

Field Inspection – QC Tips for Paving Crews

Mid-Atlantic Asphalt Expo & Conference
December 6th, 2023



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Carter

CAT

What do we care about?

1. Consistency
2. Density
3. Smoothness
4. Longitudinal Joints
5. Segregation & Mat Texture

Communication!!

Consistency!!

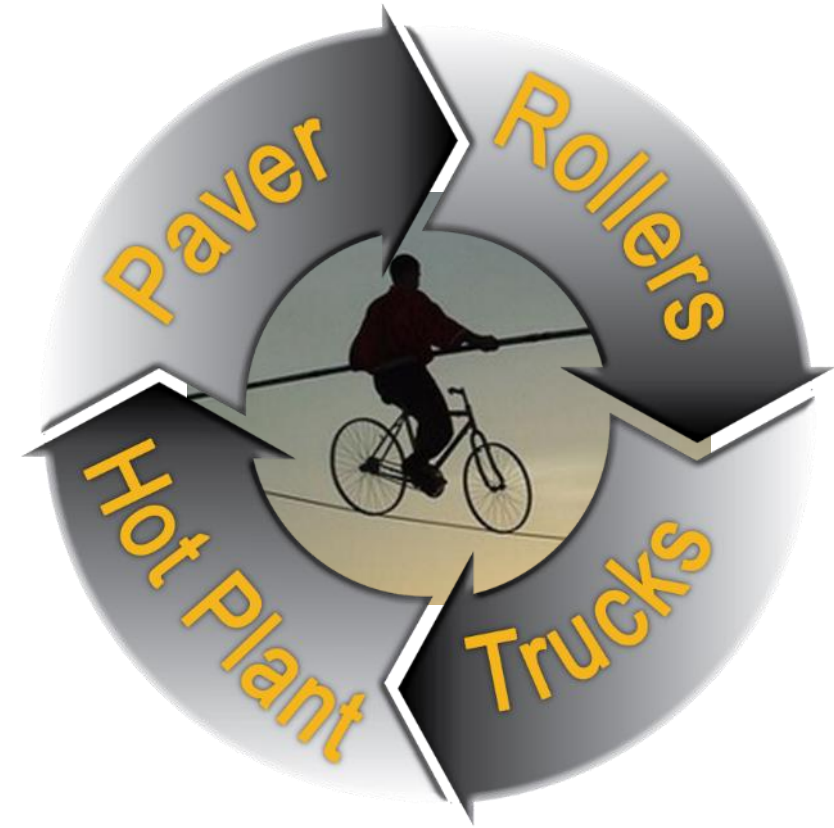


How do we get there?

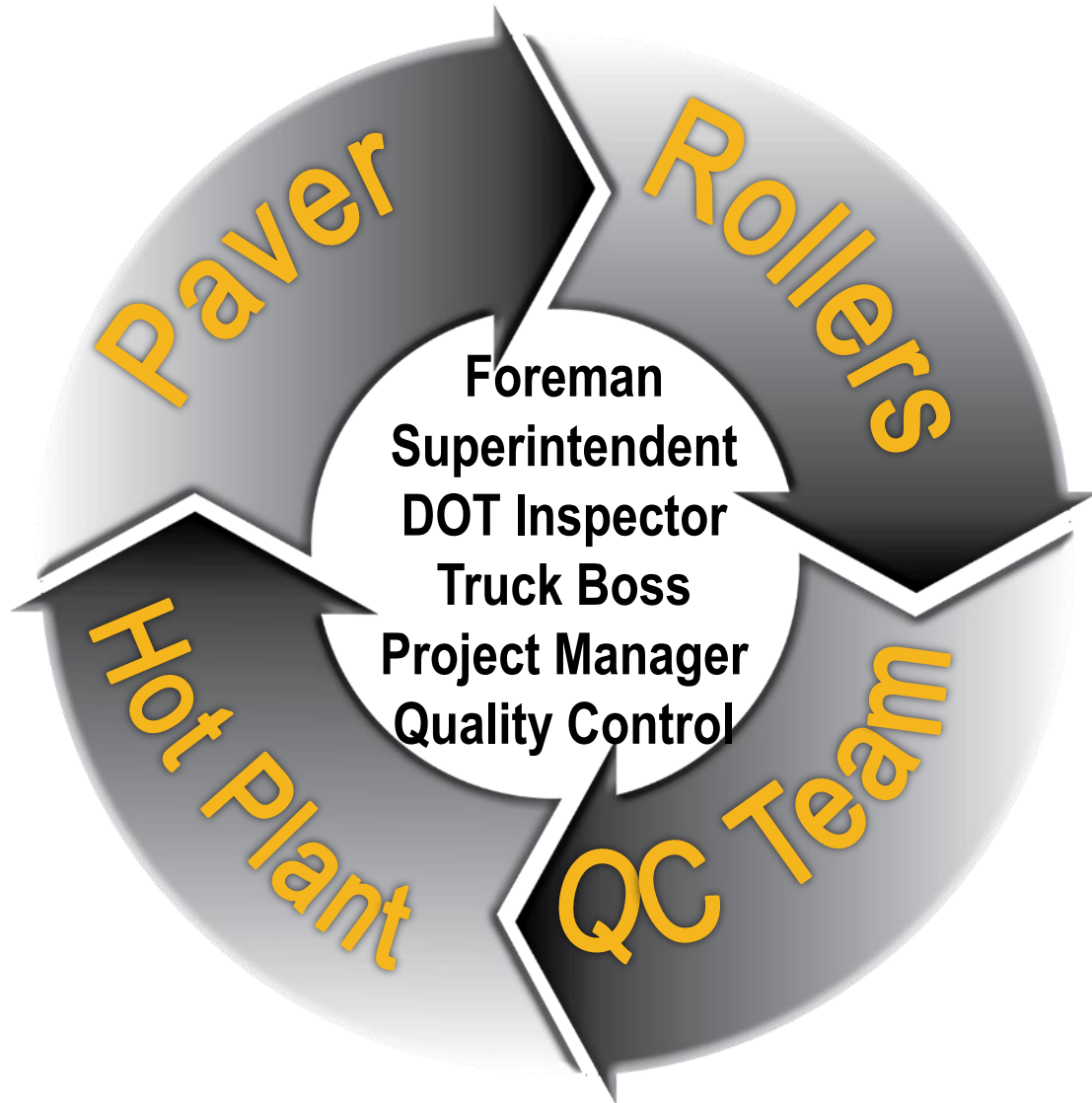
Communication!!



Consistency!!



Talk with each other!



Emergency 911

Makesno Sense	Project Manager	555-234
Lotsa Iron	Equipment Manager	555-234
Alwayson Myphone	Area Superintendent	555-234
Ihate Timecards	Paving Foreman	555-234
Orange Cone	Traffic Control	555-234
Big Mack	Trucking	555-234
Marshall Hammer	Quality Control Manager	555-234
Thirsty Formore	Water truck	555-234
Reemove Andreplace	DOT Inspector on site	555-234
Hot Mixer	Batch room @ drum plant	555-234
Billitoo Anyjob	Equipment dispatch	555-234
I. Fixit	Mechanic	555-234

Consistency: Balanced Paving Operation



- Goal is non-stop paving
- Set to match mix delivery
- Balance paver & roller speed
- Quick starts/stops
- 60 fpm maximum



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

Calculating Constant Paver Speed

CATERPILLAR® **PRODUCTION PLANNING**

Paver Speed Calculator

Trucking
Paver Speed
 Compaction
 Windrow
 Yield
 Slope
 Thickness
 Job Summary
 Legal
 EXIT

General Inputs

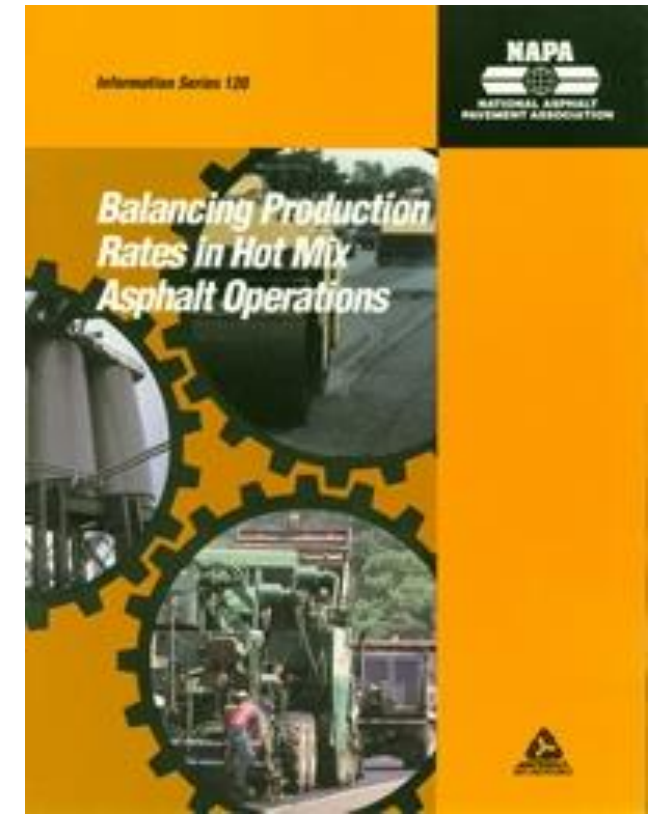
	ENGLISH UNITS	METRIC UNITS
Paving Thickness	2.00 in	50.8 mm
Paving Width	12.00 feet	3.658 meter
Material Density Uncompacted	140 lbs/ft ³	2243 kg/m ³

Paver Speed @ Given Production Rate

	ENGLISH UNITS	METRIC UNITS
Production Rate of Hot Plant	250 tons/hr	227 tonnes/hr
Calculated Paving Speed - 100% Efficiency	29.8 ft/min	9.09 m/min
Calculated Paving Speed - 95% Efficiency	31.3 ft/min	9.54 m/min
Calculated Paving Speed - 90% Efficiency	32.8 ft/min	10.00 m/min
Calculated Paving Speed - 85% Efficiency	34.3 ft/min	10.45 m/min
Calculated Paving Speed - 80% Efficiency	35.8 ft/min	10.91 m/min
Calculated Paving Speed - 75% Efficiency	37.3 ft/min	11.36 m/min

Effective Paving Speed **29.8** ft/min **9.09** m/min

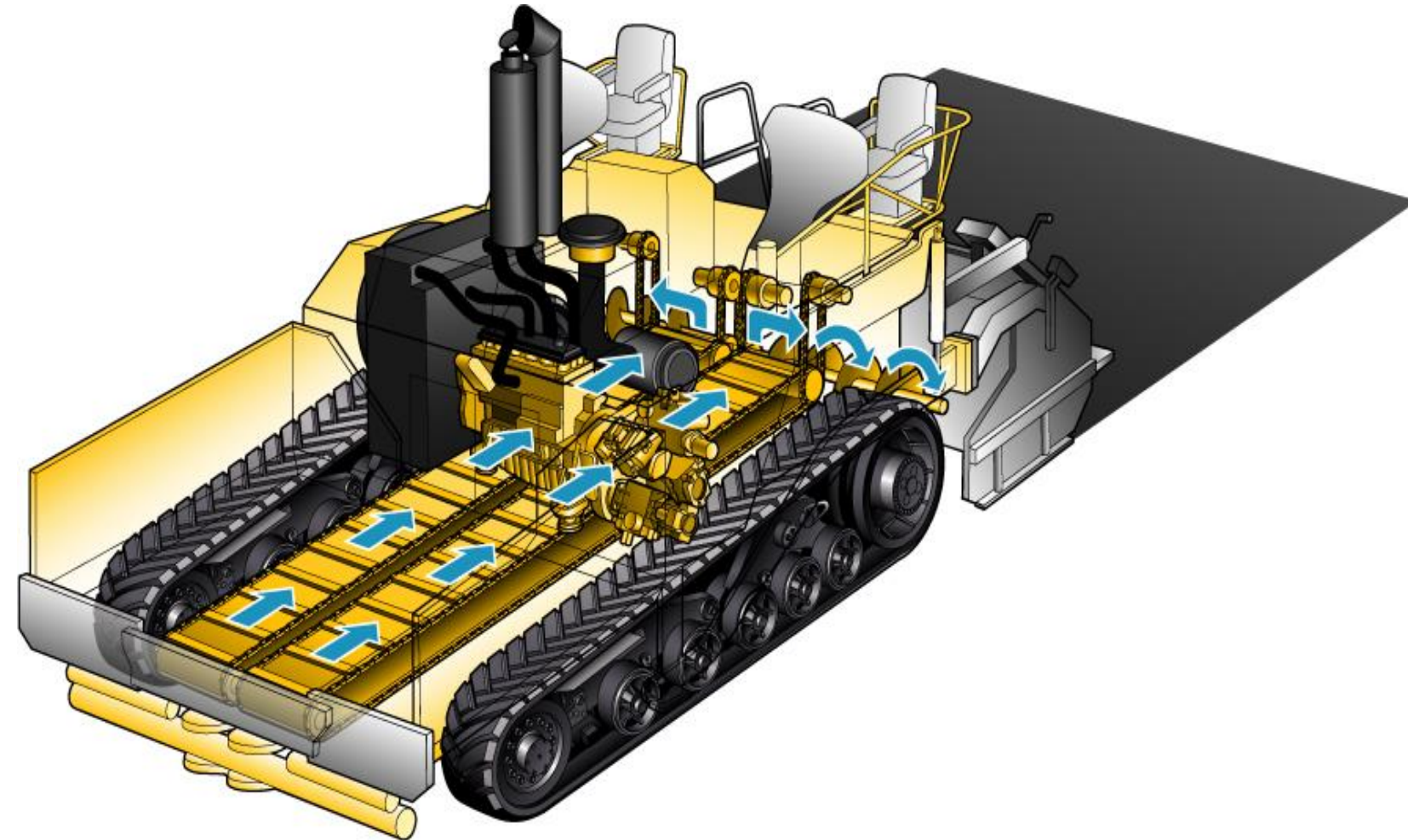
R 2.0



Consistency – “feed system”

Material Feed System

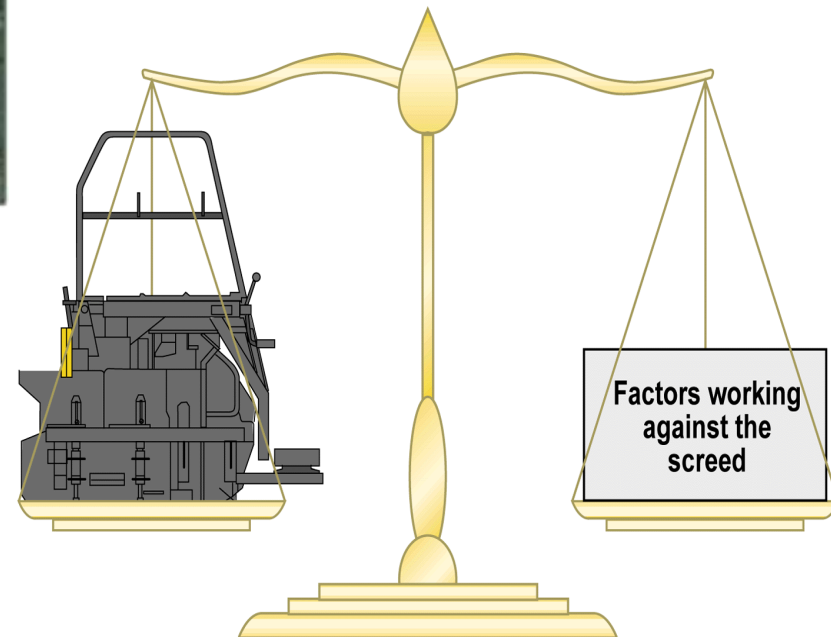
1. Hopper
2. Feeder bars (chains)
3. Adjustable augers
4. Feed sensors



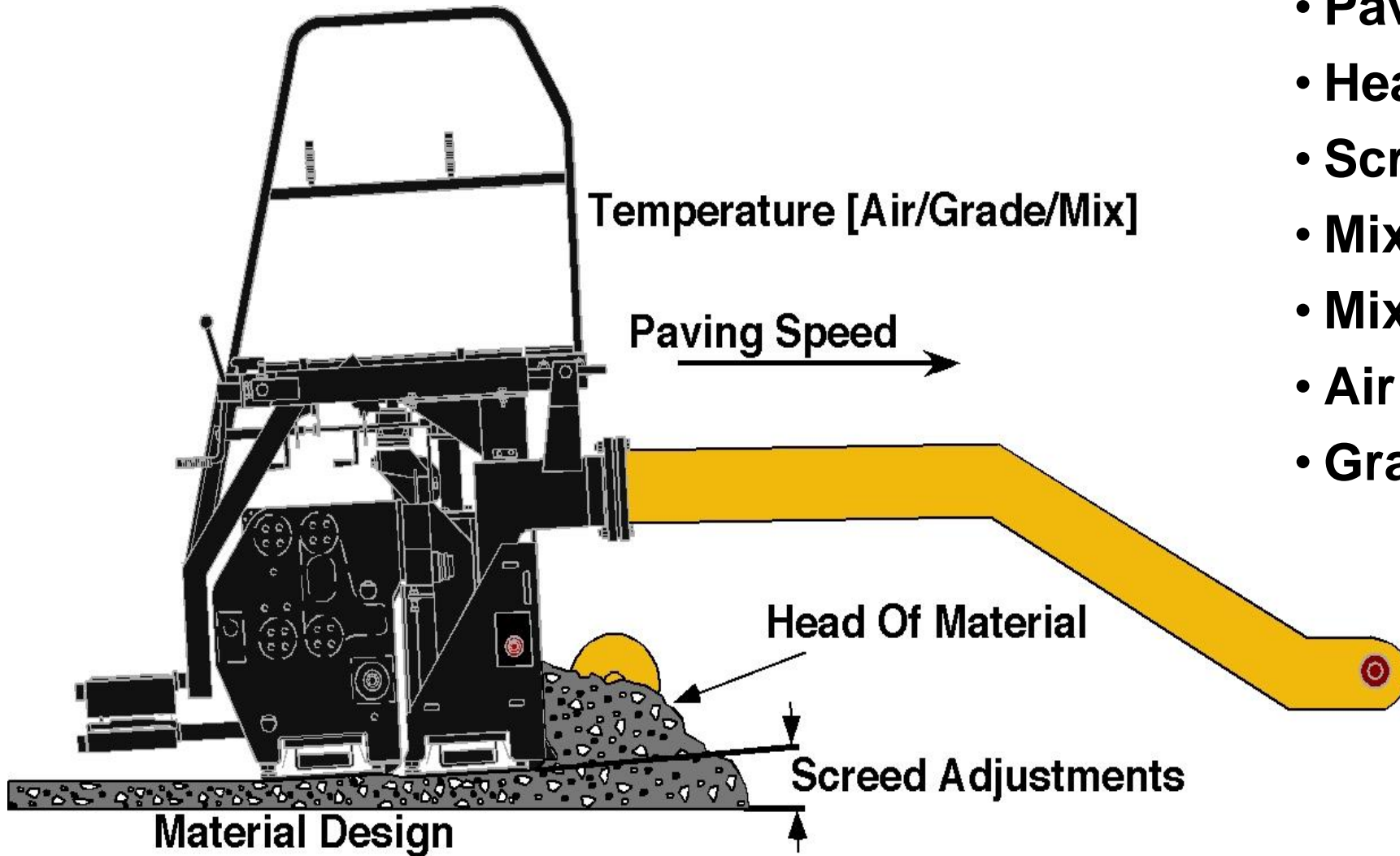
Consistency - Free-Floating Screed



- **Screed position determines mat thickness**
- **Screed position is constant as long as all factors remain constant**



Factors Affecting the Screed



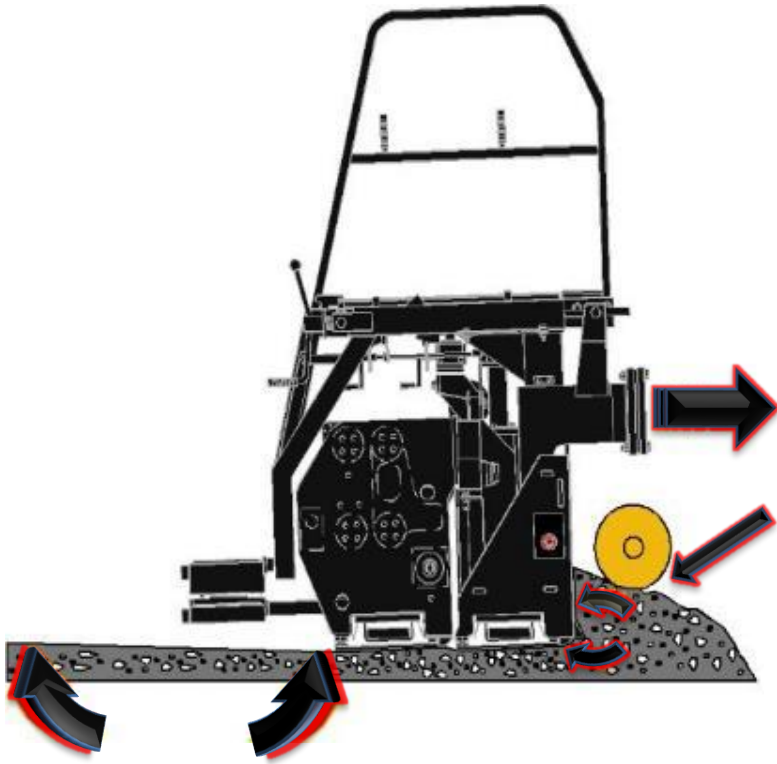
- Paving speed
- Head of material
- Screed adjustments
- Mix design
- Mix temperature
- Air temperature
- Grade temperature

What is “Head of Material” ????



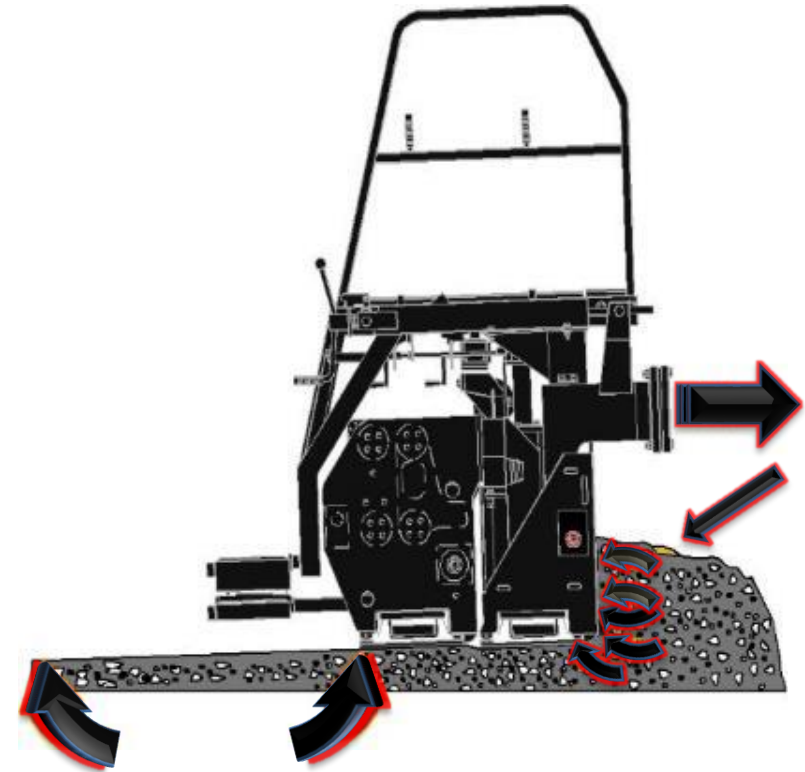
Half auger height

Changes in Head of Material



Head of Material Decreases

- Resistance decreased
- Depth decreases



Head of Material Increases

- Resistance increased
- Depth increases

Head of Material



- Half auger height @ center auger chamber



Managing Head of Material @ 1/2 Auger

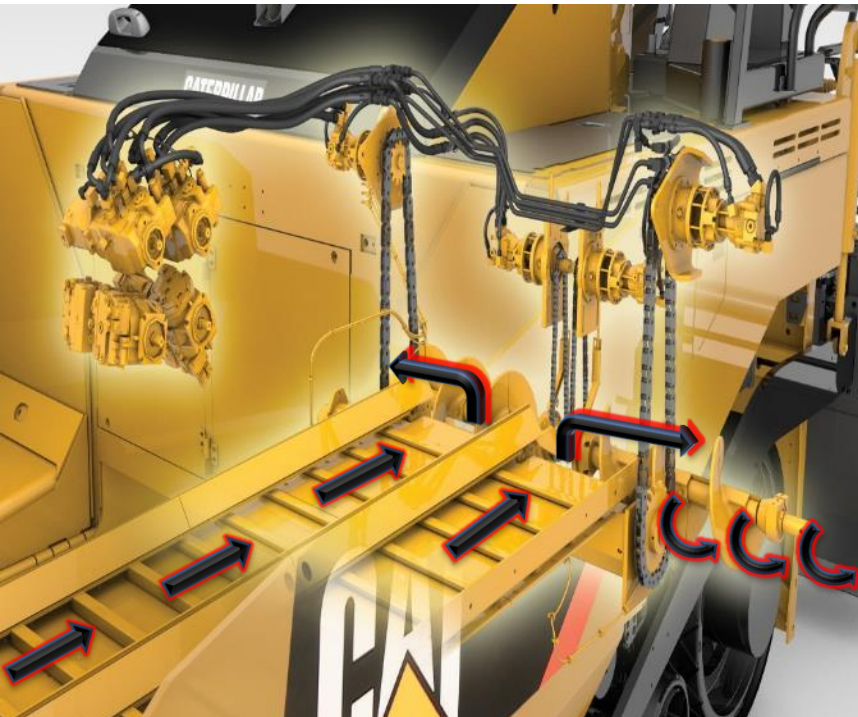


1. Ratio dials (flow gates)
2. Auger height
3. Auger speed
4. Feed sensor position



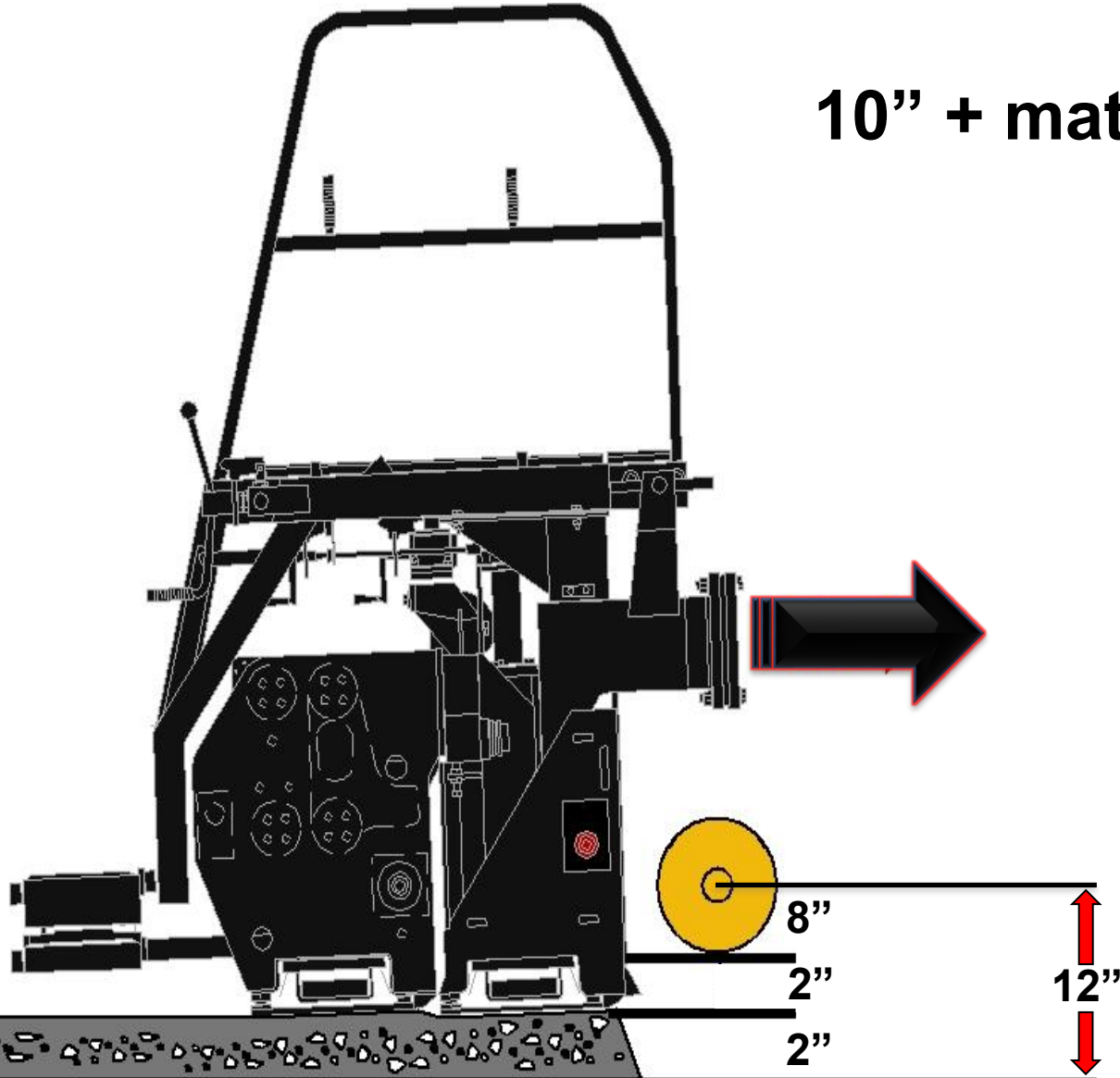
Mix Feed – Conveyor Ratio Dials / Flow Gates

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



Auger Height

10" + mat thickness = auger height



Auger Speed



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

Feed Sensor Position

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



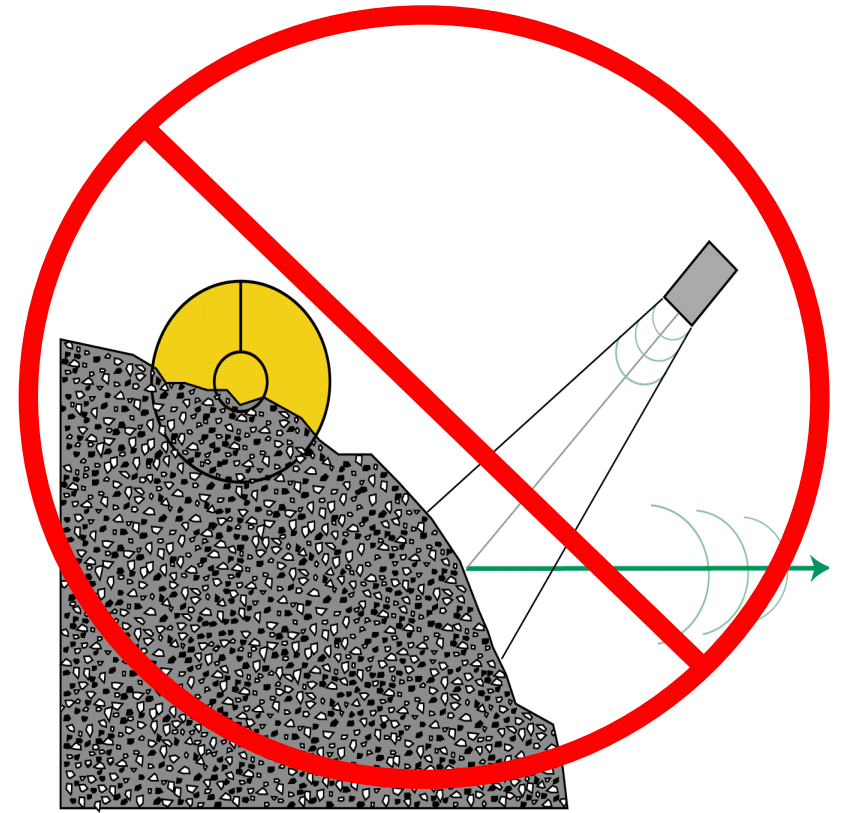
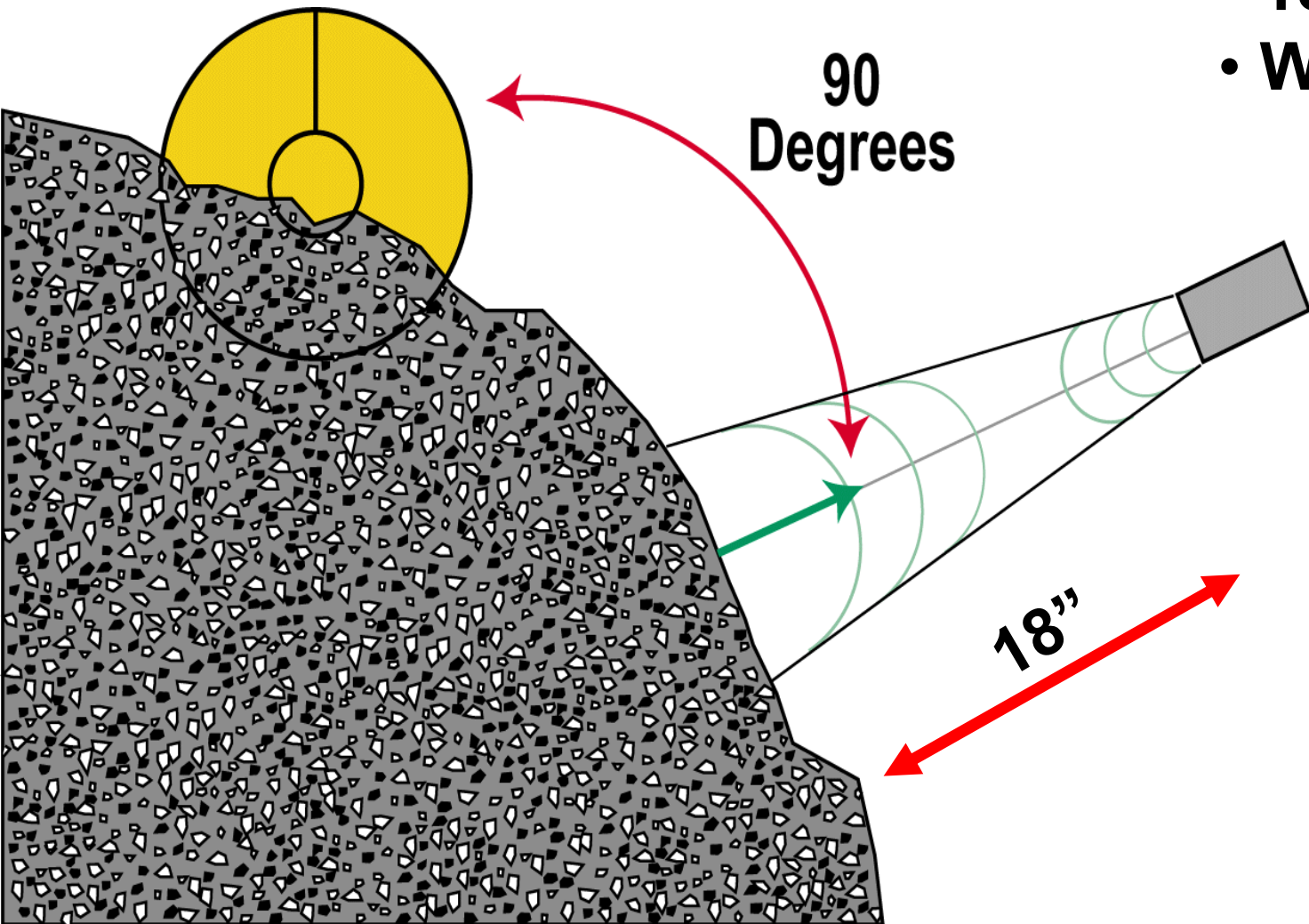
Aiming Sonic Feed Sensors

- 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"



Paddle sensor at 18" and 45°



Mat Texture – on/off augers

- Aim feed sensors for continuous auger movement



Head of Material – common issue



Dip



Bump

Density



- **Temperature**
- **Rolling Pattern**
 - Temp zones
 - Number of passes
 - Roller speed
 - Amplitude, frequency
 - Tender mix
- **Reference density – “Rice gravity”**

Phases of Compaction – “temp zones”

- **Breakdown** – gets majority of density 90% or better
- **Intermediate** – gets final density
- **Finish** – cleans up/removes any roller marks, slight gain density










90%
Breakdown

Intermediate

Finish

Final Rolling Pattern

	Breakdown	Intermediate	Finish
%TMD	90-92%	92-94%	94% + take out marks
			
Temp	280-252°F	252-230°F	200-160°F
Coverage	2 (5-pass pattern)	3 (7-pass pattern)	2 (1 vibrate/1+ static)
Settings	High A, Low F	90 psi	Low A, High F, static
Distance	 120 ft	 200 ft	 200 ft
Speed	252 fpm	300 fpm	350 fpm

Temperature is Critical

320 – 260F Breakdown rolling

260 – 220F Intermediate rolling

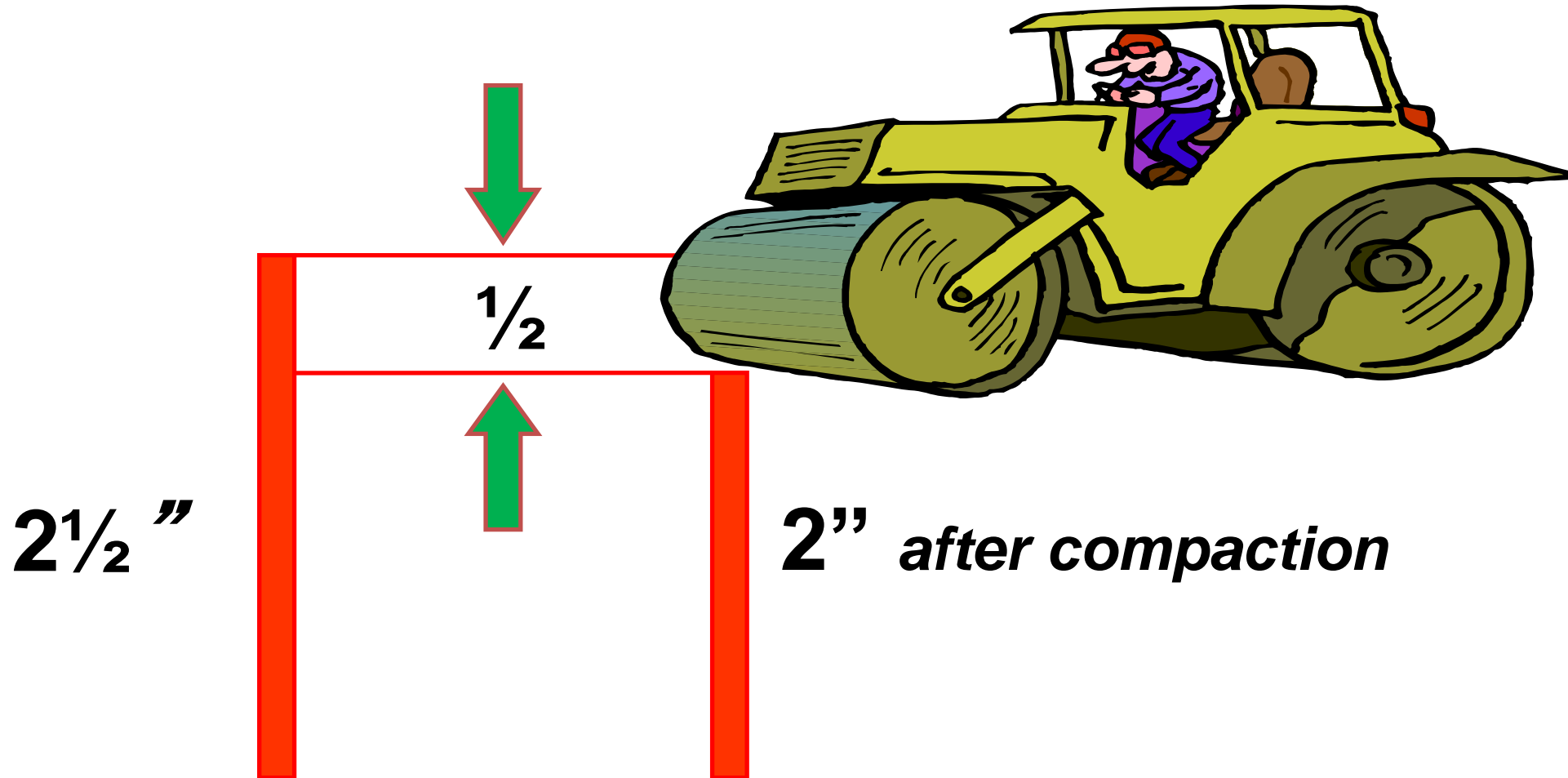
240 – 190F possible tender zone

220 – 160F Finish rolling

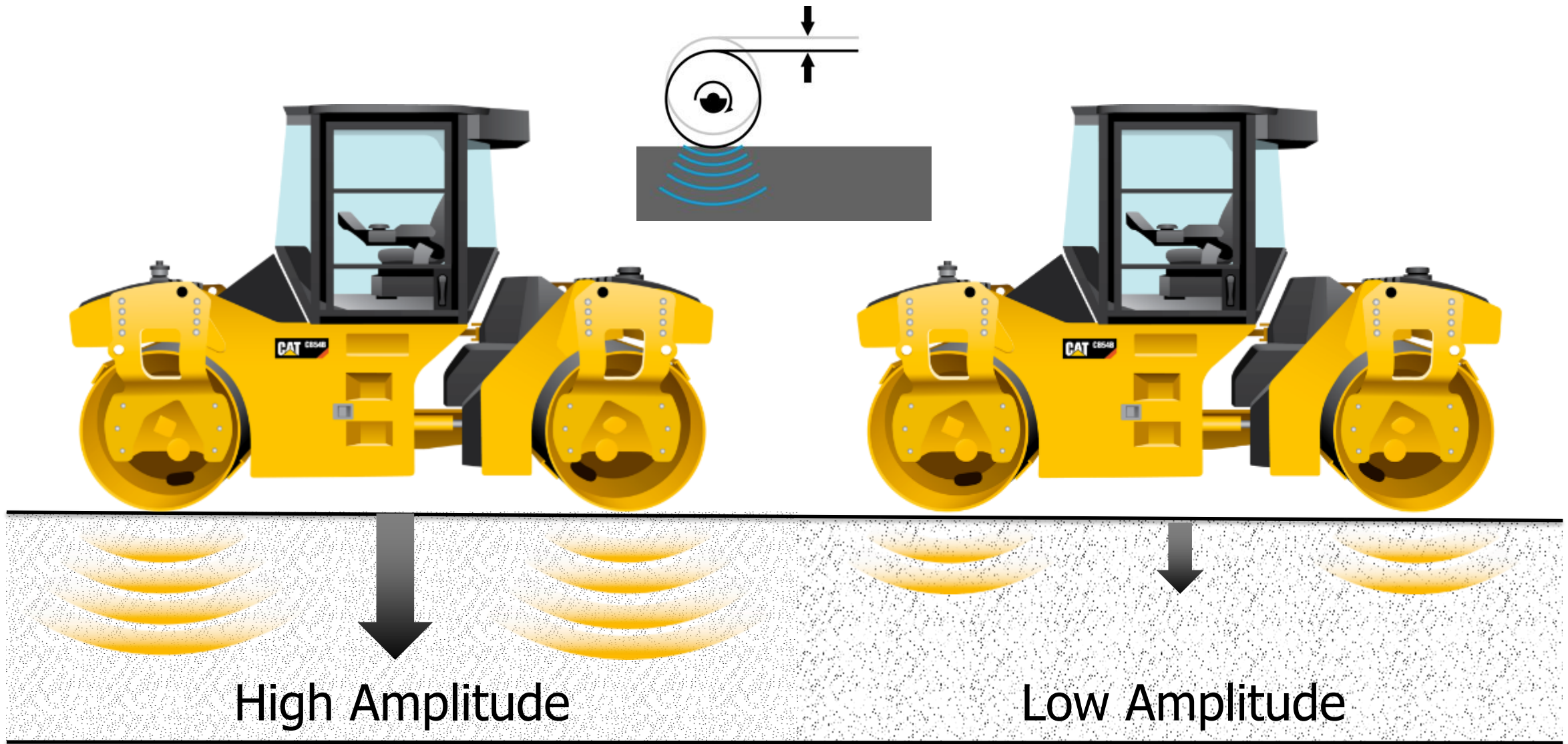
160F – Stop rolling



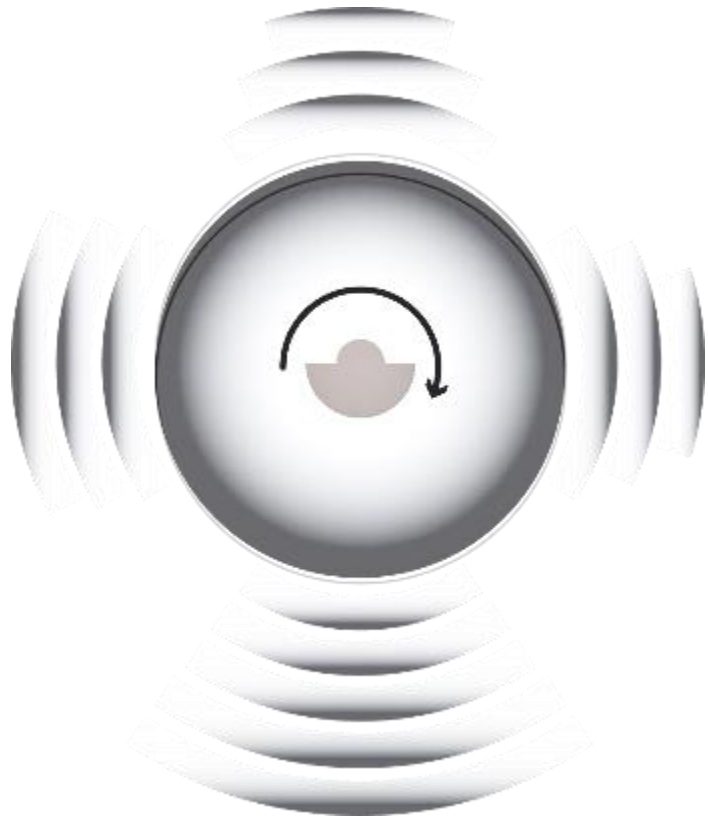
Fluff Factor (roll down) $\frac{1}{4}$ " per 1"



Amplitude = compactive effort



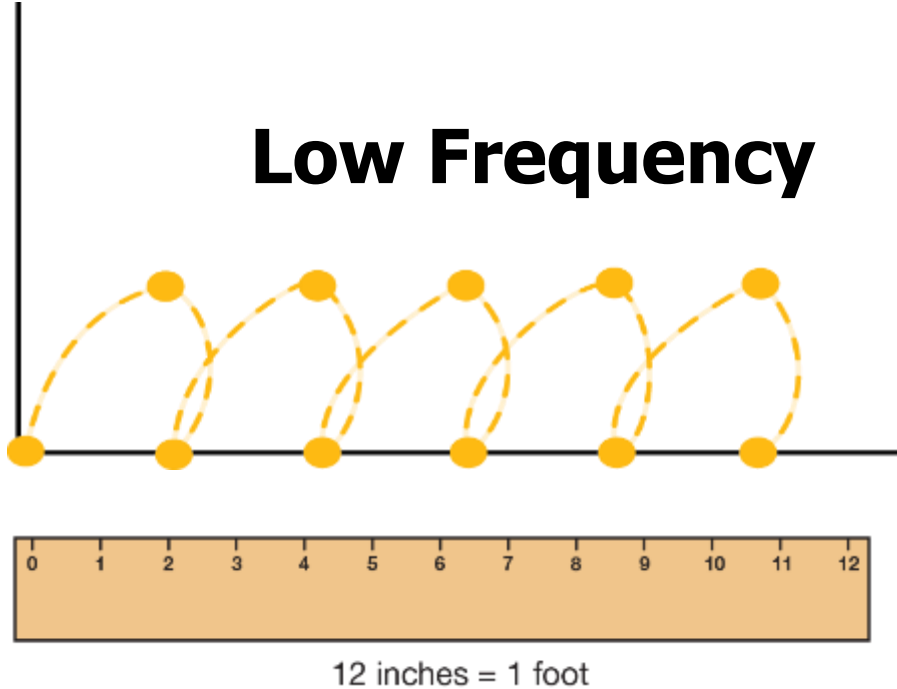
Frequency



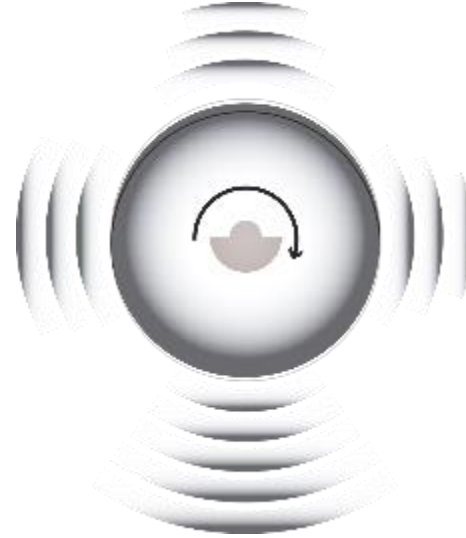
RPM of eccentric weight or shaft in drum

Impacts per foot (IPF)

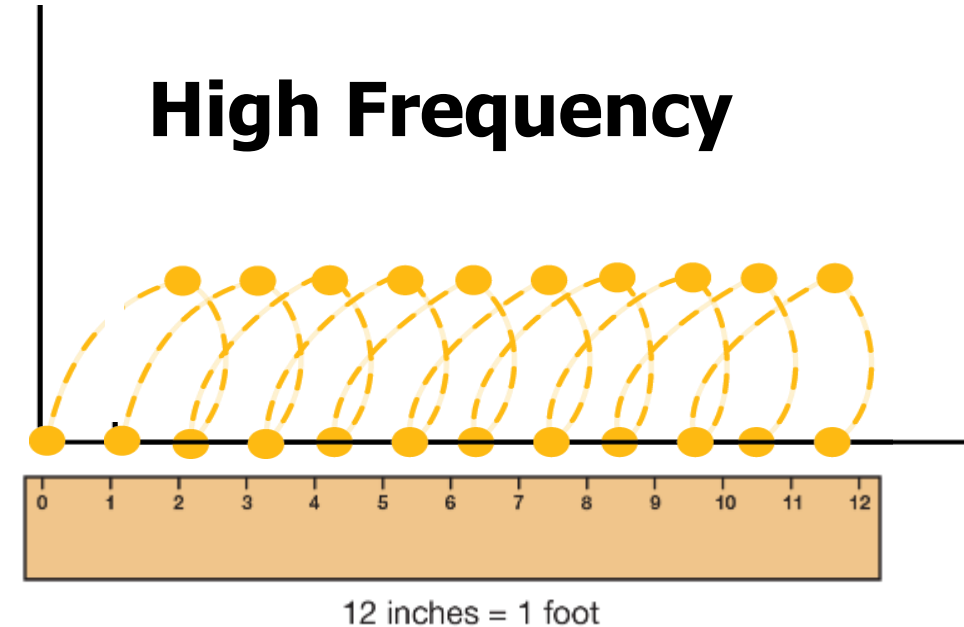
Low Frequency



6 ipf



High Frequency



12 ipf

Roller speed is constant

IPF, Frequency & Roller Speed



10 to 14
Impacts per foot

Roller Speed

$$\text{Roller speed (fpm)} = \frac{\text{Frequency (vpm)}}{\text{Impacts per foot}}$$

$$\text{Speed} = \frac{2,520 \text{ vpm}}{10 \text{ ipf}} = 252 \text{ feet per minute}$$

10 – 14 impacts per foot

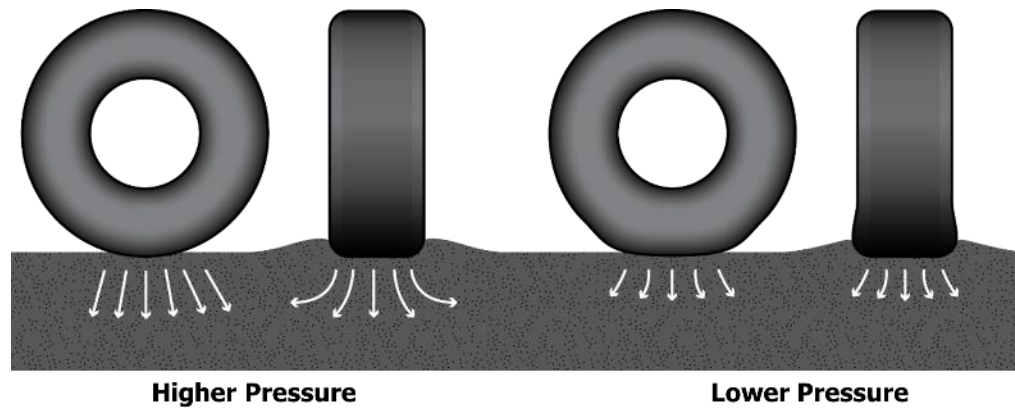


Higher Amplitude \approx Lower Frequency

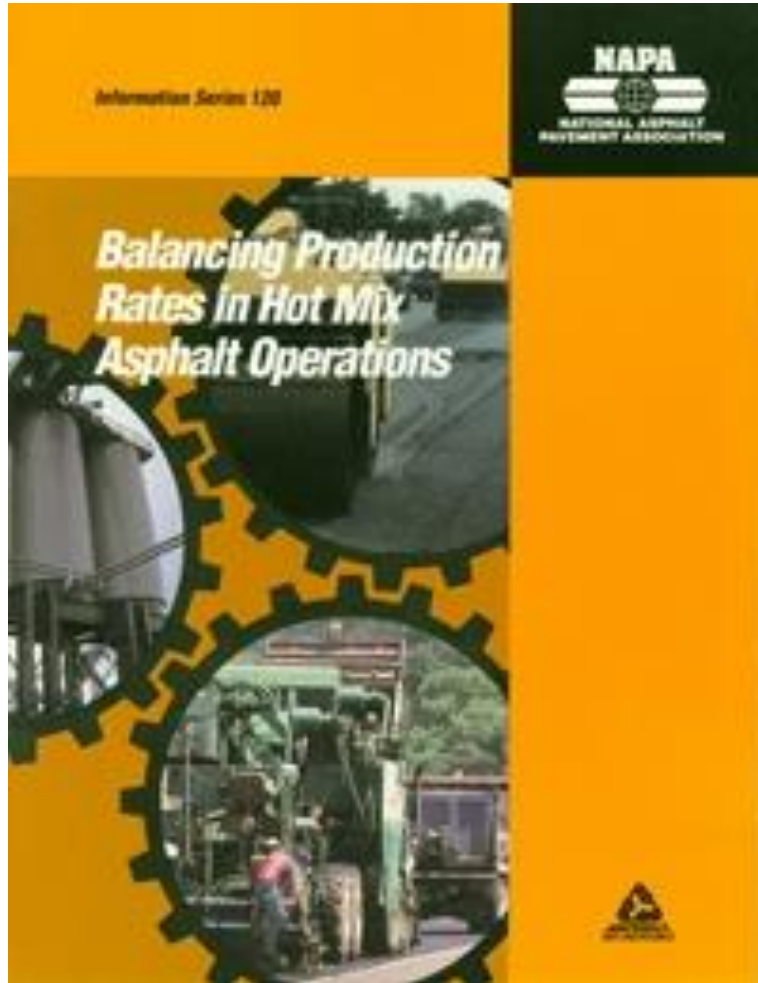
Amplitude	Frequency
0.86 mm	2520 vpm
0.73 mm	2520 vpm
0.44 mm	3800 vpm
0.33 mm	3800 vpm

- When changing to high amplitude, frequency will be lower
- What does this mean?

Pneumatic Tire Rollers



Balancing paver speed & rollers

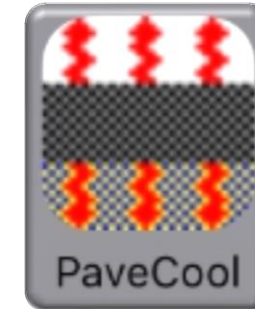


Pre-paving planning

- 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



Smoothness: Constant Paver Speed



- **Constant paver speed**
 - Balanced with mix delivery (trucking)
- **Minimize paver stops**
 - Quick starts/stops
- **Transverse Joints**

Smoothness: Changes in Paver Speed

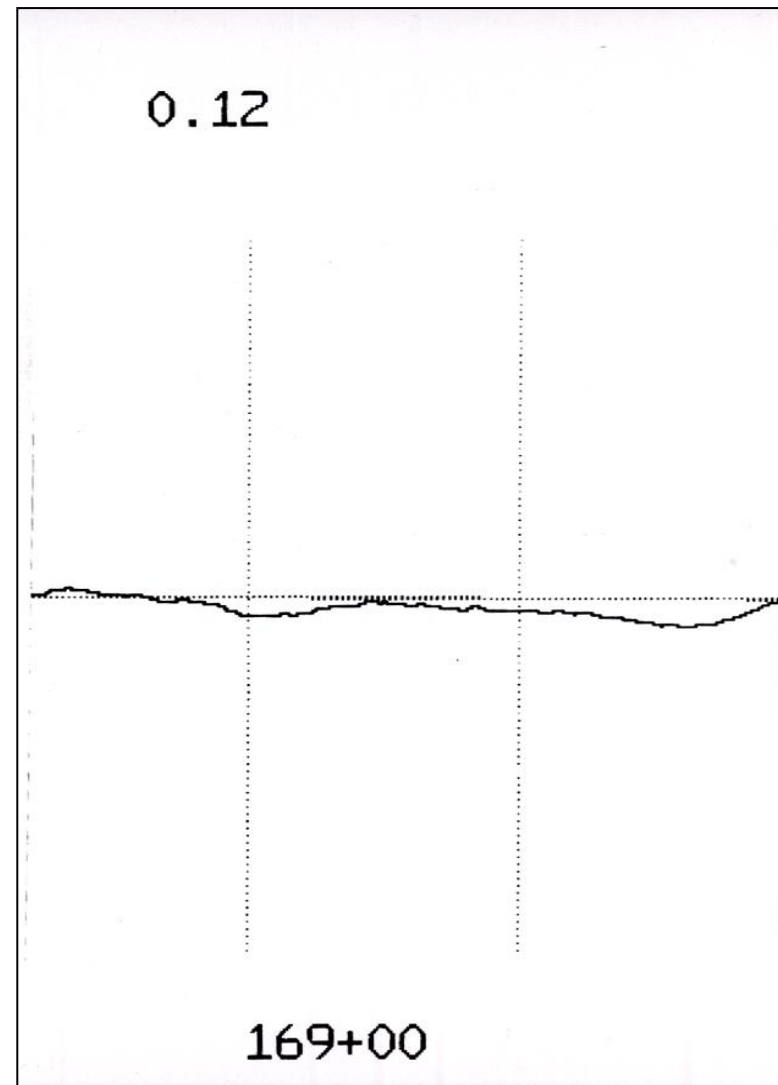
- Changes in paving speed may require feeder system adjustments



- 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



Quick Starts & Stops – Head of Material



Consistency – Take offs



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



QEX01403-04
(Replaces QEX01403-03)

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Taking off: Is this a good place to start?



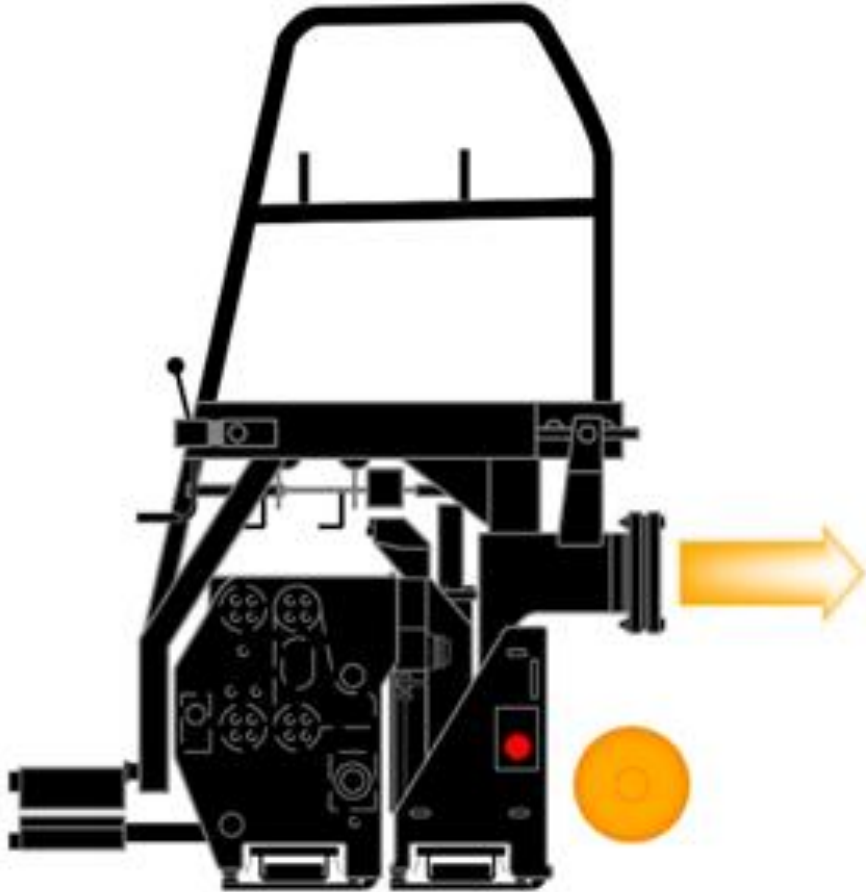
What's this guy doing?



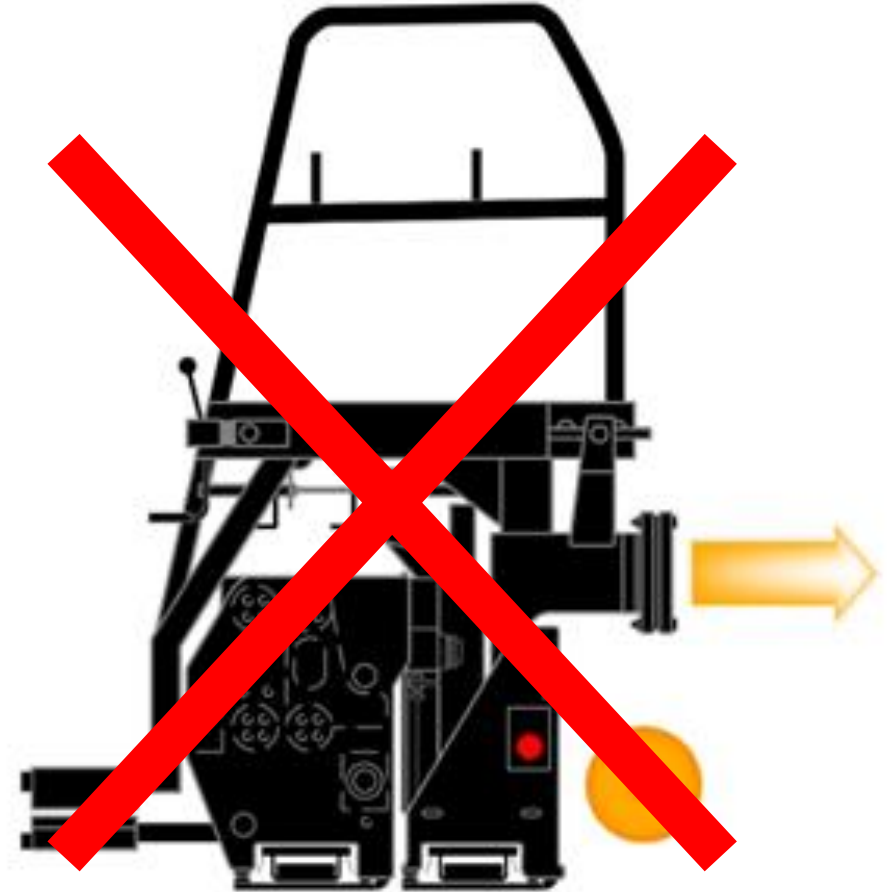
- Calculate thickness of starter boards
- General rule:
 $\frac{1}{4}$ " compaction per 1" loose mix



Boards must support main & extenders



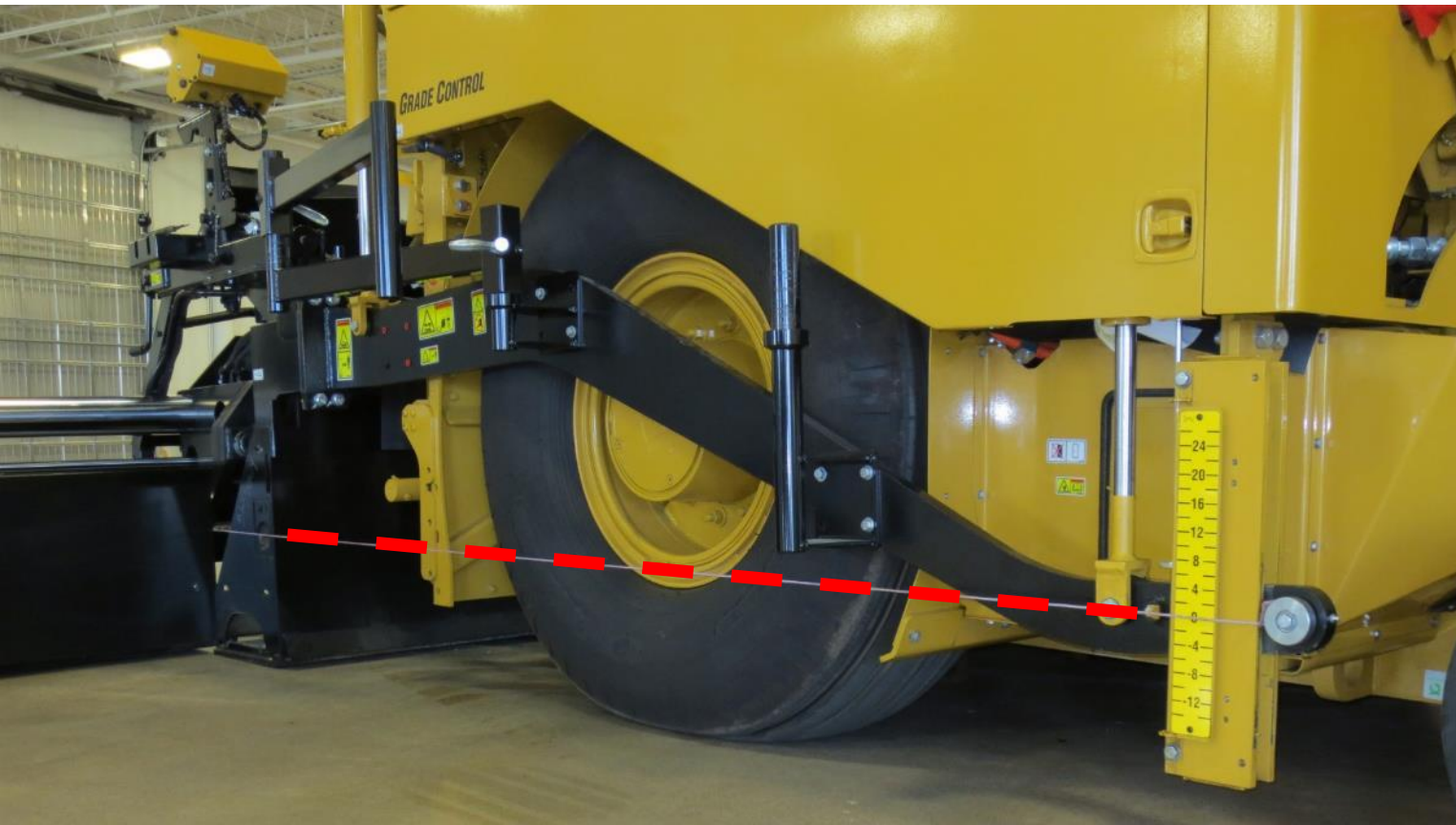
Full Support Main & Extenders



Screed will drop or 'nose over'

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

What's wrong with this take-off ?



No starter boards!

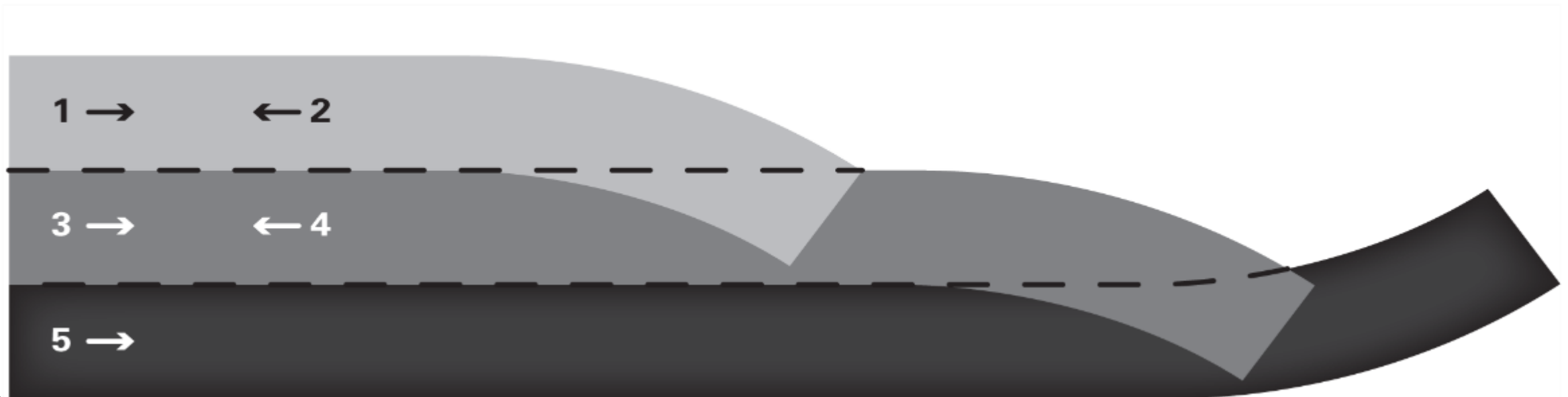
Straightedge tells the story



Stop at an angle to the mat

- Roller stops at an angle
- Turn off vibration just before roller starts turning
- Next pass rolls through stop mark
- Stop marks are staggered

REVERSING



What's wrong with this?

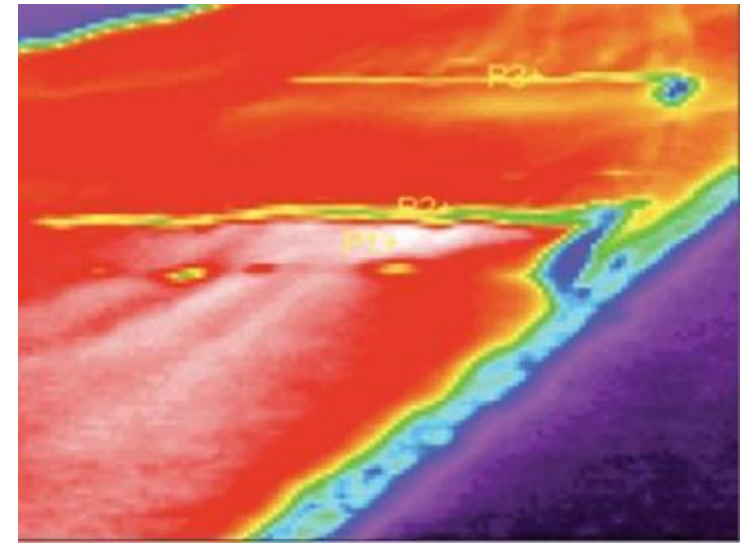


Stop at an Angle to the Mat



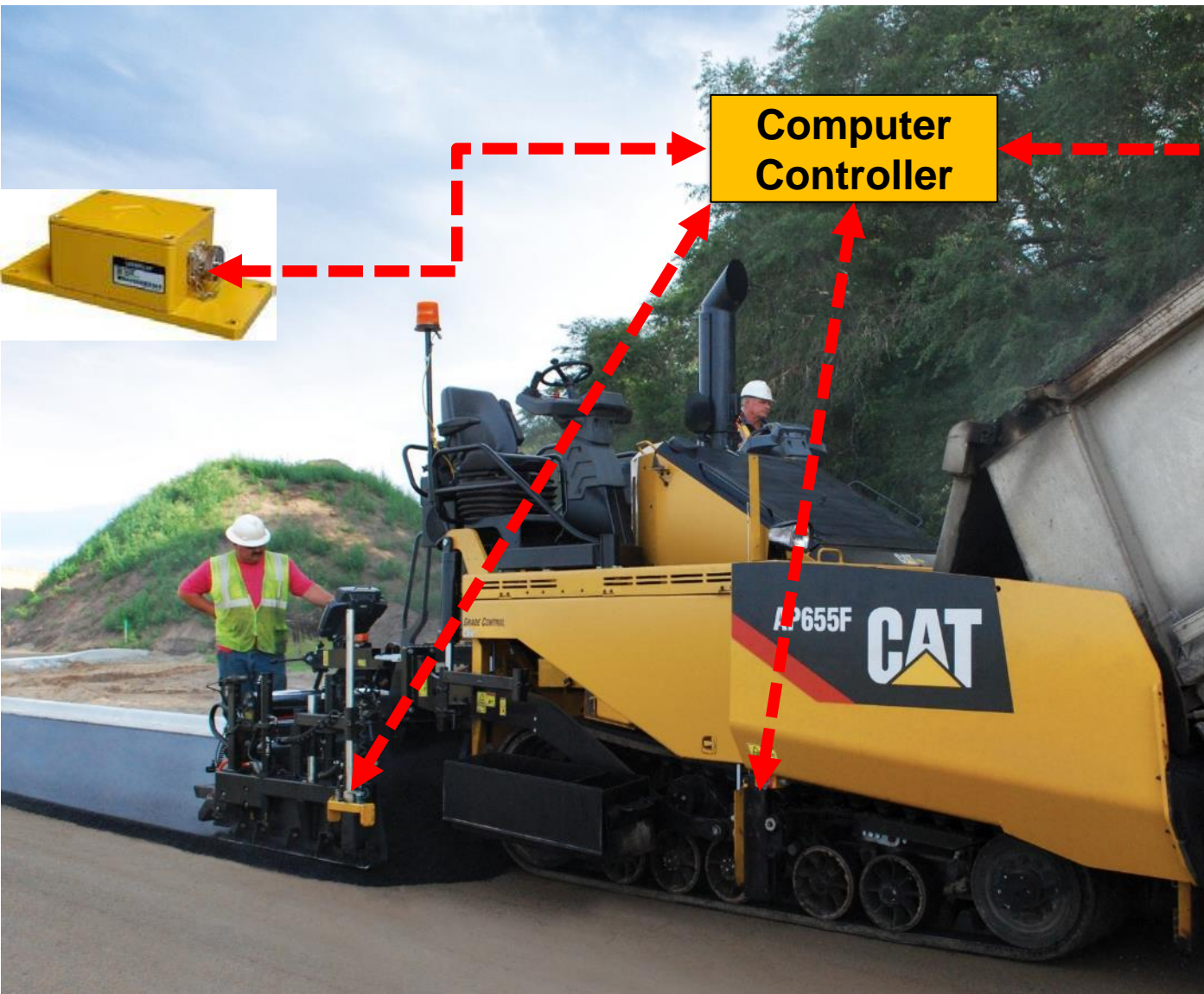
- **Approximately 30° arc**
- **Roll through stop marks on next pass with vibe on**
- **Drum mark will roll out**

Stopping on the Mat



- **Never park on hot asphalt**
- **Leaves dents that will not clean up**
- **Park on cold asphalt**
- **Park on shoulder, if available**
- **Stop on cold mat to change direction**

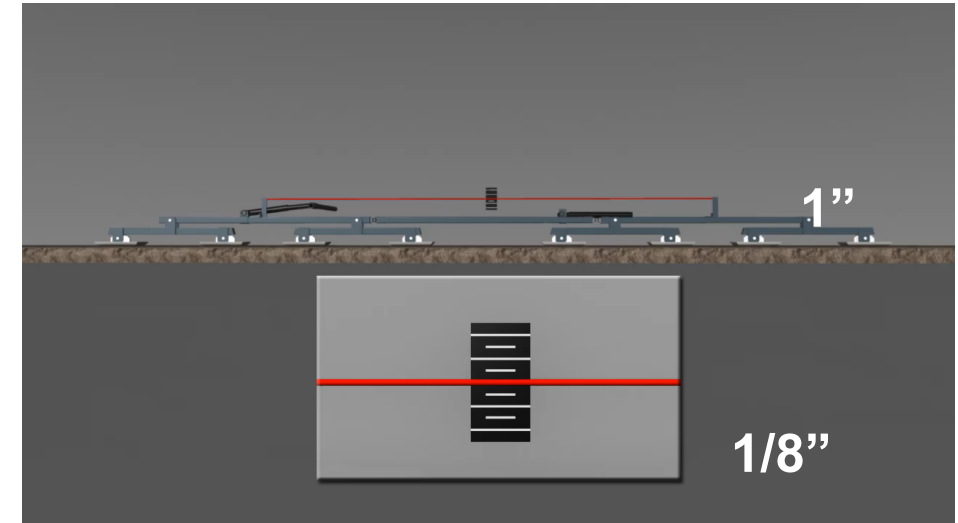
Automatic Grade Controls - Smoothness



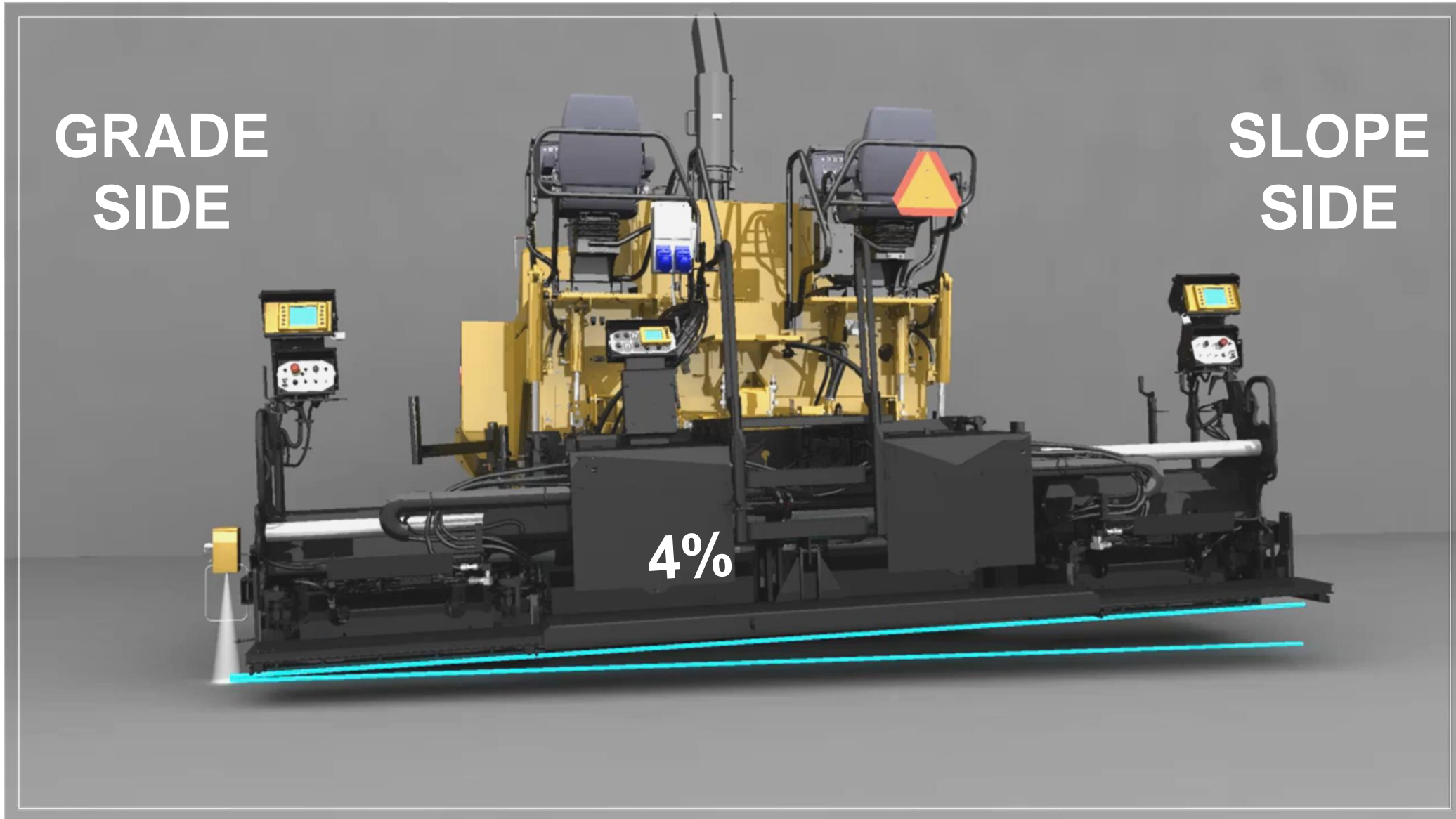
Averaging Ski



- Provides Smoother Mat
- Deviation at center is reduced by factor 1/8 with drag ski



Slope control is not good for smoothness



Truck Exchange: Paver picks up truck



Truck Exchange: Paver picks up truck



Longitudinal Joints

1. Paver setup
2. Compaction



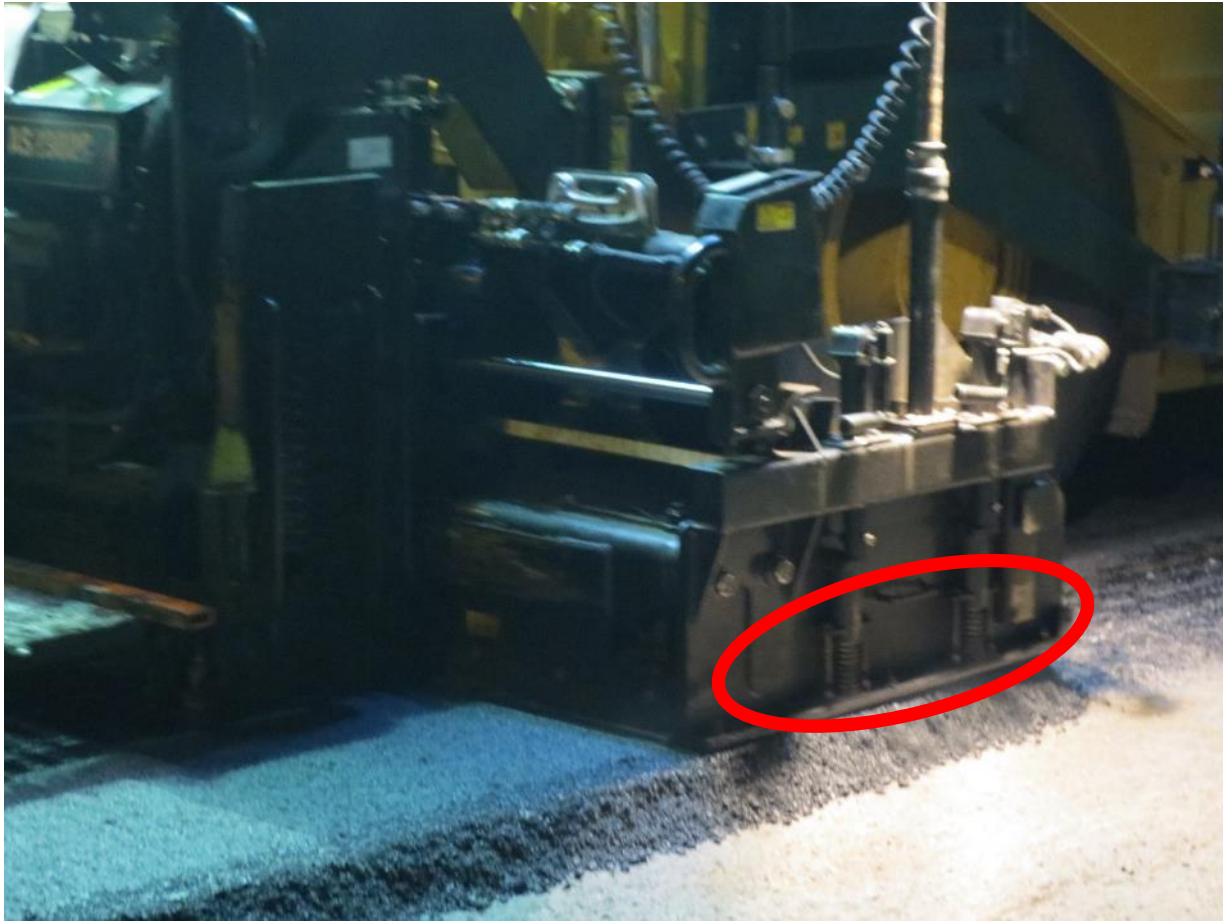
What's going on with these joints?



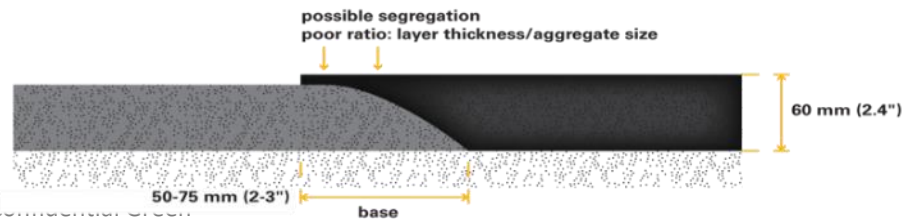
- **Problems getting enough mix to the joint**
- **It looks terrible!!**



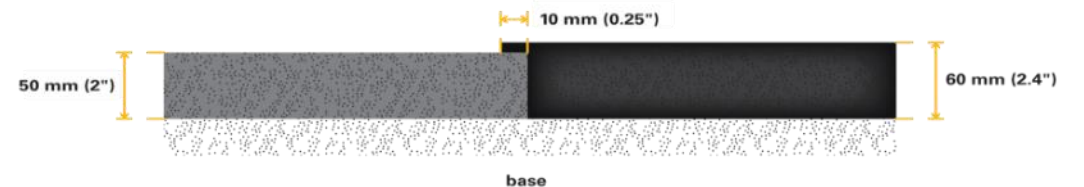
End Gates: Clean springs & slides daily



INCORRECT SQUARE JOINT — END GATE UP



CORRECT SQUARE JOINT — END GATE DOWN



End Gates Down



Confines the mix – higher density!

First Pass on Unsupported Edge



Longitudinal Joint: Roll from hot side



Locking in the Joint



Locking in the Joint



Sensor Position for Joint Matching



Segregation & Mat Texture

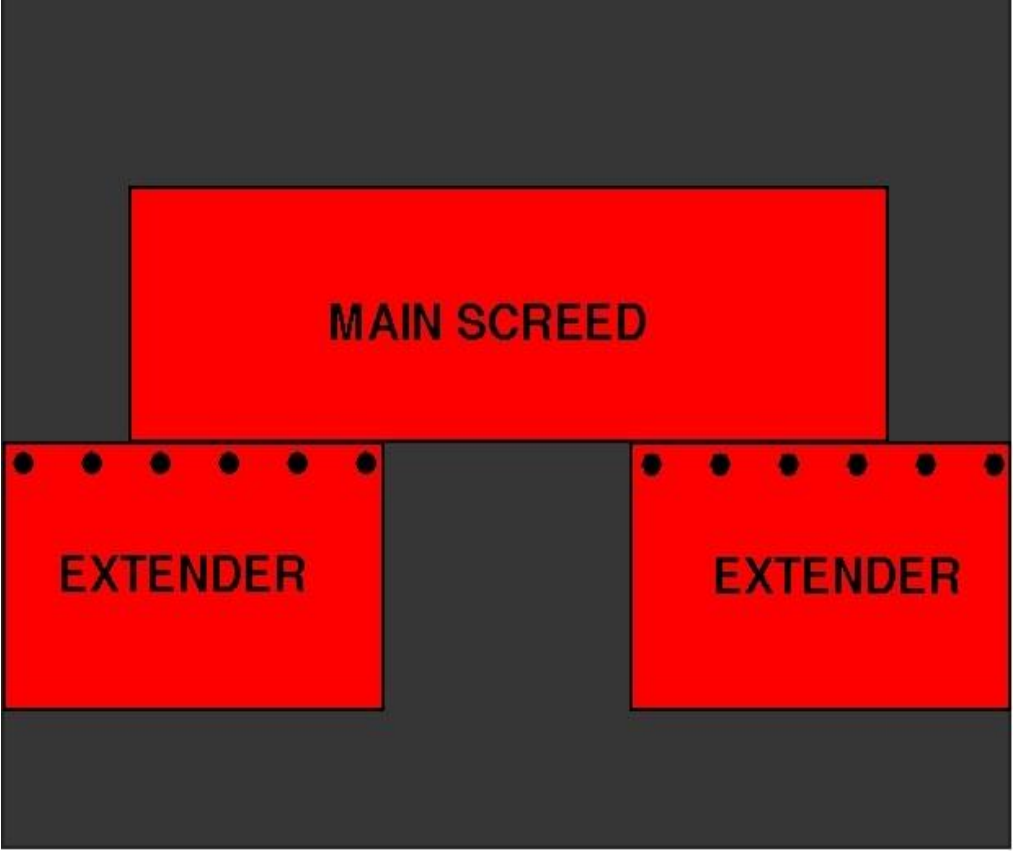
Texture



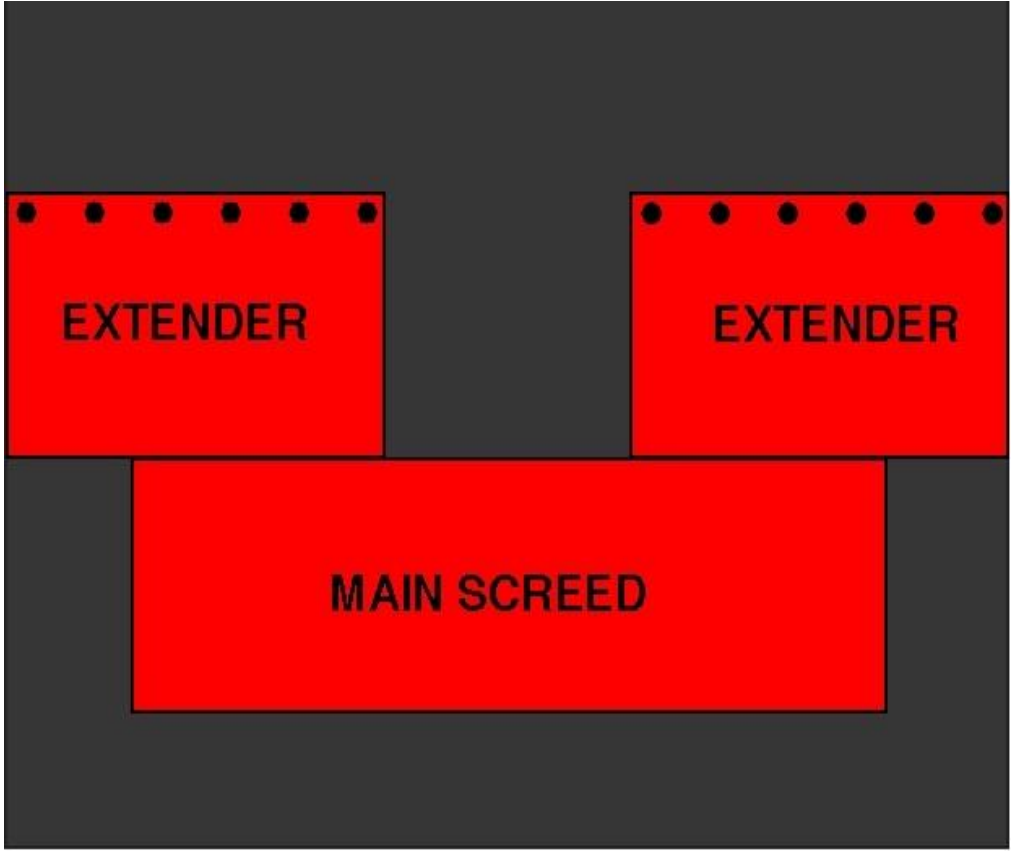
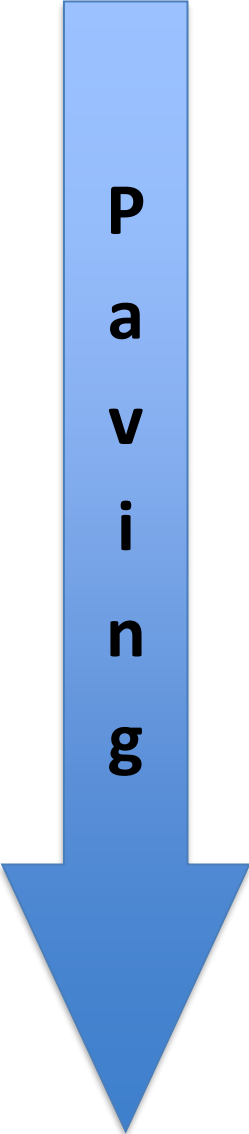
Segregation



Front-mount and Rear-mount Screens



Front-mount



Rear-mount

Auger Extensions (18"/front 36" rear)

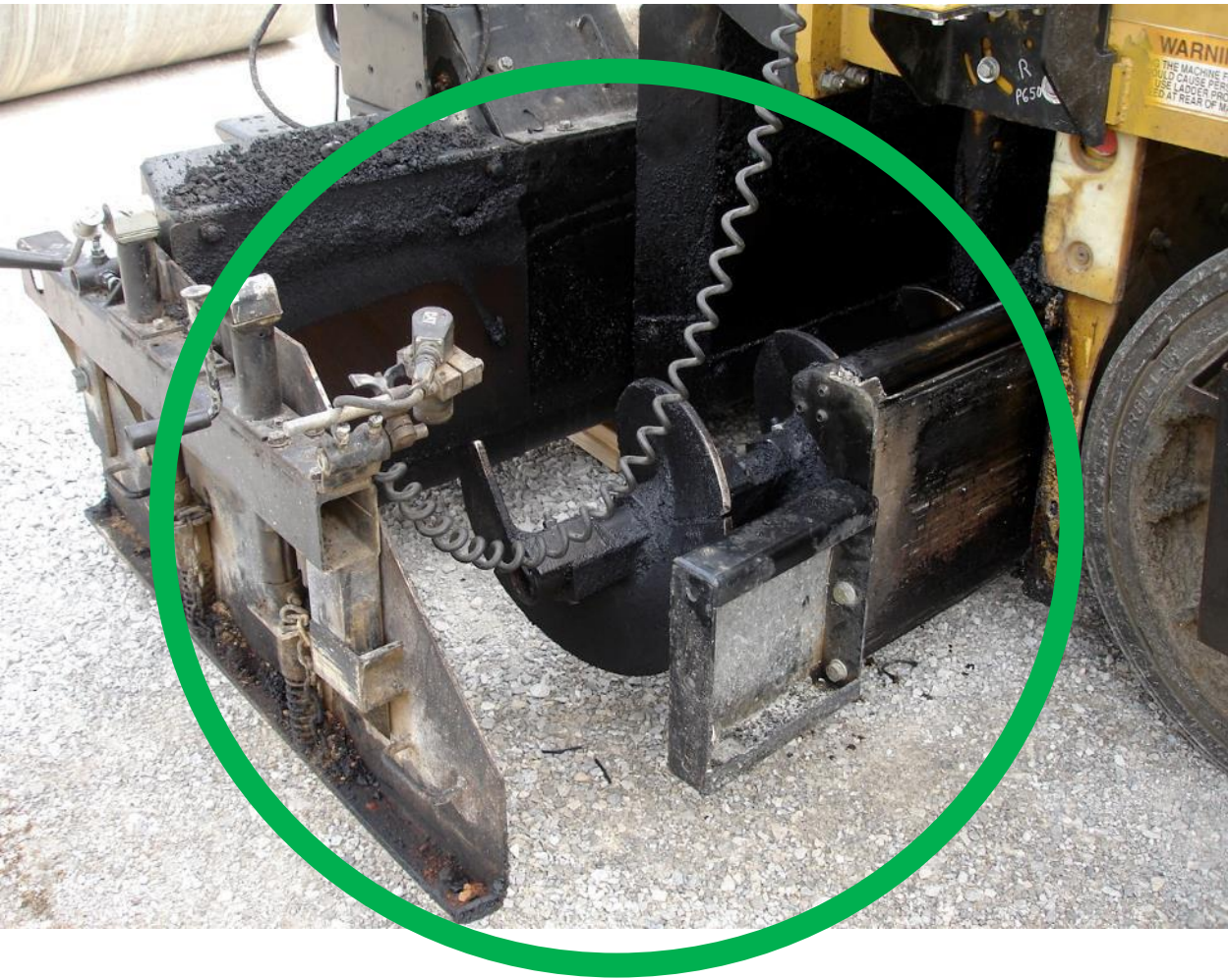


18" with front-mount



36" with rear-mount

Always Extend Tunnel in front of Augers



Variable Width Paving

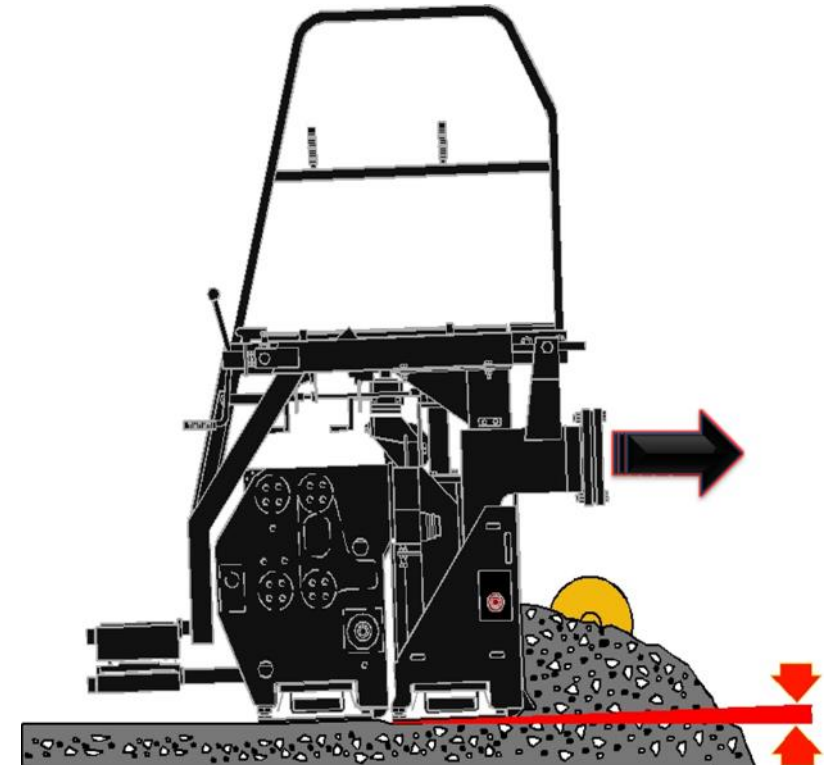


- Auger extensions & tunnels to minimum width
- Be prepared to shovel as needed at wider widths

Texture: Angle of attack adjustments



- Different angles of attack between main screed and extenders



Managing Segregation – Truck Exchange



Spills on grade

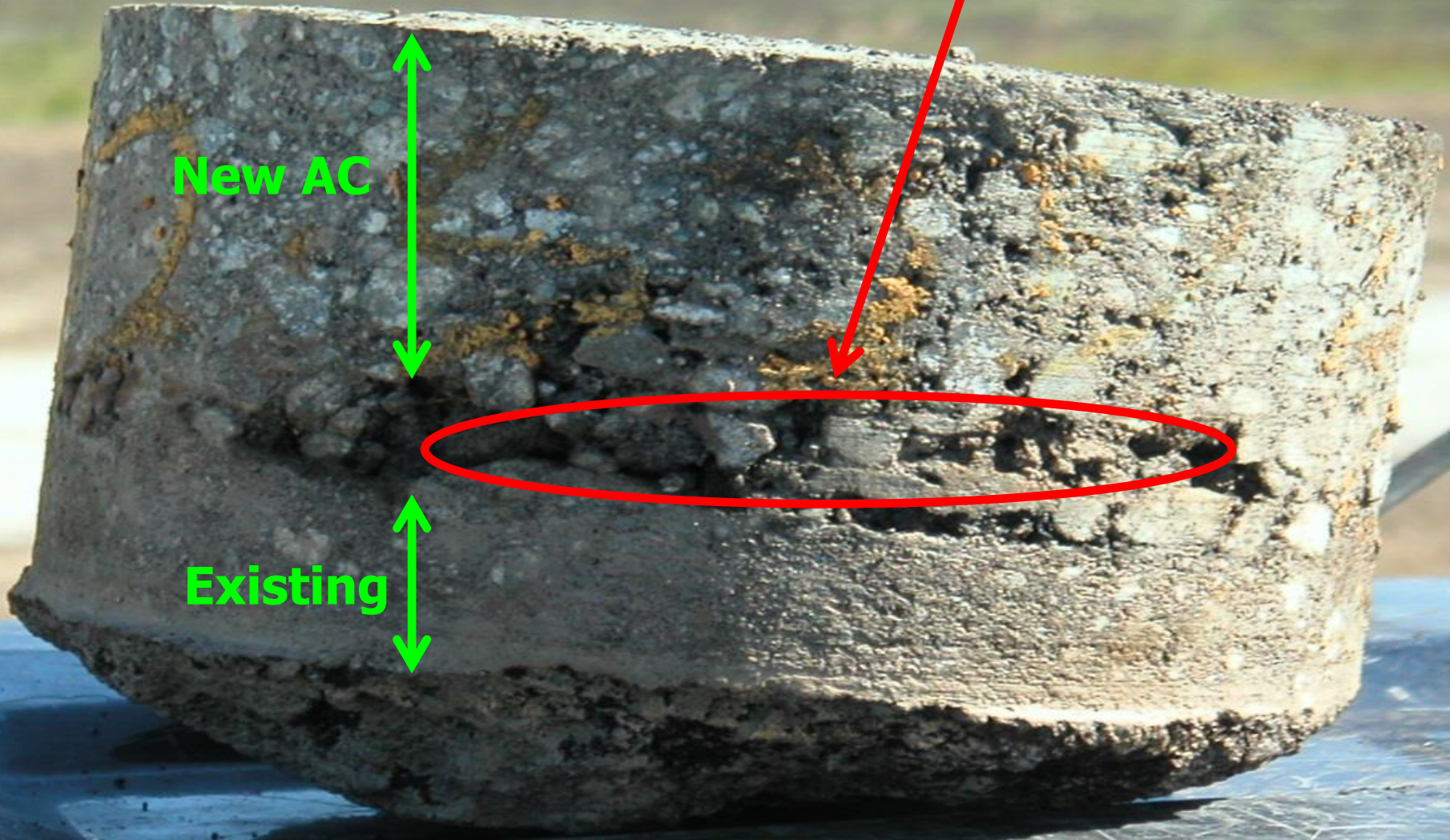


- Potholes
- Density problem
- Smoothness problem

Low Density

New AC

Existing



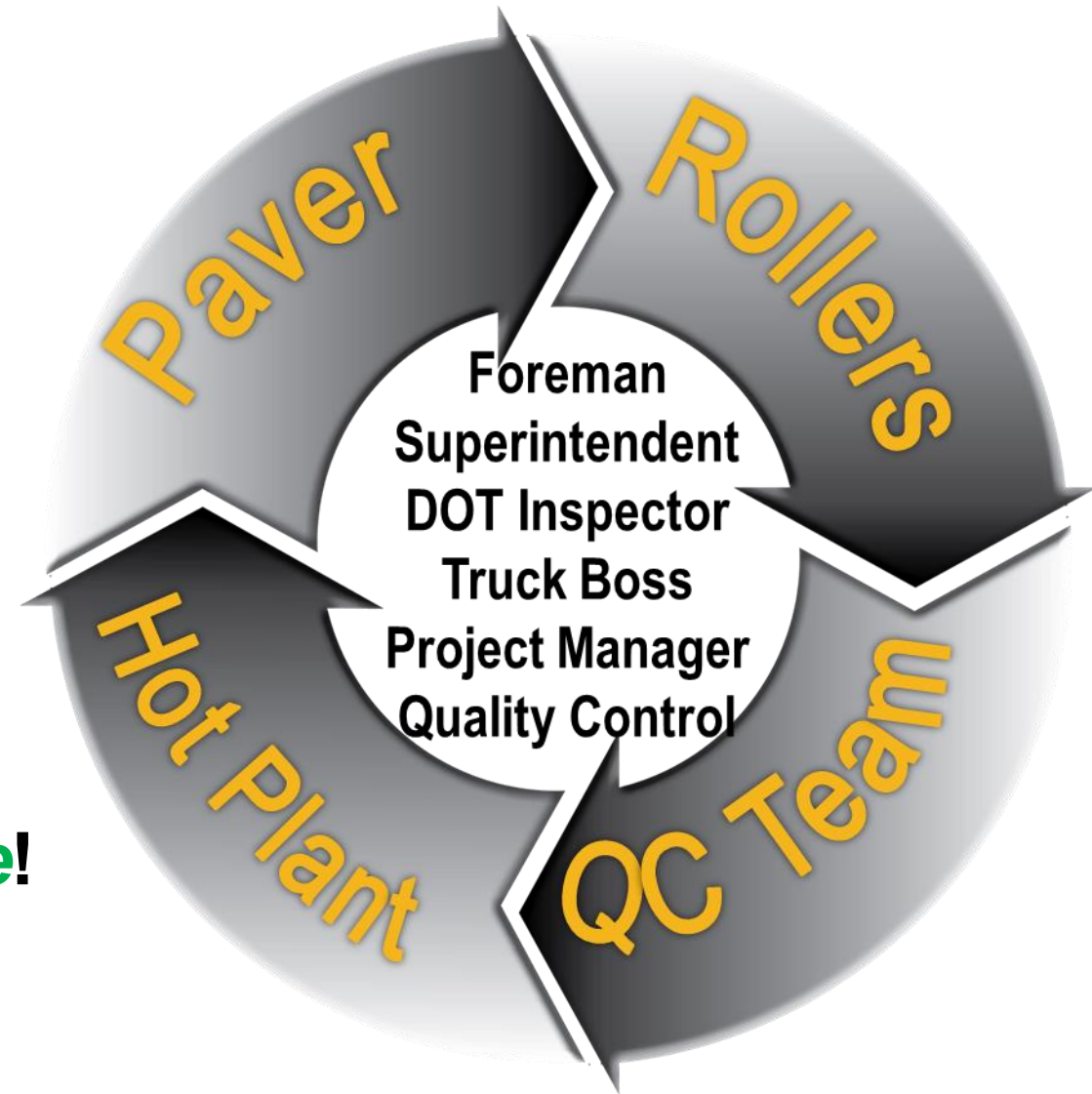
Segregation – running hopper too low



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!*



Mat Defects - Troubleshooting



Problem	Excessive Play in Screed	Overcorrecting	Too Little Lead	Too Much Lead	Feeder Screws Overloaded	Fluctuating Head of Material	Screed Plates Worn Out or Warped	Moldboard on Strikeoff Too Low	Cold Screed	Feeder Gates Empty Between Loads	Incorrect Nulling of Screed	Screed Extensions Installed Incorrectly	Vibrators Running Too Short	Grade Control Hunting (Sensitivity Too High)	Grade Reference on Reference	Sitting Long Period	Improper Mat Thickness	Trucks Bumping Aggregate	Improper Joint Overlap	Reversing or Turning Too Fast	Improper Base Rolling Operation	Improper Parking	Improper Mix Design (Aggregate)	Improper Mix Design (Hot Mat)	Variation of Mix	Mix Segregation	Moisture in Mix	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

- Find problem above.
- 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.

Thank-you for your attention 😊



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