partial-depth top-down cracking, random cracking, and thermal cracking
 2. Remove ± 2 inch rutting/shoving to control the overlay thickness and volume of concrete required for the overlay
 3. Correct profile and cross-slope variability (often referred to as profile milling). 3D machine control very helpful!



4. Assess Milling & Profile Grade Adjustments

- Purpose:
 4. Remove a stripped asphalt surface and/or intermediate layer to expose structurally sound asphalt

Asphalt core that shows the pavement can be milled to remove unsound material



4. Assess Milling & Profile Grade Adjustments

Well done milling provides uniform surface with increased surface area



Source: FHWA

4. Assess Milling & Profile Grade Adjustments



IF:

Milling exposes the underlying base course or subgrade

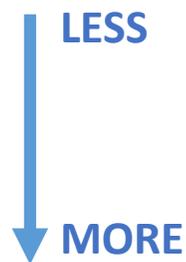
THEN:

Mill around the exposure an additional 2 to 3 in.

You can fill this area with concrete during overlay placement

5. Validate Existing Pavement Condition

- Use Coring, NDT and Material Testing
 - Core for thickness & layer integrity
 - FWD for pavement integrity/uniformity
 - GPR for known problem areas
 - If composite pavement, check potential for asphalt stripping (ASTM D4867)
- Can vary level of review by functional class
 - Low-Volume Rural or Urban
 - Arterial or Urban Intersection
 - Secondary (State Route)
 - Primary (US Route/Interstate)



...BUT CORING IS NECESSARY!



Image source: Voigt

Use of ASTM standard is not a Federal requirement

6. Make Final Determination on Feasibility

- Can the existing pavement provide a uniform subbase to overlay?
- If not, what pre-overlay repairs may be necessary to obtain that uniformity?
- If I am targeting a bonded solution, will I have enough structure remaining in old pavement after repair/milling?
- What interlayer treatment do I need to either bond or separate the overlay?
- Can a thicker overlay work within any vertical constraints?
- Is a concrete overlay an appropriate strategy for the existing pavement?

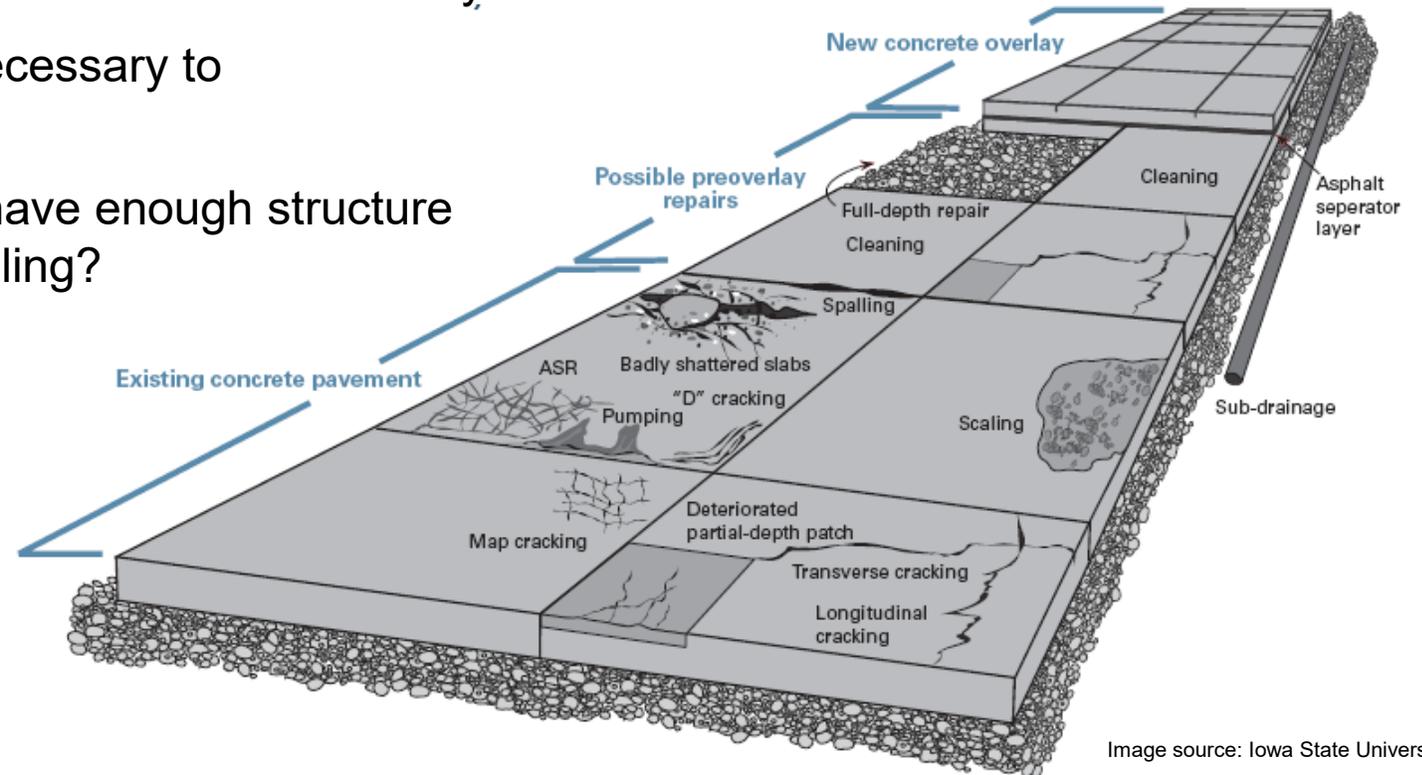


Image source: Iowa State University

Existing Pavement/Condition Should Drive Solution

GOOD

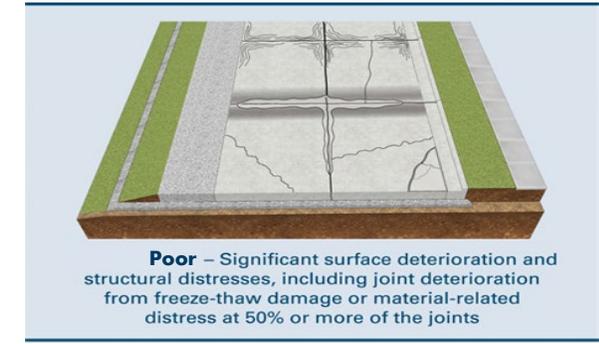
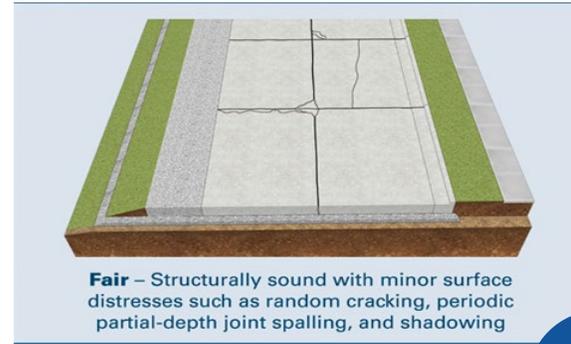
FAIR

POOR

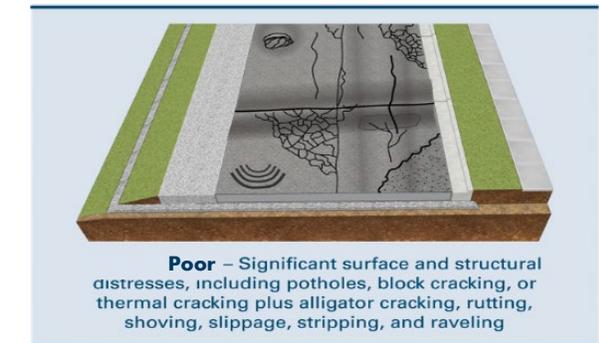
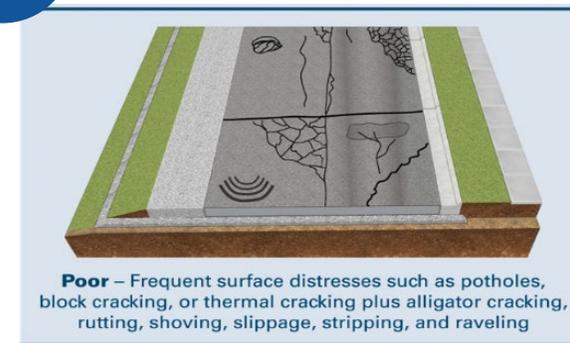
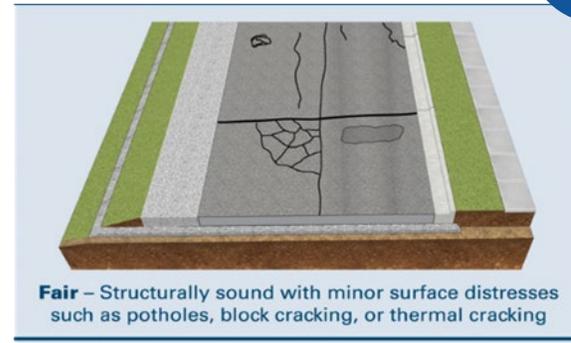
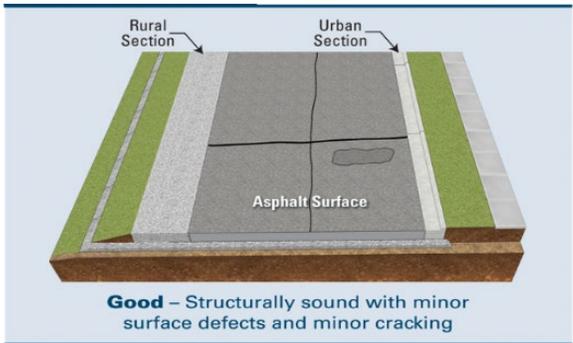
POOR

(w/Significant MRD)

CONCRETE



ASPHALT

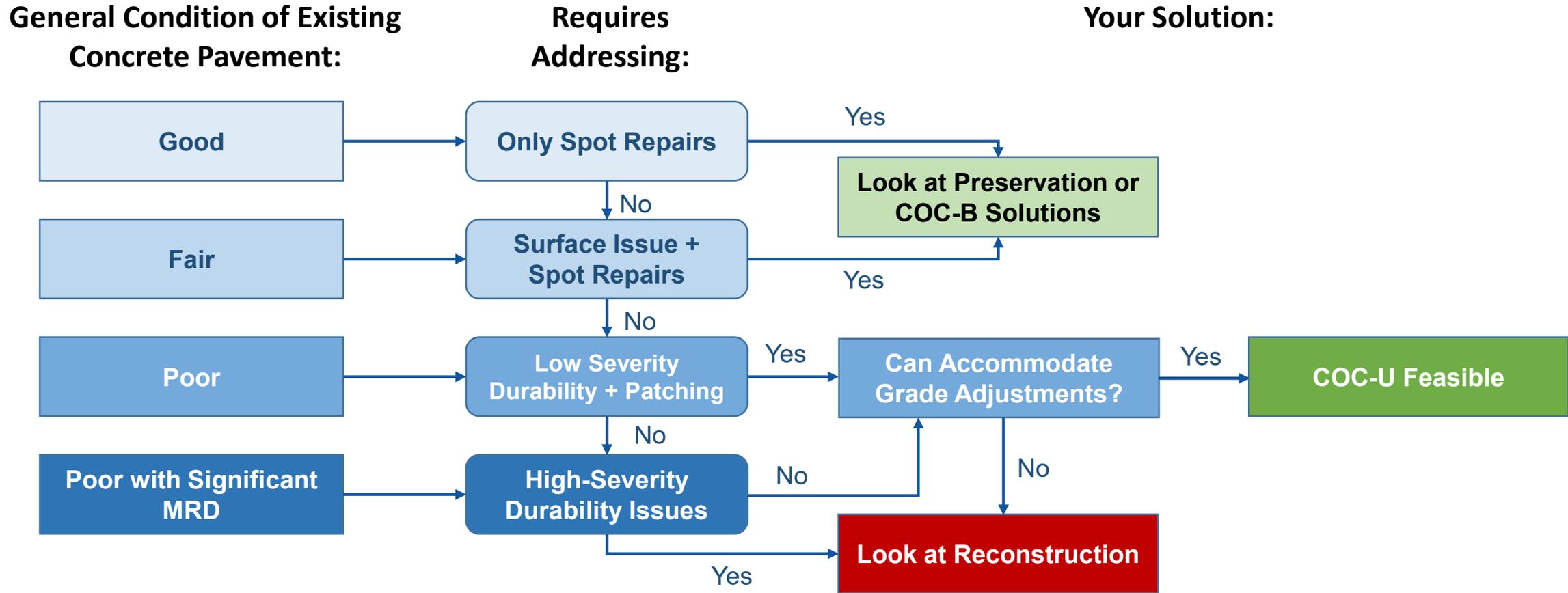


MRD = Materials Related Distresses

Source: CP Tech Center



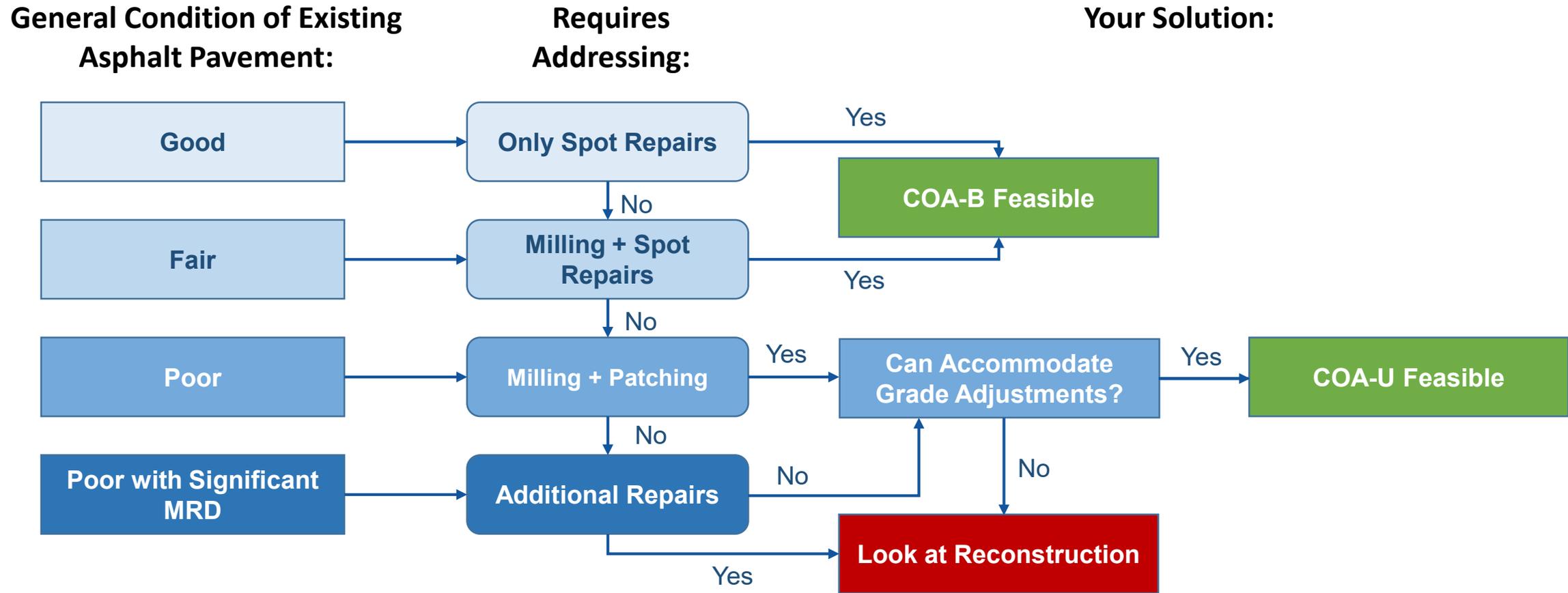
Potential Feasibility Decision Tree for COC



MRD = Materials Related Distresses

Use of feasibility decision tree is not a Federal requirement

Potential Feasibility Decision Tree for COA



MRD = Materials Related Distresses

Use of feasibility decision tree is not a Federal requirement

Discussion...





Concrete Overlay Solutions Workshop

Module 4 – Special Considerations for
Concrete Materials, Interlayer, Jointing &
Plan Details



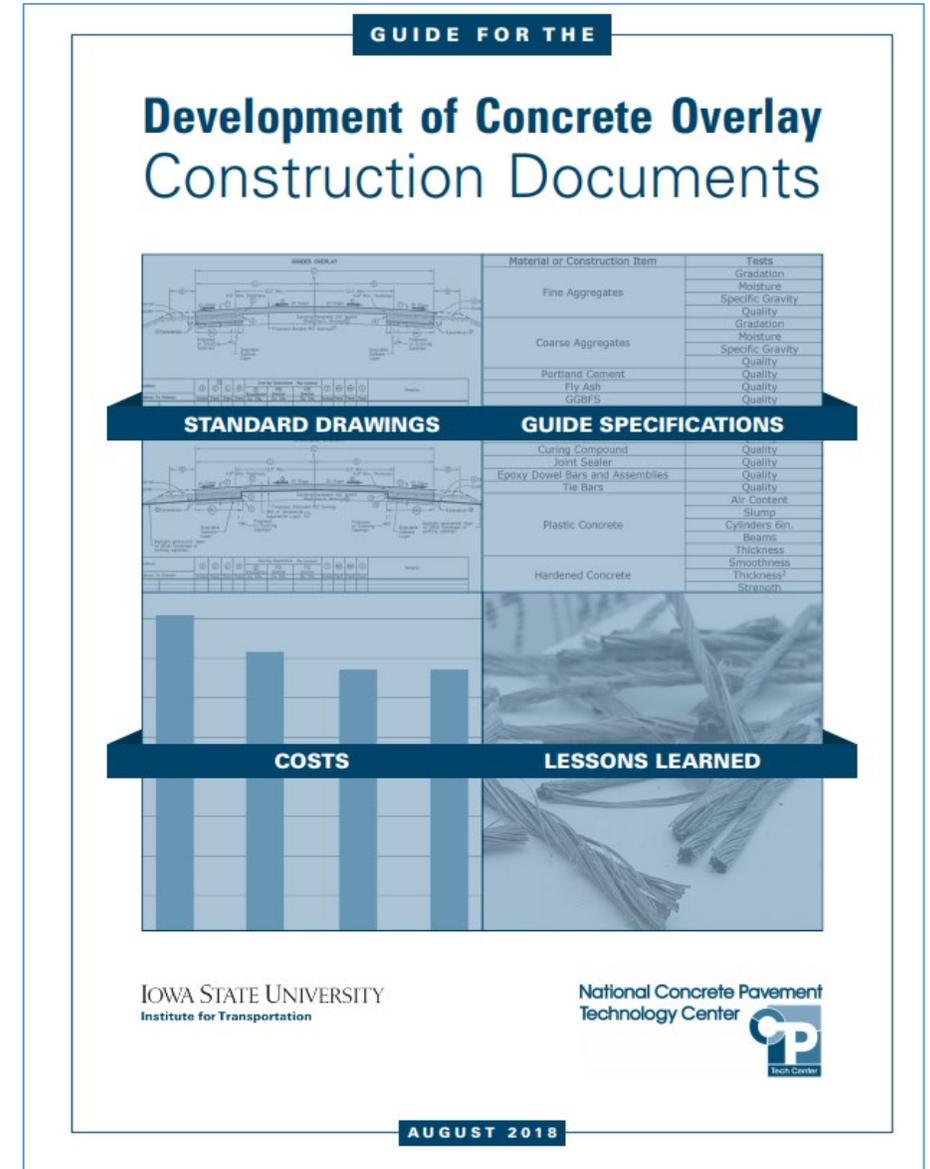
Image source: FHWA

What We'll Cover

- Typical Plans
- Materials
- Fibers
- Interlayers
- Jointing
- Special Details

Excellent Resource:

Example drawing sheets, construction details, guide specifications, and cost



Overlay Plan Set Typical of Standard

Drawing sheets for a concrete overlay on a rural state route or county road:

- Title sheet
- Typical sections
- Estimated quantities
- *Plan and profile*
- Survey information
- Maintenance of traffic
- Typical construction details

TITLE SHEET

| MILEAGE SUMMARY | | | |
|-----------------|----------|----------|-------|
| Sta. | Location | Lin. Ft. | Miles |
| 1 | | | |
| Total Length | | | |

Highway Division

PLANS OF PROPOSED IMPROVEMENT ON THE

PROJECT NAME

PCC OVERLAYS AND WIDENING - BONDED & UNBONDED

[Project Description]

| REVISIONS | |
|-----------|-------------------------------|
| | PROJECT IDENTIFICATION NUMBER |
| | PROJECT NUMBER |
| | R.G.W. PROJECT NUMBER |

| INDEX OF SHEETS | |
|-----------------|---|
| No. | Description |
| A.1 | Title Sheet |
| A.2 | Legend and Survey Control |
| A.3 | Estimated Quantities and Reference Information |
| B.1 | Existing Section and Milling Sheet |
| B.2 | Bonded and Unbonded Typical Cross Section |
| B.3 | Bonded PCC Overlay Jointing (with and without widening) |
| B.4 | Unbonded PCC Overlay Jointing (with and without widening) |
| B.5 | Miscellaneous Details |
| B.6 | Profile Transition Details |
| B.7 | Right Turn and Bridge Approach Details |
| B.8 | Shoulder and Paved Access Details |
| B.9 | Guardrail and Paved Shoulder Detail |
| C.1 | Quantity Tabulations |
| D.1 | Existing Roadway Plan and Profile for Reference Only |
| J.1 | Staging and Traffic Control Notes |
| J.2 | Staging Construction Open to Traffic |
| L.1 | Staking Layout |
| L.2 | Jointing Layout |

Location Map

Detour Map

| DESIGN TRAFFIC DATA | | INDEX OF SEALS | | |
|---------------------|-----|----------------|------|------|
| 20' ... | AMT | V.P.D. | NAME | TYPE |
| 20' ... | AMT | V.P.D. | | |
| TRUCKS | | Y | | |
| Total Design ESALs | | | | |

 LETTING DATE
 PCC OVERLAYS - BONDED AND UNBONDED

 Signature _____ Date _____
 My license renewal date is _____
 Pages or sheets covered by this set: _____

The information included herein does not represent a specific project, but may be used as an example of what should be included for a PCC bonded or unbonded overlay project.

This index is representative of an overlay project (bonded or unbonded) with many details including: staging, traffic control, varying existing cross-sections, turn lanes, transitions for bridges, and construction under traffic. Sheets B.7 to L.2 are optional, depending on the scope of the project.

The location map is helpful to the contractor when planning haul routes, traffic control, and staging.

The detour map is used only if roadway is closed to traffic during construction. If through traffic is allowed during construction, typically traffic control zones are kept to a 0.25 mile maximum length without the use of pilot cars as long as adequate sight distance is available. Construction zones that utilize pilot cars are typically 2.5 to 3 miles in length or no more than 10 minutes wait time per zone.

The title sheet shows general project information including name, description, jurisdiction, index of sheets, mileage summary, traffic, and engineering certification.

FILE NO. ENCL. DESIGN TEAM COUNTY PROJECT NUMBER SHEET NUMBER A-1

Urban Project Plans

May Need Additional Information for:

- Intersection layout
- Right of way/access constraints (may include property lines)
- Curb and gutter details
- Utility access details, including adjustments of storm inlets, manholes, etc.

Plan and Profile?

- Not typically required as drawing sheet(s)
- May include supplemental survey information
- Plan revisions may be necessary if the existing pavement condition deteriorates before going to bid.

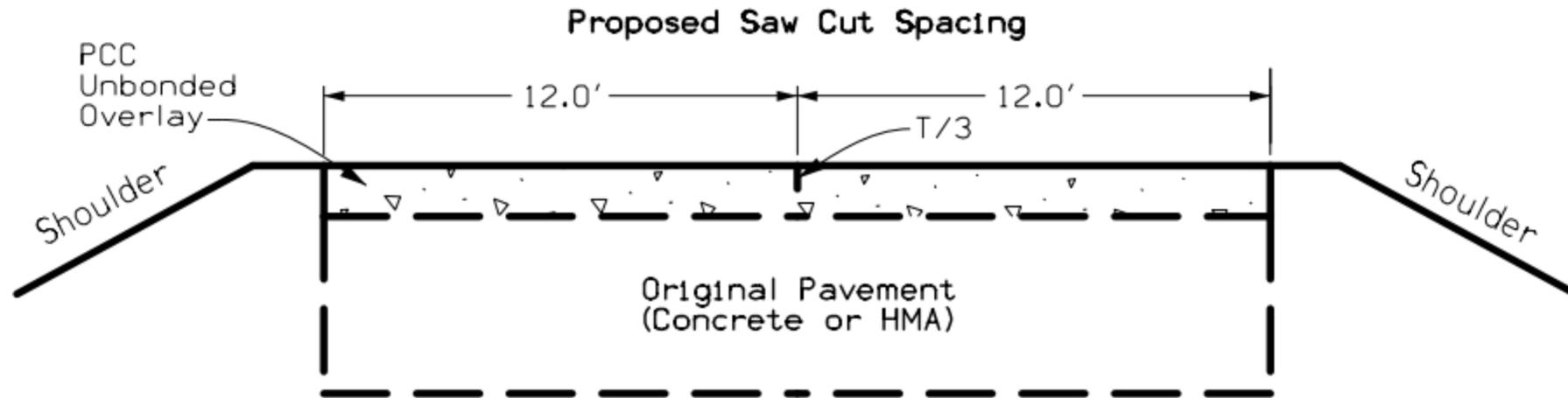
Plan & Spec Development: Information Needed

- Location
- Geometrics
- Maintenance of traffic requirements
- Existing & proposed profile(s)
- Special Details:
 - Pre-Overlay repair directions
 - Milling & Interlayer treatment (B or U)
 - Jointing
 - Transition and adjustment details for addressing profile elevation at bridges, curb & gutter, side slopes, etc.

Include digital survey & design data when available:

- Design model
- Elevations
- LiDAR scans of existing pavement

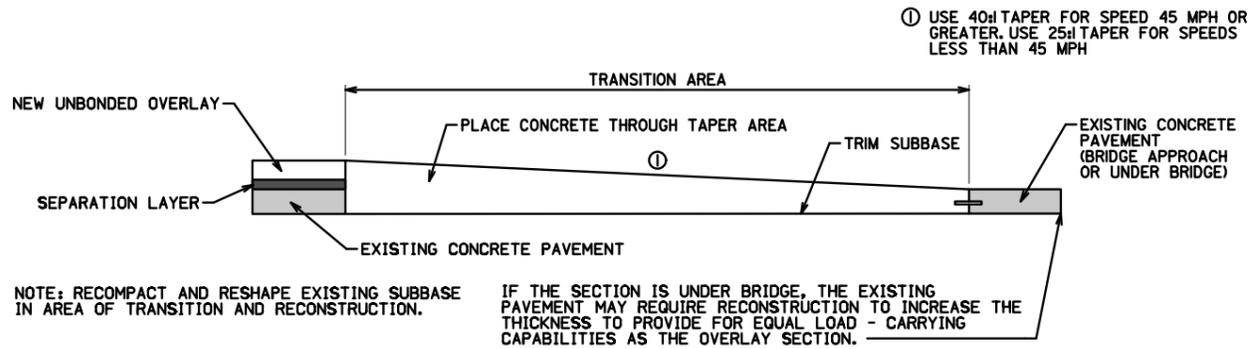
Example of Typical Overlay Section Detail



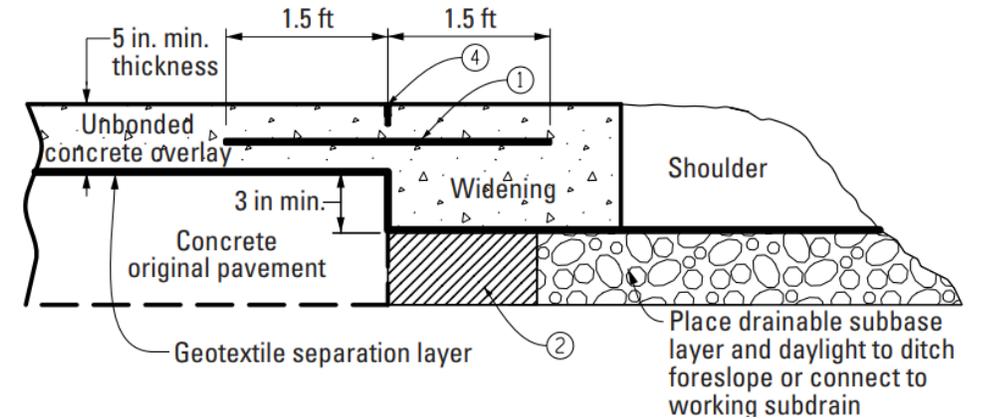
Source: CP Tech Center

Unbonded concrete overlay on asphalt (COA-U) without widening

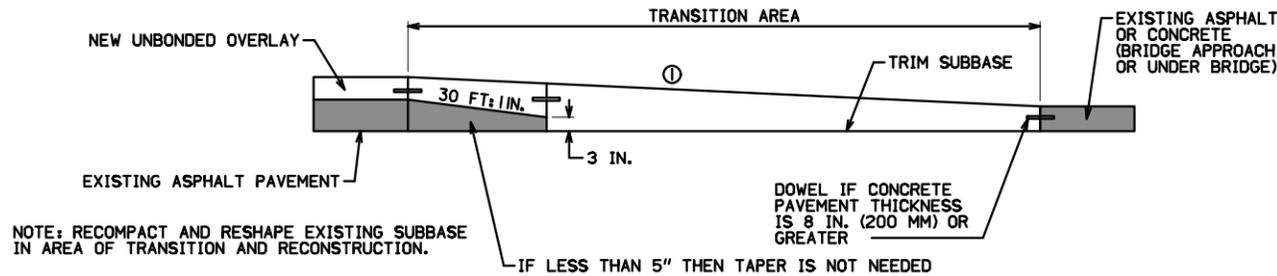
Standard Details



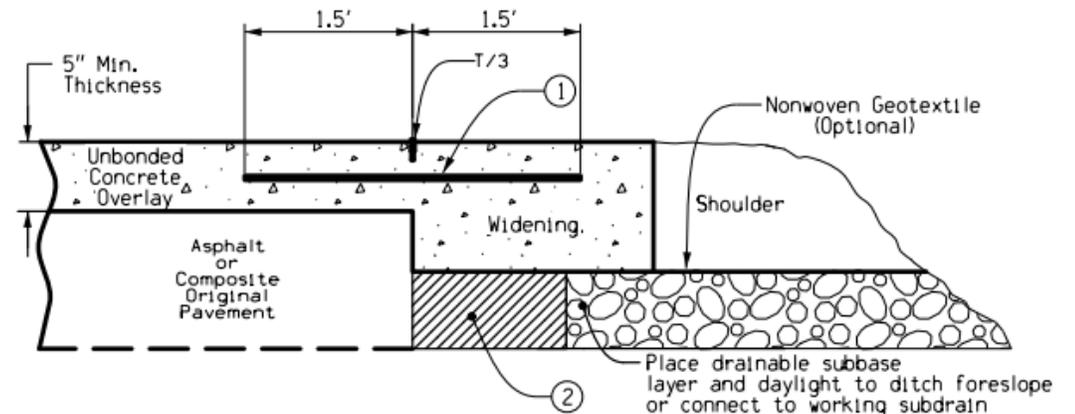
COC-U Transition Detail



COC-U Widening Detail (geotextile separation)



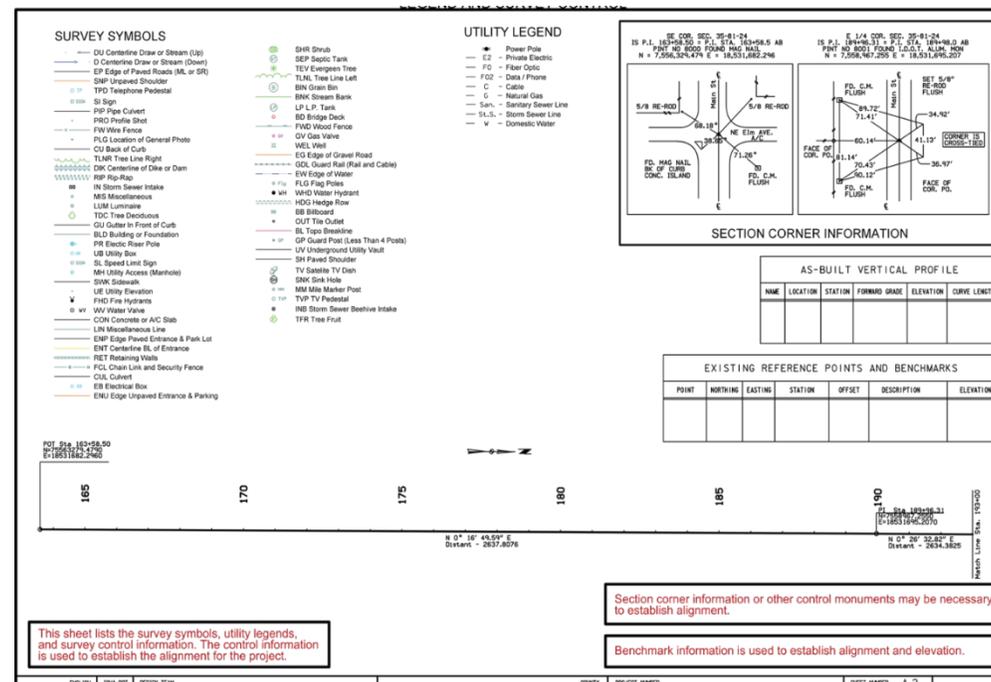
COA-U Transition Detail



COA-U Widening Detail

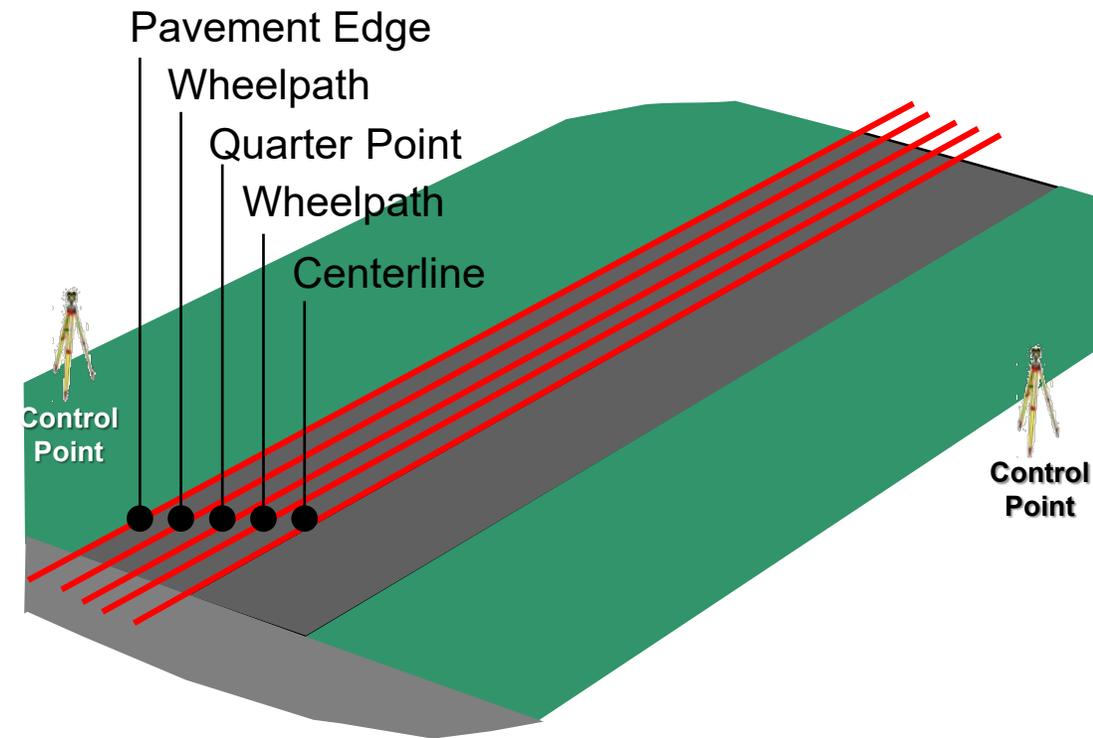
Survey Information Sheet(s)

- Survey of existing pavement required if profile needs to be changed or ride quality needs improvement.
- Contractor needs info to develop the design profile and pavement model (for 3D machine control)
- Include:
 - Control points
 - Alignment & Curve data
 - Existing pavement elevations



Survey Information Sheet(s)

- An optimized overlay profile should meet three objectives:
 1. ensuring that the concrete overlay is constructed to the proper thickness tolerance
 2. achieving a specified smoothness
 3. minimizing yield loss on the volume of concrete needed
- To meet all three, prepare and include a survey of the existing pavement that accurately models the surface



Maintenance of Traffic Sheet(s)

- Include if insufficient detour routes make road closure impractical
- Details may depend on overlay thickness, width, edge drop-off
- Tailor details to facilitate desired construction durations
 - Time-related incentives and disincentives
 - Provide for accelerated concrete at critical access locations
 - Be careful on durability qualification of accelerated concrete mixtures
 - Accelerated curing with insulating blankets
 - Maturity monitoring to determine opening

Maintenance of Traffic – Best Approach

- Engineer should specify criteria to contractor:
 - Number of lanes to remain open
 - Pilot car queue length (time limit)
 - Required milestone dates
 - Access requirements to businesses/private residences
- Contractor should provide:
 - Staging plan to execute work
 - Communication plan to local businesses/residents

Materials



Constituents – Cementitious Materials

- Cement: Typically Type I, IL or II
 - Consider availability and sustainability
- SCMs: Typically Class C or F fly ash and slag cement
- Blended cements (ASTM C595) and hydraulic cements (ASTM C1157) also used successfully
- Type III cement – NOT recommended because of increased cracking due to drying and thermal shrinkage

Constituents – Aggregates

- Follow your typical state requirements for concrete paving or conform to ASTM C33/C33M for physical properties
- Follow guidelines for a combined gradation that produces a well-graded blend of coarse/fine material
- Follow your state requirements for durability (ASR, D-cracking)
- Assess through trial batches of concrete using the specific project aggregates that establish the final mixture characteristics



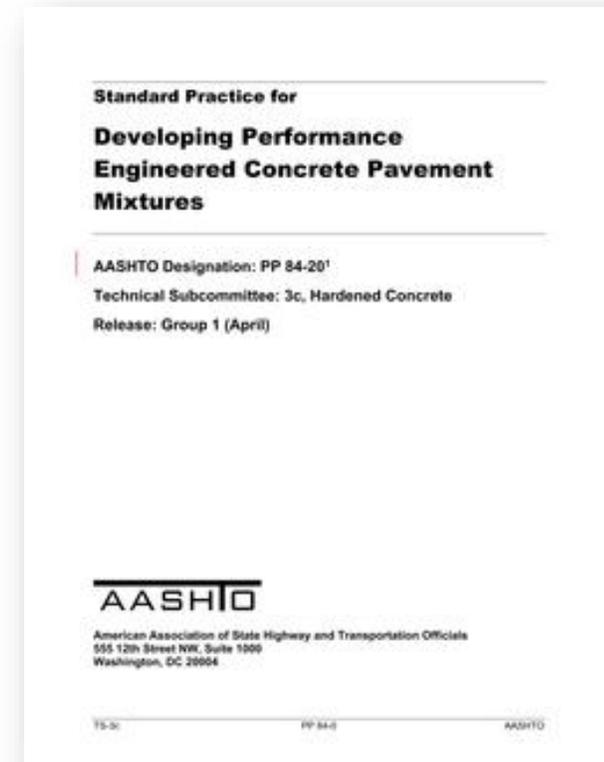
Constituents – Admixtures

Including:

- Air entraining admixtures (ASTM C260/C260M)
- Water reducers (ASTM C494/C494M and AASHTO M 194)
- Accelerators (use caution especially during warm weather)
- Set-retarding admixtures (use with caution for thin overlays)
- Prepare trial batches with job materials under job conditions

Performance Engineered Mixtures (PEM)

- AASHTO R101 specification
- PEM can help define and achieve the desired performance properties for a given mixture
- PEM focuses on:
 - Strength
 - Cold weather resistance
 - Wet freeze-thaw
 - Workability
 - Shrinkage
 - Aggregate stability
 - Permeability.



AASHTO R101 (PP 84) specification

PEM – Strength

- Similar to conventional paving mixture
- Do not specify high-strength materials for thin overlays (<6 in.)
- Mixture must obtain the design strength requirement, but also be workable and durable for local environment
- Adding macrofibers increases toughness, which is more beneficial than increasing strength
- Maturity testing helpful



PEM – Workability

- Similar to that of a conventional paving mixture
- Important in slipformed paving
- Influenced by:
 - Aggregate gradation
 - Mix proportioning
 - Placement sequence
 - Macrofibers
 - Water-reducing admixtures
- In addition to slump test, also recommend:
 - Vibrating Kelly ball (VKelly) test
 - Box test

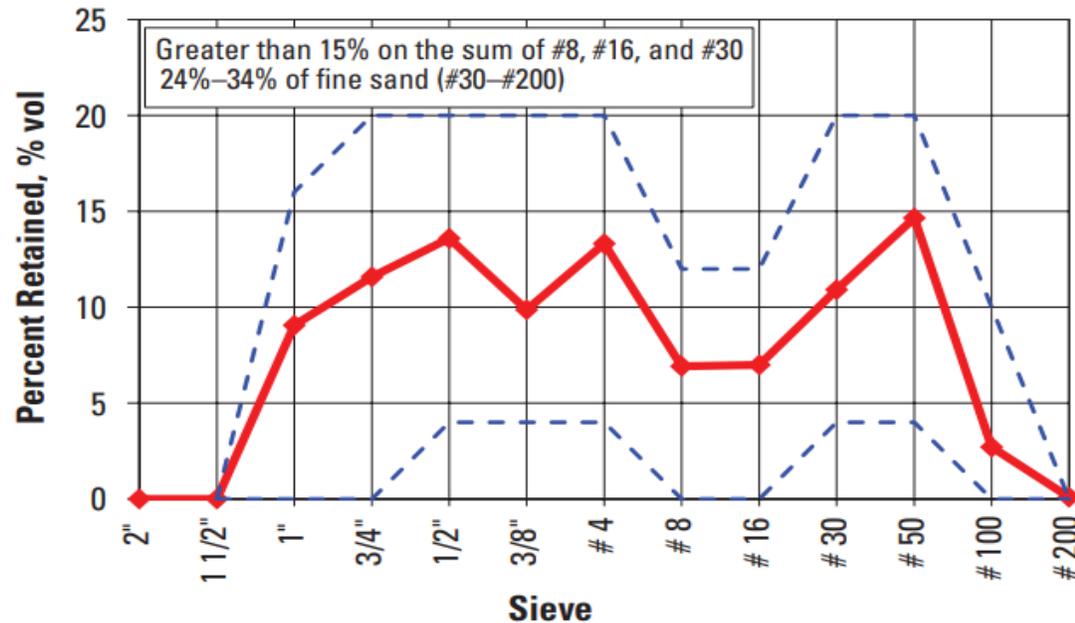


PEM – Shrinkage

- Thinner (<6 in.) concrete overlays can be more susceptible than conventional pavements to shrinkage
- Volume of paste is the main factor controlling the shrinkage magnitude of a mixture.
- Volume of paste can be reduced by:
 - Limiting the cementitious materials content
 - Adopting an optimized aggregate gradation (Tarantula Curve)
- Paste volume of 25% or less may provide successful mixes.

PEM – Aggregate Gradation

- Tarantula curve: effective means of “optimizing” the aggregate blend
- Adjust the ratios of the aggregates available to achieve the desired combined gradation within the envelope



Information available at:
<http://www.tarantulacurve.com/>

PEM – Cold Weather Resistance

- Minimize joint spalling risk in cold weather environments:
 - Adequate air content and proper air distribution
 - Low permeability
- Using SCMs in mixture can help reduce the risk of joint deterioration and spalling
- ACI Committee 201 suggests using a spacing factor of 0.008 in. and specific surface of 600 in^{-1} to determine frost susceptibility
- Super Air Meter (SAM) Test may be helpful

Water to Cementitious Materials Ratio

- w/cm ratio is a key parameter affecting workability, strength, permeability, and durability of any concrete – overlays are no exception
- It is advisable to design a mixture for concrete overlays using a w/cm ratio between 0.40 and 0.45 (or lower) depending on the local climate and materials

Water to Cementitious Materials Ratio

Ways to achieve a moderately low w/cm ratio while maintaining satisfactory workability:

- Using SCMs in appropriate dosages
- Using a well-graded system, which reduces the paste volume for the same level of workability
- Using water-reducing admixtures
- Controlling concrete temperatures. High temperatures can lead to higher w/cm ratios. In cold temperatures, SCMs can reduce set time.

High-Early Strength Considerations

- Limit use to critical access locations only if no other options are available
- Generally, high-early strength mixtures have:
 - Higher cementitious material contents
 - Lower w/cm ratios
 - Water reducing and accelerating admixtures
- Such mixtures undergo more shrinkage and have rapid heat generation compared to conventional mixes, requiring more careful attention.

Fibers



Overlay Materials – Macrofiber

Measurable benefits of macrofibers:

- Additional structural capacity from fatigue resistance (allowing thinner concrete slabs)
- Reduction in crack widths
- Maintenance of joint or crack load transfer efficiency
- Extension of pavement serviceability through reduced crack deterioration
- Minimal panel migration



Overlay Materials – Macrofiber

Types of macrofibers:

- Synthetic (more common)
- Steel

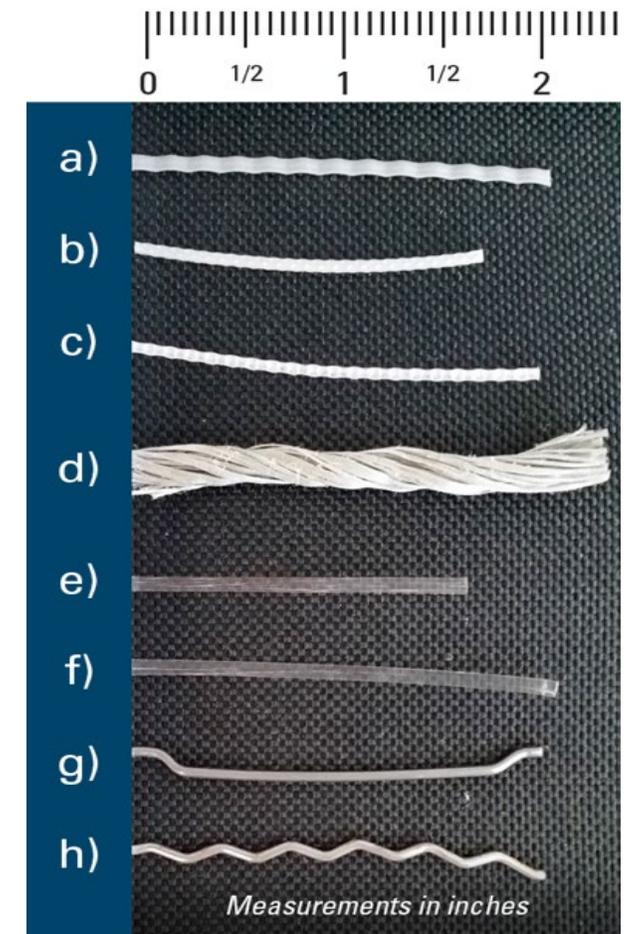
1.0 to 2.5 in. long with an aspect ratio of 30 to 100

(a-c) crimped, embossed, or bi-tapered synthetic;

(d) twisted synthetic;

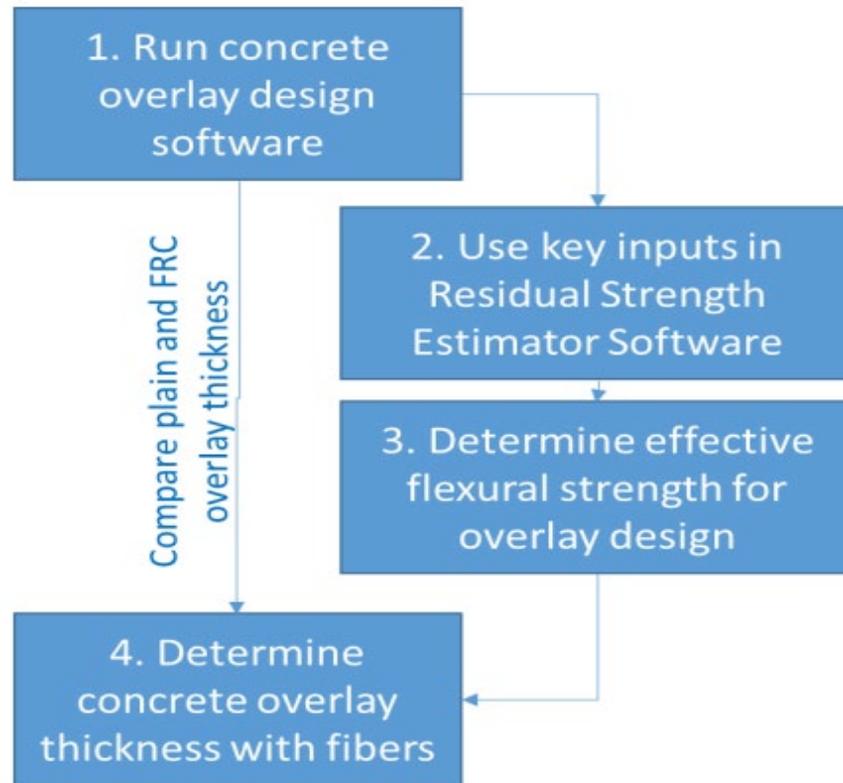
(e-f) straight fibrillated synthetic;

(g-h) hooked end and crimped steel

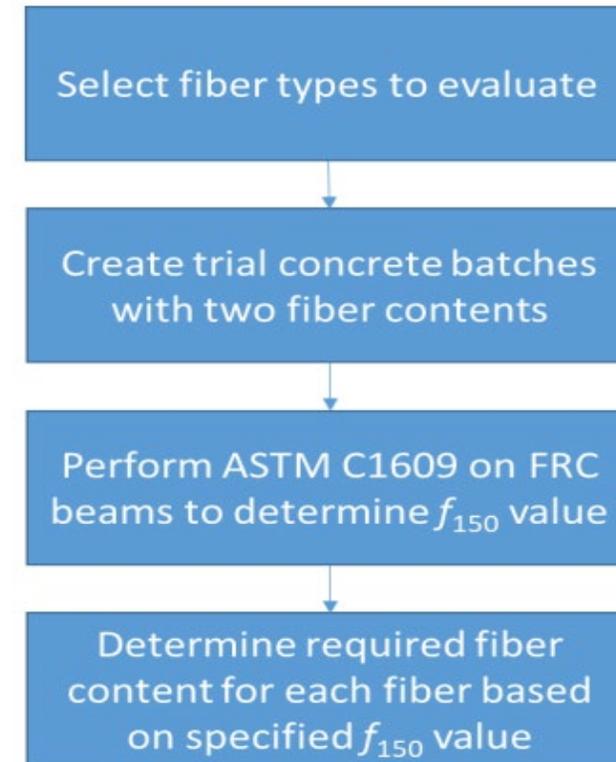


Overlay Materials – Macrofiber

Designing overlay FRC overlay thickness:



Determining quantity of fibers needed:



Dosage depends on required strength

Overlay Materials – Macrofiber

The required macrofiber content, volume percentage, and dosage rate depend on:

- Specified residual strength
- Constituents and proportions
- Strength of the concrete

The typical macrofiber dosage rates in concrete overlay:

- 3 to 8 pounds per cubic yard for synthetic fibers
- 25 to 75 pounds per cubic yard for steel fibers, or approximately 0.2% to 0.5% by volume

(Roesler et al. 2019)

Overlay Materials – Macrofiber

Effects on the fresh and hardened properties of concrete:

- Decreased concrete workability: use water reducing admixtures
- Air content can be indirectly affected: use air entraining admixture
- Macrofiber balling due to type and volume of macrofibers and type of mixer: follow manufacturer's recommendations
- Improved post-cracking strength, toughness, and the flexural fatigue performance of concrete

Useful Resources to Help You With Macrofibers

Residual Strength Estimator for Fiber-Reinforced Concrete Overlays

Instructions: Run an overlay design software to determine the design inputs. Select design choices from the drop-down menus below to narrow down the recommended performance requirement of FRC for the proposed overlay pavement. Determine the effective flexural strength to input into overlay design software instead of design concrete flexural strength. Prepare specifications to achieve design residual strength of FRC material.

Design Input Choices

| | |
|---|-------------------------------|
| Type of Overlay Road | Local Road/Street |
| Millions of ESALS in Design Life | 0.01 to 5.0 million ESALs |
| Asphalt Pre-Condition* | Fair |
| Desired New Concrete Thickness | 3 to 4.5 inch PCC thickness |
| Remaining HMA Thickness after Milling | 4.5 to 6 inches HMA remaining |
| Overlay Slab Size | 6ft joint spacing |
| Desired Performance Enhancements <i>(this will generate a higher residual strength, but not included in effective flexural strength)</i> | basic FRC overlay |
| Plain Unreinforced Concrete Flexural Strength (MOR) <i>based on 28 day Four Point Bending (ASTM C78 or ASTM C1609)</i> | 600 psi |

*refer to Tech Report to example estimates of asphalt pre-condition

Design Suggestions/Warnings:

Recommended Residual Strength (f_{res})

Use value within this range for the Material Specification:

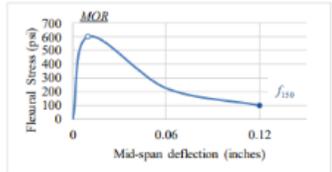
100 to 150 psi (target value from ASTM C1609 test results of FRC)

Effective Flexural Strength (f_{ef})

Replace the MOR from the Pavement Design Software with this value:

700 psi

NOTE: Actual fiber dosage rates are dependent on fiber type, fiber dimensions, concrete mixing/placement technique, cement content and fiber content or volume fraction. The intended fiber and dosage rate should be verified by ASTM C1609 test method. These recommended values are based off of previous field and laboratory testing of fibers used in concrete overlay pavements. Refer to the Tech Guide or Tech Report for more details.



Fiber-Reinforced Concrete for Pavement Overlays: Technical Overview

Final Report
April 2019



Sponsored by
Federal Highway Administration
Technology Transfer Concrete Consortium (TTCC) Pooled Fund TPF-5(313)
(Part of Intrans Project 15-532)

IOWA STATE UNIVERSITY
Institute for Transportation

National Concrete Pavement Technology Center

Optimized Joint Spacing for Concrete Overlays with and without Structural Fiber Reinforcement

Final Report
May 2019



National Concrete Pavement Technology Center

IOWA STATE UNIVERSITY
Institute for Transportation

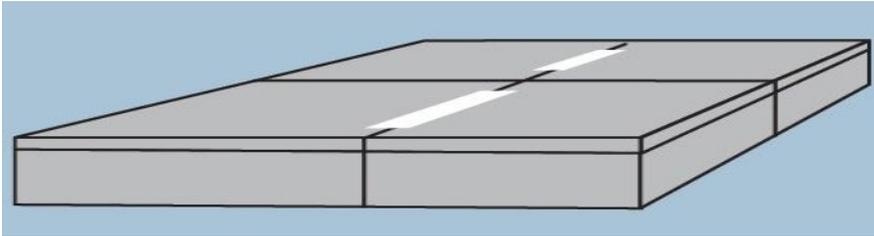
Sponsored by
Iowa Highway Research Board (IHRB Project TR-698)
Iowa Department of Transportation (InTrans Project 15-559)

These reports are disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange under Cooperative Agreement 693JJ31950004, Advancing Concrete Pavement Technology Solutions. The U.S. Government assumes no liability for the use of the information.

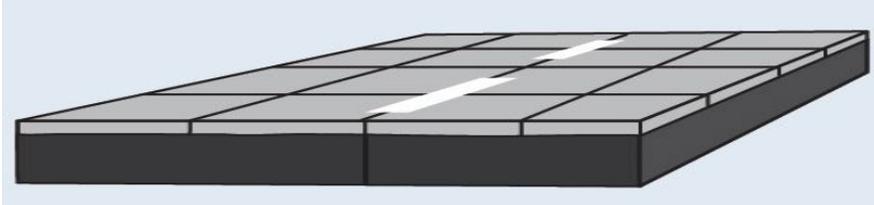
Interlayers



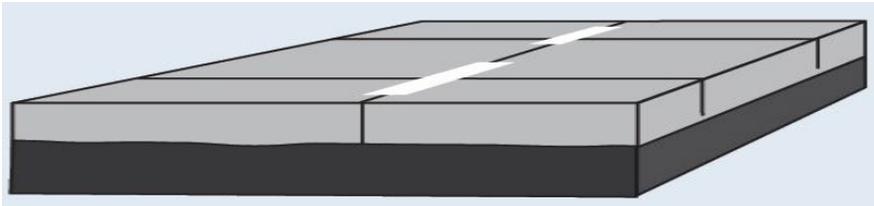
Interlayer Basics



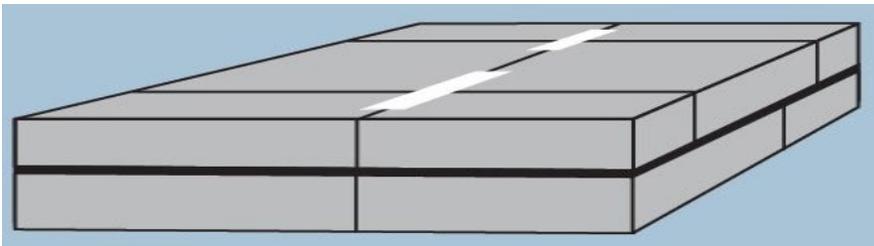
COC-B



COA-B



COA-U



COC-U



No material required; just milling to roughen surface and cleaning to help improve bonding

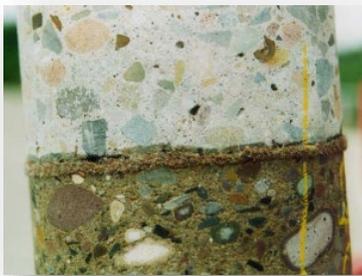
No material or milling/cleaning required

Separation interlayer material required

Separation Interlayer Specific to COC-U

- Goal is to allow concrete pavements to act independently
- Two basic options:
 - Nominal 1-in asphalt layer
 - Geotextile fabric interlayer

(Isolation, drainage, bedding)



← Create Smoother Slip Plane →

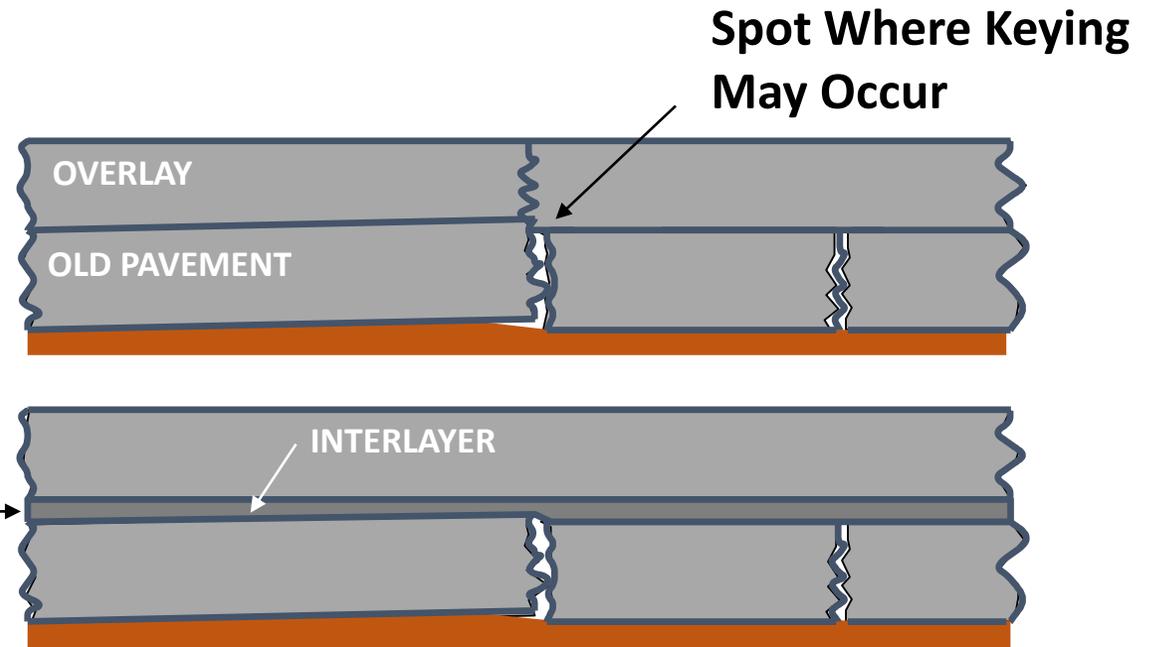


Image source: American Concrete Pavement Assn.

Image source: Voigt

Asphalt Interlayer Option in COC-U

- Keep layer about 1 in. thick to minimize risk of additional consolidation (lack of density)
- Apply your state asphalt material spec
 - Aggregate gradation appropriate for 1- inch nominal mat
 - Typical density/air void requirements
 - Require anti-stripping agent (lime)



Consider open-graded asphalt only if concerned with drainage or heavy truck traffic unique to project

Fabric Interlayer Option in COC-U

- Nonwoven geotextile specifically made for use as interlayer
- Used in US since 2008
- Provides uniform, elastic support
- Reduces pumping and minimizes reflective cracking from the underlying pavement



Fabric Interlayer Option for COC-U

SPECIFY:

- Non-woven fabric
- < 5 inch thick overlay – 13 ounces/square yard @130 mils thick
- \geq 5 inch thick overlay – 15 ounces/square yard @170 mils thick

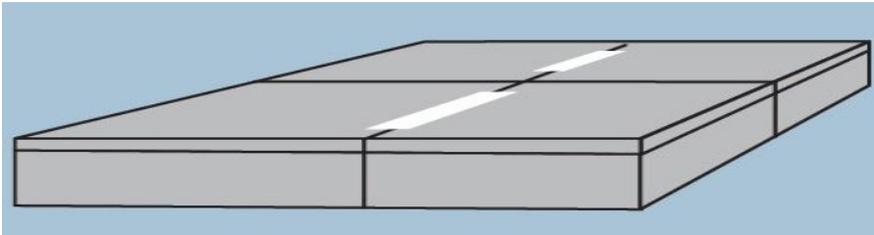


Jointing Details



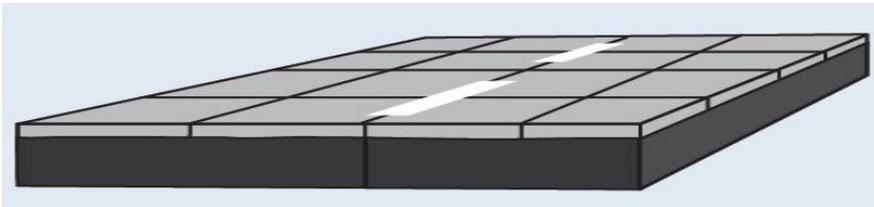
Image source: CP Tech Center

Jointing Basics



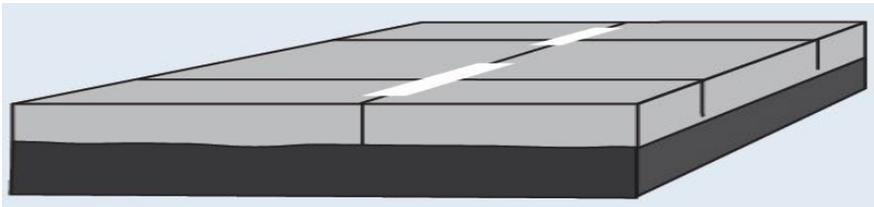
COC-B

Must match all existing joints (Lng. & Tr.);
no dowel bars or tiebars required



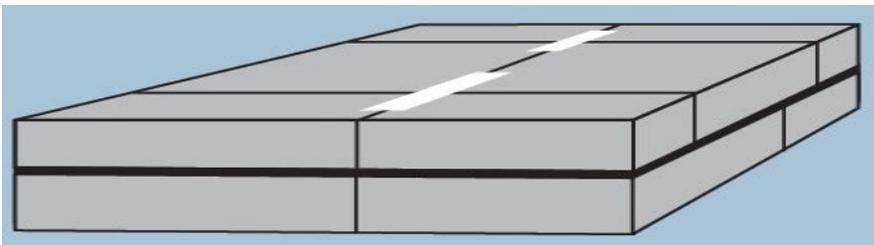
COA-B

Shorter spacing can strengthen thinner
overlays; need for dowel bars and
tiebars depends on thickness



COA-U

Use conventional joint spacing and dowel/tiebar
recommendations; no special requirements



COC-U

Use conventional joint spacing and dowel/tiebar
recommendations; mismatching joints optional

Jointing Basics

- Use same details/notes as for conventional concrete pavement for:
 - Cut-depth = $T/4$ min. to $T/3$ max.
 - Joint width = Min. 1/8 inch (wider if sealing not filling)
 - Sealant reservoir = as applied in your state

Some states had issues with stripping of asphalt interlayers – in addition to adjusting the asphalt mixture to address the problem they recommend sealing/filling joints when using this type of interlayer for COC-U

Joint Spacing for COC-U and COA-U

- For ≤ 6 in. thick overlays keep max spacing to 21 times thickness
- For > 6 in. thick overlays keep max spacing to 24 times thickness
- Do not exceed 15 feet
- Extra considerations for COC-U:
 - Match isolation/expansion joints in overlay if such joints are present in existing pavement
 - Mismatch transverse joints if feasible

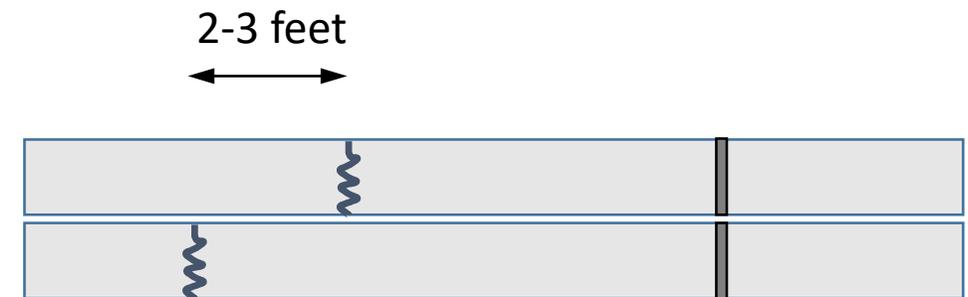


Image source: Voigt

Joint Spacing for COA-B

- Shorter joint spacing helps reduce slab bending under load
- Should range between 12 to 18 times overlay thickness.
- Avoid wheel path locations if possible
- Typical is 6 ft (Lng. and Tr.) to divide conventional 12 ft lane equally and avoid wheel paths



Joint Spacing for COA-B



COA-B

- Because thinner...requires spacing closer than conventional pavement.
- Squares divisible to lane geometry easiest to apply
- 6x6 ft common
- Single saw cut

Dowel & Tiebar Details



Tiebars in Longitudinal Joints?

- Standard for: COC-U, COA-U
- Optional for: COA-B



Dowels in Transverse Joints?

- Standard for: COC-U, COA-U
- Optional for: COA-B

Keep your conventional state requirements for dowels & tiebars in COC-U and COA-U

COA-B Dowel Bar Considerations

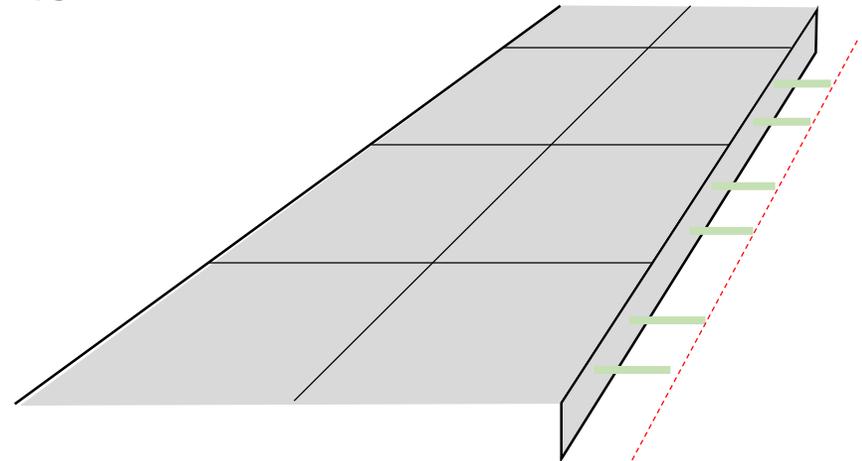
- Not required if thickness ≤ 6 in.
- Optional “additional assurance” at +7 in.
- Select bar diameter
- Anchoring important to asphalt substrate
 - Power nailing with clips
 - Adjust anchor length for secure hold
 - Clip both approach and leave sides
 - Min. 8 per 12-ft standard length basket
- Do not cut shipping wires and weaken frame

| COA-B Thickness | Dowel Diameter |
|-----------------|-----------------|
| 6 in. or less | -- |
| 7 in. | 1.0 in. (opt.) |
| 8 or more | Follow Standard |



COA-B Tiebar Considerations

- Technically not necessary when bonding to a milled surface
- Sometimes specified as “additional assurance”
- May complicate:
 - Maintenance of traffic (MOT) because requires larger work area
 - Constructability to avoid transverse joints
 - 2 tiebars per slab ideal
 - 6 ft panel would require 24 in spacing and skipping every third bar
- If use, limit size 18 in. No. 4 bar



Joint Filling/Sealing for Overlays

- Value may depend on the climate and the overlay's slab geometry.
 - Multiple states omit when slabs ≤ 6 ft.
 - MNDOT performance history indicates filled joints extend overlay life
- If used, then:
 - Fill – don't seal (no backer rod!)
 - Use state's filler installation and material specs

Special Details

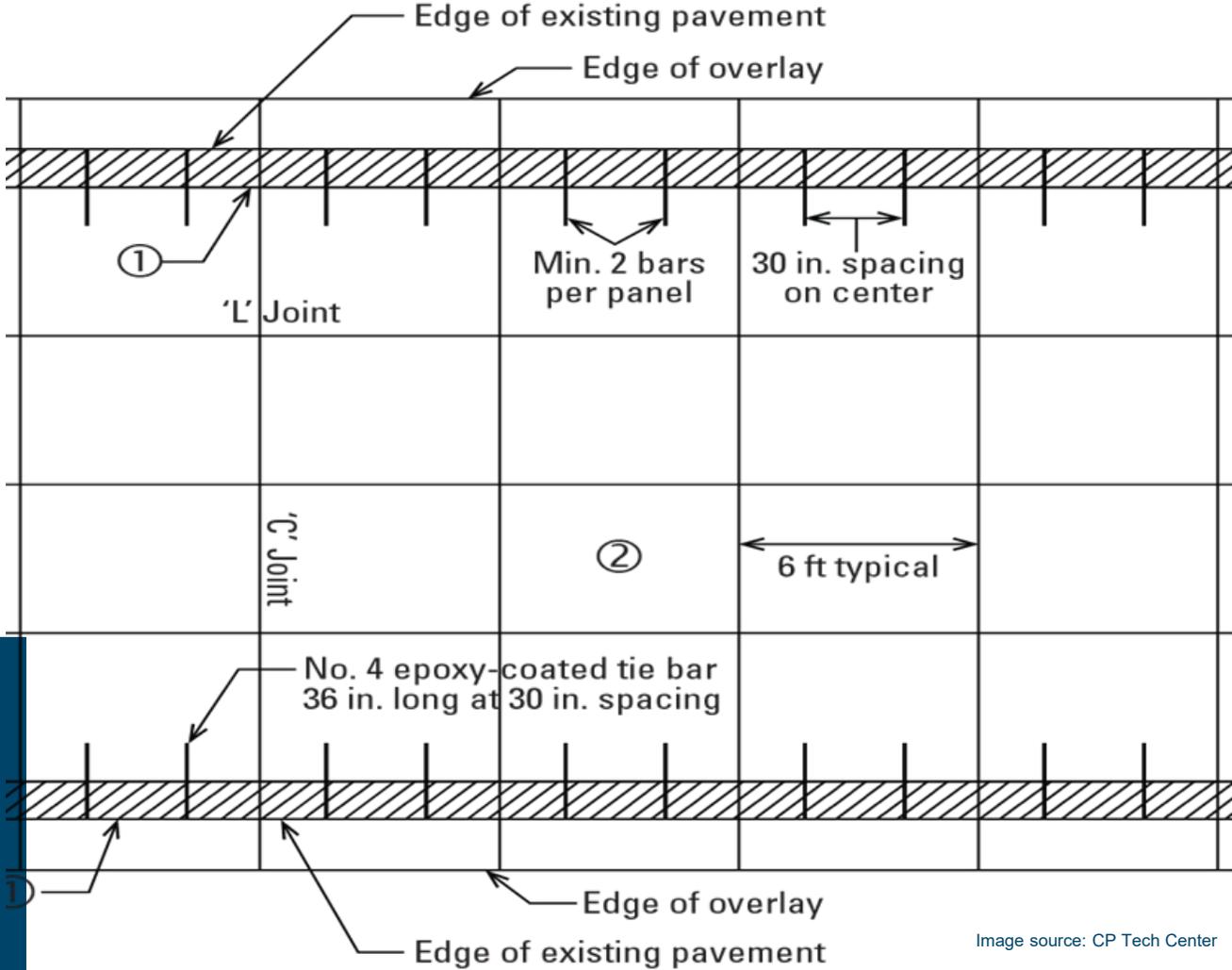


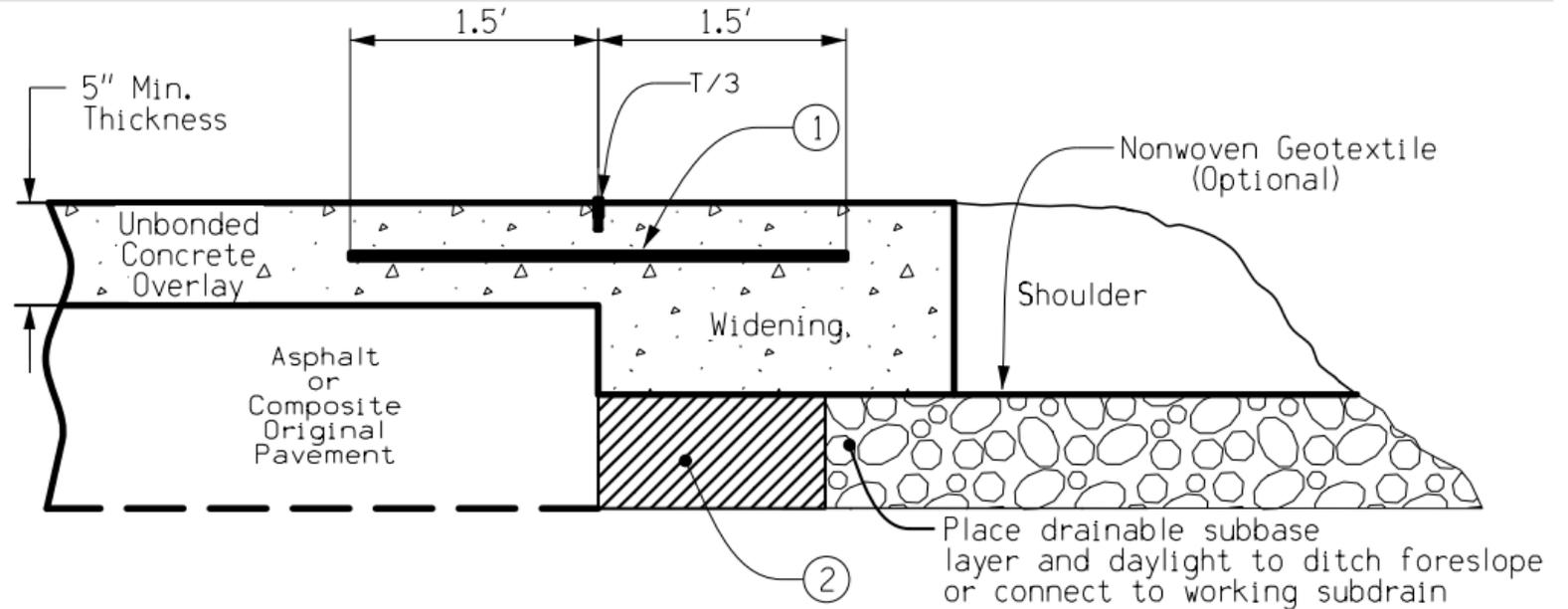
Image source: CP Tech Center

Special Details - Widening

- Reinforcing steel:
 - max no. 4 deformed tie bars to prevent longitudinal cracking
 - overlay ≥ 5 in. thick: place bars at the mid-depth of slab
 - overlay < 5 in. thick: secure bars to surface of existing pavement
- Improved drainage:
 - incorporate a drainable subbase layer
 - daylighting the separation layer material to the edge of the roadway
- Widening unit in the existing pavement:
 - Remove if existing pavement is asphalt or concrete < 3 ft wide

Widening Detail

COA-U Example



UBCOA

WIDENING DETAIL

UNBONDED CONCRETE OVERLAY OVER
ASPHALT OR COMPOSITE WITH WIDENING

Source: CPTech Center

Widening Detail

COC-U Example

Notes: Dimensions of panels may change based on project specifics

L= Longitudinal joint (T/3)

C= Sawed transverse joint (T/3)

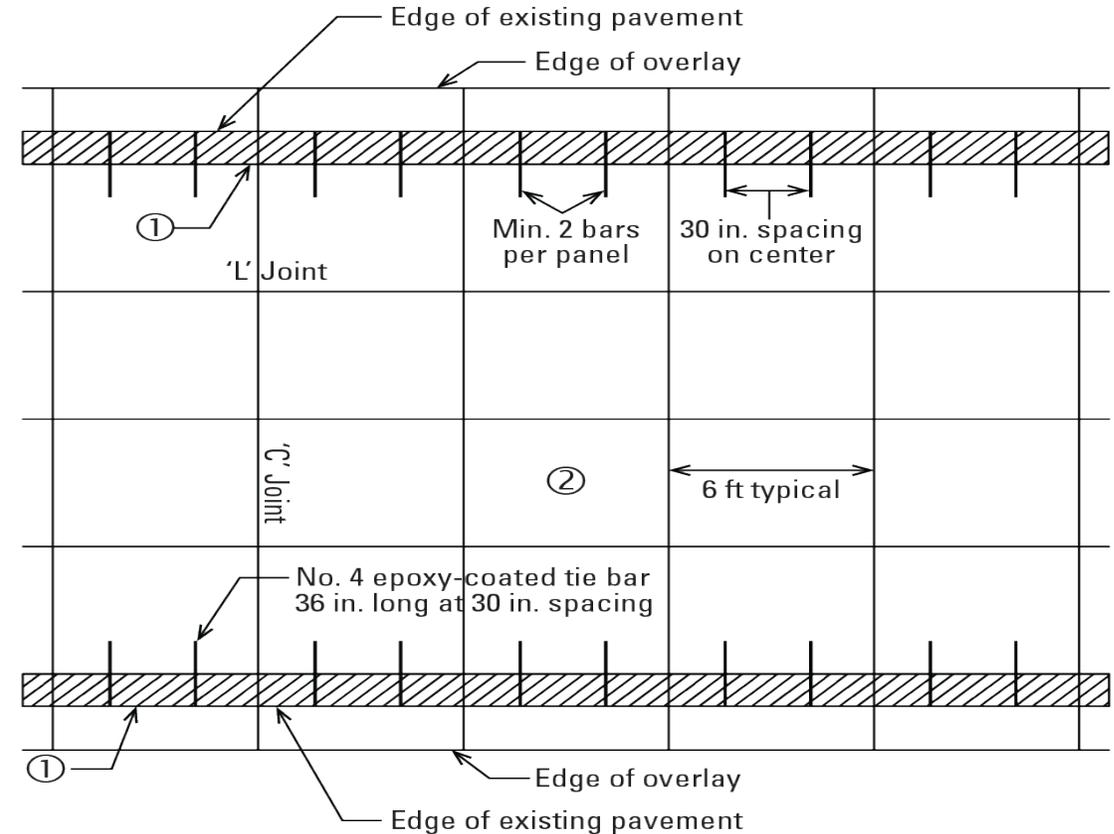
① Existing widening unit:

If asphalt, remove unit.

If concrete, unit may remain if stable and 3 ft wide.

If no widening unit, excavate and place drainable subbase.

② For unbonded overlays equal to or less than 6 in. thick, maximum joint spacing in feet is 1.5 times the overlay thickness in inches. For unbonded overlays greater than 6 in. thick, maximum joint spacing in feet is 2 times the overlay thickness in inches. Maximum recommended spacing is 15 ft.

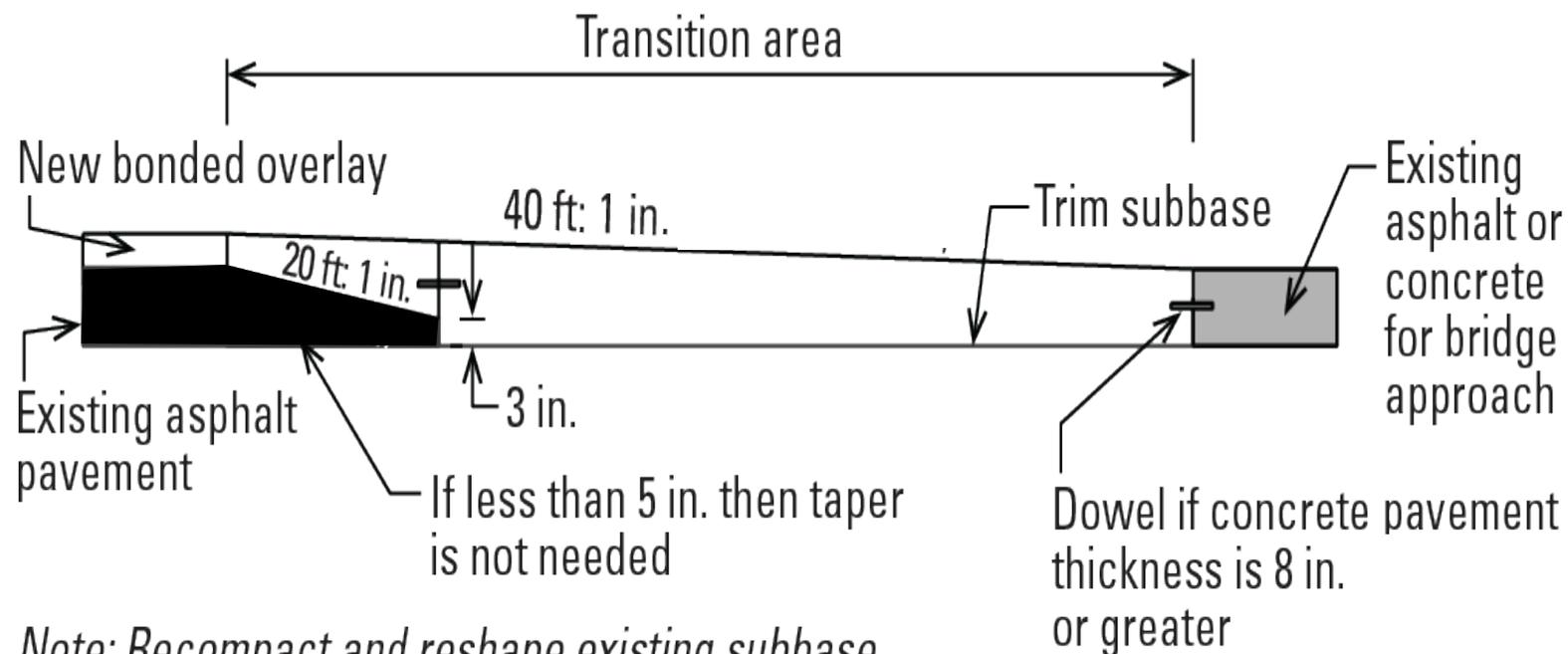


Source: CPTech Center

Special Details – Profile Transitions

- At the beginning and end of concrete overlay sections
- At transitions into bridge approaches
- Under structures where vertical clearance must be maintained
 - At bridge approaches always require full-depth pavement removal and replacement
 - For speed limit of 45 mph or greater: use a 40:1 vertical taper
 - For speed limits less than 40 mph: use a 25:1 vertical taper

Transition Detail

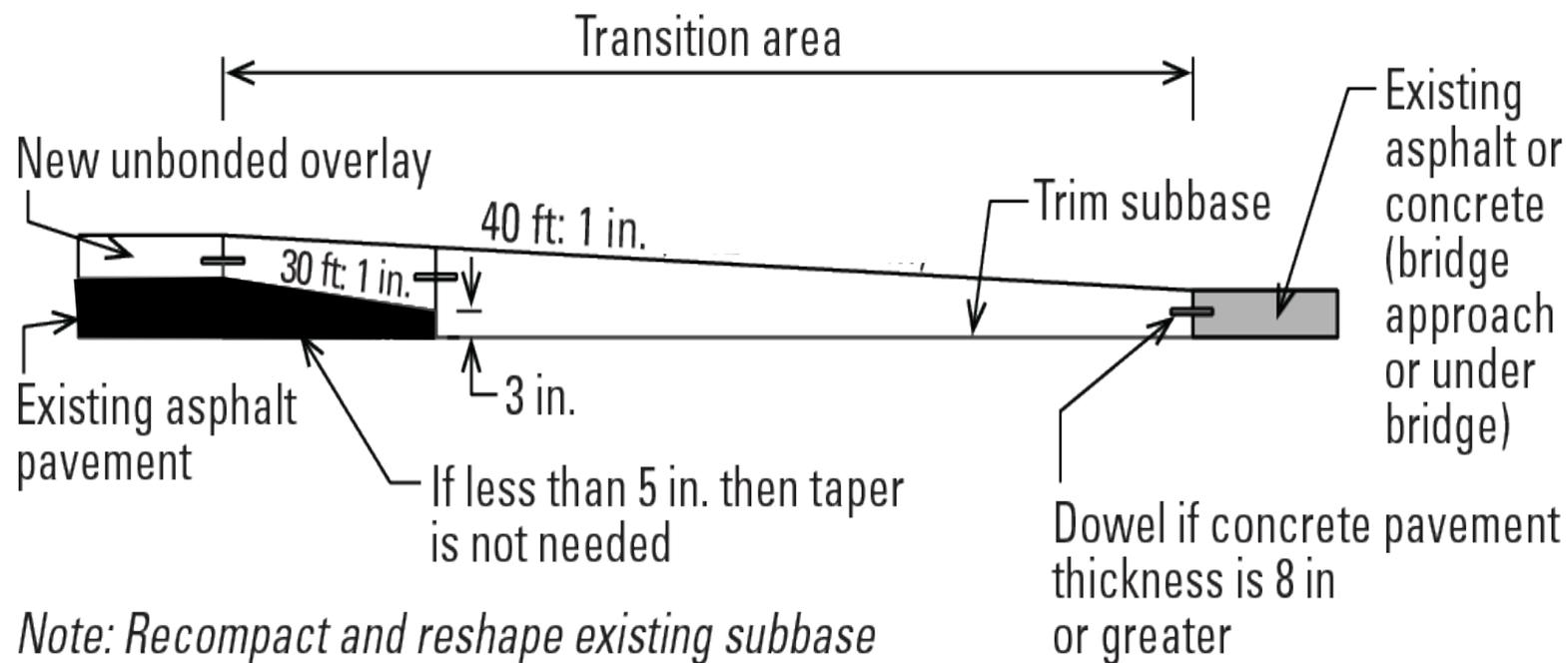


Note: Recompact and reshape existing subbase in area of transition and reconstruction.

Transition for a COA-B overlay

Source: CPTech Center

Transition Detail



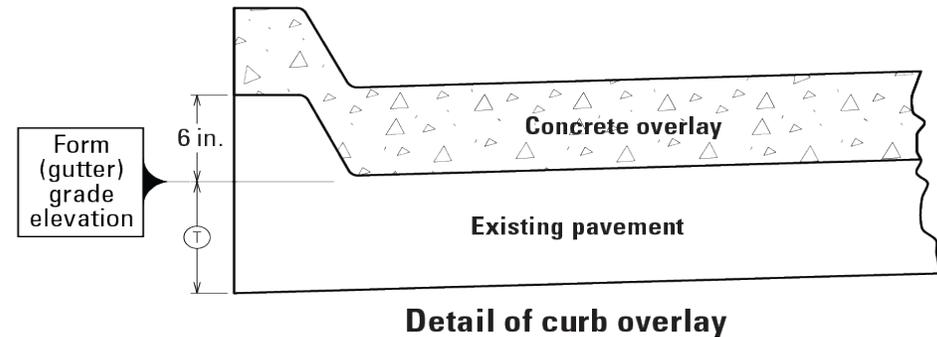
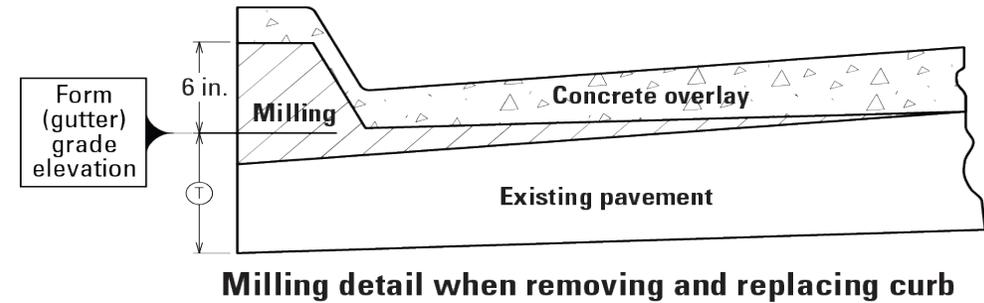
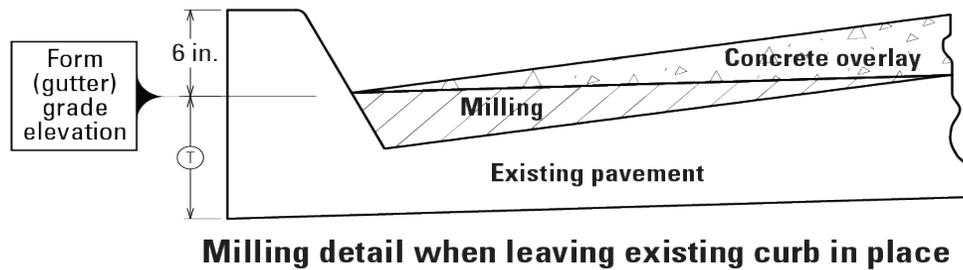
Note: Recompact and reshape existing subbase in area of transition and reconstruction.

Transition for a COA-U overlay

Source: CP Tech Center

Special Details – Curb & Gutter

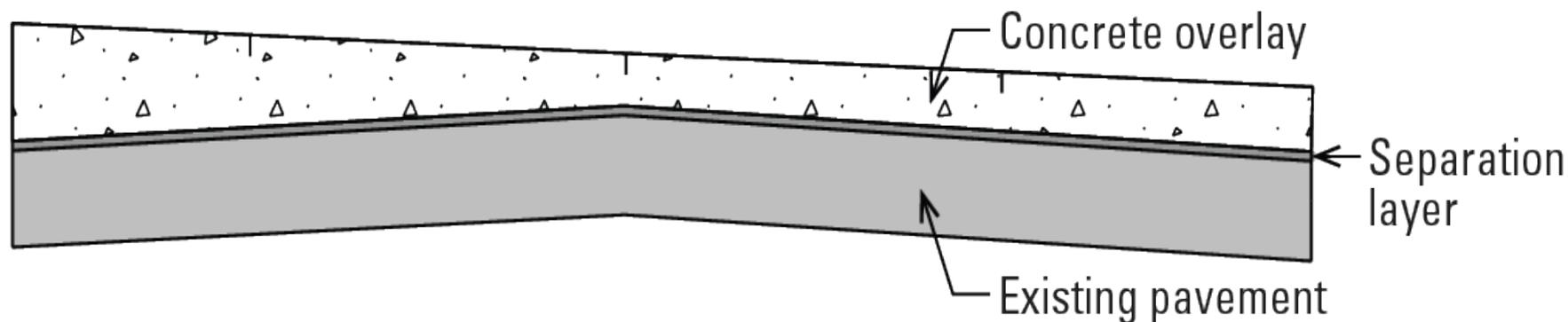
Three Options



Source: CPTech Center

Special Details - Superelevations

Apply if new areas of superelevation or increased superelevation



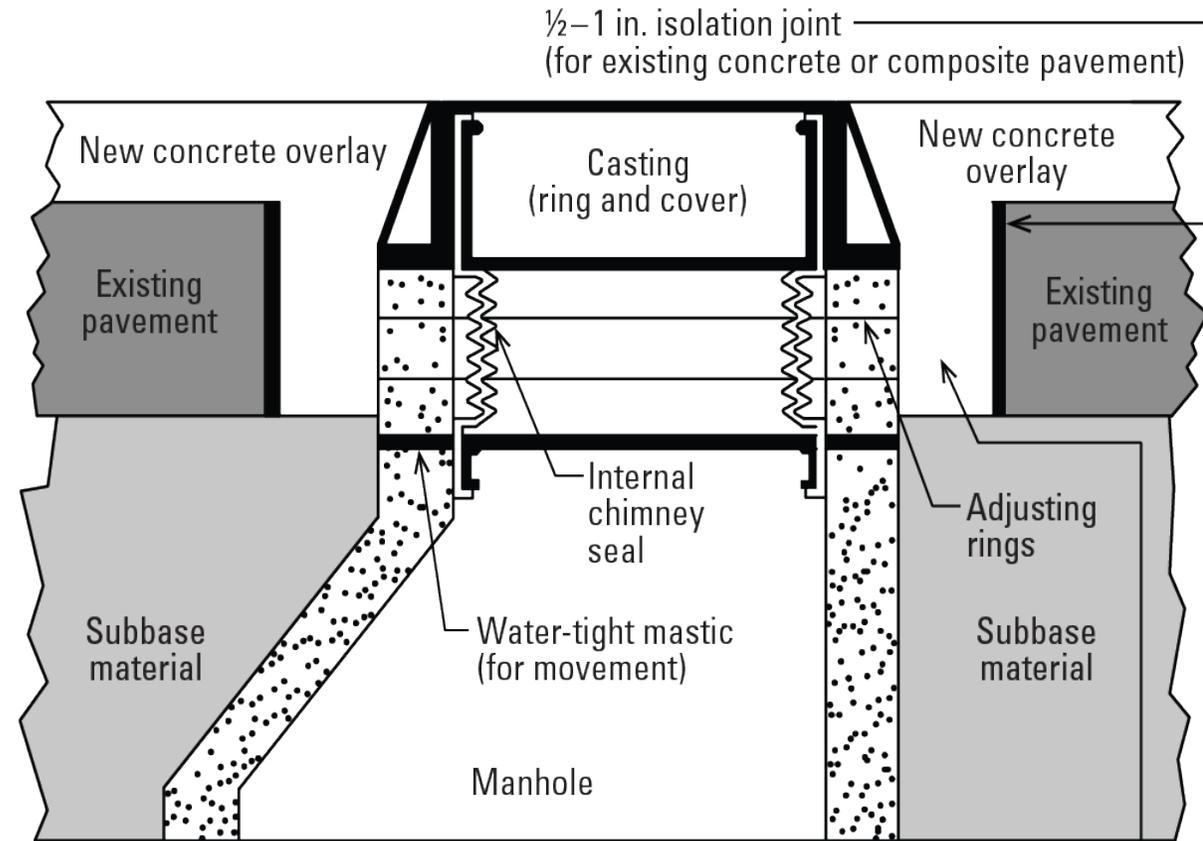
Note:

- *Ensure adequate sawing depth in thicker superelevated pavement areas.*
- *Maintain a minimum 2 in. cover if dowel bars are used.*

Source: CPTech Center

Special Details – Utility Access

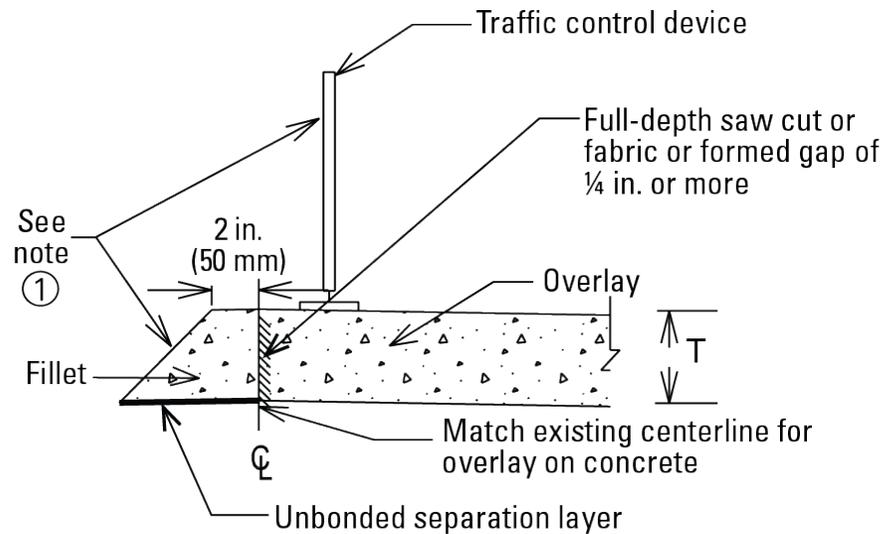
Ensure proper separation between structures and overlay



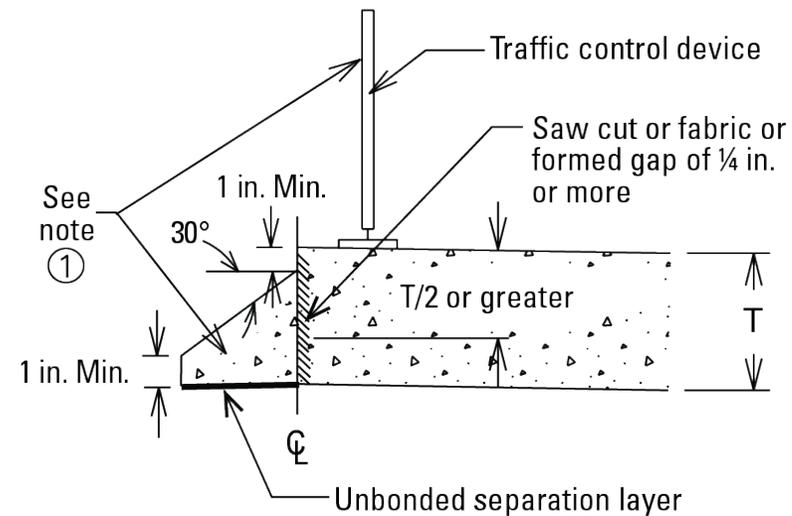
Note: Remove existing pavement around manhole and replace with concrete

Special Details – Temporary Safety Edge

- Required when constructing while adjacent lane is under traffic (temporary)
- The typical beveled angle is 30 degrees



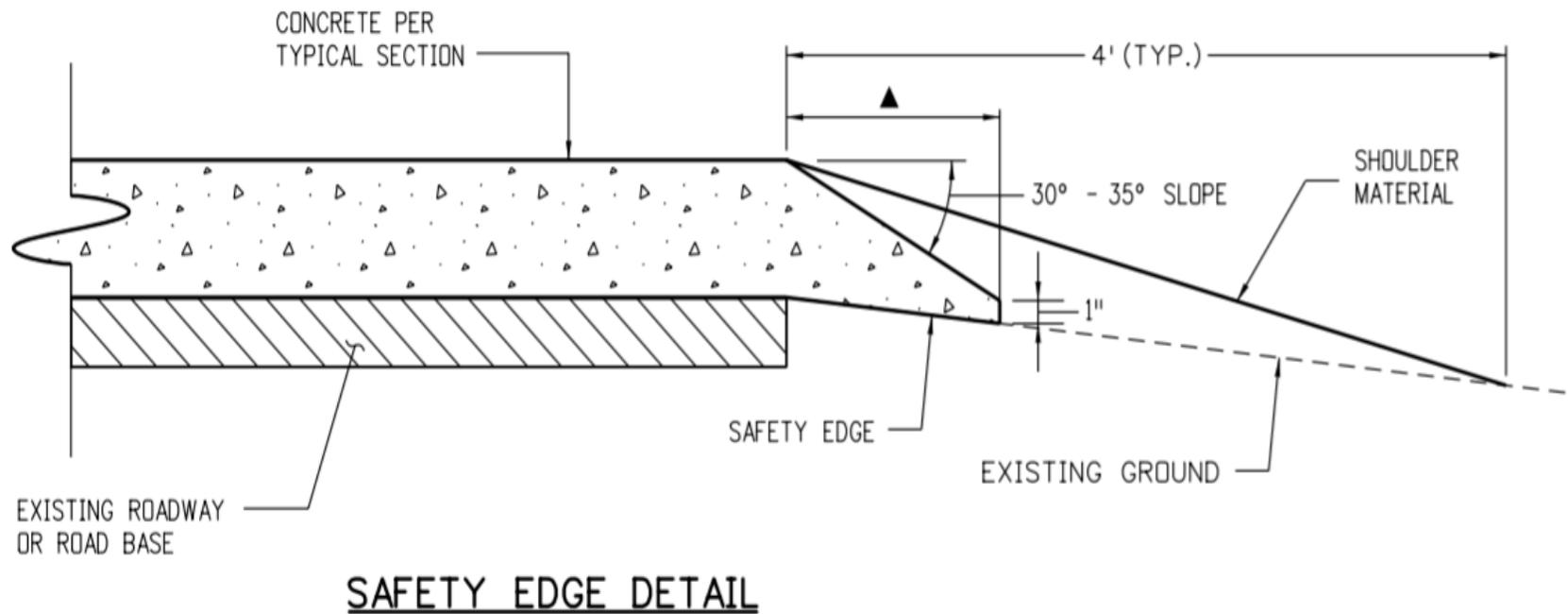
Bonded and unbonded overlay 3 in.–4 in. (50–100 mm) thick



Unbonded overlay greater than 4 in. (100 mm)

① Traffic control and slope of fillet depends on jurisdictional requirements.

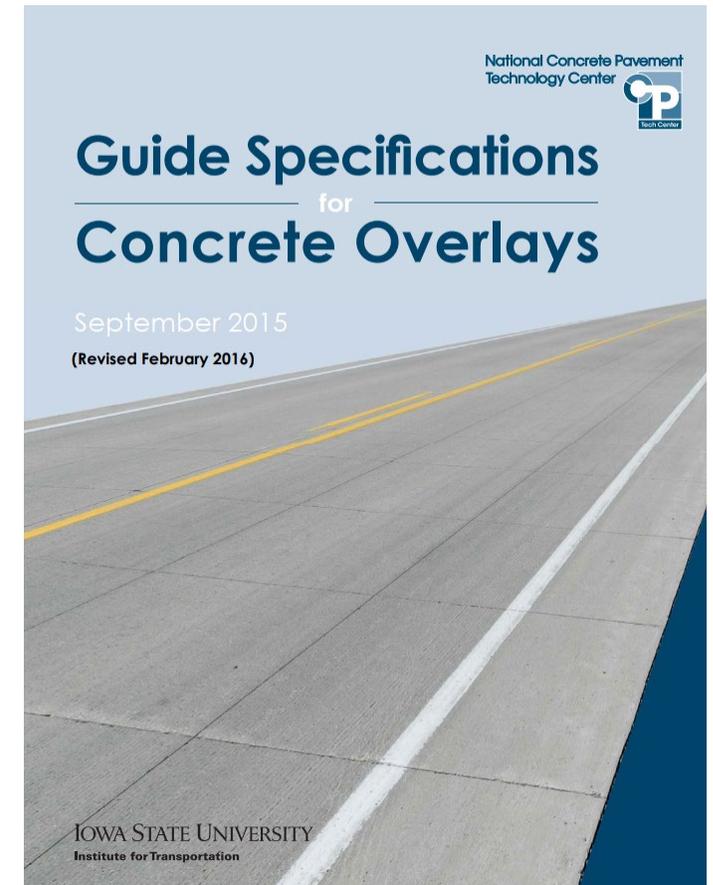
Special Details – Permanent Safety Edge



Source: CPTech Center

Construction Specifications

- Excellent resource
- Addresses all aspects
 - **General:** types of concrete overlay, types of submittals, quality control, scheduling, delivery, measurement, payment
 - **Products:** Allowed materials and concrete mixtures according to the agency's standard and contract documents, recommended geotextile material requirements
 - **Execution:** requirements for equipment, pavement construction, surface preparation, paving operations, finishing, curing, jointing



Handling Quantities in Plans/Specs

- Select overlay type from state list (if available) and use standard item unit
- For more precise bidding recommend applying two bid items:
 - Cubic Yard – for furnishing concrete material
 - Square Yard – for all paving activities including
 - Placement/Paving
 - Texturing/Curing
 - Jointing
- For concrete use surveyed volume rather than batch tickets

Using only one bid item (SY) for concrete overlays presents more risk to the agency in the form of higher bid prices.

Risk can be minimized by:

- Split bid items – or –
- Including profile milling as part of the project

See FHWA Technical Advisory 5040.39

Discussion...





Concrete Overlay Solutions Workshop

Module 5 – Successful Construction
Practices and MOT Strategies



Overlay Construction Overview

- Placing an overlay is typical of other concrete paving
- Slipform construction steps are similar
- Using best practices increases odds of great results
- Suggestions to pay special attention to:
 - Preparation (repair) of existing pavement (incl. milling existing asphalt)
 - Installing interlayer (if required)
 - Slipform machine control
 - Jointing, curing & opening

Construction Topics We'll Cover

- Pre-overlay repairs (for existing concrete or asphalt)
- Separation layer installation (for COC-U)
- Concrete overlay placement considerations
 - Concrete overlay curing
 - Concrete overlay jointing
- Traffic management considerations
 - Opening the overlay to traffic

Pre-Overlay Repairs



Image source: CP Tech Center

Pre-Overlay Repairs to Address

Existing Concrete Pavement

- Deteriorated joints
- Subgrade/subbase failures
 - Soft areas
 - Poorly draining areas

Cracked concrete slabs generally do not need repair for a COC-U overlay

Existing Asphalt Pavement

- Surface Issues
- Thermal cracking
- Subgrade/base failures
 - Soft areas
 - Poorly draining areas

Pre-Overlay Repairs – Asphalt

Reasons for milling an existing asphalt surface prior to placing a concrete overlay:

1. To remove nonstructural surface distresses (potholes, cracking)
2. To remove severe rutting (± 2 inches) and reduce the required volume of concrete to expose structurally sound asphalt
3. To increase the existing pavement's surface texture to enhance the bond between the overlay and the existing asphalt surface
4. To remove pavement to minimize changes in the profile grade
5. To correct profile and cross-slope variability (referred to as profile milling) using 3D machine control when the existing asphalt is thick

Pre-Overlay Repairs – Asphalt

Keys When Milling for COA-B

- Control depth:
 - By stringline, ski, or 3D machine control
 - Work so that the planned thickness of asphalt layer remains after milling.
- Exposed layer should be solid
 - Remove all scabs/loose asphalt
- Exposed surface should not be oily
- Address areas if an underlying layer is exposed:
 - Increase overlay thickness in that area



Source: Voigt

Pre-Overlay Repairs - Asphalt



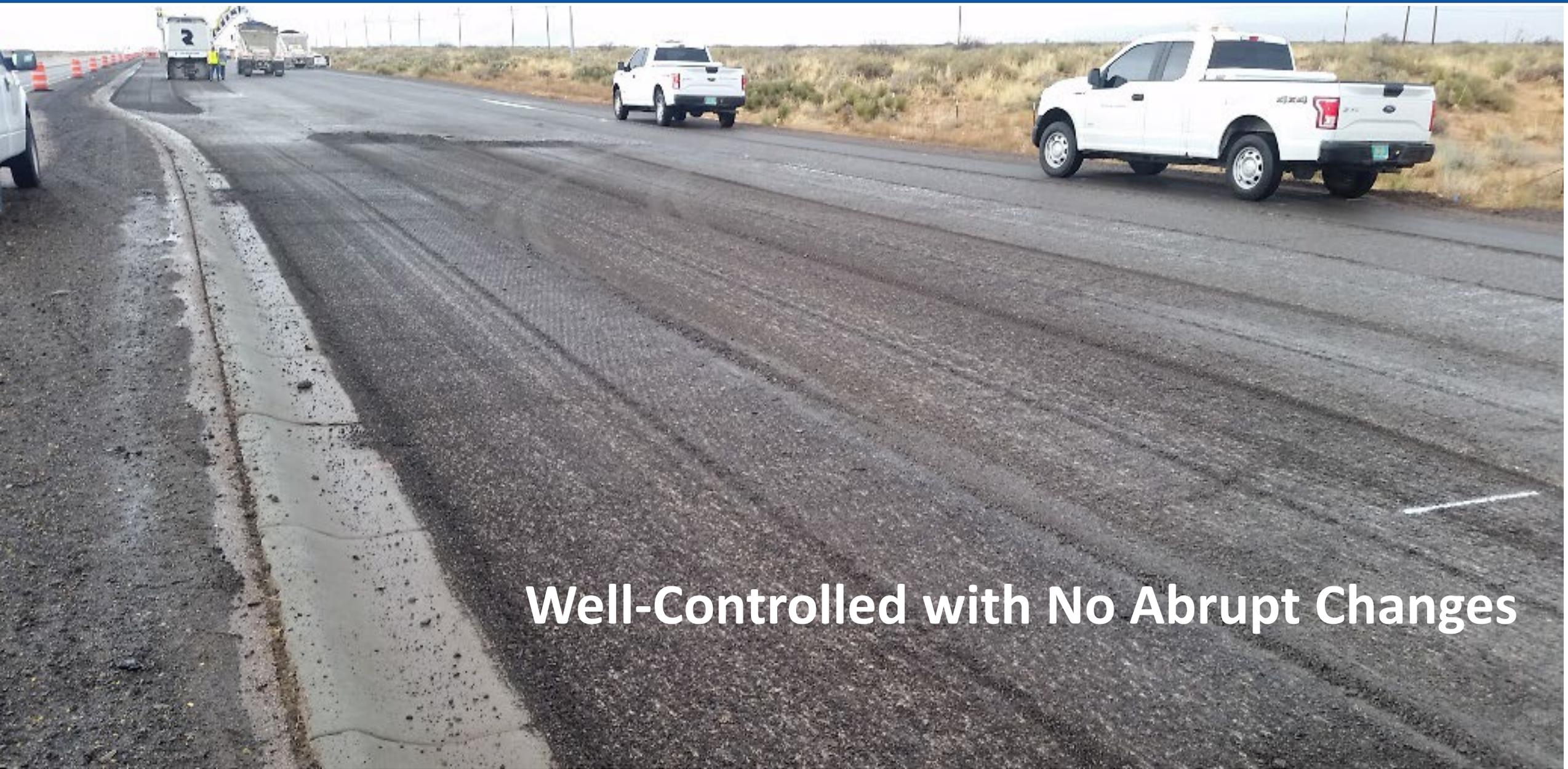
IF:

Milling exposes the underlying base course or subgrade

THEN:

Mill around the exposure an additional 2 to 3 in.

Fill this area with concrete during overlay placement

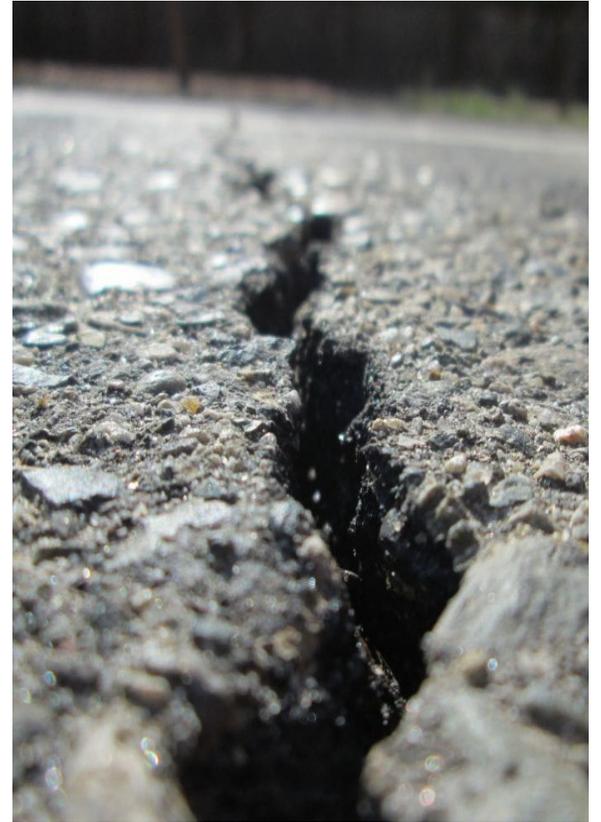


Well-Controlled with No Abrupt Changes

Pre-Overlay Repairs - Asphalt

To Address Thermal Cracking

- Narrow cracks – Do nothing
- Address cracks that are wider than the maximum coarse aggregate size in concrete overlay mixture.
- Fill wide cracks with one of these options:
 - Joint filler material
 - Flowable mortar mixture
 - Sand or fines produced by the milling operation



Pre-Overlay Repairs – Concrete

For COC-U

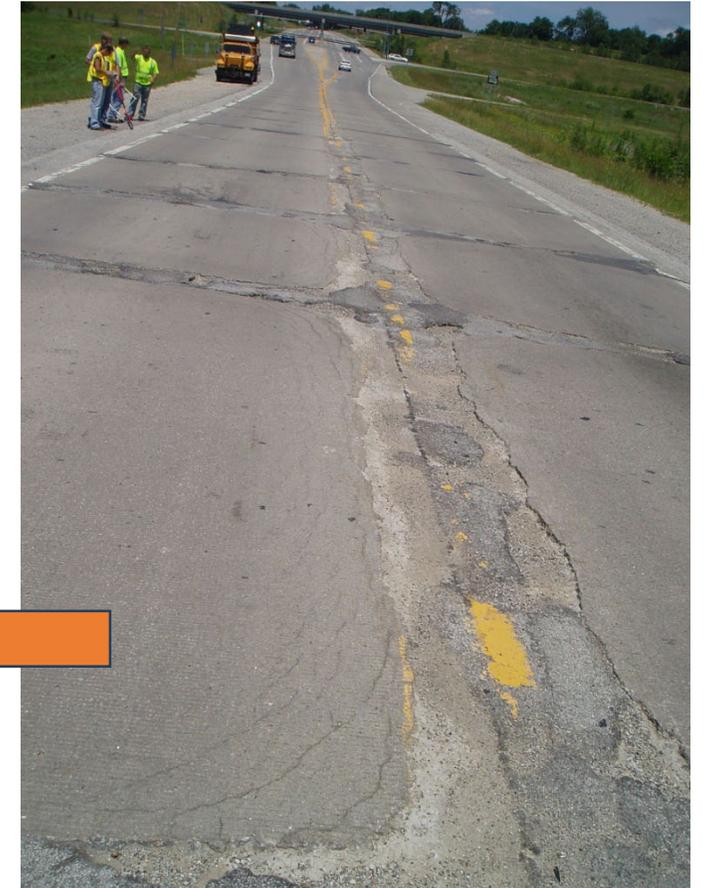
- Only distresses that compromise structural support must be addressed
- Distressed, but stable areas do not require repair

| Existing Pavement Condition | Severity | Repair to Consider |
|--|----------|---|
| Faulted joints | L-M-H | None |
| Joint spalling | H | Remove loose material & fill area |
| Cracked Slab (1-2 cracks/panel) with movement (spalling/pumping) | H | Remove loose material & fill area |
| Shattered Slabs (+3 cracks/panel) with movement (spalling/pumping) | H | Full-Depth Patch |
| Pumping of fines from subbase or subgrade | M-H | Full-Depth Patch and drainage improvement |

Pre-Overlay Repairs – Concrete

To Address Deteriorated Joints

- Remove all loose material in the joints and use compressed air (~150 psi).
- Fill joints flush with:
 - Flowable mortar mixture
 - Asphalt milling fines
 - HMA



Pre-Overlay Repairs – Asphalt or Concrete

To Address Inadequate Support/Poor Drainage

- Subcuts and patching with suitable materials (likely)
- Regrading ditches (likely)
- Installing underdrain systems (rare)



COC-U and COA-U can bridge some distresses COA-B cannot, but a compromised subgrade will compromise performance of any type of overlay

Pre-Overlay Repairs – Asphalt or Concrete

Subgrade/Subbase Repairs for Existing Concrete

- Use full-depth repairs
- Replace structurally unsound and/or moving slabs
- Repair damaged subgrade and subbase too
- Target concrete compressive strength of 3,000 psi at 28 days and use tie bars.

Subgrade/Subbase Repairs for Existing Asphalt

- Use full-depth repairs
- Correct subgrade, subbase and base failures
 - Use either asphalt or concrete for repairs
 - For COA-U, use a geotextile fabric to prevent bonding
 - For COA-B, scarify the new asphalt with a mill to enhance bonding

Installing Separation Layer



Image source: Voigt

Separation Layer – for COC-U ONLY



Fabric

OR



Asphalt Layer (~1 in.)

Asphalt Separation Layer for COC-U

- Apply dense-graded or drainable asphalt layer per specs
- Achieve minimum 1-inch thickness to avoid keying
- Place/roll to density
 - In-place air voids is a key parameter for dense-graded asphalt mixtures
 - It is important to get proper compaction and avoid secondary consolidation, volume change, and increased risk of stripping.

Fabric Separation Layer for COC-U

- Sequence the geotextile placement intentionally:
 - Not too late
(interrupts paving operation)
 - Not too early
(exposes geotextile to damage)
- Sweep the pavement surface clean just ahead of installation



Image source: Propex Geosolutions

Installing/Securing Fabric

- Align the geotextile carefully to pavement edge
- Terminate in underdrain trench/drainage inlet (if in design)
- Avoid wrinkles while unrolling



Images source: Propex Geosolutions

Installing/Securing Fabric

- Provide 6 to 10 inches of overlap between sections
- Secure the fabric to the existing pavement using either geotextile adhesive or power nails



Image source: Propex Geosolutions



Image source: Propex Geosolutions



Image source: Iowa State University

- Spray adhesive application
- Wrinkles should be cut out and fixed before paving over



- Geotextile interlayer survives construction traffic well
- Avoid sudden changes in acceleration
- Avoid sharp or sudden turns

Image source: Propex Geosolutions

- Instruct haulers how to dump to avoid damaging geotextile
- May need braking off and having truck in neutral if using certain spreaders



Image source: Propex Geosolutions

Overlay Placement Considerations



Image source: CP Tech Center

Overlay Placement... Contractor May Employ

- Stringless paving – typically needs 1-2 feet less clearance each side
- Zero-clearance is also a custom option
- Distributing concrete in front of machine (not from side haul road)

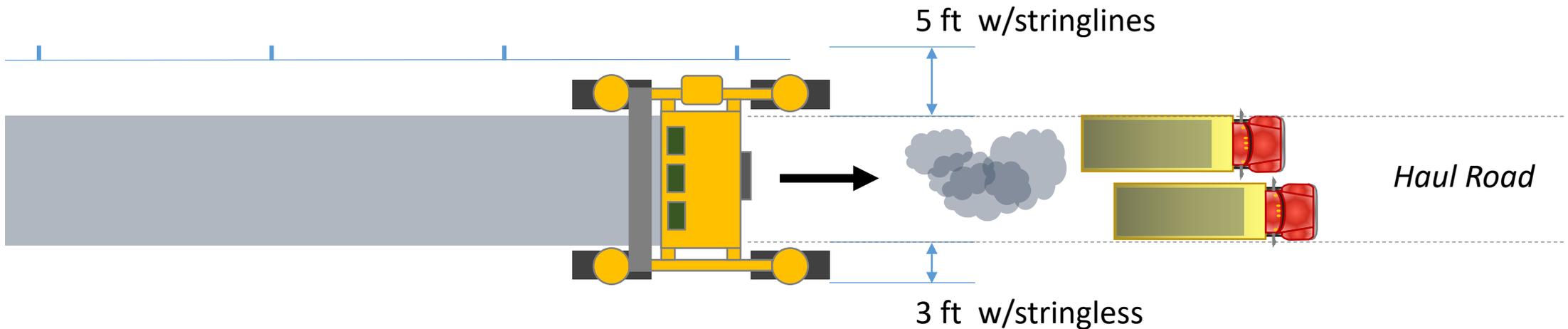


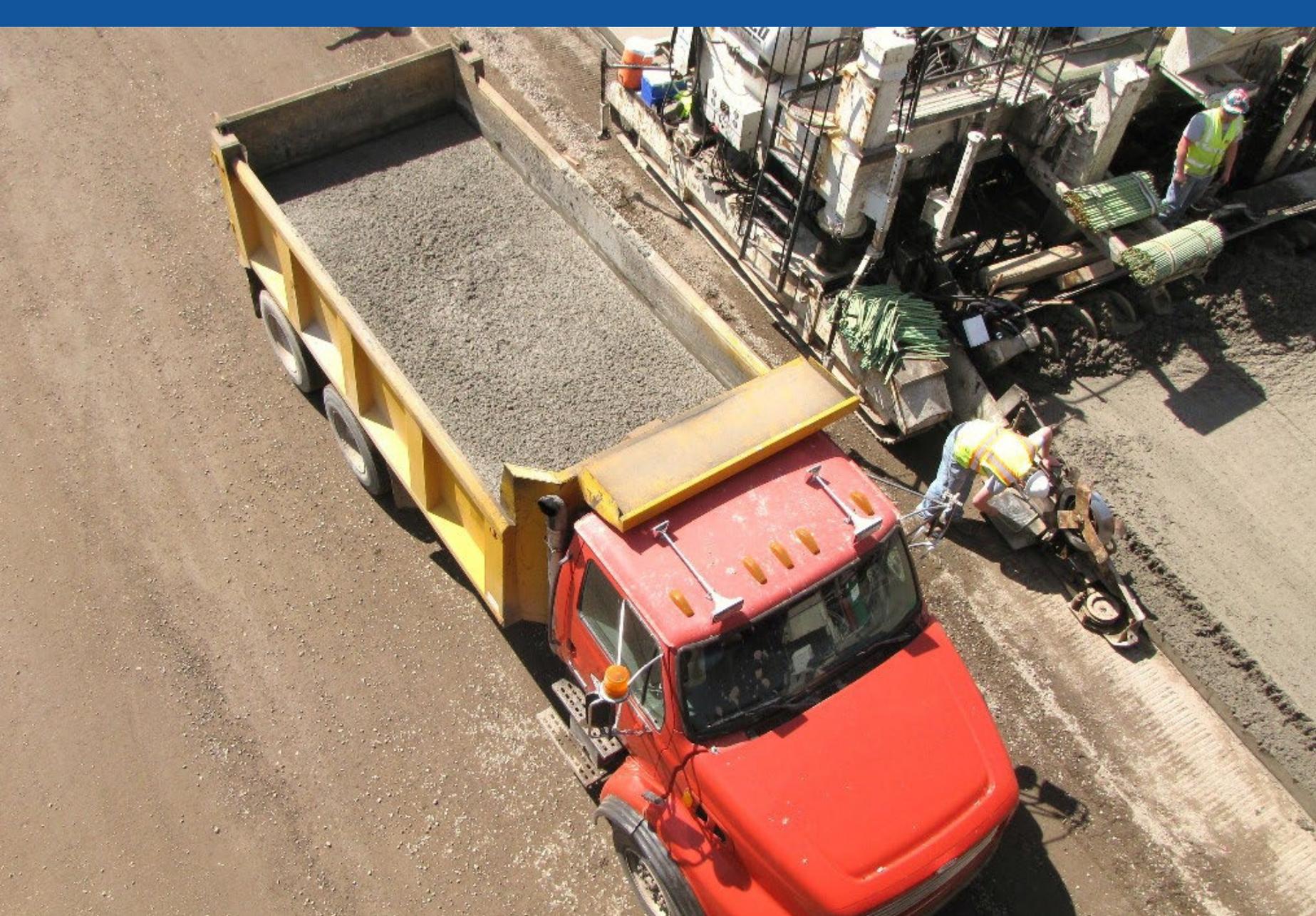
Image source: Voigt

Equipment Clearance



Image source: Voigt

- A string-controlled paver typically needs about 4 to 5 feet clearance on each side:
 - 3 feet for paver track and workers
 - 1 foot for hubs and stringline stakes
 - 1 foot for safety devices



Overlays usually do not require this kind of space needed for a side haul road

Image source: Voigt



Image source: Voigt

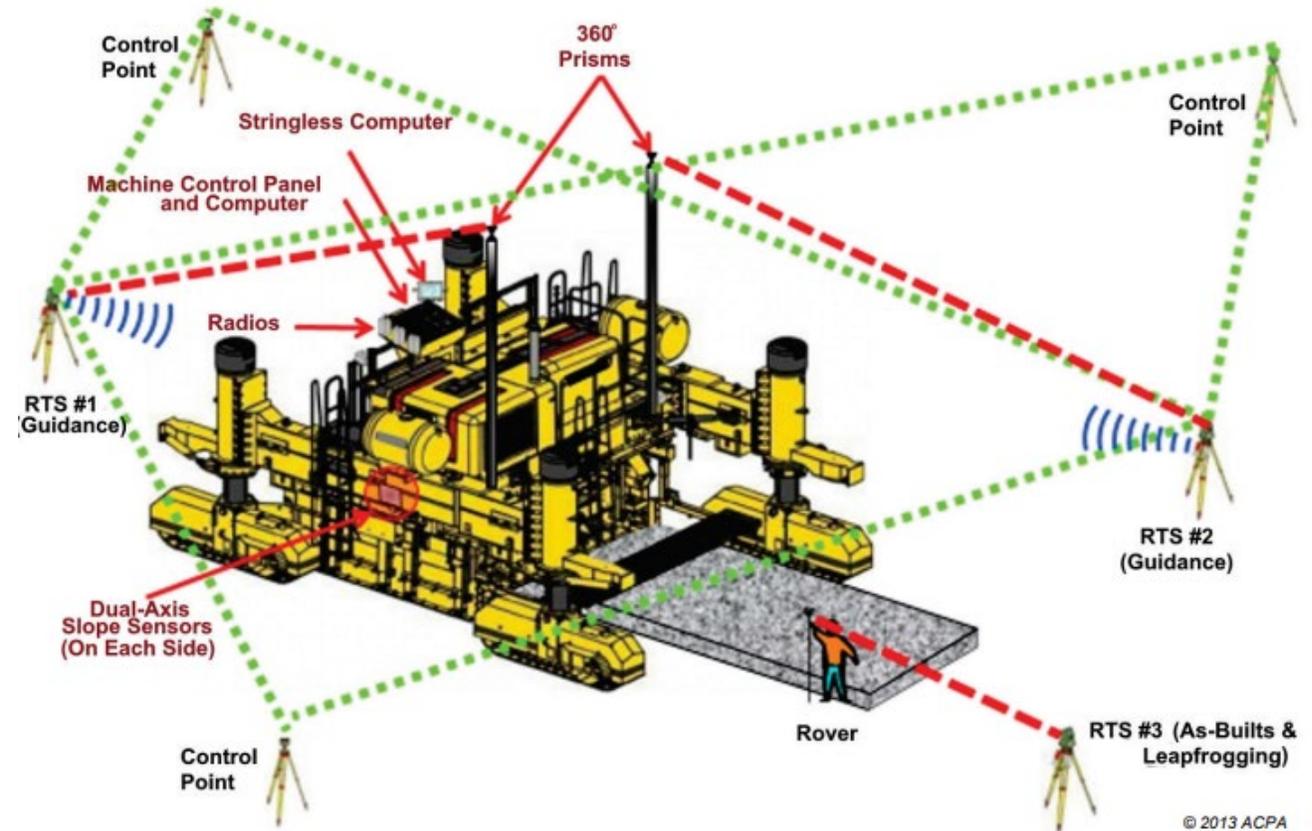
Overlays allow using truck dumping ahead of paver... But necessitate care on the interlayer



Using a spreader with truck dumping provides a very consistent head of concrete to the paving machine

Staking and Machine Control

- Accurate machine controls necessary to achieve desired:
 - Profile
 - Thickness
 - Smoothness
- Accurate survey data vital to control machine

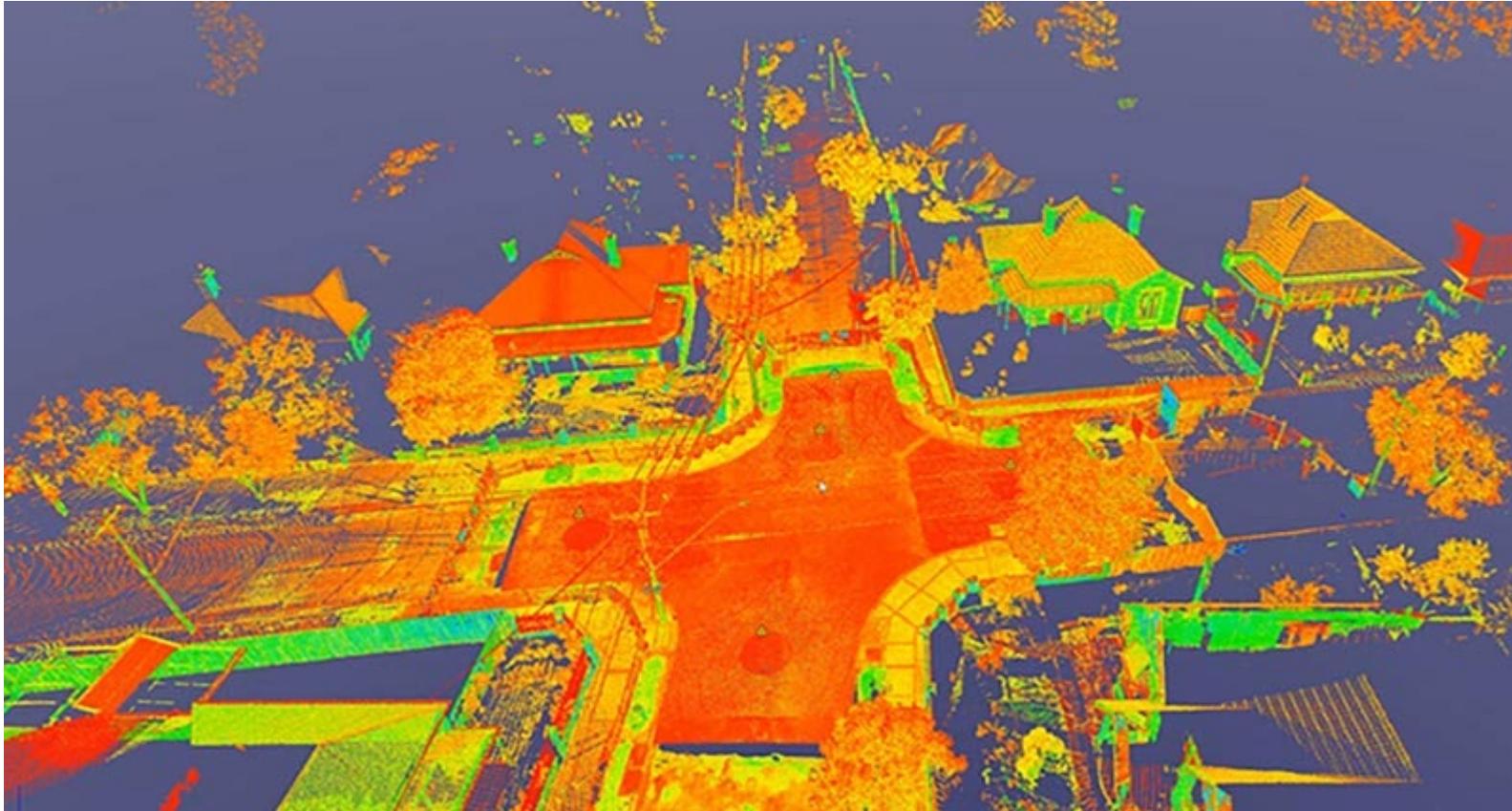


Staking and Machine Control

To achieve optimum profile contractor needs to build a 3D model using:

- Data for existing surface profile from a sufficient number of conventional survey lines to capture
 - Slope breaks
 - Rutting and other surface irregularities
- Possible to employ data from newer surveying techniques
 - LiDAR scanning
 - Aerial drone surveying

LiDAR Scanning Example



Images source Leica Geosystems

3D laser scanning can capture data quickly in the field, which can then be processed in the office to deliver conventional 2D and 3D models

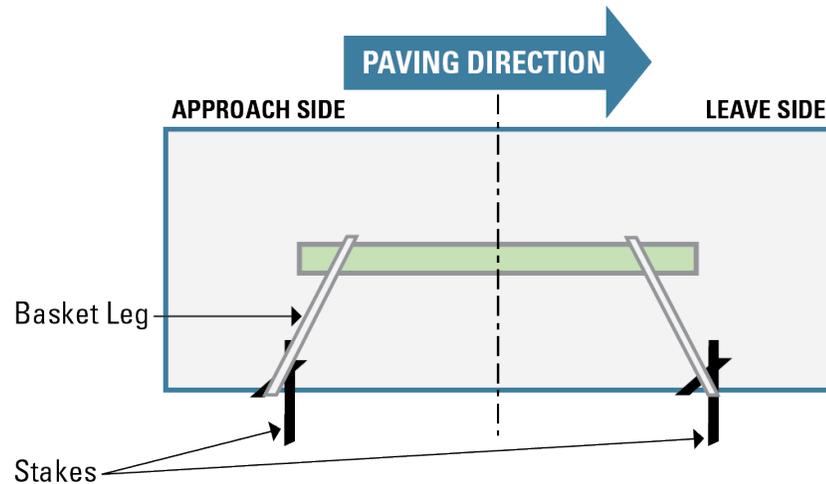
Concrete Overlay Placement

Surface Prep Before Paving

- Sweep or blow the prepared surface (or interlayer)
- Keep a fabric interlayer damp after sweeping
 - Not wet - Remove free water
 - Overwatered geotextile can become saturated and cause excess bleed water especially at the bottom of vertical curves

Placing/Securing Dowel Baskets

- Anchor securely to the existing pavement
- Always place anchors on leave side of basket wire on both sides
- Use anchors that extend through an asphalt interlayer (if used)



Images source American Concrete Pavement Assn.

Placing/Securing Dowel Baskets

- Verify dowel placement
- Methods for checking placement:
 - MIT-SCAN
 - MIT-SCAN-T2
 - ground penetrating radar
 - Coring
- QC should suspend paving operations if baskets are moving until a plan for securely anchoring them is approved



Images source ACPA

Concrete Overlay Curing

Three primary issues impact the curing of concrete overlays:

1. Timing – Apply curing compound before surface evaporation
2. Materials – Good-quality curing compound, some state DOTs have had success with alpha-methyl-styrene curing compounds.
3. Coverage – Ensure full coverage of the surface and sides of overlay with no streaking or gaps (like a white sheet)





Should look Like a Sheet of Paper

Good Curing and Timely Sawing Addresses

- Influence of stiff underlying layers that increase the internal stresses in the early-age concrete.
- Added restraint from bonding.
- Higher ratio of surface area to concrete volume affecting moisture evaporation impact.
- Faster strength gain due to solar radiation and increasing sensitivity to drops in ambient temperature.
- Moisture and temperature differentials within the slab which can cause early-age curling and warping.

Concrete Overlay Jointing

- Many factors influence saw timing
- Proper planning can ensure the production not hindered by limited availability of joint saws
- HIPERPAV is a useful tool to predict stresses in concrete, especially for quantifying the risk of early-age cracking and planning the sawing



Image source: Iowa State University



For sawing shorter spacing...Must have enough saws!

Maintenance of Traffic Considerations



Image source: CP Tech Center

Two Maintenance of Traffic Options

Roadway Closure with Detours

- Often the ideal scenario
- Safer for workers
- More space to work
- Simpler traffic control set up
- Less confusing to public
- Often faster construction

Construction Under Public Traffic

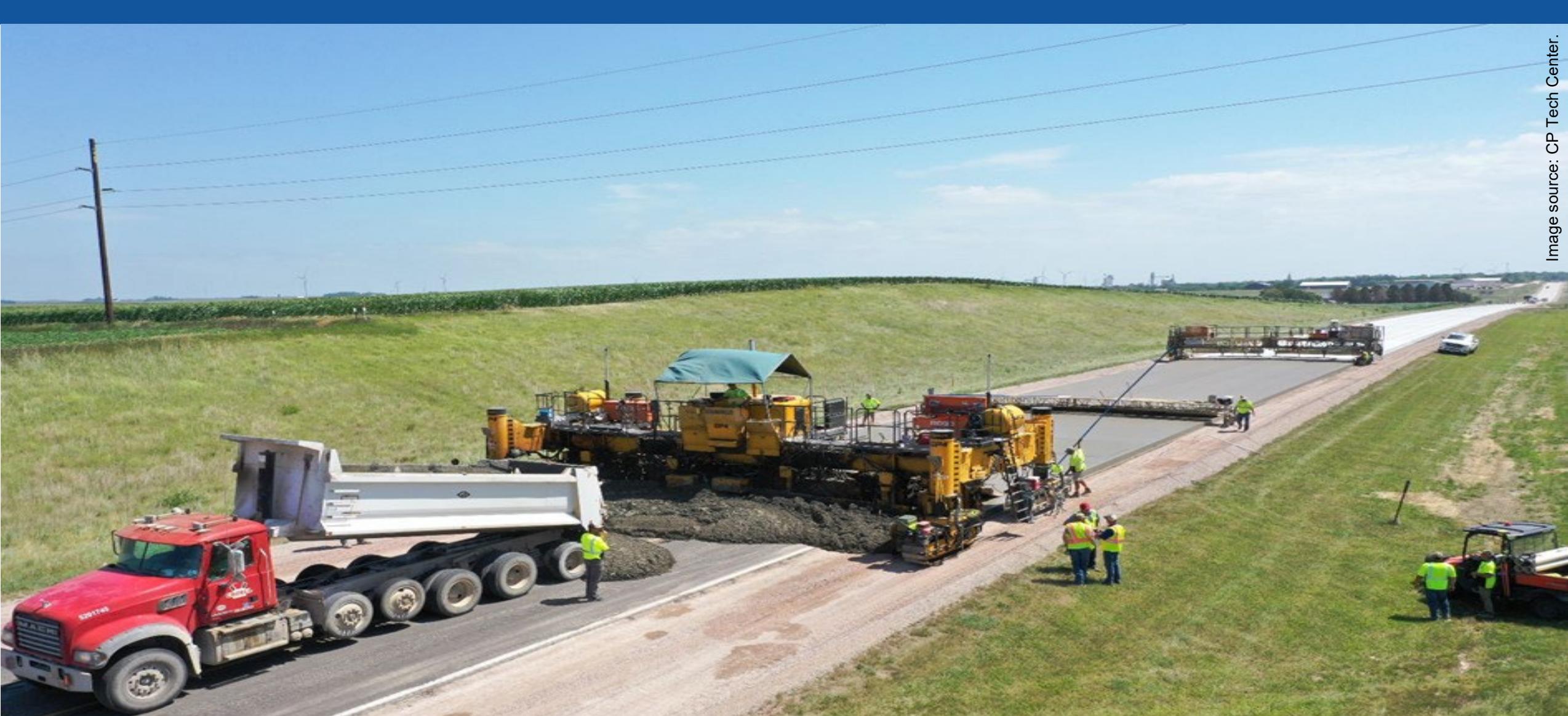
- Often a necessity (urban areas)
- Contractor often must address work zone constraints
- Can employ same sequencing scenarios as other paving
- More effort likely needed on public relations



Stringless Paving Full-Width 2-Lane 2-Way COA-B



Stringless Paving Full-Width 2-Lane 2-Way COA-B w/Widening



Stringless Paving Full-Width 2-Lane 2-Way COA-B w/Widening



Lane Delineators Do Not Require Much Work Zone Space!



Stringless Paving Half-Width COC-U; Public Traffic Alongside

Considerations for Two-Lane Roadway (Under Traffic)

- Minimum width lane for live traffic – 11 feet typical
- Work zone length:
 - If >0.25 miles – pilot car & flaggers may be needed, or
 - Temporary traffic signals or other MUTCD traffic control devices
- Existing roadway/shoulder should be brought to condition to handle the traffic during construction
 - Pre-overlay patching & stabilization
- Edge drop-off may become issue for staging (thicker overlays)

Pilot Car Considerations

- Useful to always have a lane of traffic open
- Contractor typically works out balance with unique capabilities
 - 2500 square yards production typical per day
 - Staggering work areas may benefit efficiencies
 - Edge fillets may help allow lane opening before shouldering completed

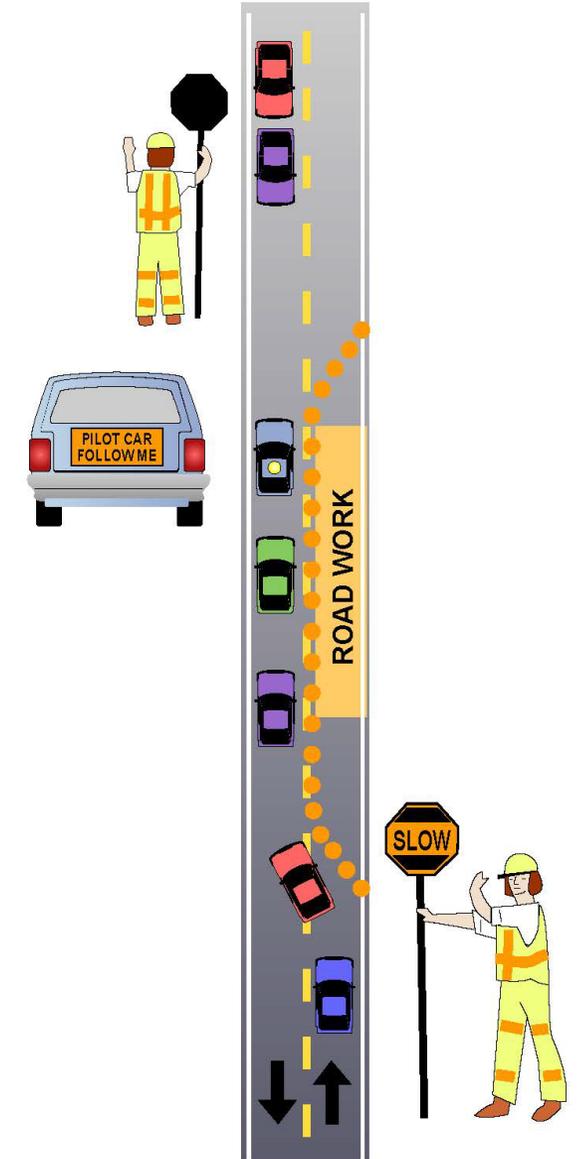


Image source: MN DOT



Typical Pilot Car for 2-Lane 2-way Projects

Temporary Safety Edge Fillets

- Useful for drop-off mitigation (typically for overlay >4 -inch)
- May allow next stage after single-lane overlay placed

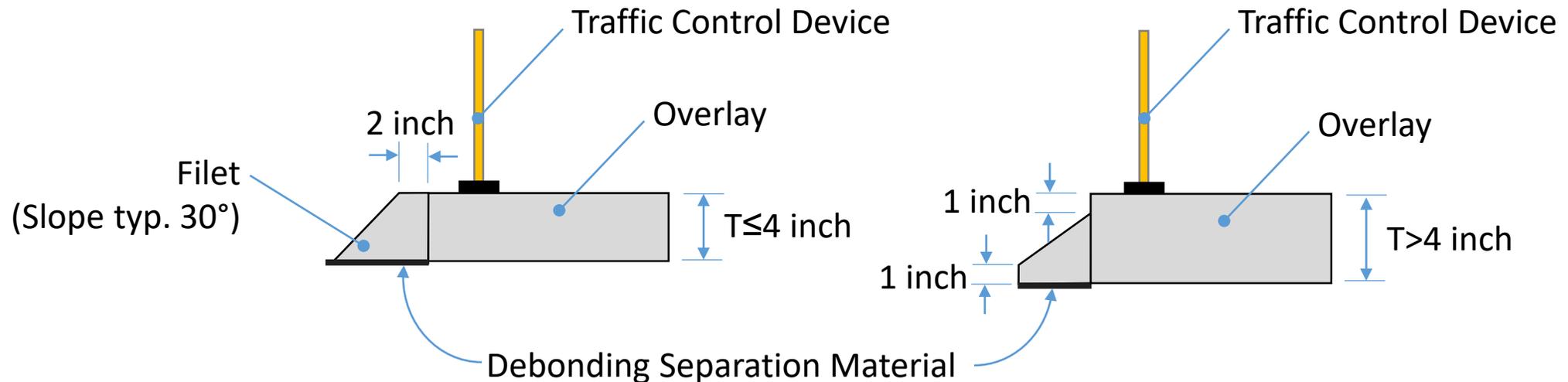


Image source: Voigt; Adapted from Iowa State Univ.

Permanent Safety Edge Fillets

- Built into pavement
- Shoe on slipform paver side form
- Addresses drop-off requirements while needed
- Covered by shoulder material after staging



Image source: CALTRANS

Permanent Safety Edge Fillets



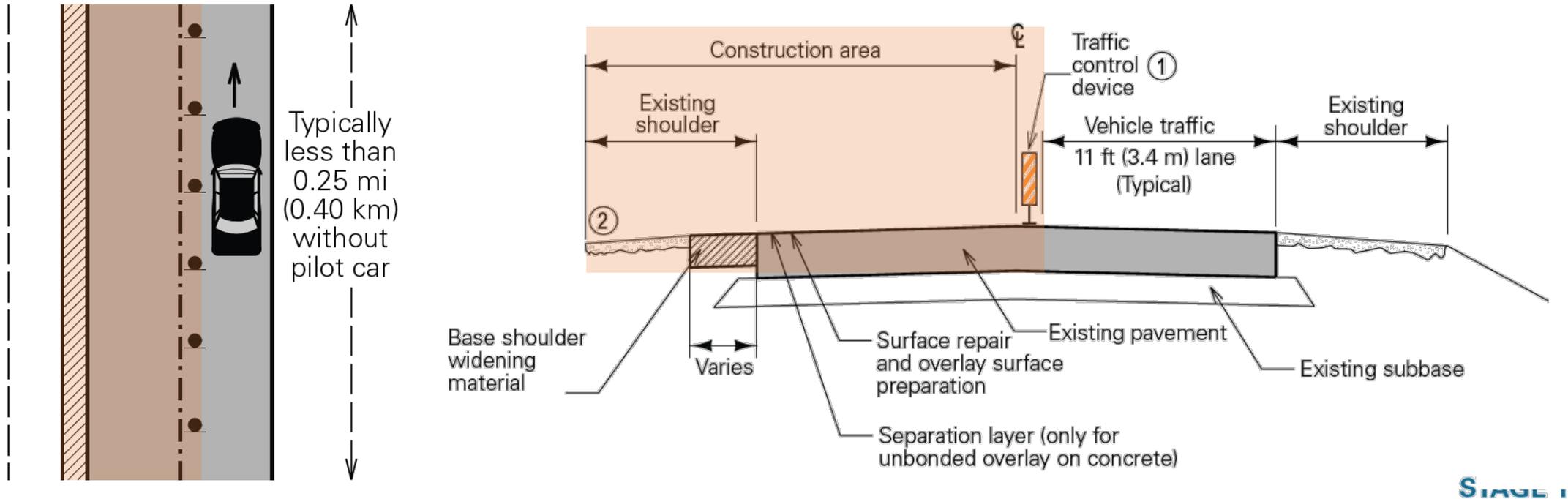
Image source: Snyder & Associates, Inc.

Permanent Safety Edge Fillets



Images source: Snyder & Associates, Inc.

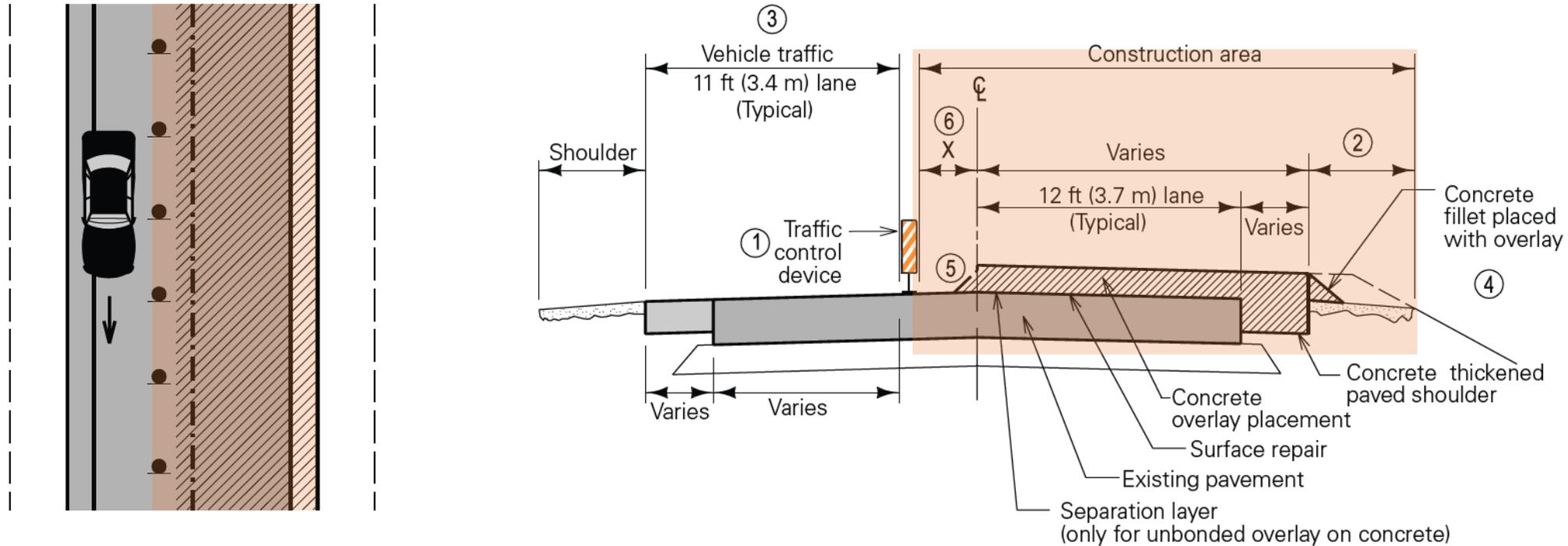
Staging Two-Lane Overlay (Under Traffic)



STAGE 1 – Repair Surface. Prepare for Overlay and Construct Base Shoulder Widening and Prepare Interlayer

Image source: Iowa State Univ.

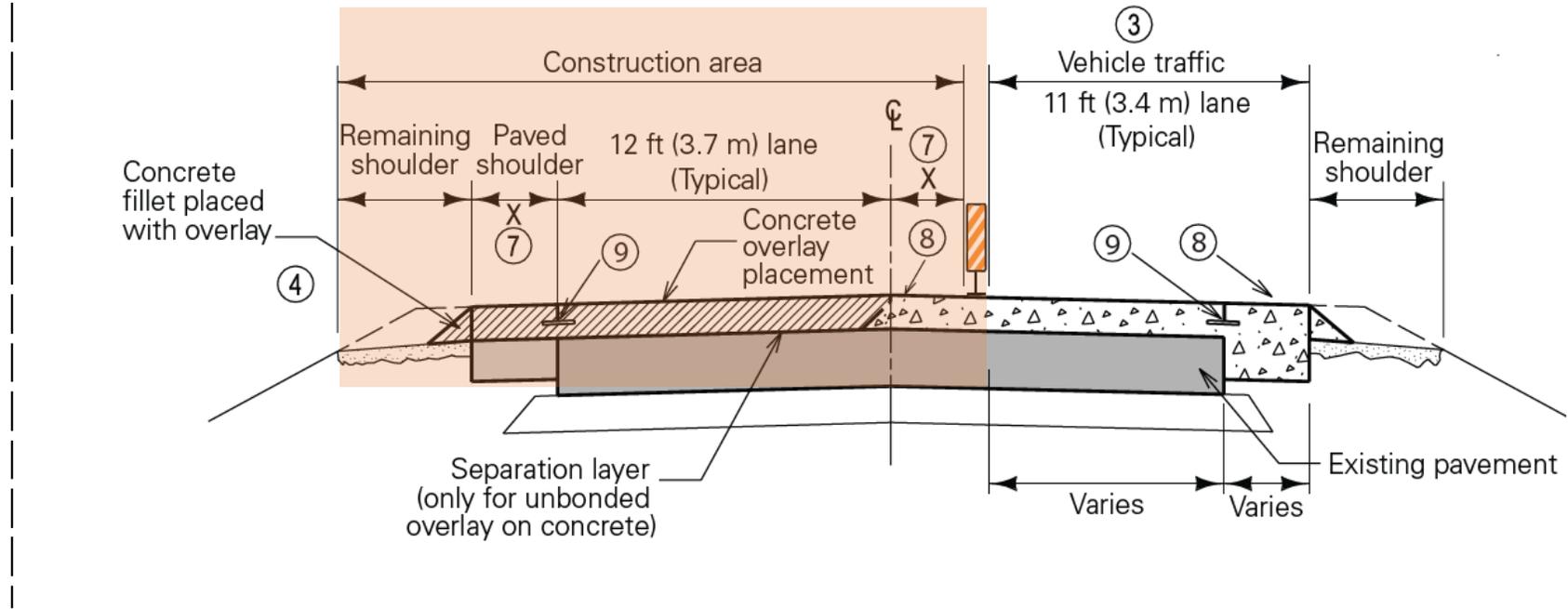
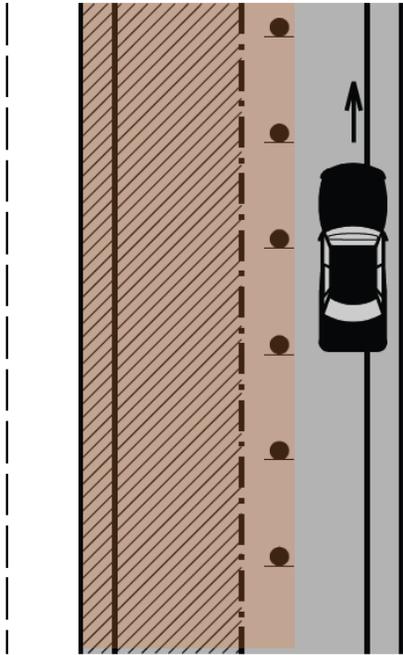
Staging Two-Lane Overlay (Under Traffic)



STAGE 2 – Construct Right Shoulder and Concrete Overlay

Image source: Iowa State Univ.

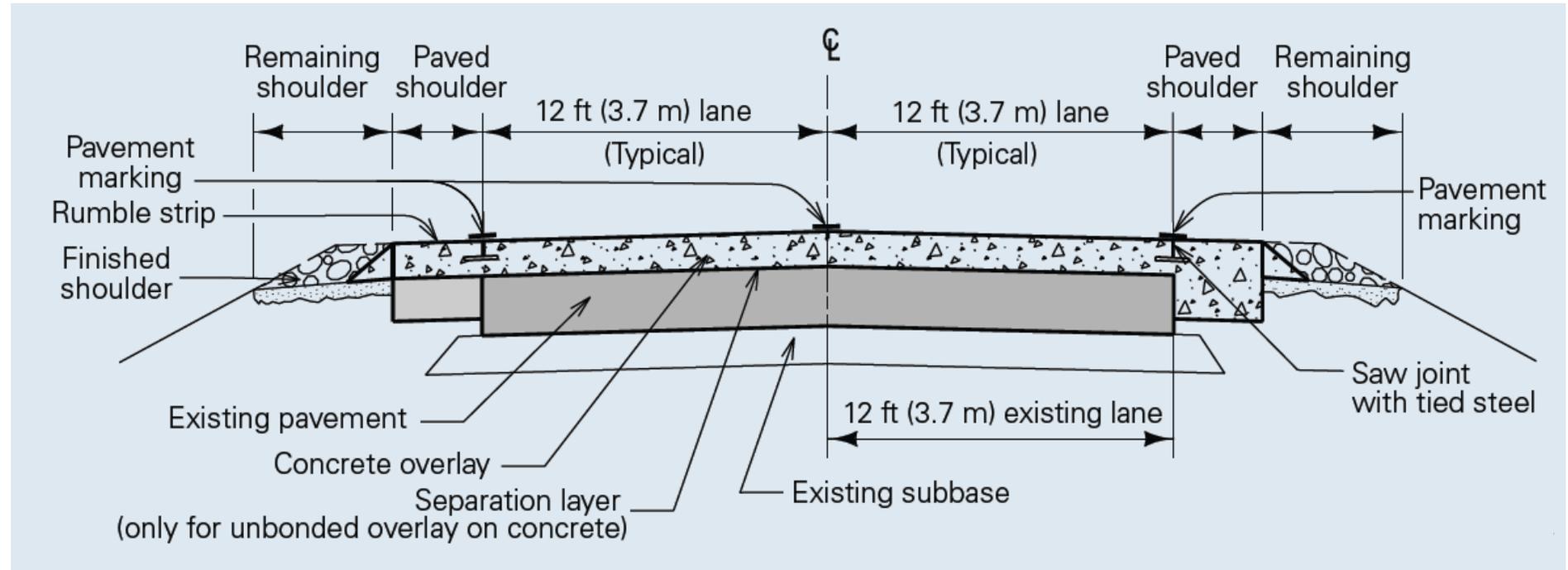
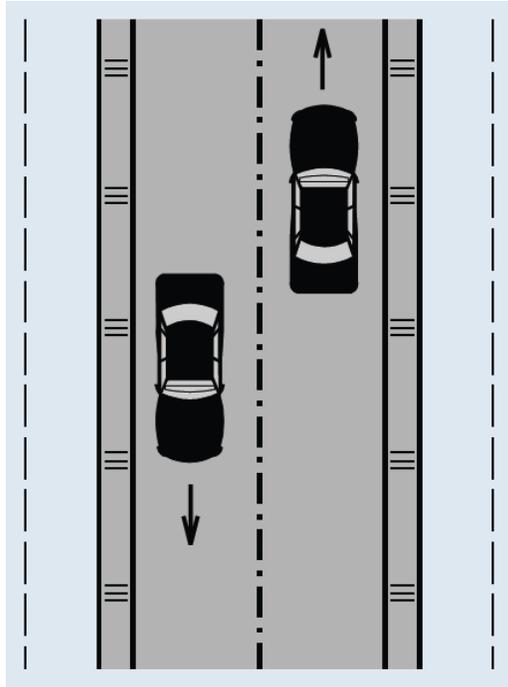
Staging Two-Lane Overlay (Under Traffic)



STAGE 3 – Construct Left Lane Concrete Overlay

Image source: Iowa State Univ.

Staging Two-Lane Overlay (Under Traffic)



COMPLETED OVERLAY

Image source: Iowa State Univ.

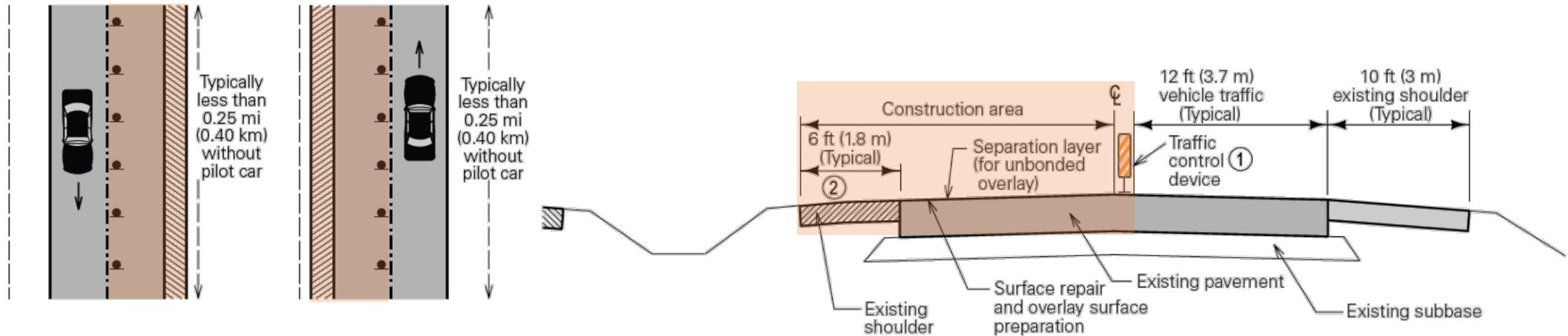


2-Lane 2-way COA-B Project with Adjacent Public Traffic



2-Lane 2-way COA-B Project with Adjacent Public Traffic at Night

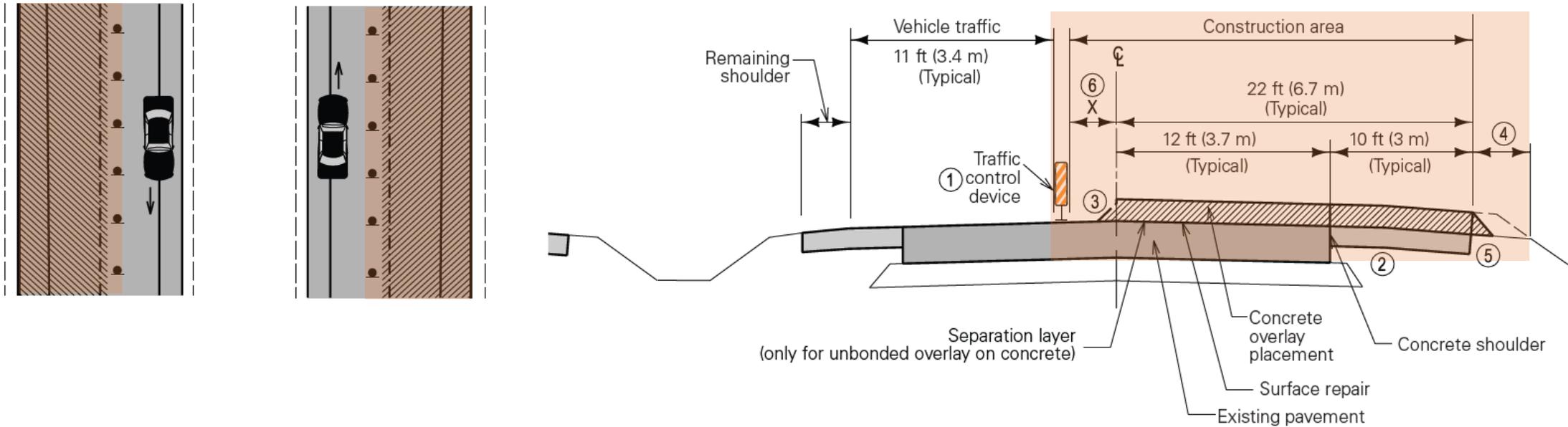
Four-Lane Roadway (Under Traffic)



STAGE 1 – Repair Surface and Prepare for Overlay

Image source: Iowa State Univ.

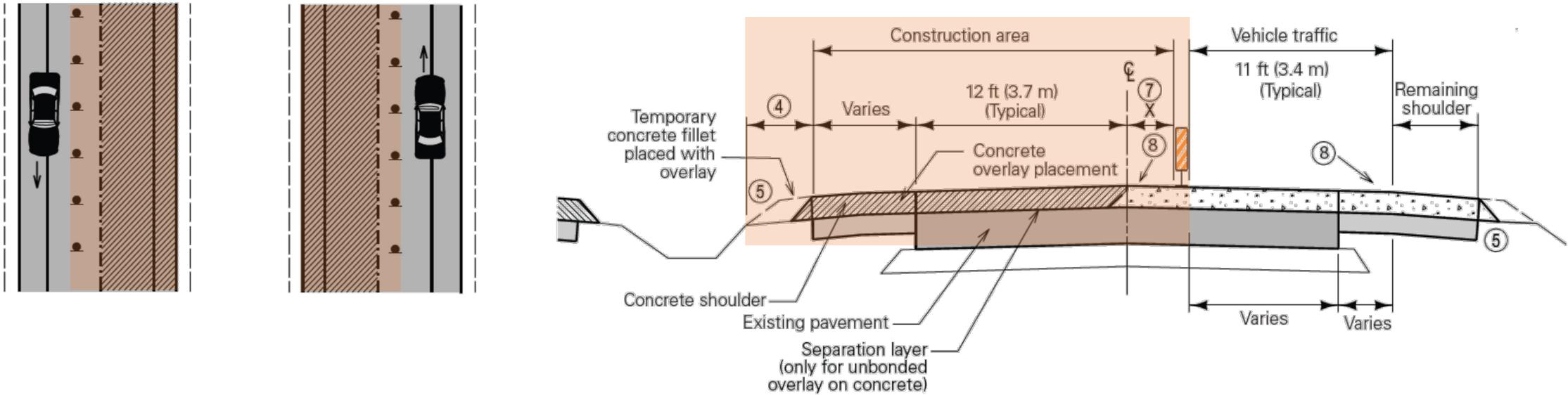
Four-Lane Roadway (Under Traffic)



STAGE 2 – Construct Concrete Overlay on Outside Lanes

Image source: Iowa State Univ.

Four-Lane Roadway (Under Traffic)



STAGE 3 – Construct Concrete Overlay on Inside Lanes

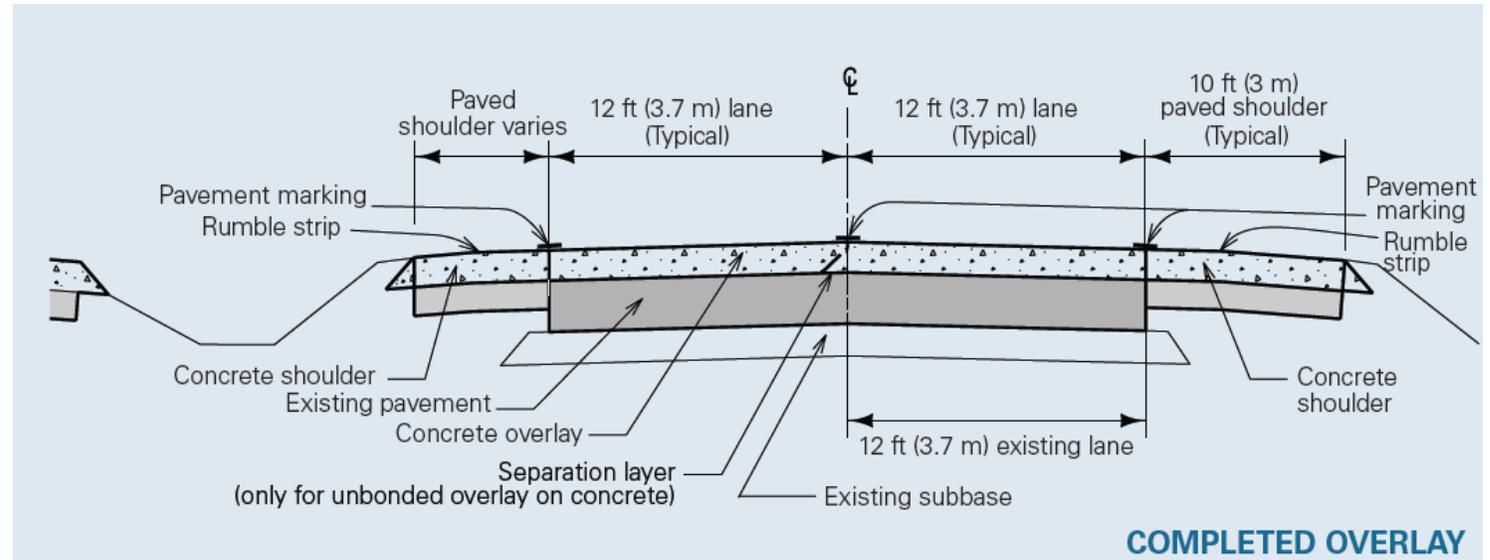
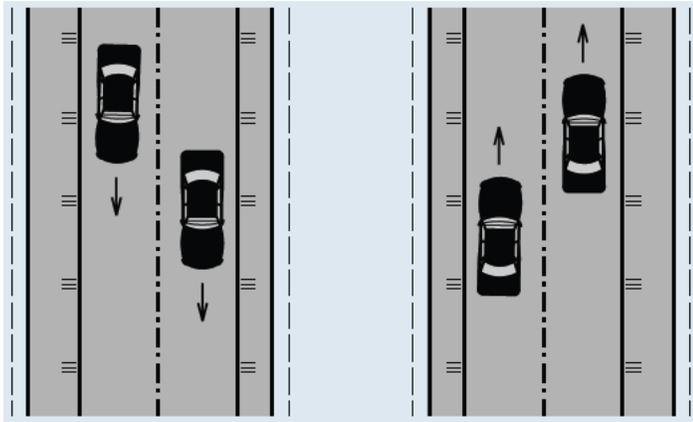
Image source: Iowa State Univ.

Four-Lane (Under Traffic)

- Head to head traffic



Four-Lane Roadway (Under Traffic)



COMPLETED OVERLAY

Image source: Iowa State Univ.

Opening to Traffic

- Commonly opened at compressive strengths: 3,000 to 4,000 psi
- Other factors considered include:
 - Type and volume of traffic
 - Slab dimensions
 - Locations of the loads relative to the edges of the slabs, and
 - Particular cement chemistry and strength gain properties of the mixture
- Where acceleration needed, some agencies have had success with Type I, IL or IP Cements and SCMs.
- Consider using maturity testing to ascertain if concrete has gained sufficient strength

Discussion...





Concrete Overlay Solutions Workshop

Module 6 – Thickness Design Case Studies



Image source: FHWA

What We'll Cover

- What is Behind Concrete Overlay Design
- Tools for Design
- WinPAS Case Studies

Concrete Overlay Design

Most Popular Current Approaches:

- Effective Support (for COA-U)
- Effective Thickness (for all types)

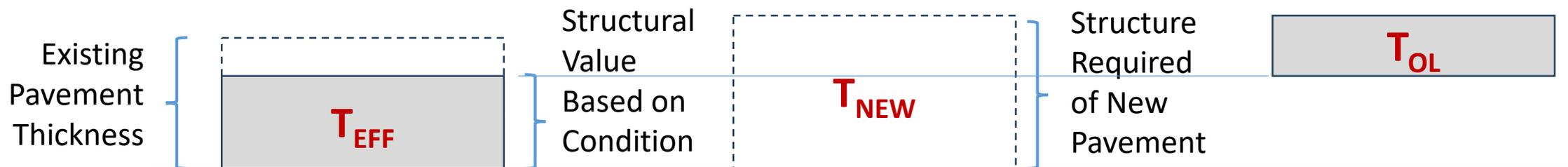
- Mechanistic-Empirical (for COA-B)
by Univ Pitt.
- Mechanistic-Empirical (for all types) by
AASHTOWare Pavement ME



*Adaptable to whatever
design method you use*

Effective Thickness Approach

- From Army Corps of Engineers
- Overlay thickness is determined from:
 - Effective structural capacity/thickness of the existing pavement.
 - Structural capacity/thickness required for new pavement



Effective Thickness Approach

Basic Formula:

$$T_{OL}^n = T_{NEW}^n - C * T_{EFF}^n$$

- T_{OL} = Required overlay thickness
- T_{NEW} = Design thickness of new pavement
- T_{EFF} = Effective thickness of existing pavement
- C = Coefficient representing condition of the existing pavement (1 is good; 0.75 is moderate; 0.35 is bad)
- n = Bond coefficient between overlay and existing pavement (1 = fully bonded; 2 = fully unbonded)

Effective Thickness Approach

| Type | n | Formula |
|-------|-----|--|
| COC-B | 1.0 | $T_{OL} = T_{NEW} - C * T_{EFF}$ |
| COC-U | 2.0 | $T_{OL} = \sqrt[2]{T_{NEW}^2 - C * T_{EFF}^2}$ |
| COA-B | | -- |
| COA-U | | Effective Support (Assign k-Value to Existing Asphalt Pavement) |

What Models Are Used in Software?

| Type | PavementDesigner.org | MEPDG | WinPAS |
|--------------|-------------------------------------|---|--------------------------------------|
| COC-B | Effective Thickness Approach | Plate theory/finite element model ISLAB2000 | Effective Thickness Approach* |
| COC-U | Effective Thickness Approach | Plate theory/finite element model ISLAB2000 | Effective Thickness Approach* |
| COA-B | Univ Pitt BCOA | Plate theory/finite element model ISLAB2000 | -- |
| COA-U | Effective Support Approach | Plate theory/finite element model ISLAB2000 | Effective Support Approach |

* Modified means to determine T_{EFF}

AASHTO's Effective Thickness Approach for COC-U

Basic Formula:

$$T_{OL}^n = T_{NEW}^n - T_{EFF}^n$$
$$T_{EFF} = (F_{JU}) * T$$

- T_{OL} = Required concrete overlay thickness
- T_{NEW} = Design thickness of new concrete pavement
- T_{EFF} = Effective thickness of existing concrete pavement
- T = Existing concrete pavement thickness
- F_{JU} = Joints and cracks adjustment factor (0.98<20; 0.94<100; 0.90<200 deteriorated joints or cracks/mile)
- n = Bond coefficient between overlay and existing pavement (1 = fully bonded; 2 = fully unbonded)

Thickness Design for COA-B

- Recommend using Univ Pitt's BCOA-ME
- Effectively accounts for:
 - Bond between layers
 - Top-down corner cracking necessary to properly model thin slabs with short joint spacing
- Use QR Code to access the free design model and associated training tools



Case Study 1

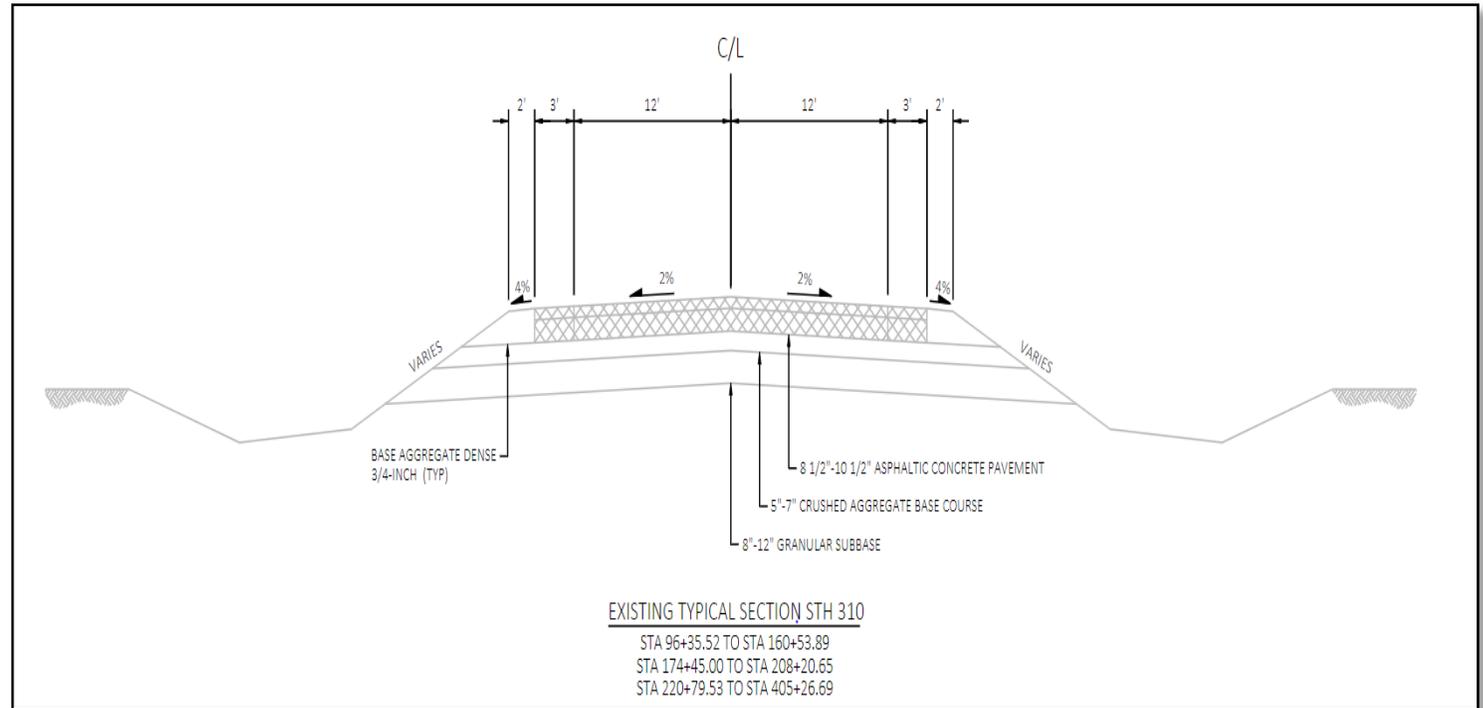
- Manitowoc County
- STH 310 (Rural Arterial)
- ADT = 6630 (11% trucks)
- 2.3 M Rigid ESALs (WisPave)



Case Study 1

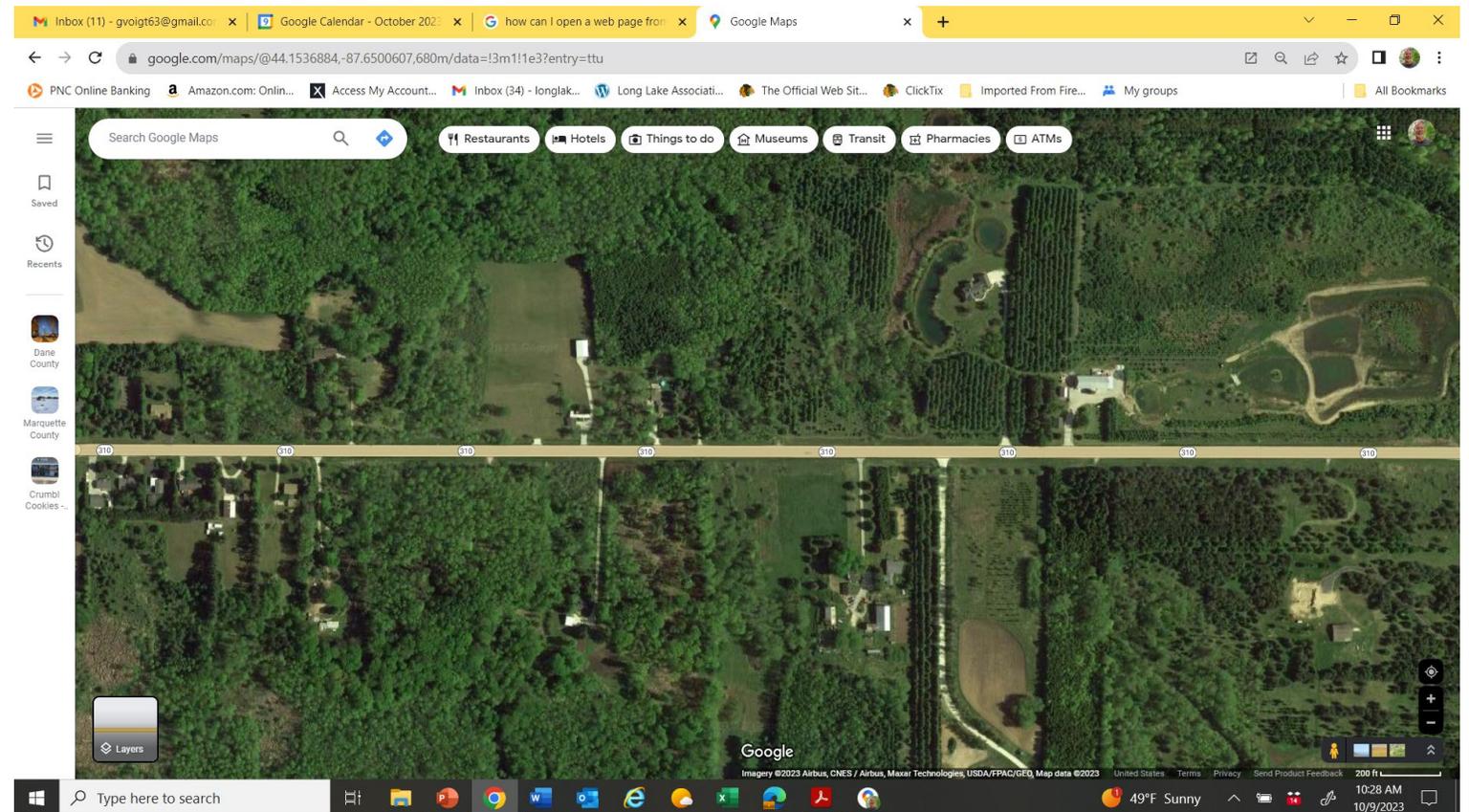
Existing Asphalt Pavement

- 8.5"-10.5" HMA over 5"-7" base over 8"-12" of subbase
- Single lane - two way
- 12' lanes; 3' shoulders
- Soil $k = 375$ psi/in
- Composite $k = 783$ psi/in



Case Study 1

Condition:



Case Study 1

Challenges

Opportunities

Case Study 2

- Marquette County
- ADT = 9894 (15.6% trucks)
- 6.3 M Rigid ESALs (WisPave)



Case Study 2

Existing Composite Pavement

- 6.5" HMA over 9" PCC over 6" of granular subbase
- Soil $k = 225$ psi/in
- Composite $k = 949$ psi/in

Case Study 2

Condition:

Case Study 2

Challenges

Opportunities

Case Study 3

- Marquette County
- ADT = 9894 (15.6% trucks)
- 6.3 M Rigid ESALs (WisPave)



Case Study 3

Existing Composite Pavement

- 9" HMA over 11" of crushed agg base on select borrow
- Soil $k = 225$ psi/in
- Composite $k = 608$ psi/in

Case Study 3

Condition:

Case Study 3

Challenges

Opportunities

Case Study 4

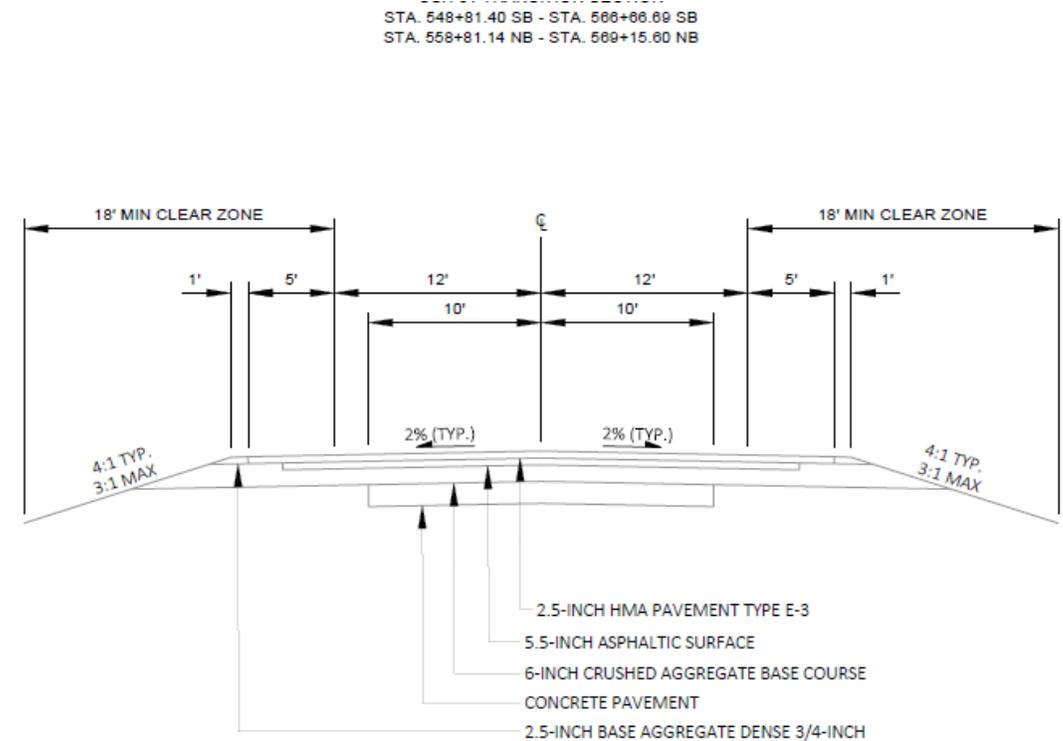
- Dane County
- Minor Arterial
- ADT = 12,000 (17.8% trucks)
- 3.9 M Rigid ESALs (WisPave)



Case Study 4

Existing (Composite?) Pavement

- 8" HMA over 6" crushed agg base (over PCC)
- Two lane - two way
- 12' lanes; 5' shoulders
- Soil $k = 150$ psi/in
- Composite $k = 366$ psi/in



EXISTING TYPICAL SECTION

STA. 569+15.60 - STA. 700+10.78 NB
STA. 708+78.83 - STA. 750+09.78 NB
STA. 754+33.41 - STA. 770+57.54 NB

Case Study 4

Condition:

Case Study 4

Challenges

Opportunities

Case Study 5

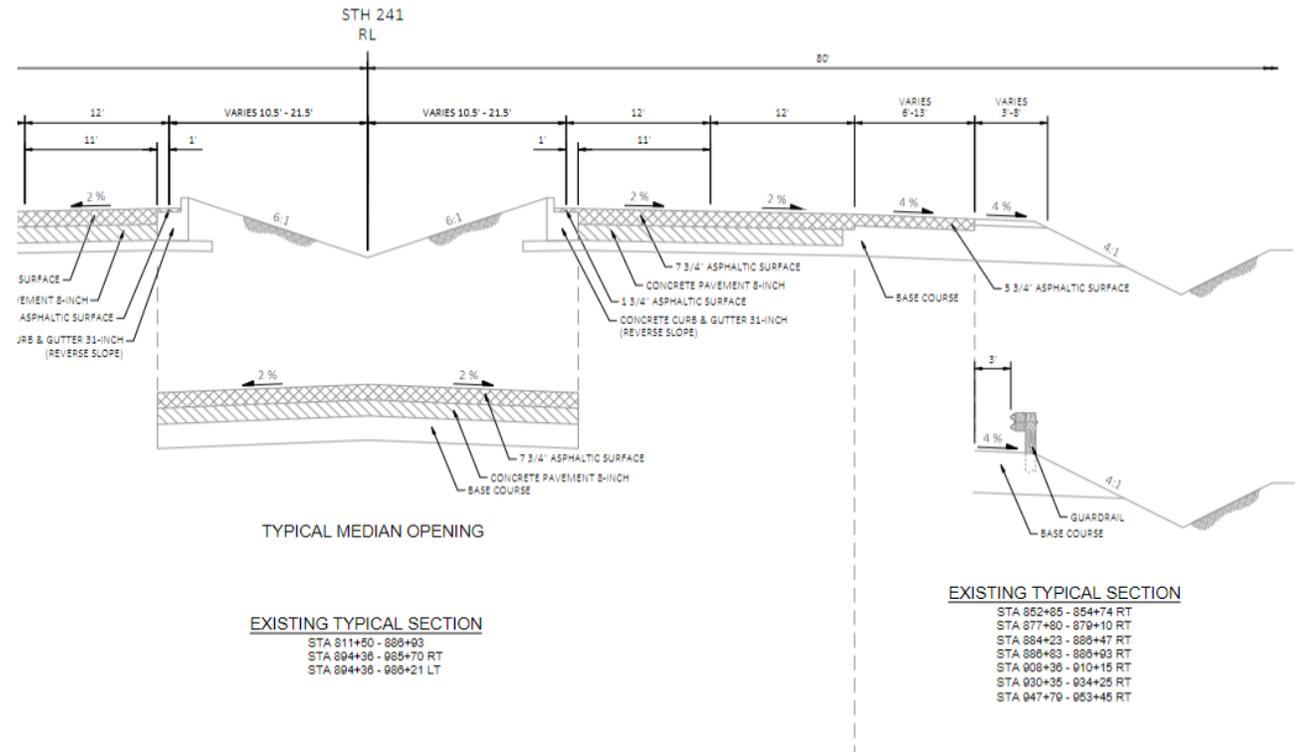
- Milwaukee County
- STH 241 (Principal Urban Arterial)
- ADT = 14,510 (8% trucks)
- 2.3 M Rigid ESALs (WisPave)



Case Study 5

Existing Composite Pavement

- 7.75" HMA over 8" PCC over ??
- Soil $k = 150$ psi/in
- Composite $k = 787$ psi/in



Case Study 5

Condition:

Case Study 5

Challenges

Opportunities

Case Study 6

- COC-U
- Highway
- 30 million ESALs



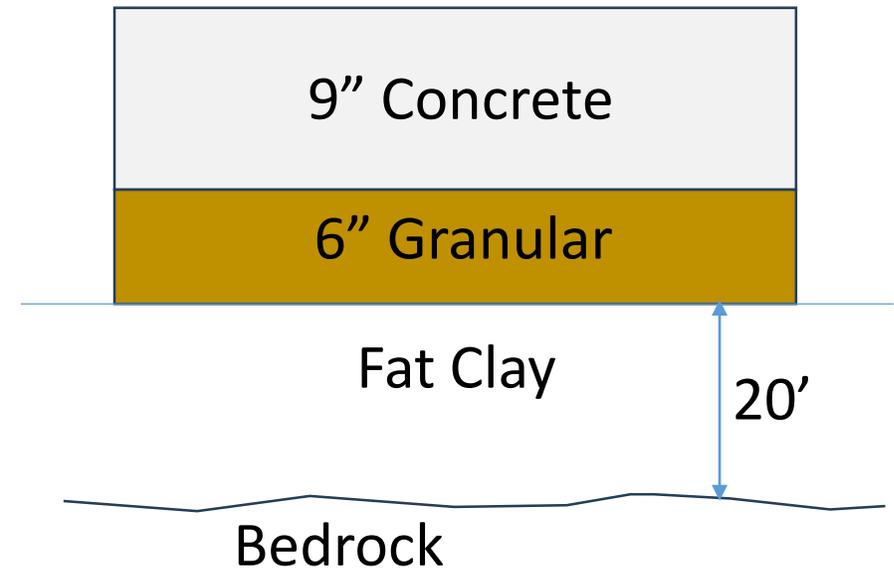
Case Study 6

Existing Concrete Pavement

- 35 yrs in service
- 20 ft joint spacing (264 joints/mile)
- Dowels and asphalt shoulders

Condition:

- Cores Avg = 710 psi
- Drainage – typical for fat clay
- Deteriorated joints - 35%
- Avg. Load transfer by FWD = 55%
- Unrepaired cracks - 10



Discussion...





Concrete Overlay Solutions Workshop

Module 7 – How to Integrate This
Solution into WisDOT Practice



Overview

- Facing the Implementation Challenges
- How to Get Started
- QR Codes for Useful Resources

Facing Implementation Challenges

Lack of inclusion of concrete overlays among treatment options in planning tools:

- Most PMS only reflect local institutional experience/solutions
 - Hard to introduce/institutionalize innovative solutions
 - Limited attention given to alternative solutions
 - May require champion to push as special solution
- Use national performance data or peer agency experience for concrete overlays until local data can be obtained

Facing Implementation Challenges

Need to grow technical competency and experience:

- Need to gain internal comfort with this solution, even though very similar to conventional concrete paving. Resources to help are available:
 - FHWA
 - Industry
 - CP Tech and other research centers
- Contractor learning curve?
 - Does not require special concrete contractors
 - Placing concrete overlays similar to placing full-depth pavement

Facing Implementation Challenges

Growing confidence in identifying candidates/applying solutions:

- Addressing pavements in poorer condition is easiest place to start
 - COC-U or COA-U overlay candidates
 - They offer widest range of applicability
 - Fits WI's targeted RSRF 30 category
- Focus on ways to overcome profile grade concerns
 - Milling options to reduce raising grade above existing
 - Replacing short sections to address clearance issues
 - Safety edge for drop-off issues during construction

Facing Implementation Challenges

Perceived lack of traffic management/detour options:

- Consider the same MOT strategies as used with asphalt overlays
 - Normal through traffic is maintained on the project
 - Where possible, close road for faster construction
- Give contractor your MOT parameters and let them devise how they can meet your expectation.
 - Require contractor to establish communication with community/stakeholders along the length of the project
 - Allow the contractor flexibility in addressing local access needs

Getting Started

1

Start with simpler projects:

Projects with no complicated staging or tight completion requirements

Make it easy to get started and focus on your procedures to work out your specifications/details

Getting Started

2

Evaluate performance:

- Build a few projects per year
- Establish a process for annual field reviews and collection of performance data

Allow first projects to build your confidence in the technology

Getting Started

3

Build your technical competency using available help:

- Technical manuals and training materials
- Peer agencies with experience
- CP Tech Center
- FHWA
- Industry (WCPA)

Take advantage of the experience around you remembering this is ready-to-implement technology!

Getting Started

4

Integrate concrete overlays into your “Mix of Fixes” over time:

- Collect local cost/performance data from your projects
- Build a database with your data
- Include data from peer organizations to get started

Make sure concrete overlays are an option in your software for project scoping!

Getting Started

5

Collaborate/reach out to peers as you learn:

- Exchange technical information
- Share your knowledge at consortiums and peer exchanges like NC²

Pay it forward by sharing what you learn from your concrete overlay solutions!

Technical Resources

Concrete Overlays—The Value Proposition

https://intrans.iastate.edu/app/uploads/2021/12/concrete_overlays-the_value_proposition.pdf



CONCRETE OVERLAYS—THE VALUE PROPOSITION

AUTHOR
Tom Cackler, PE
Woodland Consulting, Inc.

SPONSOR
Federal Highway Administration

The paved roadway system in the United States consists of nearly 3 million miles of interconnected federal, state, and local networks. Given increasing traffic demands, aging infrastructure, and relentless constraints on available funding, most, if not all, jurisdictions struggle to keep the condition of their roads at levels of service expected by the public and commercial trucking industry.

The American Society of Civil Engineers' 2021 Report Card for America's Infrastructure has highlighted this challenge by assigning the nation's roads a grade of D. The assessment notes that currently 43% of US public roadways, the vast majority of which are on urban and rural collectors and non-Interstate highways, are in poor or mediocre condition. The report card recommends that agencies focus resources on preserving roads in a state of good repair because the nation will never be able to fully build its way out of congestion (ASCE 2021).

As public agencies struggle with this challenge, many have found that including concrete overlays in their "mix of fixes" has proven to be a valuable strategy for improving the overall condition of their roadway networks over time. Their experiences have inspired the title of this publication: *Concrete Overlays—The Value Proposition*.

Although concrete overlays have been built for over 100 years, the reader will find that the technology has advanced significantly in recent years due to the following:

- Development of performance-engineered concrete mixtures for materials optimization and increased mixture durability under harsh winter maintenance environments
- Advancements in overlay design procedures
- Innovations in separation layer materials
- Improvements in traffic management strategies and tools, including rapid opening to traffic based upon maturity concepts
- Advancements in construction technologies, including vibrator monitoring, real-time smoothness, and stringless paving
- Availability of scanning technologies to rapidly measure existing pavement geometry, making it easy to design profile improvements
- Documentation of practical experience, which has shown widespread and substantial benefits

A more in-depth technical overview of concrete overlays and how to effectively deploy them is offered in a companion document entitled *Concrete Overlays—A Proven Technology*. That document is intended to provide an introduction to concrete overlay selection, design, and construction practices for those with limited experience with concrete overlay technology, while this document focuses on the value proposition concrete overlays offer to agencies.

National Concrete Pavement
Technology Center
2711 South Loop Drive, Suite 4700
Ames, IA 50010-8664
nctechcenter.org

Director, Peter Taylor
515-294-3230 / ptaylor@iastate.edu

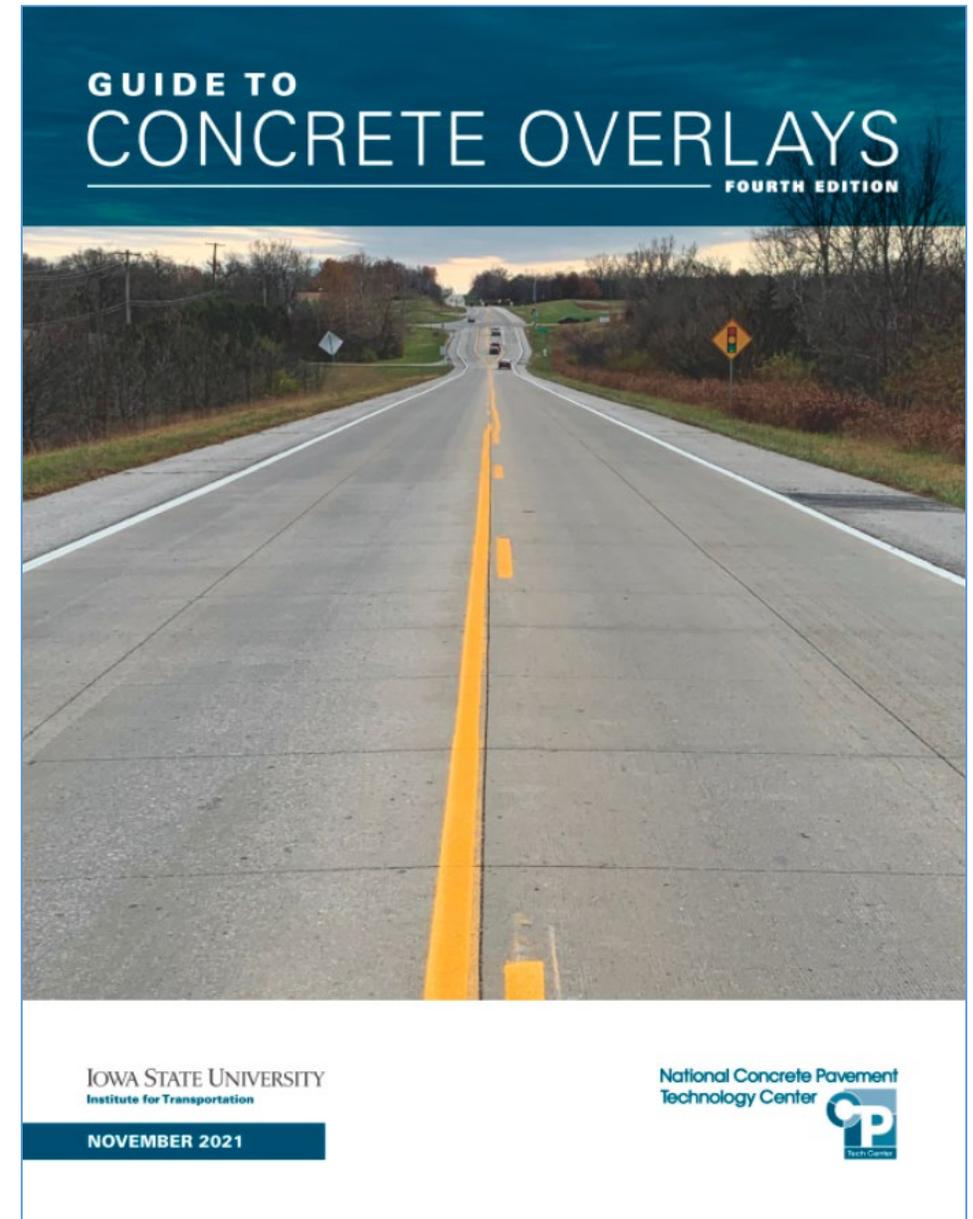


IOWA STATE UNIVERSITY
Institute for Transportation

Technical Resources

Guide to Concrete Overlays (4th Edition)

https://intrans.iastate.edu/app/uploads/2021/11/guide_to_concrete_overlays_4th_Ed_web.pdf



Technical Resources

MAP Brief Winter 2023

https://intrans.iastate.edu/app/uploads/2023/01/concrete_overlays_winter_2023_MB.pdf



"Moving Advancements into Practice"

MAP Brief Winter 2023

Best practices and promising technologies that can be used now to enhance concrete paving

Concrete Overlays

WINTER 2023

PROJECT TITLE

Concrete Overlays

AUTHOR

Jerod Gross, Snyder & Associates, Inc.

EDITORS

Zane Charter
Oksana Gieseman
Peter Hunsinger

SPONSORS

Technology Transfer Concrete Consortium
TPF-5(437)

MORE INFORMATION

National Concrete Pavement Technology Center
515-294-5798
dfwagner@iastate.edu
www.cptechcenter.org/
national-concrete-consortium

Introduction

Concrete overlays serve as a viable, cost-effective preservation treatment that can improve the performance of existing roadways. Concrete overlays are an important part of the Federal Highway Administration (FHWA) Every Day Counts initiative, including the innovative Targeted Overlay Pavement Solutions (TOPS) program. Potential TOPS benefits for concrete overlays include improved safety, improved performance, retained investments, cost savings, and environmental soundness. This program provides technical support and educational materials to state highway agencies (https://www.fhwa.dot.gov/pavement/tops/concrete_resources.cfm).

This document provides a brief background, technical resources, and key benefits for concrete overlays to argue that they should be considered a long-life preservation treatment for aging roadway facilities. Concrete overlays are simple and sustainable and have shown a history of long-term performance for multiple agencies.

Concrete Overlay Types

A concrete overlay is a concrete pavement layer placed directly on an existing pavement. Concrete overlays are constructed using the same materials, equipment, and processes as a conventional concrete pavement placed on a base course. Concrete overlays are categorized into four main types:

- Concrete on asphalt-bonded (COA-B)
- Concrete on asphalt-unbonded (COA-U)
- Concrete on concrete-bonded (COC-B)
- Concrete on concrete-unbonded (COC-U)

Concrete on Asphalt (COA)

If the existing pavement is asphalt and is in fair or good condition, a COA-B overlay can restore and improve an existing pavement's structure value. In a bonded overlay, the existing pavement serves as a structural component to the new pavement system.

If the existing pavement is asphalt and is in poor or deteriorated condition, a COA-U overlay can add structural value to the roadway. Although the placement of concrete on a clean and stable pavement will inherently have some amount of bonding, this bond is not considered to aid in the design for bonded concrete overlays. The existing pavement serves as a uniform support layer.

Concrete on Concrete (COC)

If the existing pavement is concrete and is in fair or good condition, a COC-B overlay can restore or increase the pavement's original structural value. Special design and construction considerations need to be followed for this type of overlay to be successful, so this type of overlay is not common.

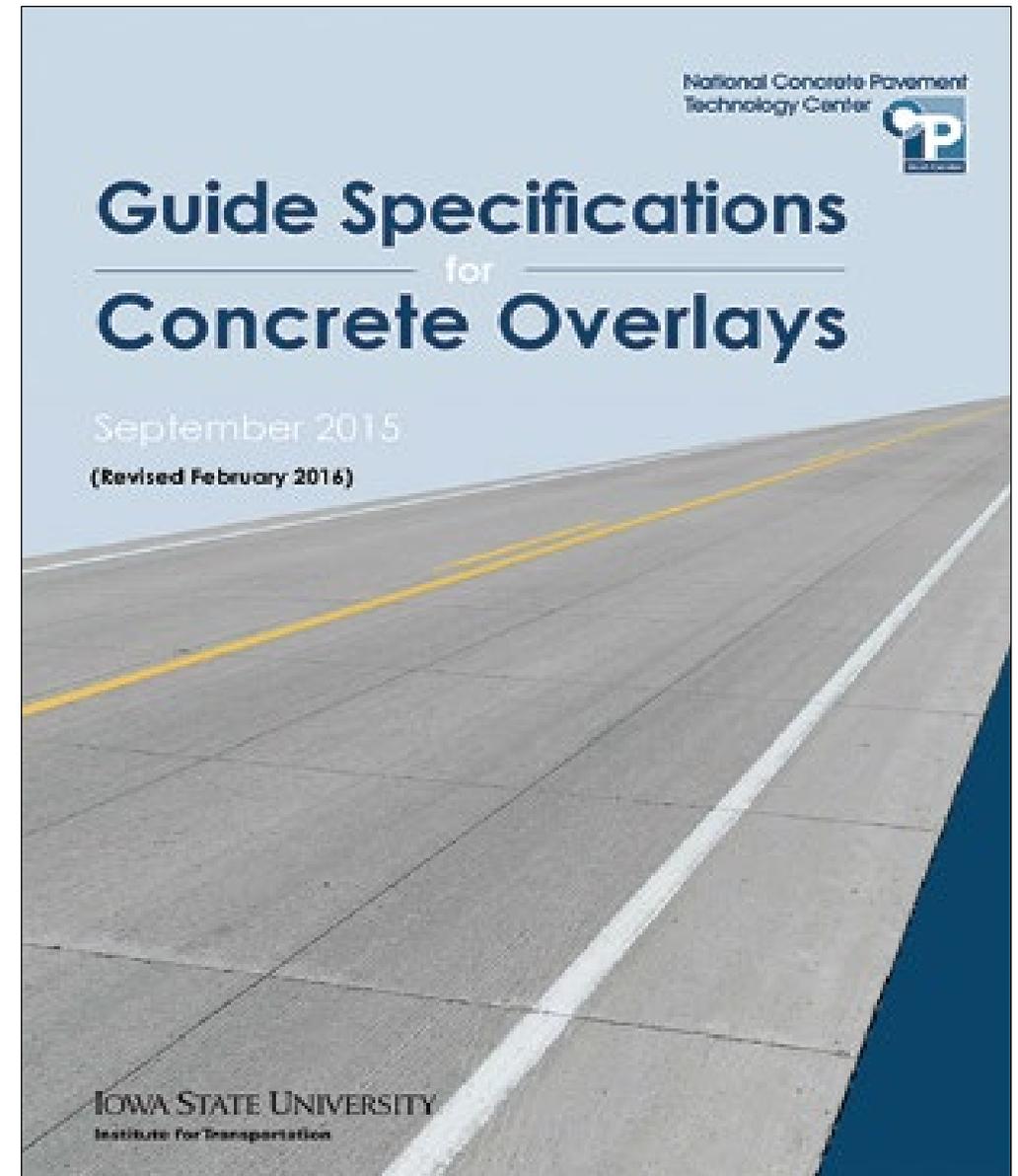
If the existing pavement is concrete and is in poor or deteriorated condition, a COC-U overlay can add structural value to the roadway. A required separation layer helps prevent cracks from reflecting up from the existing pavement, prevents bonding, and provides drainage. The separation layer is either a nonwoven geotextile or a thin (1 to 2 in.) layer of hot-mix asphalt (HMA).

Figure 1 illustrates the four types of concrete overlays.

Technical Resources

Guide Specifications for Concrete Overlays

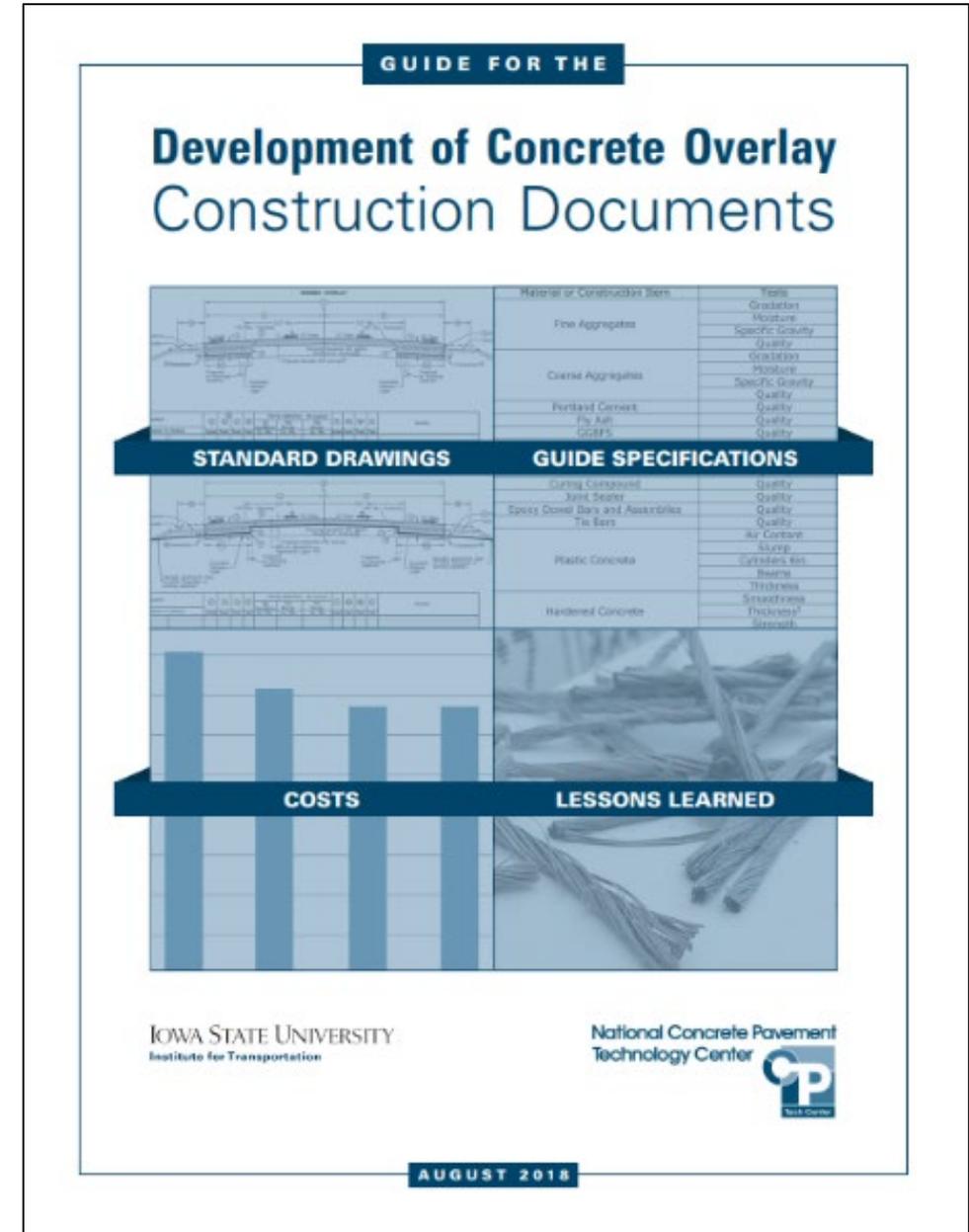
https://intrans.iastate.edu/app/uploads/2018/08/overlay_guide_specifications.pdf



Technical Resources

Guide for the Development of Concrete Overlay Construction Documents

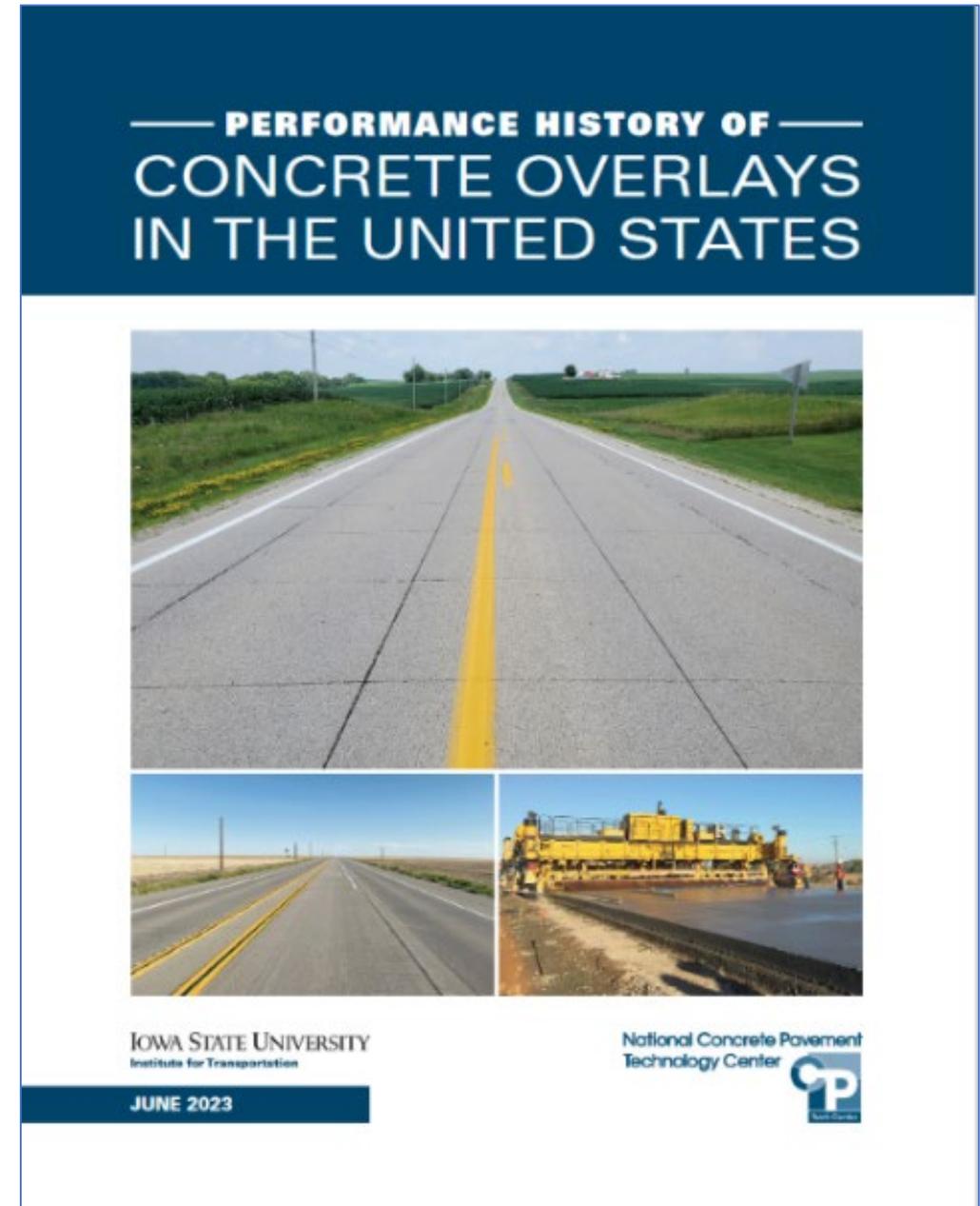
https://intrans.iastate.edu/app/uploads/2018/09/overlay_construction_doc_dev_guide_w_cvr.pdf



Technical Resources

Performance History of Concrete Overlays in the United States

https://intrans.iastate.edu/app/uploads/2023/06/performance_history_of_US_concrete_overlays_web.pdf



Technical Resources

Concrete Overlay Performance on Iowa's Roadways



Concrete Overlay Performance on Iowa's Roadways

Field Data Report
July 2017

National Concrete Pavement
Technology Center 

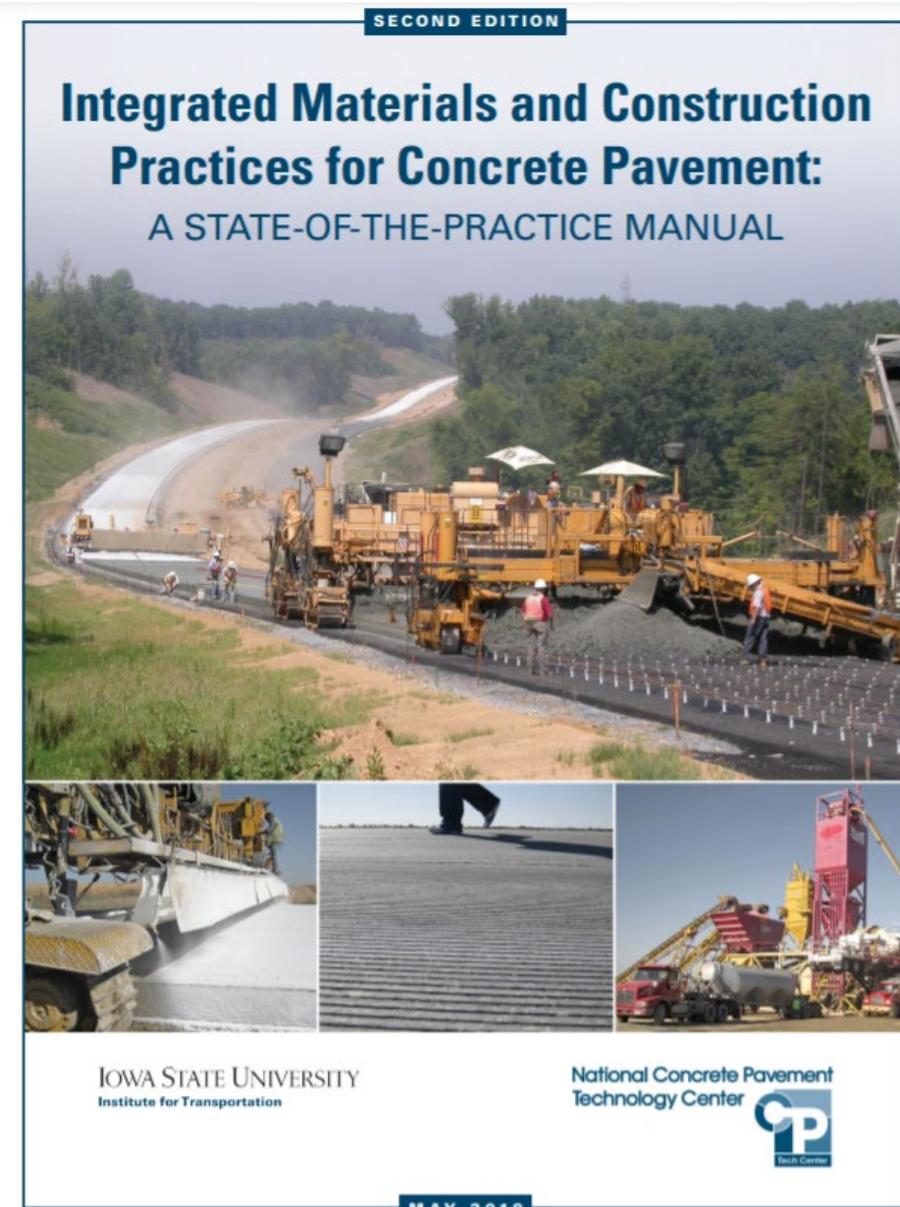


IOWA STATE UNIVERSITY
Institute for Transportation

Sponsored by
Iowa Highway Research Board
(IHRB Project TR-698)
Iowa Department of Transportation
(InTrans Project 15-559)

Technical Resources

Integrated Materials and Construction
Practices for Concrete Pavement–IMCP Manual
https://intrans.iastate.edu/app/uploads/2019/05/IMCP_manual.pdf

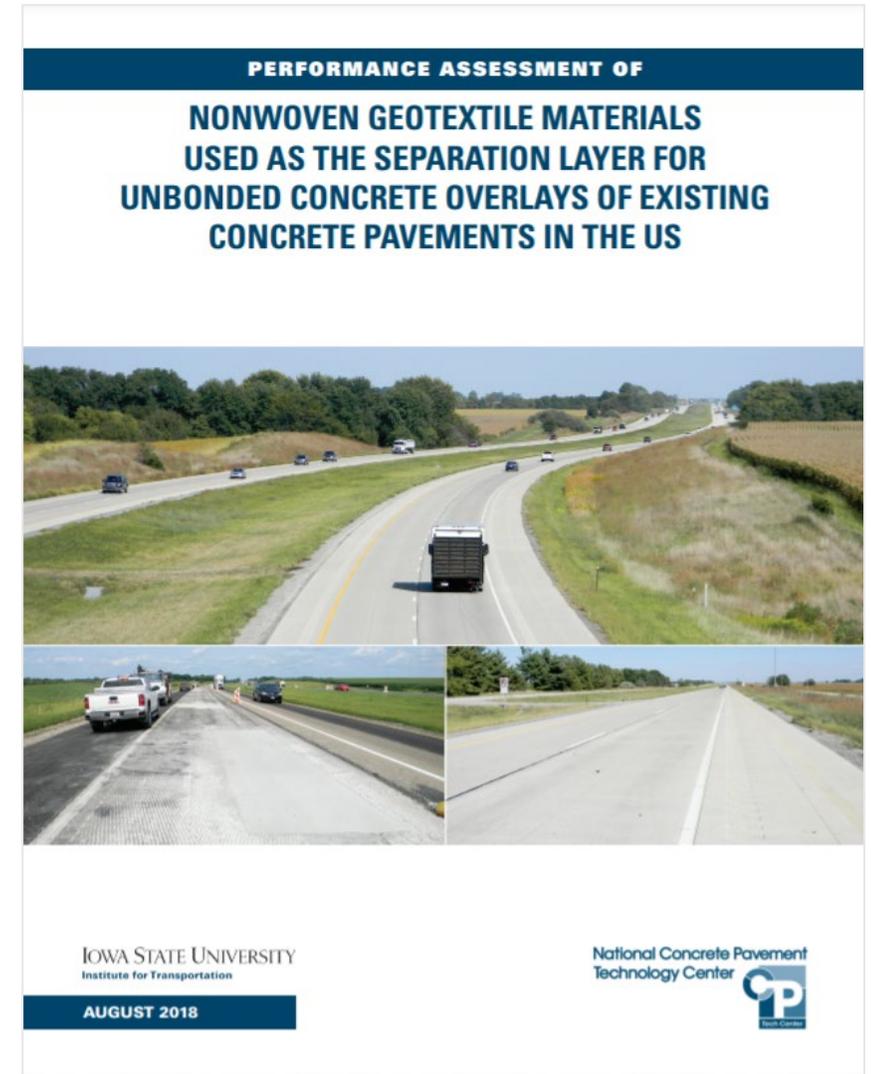


Technical Resources

Performance Assessment of Nonwoven Geotextile Materials Used as the Separation Layer for Unbonded Concrete Overlays of Existing Concrete Pavements in the US



https://intrans.iastate.edu/app/uploads/2018/10/US_geotextile_performance_w_cvr.pdf



Technical Resources

Fiber-Reinforced Concrete for Pavement Overlays: Technical Overview

https://intrans.iastate.edu/app/uploads/2019/04/FRC_ov_erlays_tech_ovw_w_cvr.pdf



Fiber-Reinforced Concrete for Pavement Overlays: Technical Overview

Final Report
April 2019



Sponsored by

Federal Highway Administration
Technology Transfer Concrete Consortium (TTCC) Pooled Fund TPF-5(313)
(Part of Intrans Project 15-532)

IOWA STATE UNIVERSITY
Institute for Transportation

National Concrete Pavement
Technology Center



Technical Resources

CP Tech Center – Concrete Overlays Webpage

- Consolidated resource center



<https://cptechcenter.org/concrete-overlays/>

Technical Resources

ACPA National Concrete Overlay Explorer

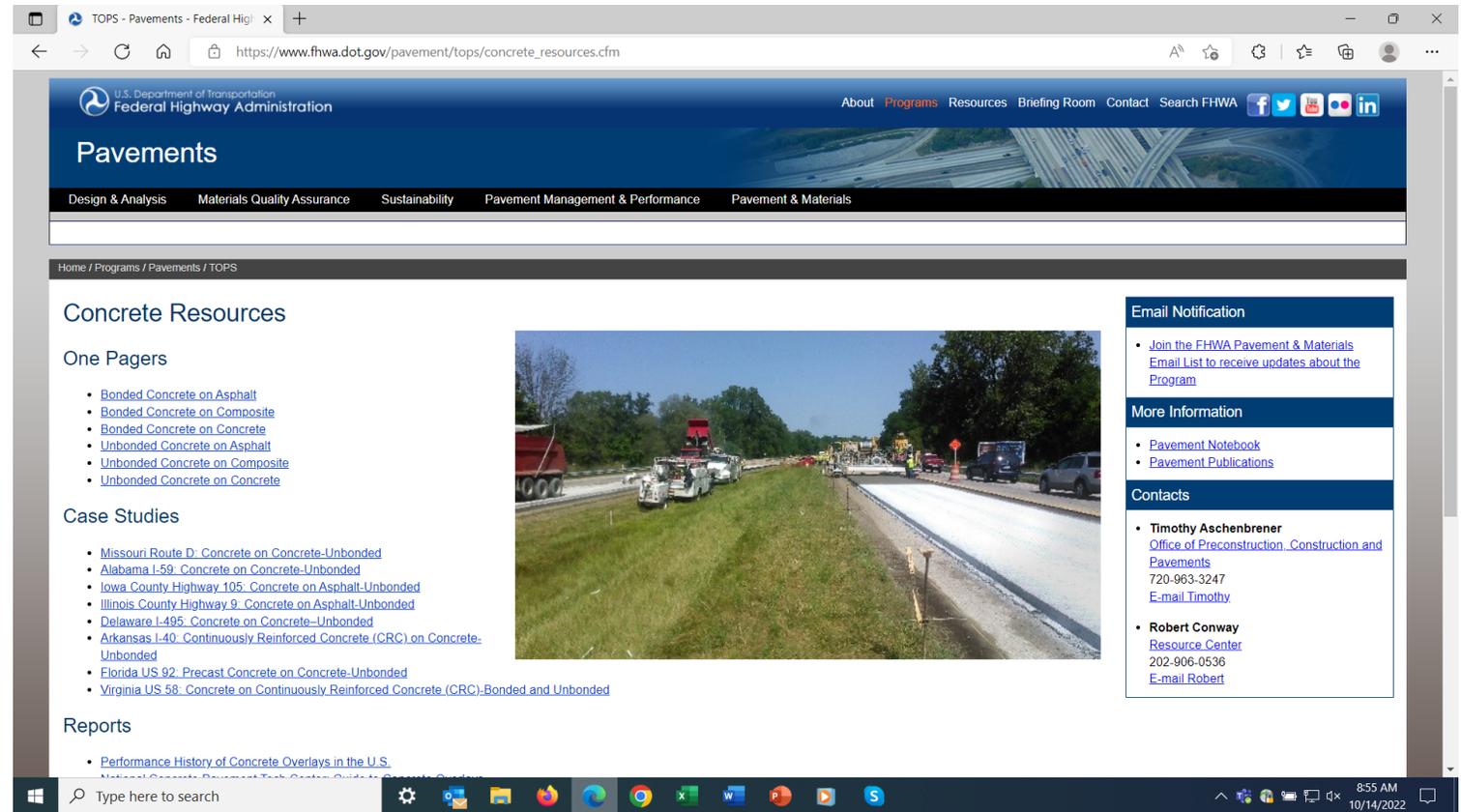
- Online historical database of concrete overlays in the US.
- Filter by overlay type, application, state, thickness, year of construction, project size, joint spacing, and reinforcing type.



<http://overlays.acpa.org>

Technical Resources

- FHWA TOPS Website



https://www.fhwa.dot.gov/pavement/tops/concrete_resources.cfm

Thank You

Jerod Gross

Snyder & Associates, Inc.

jgross@snyder-associates.com

515-669-7644

Jerry Voigt

Square One Pavement Consulting

gvoigt63@gmail.com

847-867-3943