Mat Defects – Fix it !

Blanchard CAT

Presented by: Todd Mansell, Caterpillar

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Role of the Paver

- **To meet specifications for grade, texture & smoothness**

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What is a Mat Defect?

Equipment setup or operational procedures that result in a non-uniform mat:

- Appearance - lines in the mat
- Non-uniform mat texture – surface appearance only
- Segregation – throughout depth – affects density, possibly smoothness
- Bumps & dips in the mat – smoothness, long-term performance
- Cracking, checking, potholes – long-term performance
- Wrong grade/slope, drainage – safety, performance
- What else??

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What Causes Mat Defects?

- Grade conditions – spills, trucks, preparation
- Loading & unloading trucks - plant
- Paver & screed
  - setup & maintenance
  - operation
- Poor take-offs at transverse joint
- Handwork, raking
- Paving too fast
- Roller settings & operation

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What Do Mat Defects Look Like?






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What Happened??


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Grade Conditions: Spills on the Grade

- Potholes
- Density problem
- Smoothness problem

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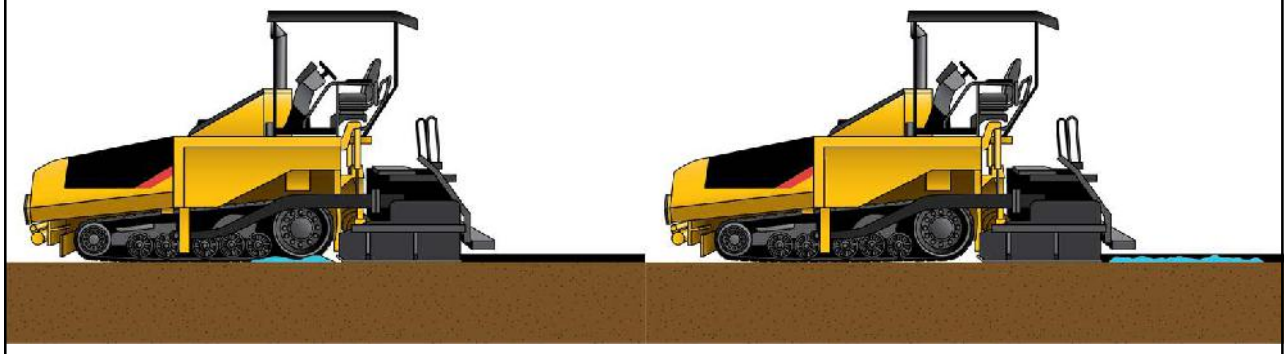
Spills on grade are BIG mistakes!



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Grade Conditions: Mix on the Grade

- Mix left by pickup machine

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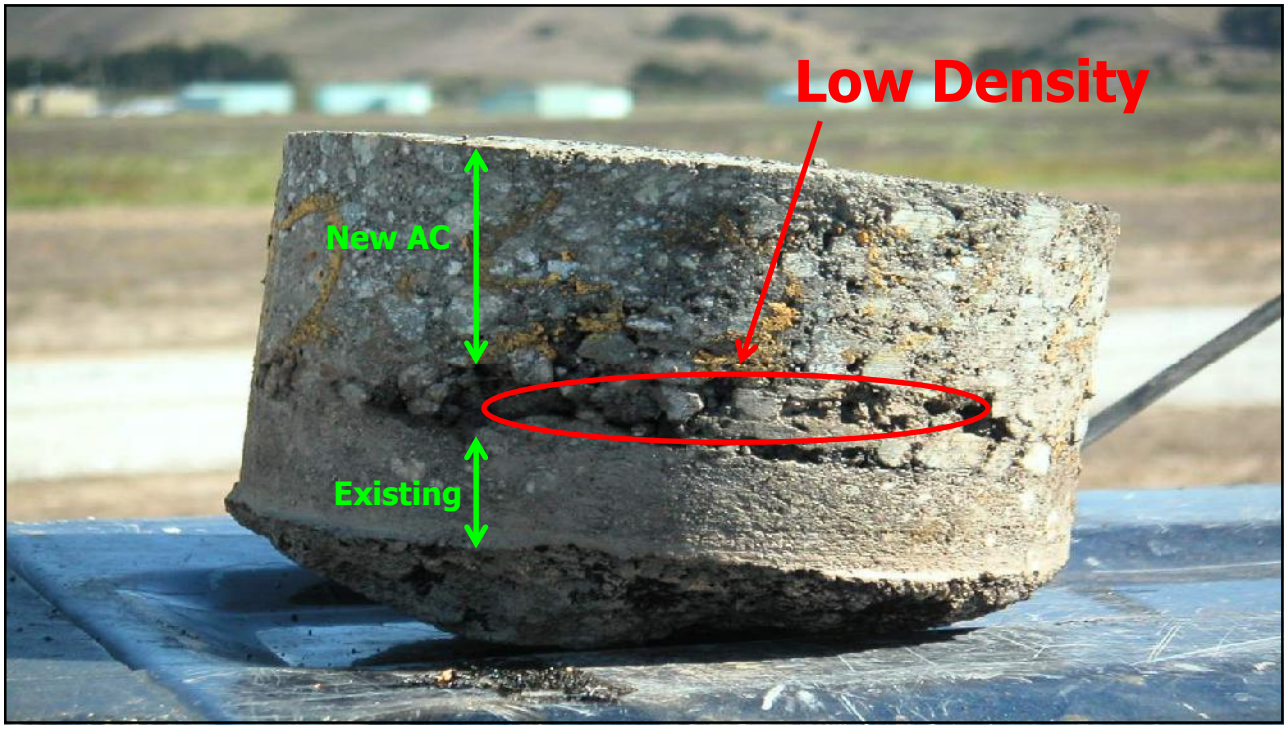

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Grade Conditions: Spills

- Continuous spill out of hopper
- May be caused by truck bed too short
- May be caused by damaged / missing flashing
- Often run over the paver undercarriage

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Grade Conditions: Spills

- Pile compacted by truck or paver
- May be completely covered by mat depending on thickness

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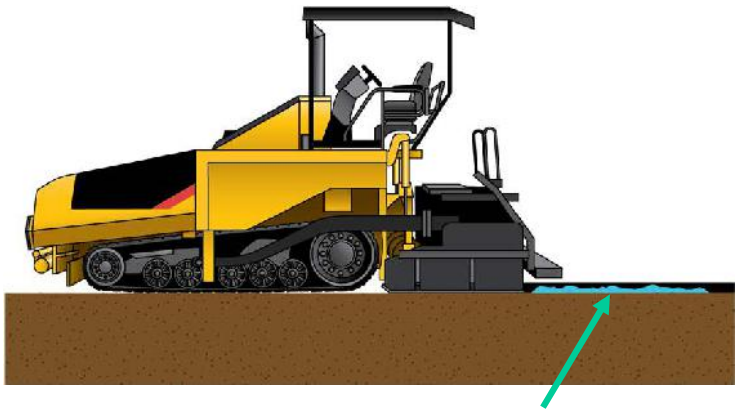
Grade Conditions – Spills



Cold Compacted Material

- Small compacted pile usually not visible in mat surface
- Thin layer of fresh mix for compaction
- Uneven compaction
- Bump
- Fractured aggregates

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The result...Potholes!

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The result...dragging rock!

- Premature raveling
- Bumps after compaction

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Grade Conditions – Spills

- Caused by folding hopper wings too soon
- Caused by damaged or missing flashing
- Becomes cooler mix covered by mat
- What should you do?

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Banging out truck beds!

What should you do?

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Direct truck to a clean out area

Mix can be recycled at end of the day

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Grade Conditions: Trucking

- Trucking has big impact
- Apply light brake pressure
- Too much brake pressure is also a problem
- Do we train our drivers?

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Grade Conditions – Inspect!

- Existing grade conditions often result in mat defects
  - Soft base
  - High spots / low spots
  - Torn up by trucks
- What do we do?

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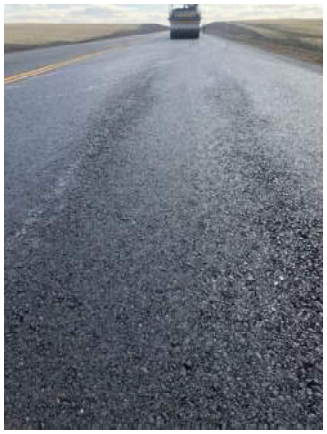
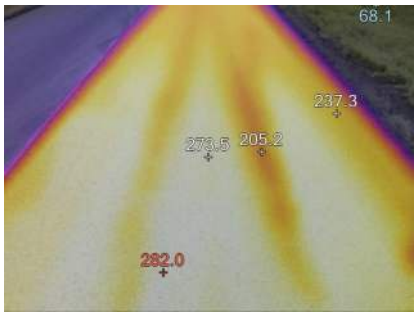
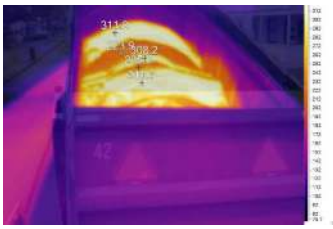
Segregation is a Mat Defect

1. **Physical – Lack of uniformity of aggregates in-place mat**
2. **Thermal – non-uniform distribution of temperature**







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What does segregation look like?

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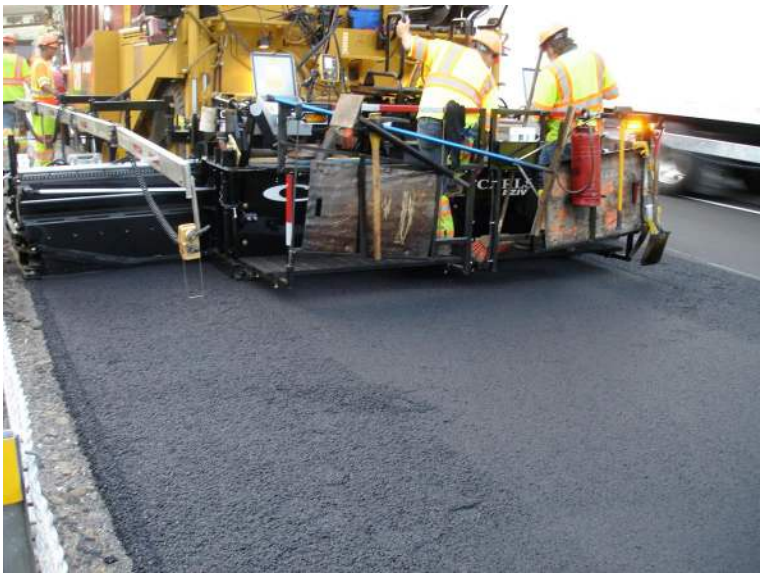
Mat Texture is not Segregation



- Visual appearance of the surface
- Not the same as aggregate segregation
- Affected by many factors
- Goal is uniformity from edge to edge

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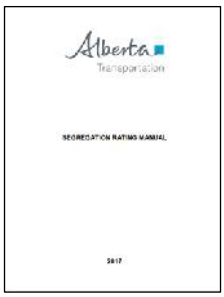
How Do We Identify Segregation?

- Visual
- Often subjective
- Some specs have procedures to quantify segregation



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Identifying Segregation: 3 Patterns

To eliminate segregation, we must identify the pattern to find the source

1. **Repeat, pattern patch**
2. **Continuous stripes**
3. **Random patch or stripe**

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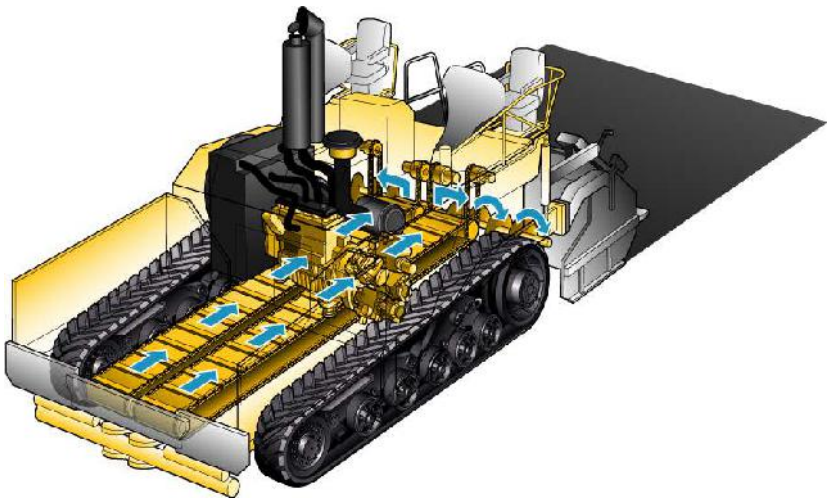
Segregation areas around the Paver



- **Feed system**
  - **Conveyors**
  - **Augers**
  - **Feed sensors**
- **Hopper**

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Segregation – Hopper Management

- Flashing in good condition
- Hopper mix level covers slat conveyors and tunnels

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Segregation – End-of-Load

- Usually equally spaced
- Often chevron shape
- Most common when aggregates are 3/4” or larger

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End-of-load – Three Drops at Plant

- Troubleshoot truck loading
- First drop at front
- Second drop at rear
- Third drop in center
- Significant reduction in material roll-down
- Very important when paving with large stone mixes

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End-of-load Segregation – Truck Bed

- Pockets of large aggregates at ends and sides of truck beds
- Keep bed raised to minimize additional rolldown

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End-of-load – Segregation in Hopper

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End-of-load – Segregation in Hopper

- Large aggregate accumulates at sides of hopper
- Prohibit folding hopper wings
- Keep conveyors full during truck exchange
- Shovel out hopper sides occasionally

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End-of-Load: Keep Tunnels Covered

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End-of-load Segregation: MTV Remixing

- Some MTVs have remixing capability
- Surge capacity with mixing augers or paddles
- Blend segregated mix prior to discharge into hopper or insert
- Specified on some projects

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End-of-Load Segregation: MTV Blending

- Pattern segregation minimized
- Highly recommended for large stone mixes and SMA

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End-of-Load – Cold Chunks

- Cold weather and long hauls may cause cold chunks
- MTV will re-mix and break up chunks
- Lower flow gates, if equipped
- Cover loads
- Insulated beds

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End-of-Load – Cold Chunks

- Lots of hand work to remove chunks and repair the mat
- Consider putting laborers at each end of the auger chamber
- May be able to shovel out chunks before going under screed

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Managing Segregation – Truck Exchange

Four step procedure

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

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Managing Segregation – Truck Exchange

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STEP 1: Release Truck

- Follow four step routine
- Step one - release truck as soon as bed is empty
- Truck lowers bed and pulls away
- ***Continue paving at normal speed***

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STEP 2: Continue Paving

- Step two - continue paving as truck pulls away
- Pave until level of mix permits cycling hopper wings without spillage– *if allowed*
- Next truck getting position

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STEP 3: Pave & Fold Hopper Wings

- Step three - continue paving at normal speed
- Slowly fold hopper wings combining mix from sides with mix in middle

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Cycling Hopper Wings

- Cycling hopper wings may be prohibited when laying large stone mixes
- Large stone rolls to sides of hopper
- Folding wings contributes to end-of-load segregation
- Shovel out sides of hopper periodically

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STEP 4: Stop Paver Quickly

- Step four - stop paver and lower hopper wings
- Mix in hopper covers deck and conveyors
- Mix in hopper will be covered by next load

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Truck Raises Bed Quickly, but Smoothly

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Trucks Bumping the Paver

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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

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Mat Defects Related to Truck Exchange

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Random Patch

- Appears in the mat without pattern
- Comes and goes
- Difficult to pin down
- Usually paver operation related and with large aggregate mixes

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Random Patch – Hopper / Insert Level

- Check level of mix in hopper or insert
- Large aggregates roll to the sides when dropped Keep insert at least half full with large stone mixes

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Random Patch – Insert Low

- Large aggregates accumulate on sides as level drops
- Center empties first
- Segregated, large aggregates empty last
- Stop paving
- Wait for more mix
- Do not empty hopper / insert
- Do not empty MTV

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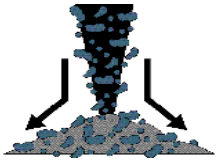
Random Patch – Drop Height

- Discharge into hopper or insert from low height
- Low height means less velocity
- Aggregates do not roll as much
- Segregation reduced



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Feed System Segregation

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

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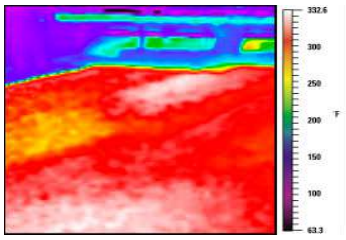
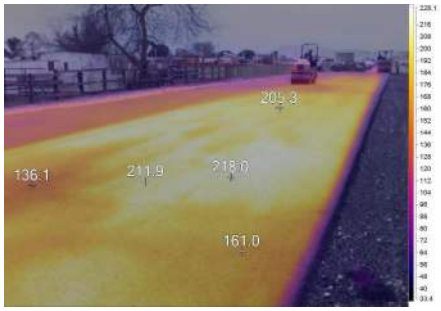
Random Patch – Feeder Erratic





- Feeder system runs erratic, On / Off, fast slow
- Large aggregates separate and roll into dead areas
- Under center chain case, auger bearing cases, tractor mainframe break
- Patches move around, appear and disappear, as feeder system changes
- Results from inconsistent paving speeds, too

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Random Patch – Sensor Position

- Important troubleshooting step
- Re-aim sonic feeder sensor
- Major factor in feeder system problems

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Continuous Stripe

- Easily confused with texture stripes
- Open texture appearance
- Presence of mostly large aggregate in the stripe
- Almost always caused by feeder system operation or set-up
- Follow the stripe to its source at the paver

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Continuous Stripe – Damaged Strike-off ?

- Hitting water valves, manholes, etc.

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Continuous Stripe - Centerline

- Centerline stripe
  - conveyor speed too high
  - auger speed too low
  - anti-segregation kit missing

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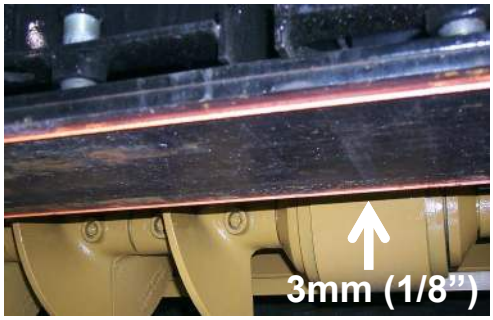
Centerline Stripe - Centerline

- Lead crown installed?
- Worn deflector plate(s)
- Reversing auger(s)



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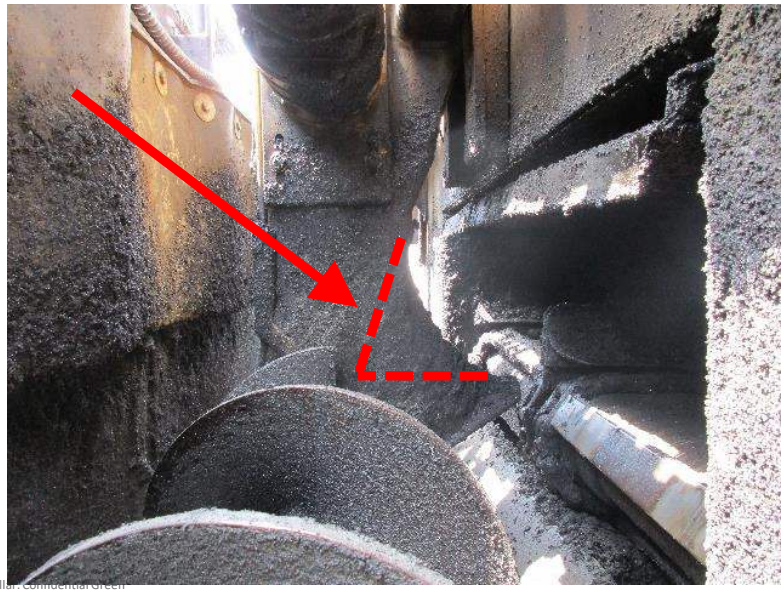
Keep deflector plates clean



- Wear item to be replaced
- Centerline streak

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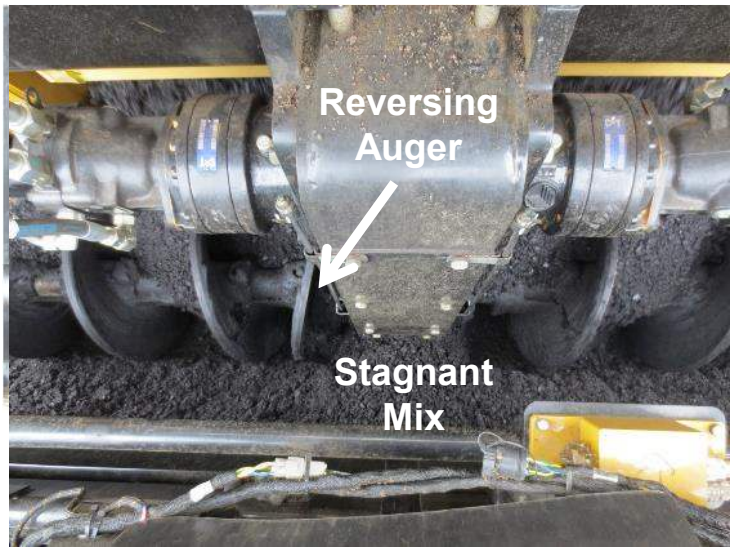
Reversing Augers



- Check condition of reversing augers
- Consider installing one “pull-type” reversing auger
- One auger segment pushing mix and one pulling mix will eliminate stagnant area

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Intermittent Stripe

- Intermittent stripes traced to feeder system
- Left auger erratic
- Head of material erratic
- Left side feeder system running at maximum speed
- Throwing aggregate to create stripe
- Sensor too far from target

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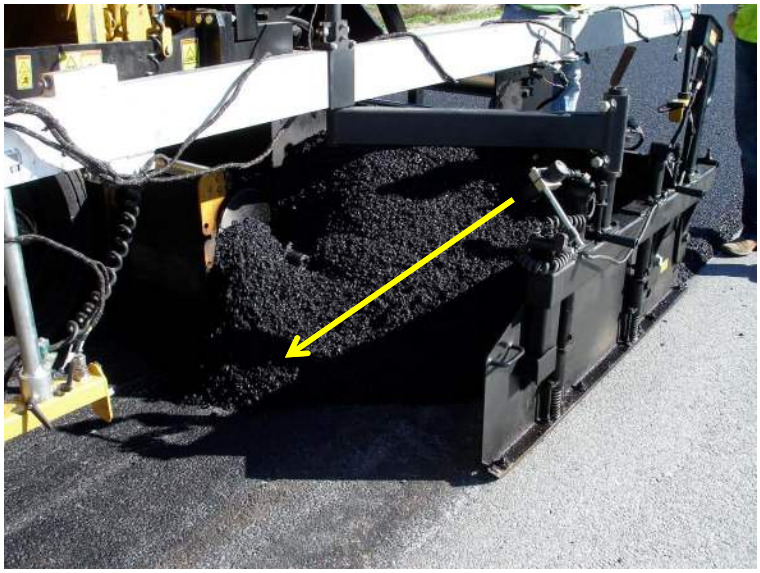
Intermittent Stripe



- Feeder system catches up to the demand
- Extension over-filled
- Auger shuts off
- Stripe stops
- Head of material recedes
- Cycle starts again
- Solutions:
  - more auger / tunnel ext.
  - re-aim sensor
  - adjust mix height dial

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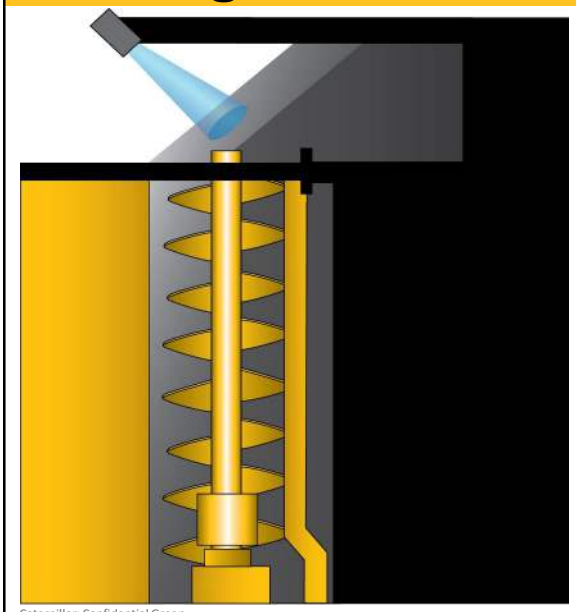
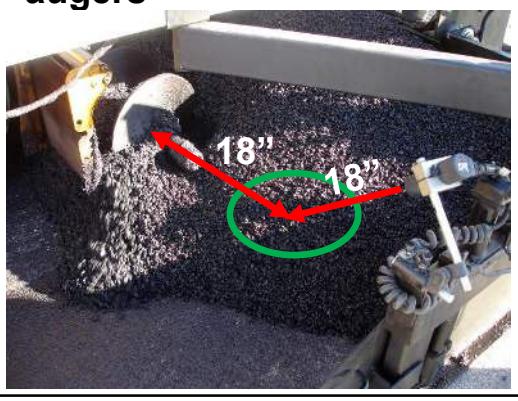
Aiming Sonic Feed Sensors



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



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Auger Speed 20 – 40 rpm

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

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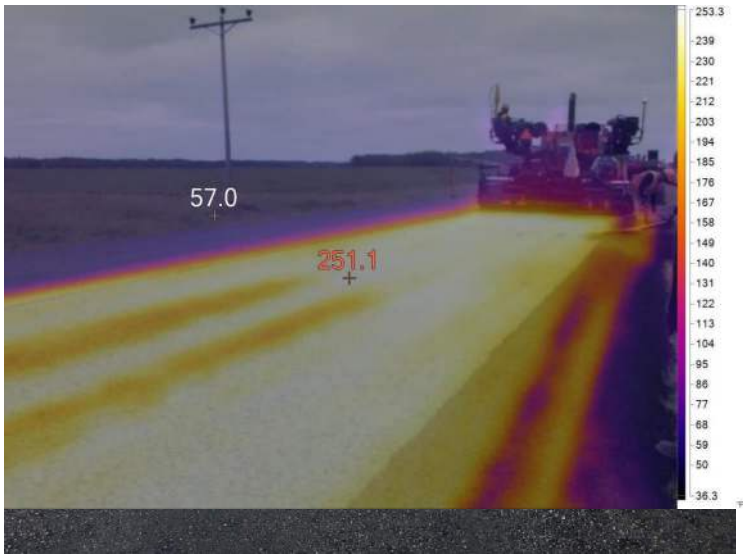
Continuous Stripes - Conveyor Speed



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Paver Speed – Texture & Segregation

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

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Changes in Paver Speed

- Changes in paver 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

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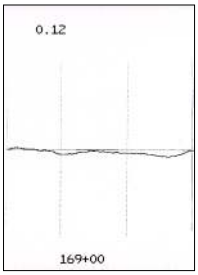
Random Patches - Quick Starts & Stops

- Feed system engages when paver leaves neutral
- Feed starts, paver isn't moving
- Amplifies end-of-load segregation



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Continuous Paving

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

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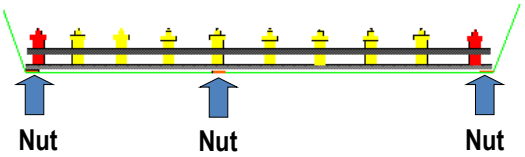
Mat Texture – Screed Condition

- Condition of screed affects mat texture
- Texture striping indicates non-uniform pressure
- Check screed flatness



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Paver Stops & Starts...Screed Settlement

- Smoothness issue
  - Will it roll out?
- Non-uniform compaction
  - Temperature differentials
- Short stops normal
- Stops > 6 min = bump
- Rolls out, no problem

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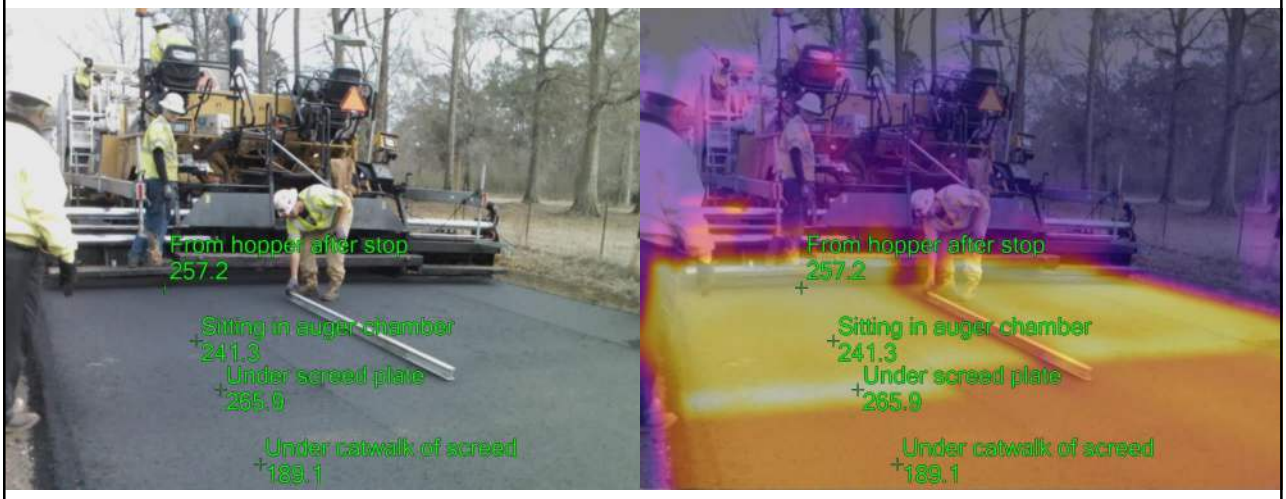
Paver Stops - density & smoothness



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Mat Texture – Auger Shadows

- Texture stripes appear directly behind the augers
- Especially common with large aggregates
- Raise augers until mat is tight and uniform

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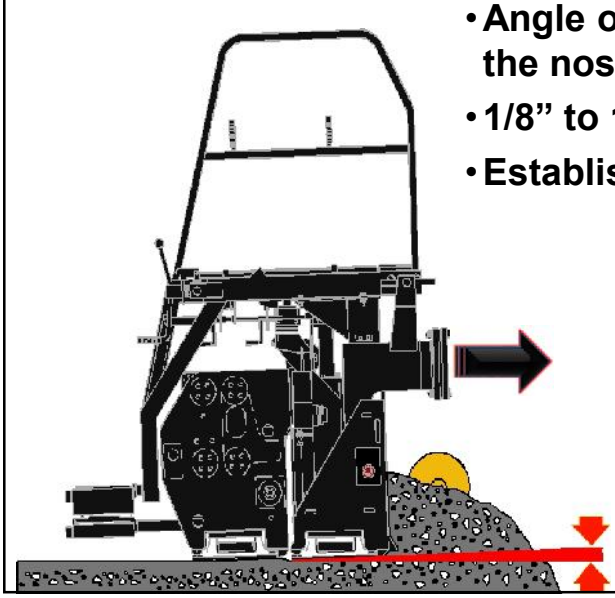
Angle of Attack



- Angle of attack is the relationship between the nose of the screed & the grade
- 1/8” to 1/4” uses all screed plate
- Established at start of each pull

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Mat Texture – Angle of Attack

- Correct angle of attack
- Uniform pressure exerted
- Uniform tight texture

- Slightly low angle of attack
- Different pressure
- Slightly open texture

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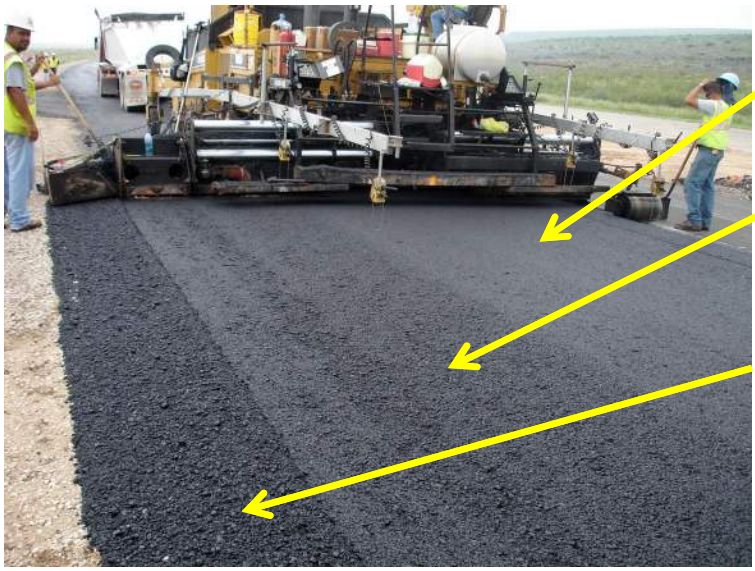
Mat Texture – Angle of Attack



- Correct angle of attack
- Flat angle of attack
  - adjustment needed
- Slough box
  - no adjustment possible

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Mat Texture – Angle of Attack Corrected

- Surface texture uniform after adjusting angle of attack
- Open texture behind strike-off slough box unavoidable

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Auger Extensions & Tunnels

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

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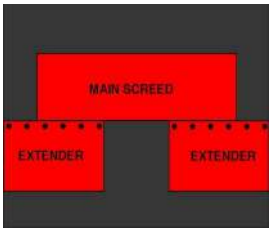
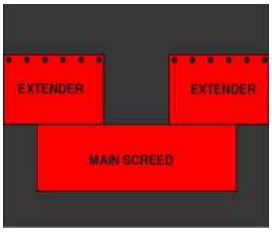
Front-mount and Rear-mount Screeds

Front-mount



Direction of paving

Rear-mount



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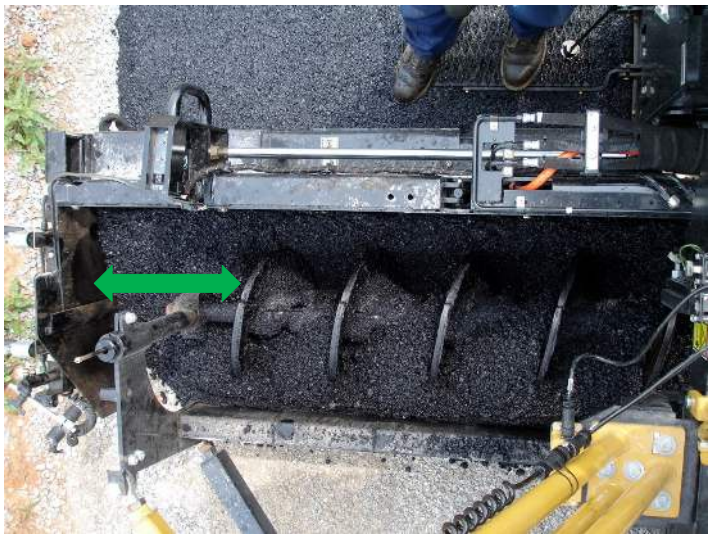
Front-mount Screeds



18” with front-mount

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Rear-mount Screeds

36” with rear-mount

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Always Extend Tunnel in front of Augers

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Continuous Stripe

- Improperly positioned feed sensor
- Crew is overloading
- Mix is 'rolling' around mainframe, creating stripe in the mat
- Need more auger extensions
- Need mainframe (tunnel) extensions

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Continuous Stripe

- Left extension out 2’
- Mix rolling around mainframe break
- Left extension was retracted from wider width
- Mix trapped between end gate and main screed
- Need to shovel out “dead” area

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Continuous Stripe - Rear Mount Screed

- “Dead zone” of cold, stagnant mix can leave stripes
- How do we fix this?

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Continuous Stripe

- Wide-width paving kit for 6’ extension
- Augers within 2’ of end gate
- Augers covered by mainframe extension
- No stripe in mat

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Mat Texture – Screed Extension Lines

- Continuous line means height mismatch between main screed and extension
- Lined up with outer edge of main screed, extension too high
- Lower extension to erase line

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Mat Texture – Screed Extension Lines

- Lined up with inner edge of screed extension, extension too low
- Raise extension to erase line
- If line re-appears behind outer edge of main screed, use extension slope switch to erase line

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Handwork: Shoveling, luting, raking

- Transverse joints
- Longitudinal joints
- Manholes, valves, etc.

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Don’t Rake Longitudinal Joints!

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“Light Bumping” if Necessary

- May be necessary with ¾” or larger stone mixes
- Where slight height mis-match when joint matching using ski

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Mat Defects Taking 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)
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Cold Screed

Heating element burned out?

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Is this a good place to start?

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What's wrong with this take-off ?

No starter boards!

What's going to happen?

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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")

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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

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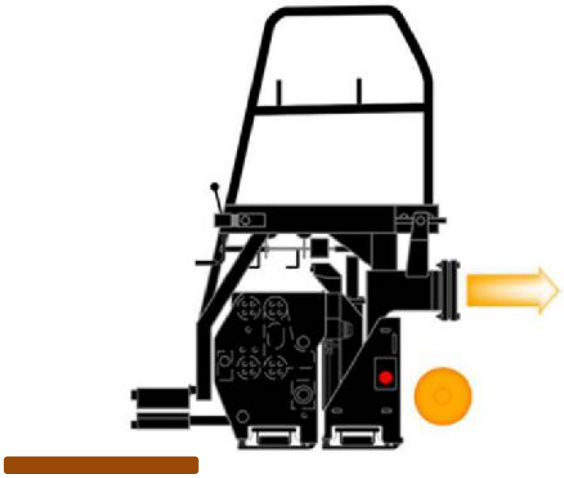
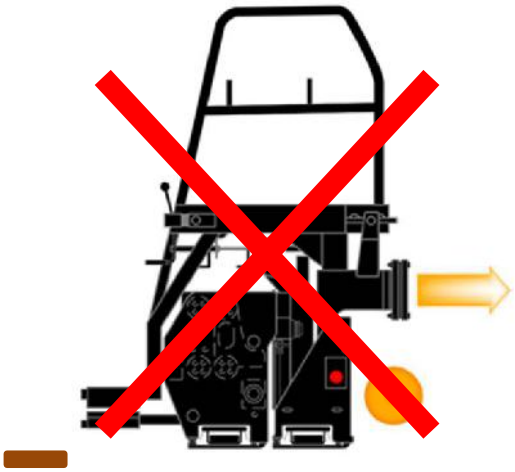
Boards must support main & extenders



Full Support Main & Extenders



Screed will drop or 'nose over'

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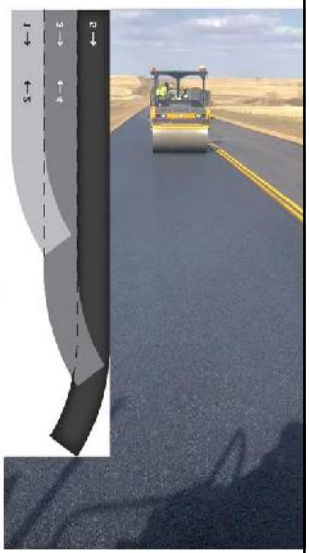
Mat Defects: Rollers



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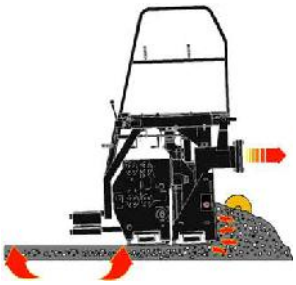
Managing Head of Material @ ½ Auger

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



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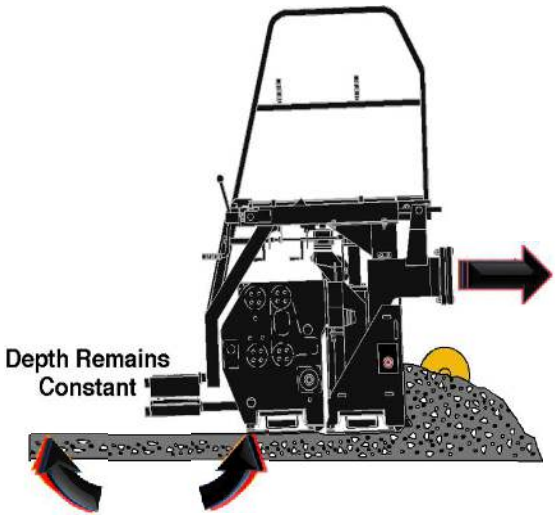
Head of Material @ ½ auger



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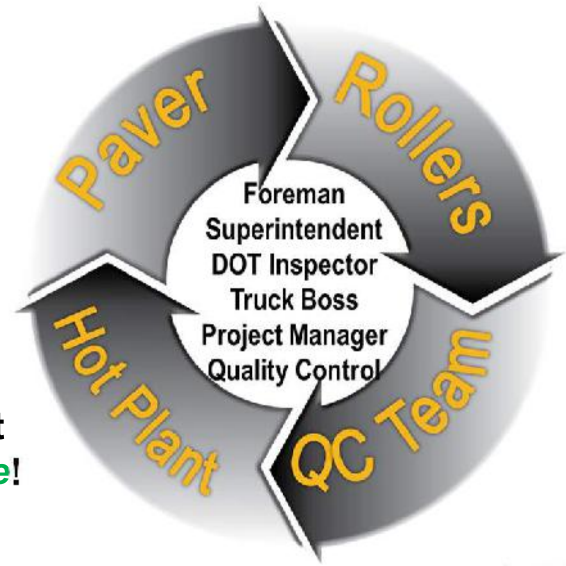
Consistency & Communication are the Keys to Success!

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

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



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Mat Defects Troubleshooting Guide

Causes

Problem	Fluctuating Head of Material	Feeder Screws Overloaded	Finisher Speed Too Fast	Too Much Lead Crown in Screed	Too Little Lead Crown in Screed	Overcorrecting Thickness Control Screws	Excessive Play in Screed Mechanical Connection	Screed Riding on Lift Cylinders	Screed Plates Worn Out or Warped	Screed Plates Not Tight	Cold Screed	Moldboard on Strikeoff Too Low	Running Hopper Empty Between Loads	Feeder Gates Set Incorrectly	Kicker Screws Worn Out or Mounted Incorrectly	Incorrect Nulling of Screed	Screed Starting Blocks Too Short	Screed Extensions Installed Incorrectly	Vibrators Running Too Slow	Grade Control Mounted Incorrectly	Grade Control Hunting (Sensitivity Too High)	Grade Control Wand Bouncing on Reference	Grade Reference Inadequate	Sitting Long Period Between Loads	Improper Joint Overlap	Improper Mat Thickness for Maximum Aggregate Size	Trucks Bumping Finisher	Truck Holding Brakes	Improper Base Preparation	Improper Rolling Operation	Reversing or Turning Too Fast of Rollers	Parking Roller on Hot Mat	Improper Mix Design (Aggregate)	Improper Mix Design (Asphalt)	Mix Segregation	Moisture in Mix	Variation of Mix Temperature	Cold Mix Temperature
Wavy Surface – Short Waves (Ripples)	✓	✓	✓				✓	✓		✓										✓	✓	✓	✓						✗	✗			✗	✗	✗	✗	✗	
Wavy Surface – Long Waves	✓	✓				✓	✓	✓					✓	✓						✓			✓	✓			✗	✗	✗		✗	✗			✗		✗	
Tearing of Mat – Full Width			✓						✓		✓															✗							✗	✗	✗	✗	✗	✗
Tearing of Mat – Center Streak					✓				✓		✓			✓	✓																							✗
Tearing of Mat – Outside Streaks				✓					✓		✓	✓		✓				✓																				✗
Mat Texture – Nonuniform	✓	✓	✓					✓	✓	✓	✓		✓					✓	✓					✓		✗			✗				✗	✗	✗		✗	✗
Screed Marks							✓																				✗	✗										
Screed Not Responding to Correction			✓				✓	✓		✓										✓						✗							✗	✗	✗		✗	✗
Auger Shadows		✓																																				
Poor Precompaction			✓					✓											✓							✗			✗									✗
Poor Longitudinal Joint	✓	✓				✓		✓												✓	✓	✓			✓					✗								✗
Poor Transverse Joint		✓					✓	✓		✓						✓	✓													✗								✗
Transverse Cracking (Checking)																													✗	✗			✗	✗		✗	✗	
Mat Shoving Under Roller																													✗	✗	✗		✗	✗		✗	✗	
Roller Marks																													✗	✗	✗	✗					✗	
Poor Mix Compaction																													✗	✗	✗	✗	✗	✗		✗	✗	✗

Procedure for Using Table
1. Find problem above.
2. Checks indicate causes related to the paver.
X's indicate other problems to be investigated.

NOTE: Many times a problem can be caused by more than one item, therefore, it is important that each cause listed be eliminated to assure solving the problem.

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Thank-you for your attention!
Questions?

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