Asphalt Paver Best Management Practices

Presented by Todd Mansell, Caterpillar

Michigan CAT

Role of the Paver

- To meet specifications for grade, texture & smoothness

The Paver: Tractor & Screed

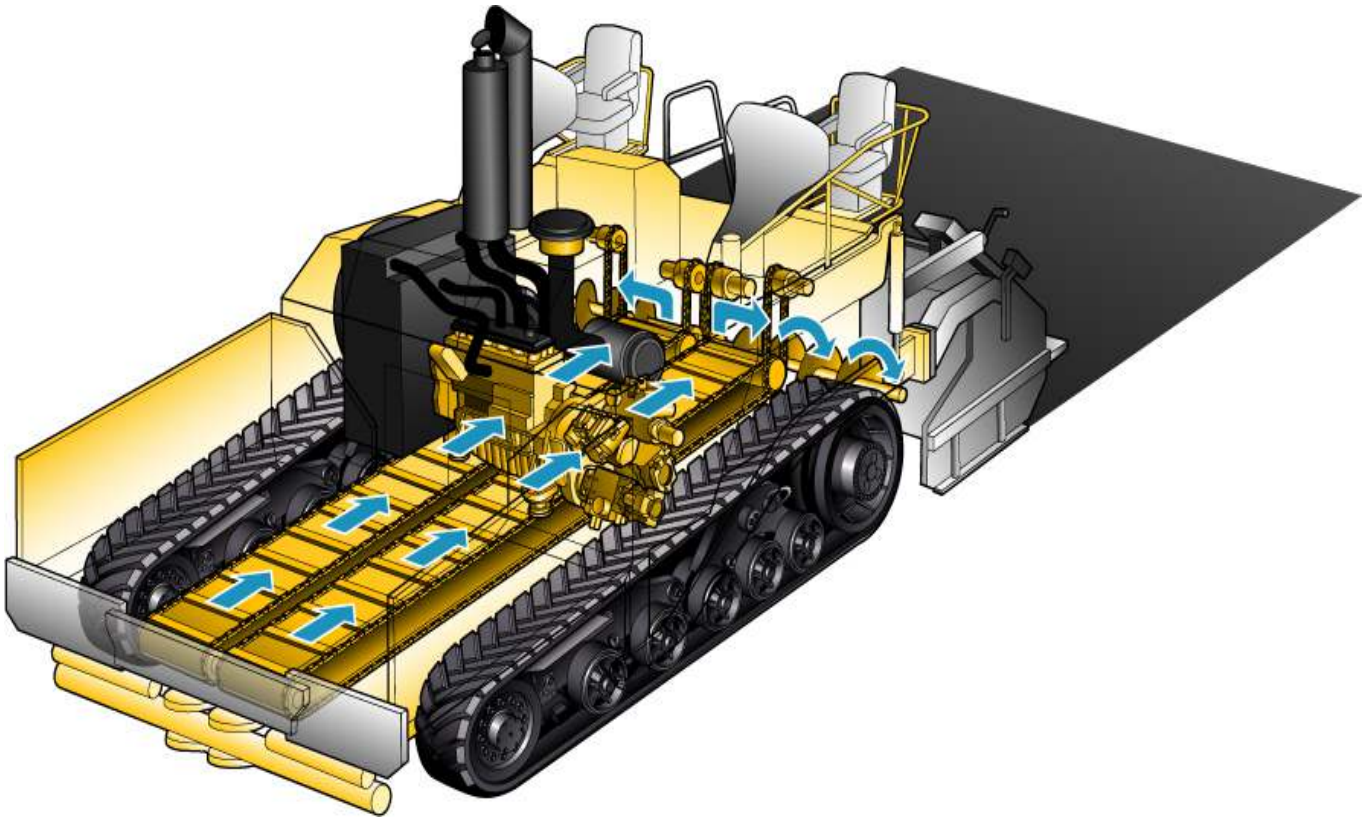
Tractor

- tows screed
- Accepts mix from trucks, MTV, etc.
- Pushes trucks
- Feeds mix to screed

Screed

- Floats on the mix
- Free to rise and fall according to many factors

Tractor



Material Feed System

1. Hopper
2. Feeder bars
3. Adjustable height augers
4. Feeder sensors (not shown)

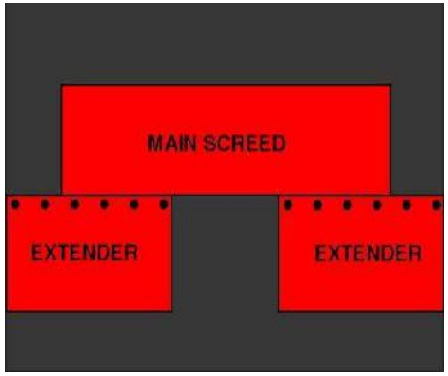
Feeds mix from hopper to screed

Screed

- Screed is extendable to pave different widths
- Hydraulic extendable and fixed-width screeds

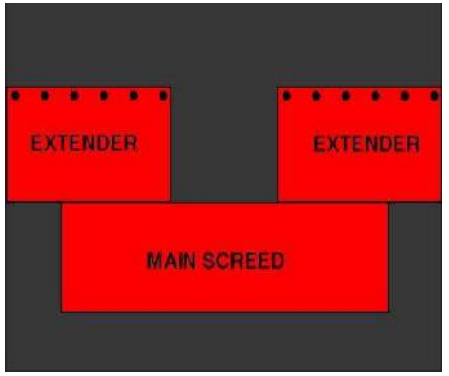
Front-mount and Rear-mount Screeds

Front-mount



Direction of paving

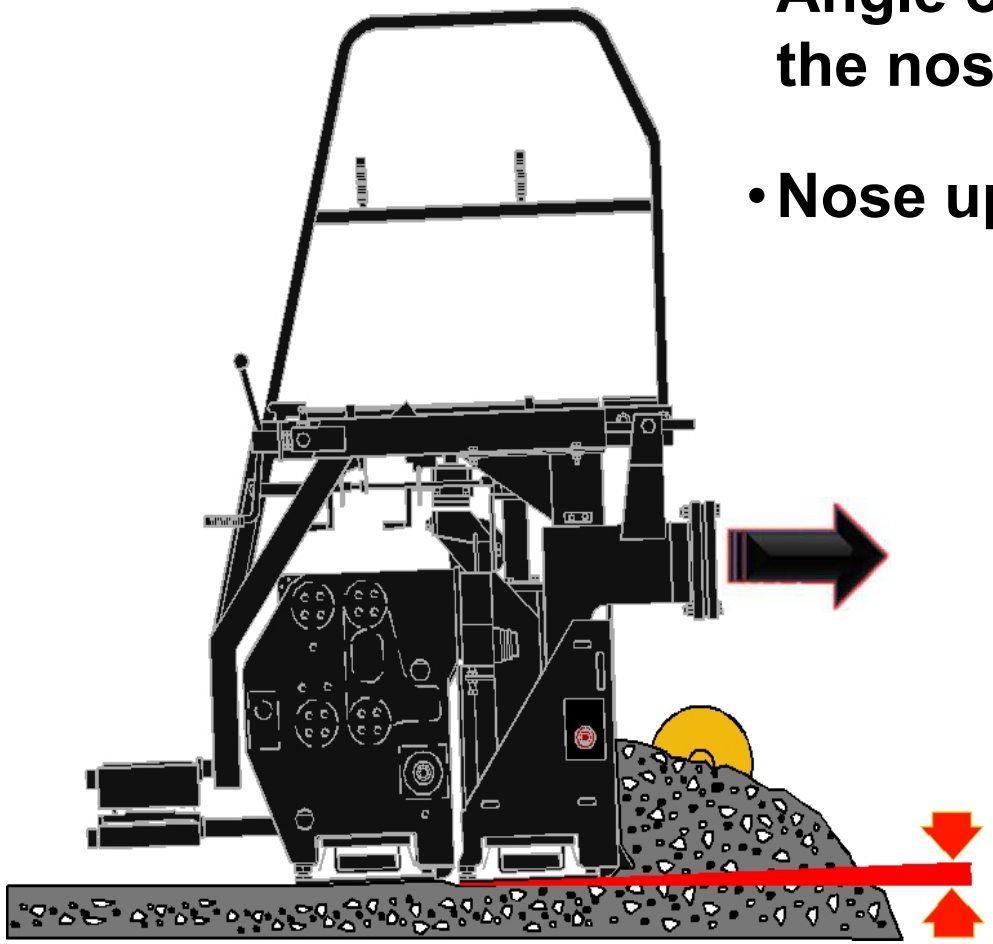
Rear-mount



Free-Floating Screed

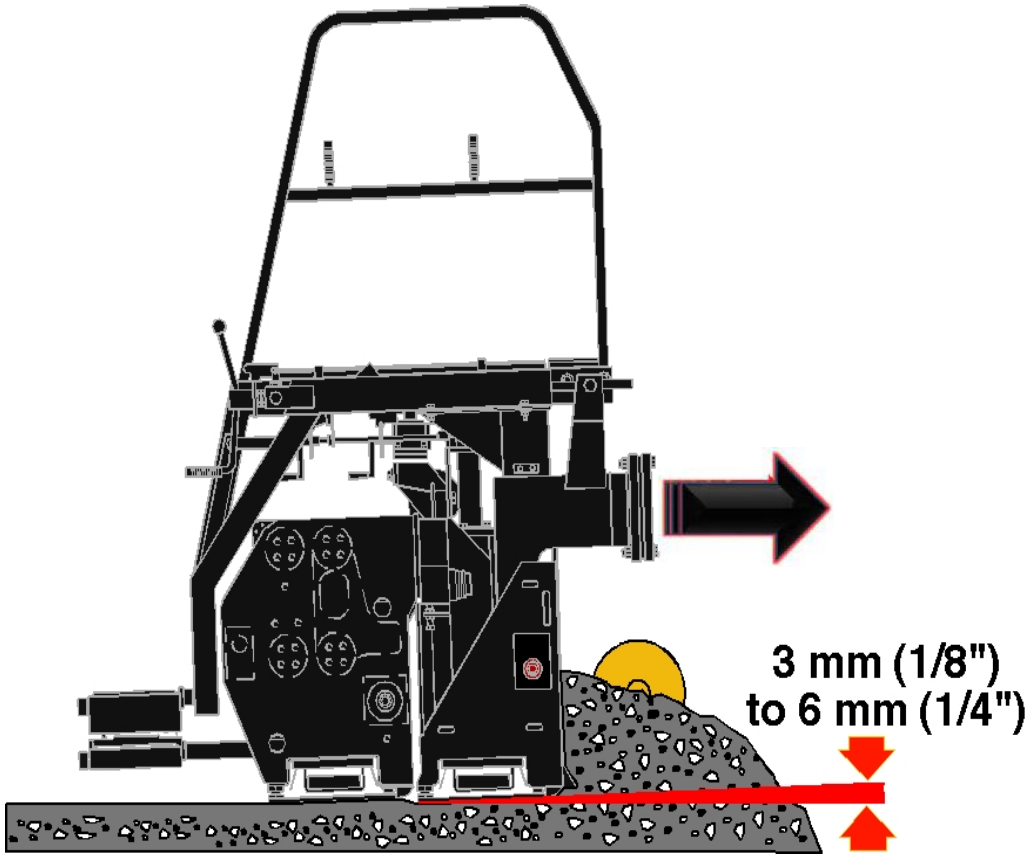
- Principle has not changed since Barber-Greene commercialized the free-floating screed in 1934

Angle of Attack



- Angle of attack is the relationship between the nose of the screed & the grade
- Nose up attitude

Angle of Attack



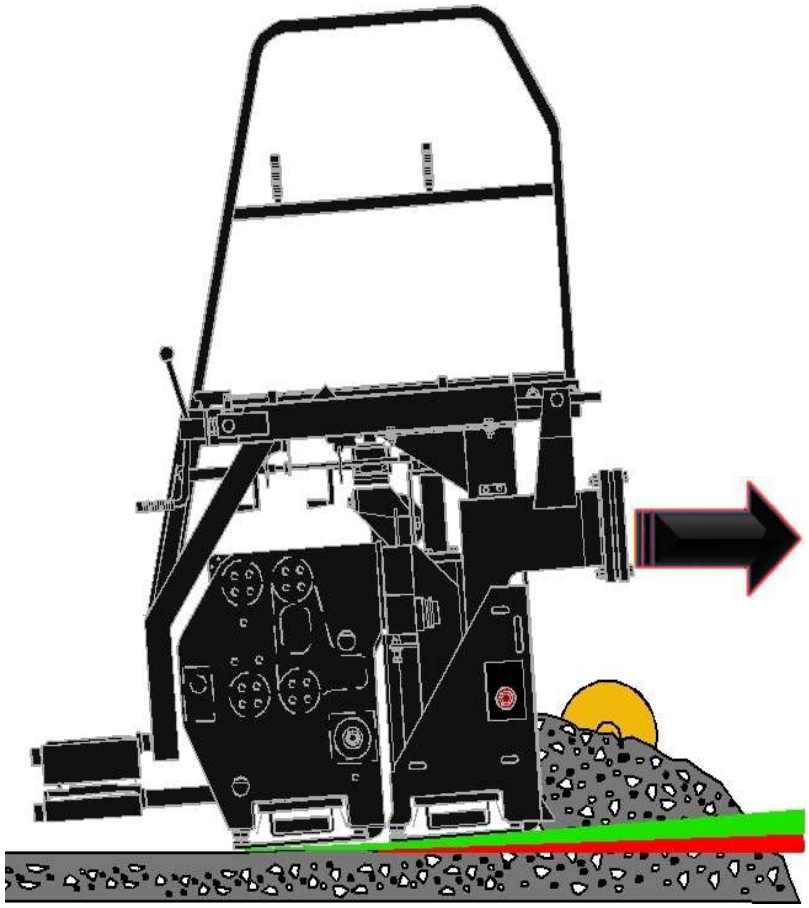
- Normally 1/8” to 1/4”
- Angle too high
  - compacts with trailing edge
  - shiny appearance
- Erratic screed behavior
- Angle too low increases shear factor and wear
  - open mat texture

How to Adjust Mat Thickness & Slope

- Use depth control cranks or “screws”

- Use tow points

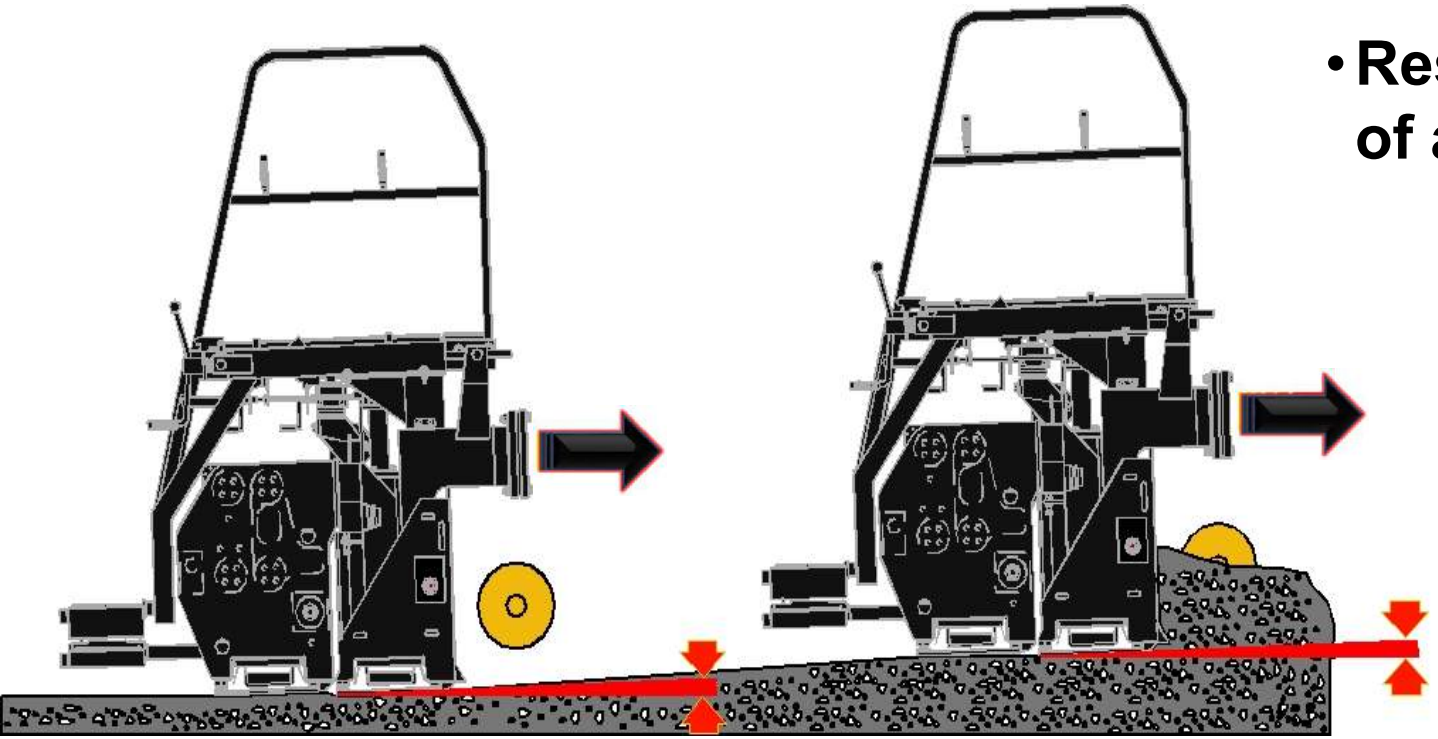
Increase Angle of Attack



- More material passes under screed
- Screed rises to new level
- As screed climbs, angle of attack decreases
- Re-establish same angle, but at increased depth
  - remember, screed travels through arc and reaches equilibrium @ new thickness

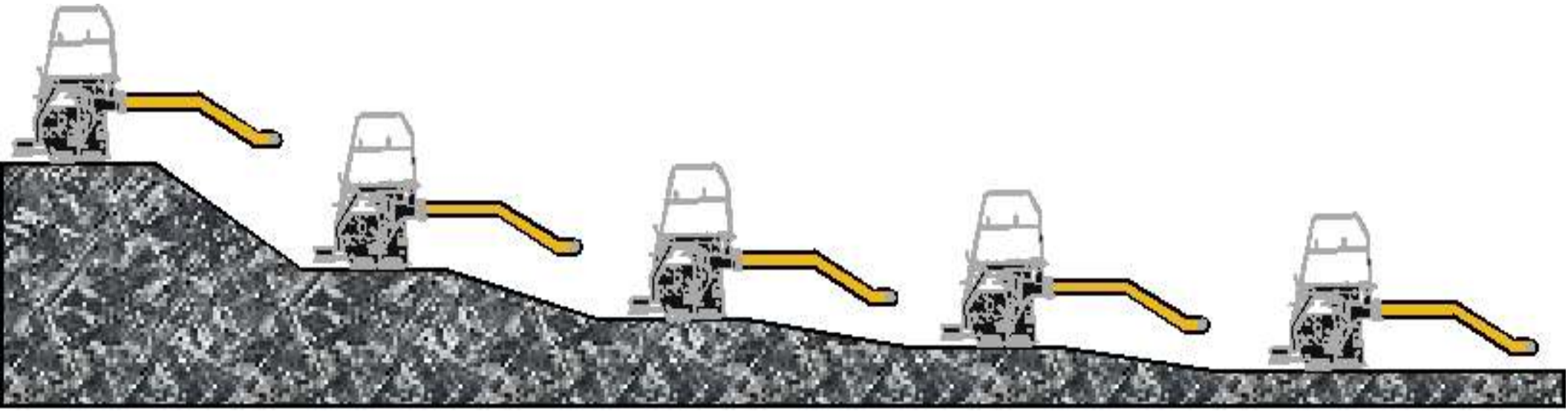
Changing Thickness

- Achieves equilibrium at new thickness
- Resumes original angle of attack

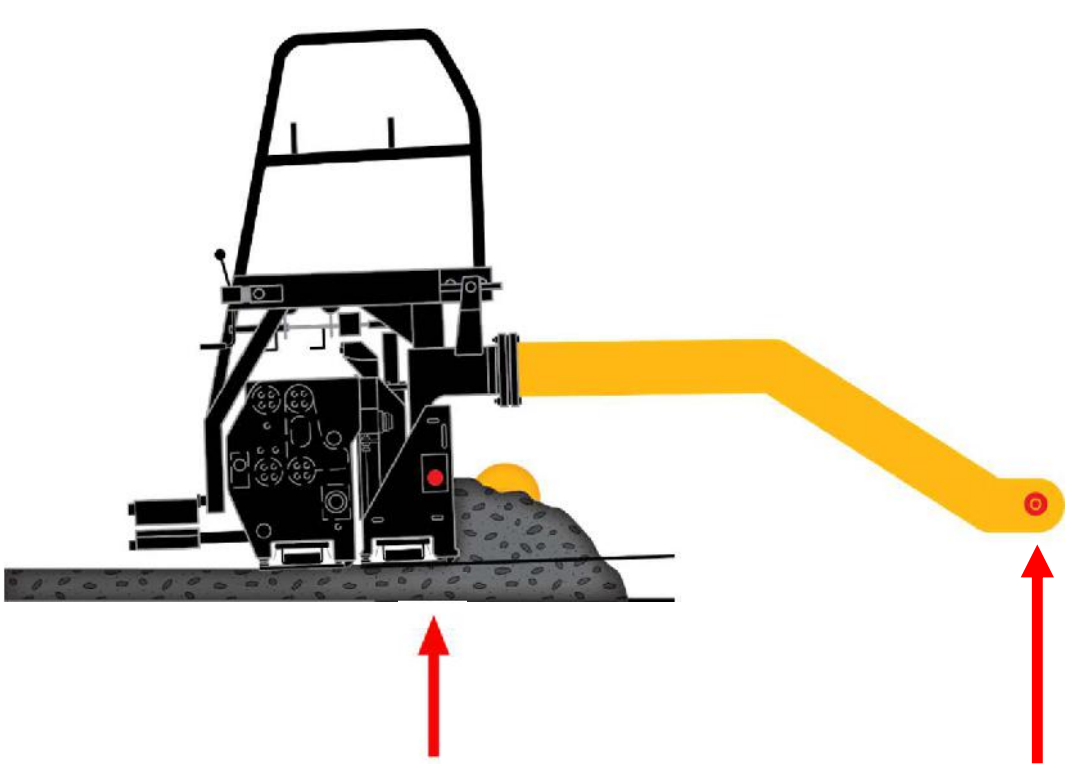


Change Over 5 Tow Arm Lengths

- 65% of change occurs in the first tow arm length
- 35% of change occurs over 4 tow arm lengths

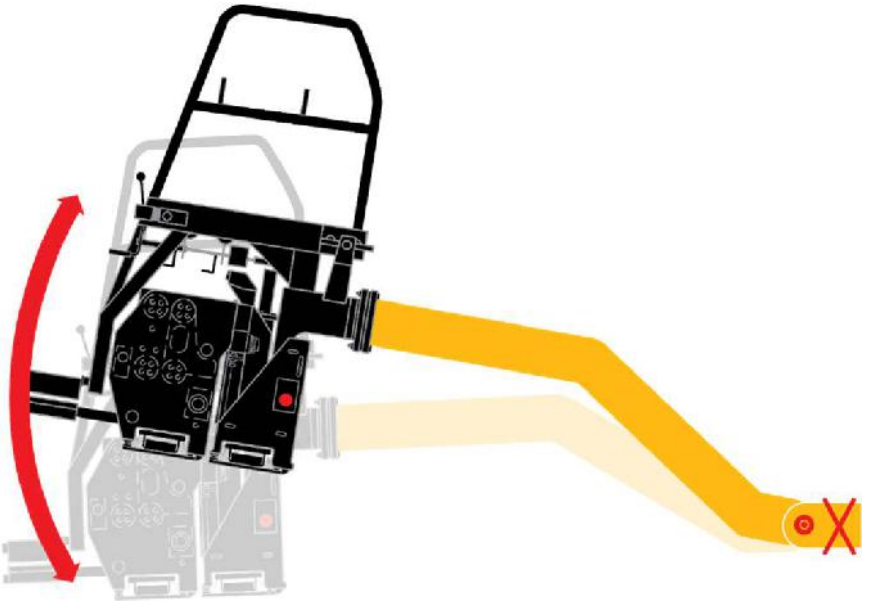


Pivot Points & Tow Points must be clean!



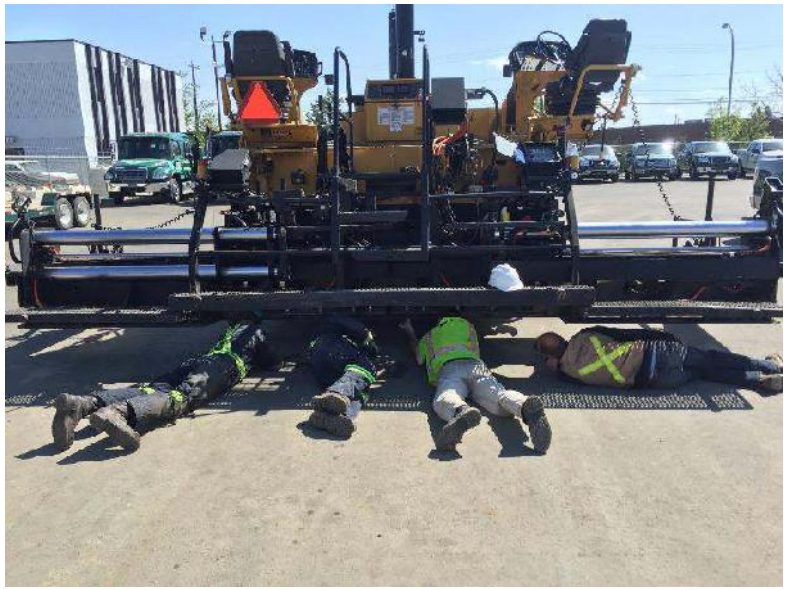
Pivot Point

Tow Point

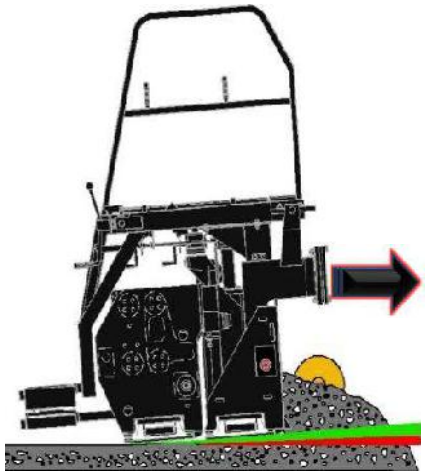


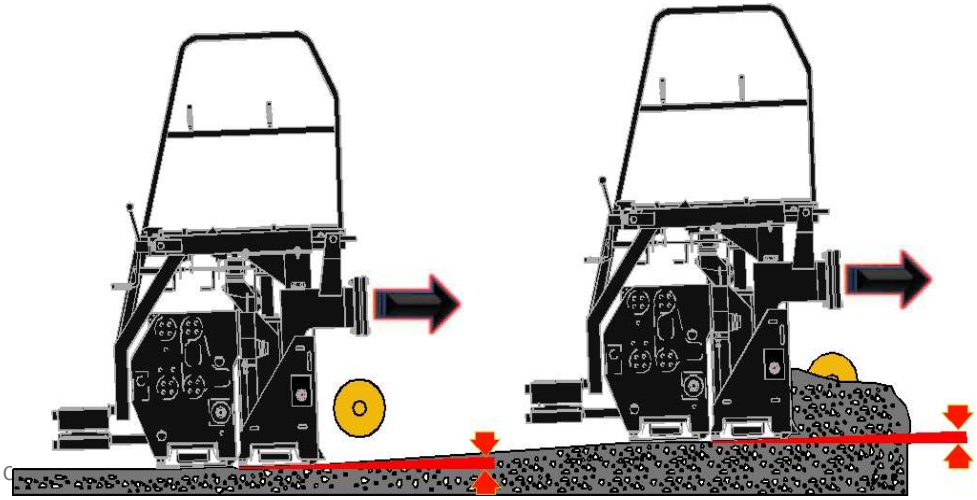
Clean your screed for it to work properly!

- Must be free to rotate about pivot points
- Strike off and nose bar must be clean
- End gate springs clean and free



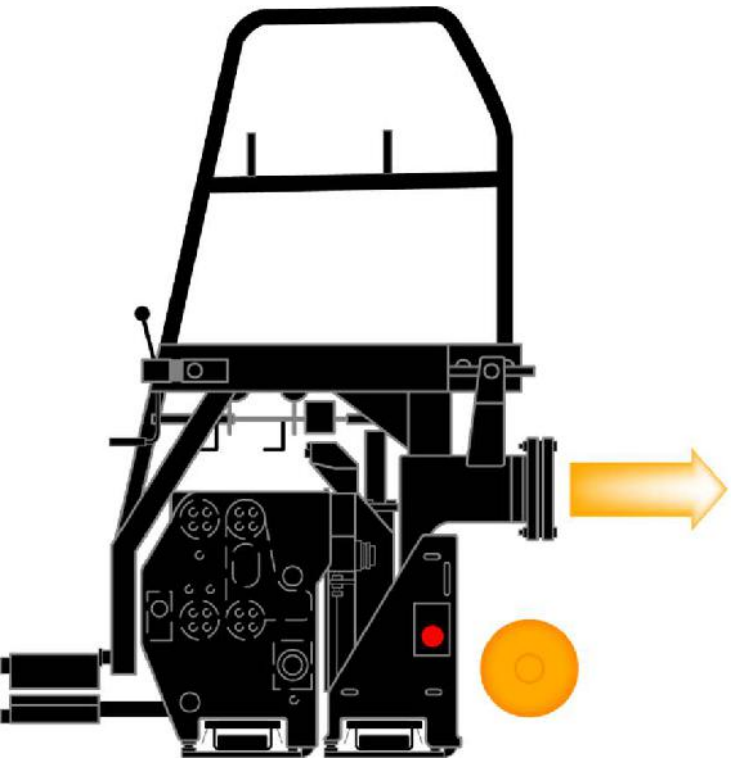
Clean pivot points allow smooth changes

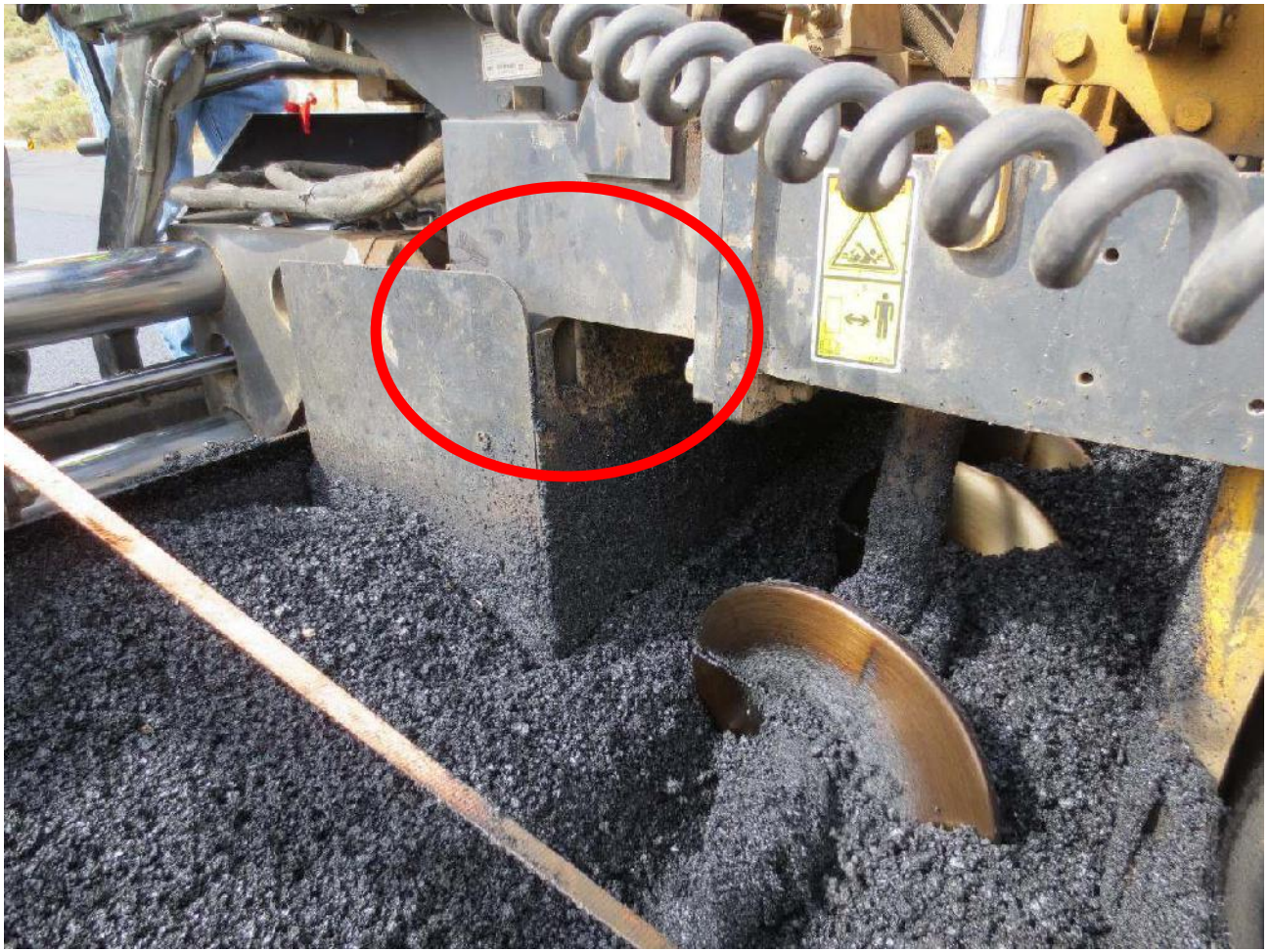




- Pivot points must be free to rotate for thickness changes to occur smoothly and for the screed to “float” relaxed
- When pins are plugged, we compensate & wear the screed out
- Smoothness suffers

Pivot Points can get plugged up





Pivot Points - keep clean & free ☺

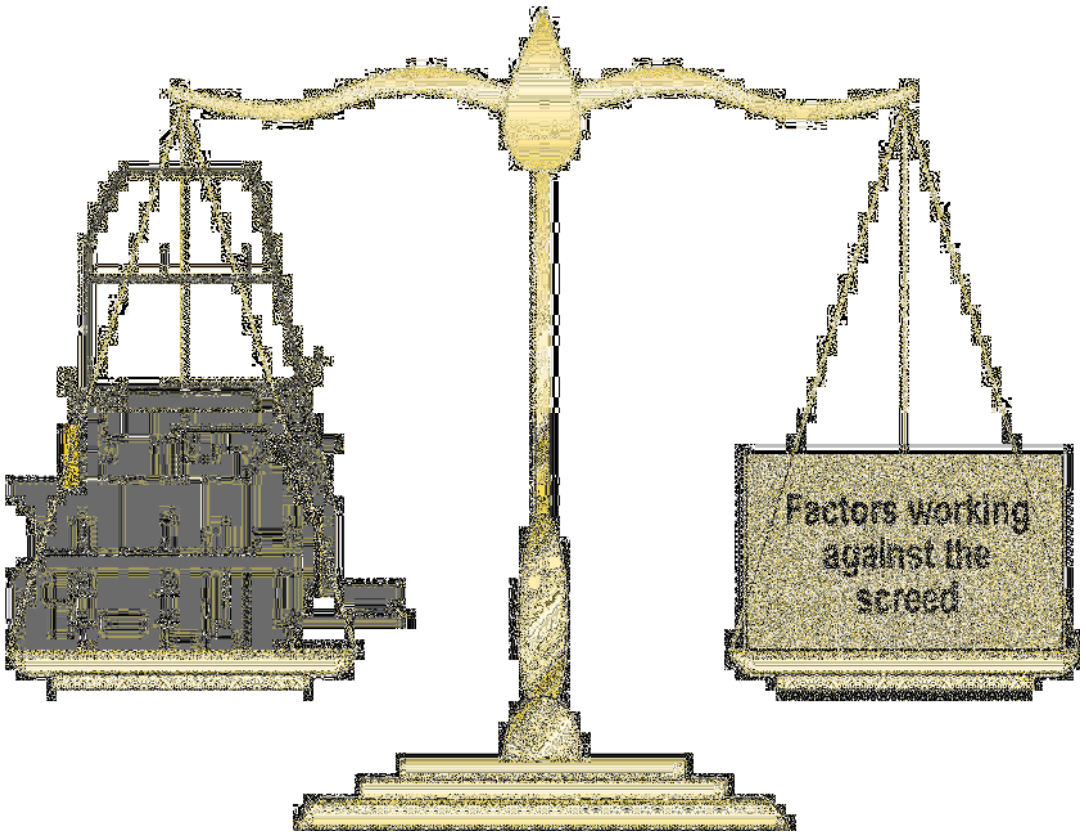
View looking down on top of pivot point

Remove side cover

Clean hardened mix out

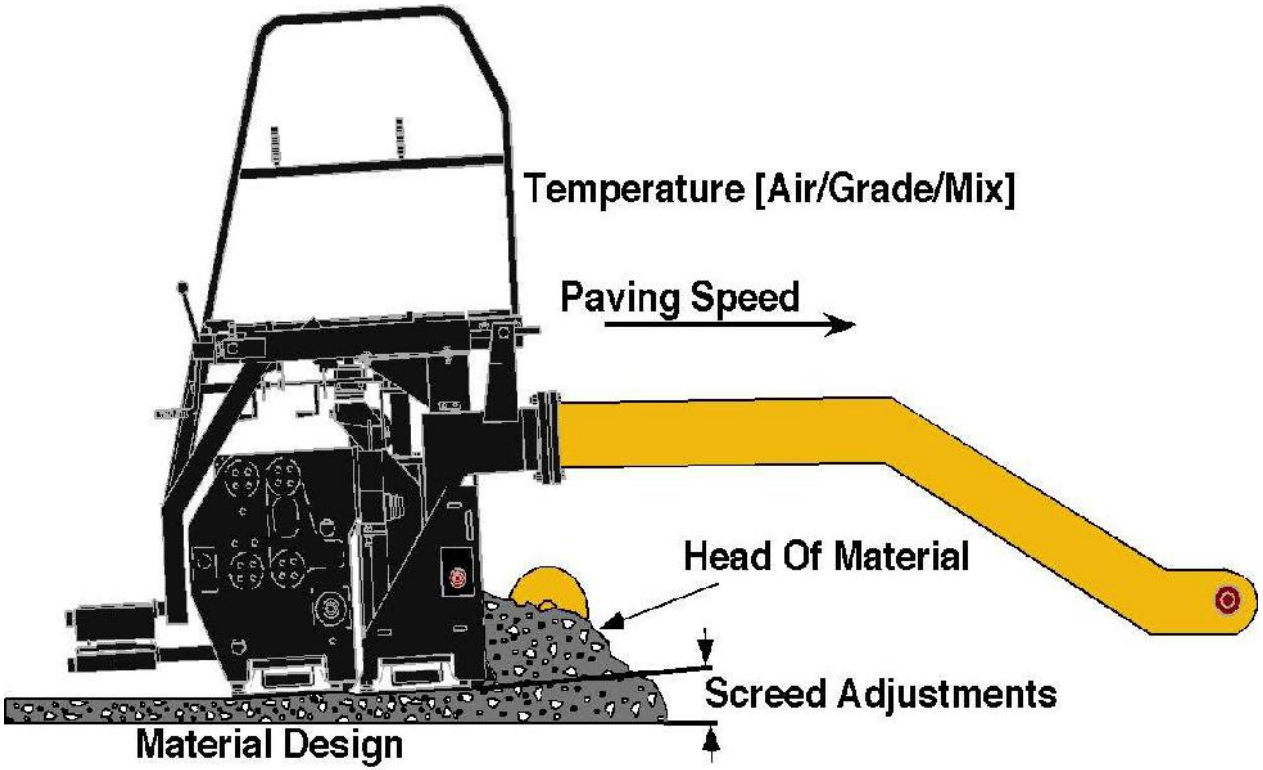
Strike Off Plate & Nose Bar

Free-Floating Screed



- Screed position determines mat thickness
- Screed position is constant <u>as long as all factors remain constant</u>

Factors Affecting the Screed



- Paving speed
- Head of material
- Screed adjustments
- Mix design
- Mix temperature
- Air temperature
- Grade temperature

Paver Set Down & Take Off

PAVING BY THE NUMBERS

1. Heat the screed
2. Set the tow points
3. Set paving width
4. Set crown
5. Set extender height
6. Set extender slope
7. Lower screed and remove slack
8. Null the screed
9. Position end gates
10. Set auger height
11. Position feeder sensors
12. Set feeder controls
13. Fill auger chamber/place in auto
14. Set accessory functions
15. Pull off starting reference

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QEXQ1403-04
(Replaces QEXQ1403-03)

CAT

Taking off: Is this a good place to start?

Good Starting Point

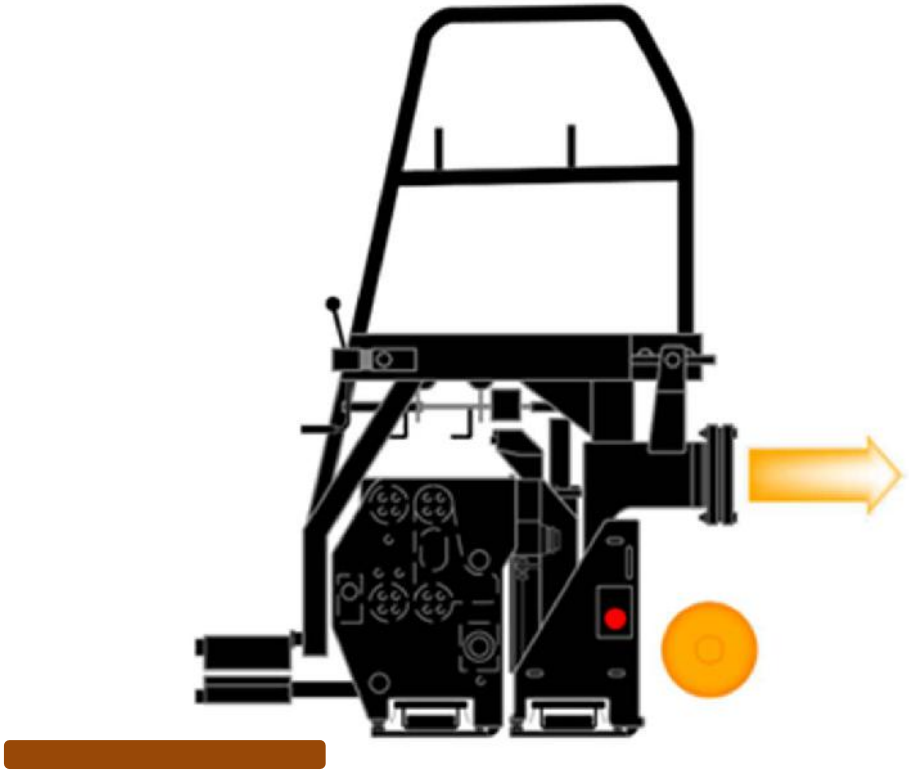
- Cut straight starting joint
- Butt joint flat

- Tack butt joint
- Clean area where screed will set down

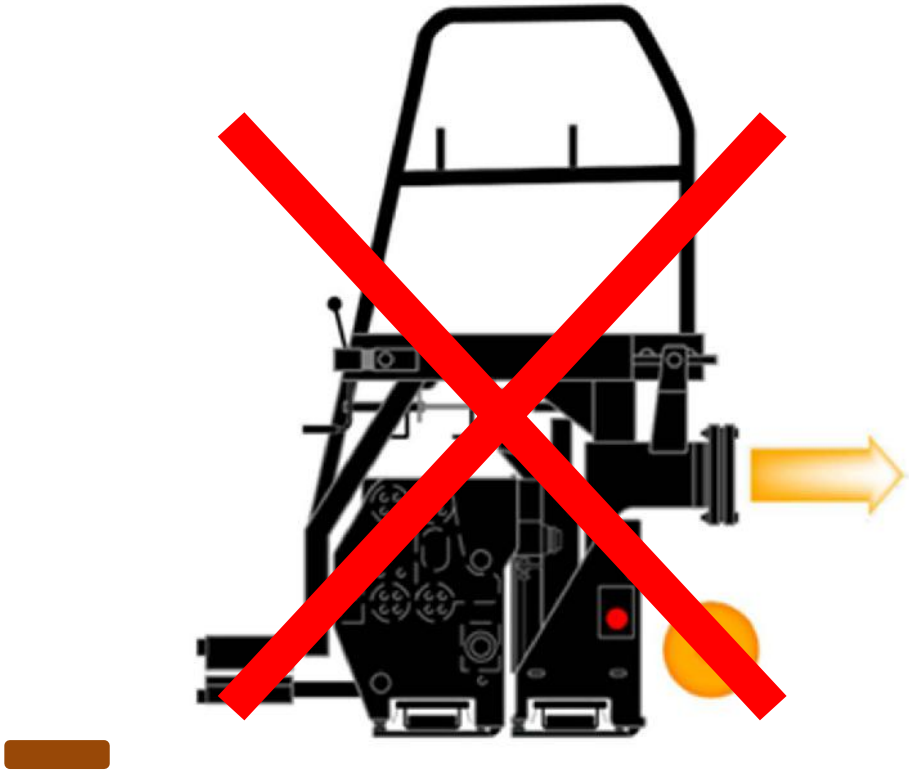
Build a Pad or use Starter Boards

- **Support full length of screed & extensions**
- **3 to 4 feet long boards**
- **Based on uncompacted mat thickness (1/4” per 1”)**

Boards must support main & extenders



Full Support Main & Extenders



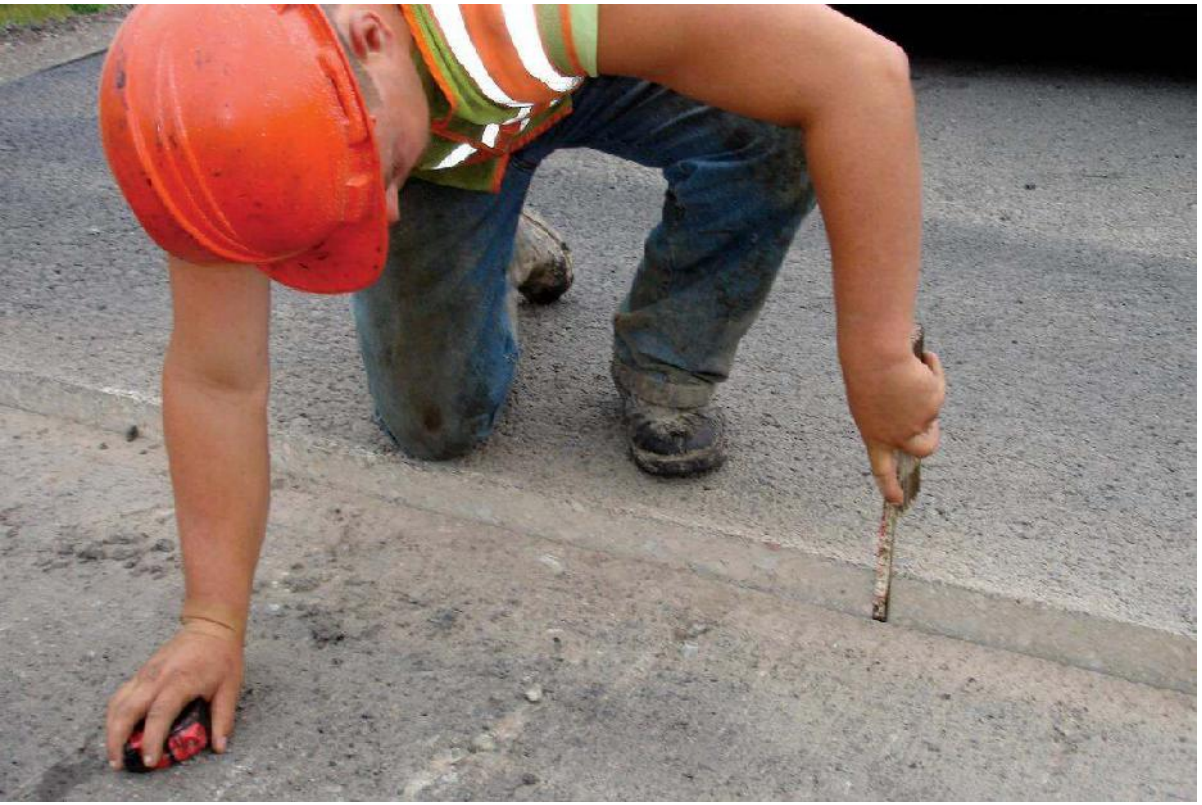
Screed will drop or ‘nose over’

What's wrong with this take-off ?

No starter boards!

What's going to happen?

Measure Height of Starting Joint



- Calculate thickness of starter boards
- General rule vibratory screed: ¼” compaction per 1” loose depth
- Example: Place 2-½” loose to end up with 2” after rolling

Set Tow Points

- Based on uncompacted mat thickness
- Establish a straight “line of pull”
- Set tow points <u>BEFORE</u> lowering the screed

Example: 2 ½ inch mat (rear-mount)

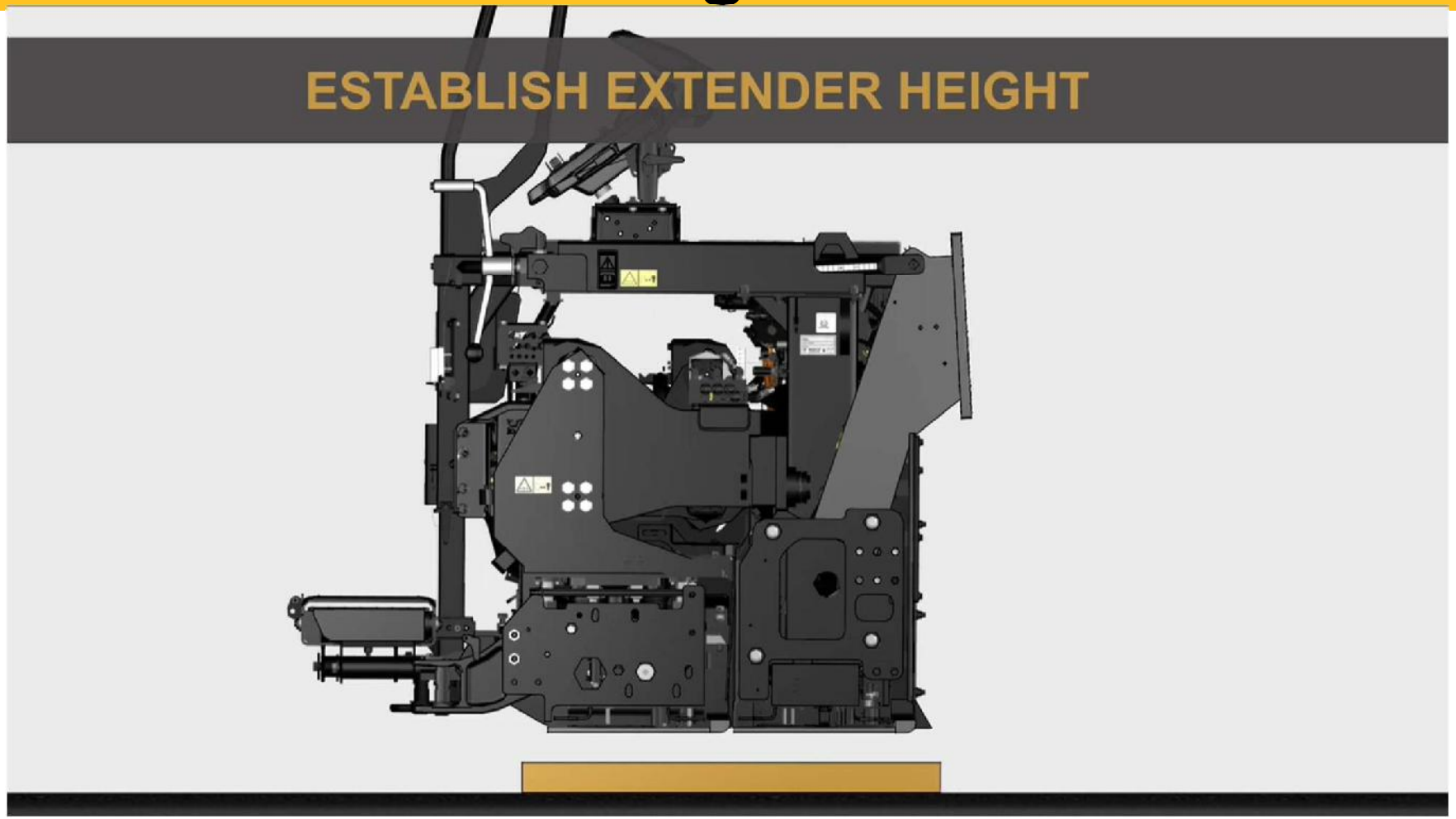
- Tow point scales are different
- Know where “0” is on your paver
- Establish a straight line of pull

Tow Point set at 2 ½

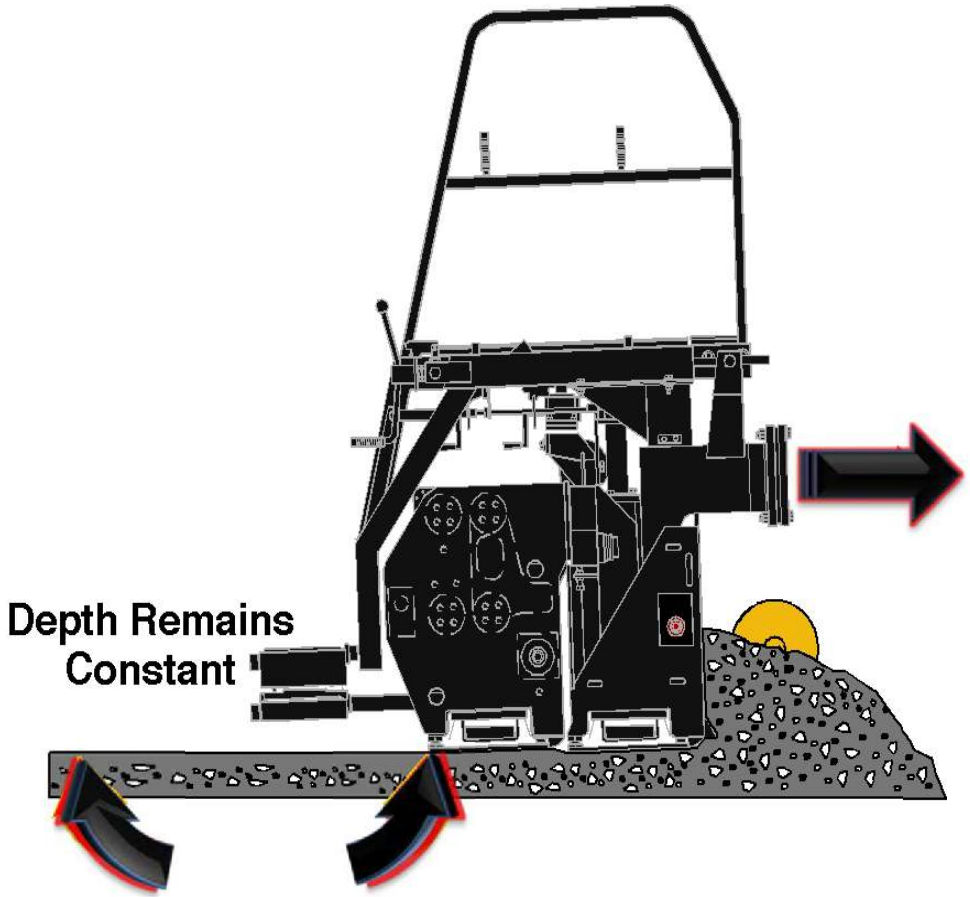
Null the Screed

- Nulling the screed removes all the tension in the screed
- Use depth screws on each side until no tension is felt
- Go to tension both sides
- The screed must be “free-floating” on the mix

Null the Screed & Angle of Attack



Factors Affecting Screed – Crew Controls



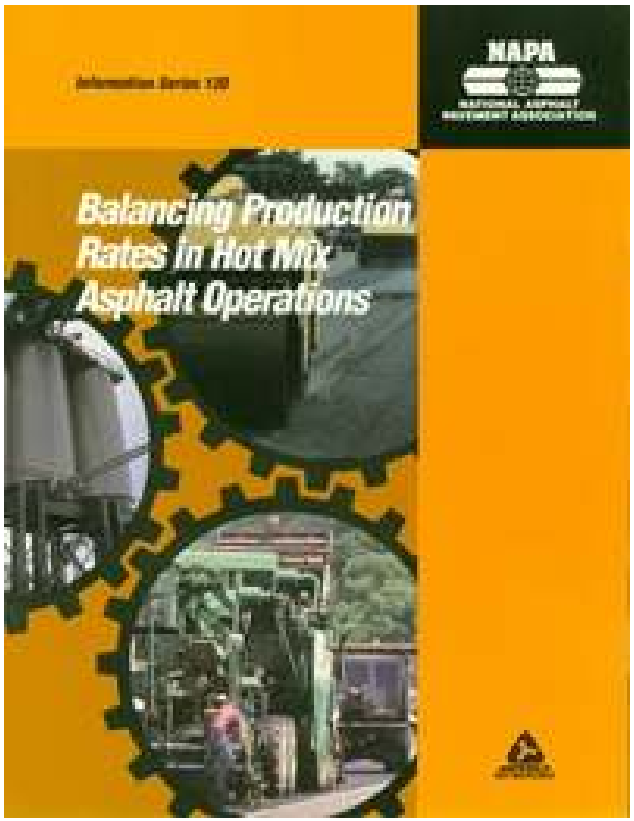
1. Speed
2. Head of Material
3. Screed Adjustments

- Shear factor is constant
- Depth remains constant

Planning a Balanced Paving Operation

- Goal is non-stop paving
- Set to match mix delivery
- Balance with rollers
- Quick starts/stops
- 60 fpm maximum

Planning ≈ 20 minutes

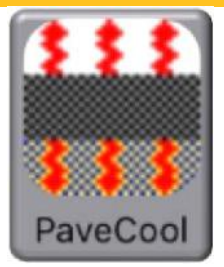


Pre- paving planning

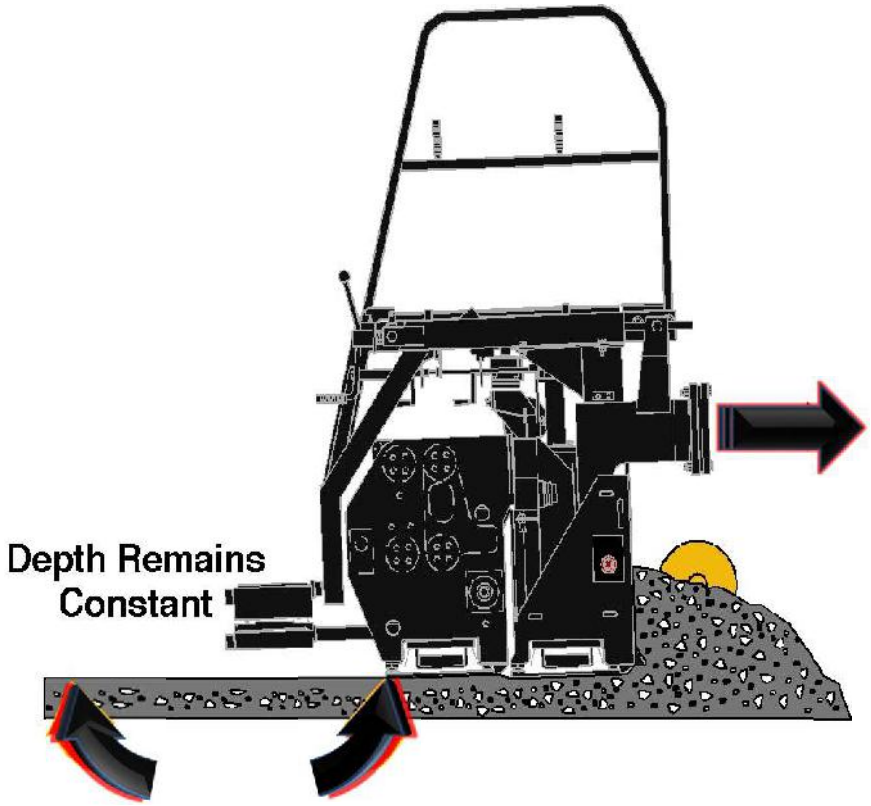
- Tons per day
- Number of trucks needed
- Paver speed
- Roller speed
- Rolling Pattern
  - Density
  - Smoothness

Tools available

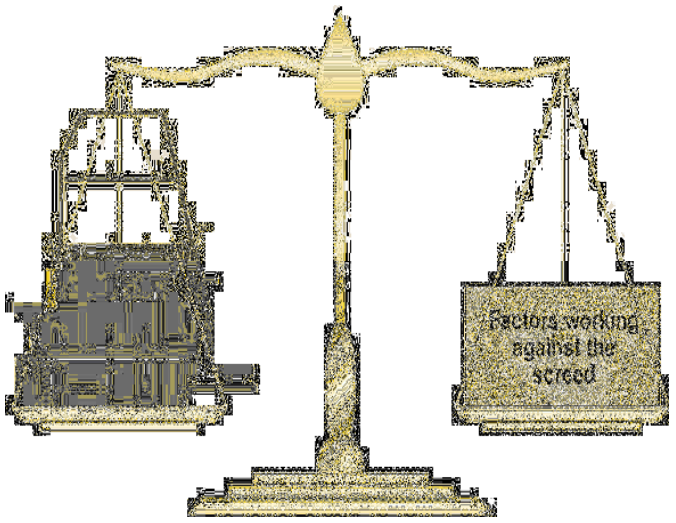
- NAPA IS-120
- Paving Production Calculator App
- PaveCool App



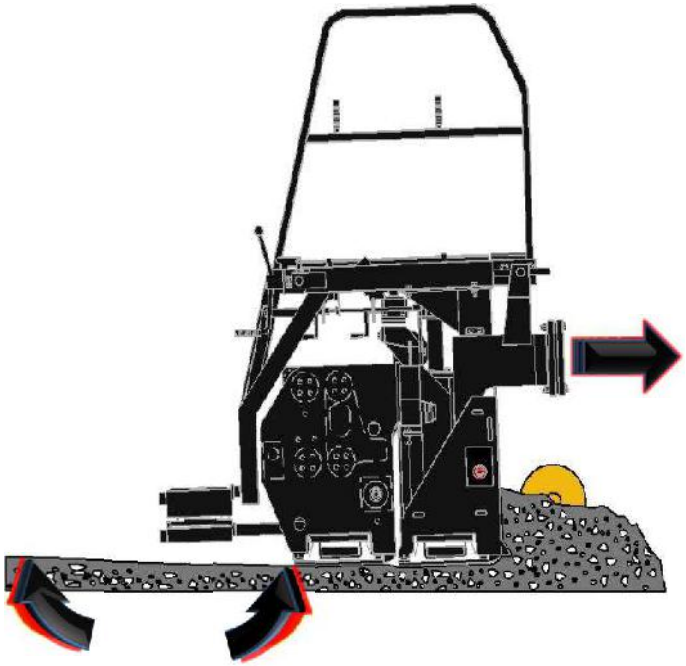
Pavement Smoothness



- Shear factor is constant
- Depth remains constant

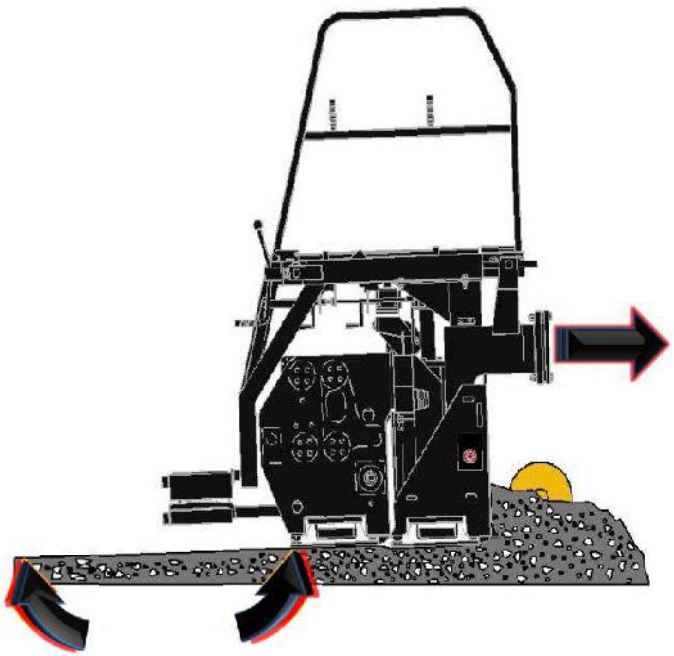


Changes in Paver Speed



Increased Speed

- **Shear factor decreases**
- **Depth decreases**



Decreased Speed

- **Shear factor increases**
- **Depth increases**

Paver Speed - Real World Paving

- Do not panic
- Stay with the plan
- Get rid of trucks in an orderly fashion
- Establish a uniform trucking pattern
- Will help density & smoothness

Changes in Paver Speed

- Changes in paving speed may require feeder system adjustments

- Too often, paver speed changes, but feeder system ratio dials or flow gates are not adjusted to match new paver speed to maintain 20 - 40 rpm auger speed

Setting Paver Speed

Pull Off Starting Boards

- ✓Pave mode (1), Screed in Float (2), throttle (3)
- ✓
- ✓Turn speed dial (4) to desired target speed (5) brake released (6)
- ✓Move propel lever full forward (7)

Setting Paver Speed using Speed Dial

Pull Off Starting Boards

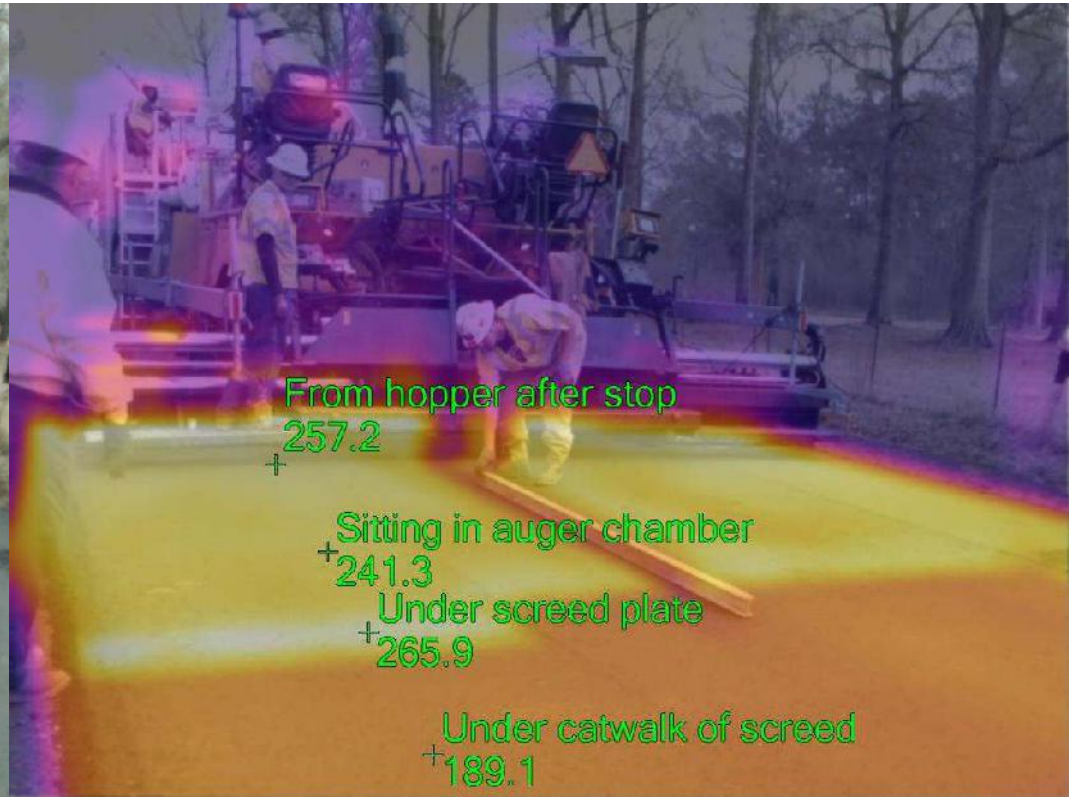
- ✓Speed control dial at zero
- ✓PAVE mode, high idle, brakes released, and propel lever full forward
- ✓Turn speed dial up until calculated paving speed is reached

Paver Stops & Starts...

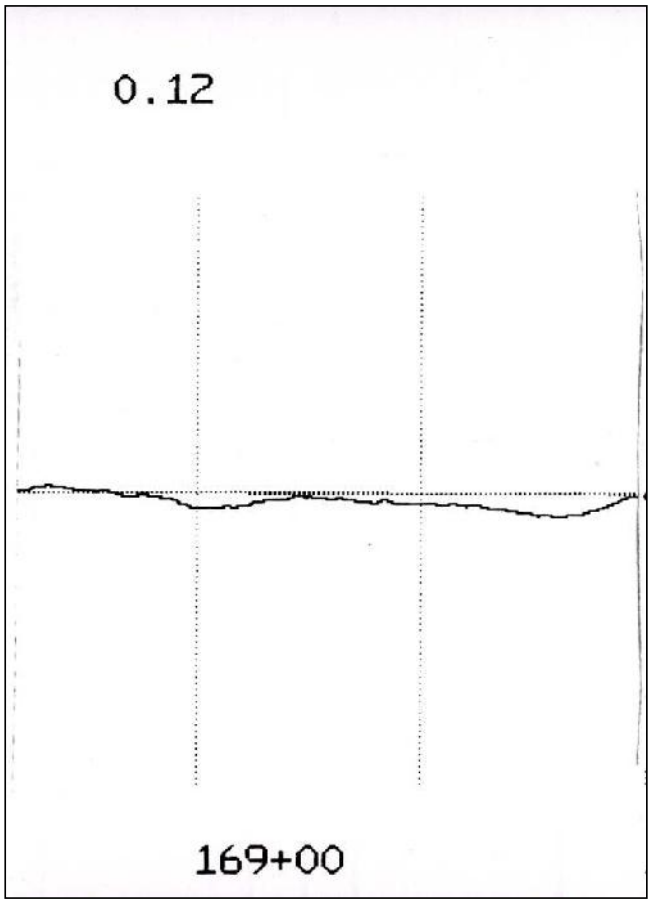
- Smoothness issue
  - Will it roll out?
- Non-uniform compaction
  - Temperature differentials
- Inefficient trucking?

- Stops > 6 min = bump

Paver Stops - density & smoothness



Quick Starts & Stops – Head of Material

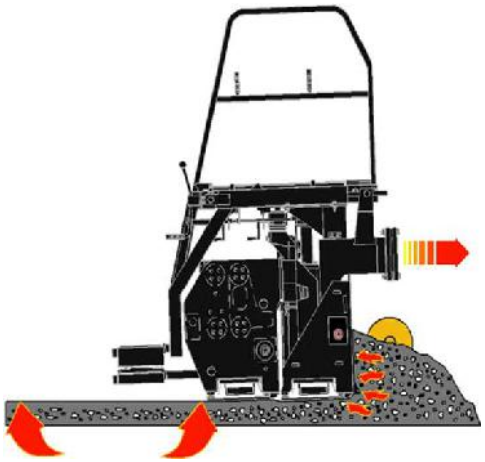


Continuous Paving

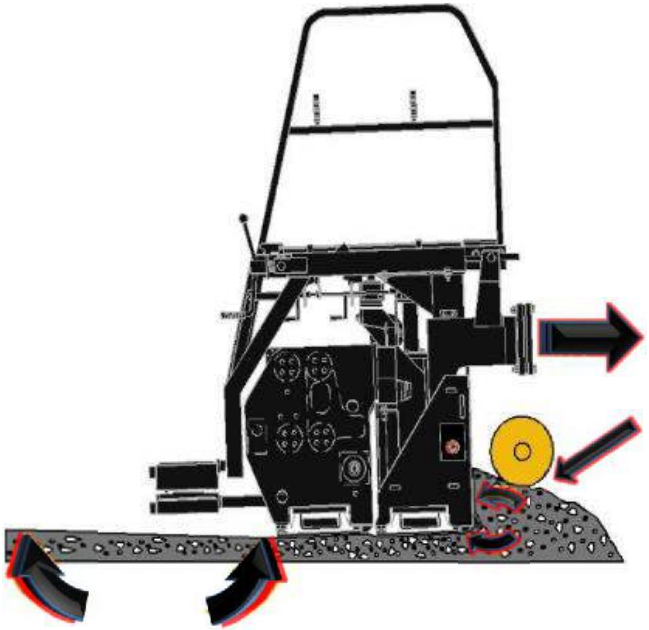
- MTVs can help
  - Non-stop between trucks
- Approximately 15% improved smoothness

Managing Head of Material @ ½ Auger

1. Ratio dials (or flow gates)
2. Auger height
3. Feed sensor position
4. Auger speed

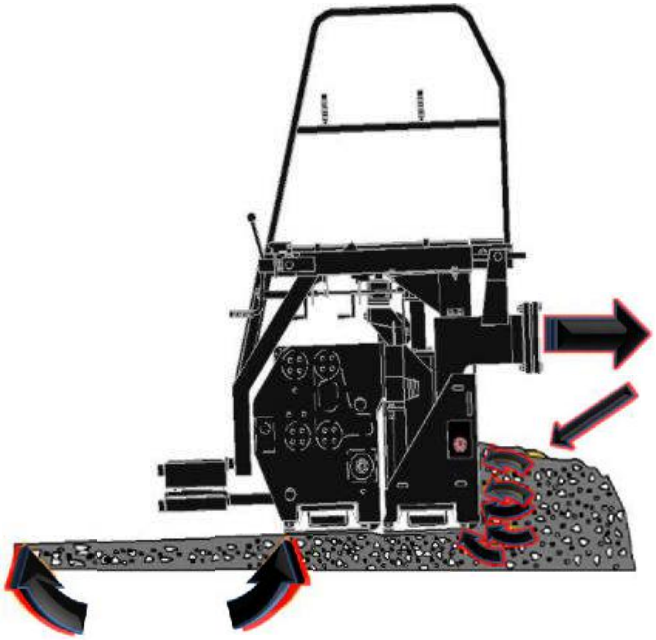


Changes in Head of Material



Head of Material Decreases

- Resistance decreased
- Depth decreases

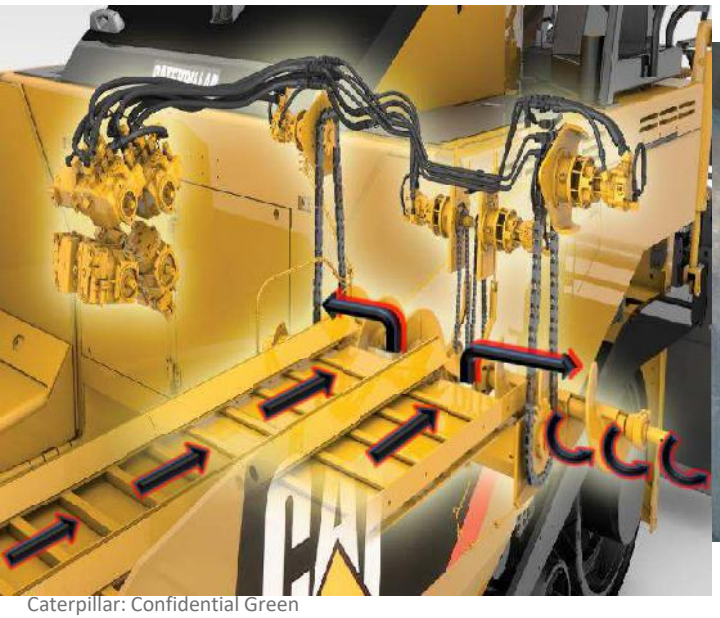


Head of Material Increases

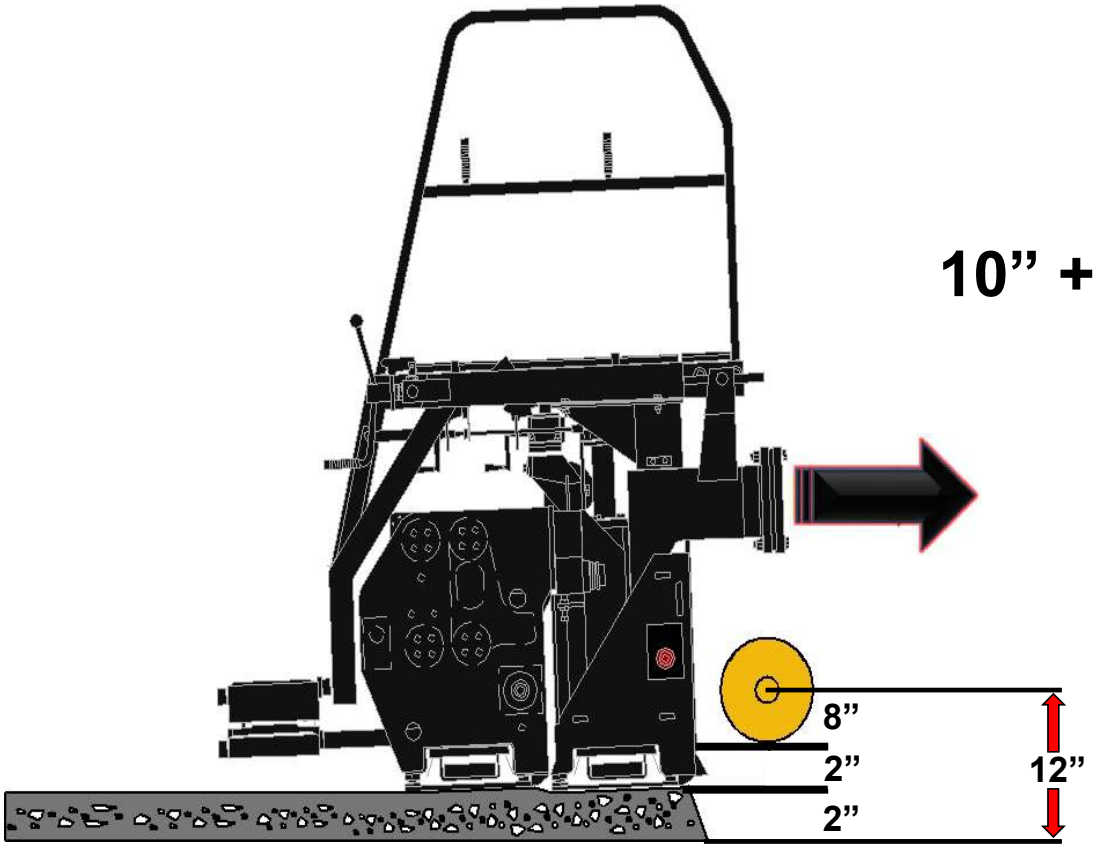
- Resistance increased
- Depth increases

Controlling Head of Material: Mix Feed

- Material level at center of auger chamber
- Material level in center area controls auger speed
- Flow gates on some pavers



Controlling Head of Material: Auger Height



- Start at 2" above level of mat
- Adjust up or down depending on mix type and appearance of mat

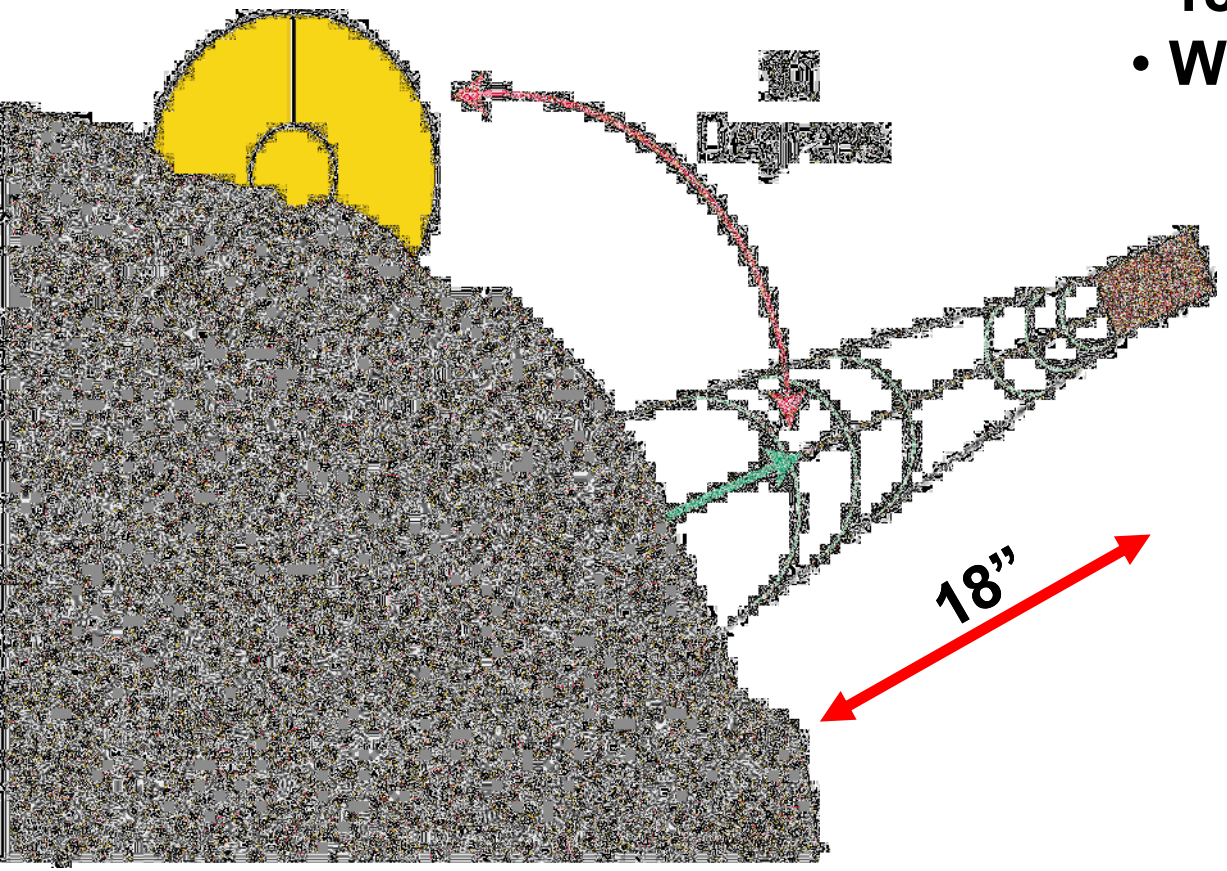
10” + mat thickness = auger height

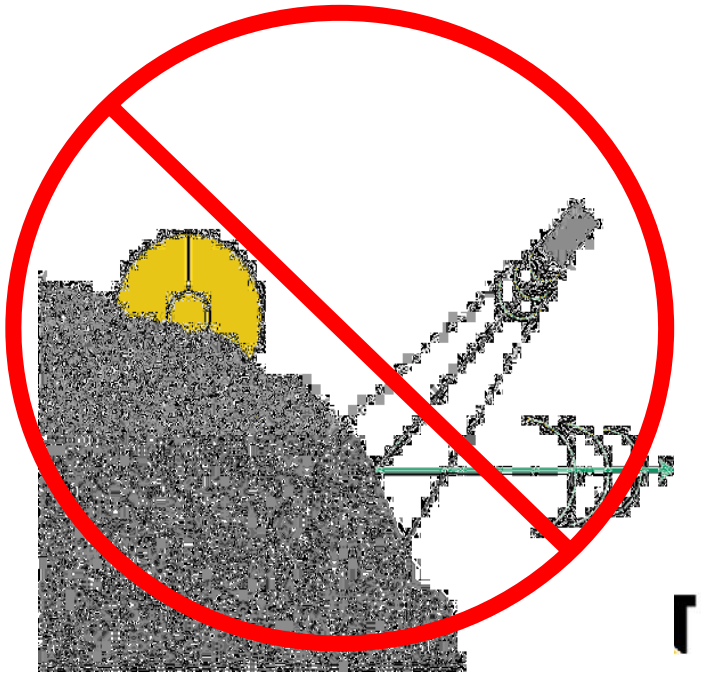
Aiming Sonic Feed Sensors

- Mechanical or sonic
- Control level of material
- Position Sensor 18" from end of augers

Sonic Sensor Mounting Distance

- 18” from mix
- 18” from last auger segment
- Working range is 12” – 32”





Feed System Segregation

- Conveyor speed too fast
- WHY?
- Do we get density here? Smoothness?

Controlling Head of Material: Auger Speed

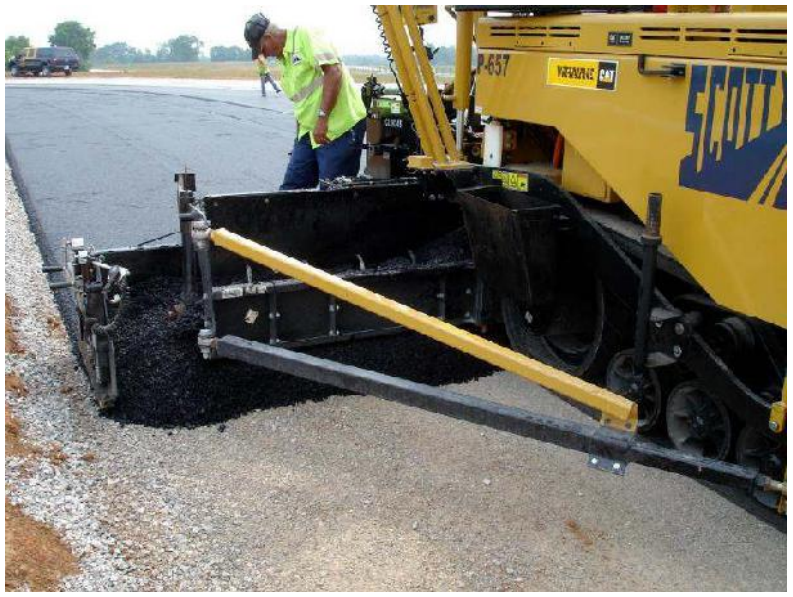
- Auger speed uniform
- 20-40 rpm
- 2s per revolution
- Auger speed too high or too low can cause stripes in the mat

Truck Exchange – HoM – Bumps & Dips

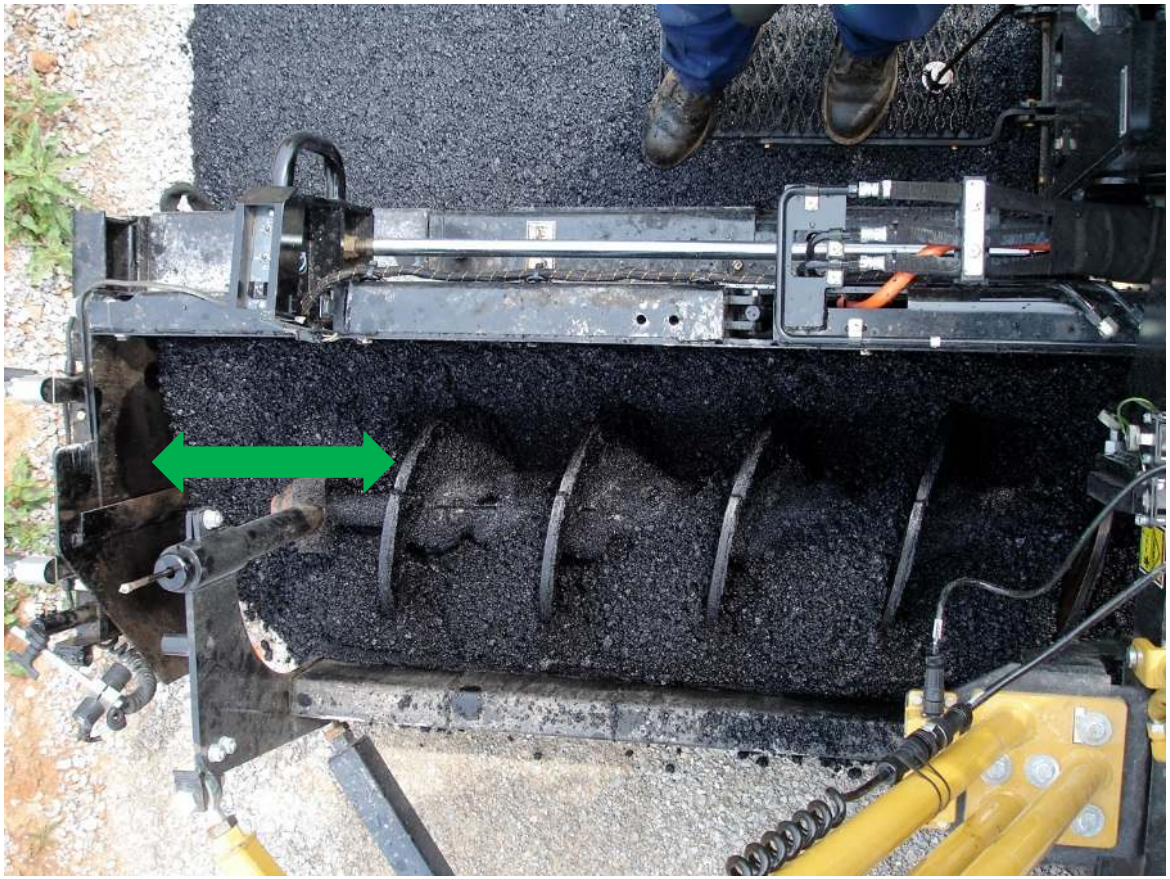
Proper Hopper Level - Segregation

Auger Extensions & Tunnels

- Fixed width paving
- Variable width paving
- Front-mount screeds
- Rear-mount screeds



Front-mount Screeds



18” with front-mount

Rear-mount Screeds

36” with rear-mount

Always Extend Tunnel in front of Augers

Fixed Width Paving

- Width is constant
- Bolt on extensions
- Setup screed with optimum auger extensions & tunnels (mainframe extensions)

Variable Width Paving

- Auger extensions & tunnels to minimum width
- Be prepared to shovel as needed at wider widths

Managing Segregation – Truck Exchange

Four step procedure

1. **Release truck**
2. **Continue paving**
3. **Pave & fold wings**
4. **Stop quickly**

Managing Segregation – Truck Exchange

Live Bottom Truck Exchange

- Stop short of paver
- Let paver pickup truck as end gate is raised
- Don’t “unload” on the grade!

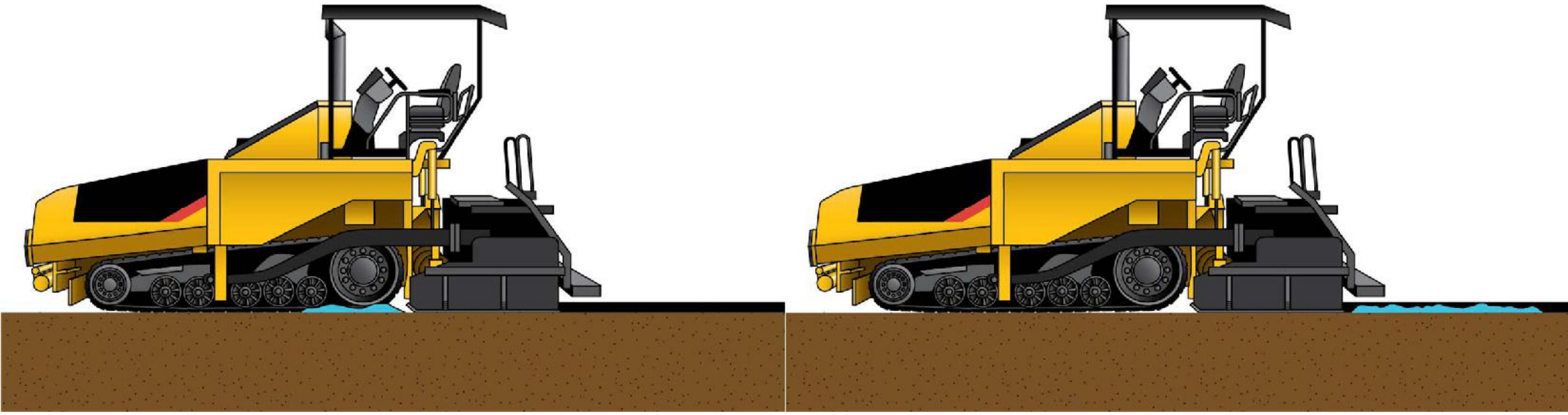
Pave & Fold Hopper Wings

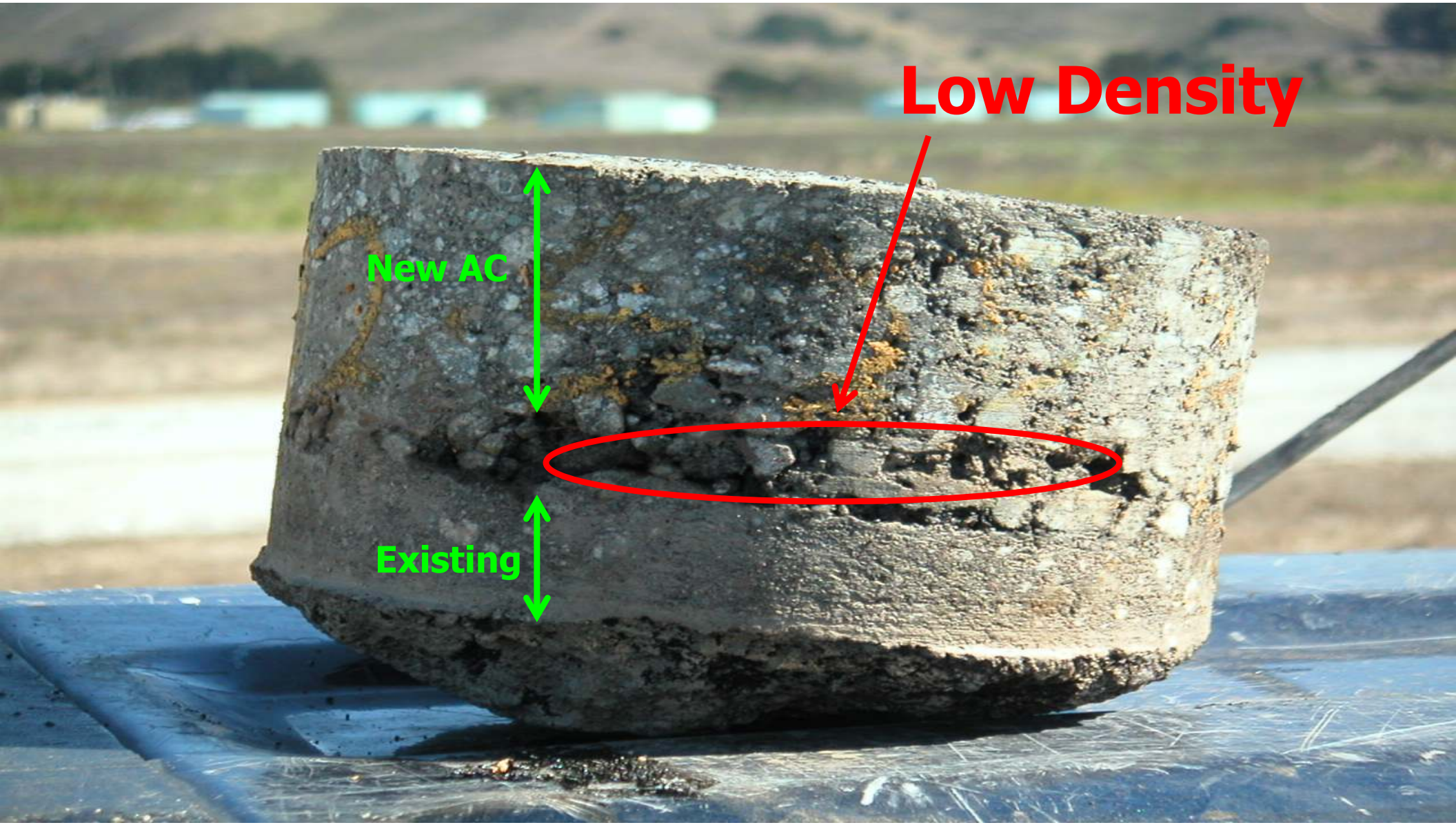
- Slowly fold hopper wings combining mix from sides with mix in middle
- Don’t spill out front
- Flashing in good shape

Spills on grade

- Potholes
- Density problem
- Smoothness problem

Spills on grade are BIG mistakes!




Low Density
New AC
Existing

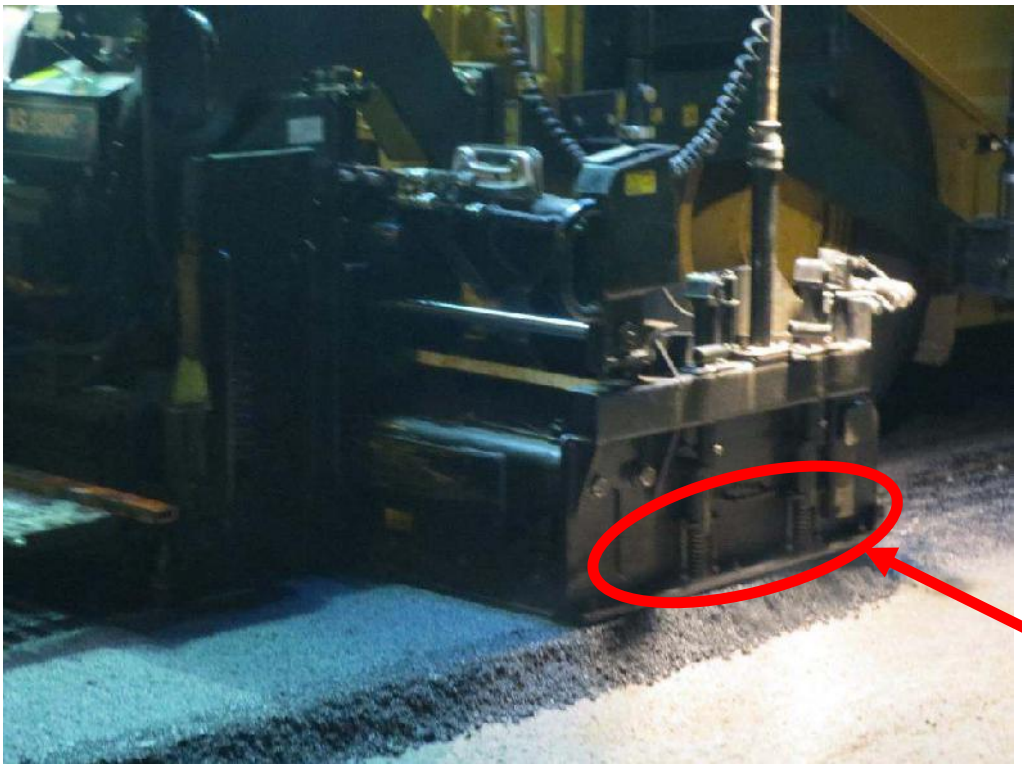
Material Transfer Vehicles

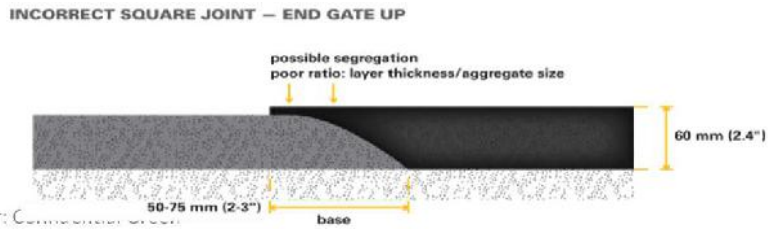
- Re-mixing MTVs
- Windrow elevators

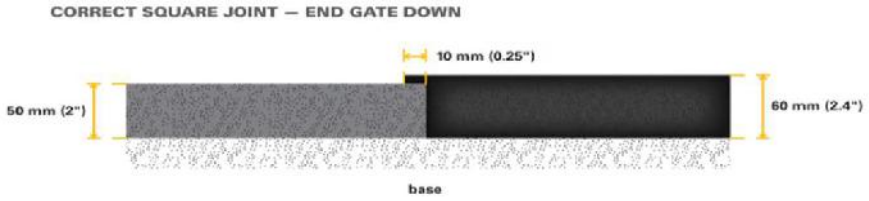
Trucks Bumping the Paver

Defects Related to Truck Exchange

Build the Longitudinal Joint to Last!







Caterpillar: Confidential Green

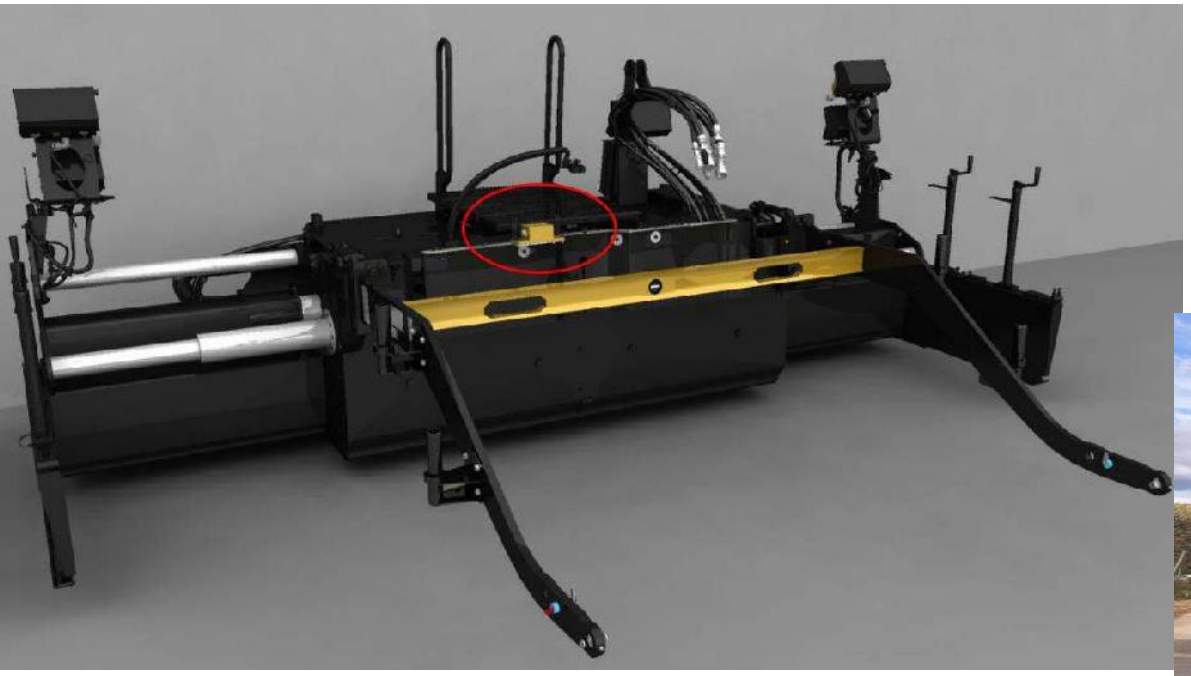
Grade Control

Grade sensor is a moving tape measure

Reading distance to grade

Reading distance to string

Slope Control

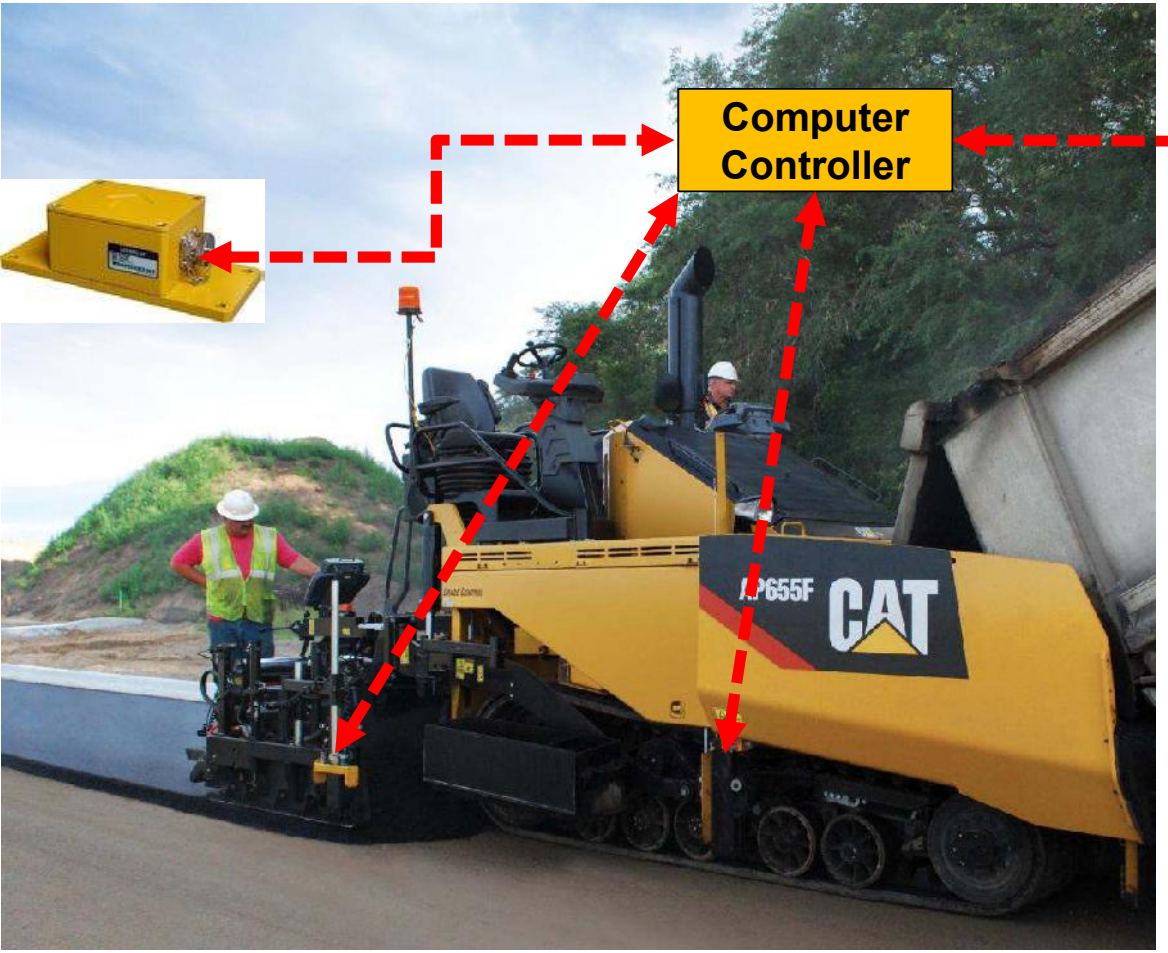


Slope box is like a carpenter’s level

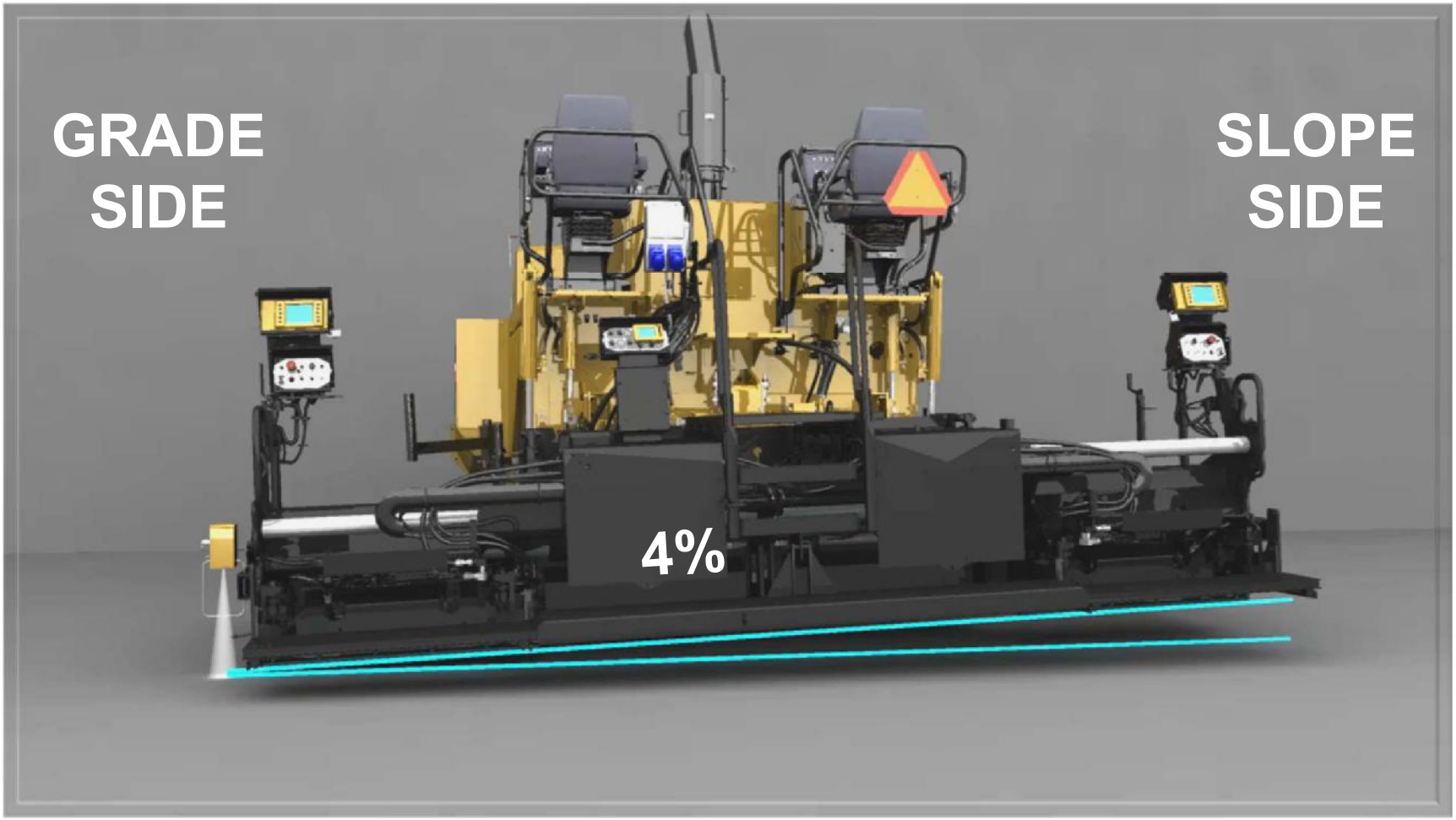
How Does Automatic Grade & Slope Work?

- Computer-controlled measurements
- Measurements several times/second
- Signals are sent to hydraulic cylinders to cause tow point movement
- Tow point movement results in mat thickness changes and/or slope changes

Grade Control Communication

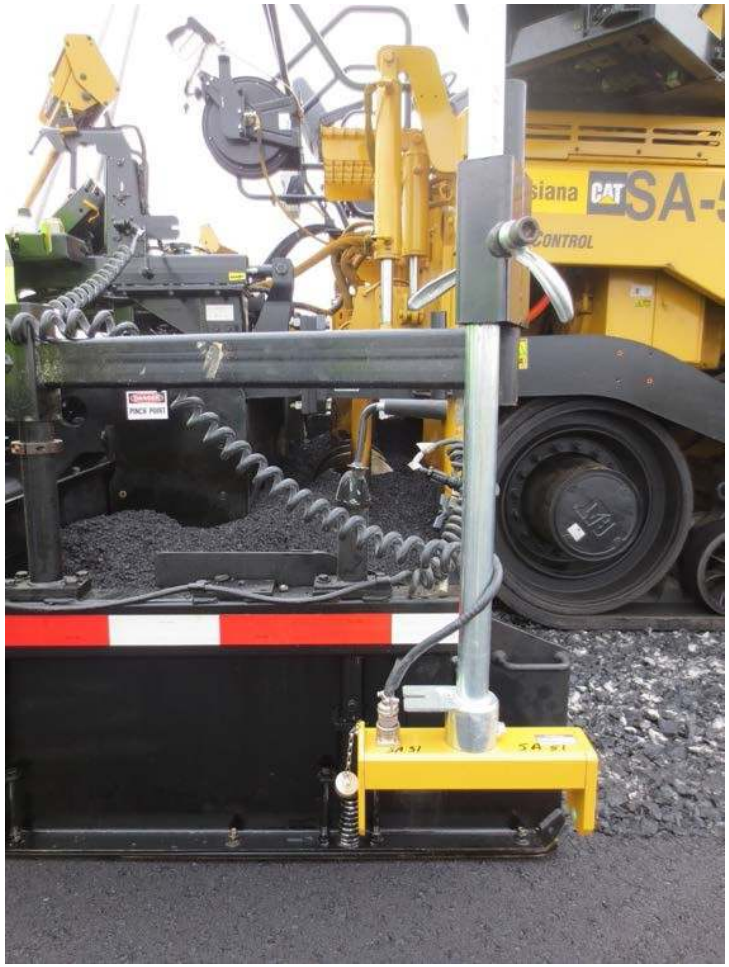


Slope FOLLOWS Grade Side Changes

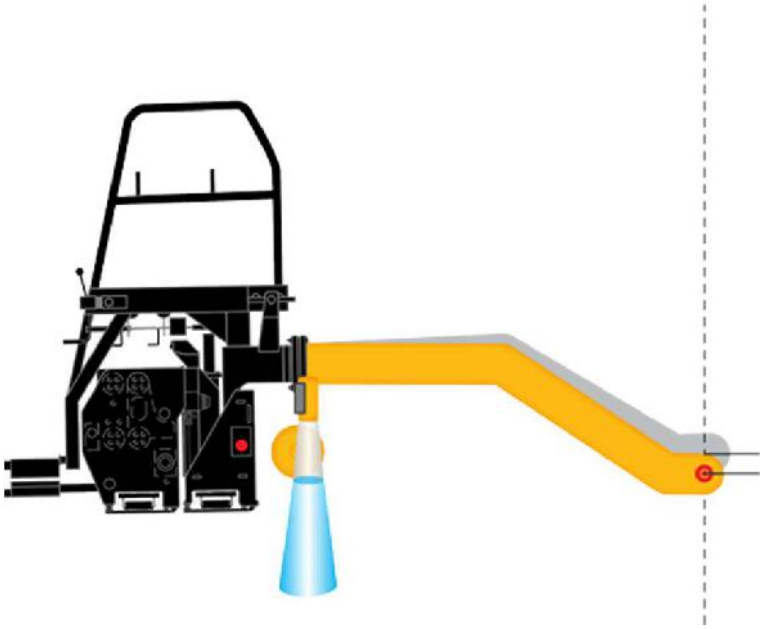


Where Does the Grade Sensor Go?

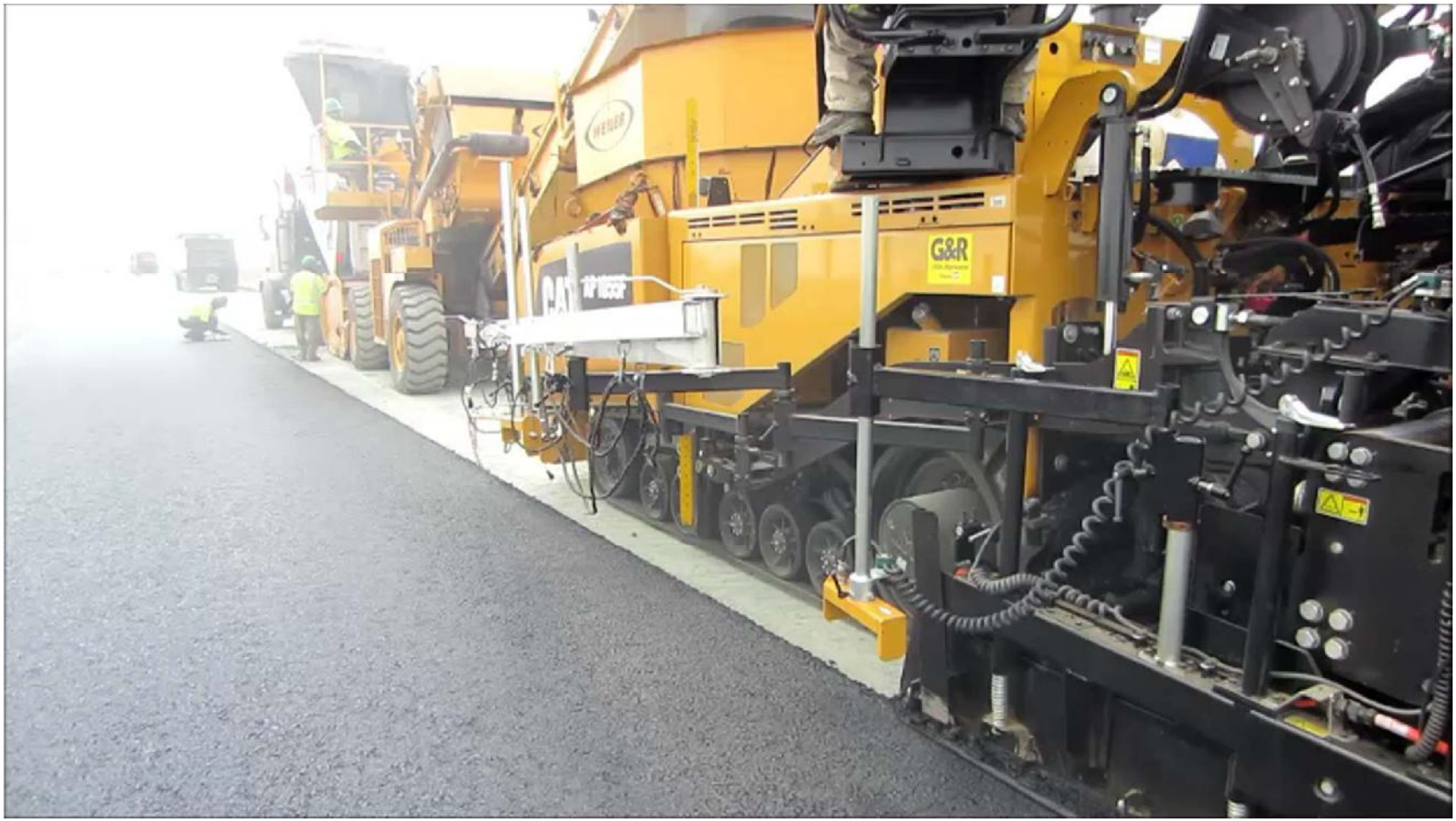
Sensor @ Auger for Joint Matching = Yield



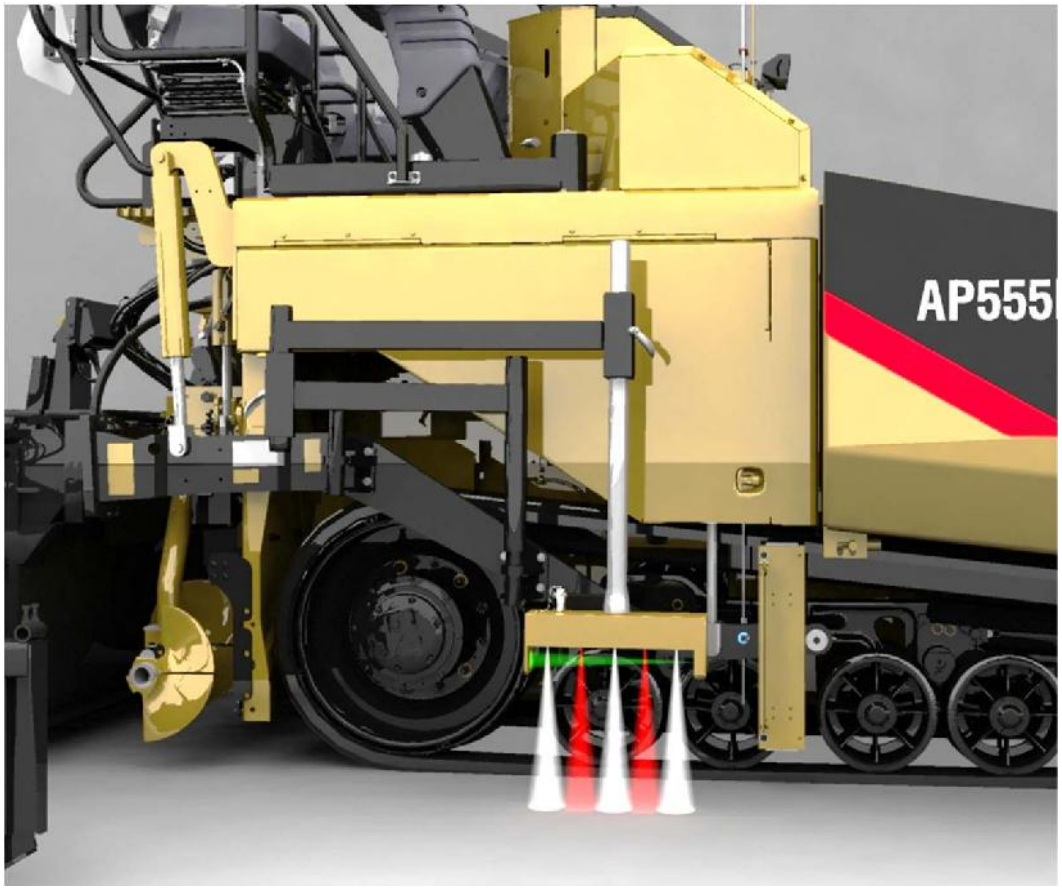
- Follows existing grade - no improvement
- Precise yield
- Fast reaction
- Tow point movement is 4:1



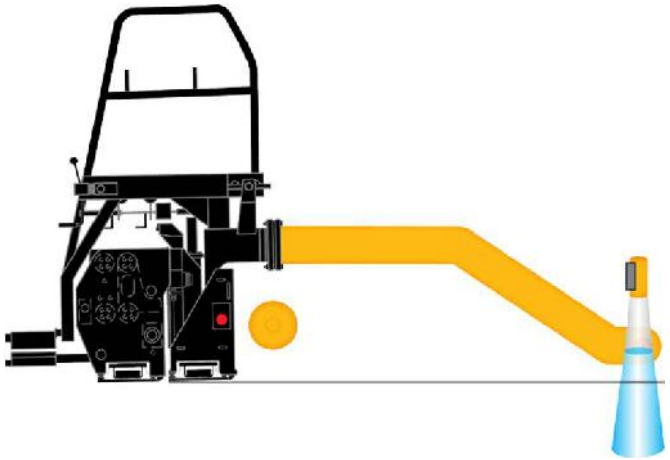
Joint Matching



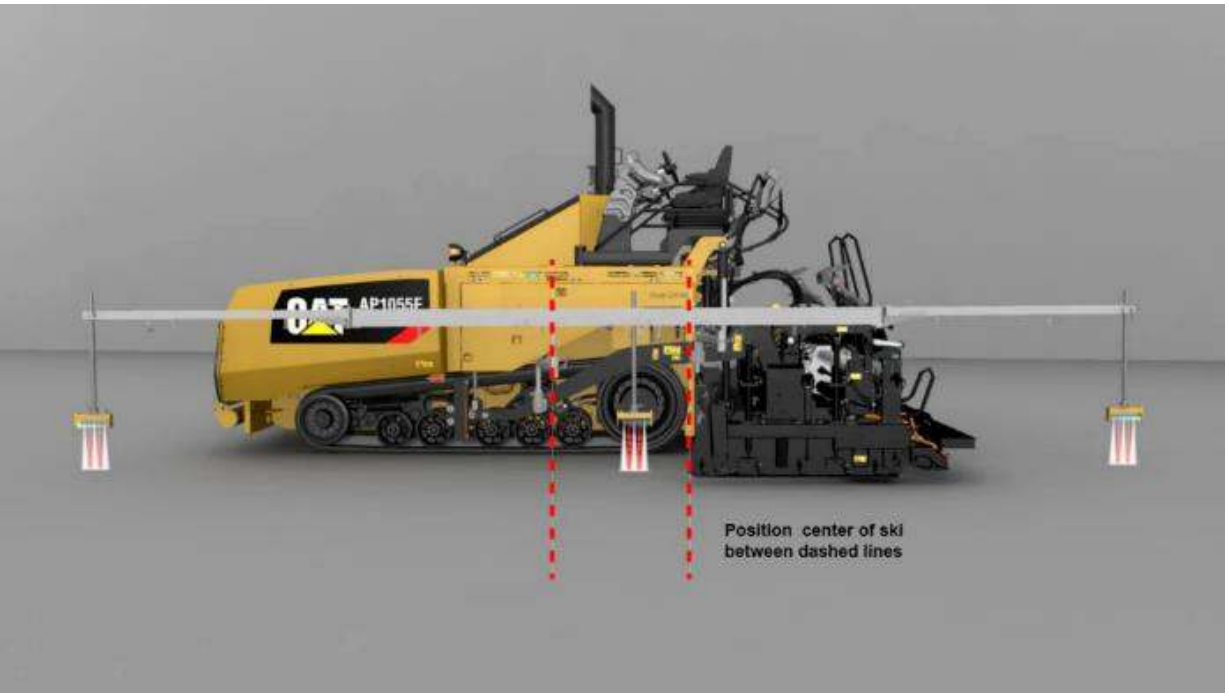
Sensor @ Tow Point for Smoothness



- Slow reaction
- Difficult to control yield
- Tow point movement is 1:1
- Screed reacts over 5 tow arm lengths

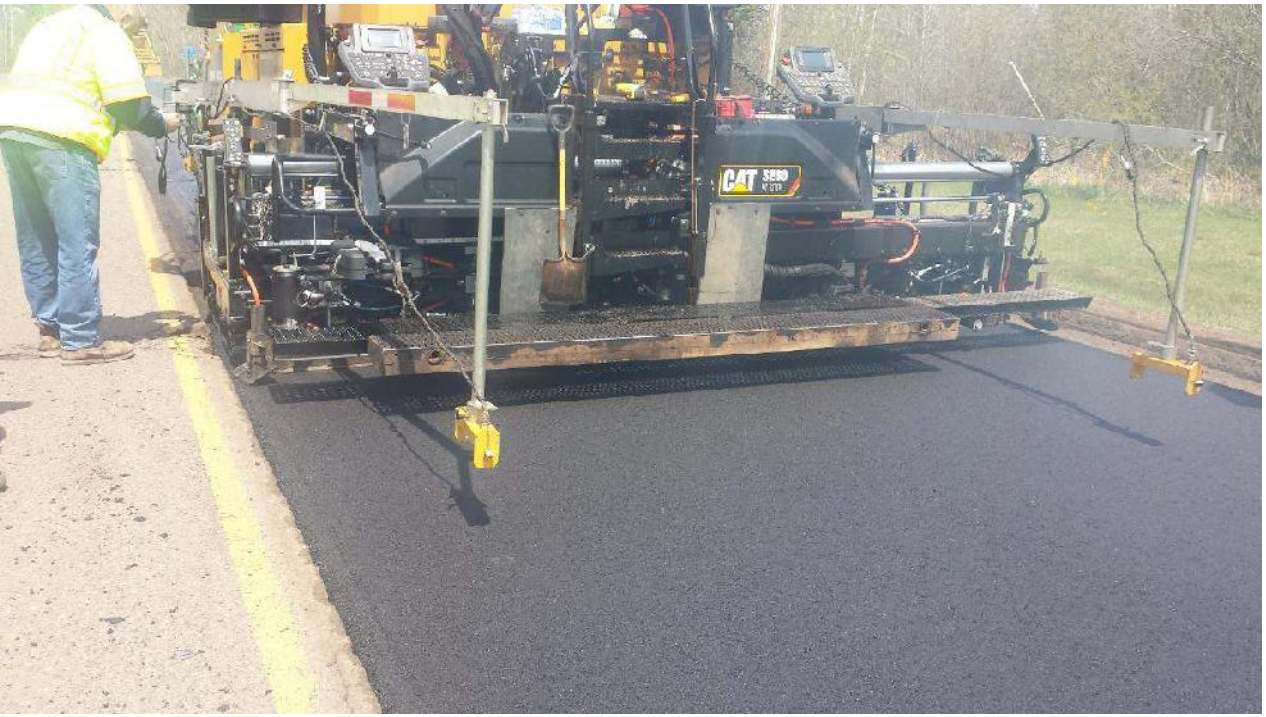


Sonic Averaging Ski (SAS)



- 30 ft beam
- Outside paving width for joint matching
- Inside paving width in tight spaces
- Averages 3 readings
- Swing rear sensor on new mat for better reference
- Yield is off, but may average over entire job

Ride Quality – Non-contact Skis – Advantages

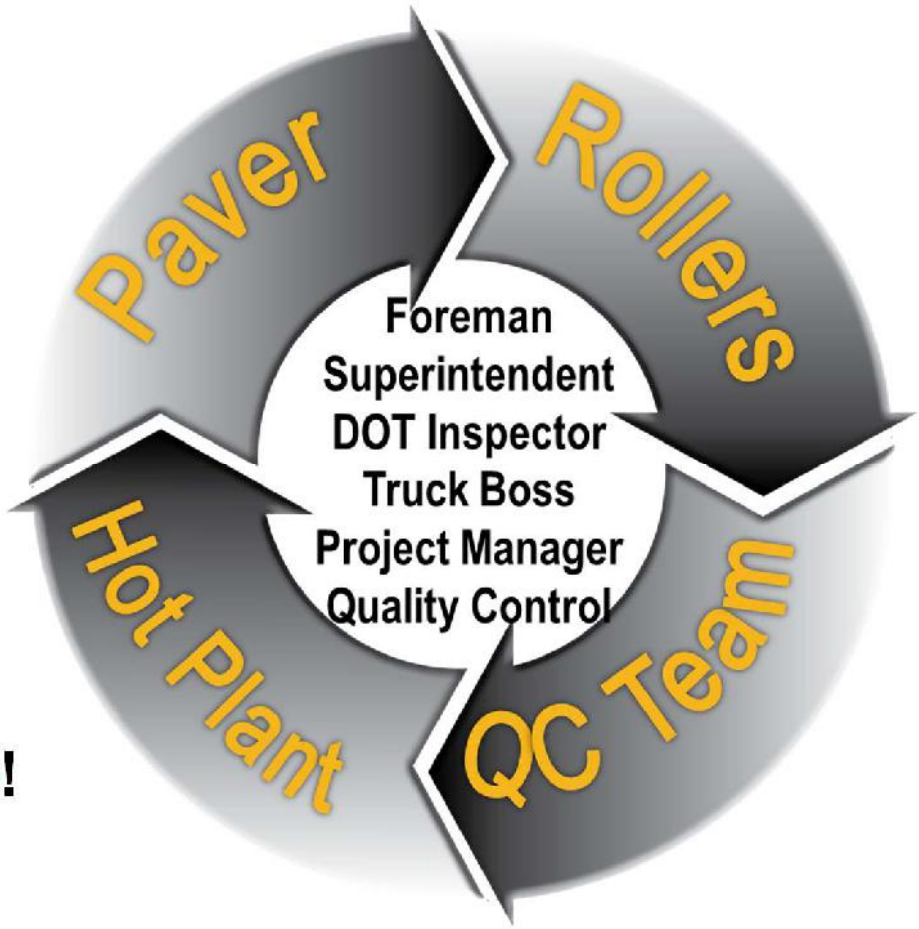


- Stay on the paver when moving around job site
- Ideal for multiple pulls
- Not affected by obstacles
- Maintenance free
- Suited for grade reference with moderate to low roughness
- Set up inside or outside paving width

Consistency & Communication are the Keys to Success!

- **Do the fundamentals right**
- **Avoid BIG mistakes**
- **Quality costs nothing**

We use the same equipment - we just need to *plan ahead* and *communicate*!



Thank-you for your attention!
Questions?