A WIRTGEN GROUP COMPANY

VÖGELE

APAM Paving Conference

Not Everything is Flat: Paving Up, Down and Around

L. Nars, Manager Commercial Support & Development

- *Understanding the Principle of the Free Floating Screed*
- *Best practices for paver setup and takeoff*
  - *Stopping / starting / steering a straight line*
  - *Managing Head of Material*
  - *Controlling Segregation*
  - *Use of Automatic Grade & Slope*
    - *On uphill and downhill grades*
    - *Wide-width paving*
    - *Paving through super elevations.*

Principles of the Free Floating Screed

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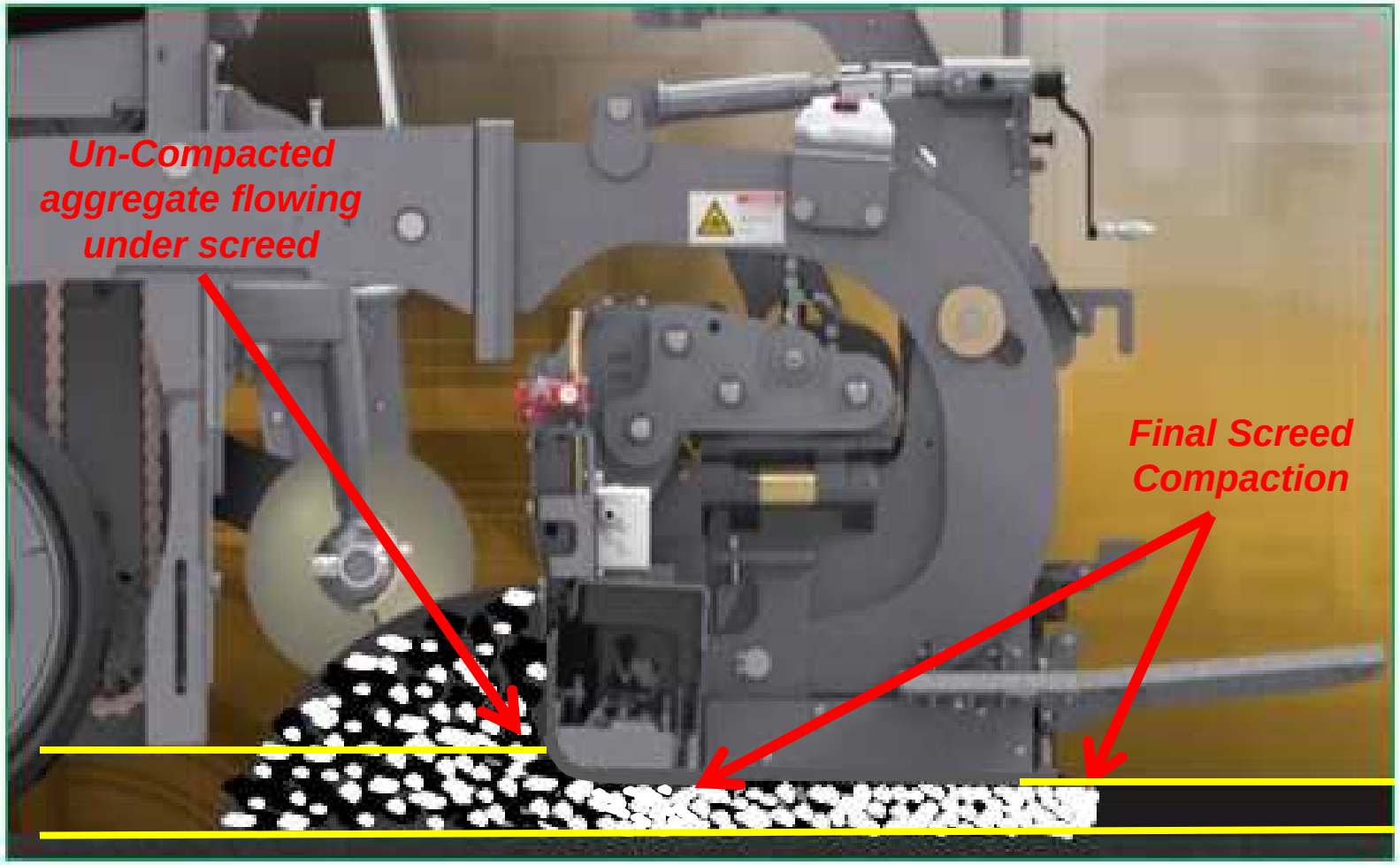
Vibratory Screed Compaction:

- ***Aggregate moves together. reduces the air Voids as the screed moves forward***
- ***The aggregate size must allow the screed to Float / Not held up on aggregate***



Principles of the Free Floating Screed

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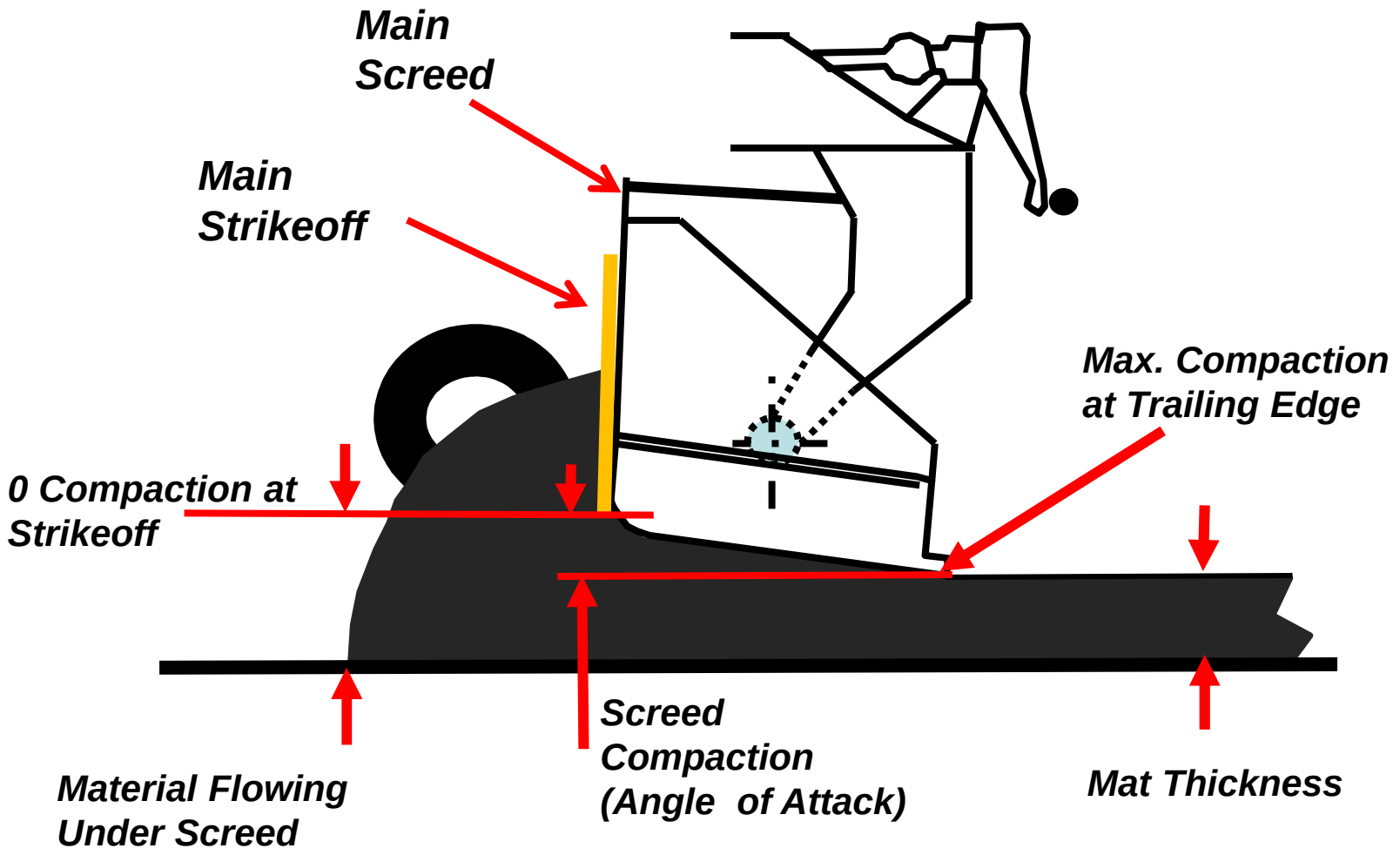
Vibratory Screed Compaction:



Principles of the Free Floating Screed

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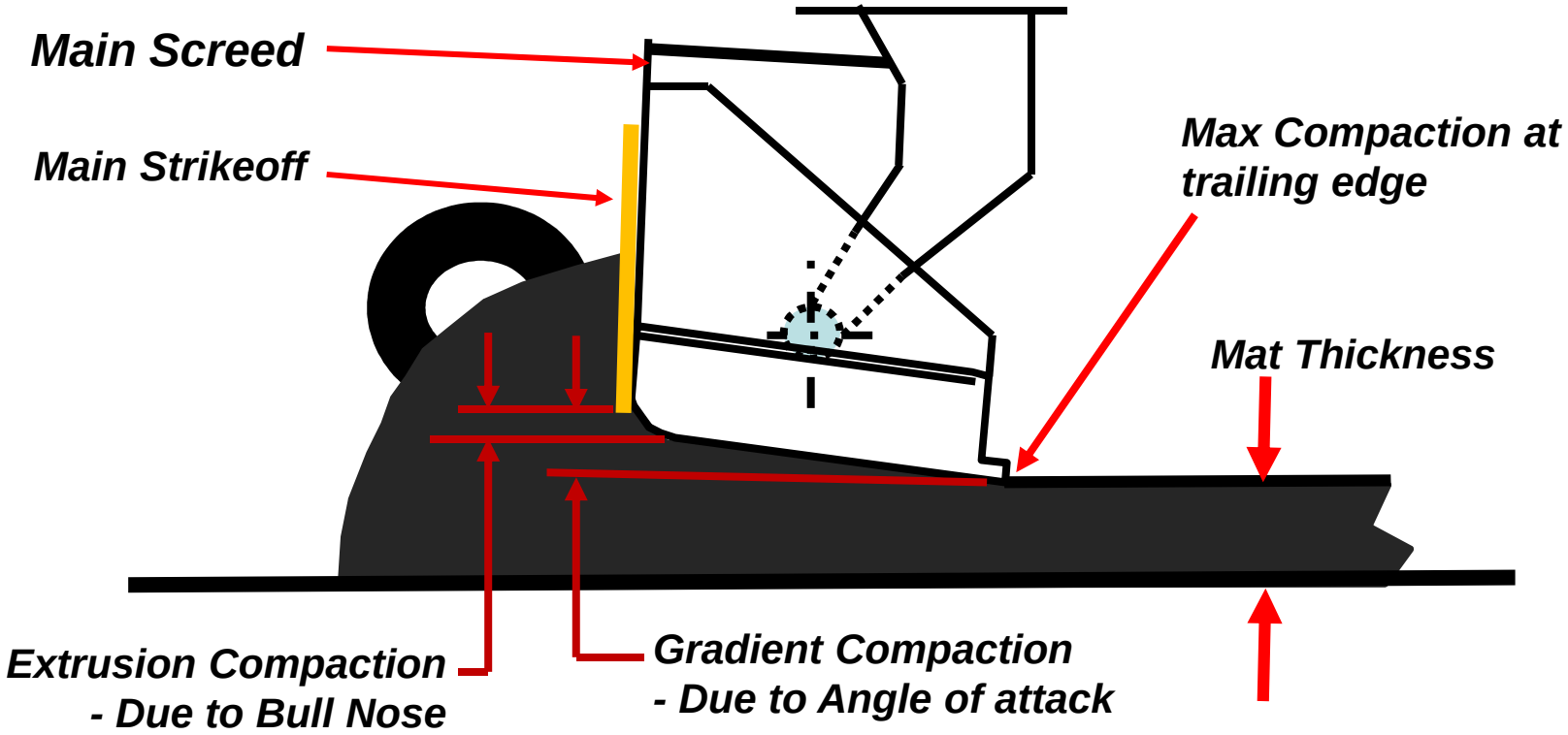
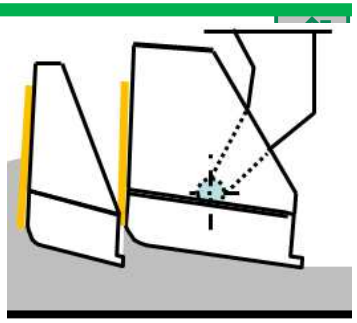
Vibratory Screed Compaction:

1. Extrusion Compaction - Due to Bull nose on screed plate
2. Gradient Compaction - Due to screed angle of attack

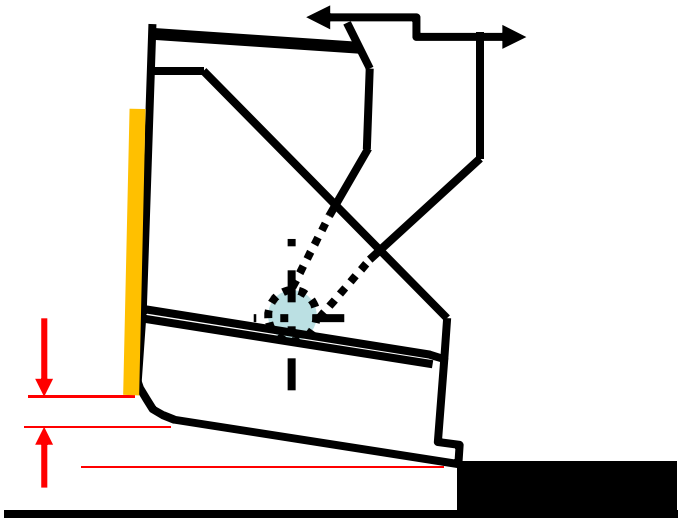


Principles of the Free Floating Screed

Vibration Screed Compaction:



Extrusion Compaction

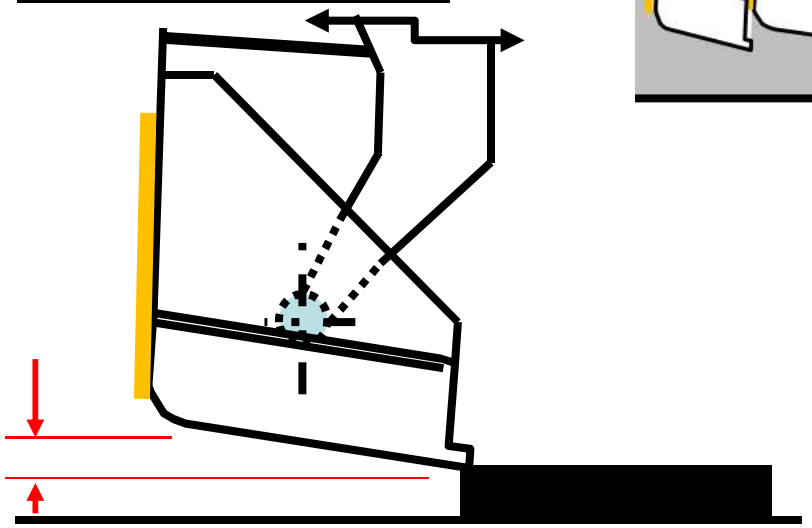


Occurs at the Bull Nose

Influence by:

1. *Main Strikeoff Adjustment*

Gradient Compaction



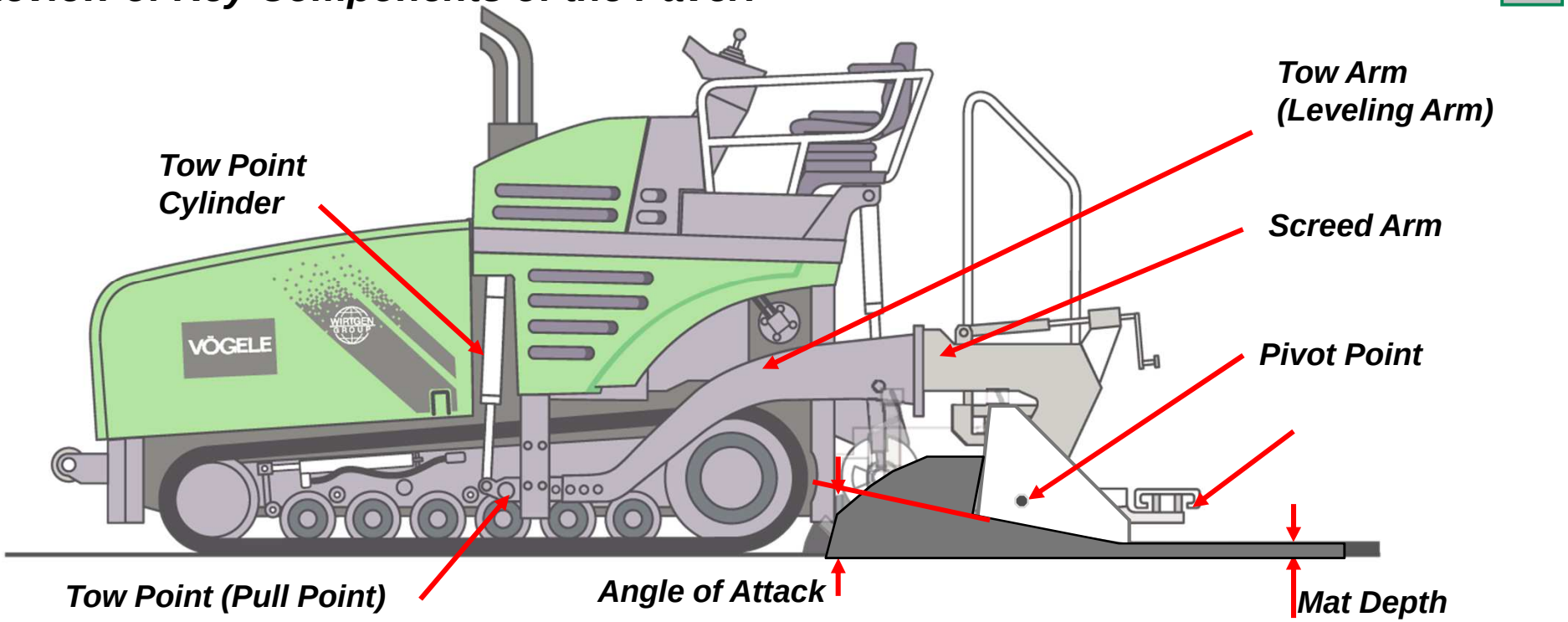
Occurs along the flat of the Angled Screed plate

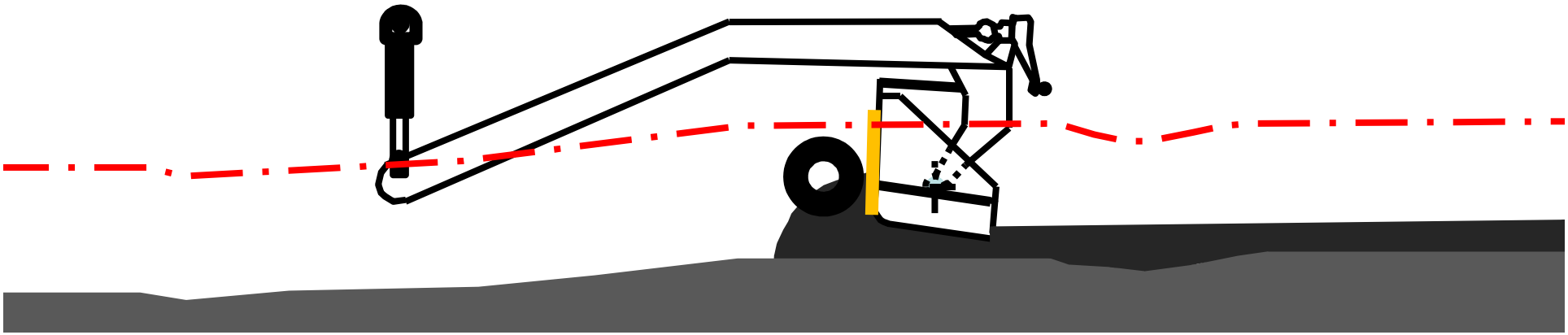
Influenced by the following:

1. *Screed weight & Vibration – By design*
    a. *Frequency*
    b. *Amplitude*
2. *Head of material*
3. *Tow point position*
4. *Extension Angle of attack & Match Height*

Principles of the Free Floating Screed

Review of Key Components of the Paver:





Principles of the Free Floating Screed

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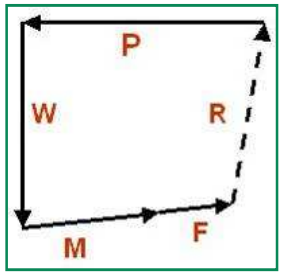
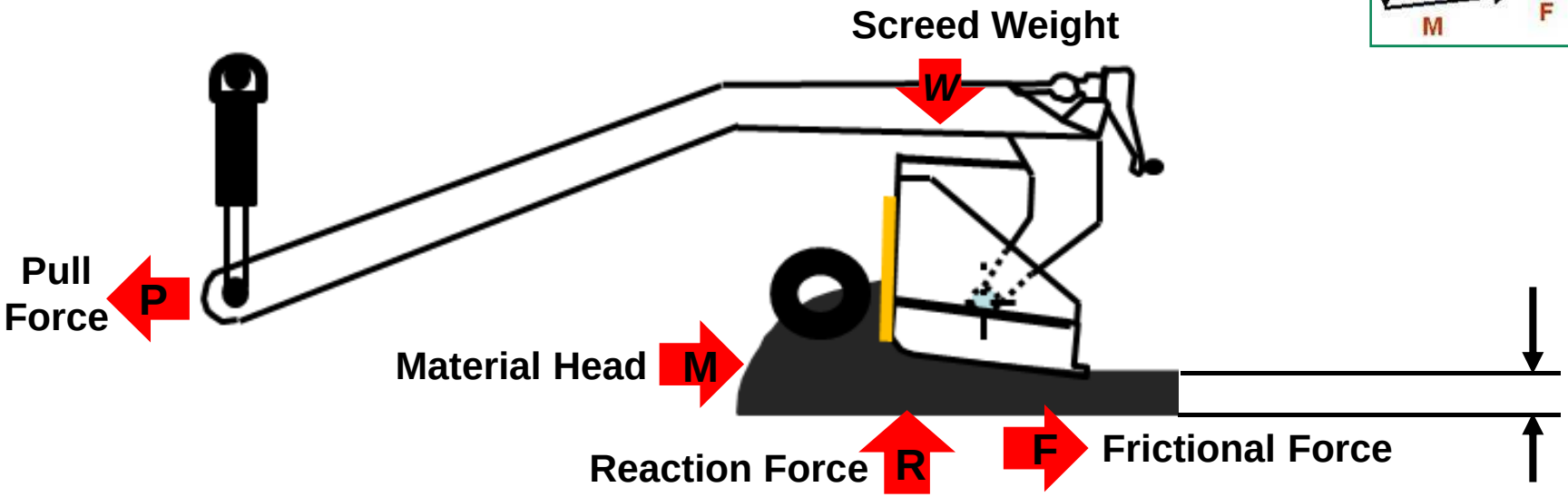
Forces acting on the screed:

- *Depth Held by 5 Forces*
- *Not by Mechanical or Hydraulic Devise*





At Equilibrium:
All Forces are in Balance

Constant Mat Depth is Maintained

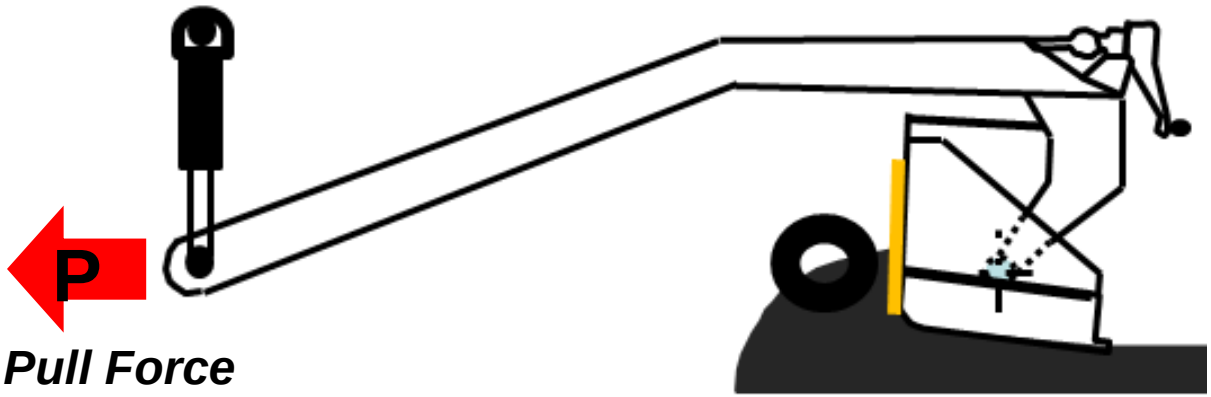
The screed is free floating with an Equilibrium Angle (Angle of Attack)

Change in any of the 5 Force cause the screed to Rise or Fall

Stopping / starting / steering a straight line

Maintain consistent Pull Forces:

- ***Must a constant Speed as Possible***
- ***Avoid Stopping & Starting where Possible***
- ***Steer a straight line***
- ***Determine if Uphill or Downhill paving is ideal***



Pull Force

Speed Dial & Display

Stopping / starting / steering a straight line

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Maintain consistent Pull Forces:

- *Use of MTV for Non Contact Continuous Paving*

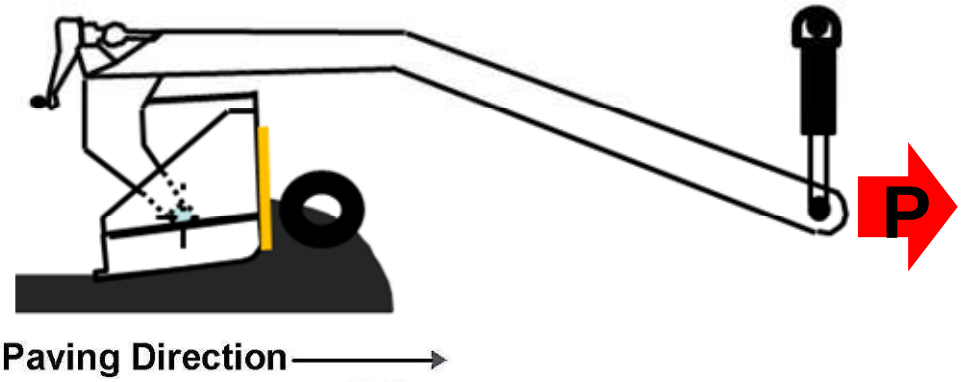
- *Exchange truck without Stopping*
- *Exchange Truck without bumping the Paver*
- *Maintain Material Consistency*
  - *Gradation Consistency (Mechanical Segregation*
  - *Temperature Consistence (Thermal Segregation)*

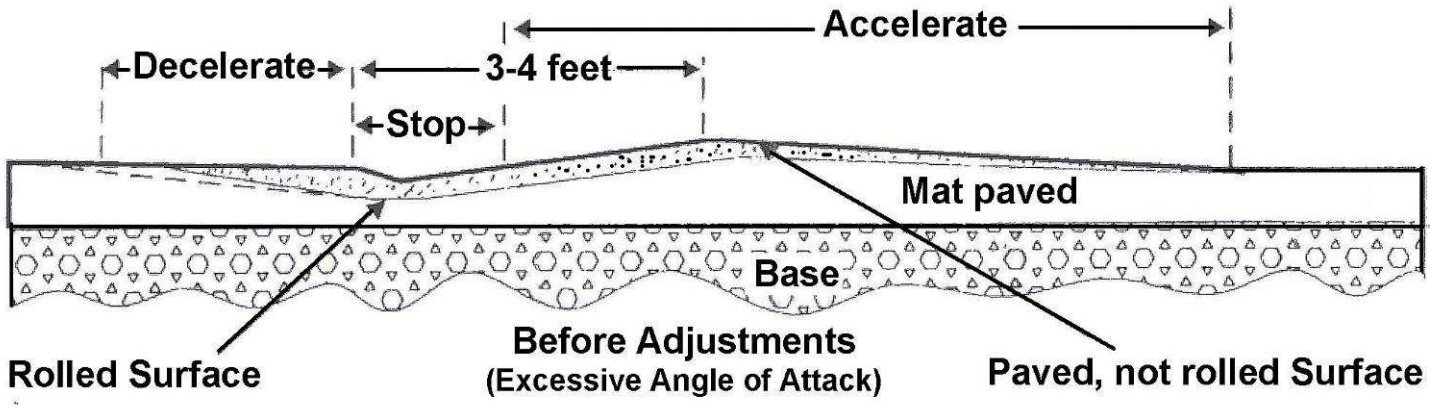
Stopping / starting / steering a straight line

Maintain consistent Pull Forces:

- ***Stopping and Starting***
  - ***Result in Settling Dents & Humps***
- ***Must Focus on:***

1. ***Automation Engaged When Stopped***
2. ***Vibration Engaged when Stopped***
3. ***Material cooling***

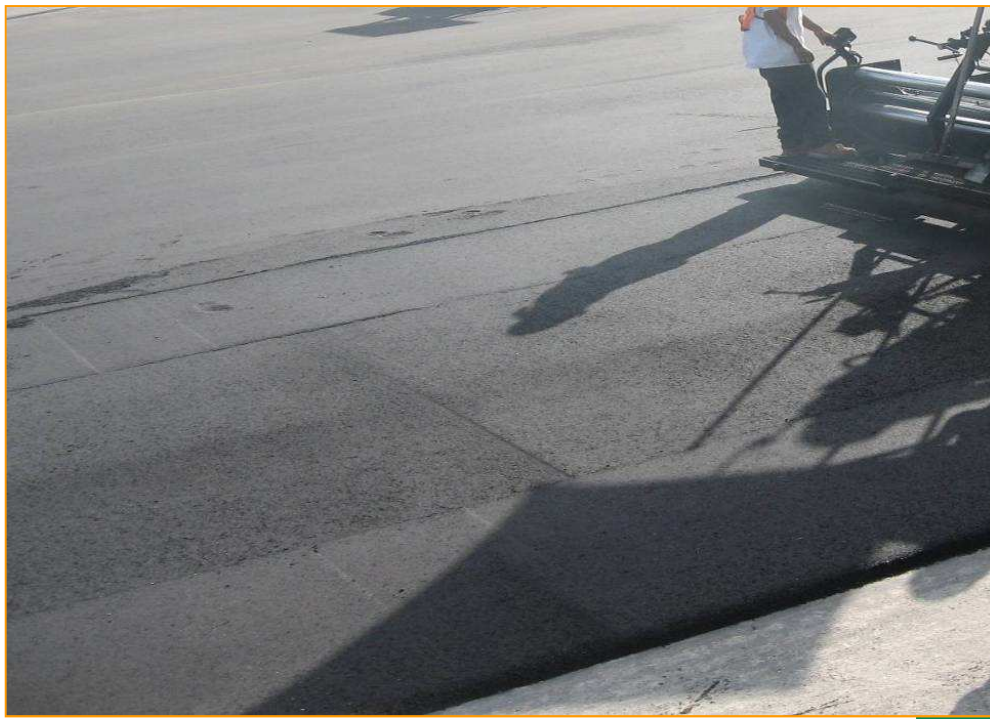




Stopping / starting / steering a straight line

Maintain consistent Pull Forces:

- *Reducing Settling & Humps*
  - *Use Screed Hold & Freeze when Available to Reduce Settling & Humps*
  - *Operators - Disengage Neutral Lock and Start Moving Instantly*



Stopping / starting / steering a straight line

Maintain consistent Pull Forces:

Always Steer Straight – use Guides / reference to follow:

- ***Maximize Smoothness***
- ***Best for Joint construction***

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Stopping / starting / steering a straight line

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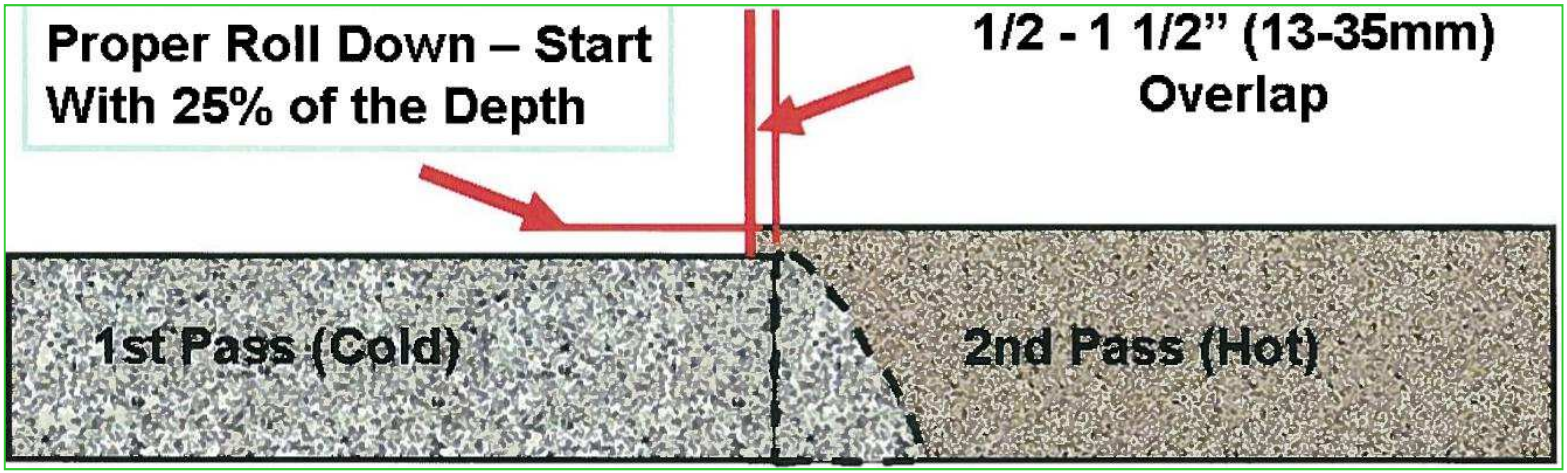
Maintain consistent Pull Forces:

Minimum Overlap required if you steer a straight line



If the Overlap is Correct
Little or No
Hand work in required

Stopping / starting / steering a straight line

Joint Edges for Safety

- *Safety Edge – Outer edge*
- *Michigan Wedge Joint – Inner Edge*
  - *Ensure proper joint compaction*

Safety Edge

Michigan Wedge Joint

Stopping / starting / steering a straight line

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Maintain consistent Pull Forces:

- ***Continuous turns – Use Trim Steer when available***
  - ***Keep the forces in Balance to maintain Consistent grade***

Use Trim Steer in Turns

Stopping / starting / steering a straight line

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Maintain consistent - Paving Uphill when you can

- ***Back the truck 1' away - then - Pick the truck up***
- ***Or use MTV if possible***

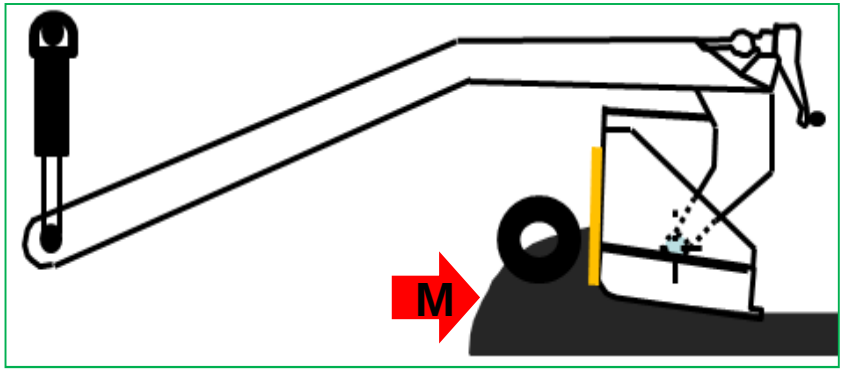
Paving Up Hill

Managing Head of Material

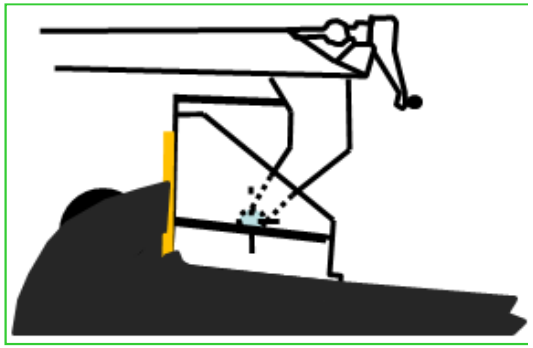
Maintain consistent Head of Material

- Maintain a consistent even head of material, covering ½ auger shaft
- Use Flow gates or Conveyor sensors to Regulate material delivery

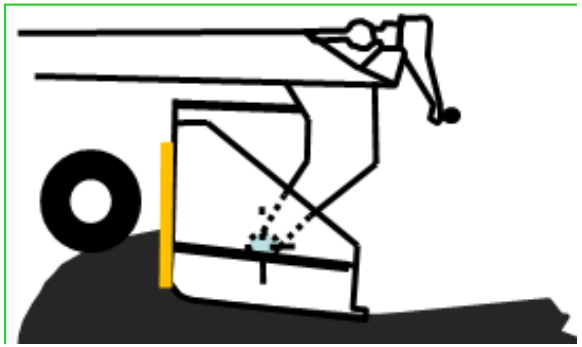
Maintain ½ Auger Shaft



Increase Head..
Screed Rises



Decrease Head..
Screed Drops



Managing Head of Material

Maintain consistent Head of Material

- ***Use Digital Display to monitor Material Delivery***
- ***Store Settings with Pave Mode***
- ***In case of Sensors failure use Back up Auto controls***

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Video

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Managing Head of Material

Maintain consistent Head of Material

Material management a challenge for Down Hill Paving:

- ***Proper Auger Extensions***
- ***Proper Tunnel Extensions.***
- ***Precise position of auger sensor***

Wide RM

Wide FM

Managing Head of Material

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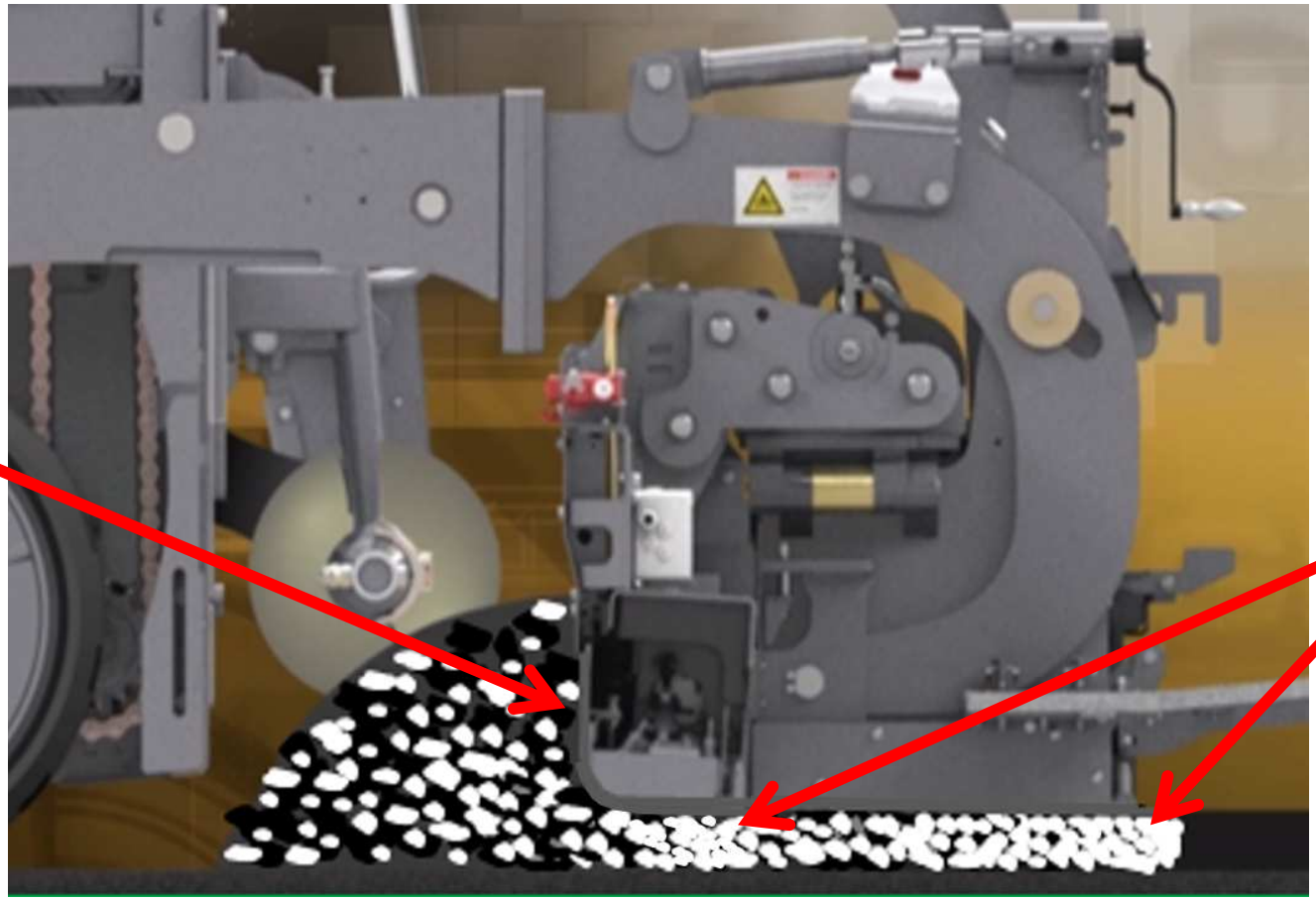
Material Management also a challenge when paving wide and on Incline

- ***Must help the material gets uphill***

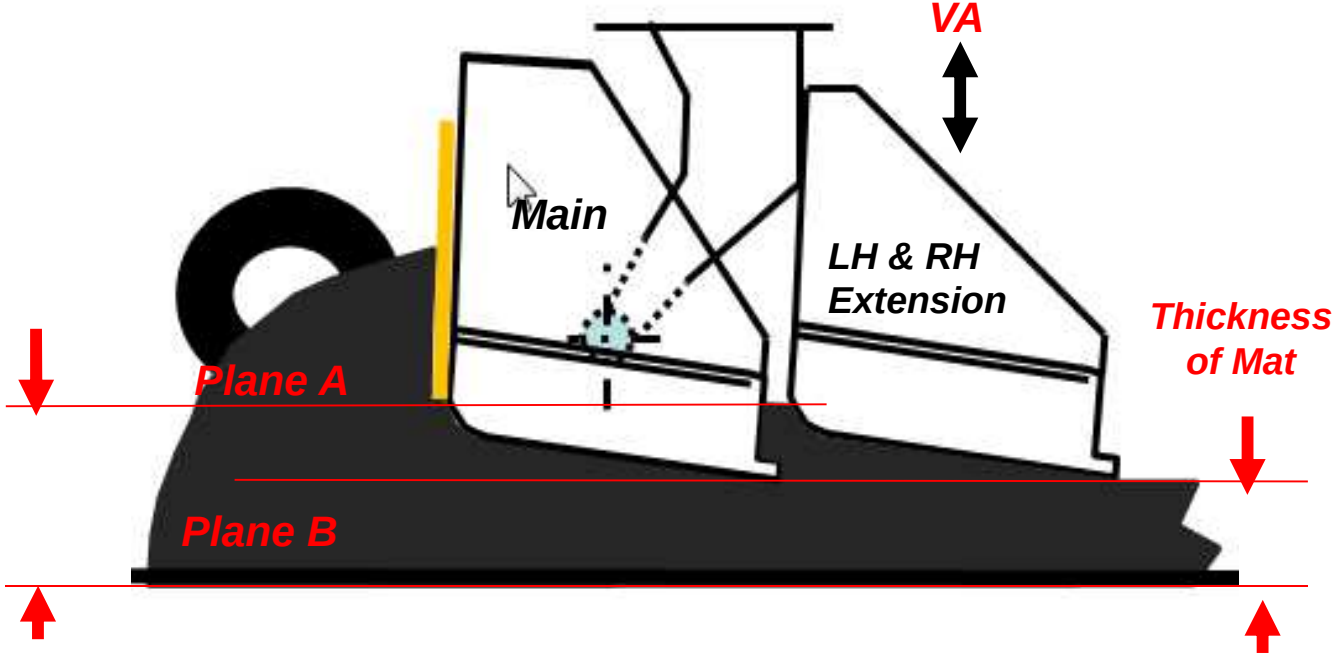
Managing Forces # 4 & 5 – Reaction & Shear Force

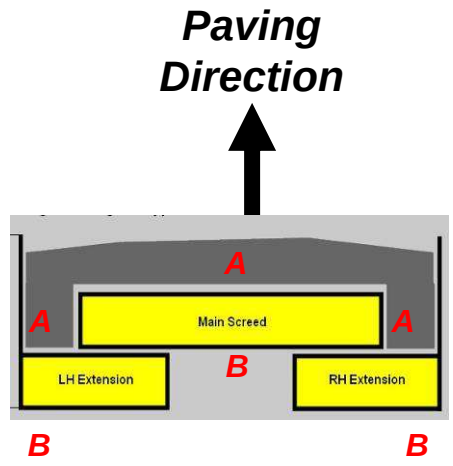
- Aggregate moves together to Interlock as the screed moves forward
  - Asphalt Content, Temperature & Gradation
- Screed Set up – Extension, Tow point, strikeoff

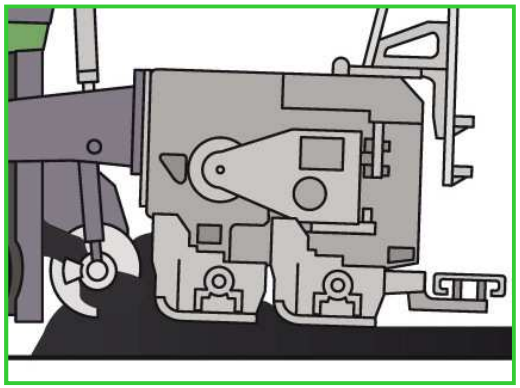


Rear Mount Angle of Attack & vertical Adjust

- Material Flowing Under all Screed Sections must Be Equal

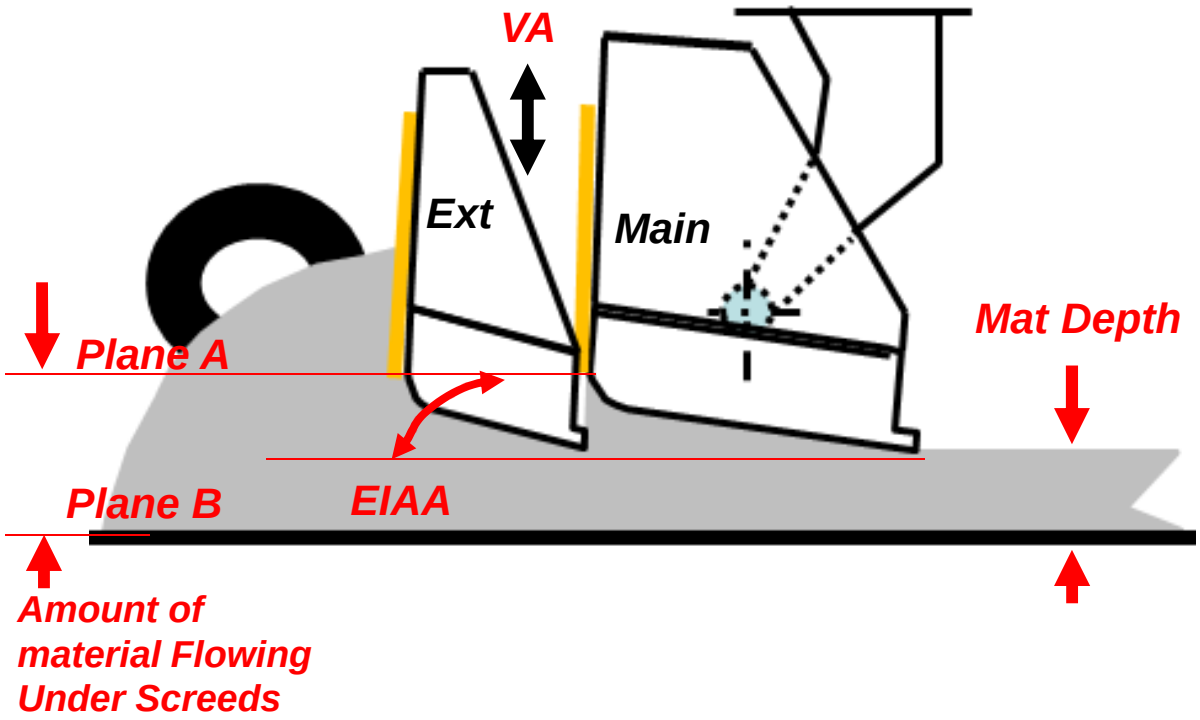


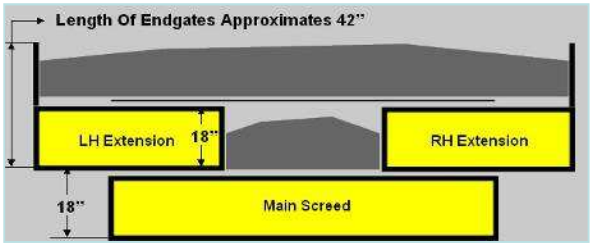


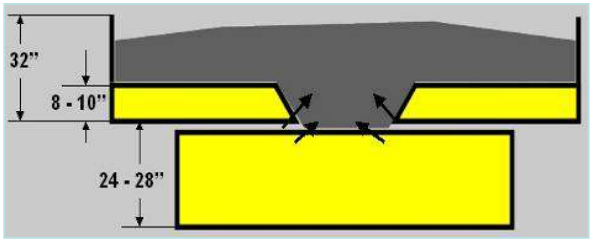


Front Mount Extension Angle of Attack & Vertical Adjust

- *EIAA - Ext. Independent Angle of Attack, Sets Leading Edges on the same plane*
- *VA - Vertical Adjust, Sets the Trailing Edges on the same plane*
- *Parallelism – Ensure VA is held at all paving width*

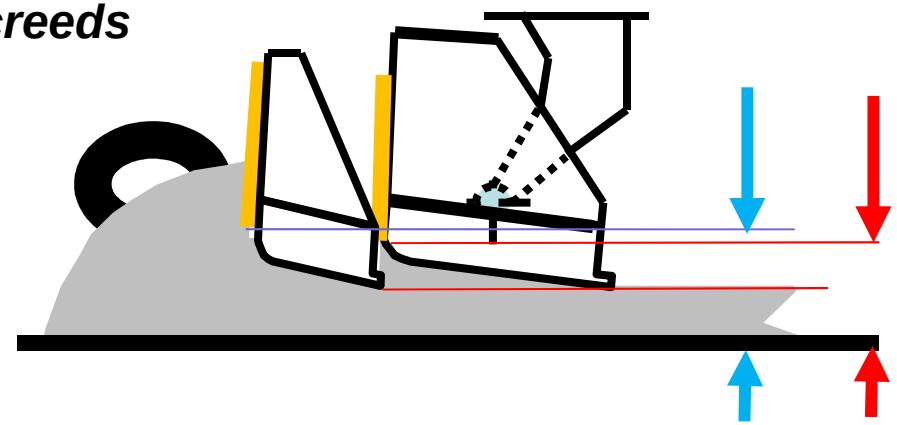




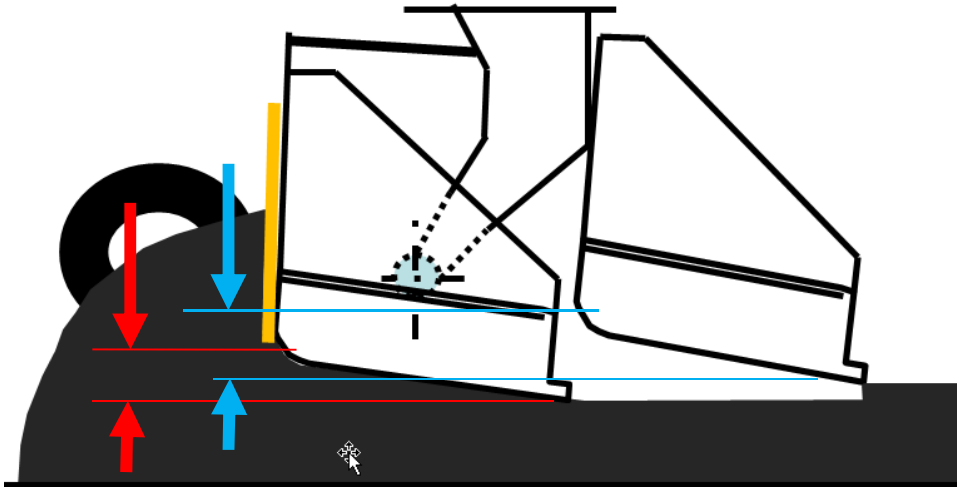


Extension Screed Higher that the Main Screed

- *The Result Is Lines & Thicker Mat Under the Ext.*
- *Inconsistent Screed Compaction*
- *Adjust on the fly with Un-equal width screeds*



Equal Width Screeds



EIAA, VA & Parallelism Could Be Out of Alignment in Several Areas

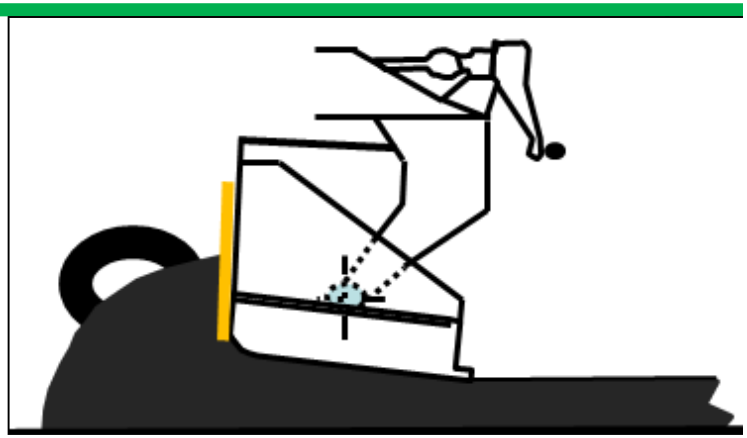
- *Rigidity & Ability to make Easy Adjustment is Critical*

Ideal Vertical Adjust (VA)…… for Unequal Width Front Mount Screed

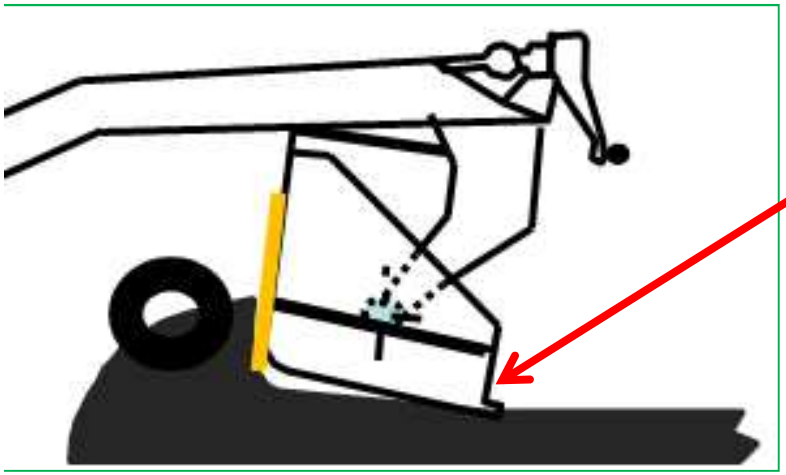
- ***Extension Slightly Higher than Main Screed to ensure Main is dominant***

Strike-off Adjustment: - Strikeoff

- *Strikeoff meters Material Flowing under screed*
- *Affect Extrusion Compaction & Angle of attack*
- *Impact on Surface Texture:*



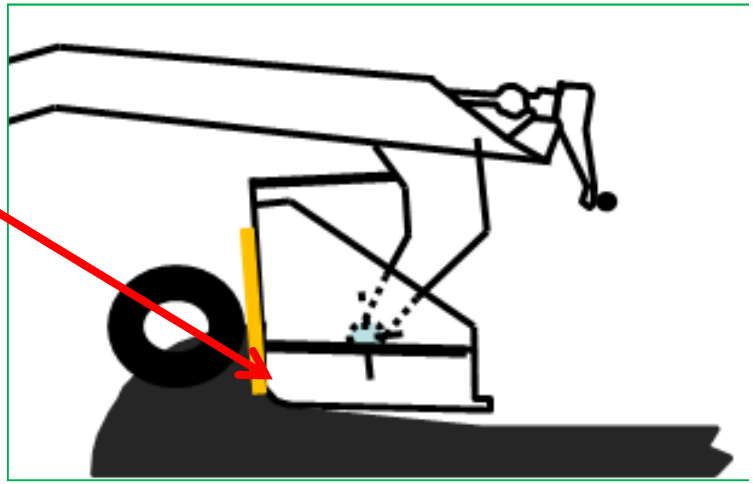
See Manufacturer Specifications



Too Low… Screed Rides on Trailing Edge

…..Premature Wear on Trailing Edge

Excess Wear

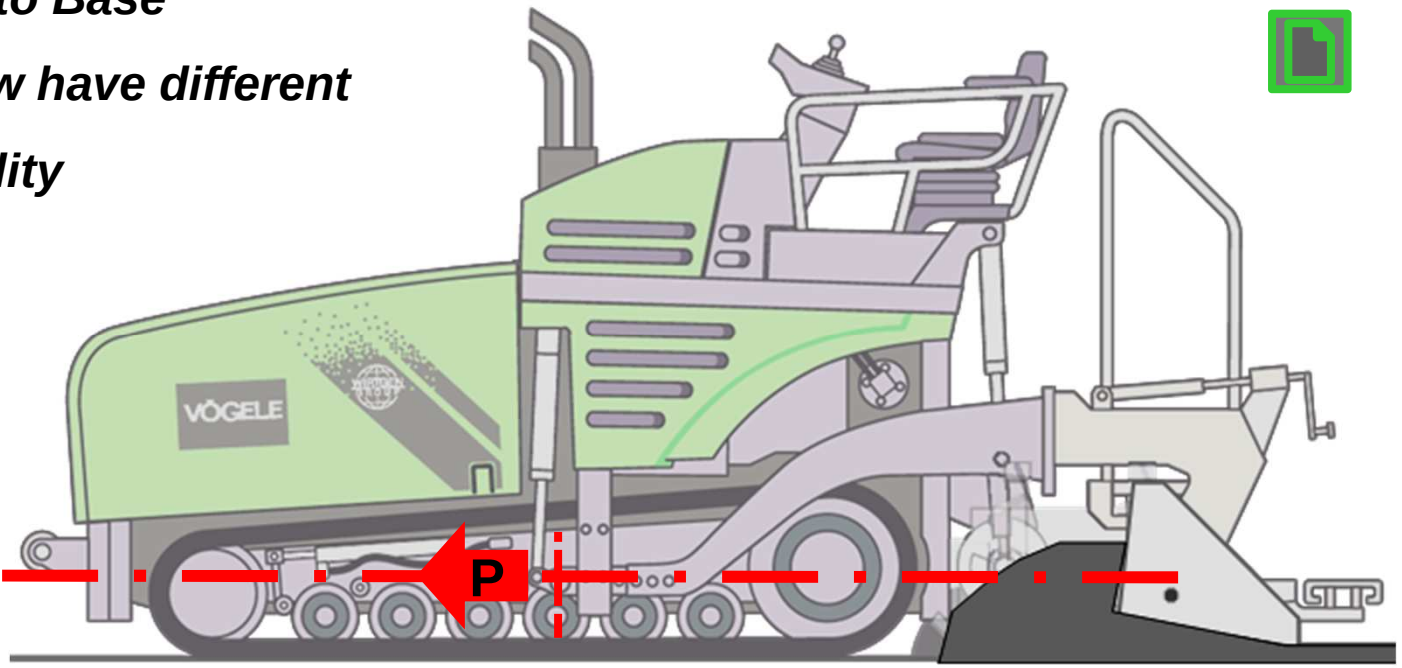


Too High… Screed Rides on Nose

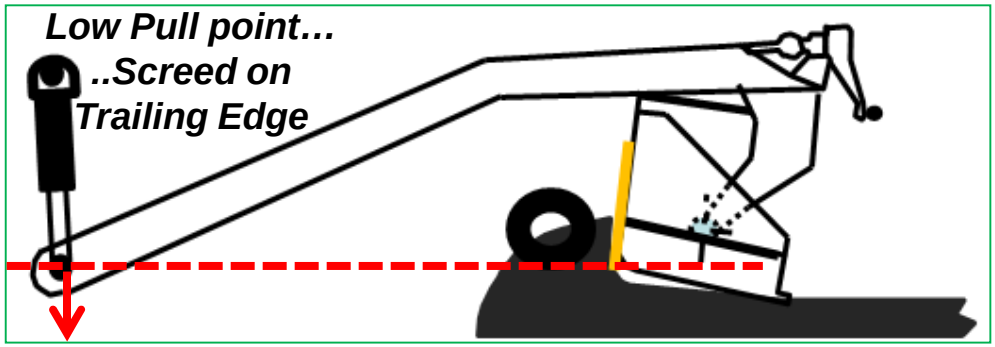
…..Premature Wear on the Bull nose

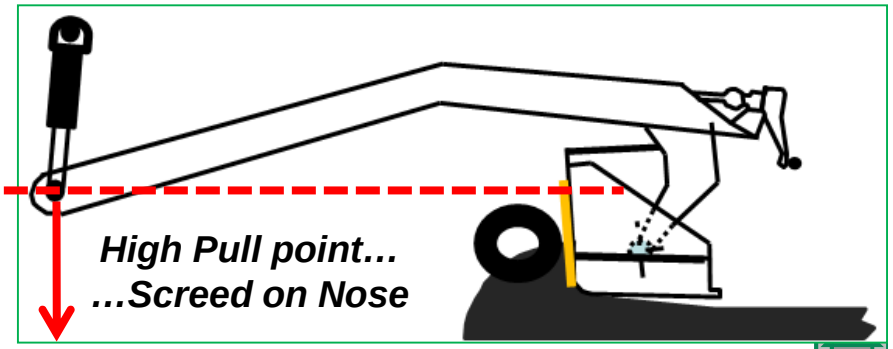
Pull Point Position for Best Results:

- *Pull Force Parallel to Base*
- *Too high or too Low have different Impact on Mat Quality*



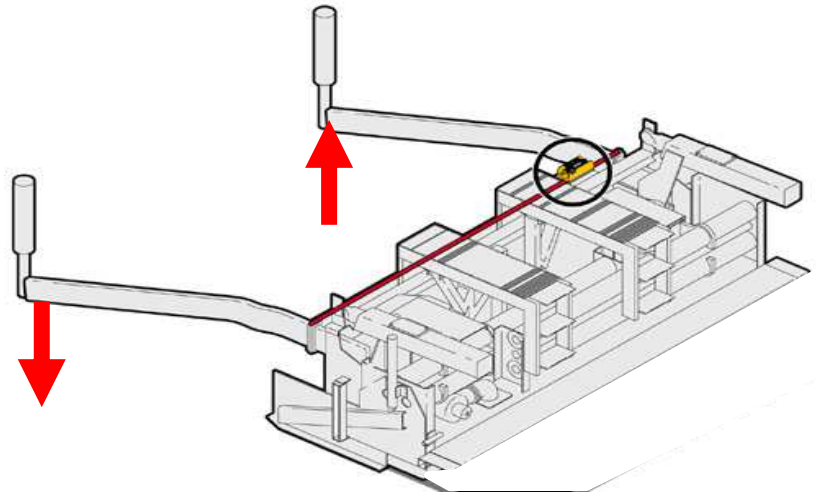
Pull point Approximately Parallel to Base

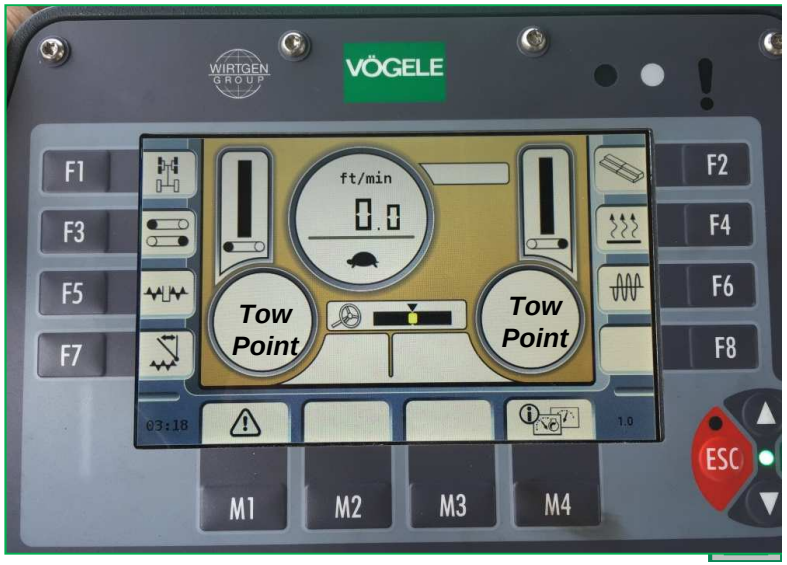




Avoid Screed Twisting: - Both Tow point should be close together

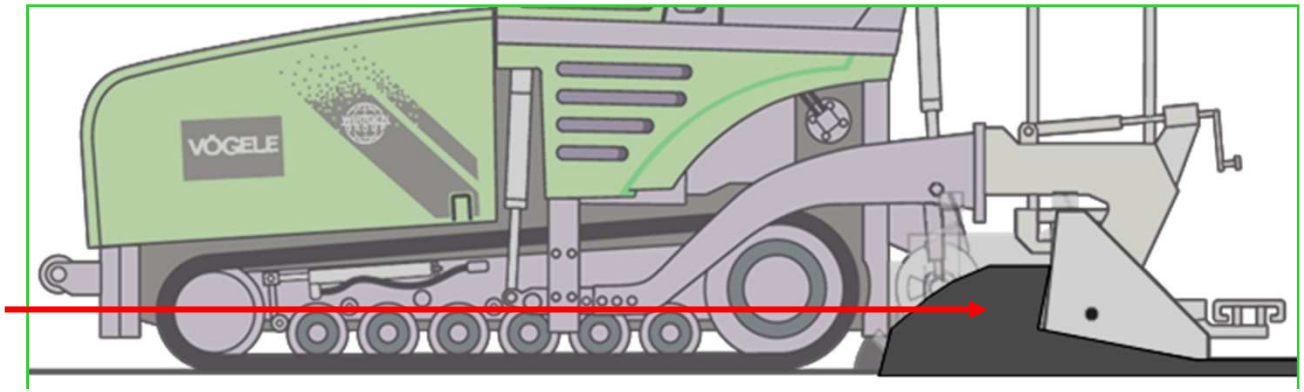
- *Either use Screw or Tow point – NOT one of each*





Ideal Adjustments for Pulling off the Joint – All applications:

1. Determine Thickness of Starting Blocks (1/4” / 1” for Roll Down)
2. Lower the screed on Starting Blocks
3. Energies Screed Float Switch In Pave Mode (On Vogele Pavers)
4. Pull Forward at least 1 ½” to take up slack at Tow Point
5. Lower Augers approx 2” above screed plate
6. Set BOTH Tow Point at SAME position based on Mat Depth (for ideal line of Pull)
7. Null Thickness Control Screw
8. Take up screw slack & add 2 to 3 turns up depending on screed
9. Fill Auger Chambers
10. Should be able to Pull off with or without Automatic



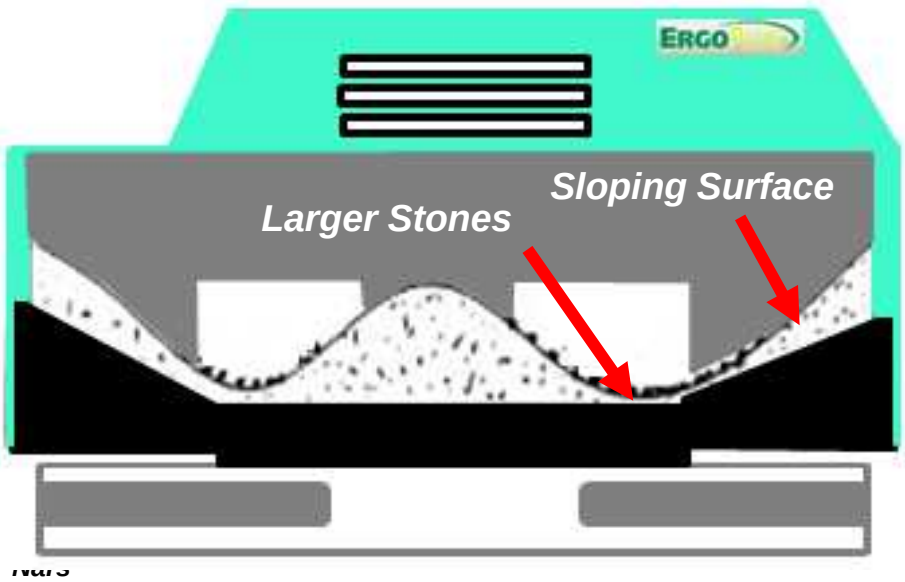
Segregation – Two Types

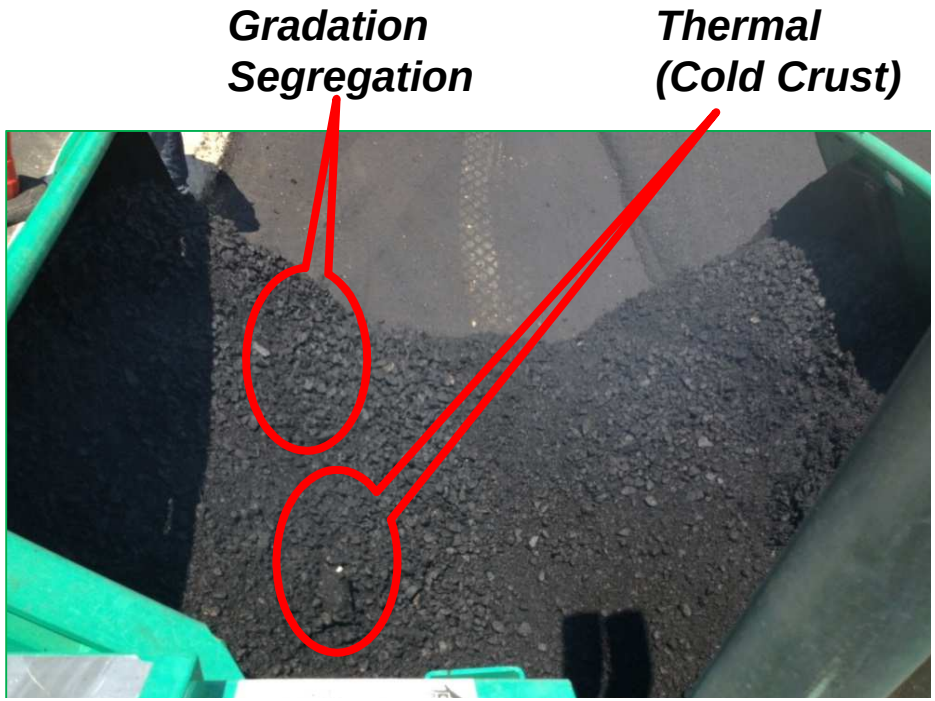
1. ***Gradation: Larger Stones separating from Smaller Stone & fines***

   Heat remains in the fines lead to accelerated cooling

2. ***Thermal: Generally Cold Crust from Long Haul / Traffic etc.***

   Also from Gradation segregation – heat remains in the fines





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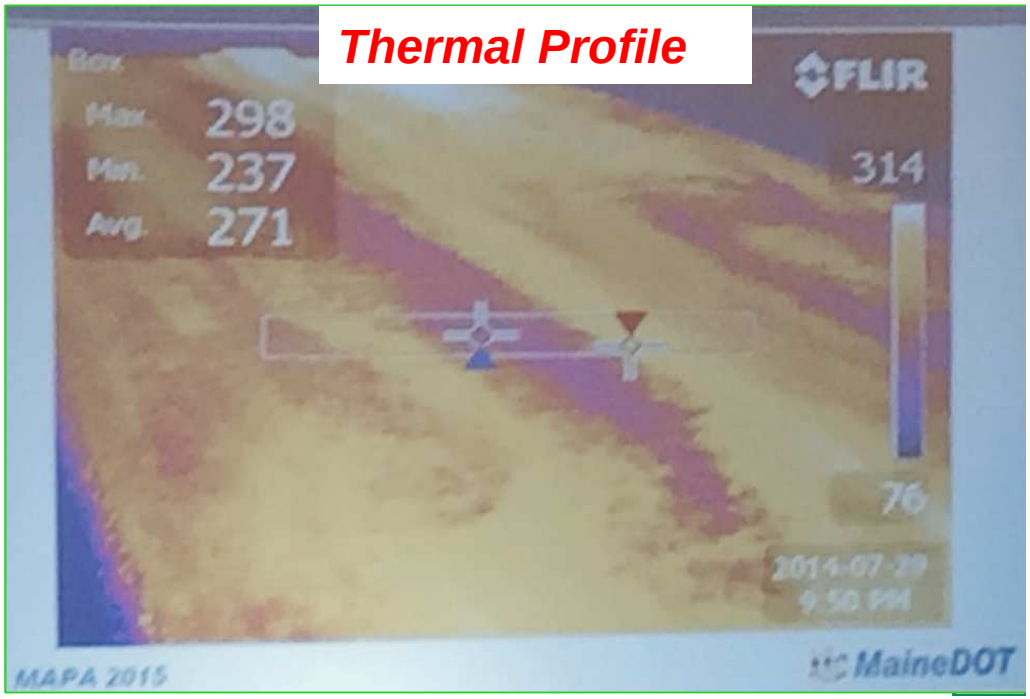
Mat Stripes

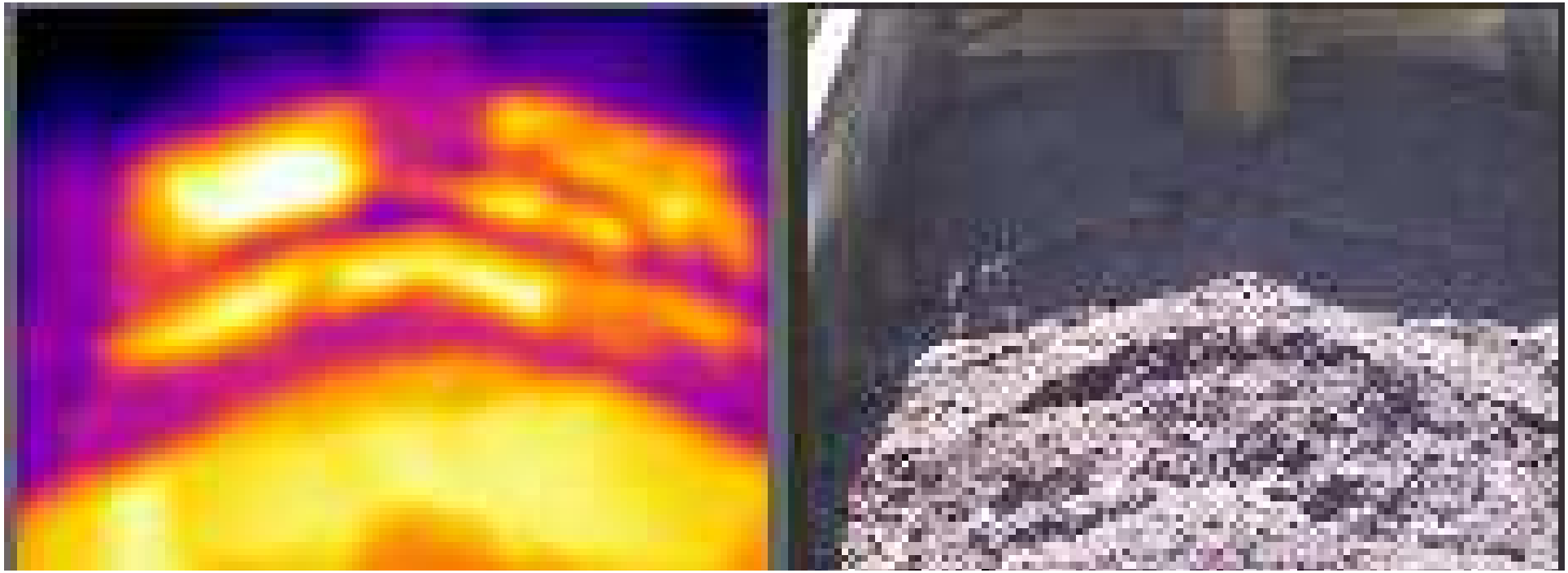
Thermal Image used to detect Segregation

- Gradation Segregation creating thermal differential
  - No fines in the segregated areas – no heat



Thermal Image used to detect Segregation

- ***Thermal Segregation from Cooling of the mix in the truck bed***
  - ***On the surface of the***
  - ***On the side walls of the bed side walls***
- ***Cooling of mix around the paver hopper wings or Paver Hopper Insert***



Standard Practice for

Continuous Thermal Profile of Asphalt Mixture Construction

AASHTO Designation: PP 80-14[1]

Table X3.1—Temperature Differential Categories

Range	Category
≤13.9°C [25°F]	Good
>13.9°C [25°F] to ≤27.8°C [50°C]	Moderate
>27.8°C [50°C]	Severe

X4. MONETARY ADJUSTMENT

X4.1. *Good*—If more than 50 percent of the day's segments fall in this category, an X percent bonus of the day's core density payment will be added.

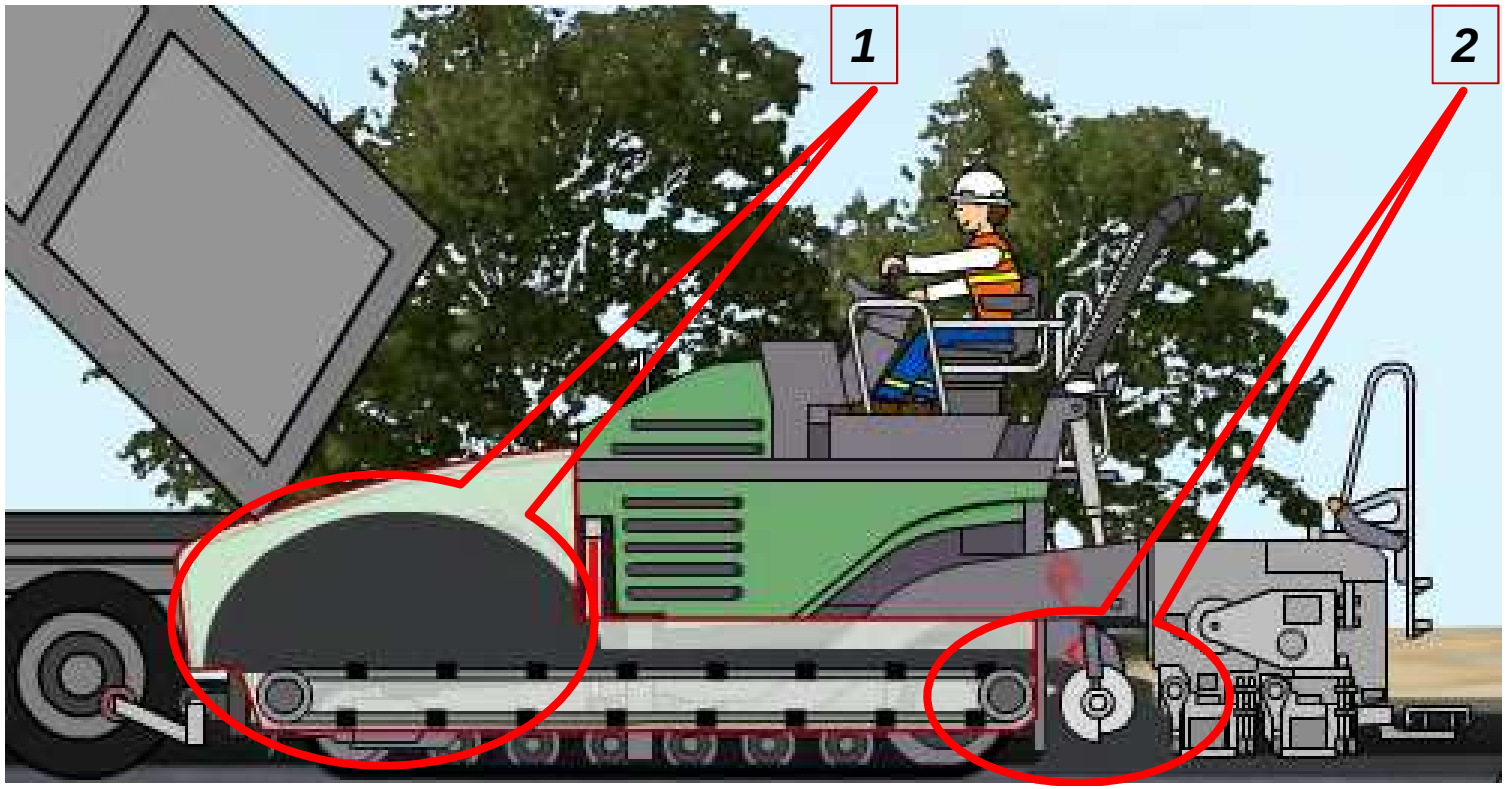
X4.2. *Moderate*—If more than 50 percent of the day's segments fall in this category, take corrective action to eliminate.

X4.3. *Severe*—If more than 25 percent of the segments fall in this category, the engineer will suspend operations and the contractor will take immediate corrective action. All incentive payment for density cores is eliminated for that day's paving.

Note X2—When determining which category the day's paving belongs in, start from severe and work backwards until one is satisfied.

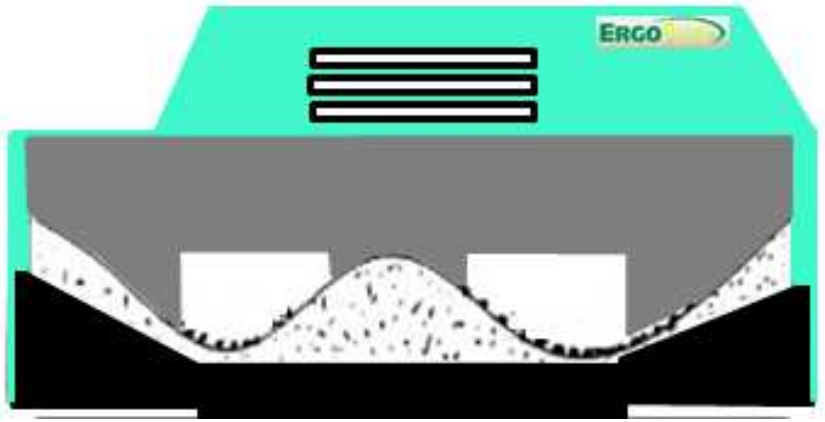
While Pushing Trucks or using MTV:

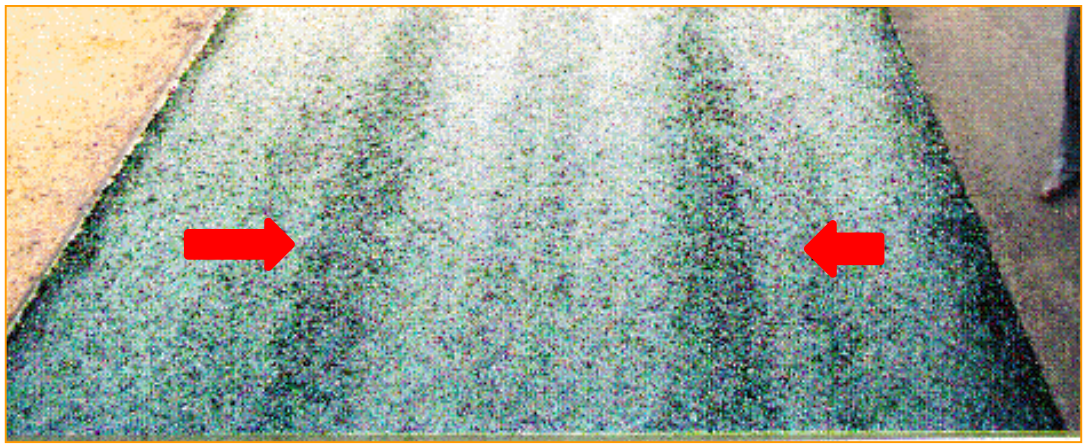
1. ***Pushing Trucks – 3 areas of concerns***
2. ***Use of MTV / MTD & Paver Hopper Insert – 4 areas of concerns***
3. ***Material management as tractor delivers to Screed – With or Without MTV***



a. Running The Hopper too low

- *Creates two valleys at the middle of flight Chain*
- *Two streaks appears in middle of the tunnel*
- *Would appear only when hopper is too low*





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b. Segregated Material at the side wall of the Hopper:

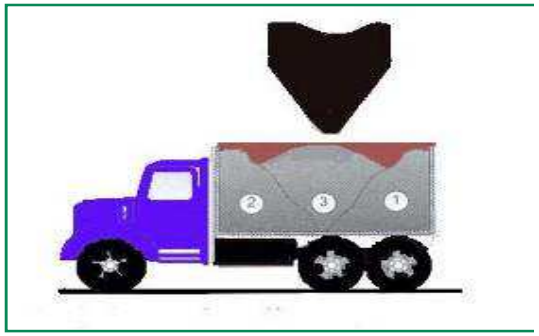
- ***From Pile in the hopper…and Truck Bed***
- ***Dump Hopper Only When Needed***
  - ***Streaks in the form of a chevron***
  - ***Chevron pointing towards Paving direction***

c. Gradation Segregation at the End & Start of Dumping

NAPA - TAS 32
(Proper Truck Exchange)

- *Follow Proper Truck filling & Dumping Practice*
- *OR Use Material Transfer Vehicle or Devise (MTV / MTD)*

(Just as Important when using MTV – Will discuss Later)



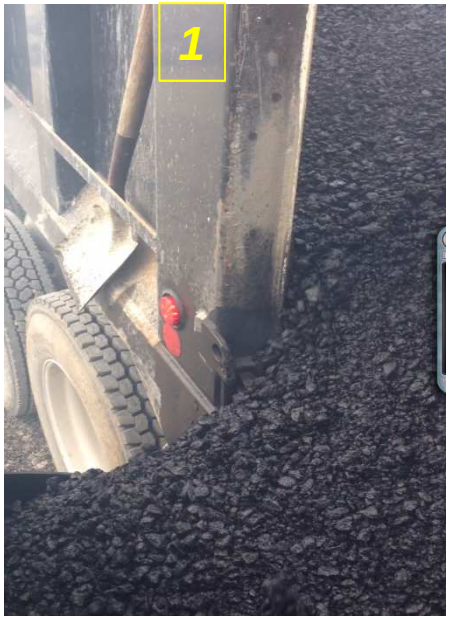
Three Types of MTV / MTD:

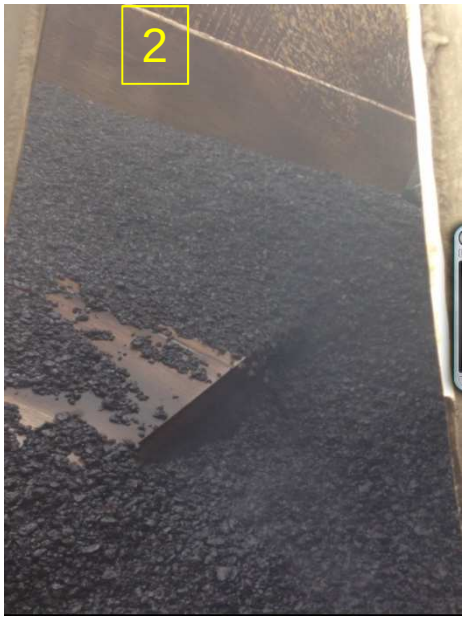
- ***Provide Non-contact Continuous Paving***
- ***Reduce Trucking and Dumping Segregation***

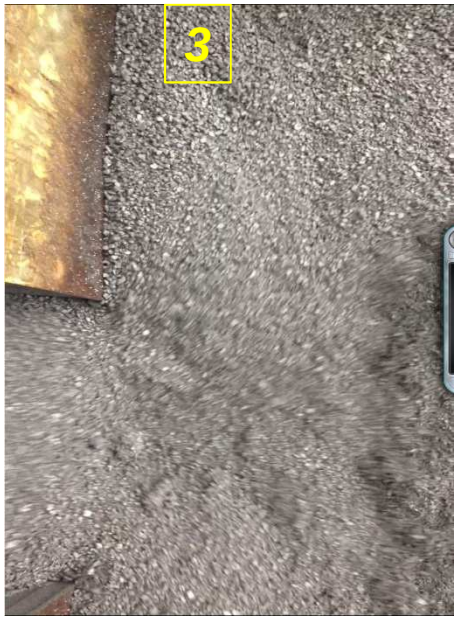
4 areas of concerns – Driving the need for Remixing???

1. ***Gradation Segregation at the side wall of the truck bed***
2. ***Gradation Segregation at the End & Start of Truck Dumping***
3. ***Thermal Segregation (Crust) on surface & side wall of truck bed***
4. ***Gradation Segregation at hopper Insert side wall during filling***

(Occurs after the MTV and with all MTV)







1. Gradation Segregation at the side wall of the truck bed

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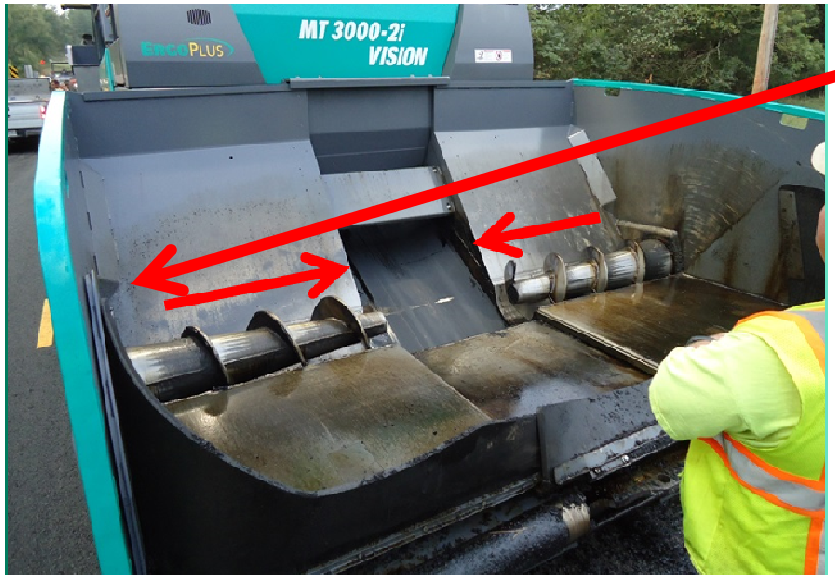
Solution: Variable Pitch / Re-mixing Augers

- Auger Re-blend Large stones from the side walls

Also Potential for Thermal Segregation

Truck Sidewall



2. Gradation Segregation at the End & Start of Truck Dumping

VÖGELE

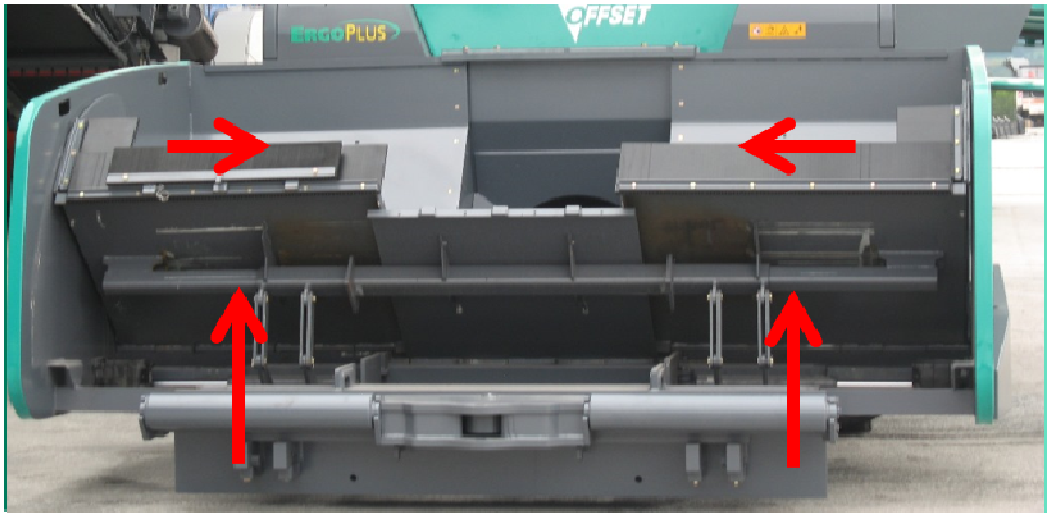
Solution: Re-mixing Augers & Front Tilting Hopper:

- Auger Re-blend End & Start of Load Segregation
- Hopper Dumps on top of Augers

End of Load

Start of Load

Proper truck exchange



3. Thermal Segregation (Crust) on surface & side wall of truck bed

VÖGELE

Solution 1:

Combination of Re-blending Augers and Flight Chains

- ***Augers re-blend cold crust as it moves the material to the belt***
- ***Several flight Chains brakes up the crust as it moves to the next conveyor***

Crust

3. Thermal Segregation (Crust) on surface & side wall of truck bed

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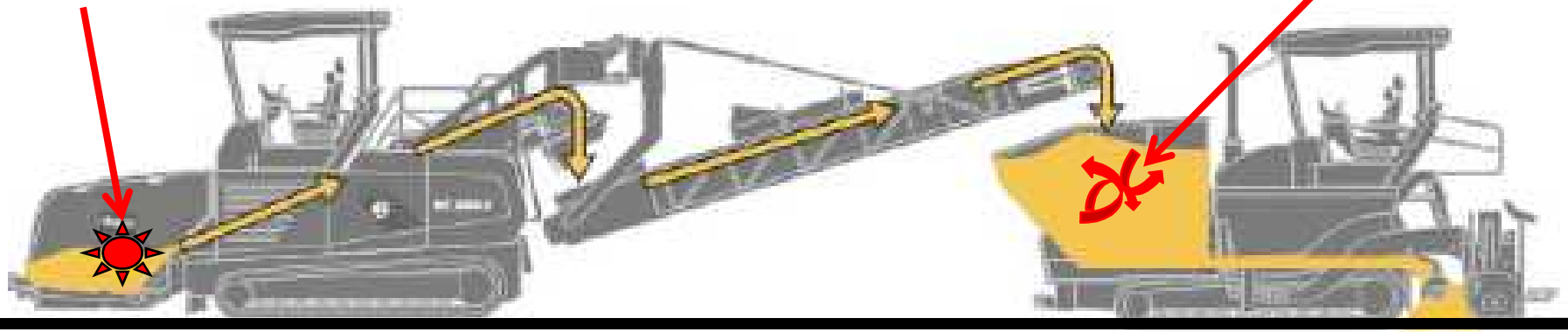
Solution 2 – Grate Baffle system:

Passive Remixing Grate System

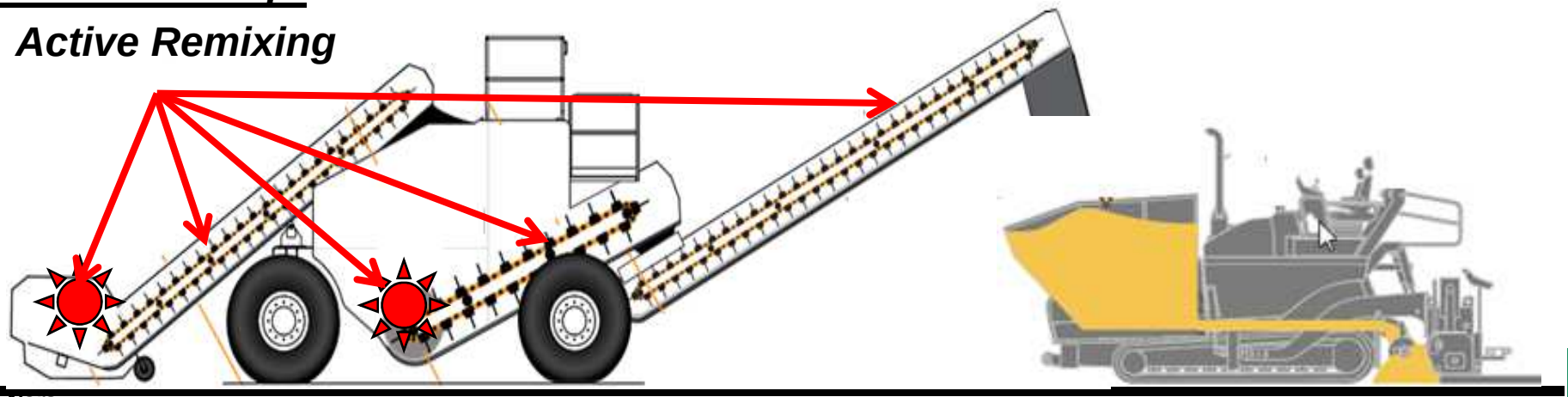
Non-Shuttle Concept

Active Remixing



Shuttle Concept

Active Remixing



4. Gradation Segregation at Hopper Insert Side wall during Filling

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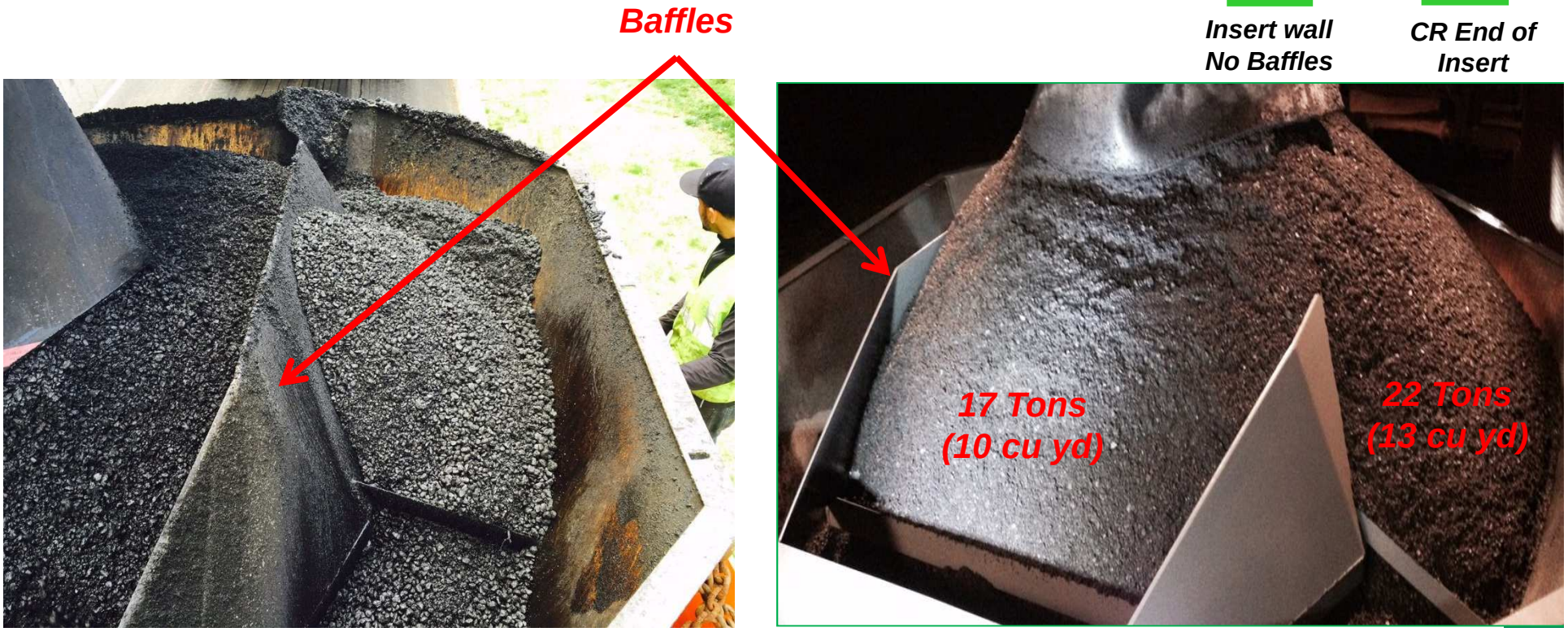
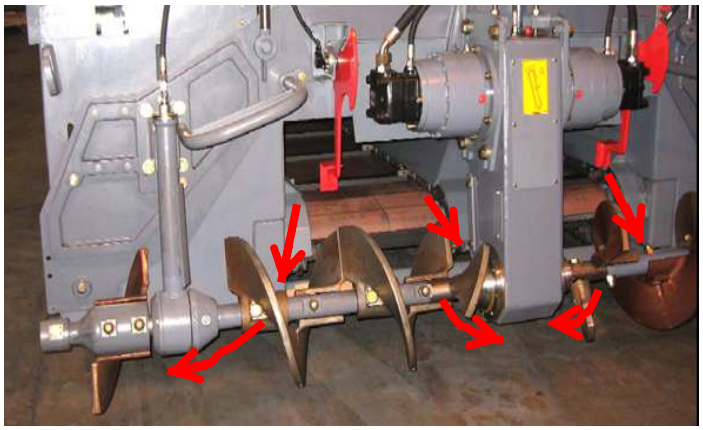
Solution: Passive Re-mixing Insert….MTV not cure all for Segregation

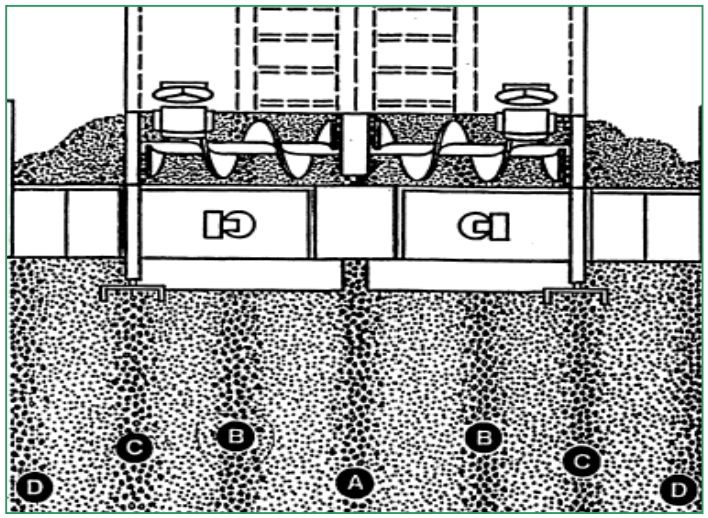
- ***Reduce the length of Sloping Face of pile***
- ***Reduce large stones at insert side wall / edge of conveyor tunnel***
- ***Prevents <u>Longitudinal failures</u> from edge of tunnel to bearing hanger***
- ***Also Provides dual Capacity***

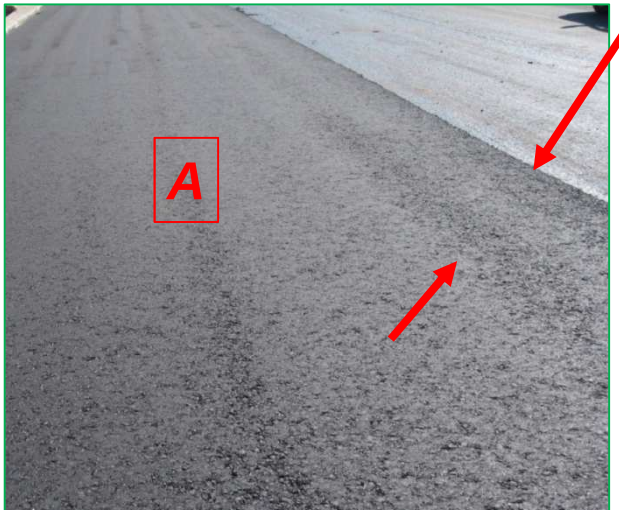


Segregation Created as Tractor Delivers to screed ….. After MTV)

- ***Several Location along width of mat***
  - ***Could be Identified by Thermal Imaging***







B, C, D

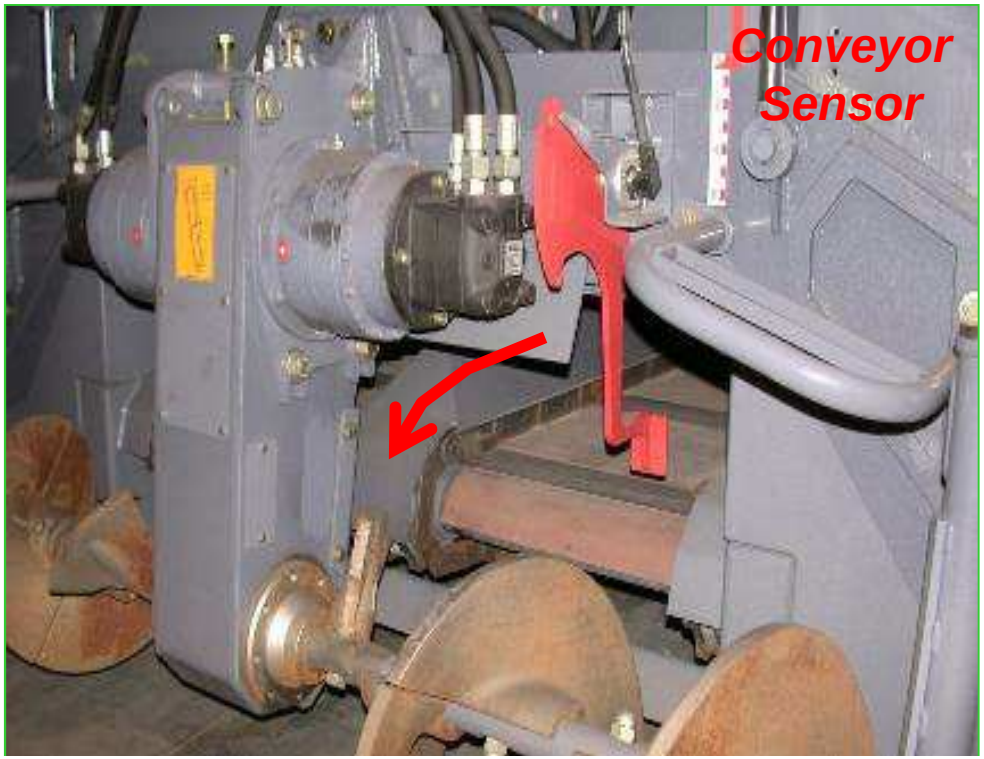
Center Line & wheel path

Solutions: (A, B, C, D, E)

Proper Auger & Conveyor Controls

- ***Provides consistent Metering of material for Continuous Auger rotation***
  - ***Always Ensure that the Augers are ½ Covered***
  - ***Conveyor delivery same as Auger Displacement***

Constant Feeding



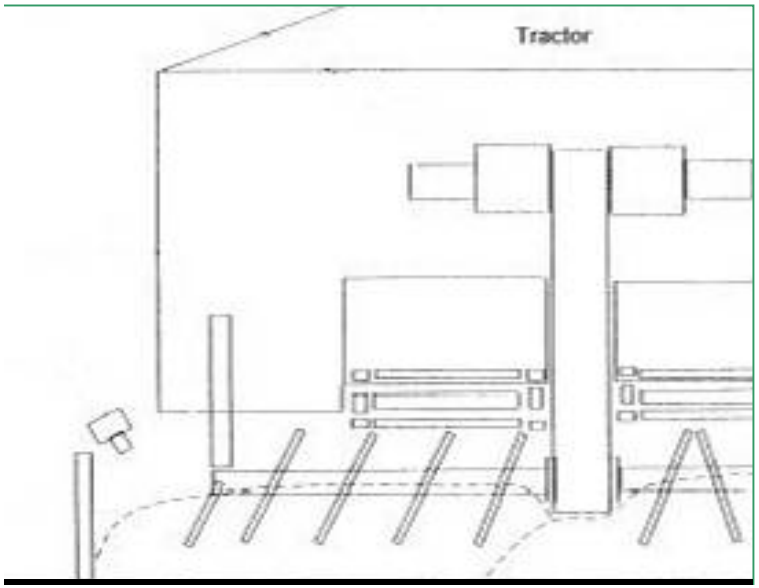
Solution: (A) Centerline Segregation

Reverse flights next to the auger box

- ***RH Reverse Flight Pushes center segregated mix to the LH side***
- ***LH augers continues to move to the LH and re-blend***

  (LH & RH Reverse Kickers tends to tuck segregated material to center)
- ***Augers must Rotate Continuously to be Effective***

¼ flight



Material management as tractor delivers to Screed

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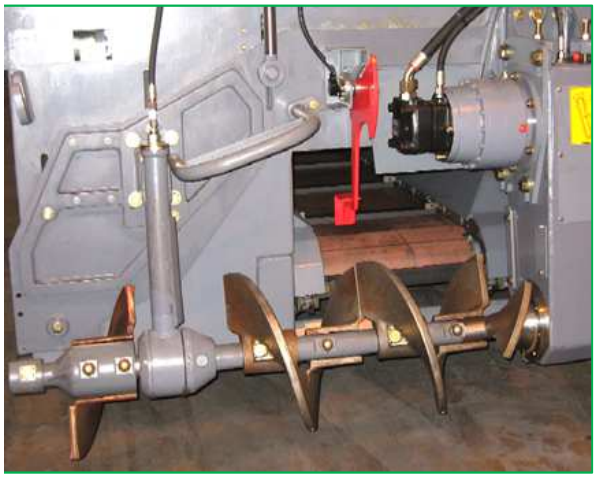
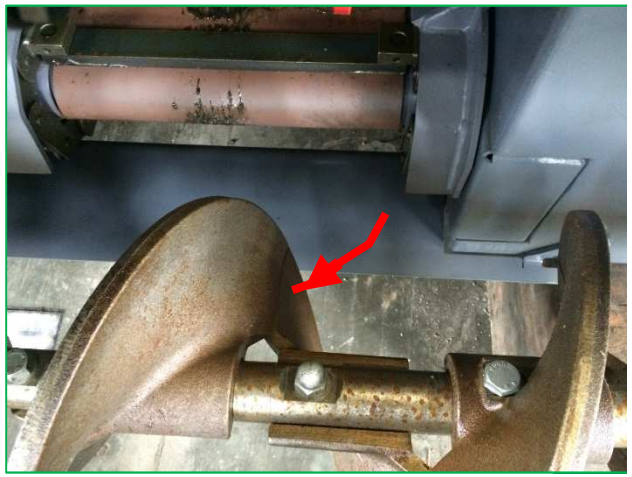
Solutions: (B, C, D, E)

Auger & Tunnel Extensions & Material Chutes

- ***Augers - Help move the material to the End gates***
  - ***Some State specify 18” to 24” From End gates***
- ***Tunnel Extensions: Confine material***
- ***Material Chutes – Allow material to drop closer to augers***
  - ***Auger Re-blends as it moves the material***

Outer Tunnel segregation





Wide Paving

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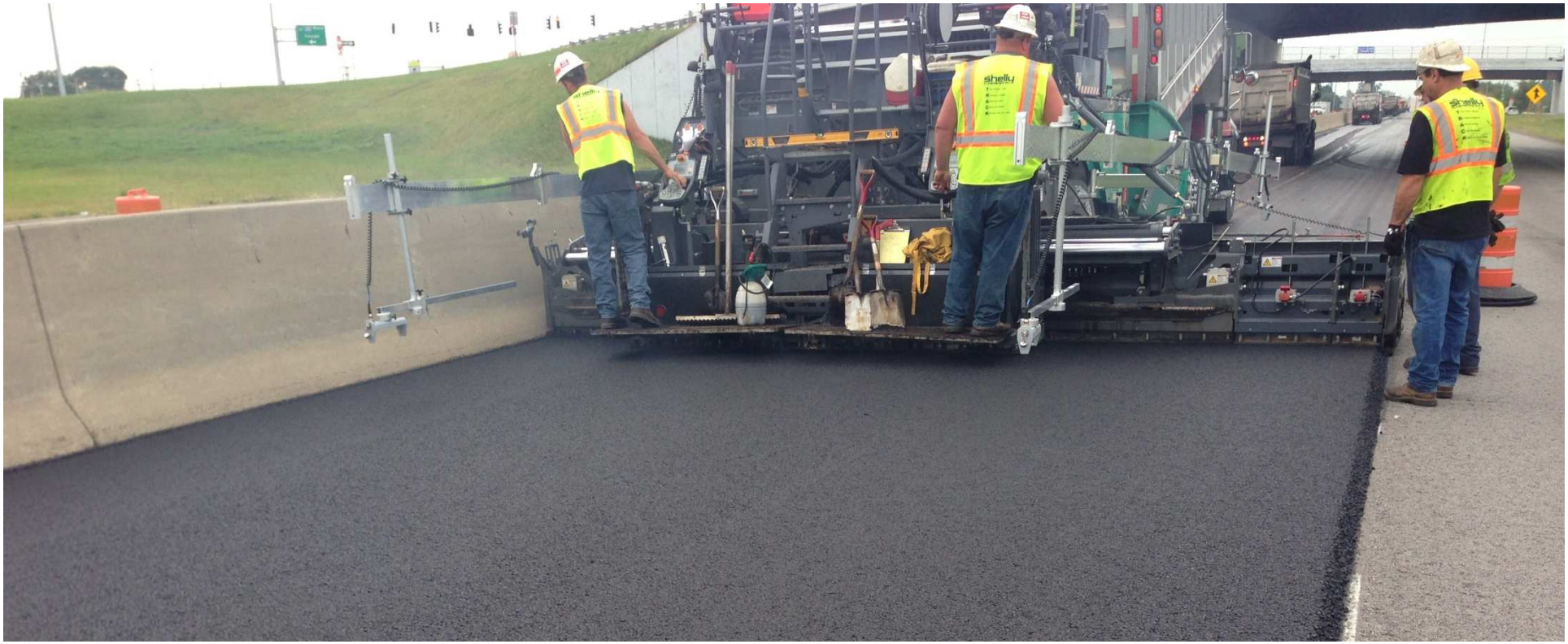
Specific Focus:

- ***Setup***
- ***Maintain Consistency – material feed and paving speed***
- ***Balance Paving where Possible – Influence by Crown & Shoulder Slope***



Wide Paving

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Proper Set Up:

- *No Different from What discussed earlier*
- *Starting Blocks Under the Extension Screed also*
- *Follow the Profile*

Wide Paving

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Material Feed:

- ***MTV Where possible***
- ***Proper Auger Extensions***
- ***Proper Tunnel Extensions.***

Wide RM

Wide FM

Automatic Grade & Slope

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Automatic Grade & Slope System:

- *Automatically Controls Pavement Grade & Traverse Slope*
  - *Grade Sensors: - Measure and Maintain the Longitudinal Grade Profile*
  - *Slope Sensors: - Measure and Hold the Traverse Slope of the Pavement*

Vogele Niveltronic

Trimble / CAT

MOBA

Topcon P-32

Automatic Grade & Slope

VÖGELE

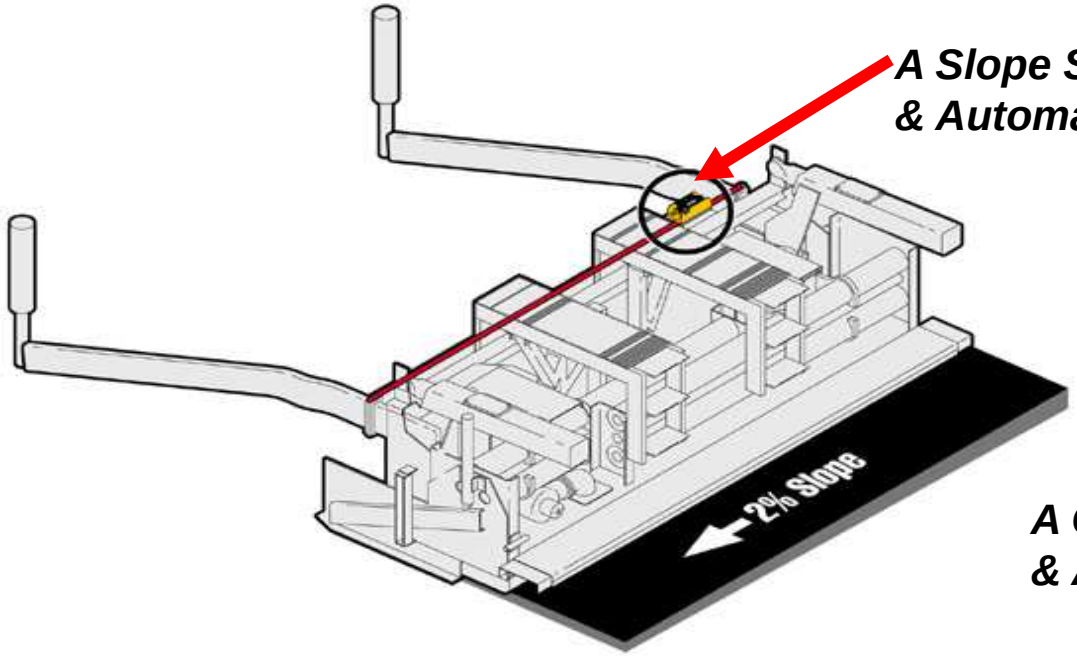
What are Grade and Traverse Slope??

Grade: ***The Longitudinal Couture or elevation of the surface being paved***

- ***In the direction of travel of the paver.***

Slope: ***The Traverse Slope of the surface being paved***

- ***Perpendicular to the direction of travel.***



A Slope Sensor Connects the Levelling Arm & Automatically Monitors Traverse Slope

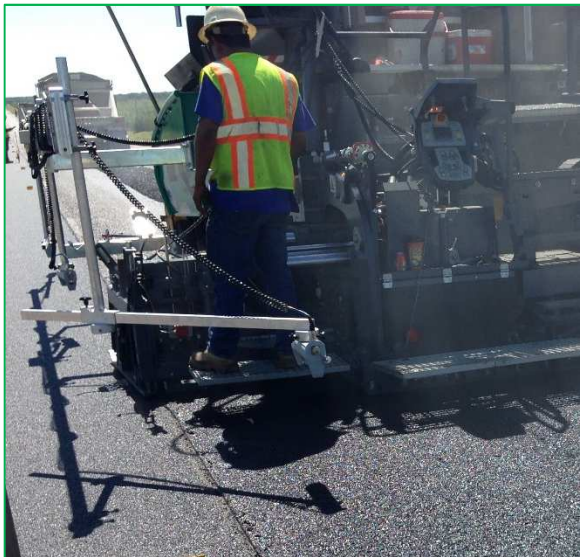
A Grade Sensor Monitors a Reference & Automatically Maintain Depth

Automatic Grade & Slope

VÖGELE

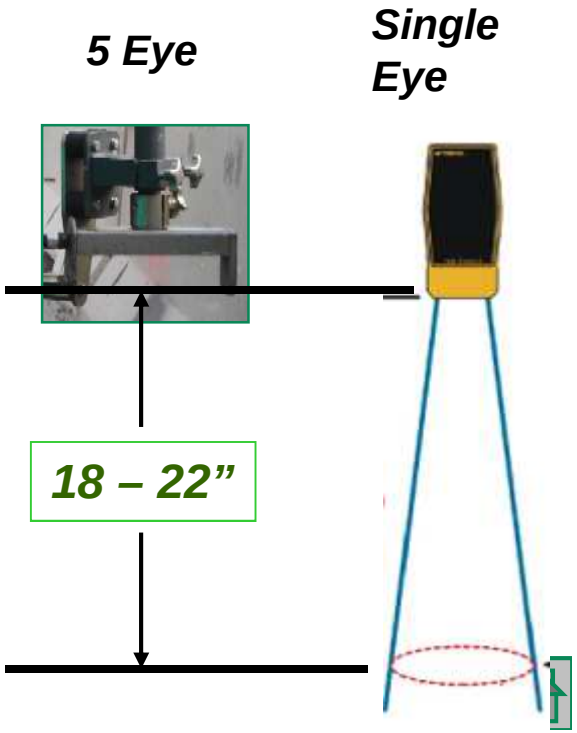
Automatic Grade Control:

- *Single Grade Sensor following Known References:*
  - *Reference Could be - Joint, a Curb, String Line*
- *Multiple Grade Sensor on a Beam (Non-Contact Ski) Following Base*
  - *Ski averages the Contour of the Base to Improve Smoothness*



Grade control Sensor Position:

- *Position Approximately At the centerline of the Drive Wheel*
- *Usually better Mounted on The Endgates*
- *Same for Track & Wheel Pavers*



Mechanical Ski - Drag Beam

- *Single Grade Sensor referencing off a Drag Beam*

Ski with Non-contact Sensors

- *23 to 50’ long – 3 to 4 sensors / ski*
- *Must be mounted outside of Endgate*

Use of Automation & Ski in Tight Turns

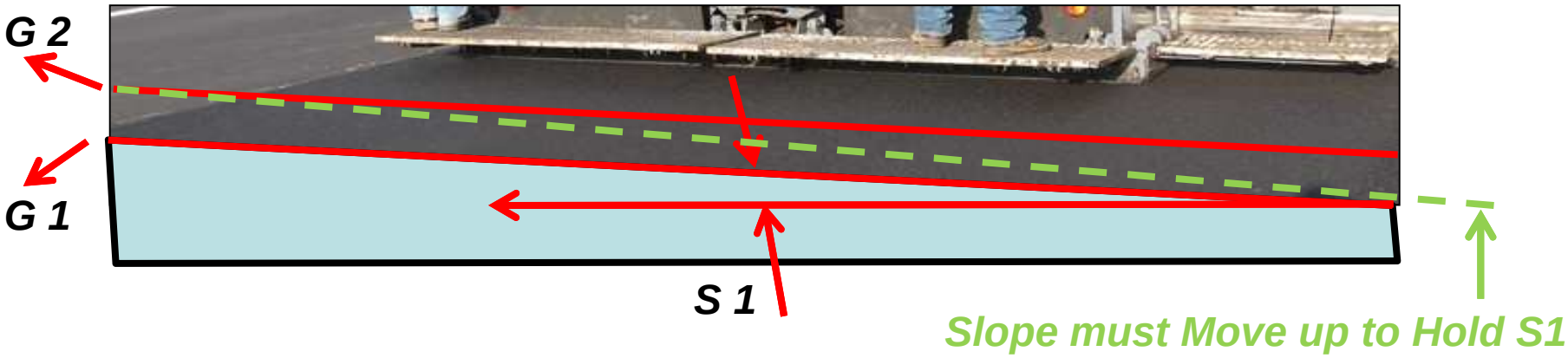
1. ***Front sensor will approach the elevated side of the turn first***

   Turn off the ski into the turn

2. ***Ensure the Tow arms are not binding against the Mainframe***

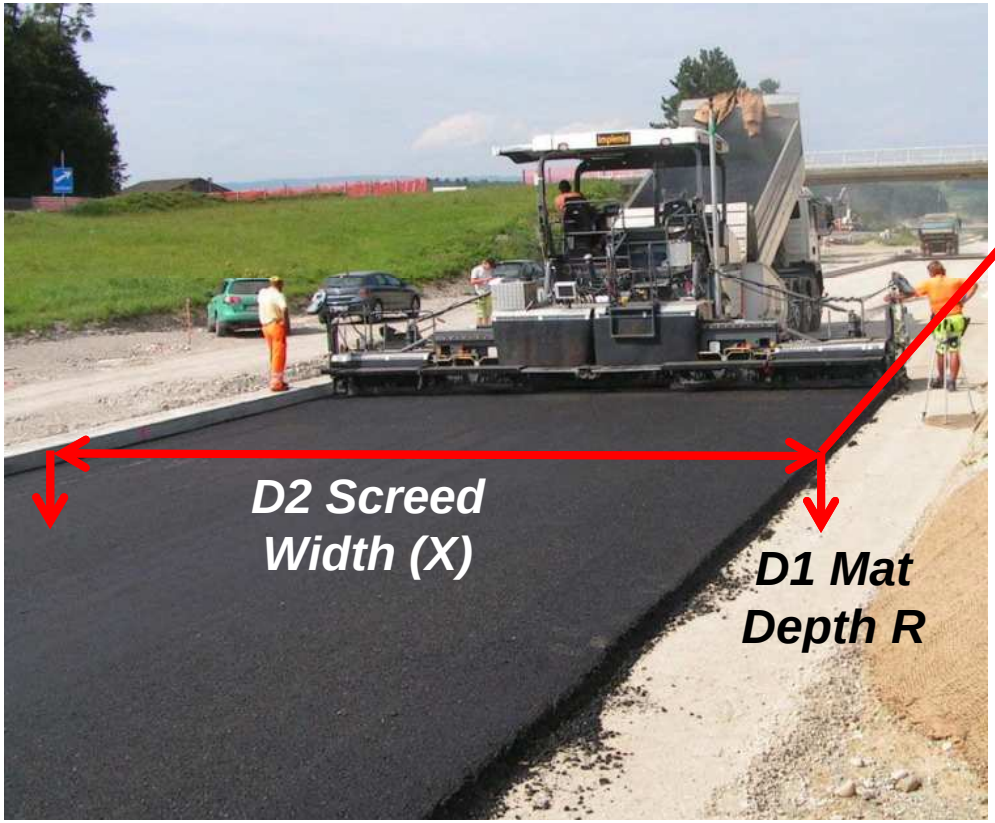
Automatic Slope is always a Slave to Grade:

- A Grade Change (G1 to G2) would change Traverse Slope
  - The Slope Sensor must Compensate to bring S2 back to S1
- As such - Yield, Grade & Slope CANNOT be controlled at the same time
  - Must find a Compromise



3D Reference, 1, 2 & 3D Paving

- ***Reference: 3D Job coordinates***
- ***Sensors: 3 D Positioning Systems, Screed Width Sensor & Steering control***
- ***Machine Control: Vogele Niveltronic***



3D – No Operator

Questions

Thank You