October 28-29, 2025
Orlando, FL

TRANSPORTATION SYMPOSIUM

Design Constructability

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Transportation Symposium Website

SCAN ME

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Outline

- Construction Equipment Overview
- Common Constructability Issues + Design Perspective
- Audience Q&A

Construction Equipment Overview

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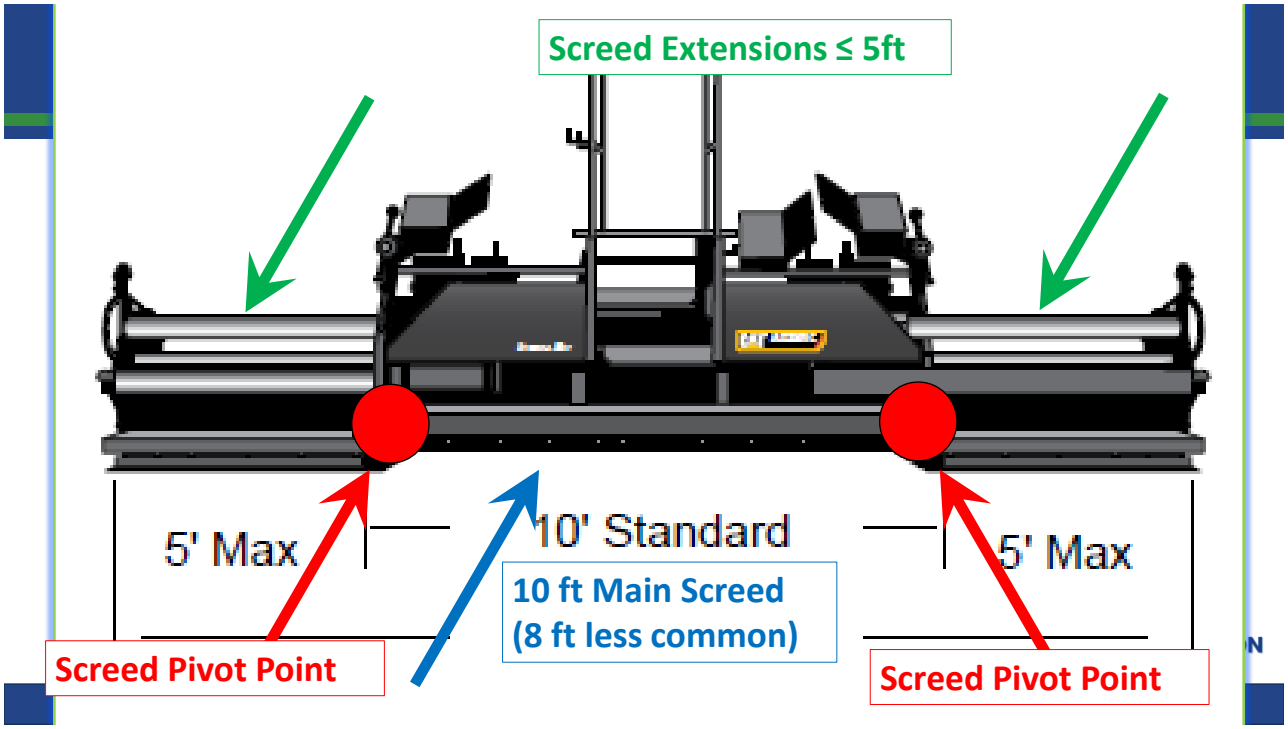

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Shoulder Width Determines Number of Paving Passes

- Even If Total Paving Width Is 20-ft or Less
- Doesn't Mean It Can Be Paved In Single Pass

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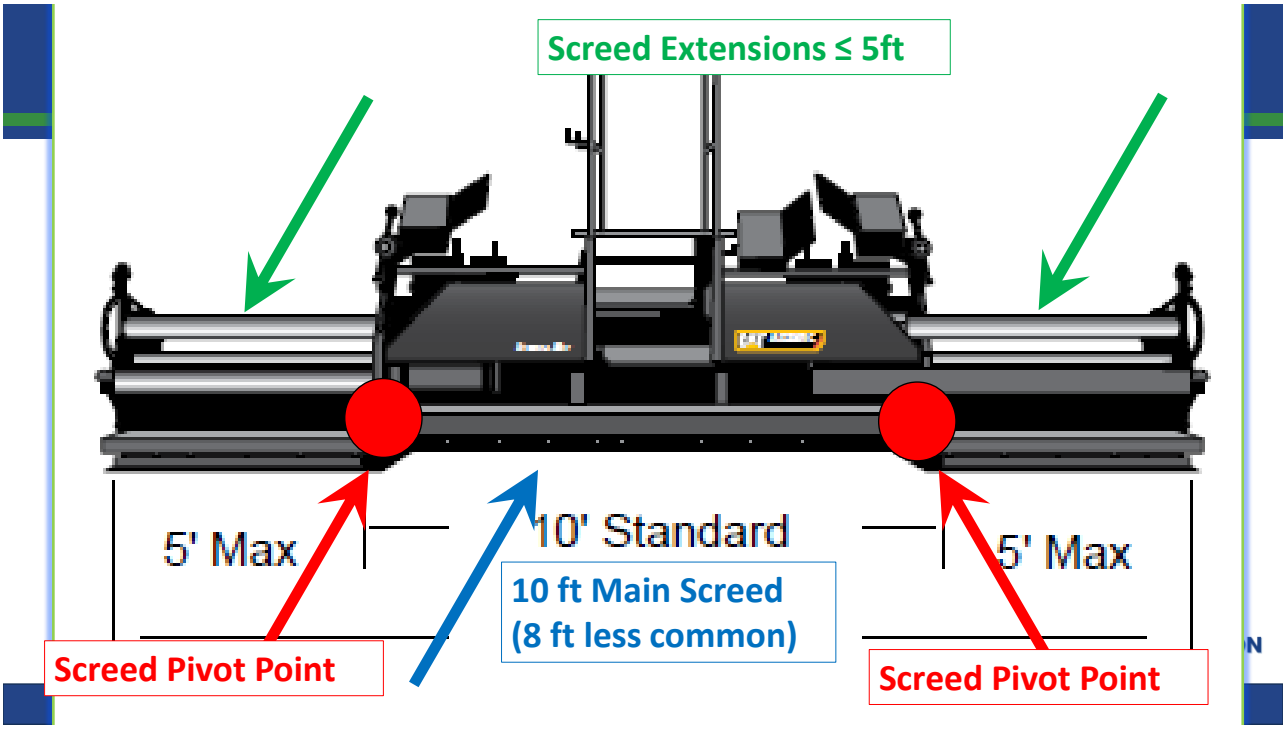

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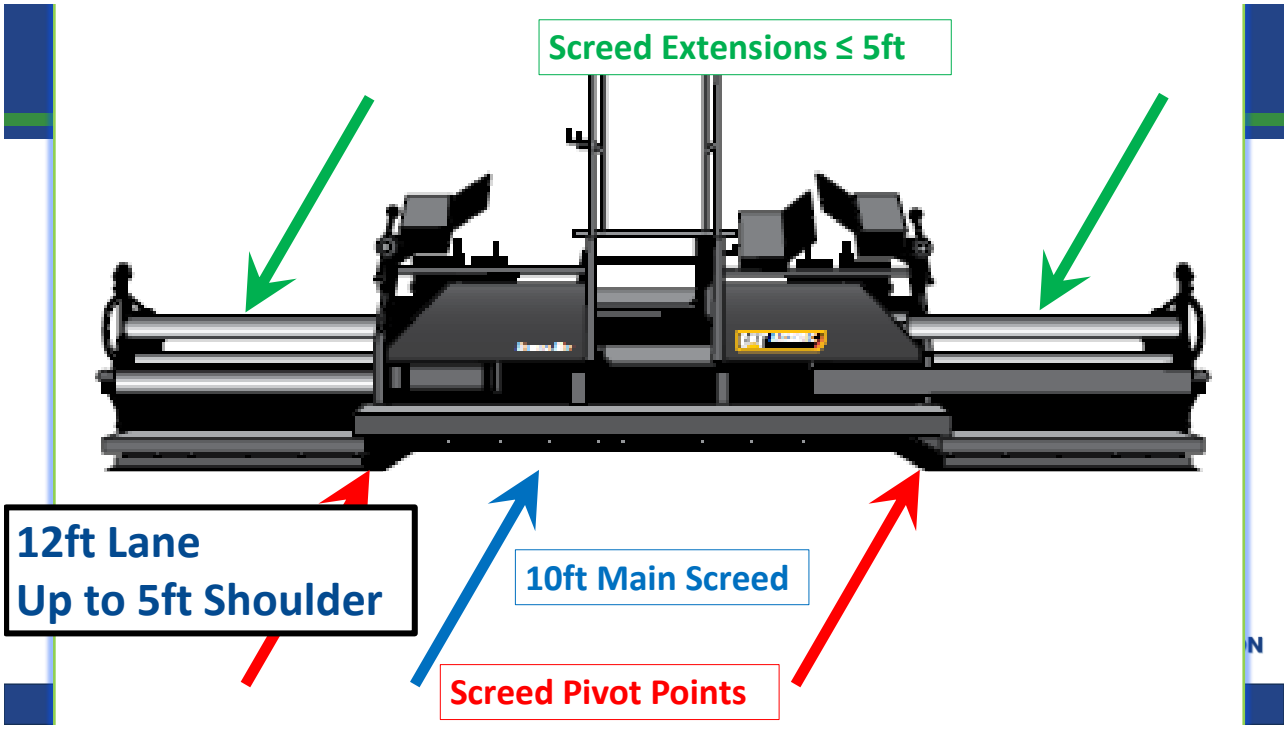
Screed Extensions ≤ 5ft
12ft Lane
Up to 5ft Shoulder
10ft Main Screed
Screed Pivot Points

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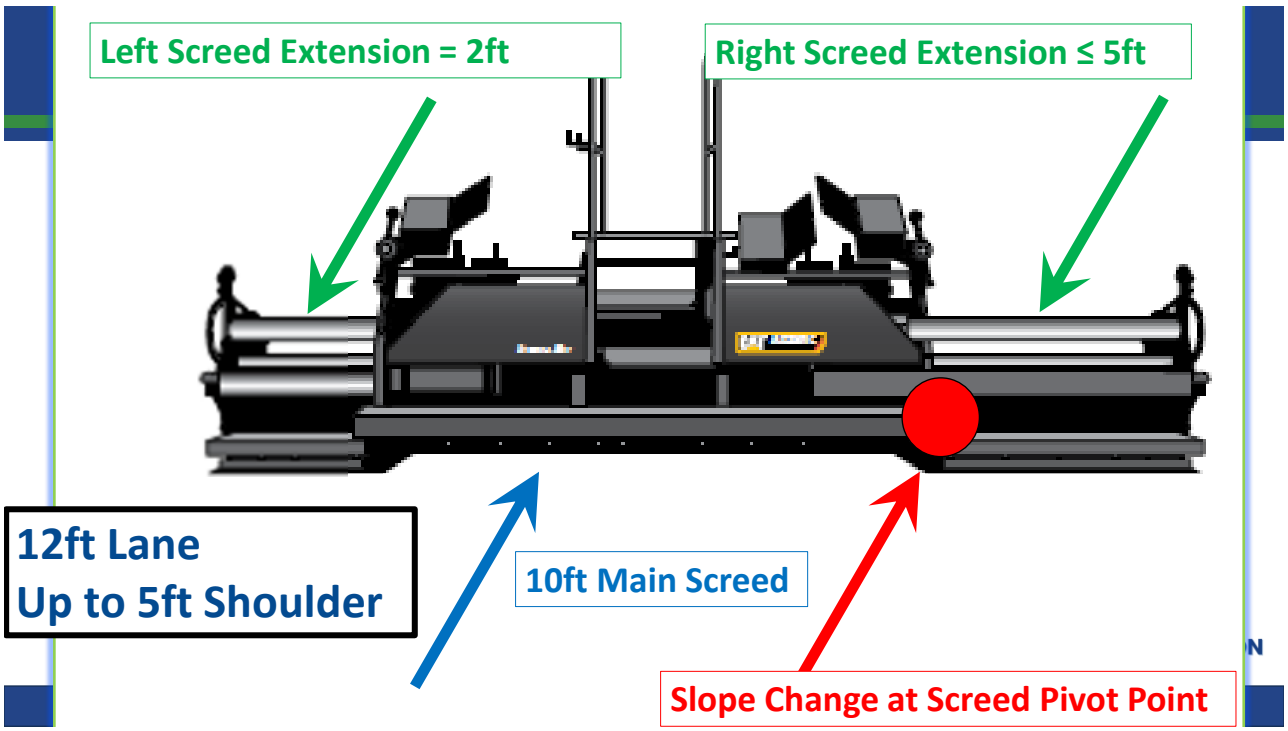
Left Screed Extension = 2ft
Right Screed Extension ≤ 5ft
12ft Lane
Up to 5ft Shoulder
10ft Main Screed
Slope Change at Screed Pivot Point

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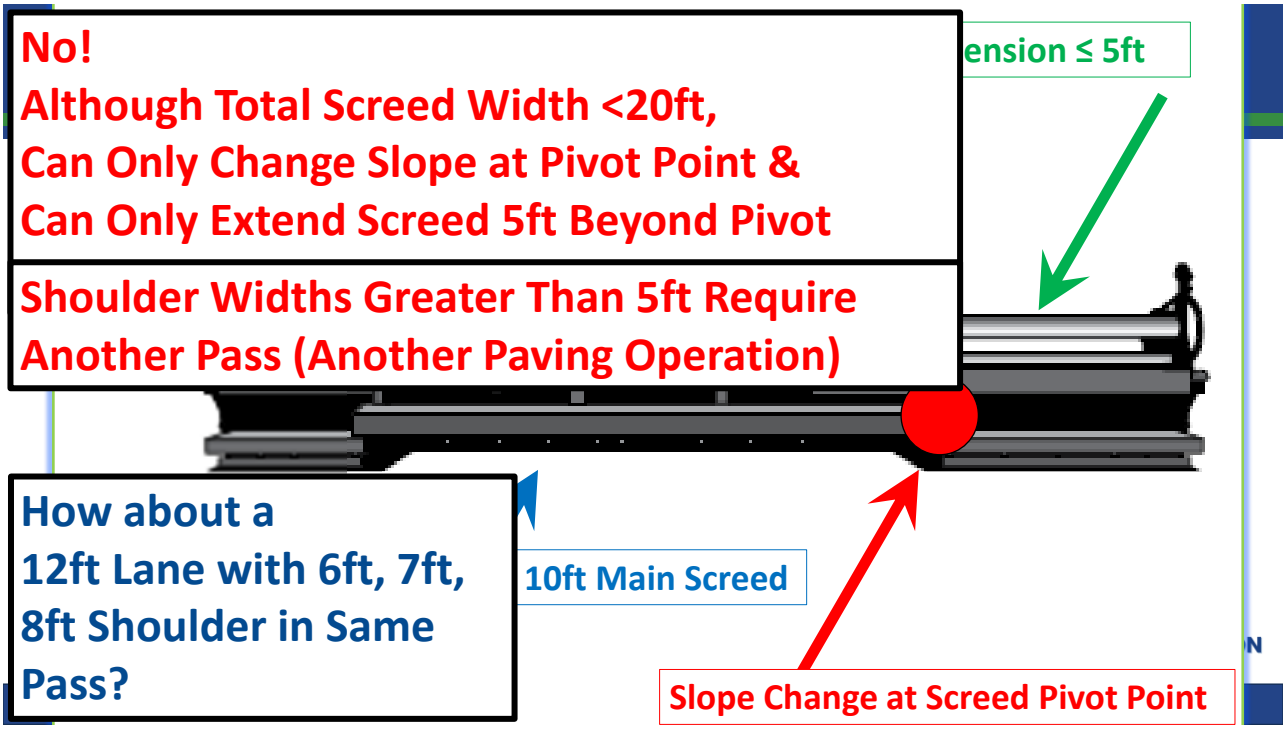

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Shoulder Width Determines Number of Paving Passes

- Two Passes – Lane & Shoulder
  - Shoulder 8ft or more (10ft or more is optimal)
  - Pave Travel Lane in First Pass (Main Screed + Extension)
  - Pave Shoulder in Second Pass (Main Screed)
- Shoulder > 5-ft to < 8-ft (Worst Case)
  - In addition to Two Passes…
  - Install Cutoff Device to Restrict Main Screed's Paving Width to the Shoulder Width (ex. Pave 6ft using 10ft Main Screed)

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Milling Machine Details

- Standard Milling Drum Width 7 - 8ft
- Allows Milling 12ft Lane in Two Passes
  - Mill One Lane Edge on First Pass
  - Mill Other Lane Edge on Second Pass
  - Overlap Allows for Variations in Actual Lane Width
- 12ft Drums Available, but Less Common
  - Mills Exactly 12 ft Wide, Not Always Ideal
  - Machine Wider Than 12ft Lane = Increases Transport Costs

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Milling Machine Details

- 30 - 40ft long
- Driver is on Top about 10ft above Road Surface
- Operator on Pavement, Behind Machine, Sets 2 Controls
  - Can “Mill for Depth” (across lane)
    - Set Both Controls to a Depth
  - Can “Mill for Slope” (with a Depth at one Lane Edge)
    - Set One Control to a Depth & One Control to Slope
  - Can’t “Mill for Constant Depth (across lane) ” AND “Mill for Slope”

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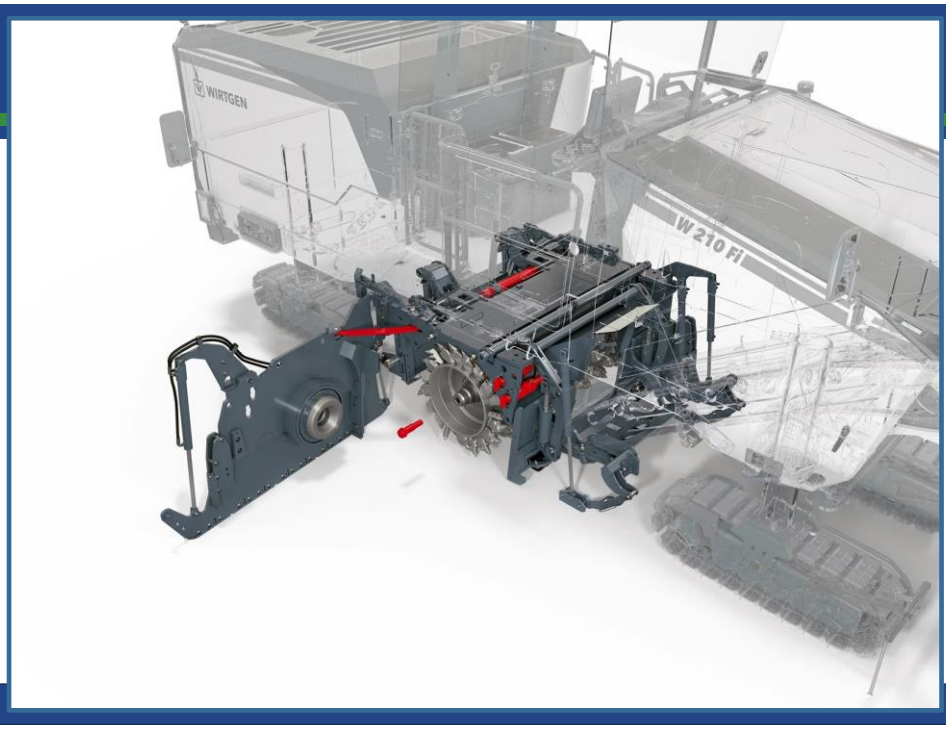

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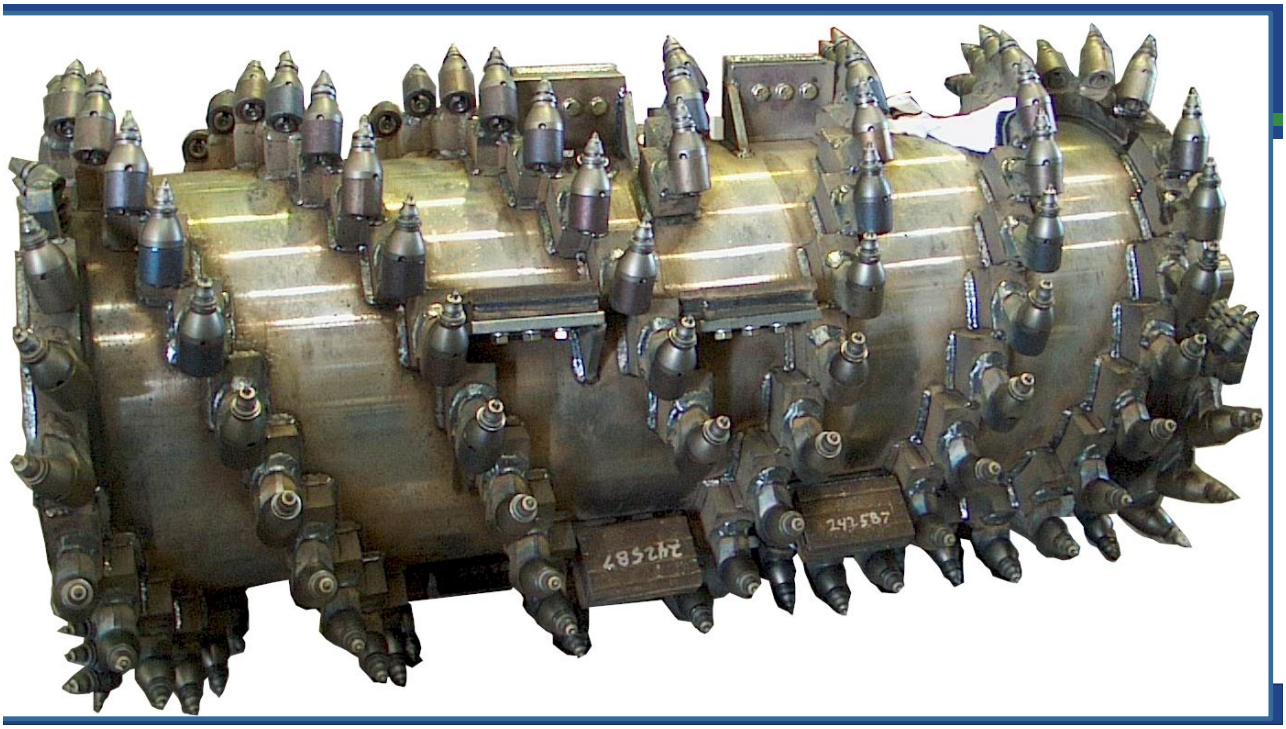

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Common Constructability Issues + Design Perspective

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Paved Shoulder Widths Matter

- Avoid Shoulder Widths > 5 feet and < 8 feet
- See Previous Slides on Paver

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Paved Shoulder Widths Matter

- **FDOT Design Manual**
  - 2022 FDM added language
    - When using bicycle symbol and lane arrow markings, outside shoulder must be 8-ft

210.4 Shoulders

Roadway shoulder width is measured from the edge of the traveled way to the shoulder break. A portion of the shoulder is required to be paved on all roadways on the State Highway System. A paved shoulder is the portion of the roadway contiguous with the traveled way for accommodation of errant vehicles, stopped vehicles, bicycle traffic, and emergency use.

When it is determined that the Helmeted Bicyclist Symbol and Bicycle Lane Arrow pavement markings (see ***FDM 223.2.2***) will be placed on the shoulder of a flush shoulder roadway, the paved width for Outside Shoulder without Shoulder Gutter must be 8 feet instead of the 5 feet shown in ***Table 210.4.1***.

Commentary: Paved shoulder widths greater than 5 feet and less than 8 feet are challenging to construct on flush shoulder roadways.

Standard asphalt paving machines have a main screed width of 8 feet or 10 feet (10 feet screed is most common), with 5-foot-wide extensions, connected at pivot points, on either side of the paver. The pivot points are the only locations on the paver where a cross slope break can be constructed. As such, up to a 5-foot-wide shoulder can be paved in conjunction with the adjacent travel lane. Shoulder widths that are 8-feet-wide or greater can be paved with a standard paver.

Due to these dimensional limitations of standard asphalt paving machines, constructing a paved shoulder width that is greater than 5 feet or less than 8 feet is challenging, and should be avoided when possible.

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Paved Shoulder Widths Matter

- **FDOT Design Manual**
  - 2022 FDM added language
    - When using bicycle symbol and lane arrow markings, outside shoulder must be 8-ft
  - 2025 FDM updated language
    - When using bicycle symbol and lane arrow markings, outside shoulder must be either 5-ft or 8-ft

210.4 Shoulders

Roadway shoulder width is measured from the edge of the traveled way to the shoulder break. A portion of the shoulder is required to be paved on all roadways on the State Highway System. A paved shoulder is the portion of the roadway contiguous with the traveled way for accommodation of errant vehicles, stopped vehicles, bicycle traffic, and emergency use.

When it is determined that the Helmeted Bicyclist Symbol and Bicycle Lane Arrow pavement markings (see ***FDM 223.2.2***) will be placed on the shoulder of a flush shoulder roadway, the paved width for the outside shoulder without shoulder gutter must be either 5 feet as shown in ***Table 210.4.1*** or 8 feet.

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Paved Shoulder Widths Matter

- What about Bicycle Lanes?
  - Different from paved shoulders
  - FDM 223 says it's best practice to consider other types of facilities for Design Speeds > 30 mph
  - *Typically* found on curbed roads, which use same cross slope for travel lane and bike lane
  - Bicycle lanes ***may*** be provided on flush shoulder roadways under specific conditions – project specific consideration – discuss details with your District

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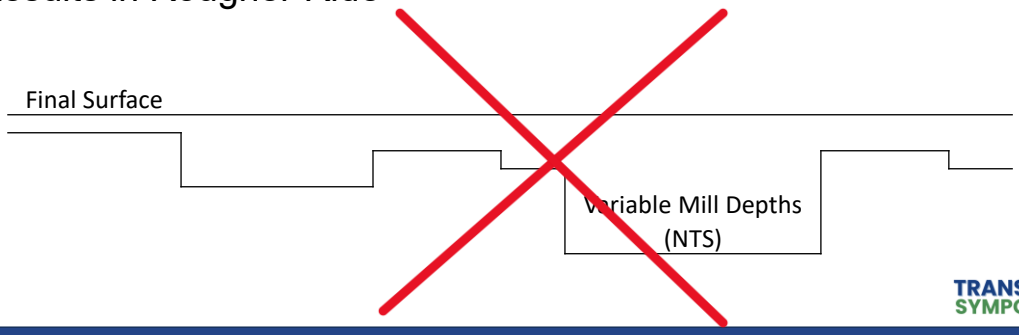
Minimize Typical Section Changes

- Increased Project Cost
- Adds More Time to Milling & Paving Operations
- Creates More Joints & Potential Scabbing on Future Resurfacing
- Results in Rougher Ride



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Minimize Typical Section Changes

- Fewer Milling Depth Changes & Paving Thickness Changes
- Expedites Milling & Paving Operations
- Helps Reduce Project Cost
- Reduces Quilting Effect & Potential Scabbing on Future Resurfacing
- Improves Smoothness

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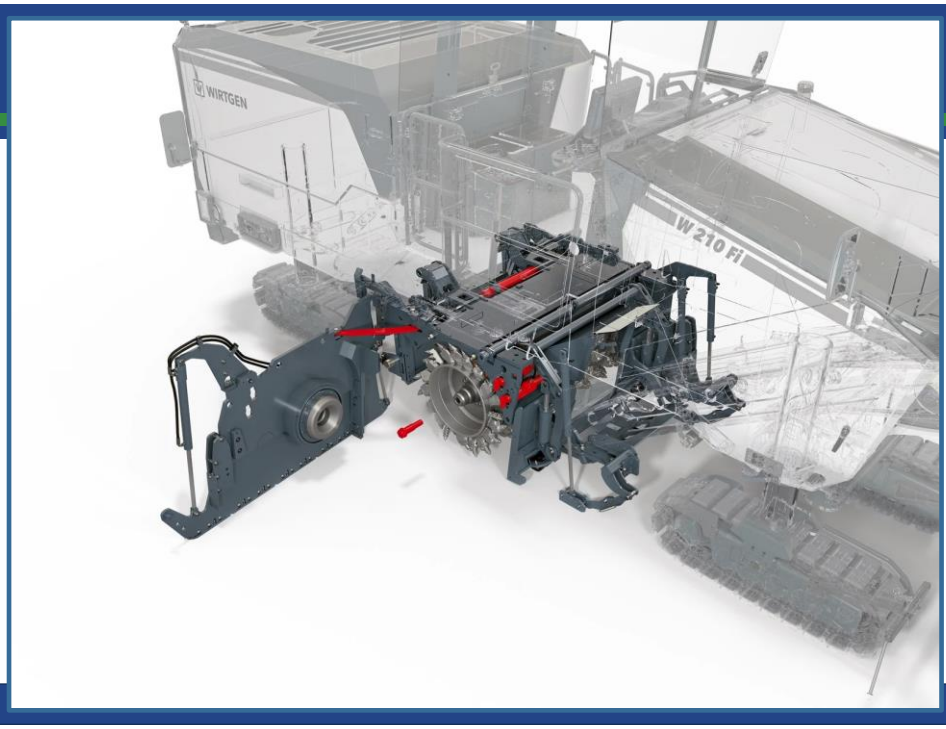

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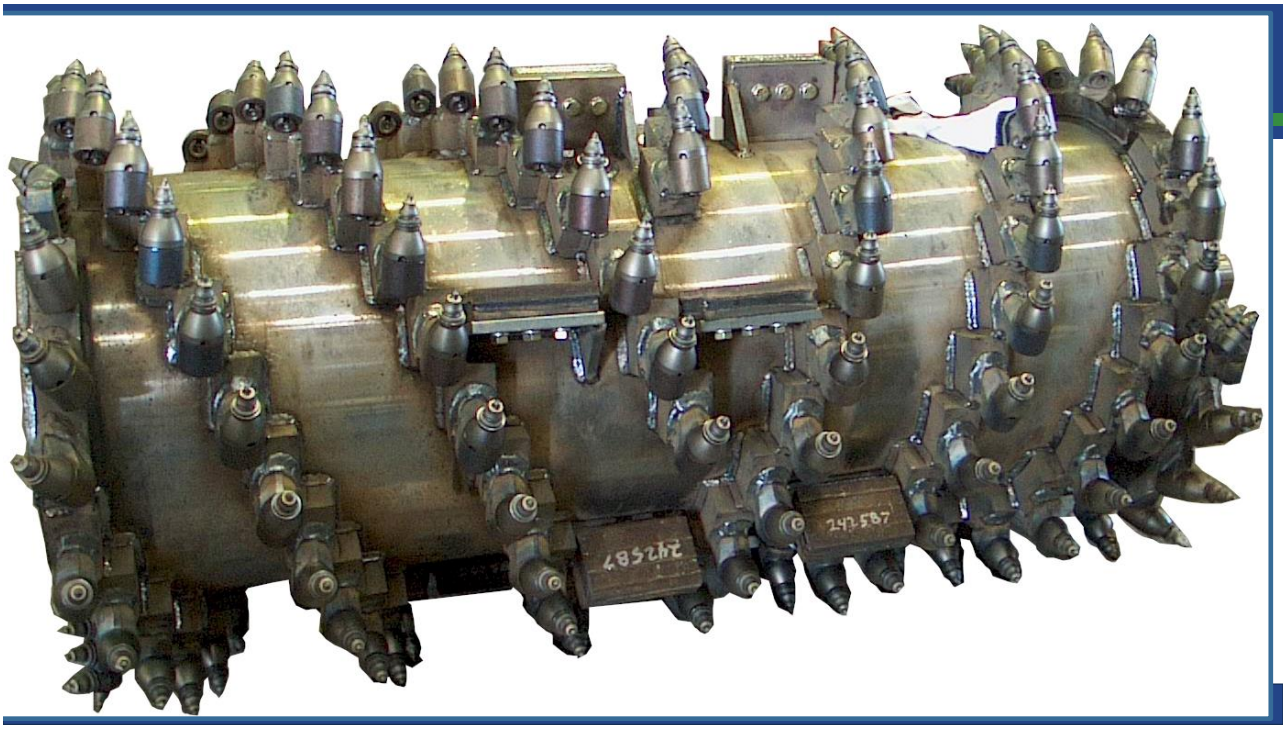

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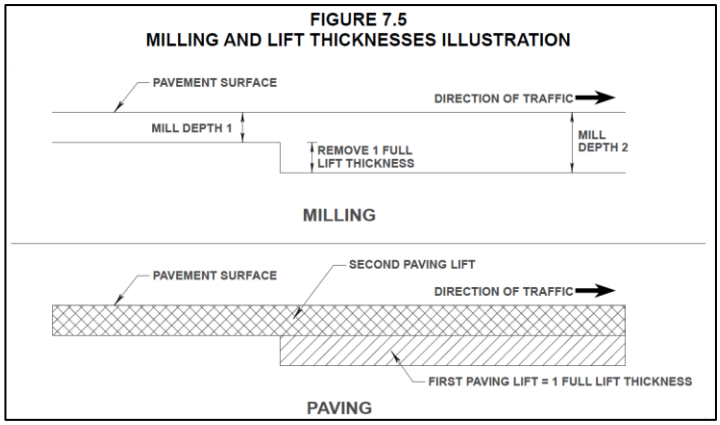
Minimize Typical Section Changes



- **FDOT Flexible Pavement Design Manual**
  - 2024 FPDM Added Language
    - Section 7.5.7, Construction Considerations
    - Best practices regarding number of mainline milling depths & milling depths within the same travel lane
    - Guidance (not policy) for engineering judgement

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Correct Cross Slope with Milling

- Results in Constant Thickness Paving
  - More Consistent, Higher Quality, Smoother Pavement
  - Density Testing is Required
    - Variable Thickness Overbuild is Exempt

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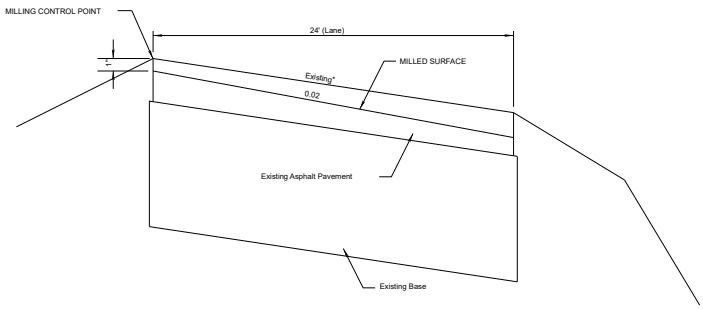
Correct Cross Slope with Milling

- What to show in plans?
  - Milling control point (e.g., EOP, CL, Lane Line)
  - Milling slope (proposed cross slope, say 2%)



- Know your existing pavement structure
  - Make sure the existing pavement is thick enough
  - Watch for existing ARMI – either completely remove it or leave it alone

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Single Lane Ramps – Constructability Issue

- Traffic Control Plan Doesn't Allow Enough Room to Pave Each Half of Ramp

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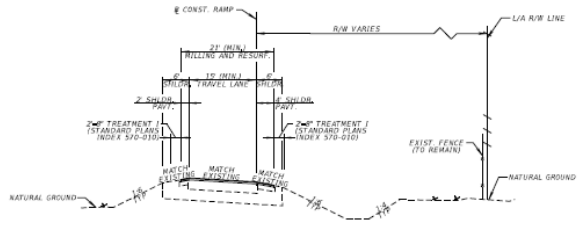
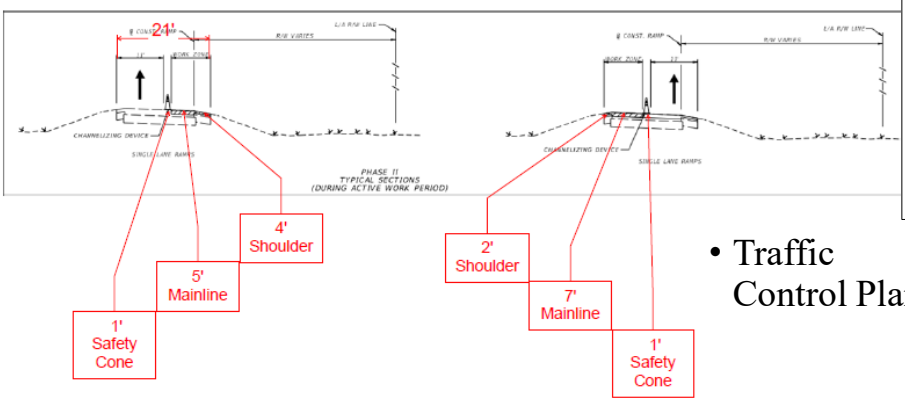


- Typical Section



- Traffic Control Plan

- Only 12' (5' + 7') of 15' ramp lane width can be paved
- Middle 3' can't be paved under proposed Traffic Control Plan

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Single Lane Ramps – Constructability Issue

- Partial Ramp Closure
  - Inability to Fit Construction Equipment in Work Zone
  - Safety & Pavement Quality Concerns
  - Takes Longer to Mill & Pave Than Full Ramp Closure
  - 2 shifts per structural lift
  - 2 shifts for friction course
  - Half ramp width paved each shift
- **Full Ramp Closure - Preferred**
  - **1 shift per structural lift**
  - **1 shift for friction course**
  - **Safter, Faster, Higher Quality**

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Single Lane Ramps – Safety

- Work Often Occurs at Night
  - Navigational Challenges for Travelling Public
- Work Occurs at Full-Posted Speed on Ramps
  - Designers Should Consider Reducing Speed in Plans
    - Difficult to Get Approval to Reduce Speed for Milling & Paving Operations
- Different Vehicle Types Trying to Navigate Various Ramp Configurations
  - Semi-truck Often Can't Navigate Safely
- Paving Dump Trucks Entering & Exiting Work Zone
  - Adds More Safety Challenges & Increases Traffic Accident Potential
- One Confused Driver Enters Work Zone & Injuries & Fatalities Occur

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Single Lane Ramps – Possible Solutions?

- Pave Temporary Asphalt on Side of Ramp
- **Full Ramp Closure**

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Single Lane Ramps – Solution?

- Pave Temporary Pavement on Side of Ramp to Create Room to Push Traffic Over
  - Works in Some Cases But Not All
    - e.g. not practical on ramps with shoulder gutter, curb inlets, guardrail, streetlights & other obstructions & confined areas
  - Paving Temporary, then Permanent Asphalt, then Removing Temporary
    - High Risk of Damage to Permanent Asphalt
    - Temporary Asphalt Increases Project Cost

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Single Lane Ramps – Long-Term Consideration?

- Design Ramps wide enough to allow for sufficient width to be milled & paved while maintaining traffic
- Can stripe for single lane use, but pavement area will provide for safe working conditions for remedial work or resurfacing

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Single Lane Ramps – Solution

- Design Full Ramp Closure
  - Allows Safer, Faster, Higher Quality Paving
    - 1 shift to mill/pave full width structural lift
    - 1 shift to pave full width friction
    - 2 shifts to mill & pave ramp
- Avoid Partial Ramp Closure
  - Takes Twice as Long to Pave, Lower Quality, More Dangerous
    - 2 shifts to mill/pave a structural lift
    - 2 shifts to pave friction
    - 4 shifts to mill & pave ramp

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Single Lane Ramps – Design Considerations

- Standard Widths for Single Lane Ramps
  - Lane Width: 15-ft
  - Outside Shoulder: 4-ft paved (6-ft full)
  - Inside Shoulder: 2-ft paved (6-ft full)
- Ramp Configurations
  - Parallel
  - Tapered
  - Loop

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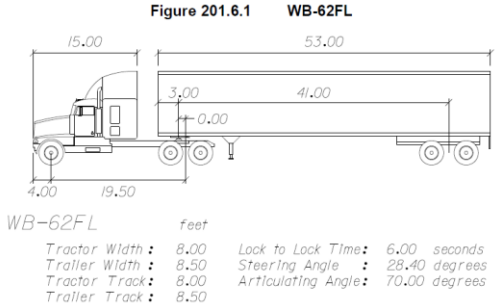
Single Lane Ramps – Design Considerations

- Design Vehicles
  - “The largest vehicle that is accommodated without encroachment… into adjacent travel lanes.”
  - Florida Interstate Semitrailer, WB-62FL
  - Tandem Tractor Trailer (for truck routes), AASHTO WB-109D



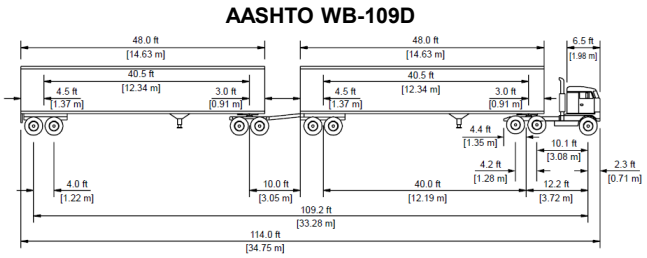


Image Source: 2018 AASHTO Greenbook, Figure 2-28

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Single Lane Ramps – Design Considerations

- Design wider ramps?
  - FDM 211.2.1 addresses this:

211.2.1 Ramps

On tangent sections, provide a 15-foot traveled way for one-lane ramps and 24-foot traveled way for two-lane ramps. Provide a 36-foot traveled way for three-lane ramps plus 12-feet for each additional lane for ramps with more than three lanes.

Consider providing a greater lane width for one-lane ramps where accommodation of future resurfacing is a factor.

Ramp widths in other areas such as terminals are controlled by the curvature and the vehicle type selected as the design control. Minimum ramp widths for turning roadways are given in ***Table 211.2.1***. Typical details for ramp terminals are provided in the ***Standard Plans, Index 000-525.***

  - However, need to also consider
    - R/W implications
    - If the ramp is widened too much, it could be mis-used as an additional lane.

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Single Lane Ramps – Design Considerations

- Considerations When Considering Overnight Ramp Closure
  - Nighttime Traffic Volumes on Ramps
  - Available Detour Routes (proximity?)
  - Public Involvement

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Design Constructability Expo(s)

- First Design Constructability Expo Held - October 14 Lake City
- Milling Machine & Paver On Site
- Sessions on Equipment Operation, Capabilities & Limitations
- Sessions on Design Requirements, Guidelines, & Recommendations
- Discuss Design Constructability Concerns & Proposed Solutions
  - Consultant & FDOT Designers, Contractor & FDOT Construction Personnel
- Planning Future Design Constructability Expos Around the State

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Safety Message

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Contact Us

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October 28-29, 2025
Orlando, FL

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DEADLINE

Please be sure to **certify your attendance** before leaving this event or no later than **Friday, November 21st**, in order to receive PDH/CEC. Detailed instructions are available on the Transportation Symposium website.

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Audience Q&A

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