Image source: NAPA

Image source: ACPA

U.S. Department of Transportation
Federal Highway Administration

TOPS

Targeted Overlay Pavement Solutions

A solution for extending the life of an existing pavement investment.

Every Day Counts
Innovation for a Nation on the Move

Disclaimer

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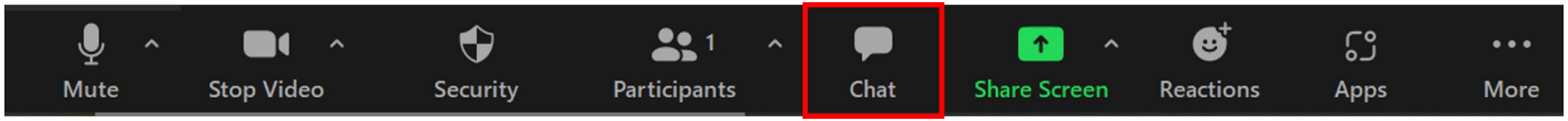
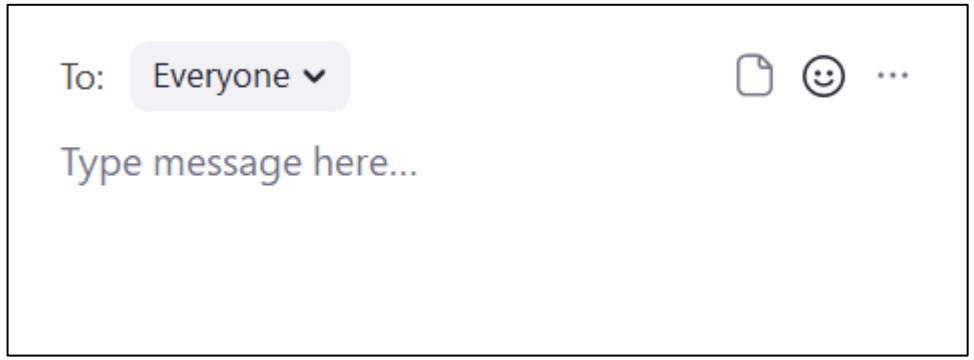
- All questions from participants will be answered during the Q&A session at the end of the webinar.





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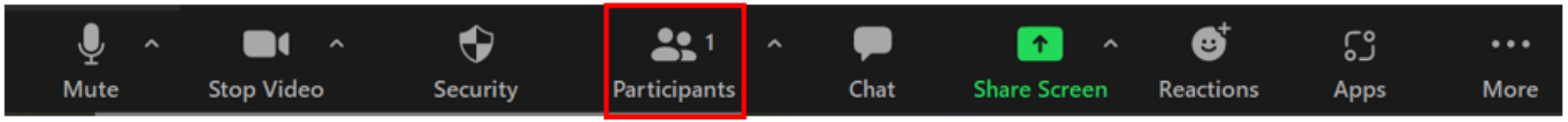

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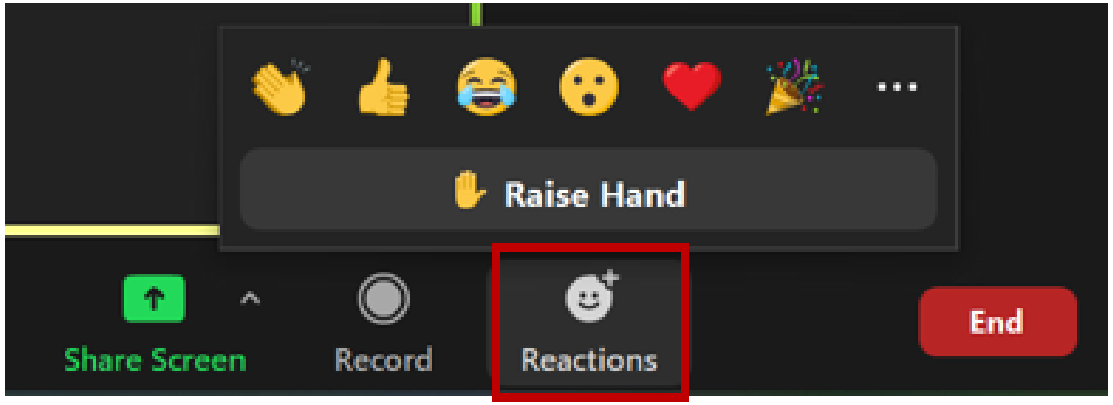

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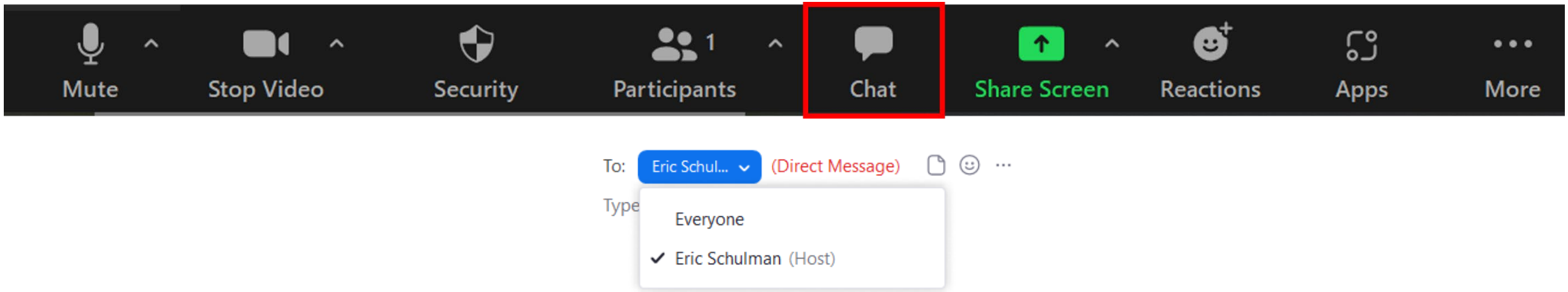

- Email eric.schulman@weris-inc.com

Webinar Overview

- Introduction to EDC-6 TOPS: Bob Conway, FHWA
- Concrete Overlay Feasibility Strategies: Jerry Voigt, FHWA Consultant
- Q & A

FHWA TOPS EDC-6 Team

Tim Aschenbrener
FHWA Headquarters

Bob Conway
FHWA Resource Center

Derek Nener-Plante
FHWA Resource Center

Background

- Over 25% of all State DOT infrastructure funds go to pavements overlays.
- State DOT manage 2.8 million miles of pavements.

- *Information source: FHWA at https://www.fhwa.dot.gov/innovation/everydaycounts/edc_6/targeted_overlay_pavement.cfm*
- *https://www.fhwa.dot.gov/policyinformation/statistics/2017/hm12.cfm*

Image source: Iowa State University

How is this different from typical overlays?

TOPS matches treatments to high-priority, high-need locations.

Image source: Georgia DOT

TOPS EDC Mission

Image source: iStock

Extend pavement life, increase load-carrying capacity, and improve safety, mobility, and user satisfaction in a cost-effective and sustainable manner by delivering targeted pavement overlay solutions to Federal, State, and local transportation agencies.

EDC-6 Goals

- Increase the number of participating agencies that demonstrate, assess, or institutionalize an additional TOPS technology not previously institutionalized.
- Build awareness and expand TOPS usage
  - Identify a champion at each State agency
  - Share information at conferences/workshops
  - Train people (webinars/peer exchanges)

What's in the TOPS toolbox? (1 of 2)

Asphalt overlay products:

- High-Performance Thin Overlay (HPTO)
- Crack Attenuating Mixture (CAM)
- Highly Modified Asphalt (HiMA)
- Enhanced friction overlay
- Stone matrix asphalt (SMA)
- Asphalt Rubber Gap-Graded (ARGG)
- Open-Graded Friction Course (OGFC)
- Ultra-thin bonded wearing course (UTBWC)

What's in the TOPS toolbox? (2 of 2)

Concrete overlay products:

- Concrete on Asphalt – Bonded (COA-B)
- Concrete on Asphalt – Unbonded (COA-U)
- Concrete on Concrete – Bonded (COC-B)
- Concrete on Concrete – Unbonded (COC-U)

TOPS Potential Benefits

- Improved Safety
- Improved Performance
- Retained Investments
- Cost Savings
- Environmentally Sound

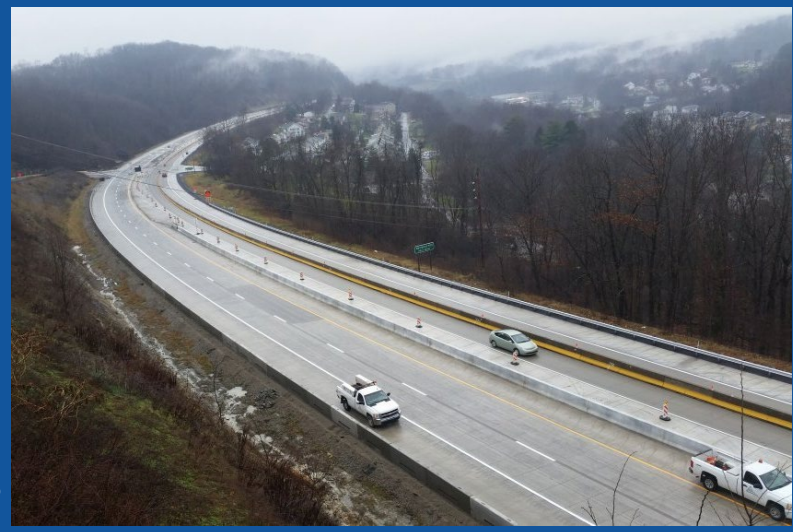

Image source: American Concrete Pavement Association

Concrete Overlay Feasibility Strategies

U.S. Department of Transportation
Federal Highway Administration

Every Day Counts
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Acronyms

- AASHTO – American Association of State Highway and Transportation Officials
- ASTM – American Society for Testing and Materials
- FWD – Falling Weight Deflectometer
- GPR – Ground Penetrating Radar
- LiDAR – Light Detection and Ranging
- NDT – Non-Destructive Testing

Overview

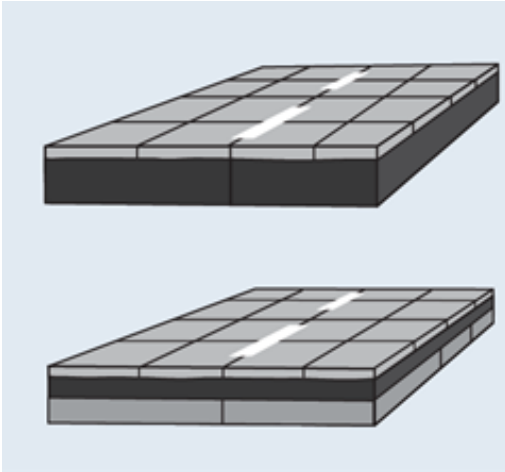
- Overview of concrete overlays
- Value points of concrete overlay solutions
- Evaluating pavements & selecting solutions
- Work zone feasibility strategies
- How you can get started & resources

Four Main Types of Concrete Overlays

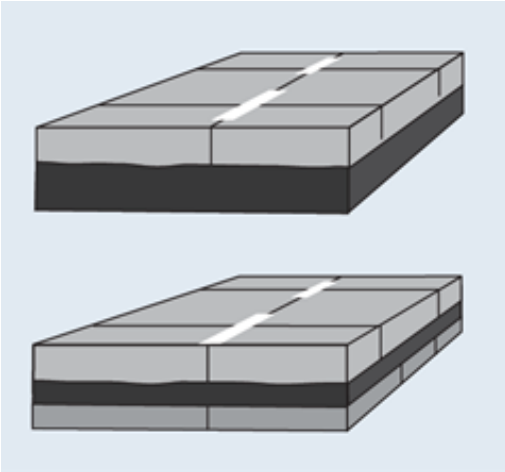
Concrete on Asphalt
Concrete on asphalt (COA) overlays can be designed to address a broad range of existing pavement conditions on both composite and full-depth asphalt pavements. Both bonded (COA-B) and unbonded (COA-U) options enable designs to cost-effectively match the condition of the existing asphalt - from deteriorated to good - as well as geometric parameters.

Concrete on Concrete
Concrete on concrete (COC) overlays can be designed for applications on both existing jointed plain concrete pavement (JPCP) and continuously reinforced concrete pavement (CRCP). The predominance of COC overlay designs are unbonded (COC-U) systems; however, bonded (COC-B) applications can be successful, provided the existing pavement is in good condition.

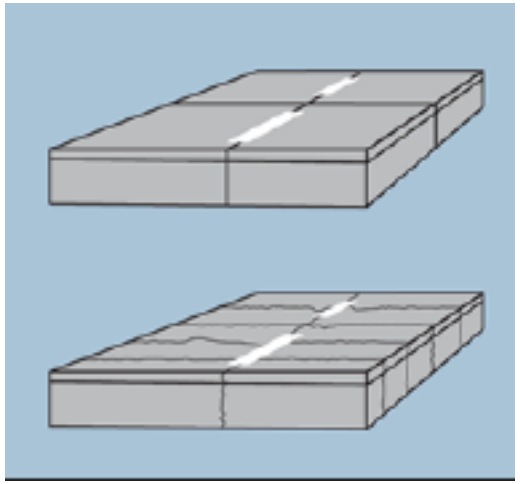
COA-B (Full Depth and Composite)



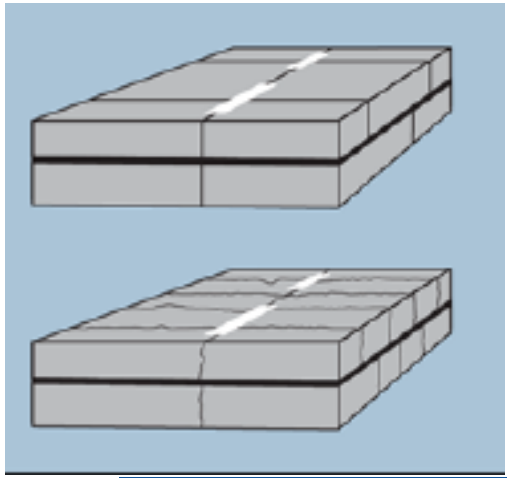
COA-U (Full Depth and Composite)



COC-B (JPCP and CRCP)



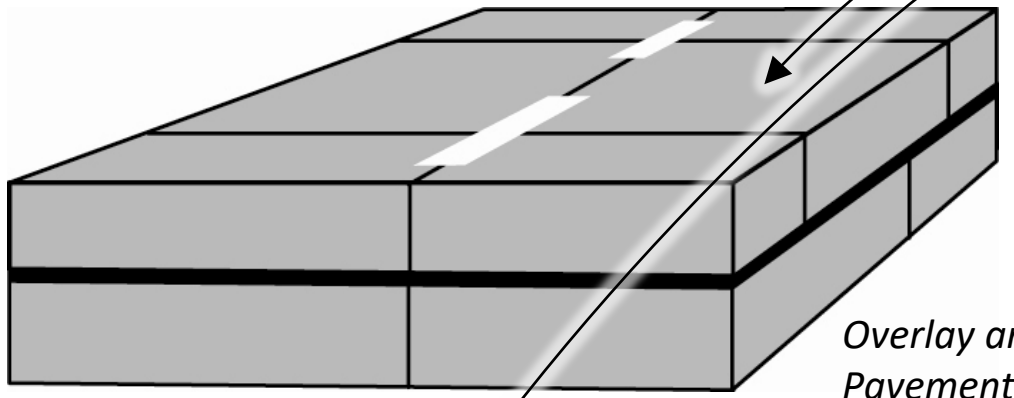
COC-U (JPCP and CRCP)



Images source: Iowa State University

The Basic Engineering

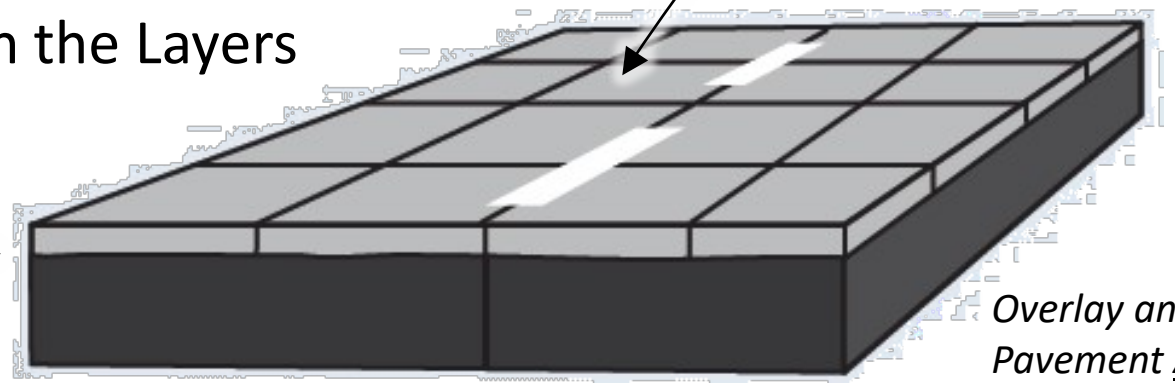
U Counts on Separating the Layers



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

Applicability


Image source: ACPA


Image source: LaDOTD


Image source: FHWA


Image source: FHWA


Image source: FHWA

Jointed Pavement	Continuously Reinforced Pavement	Composite Pavement	HMA or WMA Pavement	Composite Pavement

Existing Concrete **Existing Asphalt**

Wide Range of Applicability

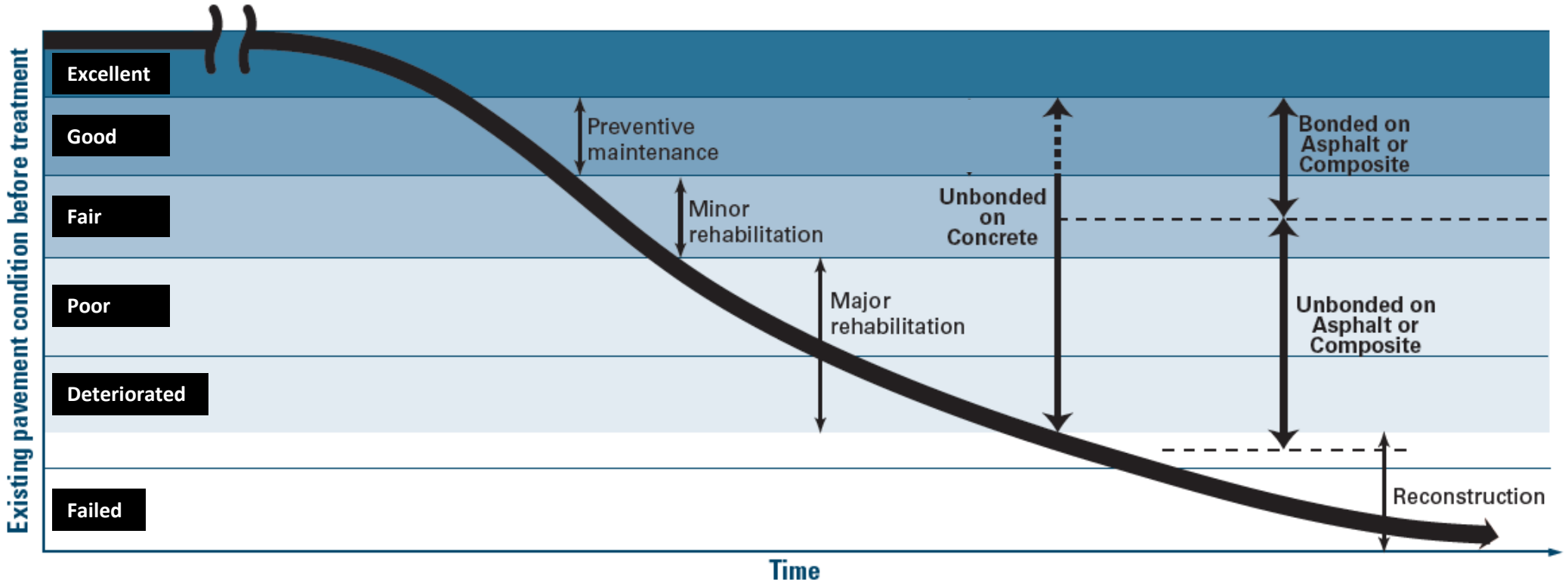
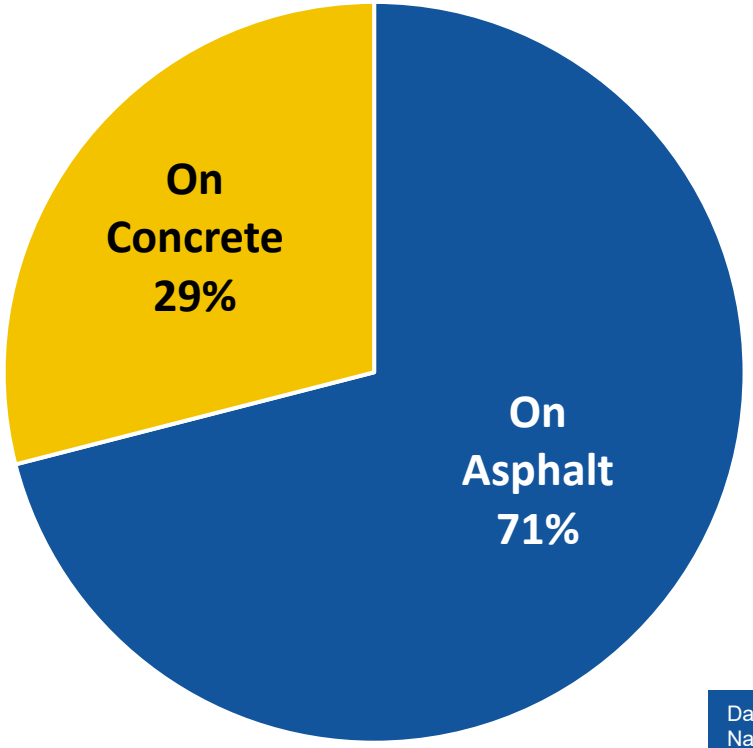


Image source: Iowa State University

Actual Applications 2000-2017



Unbonded:

- More prevalent than bonded
- Why? Can be adapted to a wider range of existing pavement conditions.

Bonded:

- Used by SHAs to capitalize directly upon the structural value in the existing concrete or asphalt pavement.

Data source: American Concrete Pavement Association, reported in Guide to Concrete Overlays,4th Edition, National Concrete Pavement Technology Center, Iowa State University*

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Value Considerations

Image source: Voigt

Low Maintenance Service Life Achievable

- Since experimental inception over 1200 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

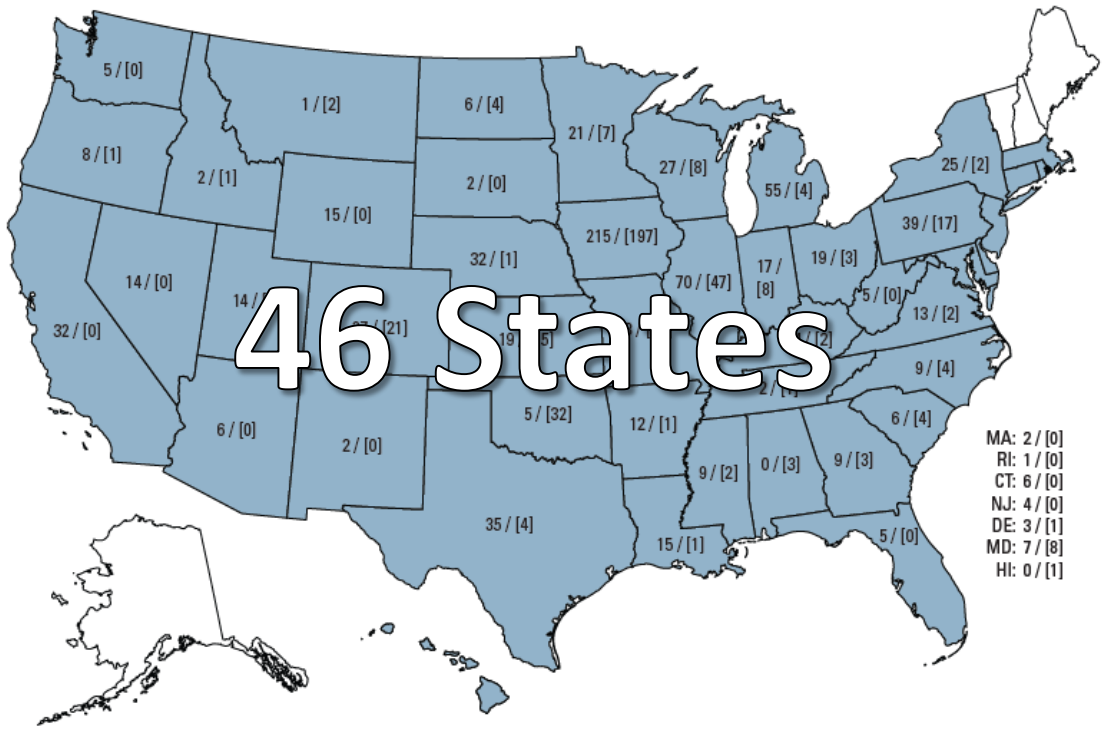
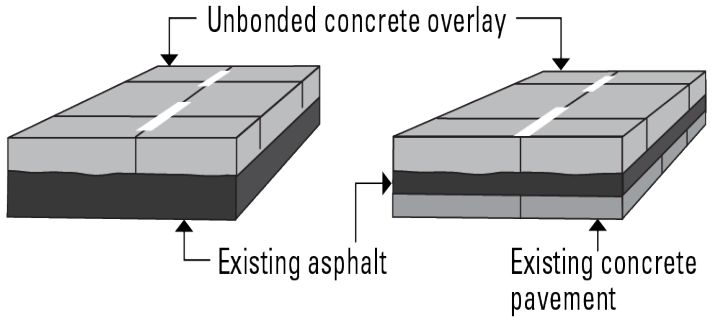
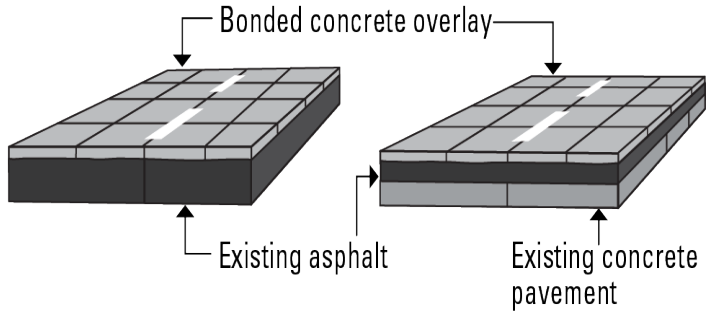
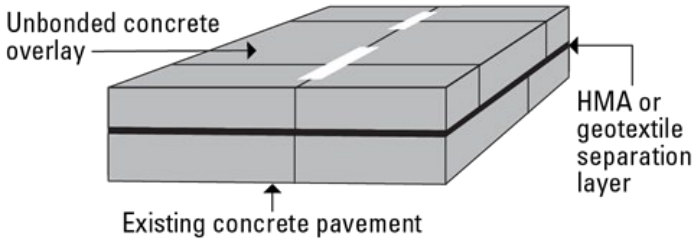


Image source: Iowa State University

Current Service-Life Examples







Images source: Iowa State University

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
- Harden the pavement system surface (for resiliency)

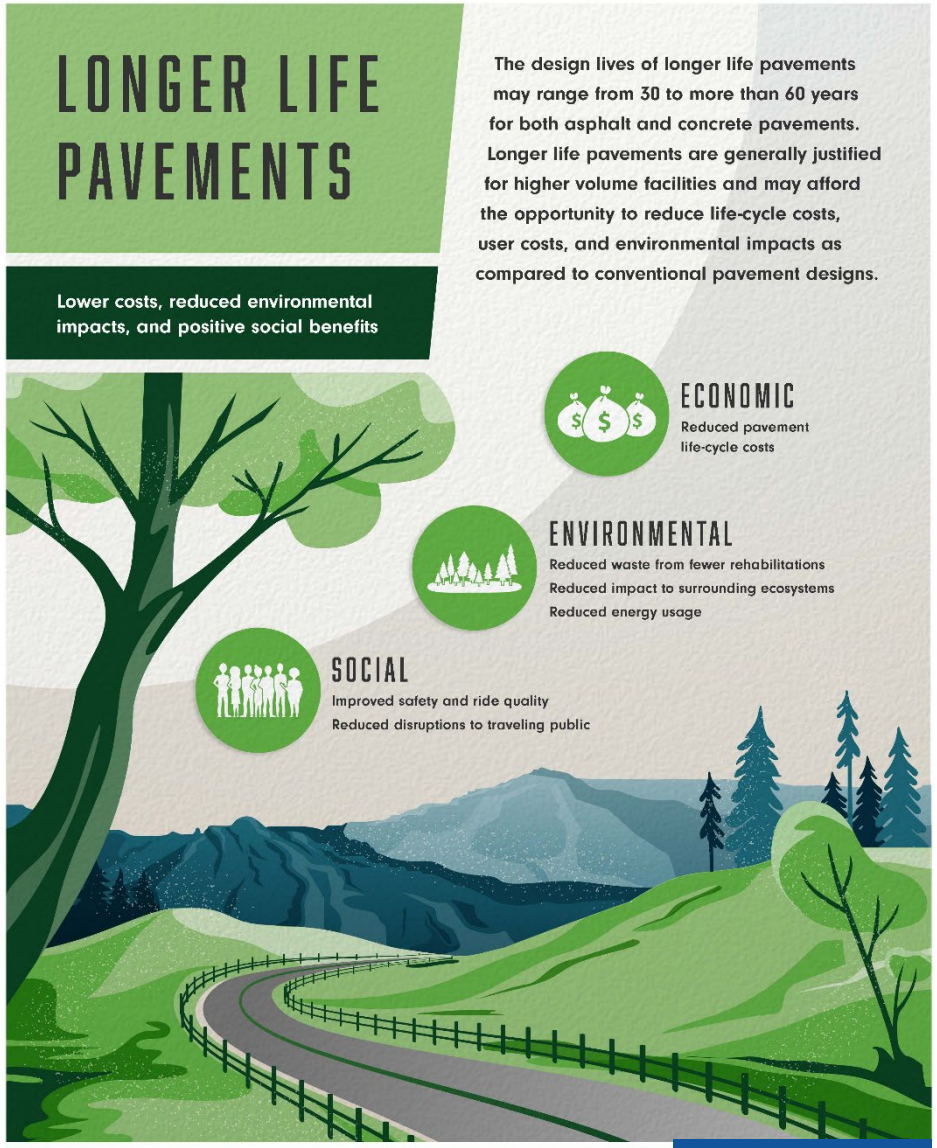
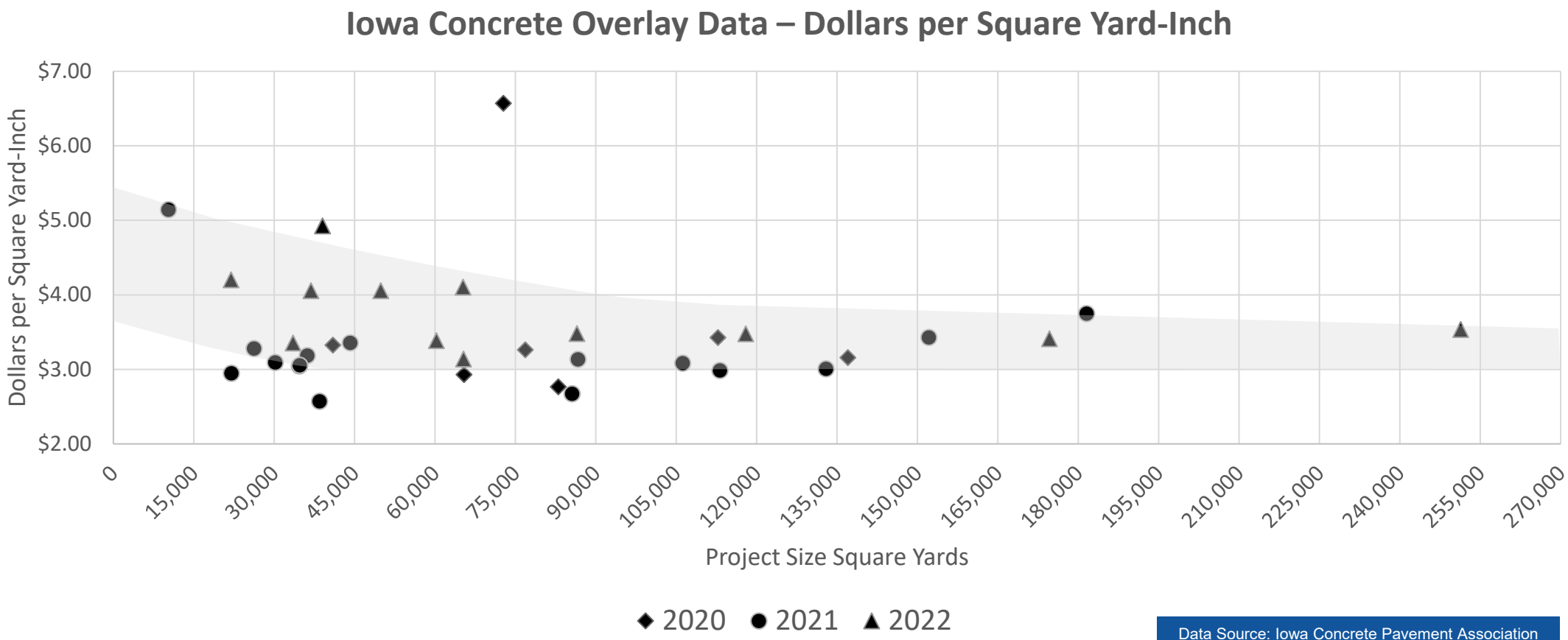


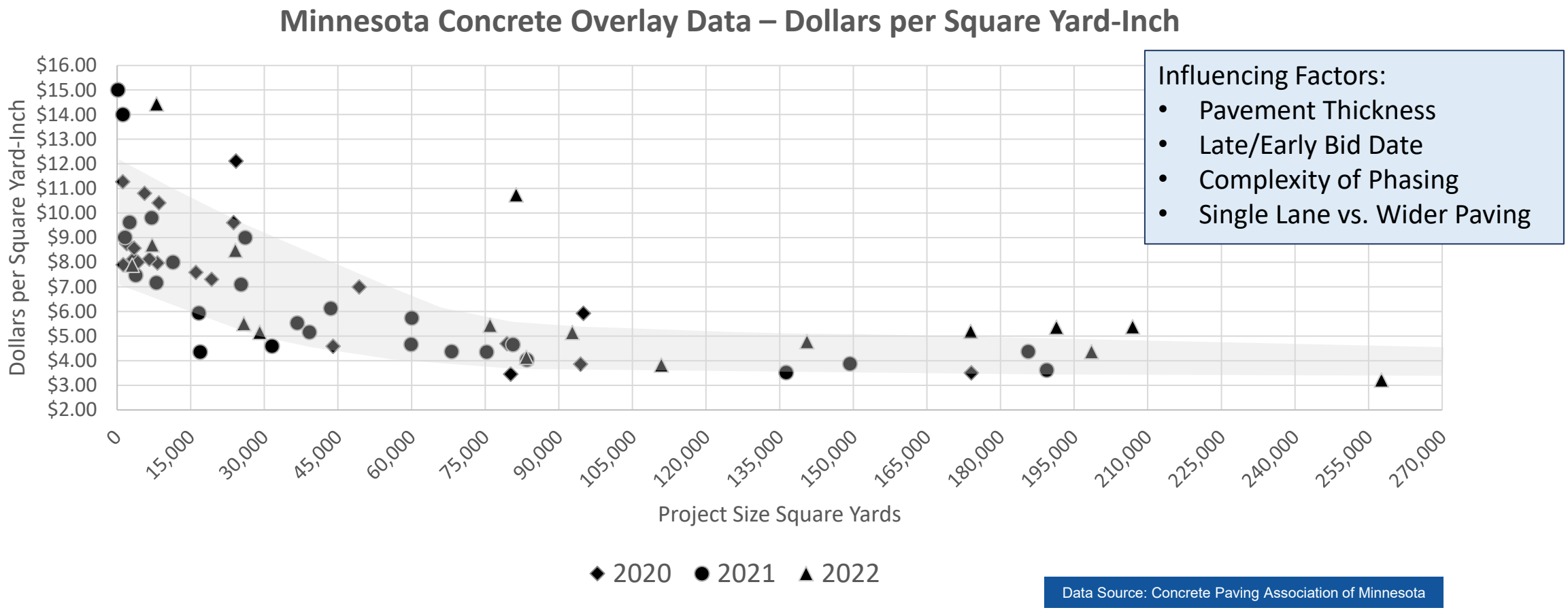
Image source: FHWA

Cost Data From Public Bid Tabulations (1 of 2)



Data Source: Iowa Concrete Pavement Association

Cost Data From Public Bid Tabulations (2 of 2)



Influencing Factors:

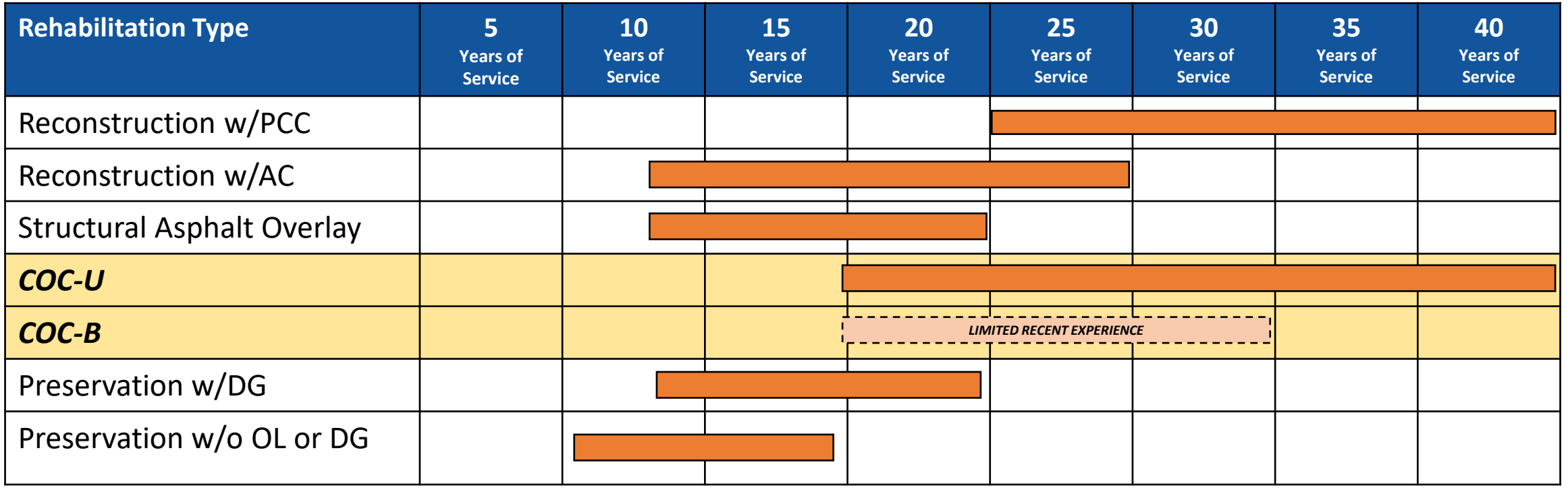
- Pavement Thickness
- Late/Early Bid Date
- Complexity of Phasing
- Single Lane vs. Wider Paving

Data Source: Concrete Paving Association of Minnesota

Life-Cycles for Rehab of Existing Concrete Roads

OL = Overlay
DG = Diamond Grinding

YEARS OF SERVICE



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

Life-Cycles for Rehab of Existing Asphalt Roads

YEARS OF SERVICE

OL = Overlay

Rehabilitation Type	5 Years of Service	10 Years of Service	15 Years of Service	20 Years of Service	25 Years of Service	30 Years of Service	35 Years of Service	40 Years of Service
Reconstruction w/PCC								
Reconstruction w/AC								
Structural Asphalt Overlay								
COA-U								
COA-B								
Non-structural Asphalt OL								
Asphalt Patching w/o OL								

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

Other Value/Cost Considerations

- Apply same:
  - Life-cycle cost analysis approach for comparison to other options
  - End-of-life strategy considerations as other options

- For more precise bidding consider using two bid items:
  - Cubic Yard – for concrete material
  - Square Yard – for all paving activities including
    - Placement/Paving
    - Texturing/Curing
    - Jointing

Pre-Overlay Repair and Interlayer Also Bid Separately!

Evaluating Pavements & Selecting Potential Solutions

Image source: Voigt

To Identify Feasibility of Overlays – Answer These Five Questions

- 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 COA-B or COC-B solution, will I have enough structure remaining after repair/milling?
- What interlayer treatment do I need to either bond or separate the overlay?
- Can a thicker COC-U or COA-U work within any vertical constraints?

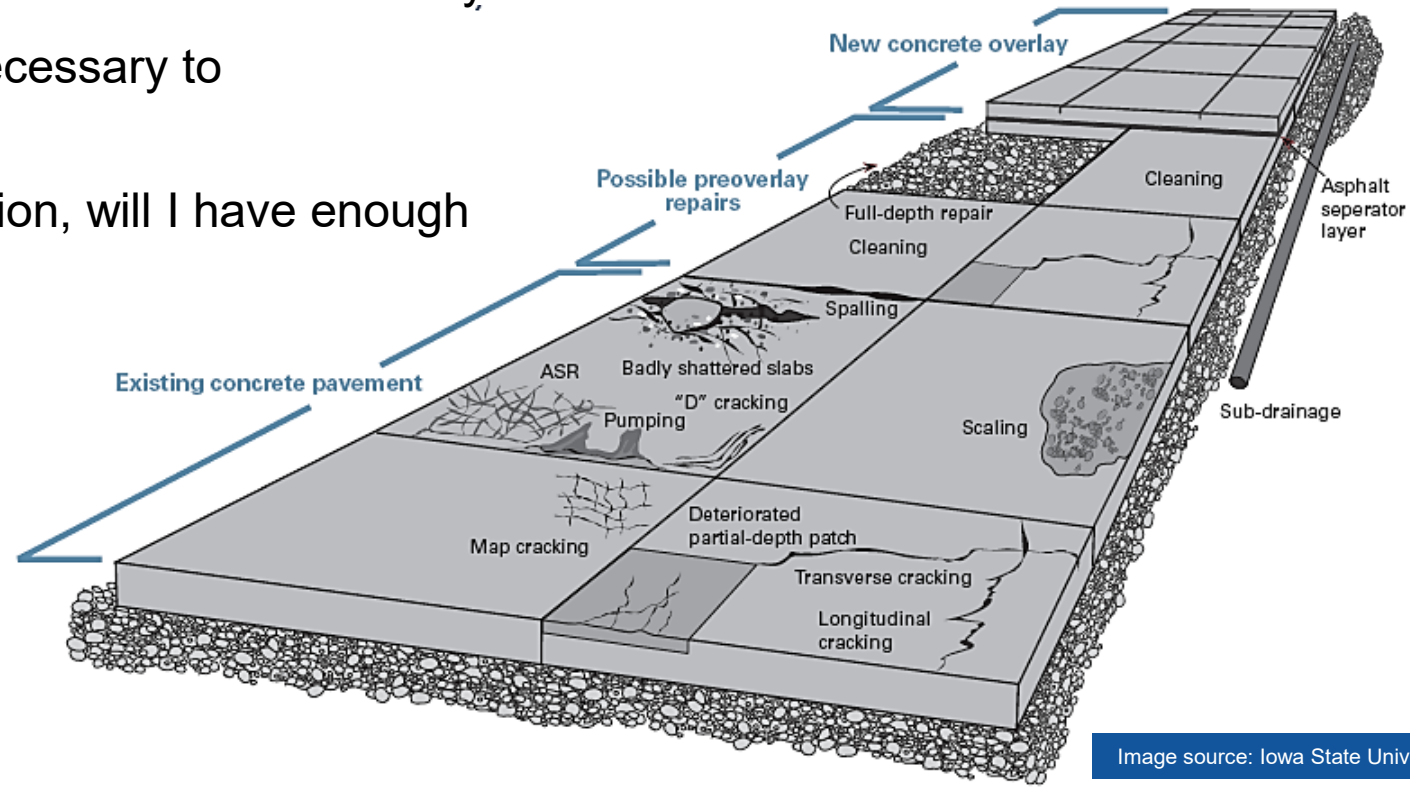
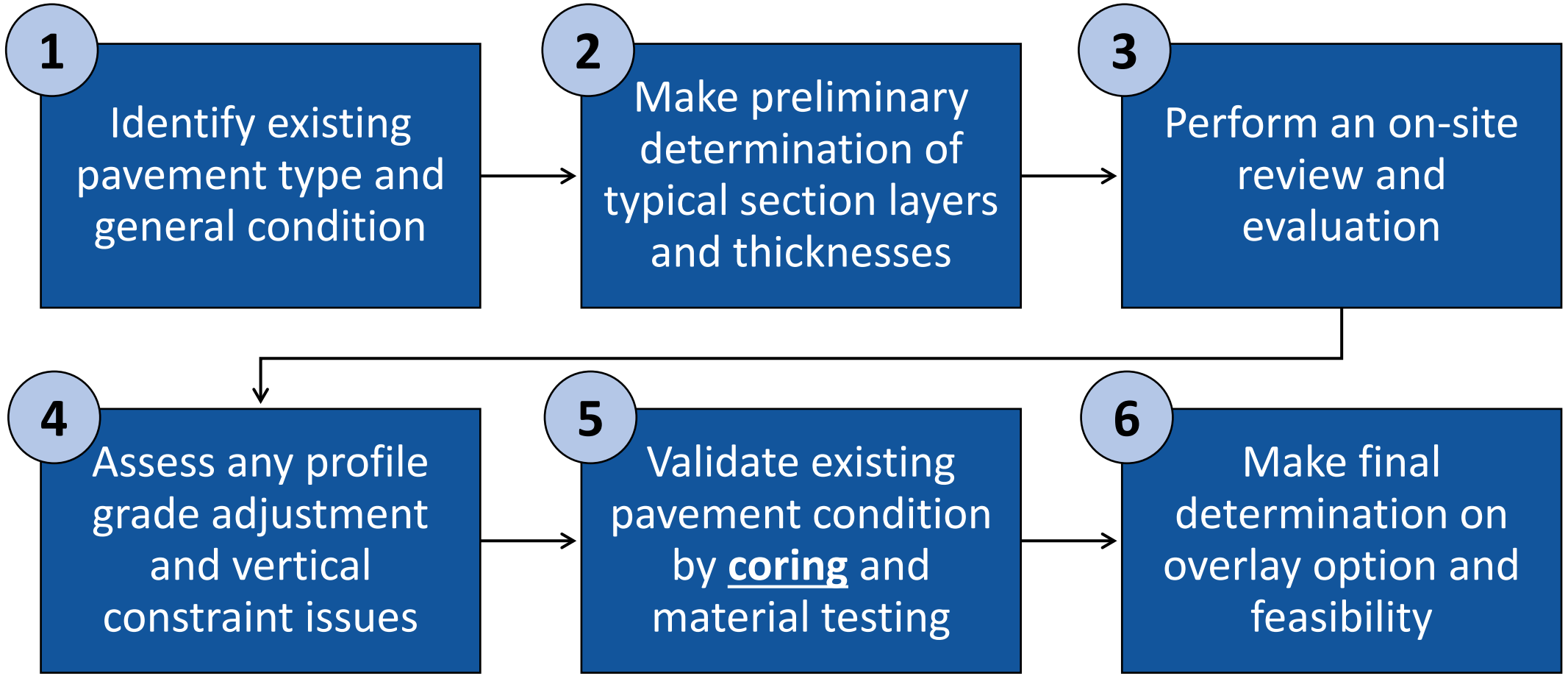


Image source: Iowa State University

Evaluation Process Steps



CORING IS MANDATORY!

Image source: Shreenath Rao

Example Minimum Evaluation Testing

Investigation/Test	Low-Volume Rural or Urban	Arterial or Urban Intersection	Secondary (State Route)	Primary (US Route/Interstate)
Coring (For Layer Thicknesses)	Two cores per lane mile from the mainline and one core per lane mile from each shoulder	Two cores per lane mile from the mainline and one core per lane mile from each shoulder	Four cores per lane mile from the mainline and two cores per lane mile from each shoulder	Four cores per lane mile from the mainline and two cores per lane mile from each shoulder
Falling Weight Deflectometer (For Support Values)	N/A	N/A	N/A	YES
Ground Penetrating Radar (For Layer Thicknesses)	N/A	N/A	YES (If core thicknesses are variable)	YES
Petrographic Analysis	When Materials-Related Distress (MRD) is suspected in the existing concrete; quantify potential for future expansion and/or deterioration			
Potential for Stripping (ASTM D4867)	As warranted from a visual examination of the cores			

Source: Guide to Concrete Overlays, 4th Edition, National Concrete Pavement Technology Center, Iowa State University*

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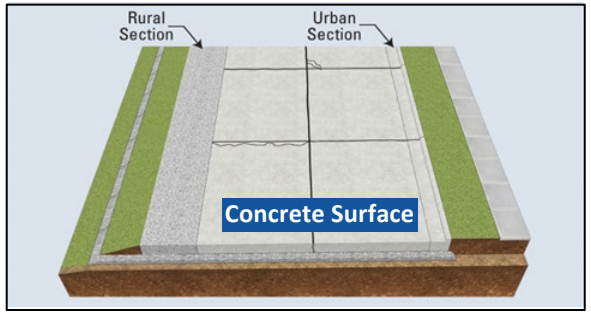
Use of ASTM D4867 is not a Federal requirement.

Existing Pavement/Condition Drives Solution

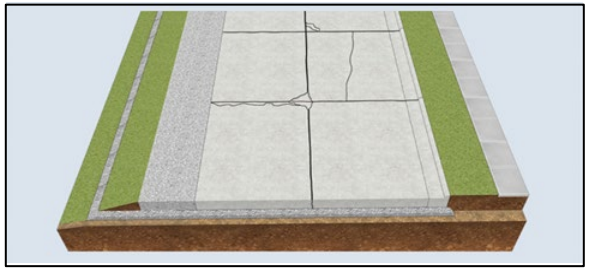
CONCRETE

GOOD



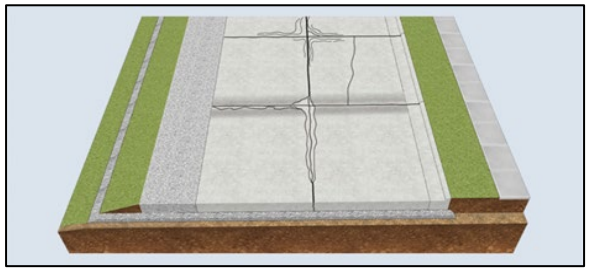
GOOD: Structurally sound with little to no cracking

FAIR



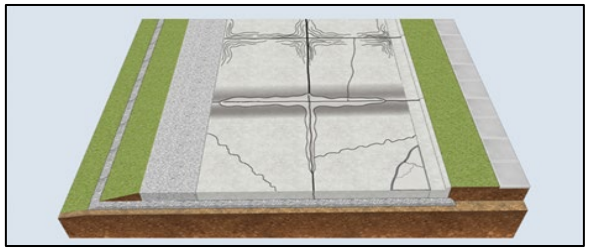
FAIR: Structurally sound with minor surface distresses such as random cracking, periodic partial-depth joint spalling, and shadowing

POOR



POOR: Full-depth joint deterioration, working cracks, spot structural failures, faulting, and/or material-related distress

POOR [w/Significant Materials Related Distresses (MRD)]

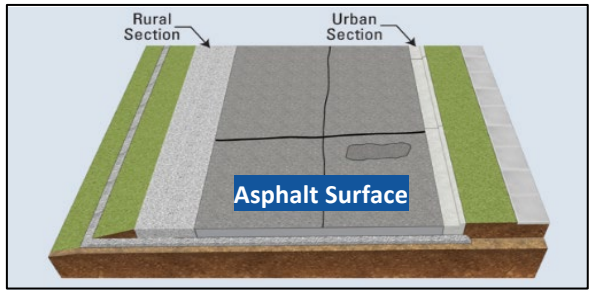


POOR: Significant surface deterioration and structural distresses, including joint deterioration from freeze-thaw damage or material-related distress at 50% or more of the joints

?

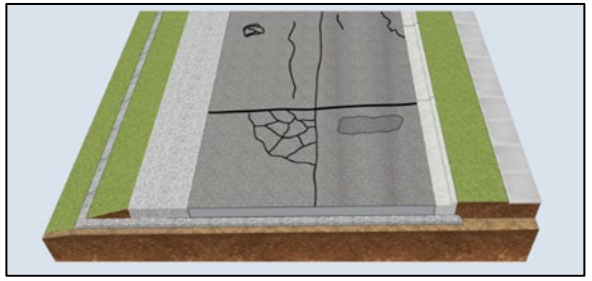
ASPHALT

GOOD



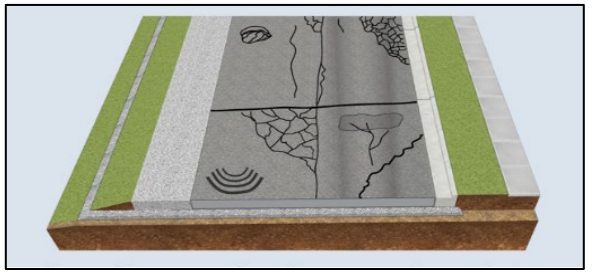
GOOD: Structurally sound with minor surface defects and minor cracking

FAIR



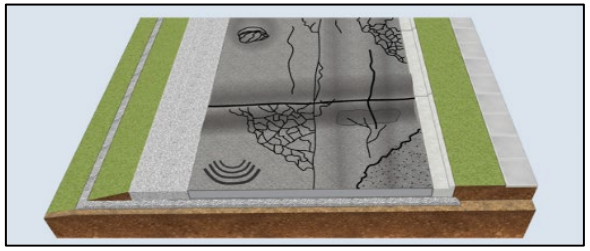
FAIR: Structurally sound with minor surface distresses such as potholes, block cracking, or thermal cracking

POOR



POOR: Frequent surface distresses such as potholes, block cracking, or thermal cracking plus alligator cracking, rutting, shoving, slippage, stripping, and raveling

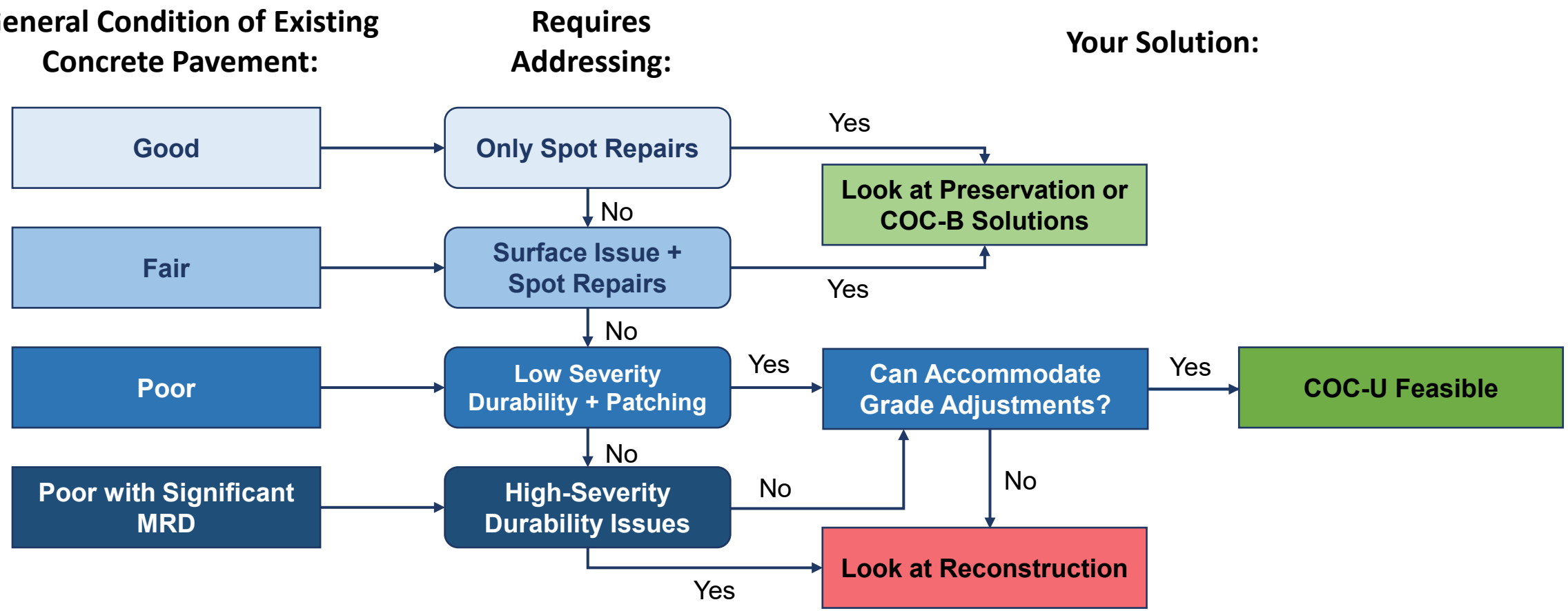
POOR (w/Significant MRD)



POOR: Significant surface and structural distresses, including potholes, block cracking, or thermal cracking plus alligator cracking, rutting, shoving, slippage, stripping, and raveling

Images source: Adapted from Iowa State University

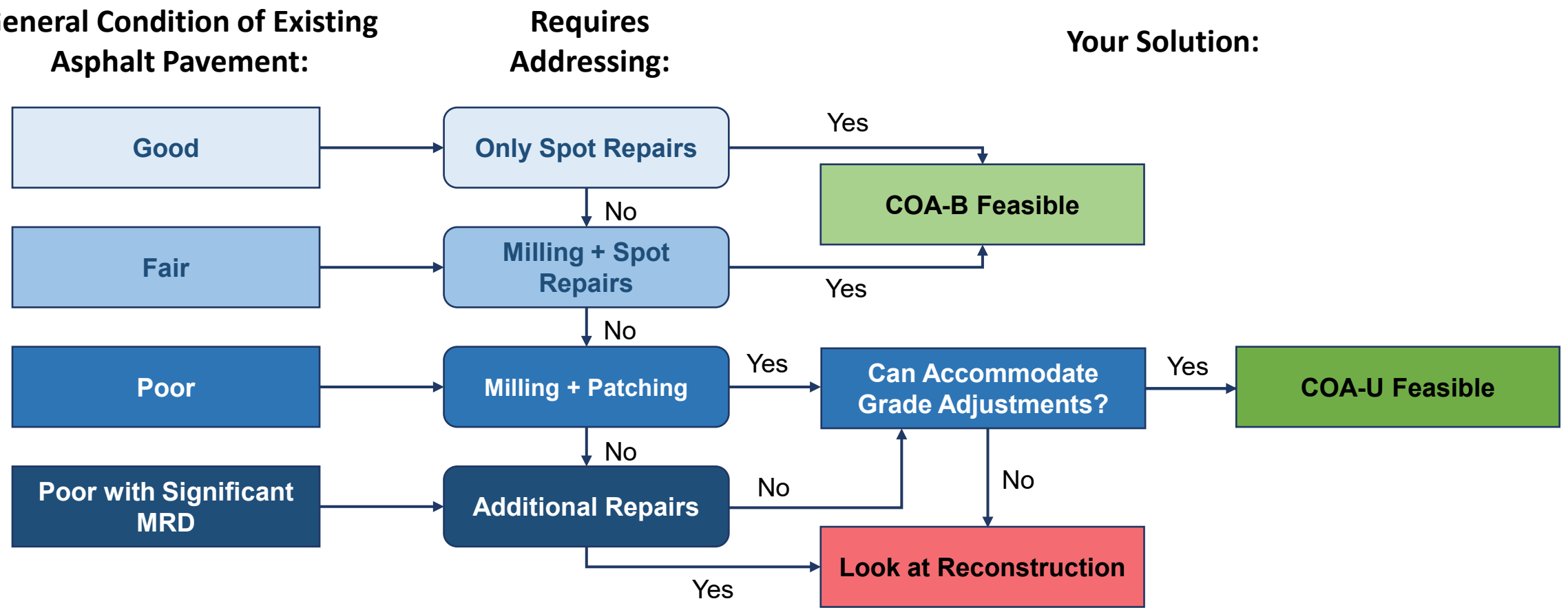
Potential Feasibility Decision Tree for COC Overlays (1 of 2)



MRD = Materials Related Distresses

Use of feasibility decision tree is not a Federal requirement

Potential Feasibility Decision Tree for COA Overlays (2 of 2)



MRD = Materials Related Distresses

Work Zone Feasibility Considerations

Image source: Voigt

Overlay Placement

- Typical of other concrete paving
  - Slipform placement, texturing, curing, joint sawing and sealing

- Traffic management can impact overlay construction staging
- Phasing construction requires special attention to:
  - Preparation of existing pavement
  - Addressing the interlayer (B or U)
  - Opening to traffic

Overlay Traffic Management Considerations

- Safety (public and worker)
- Traffic flow
- Number of sequences
- Required work zone space
- Impact to shoulders/lanes during sequencing

Image source: Iowa State University

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

More Challenging in Urban Settings

Added considerations or constraints with:

- Intersections
- Bridges
- Connections
- Utilities
- Curb and gutter
- Businesses
- More traffic

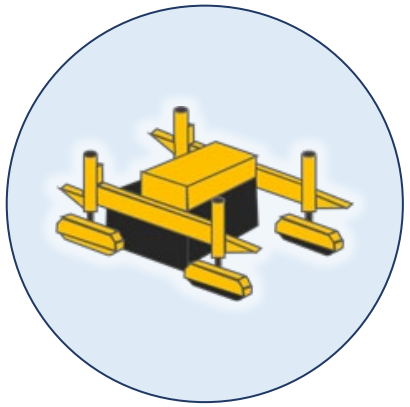
Image source: Iowa State University

How to Address Maintenance of Traffic

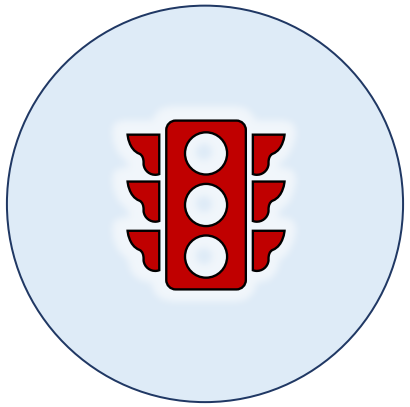
- Engineer should provide criteria to contractor:
  - Number of lanes to remain open
  - Pilot car queue length (time limit)
  - Required milestone dates
  - Access requirements to businesses/private residences

- Contractor should provide:
  - Staging plan to execute work
  - Communication plan to local businesses/residents

Contractor's Three Overlay Work Zone Factors



CONSTRUCTION CLEARANCES



TRAFFIC CONTROL METHOD

PROJECT STAGING PLAN

Image source: ACPA

Typical Equipment Clearance

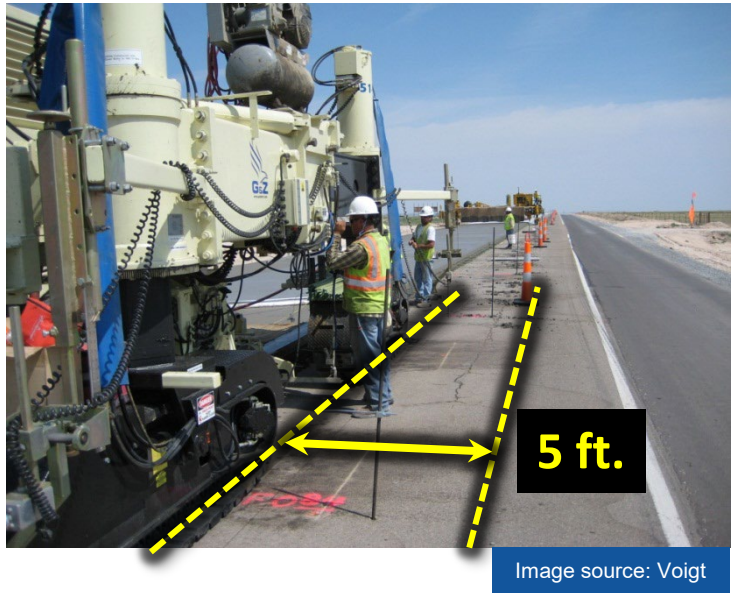


Image source: Voigt

- 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

To Address... 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)

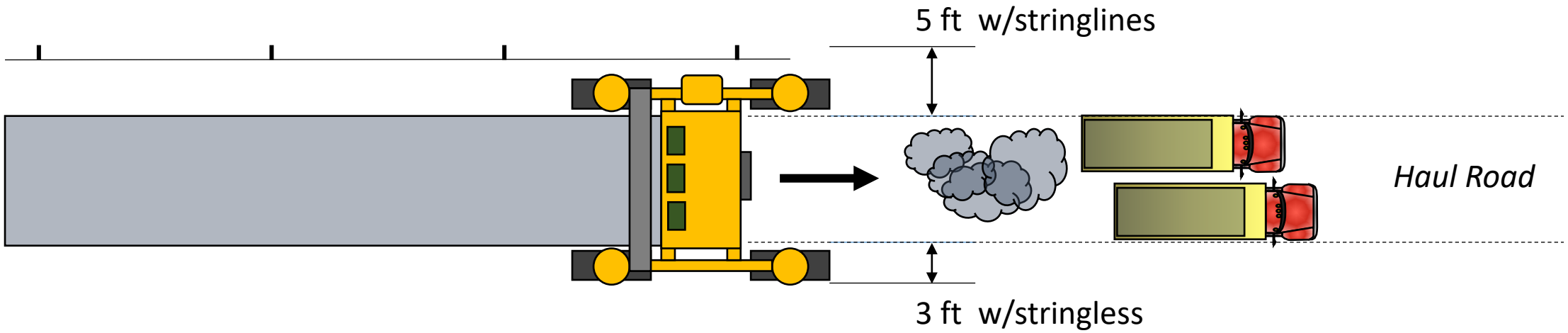


Image source: Voigt

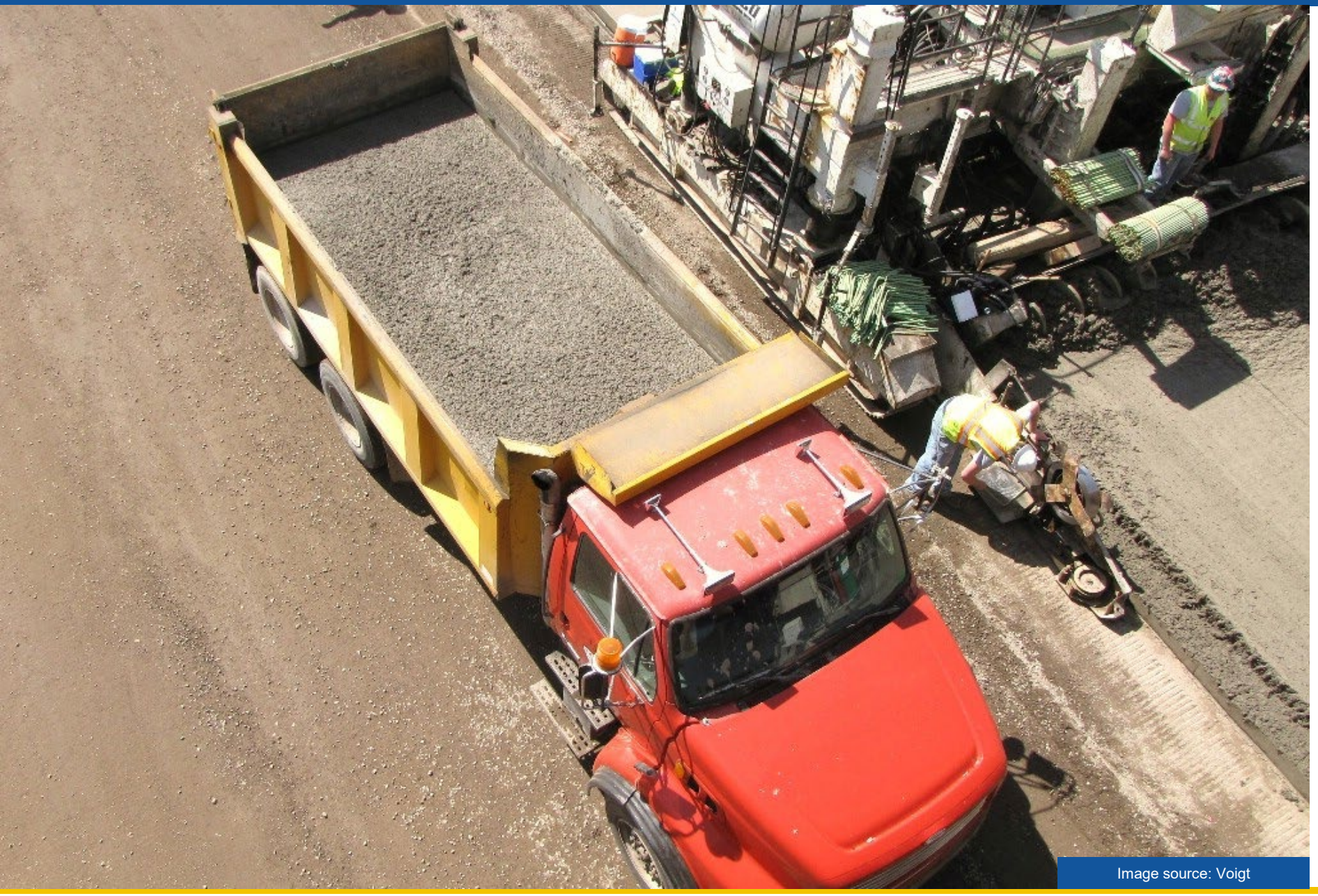


Image source: Voigt

Overlays usually do not provide the space needed for a side haul road

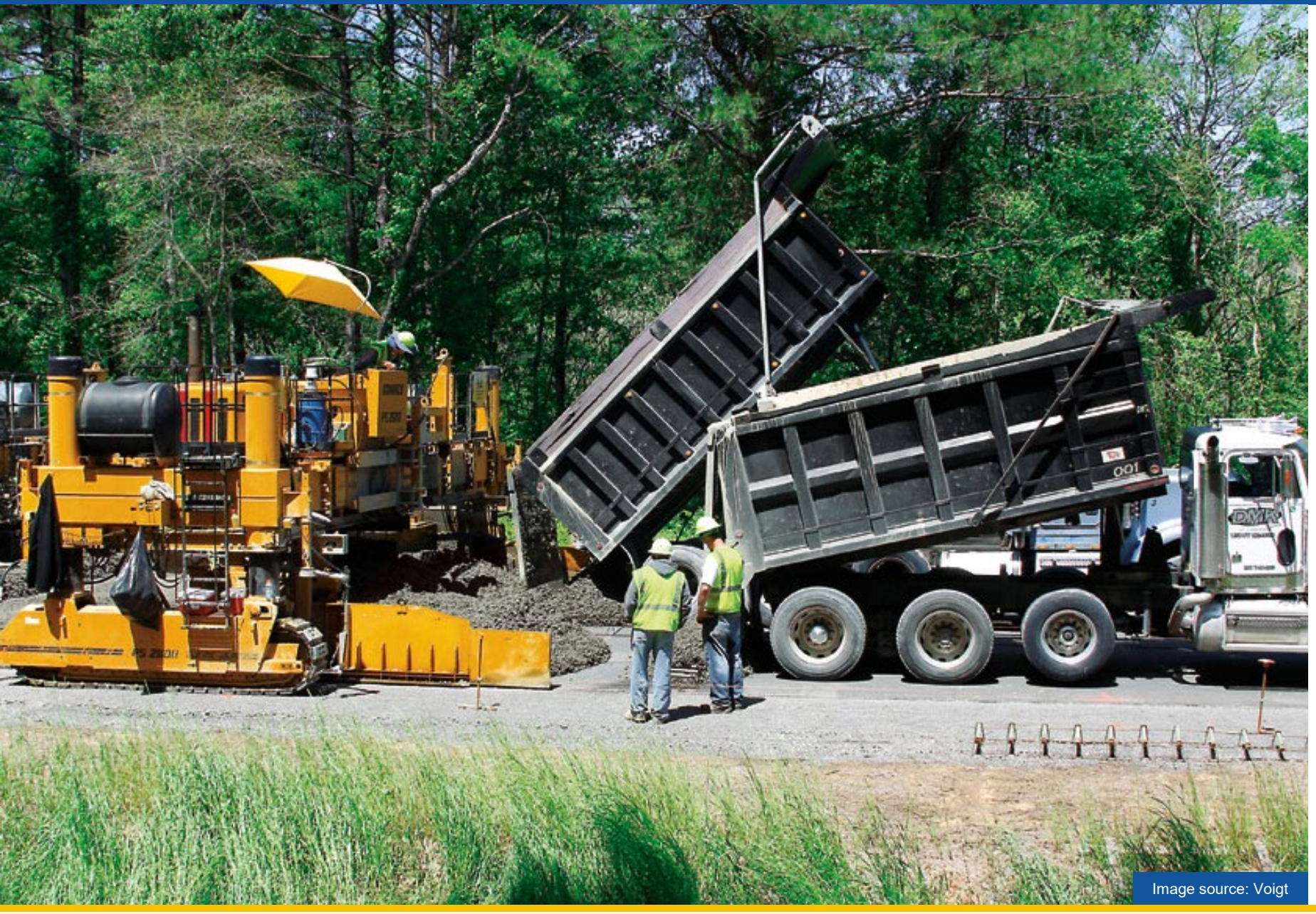
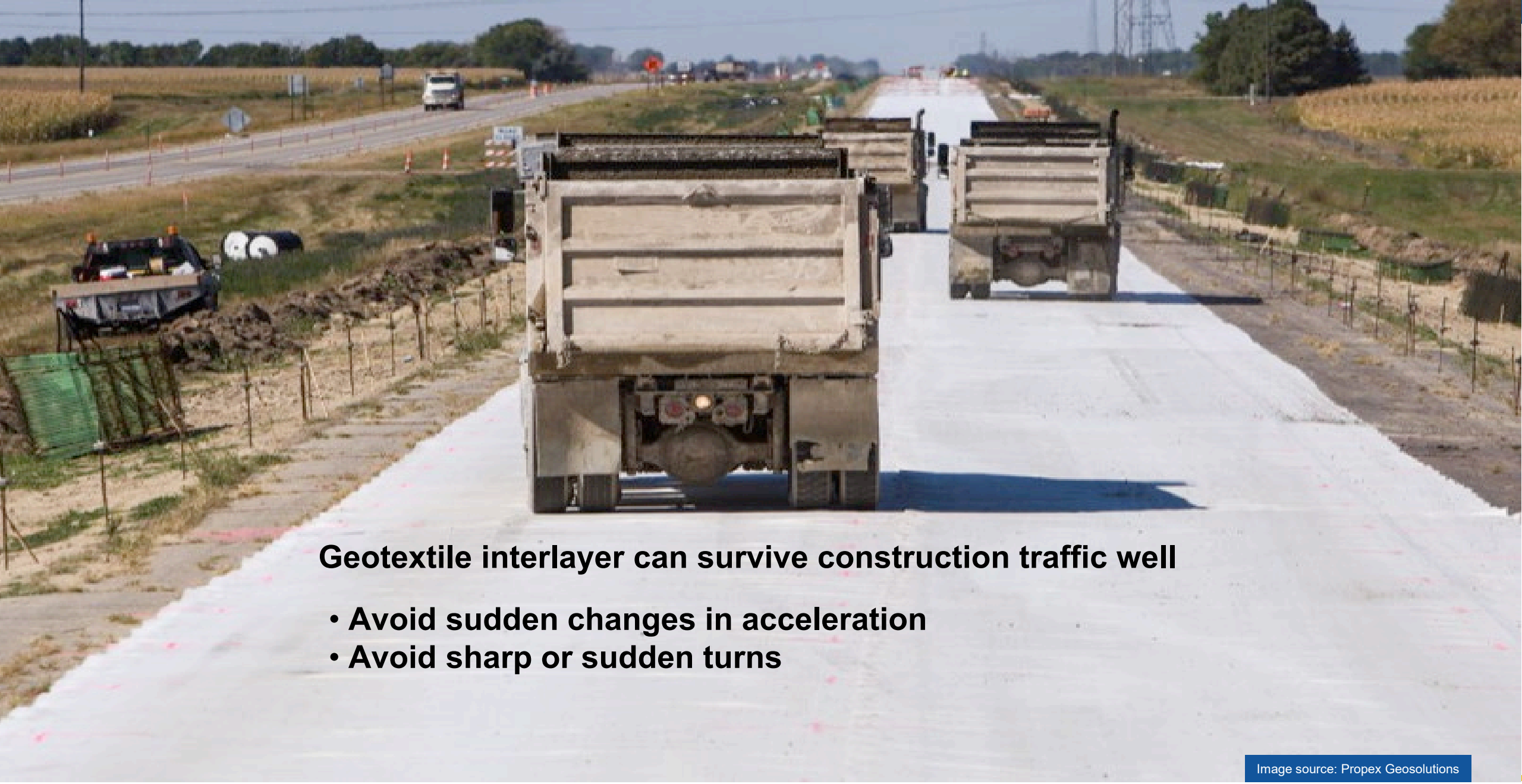


Image source: Voigt

Using truck dumping ahead of paver necessitates care on the interlayer

Image source: Voigt

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



Geotextile interlayer can survive 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 breaking off and having truck in neutral if using certain spreaders

Image source: Propex Geosolutions

Traffic Control

- Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), approved by FHWA is the national standard for all traffic control devices under 23 C.F.R. 655.603(a)

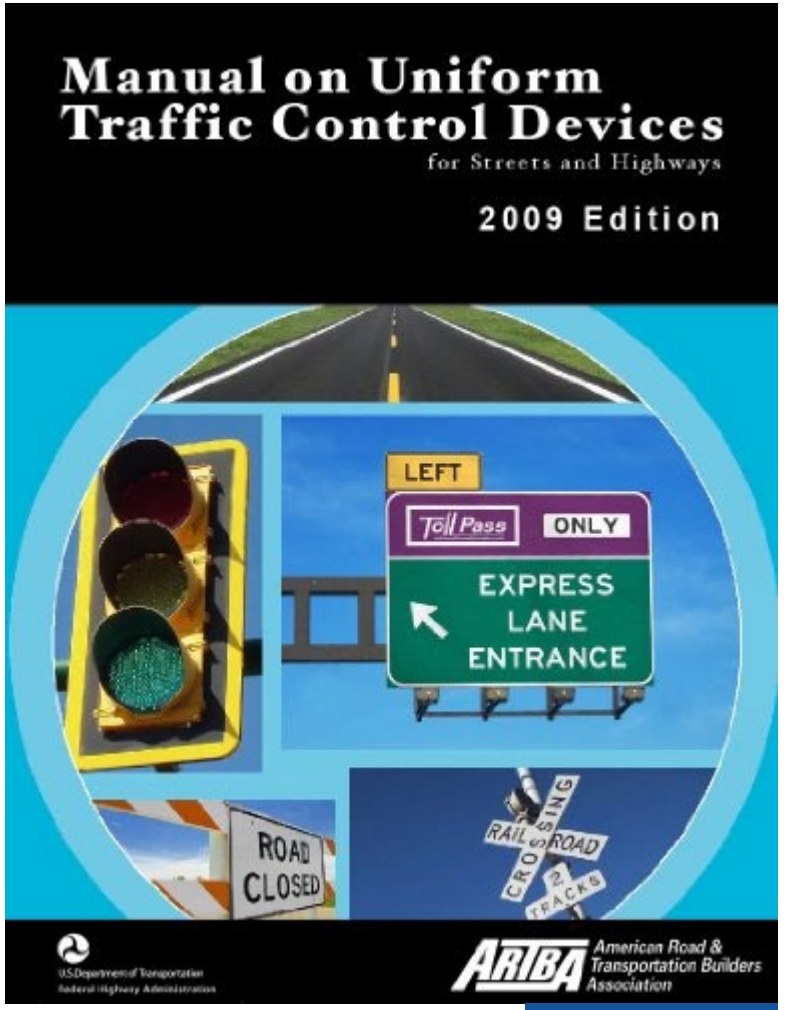


Image source: FHWA

Image source: GOMACO Corp.

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

Image source: Voigt

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

Image Source: Cillessen & Sons

Lane Delineators Do Not Require Much Work Zone Space

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

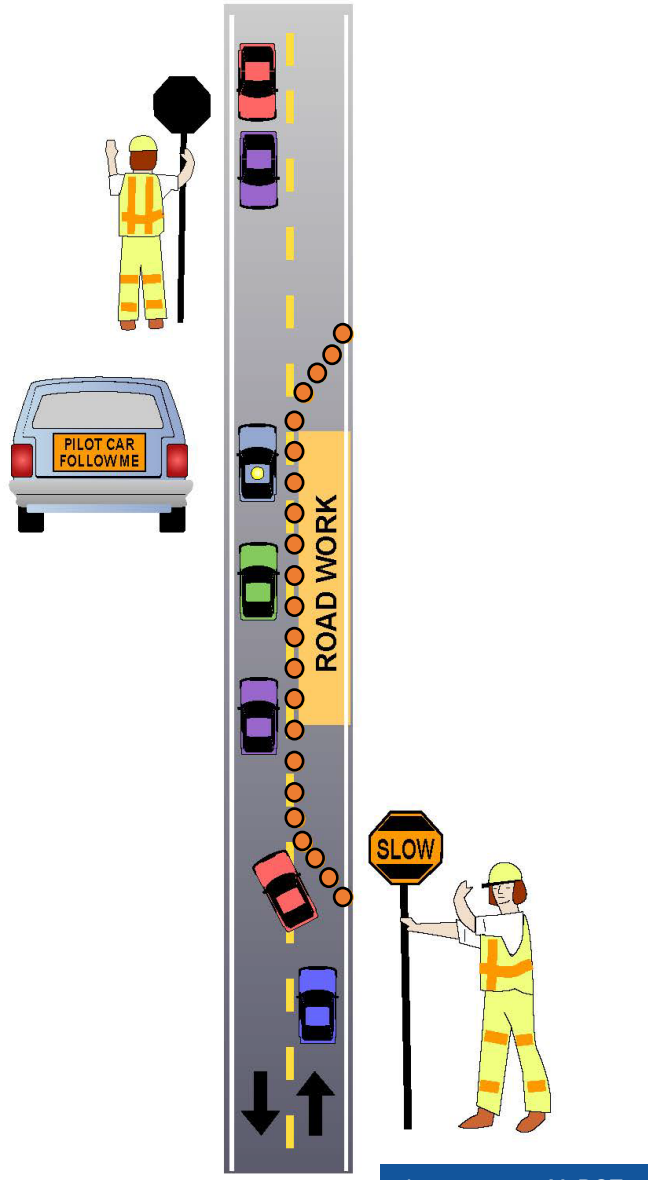


Image source: MnDOT

Image source: South Dakota DOT

Typical Pilot Car for 2-Lane 2-way Projects

Safety Edge Filets

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

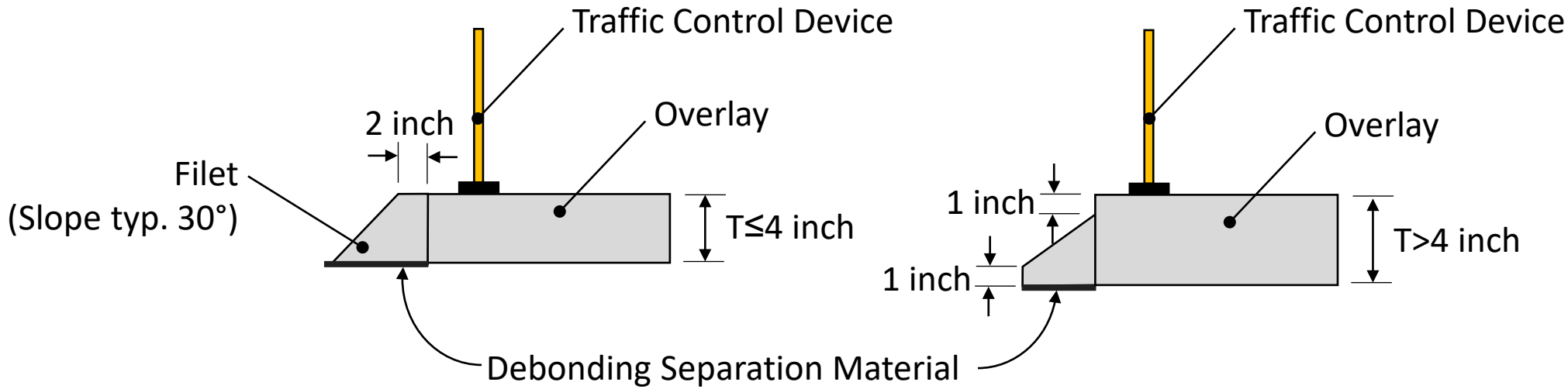
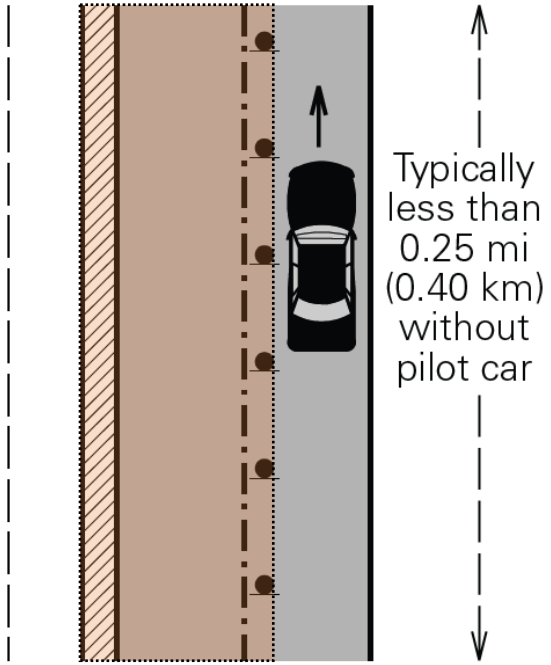
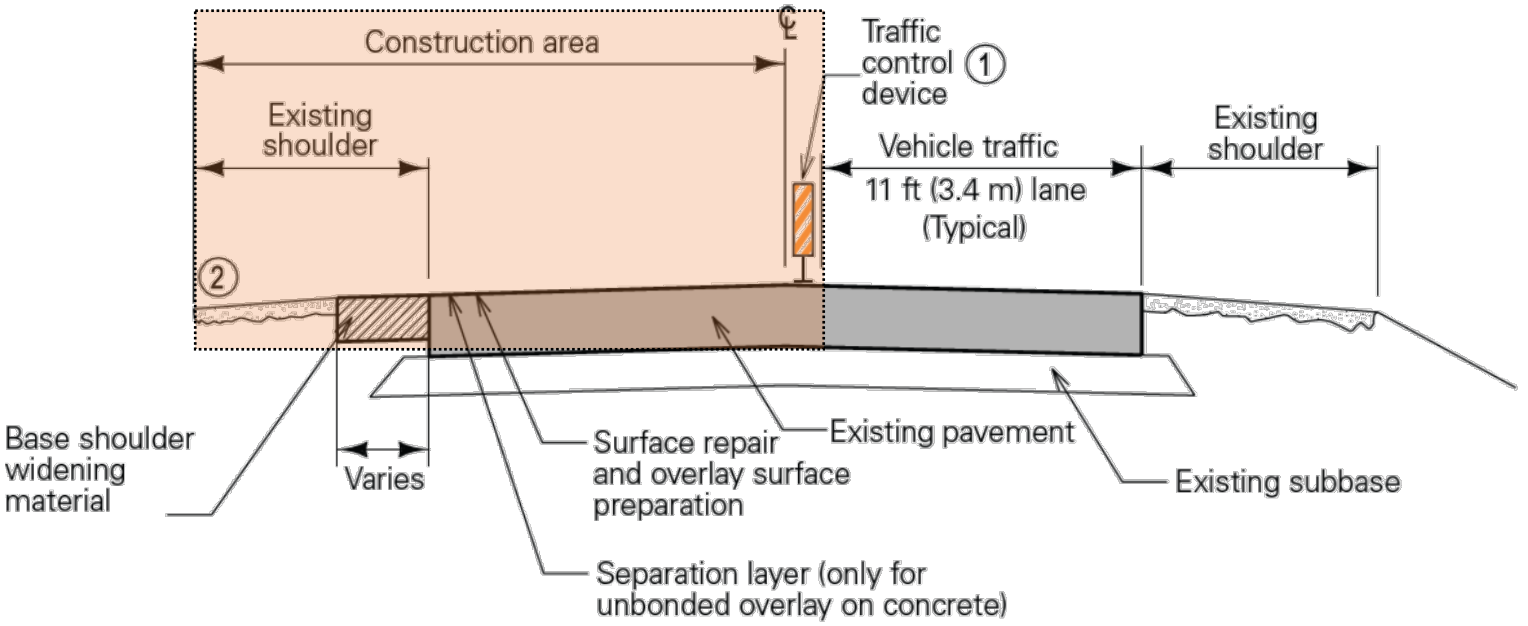


Image source: Voigt; Adapted from Iowa State Univ.

Staging Two-Lane Overlay [Under Traffic] (1 of 4)

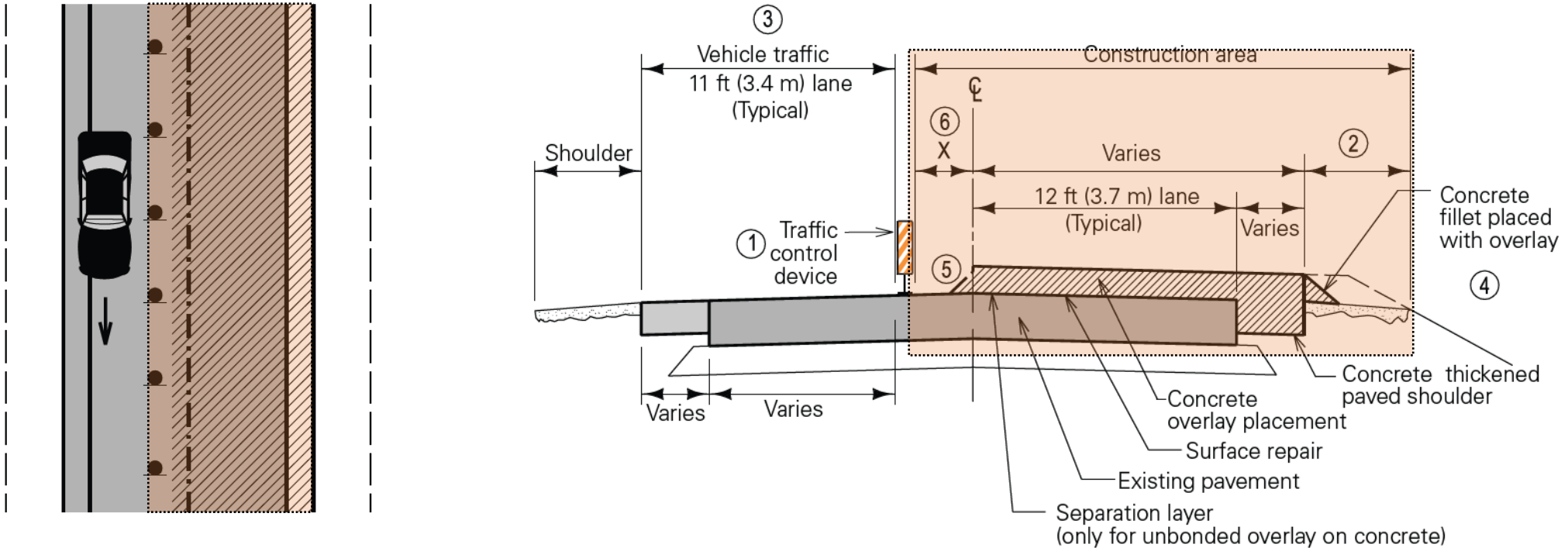




STAGE 1 – Repair Surface. Prepare for Overlay and Construct Base Shoulder Widening and Prepare Interlayer

Image source: Iowa State Univ.

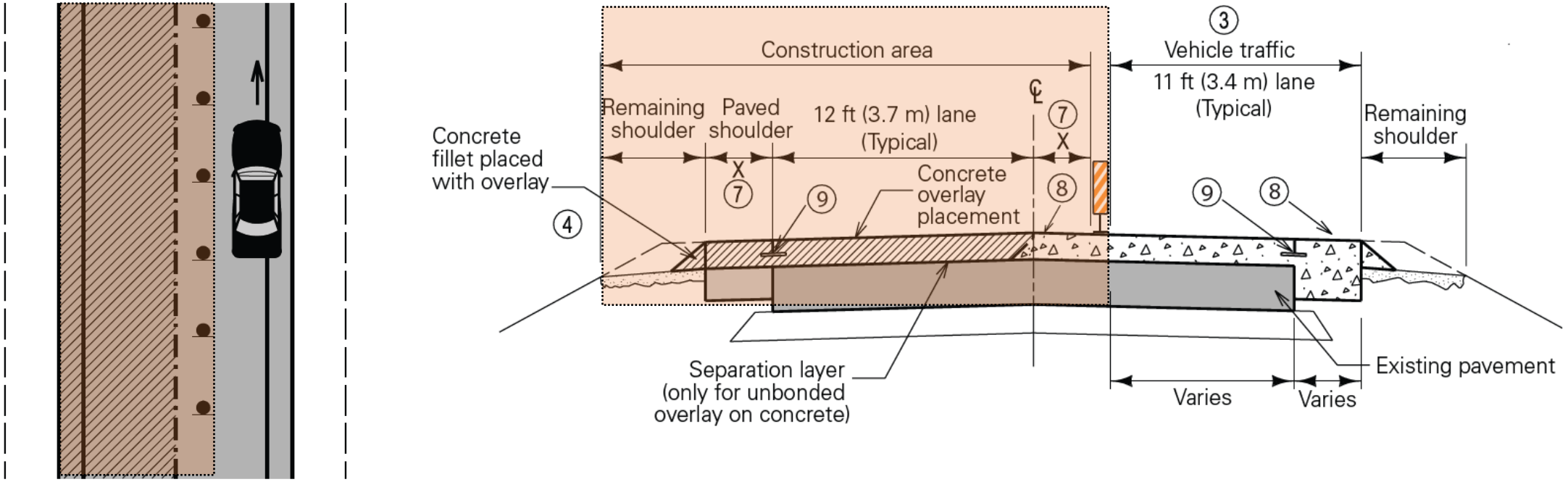
Staging Two-Lane Overlay [Under Traffic] (2 of 4)



STAGE 2 – Construct Right Shoulder and Concrete Overlay

Image source: Iowa State Univ.

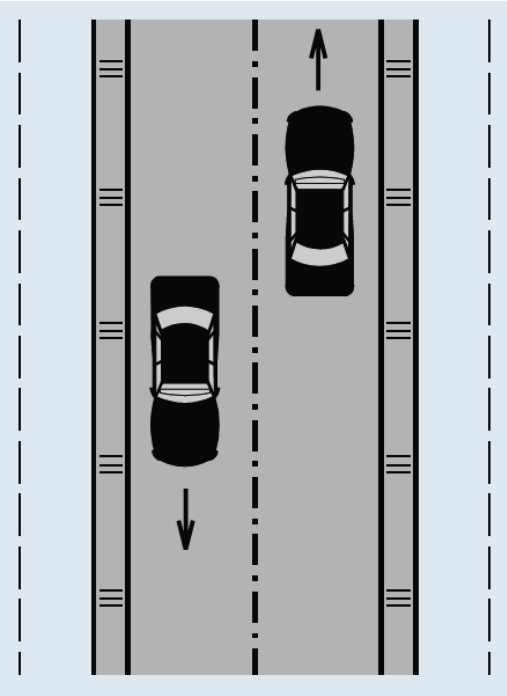
Staging Two-Lane Overlay [Under Traffic] (3 of 4)

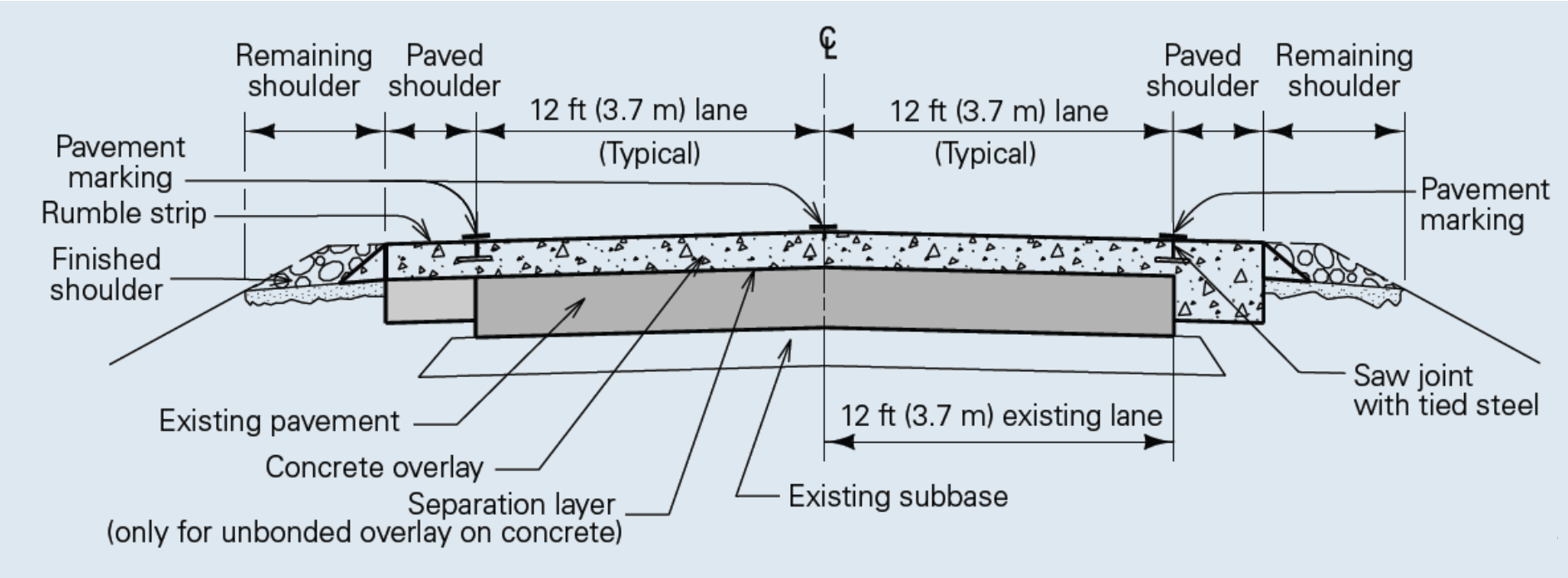


STAGE 3 – Construct Left Lane Concrete Overlay

Image source: Iowa State Univ.

Staging Two-Lane Overlay [Under Traffic] (4 of 4)





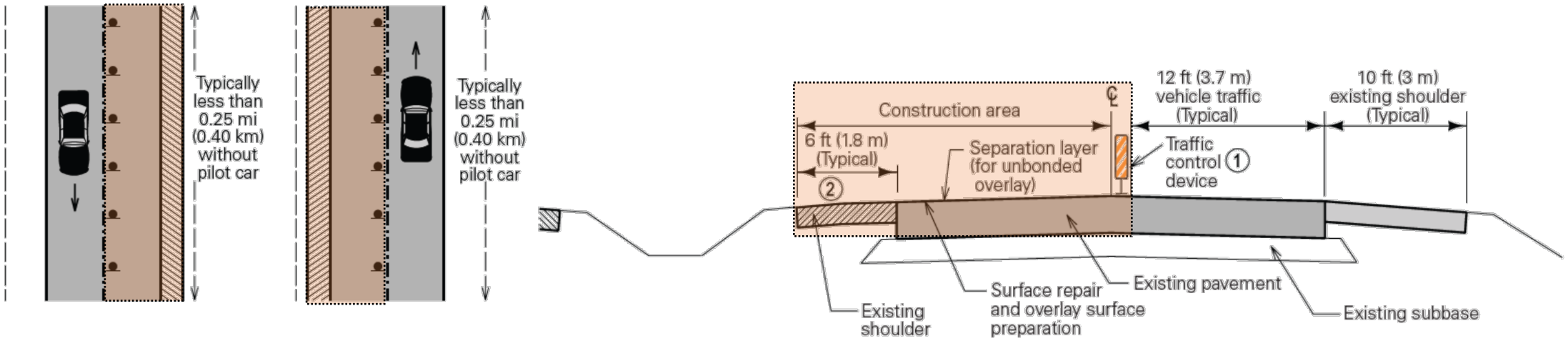
COMPLETED OVERLAY

Image source: Iowa State Univ.

Image source: Iowa State Univ.

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

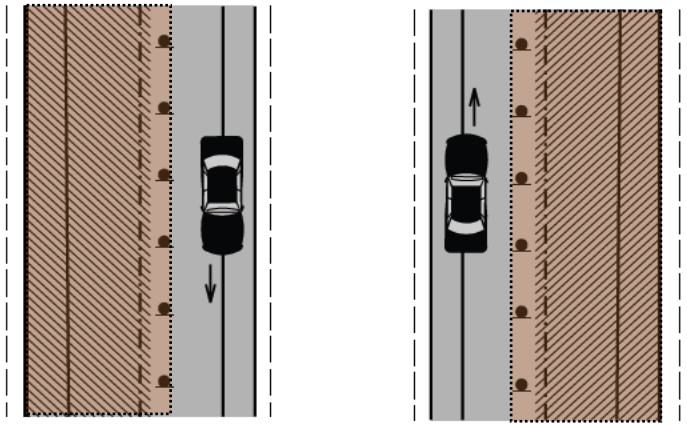
Four-Lane Roadway [Under Traffic] (1 of 4)

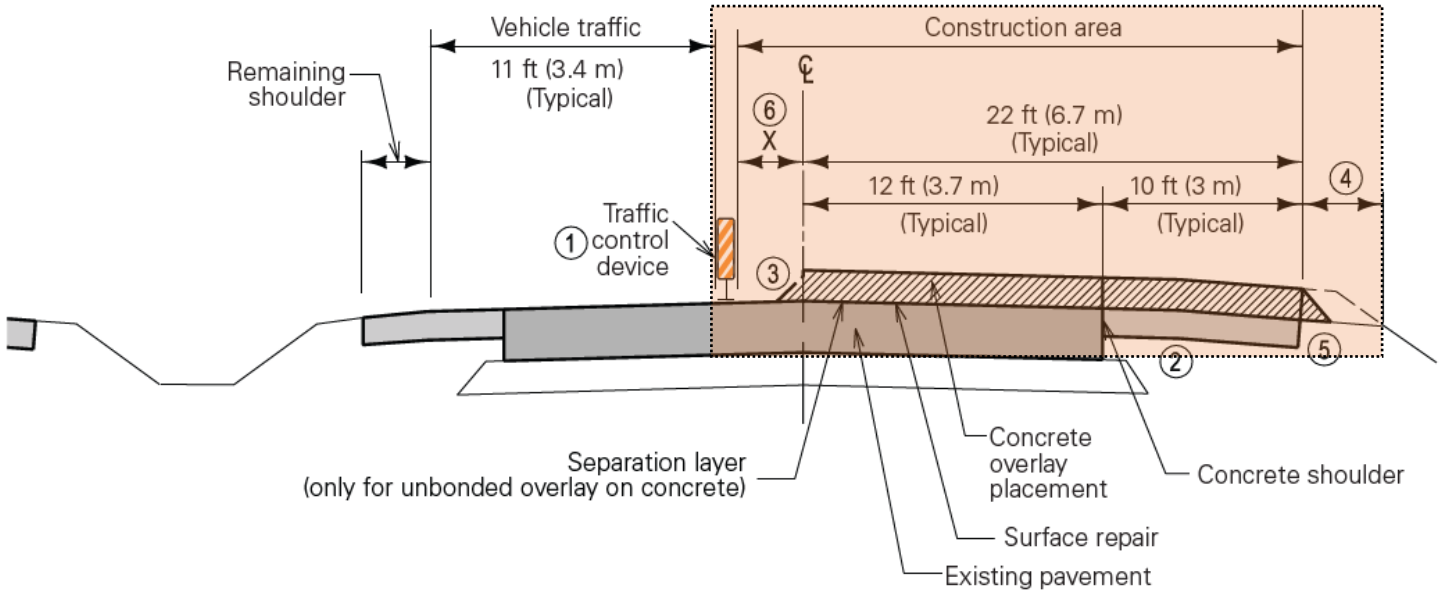


STAGE 1 – Repair Surface and Prepare for Overlay

Image source: Iowa State Univ.

Four-Lane Roadway [Under Traffic] (2 of 4)

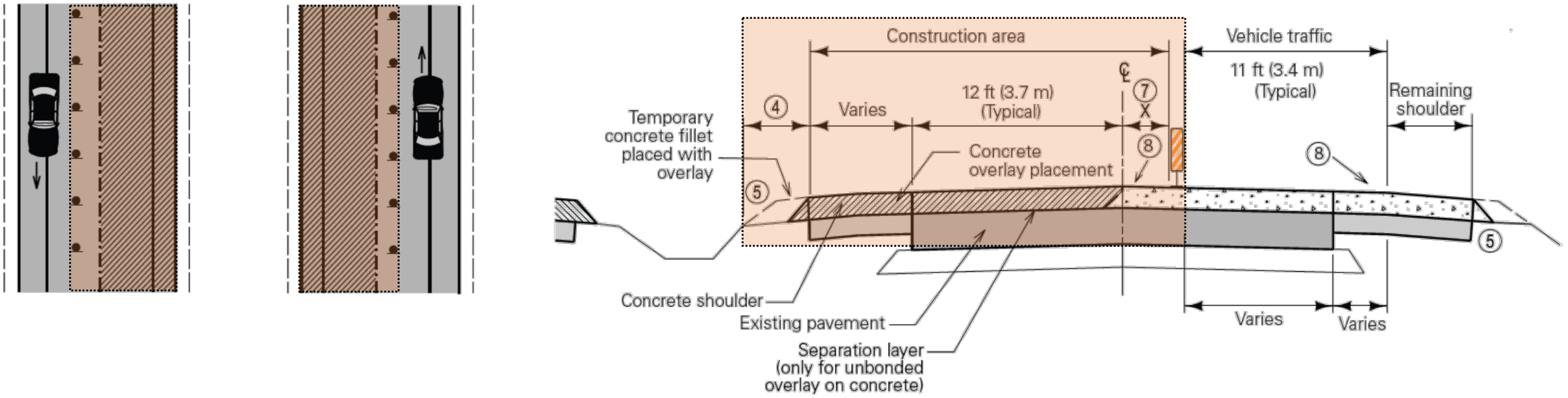




STAGE 2 – Construct Concrete Overlay on Outside Lanes

Image source: Iowa State Univ.

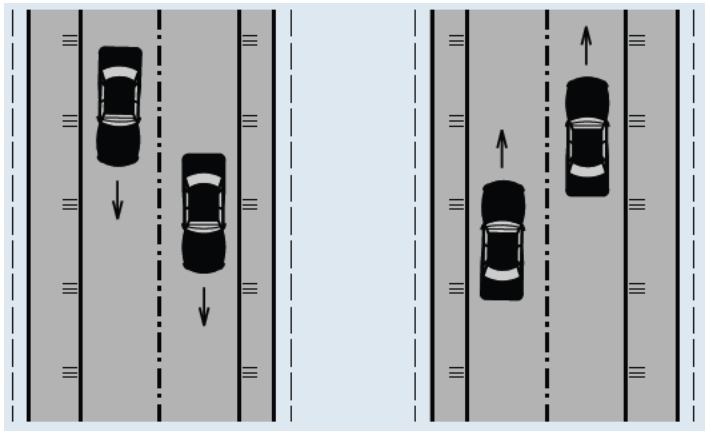
Four-Lane Roadway [Under Traffic] (3 of 4)

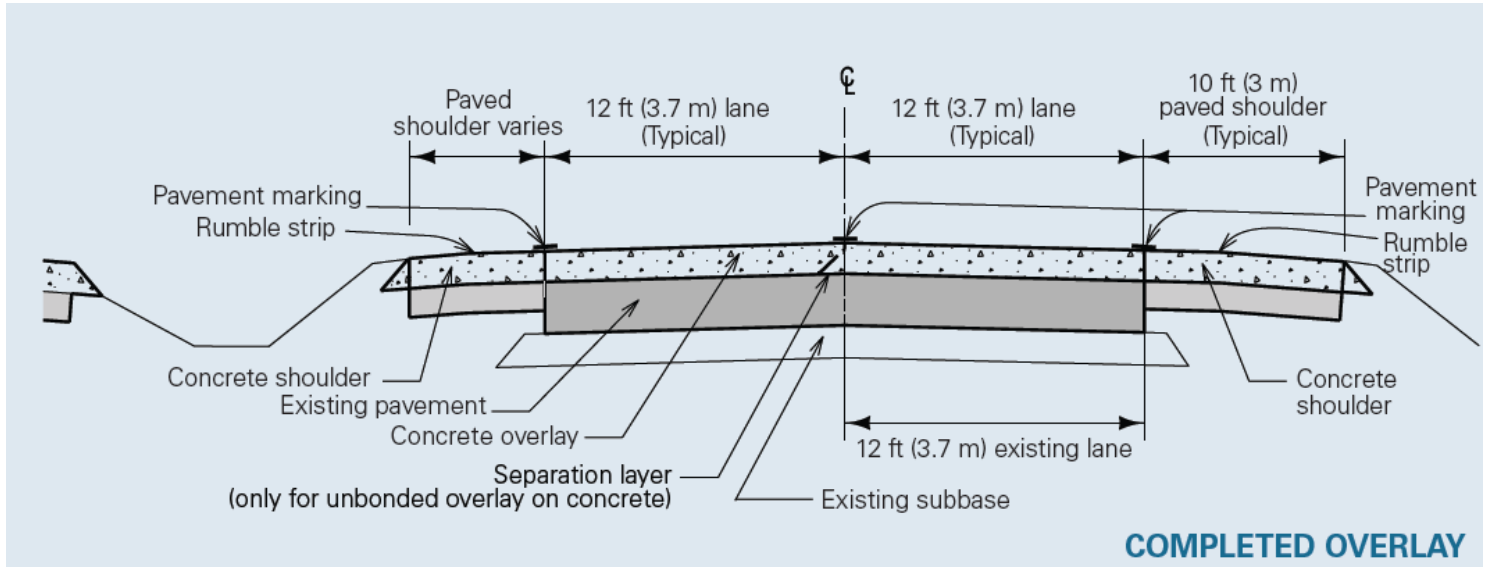


STAGE 3 – Construct Concrete Overlay on Inside Lanes

Image source: Iowa State Univ.

Four-Lane Roadway [Under Traffic] (4 of 4)





COMPLETED OVERLAY

Image source: Iowa State Univ.

Traffic Opening

- 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
- Early traffic loading assists joint activation.
- Where acceleration needed, some State DOTs have had success with Type I Cement and SCMs.

How Do You Get Started? Next Steps

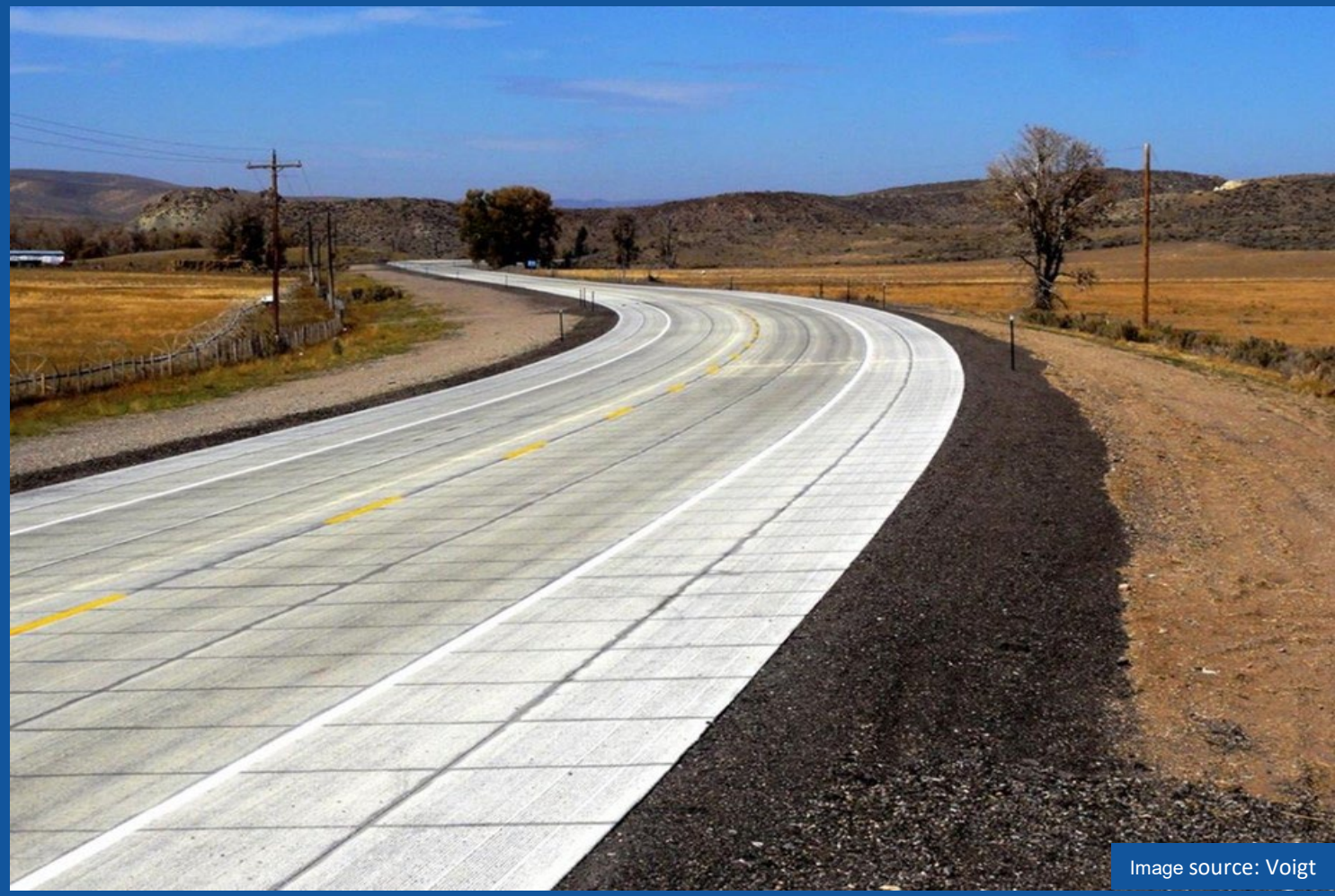


Image source: Voigt

Getting Started (1 of 5)

1

Start with simple projects:

A project with no complicated staging or tight completion requirements

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

Getting Started (2 of 5)

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 of 5)

3

Build your technical competency using available help:

- Use the technical manuals and training materials
- Reach out to peer agencies to gain from their experience
- Consult FHWA for help

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

Getting Started (4 of 5)

4

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

- Collect local cost and performance data from your overlay projects
- Build a database with your data and include data from peer organizations to get started

Make sure concrete overlays are an option in your software for project scoping and update that system with your data over time

Getting Started (5 of 5)

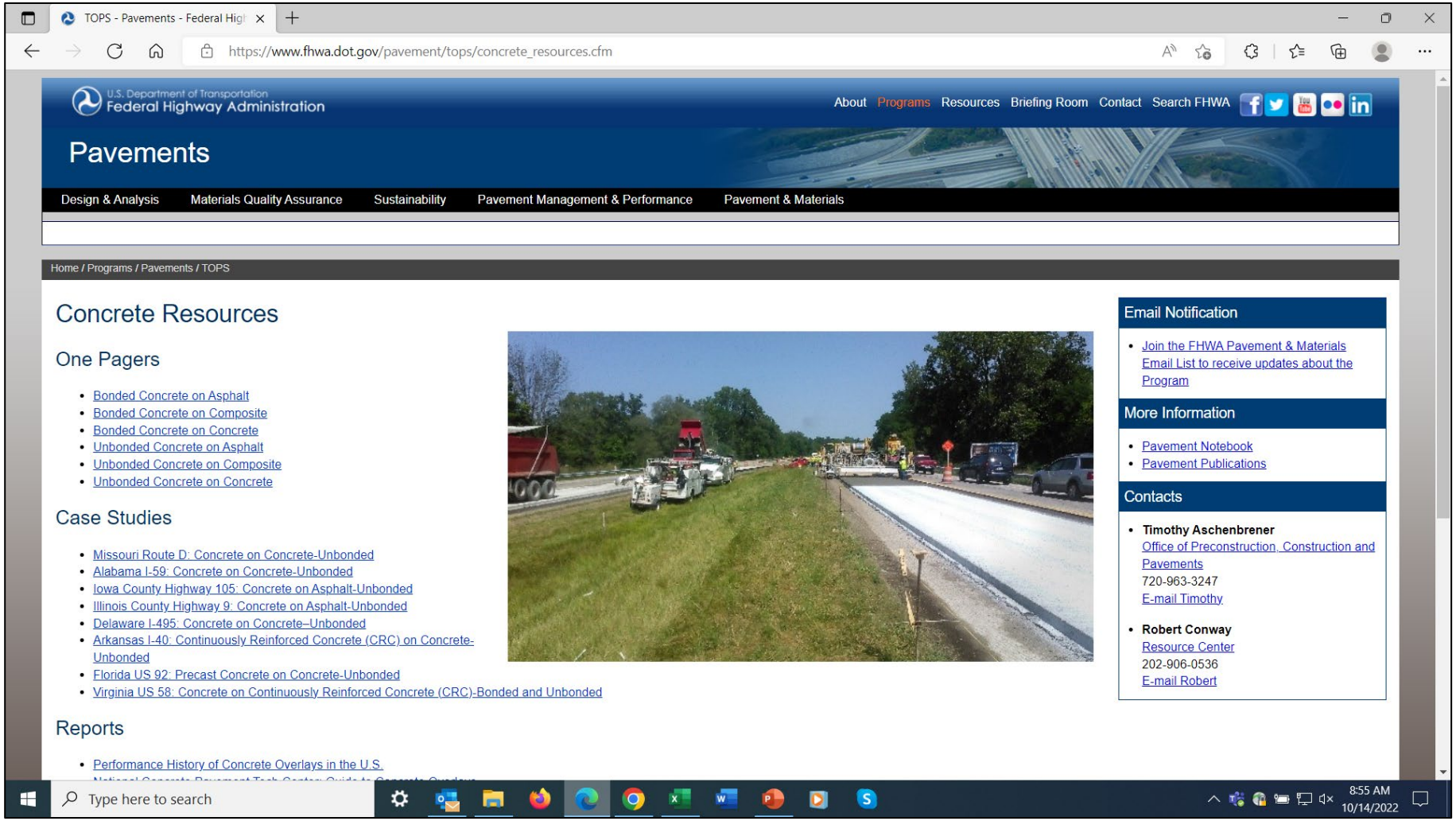
5

Collaborate/reach out to peers as you learn:

- Exchange technical info/support with FHWA
- Share your knowledge at consortiums and peer exchanges

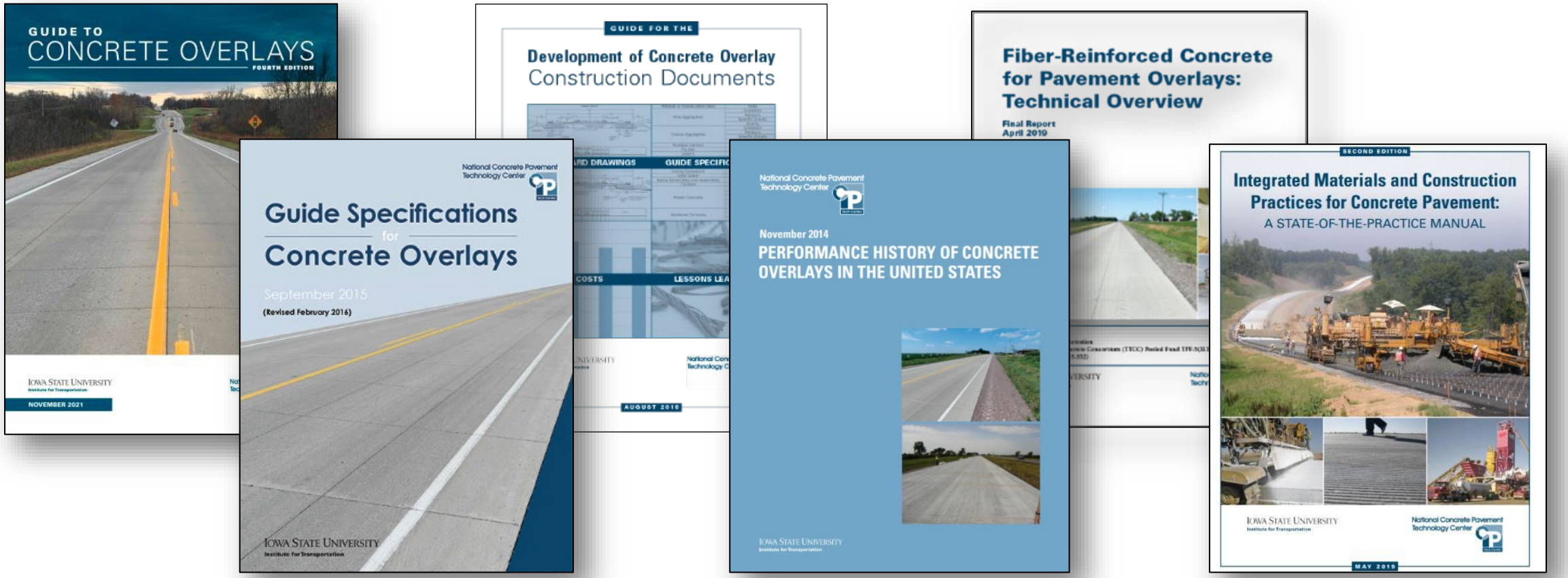
Pay it forward by sharing what you learn from your concrete overlay solutions!

TOPS Website Resources (Concrete)



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

Remember These Technical Resources!



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