



# From Mix to Mat: Achieving Quality in Paving & Compaction

Jim Warren

Asphalt Pavement Exchange

[jwarren@APEXTX.org](mailto:jwarren@APEXTX.org)

# From Mix To Mat: Achieving Quality In Paving & Compaction



# Achieving Quality

- What is your Definition of Quality relative to Paving & Compaction?
- Click on this QR Code to engage and post your opinions and views.



Let's get involved.

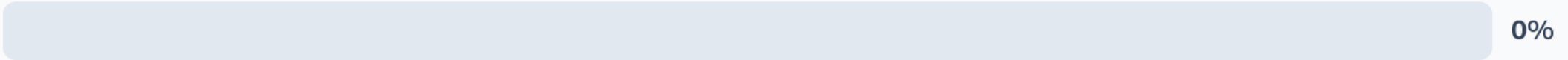
[Pollev.com/jimw285](https://Pollev.com/jimw285)

Text **jimw285** to **22333**

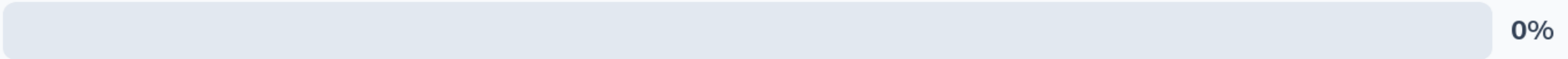


## Who do you work for?

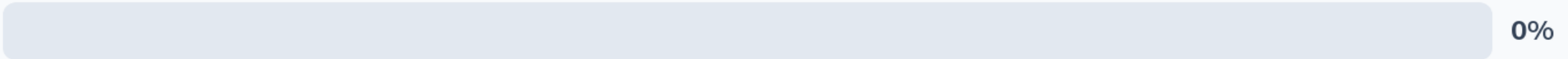
(A) TxDOT



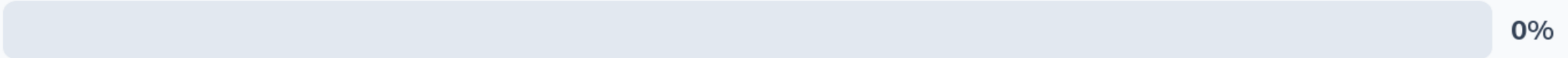
(B) Consulting Engineer / CEI



(C) Asphalt Producer or Contractor

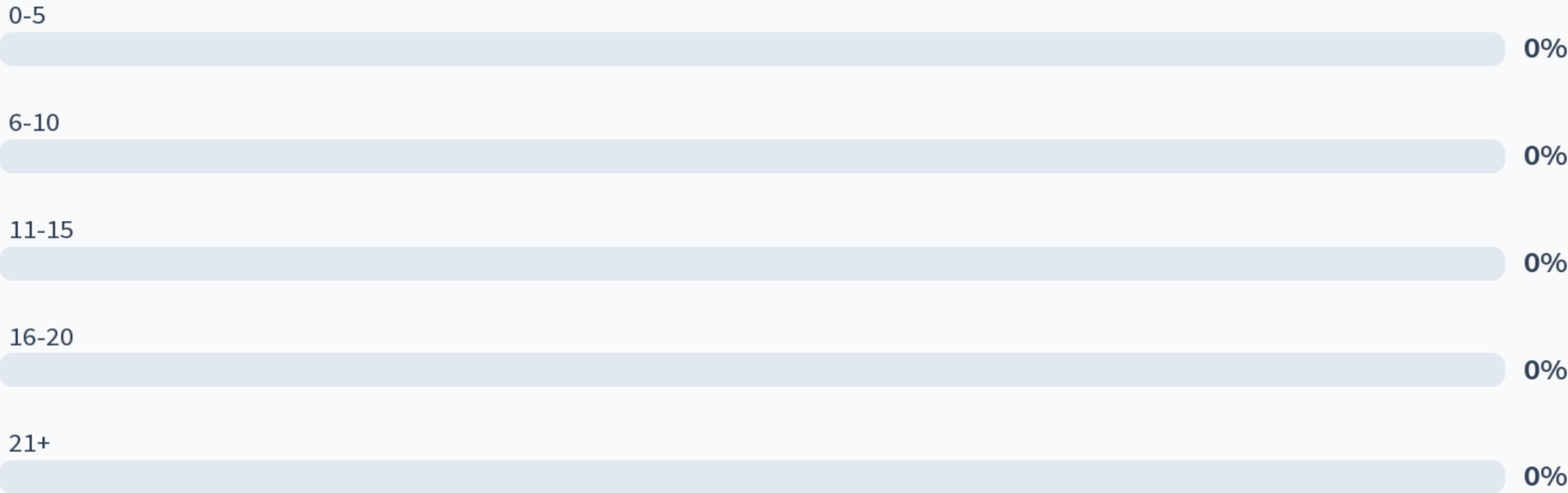


(D) Supplier/Exhibitor



Start the presentation to see live content. For screen share software, share the entire screen. Get help at [pollev.com/app](https://pollev.com/app)

# How many years experience in asphalt do you have?



Start the presentation to see live content. For screen share software, share the entire screen. Get help at [pollev.com/app](https://pollev.com/app)



Start the presentation to see live content. For screen share software, share the entire screen. Get help at [pollev.com/app](https://pollev.com/app)



# Paving and Compaction Quality Attributes

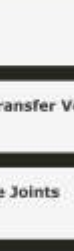
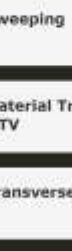
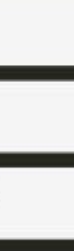
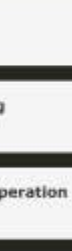
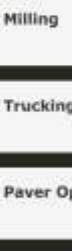
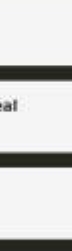
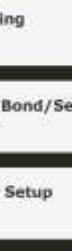
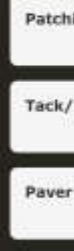
***Let's compare your attribute list to mine.***

- ✓ Thickness
- ✓ Ride/Smoothness
- ✓ Cross Slope
- ✓ Texture
- ✓ Density (In place Air Voids)





# Let's talk about Paving.



## Paving Checklists

Safety

Project Planning

Balancing Operations

Patching

Milling

Sweeping

Tack/Bond/Seal

Trucking

Material Transfer Vehicle  
MTV

Paver Setup

Paver Operation

Transverse Joints

Longitudinal Joints

Compaction Setup

Roller Operation

Field Testing

Smoothness & Ride

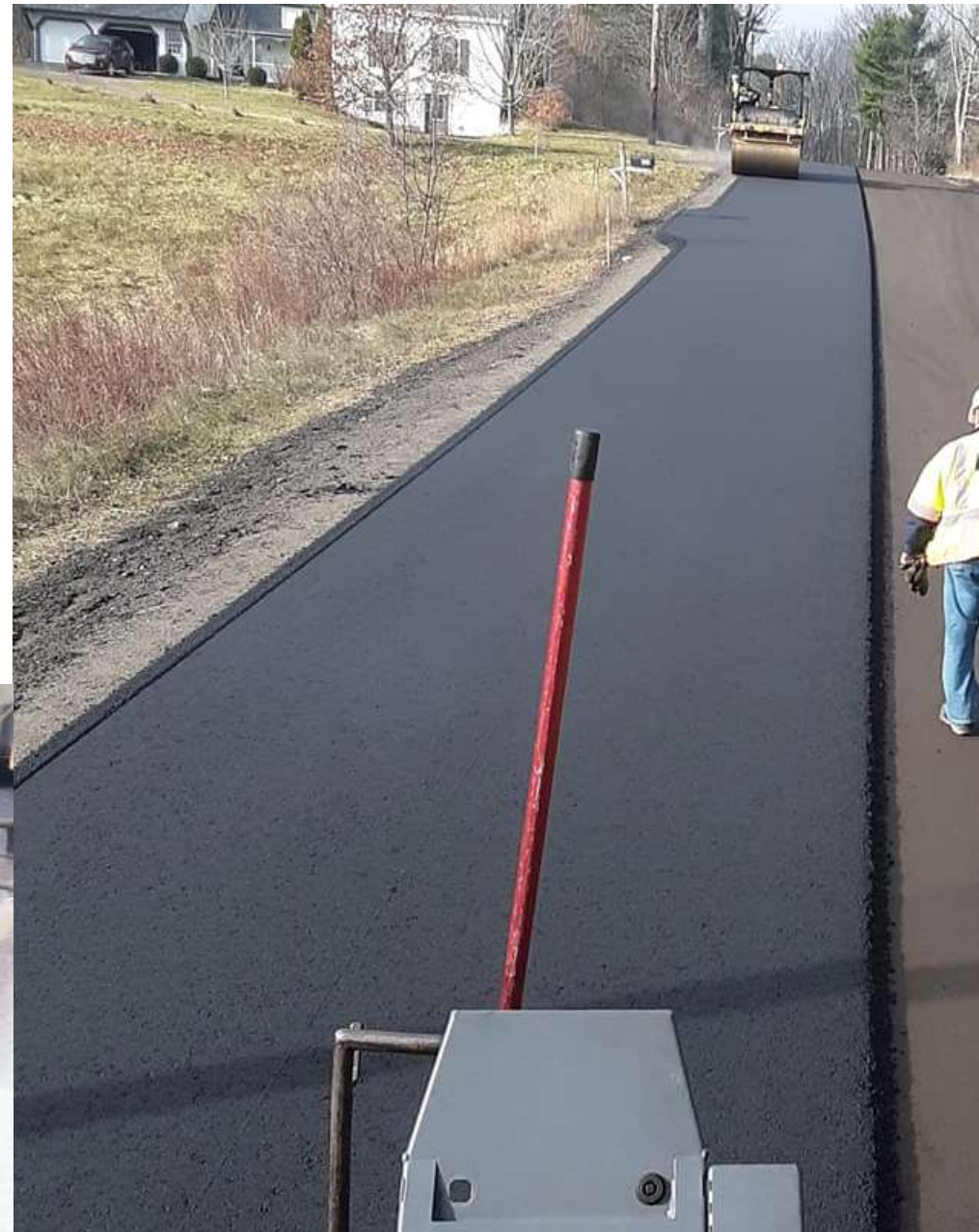
Resources

- **Paver – *It's the mobile factory that creates the finished mat.***
  - How does it work?
- **Screed – *Establishes Width, Texture , and initial Density.***
  - How does it work?
- **Grade control – *Establishes Ride, Spreadrate, OR Thickness***
  - How does it work?



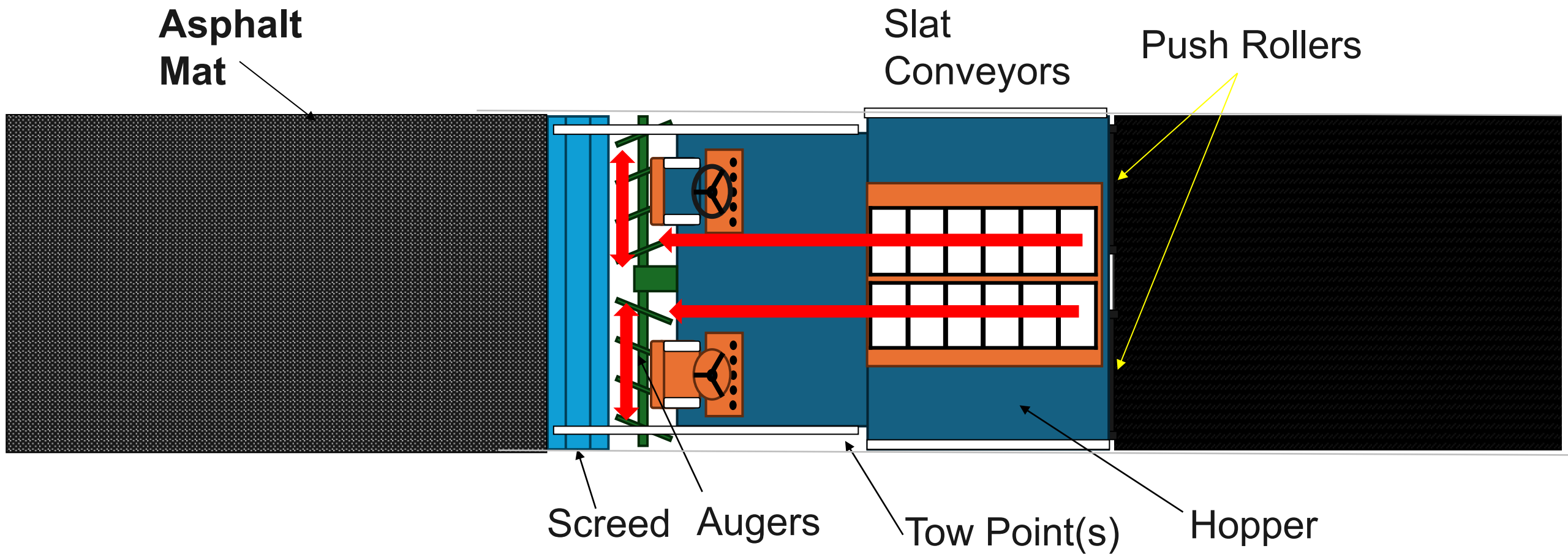
# Paver

- Mat Alignment (longitudinal joint)
- Mix Delivery
- Head of Material
- Speed of Paver



# Paver Unit - overview

Paving Direction 





# Always Keep a Uniform Head of Material

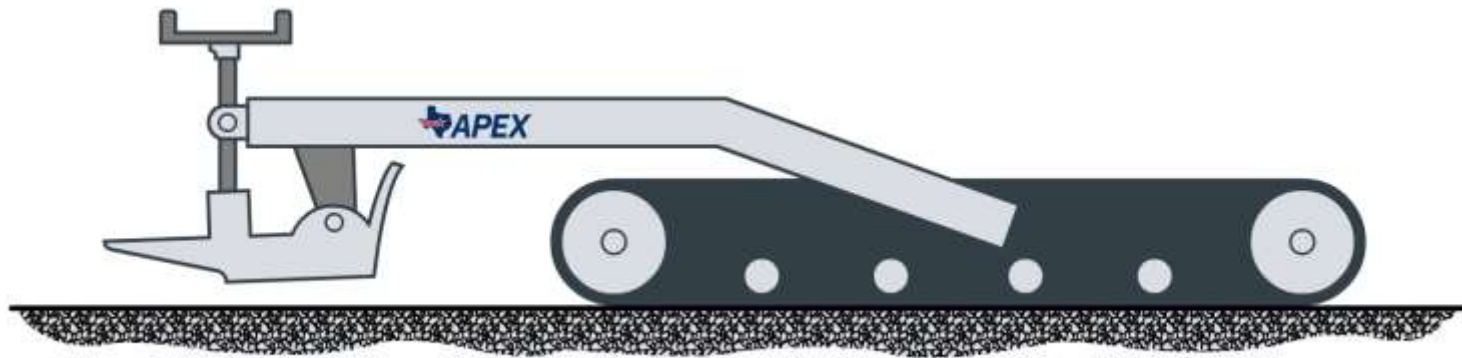
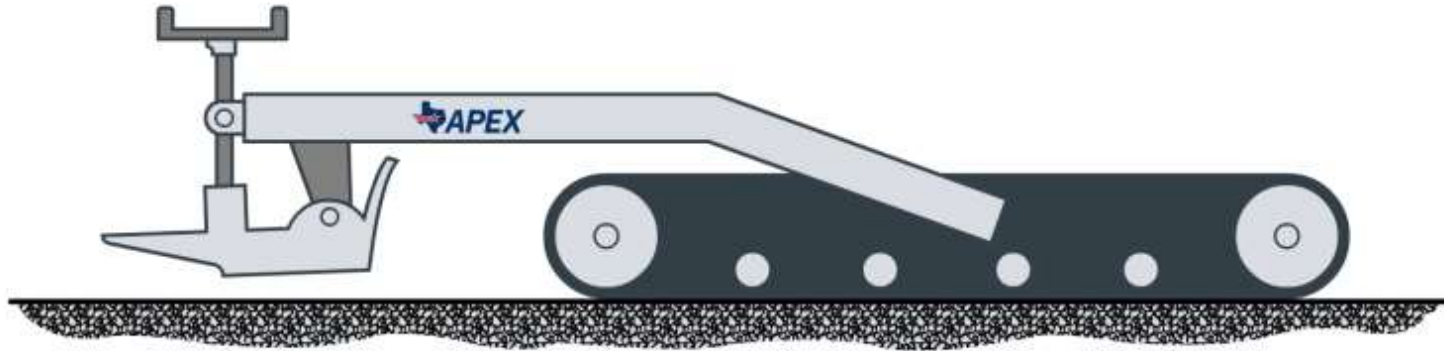
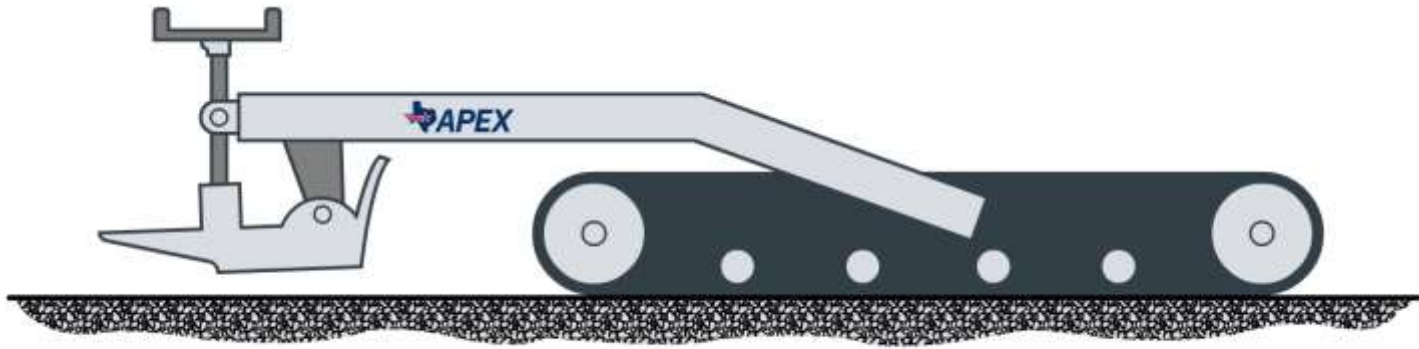




# Screed

- Shapes and extrudes mix into a uniform layer or mat.
- Develops initial mix density.
- Develops a surface texture unique to mix type.











# Setting screed on joint - before takeoff.

Direction of Paving



Starting  
Blocks

Screed

Augers

Head of Material

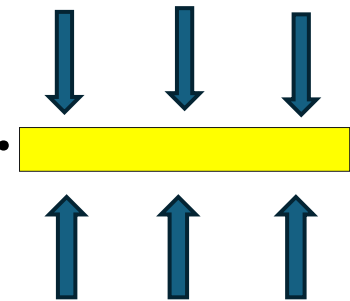
Cold Mat

- Use starting blocks on both sides of screed.
- Blocks should be thickness of expected roll down. ~1/4" per inch of compacted thickness.
- Setup of screed and paver per "Paving by the Numbers"
- Don't "bury the augers" when filling the auger chamber.
- Pull off joint and check settings.

# Checking Transverse Joint - after pulling off.



- Place 10ft straightedge with ~2 ft overlapping on joint.
- Area underneath straightedge should be uniform thickness.
- Check in several locations across the width of mat.
- Indicates screed setup properly and parallel new mat.



# Grade Control

- Establishes Ride, Slope, Yield OR Thickness
- Grade Control Reference/Ski – single side towpoint input
- Joint Matcher – single side towpoint input
- Cross Slope – single side towpoint input
- Paver only has two towpoints – you can't do everything in a single pass.



# Grade and Slope Controls adjust Tow Point





# Dual Non-Contact Grade Controls

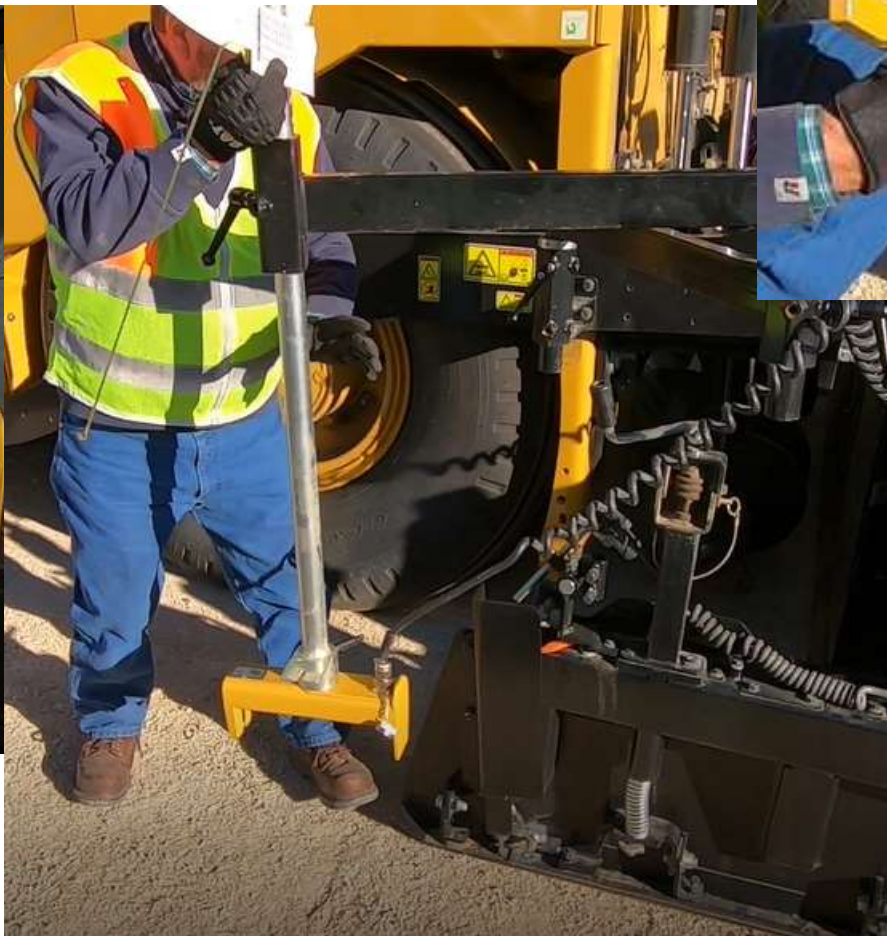




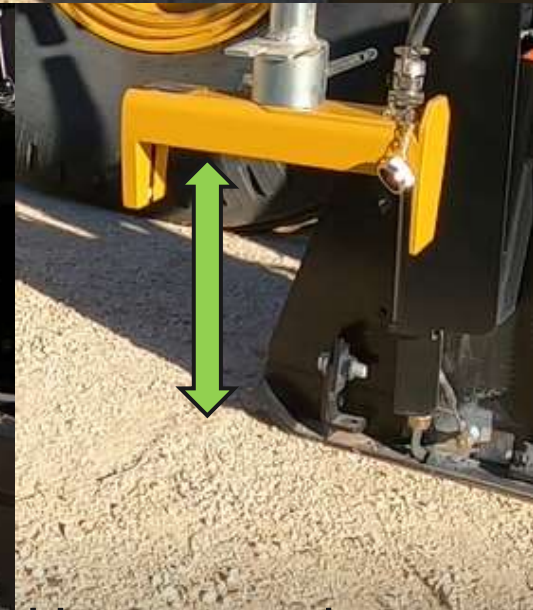
# Grade Sensor and Position



Sonic sensor position close to tow point improves ride.



Grade sensor at leading edge of screed matches joints.



Uses sound waves to measure distance.



# Tow point response to sensor position



# Paver Interactions

- How do paver settings, screed settings, and grade control settings interact?



# How many things are being done right?



Copyright TXAPA 2024

# Now, let's talk about Compaction

## Jim's Rules:

- 1. Get Density/In Place Air Voids.***
- 2. Preserve Ride/Smoothness/IRI.***
- 3. Do No Harm.***





# Compaction

- Rollers
- Variables

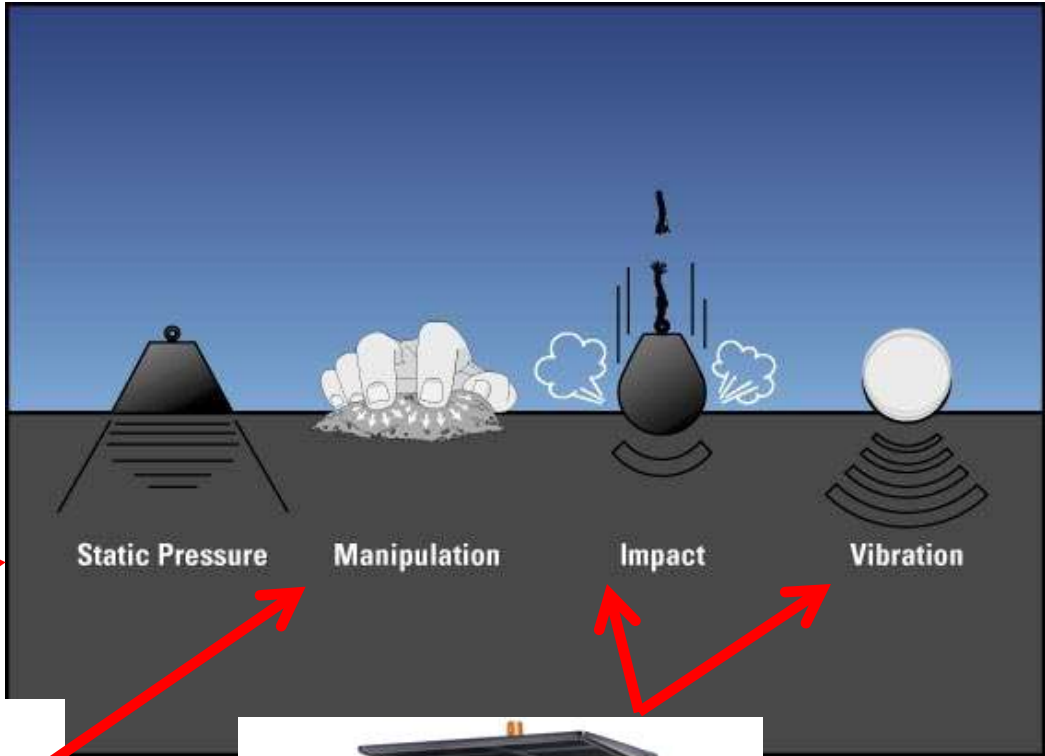




# Forces of Compaction - Roller Types



Static Steel-Wheeled



Pneumatic



Vibratory

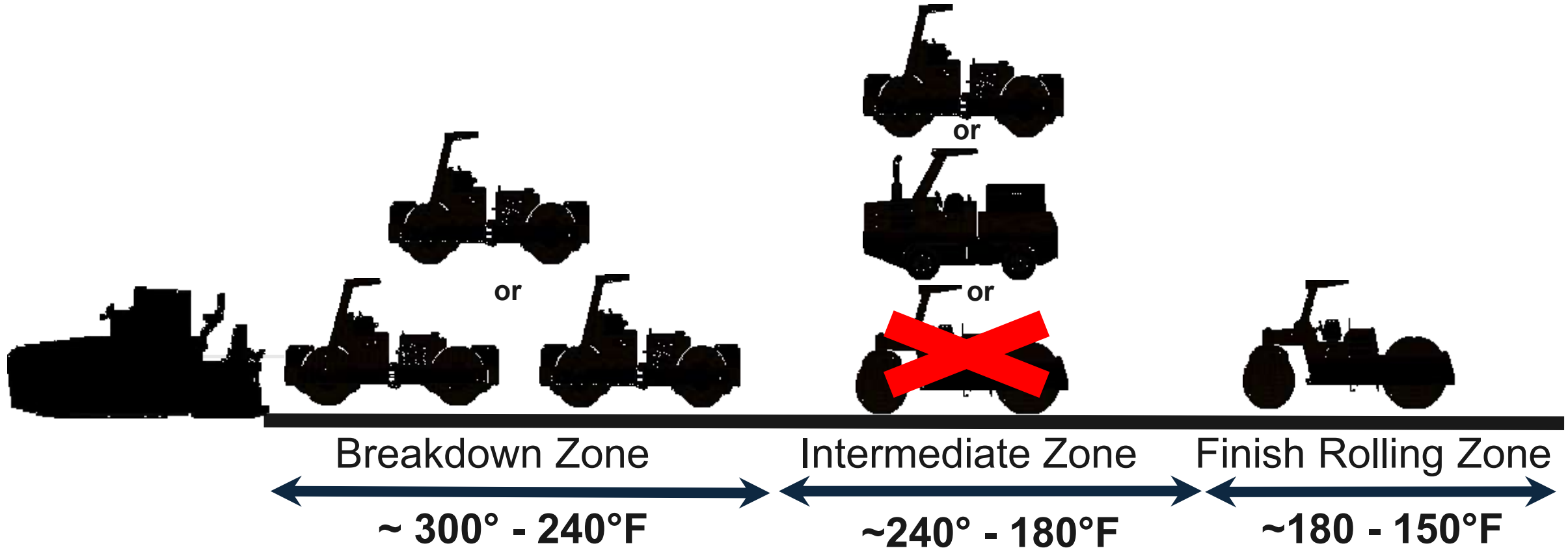


# Many Options for Compacting

- Pressure
- Vibration
- 1 or 2 rollers

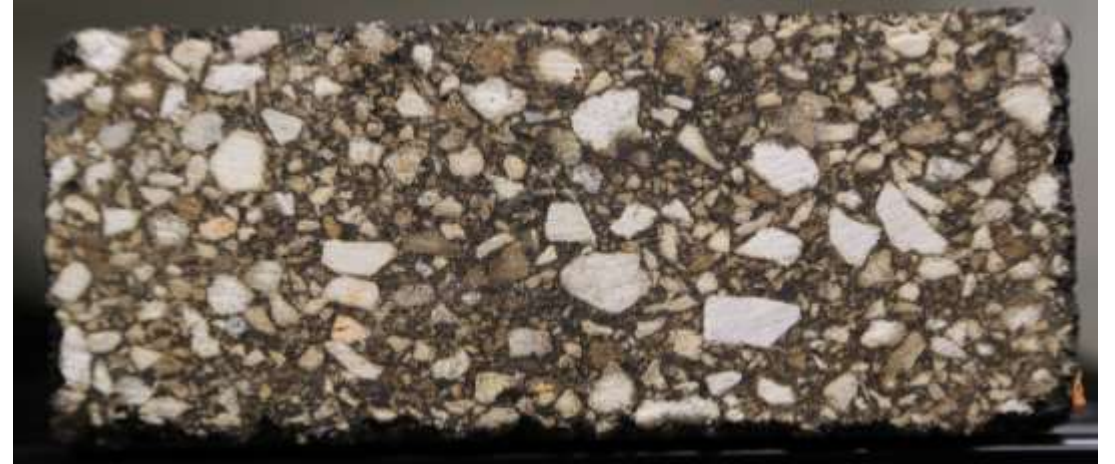
- Pressure/Static
- Manipulation
- No roller

- Pressure/Static only

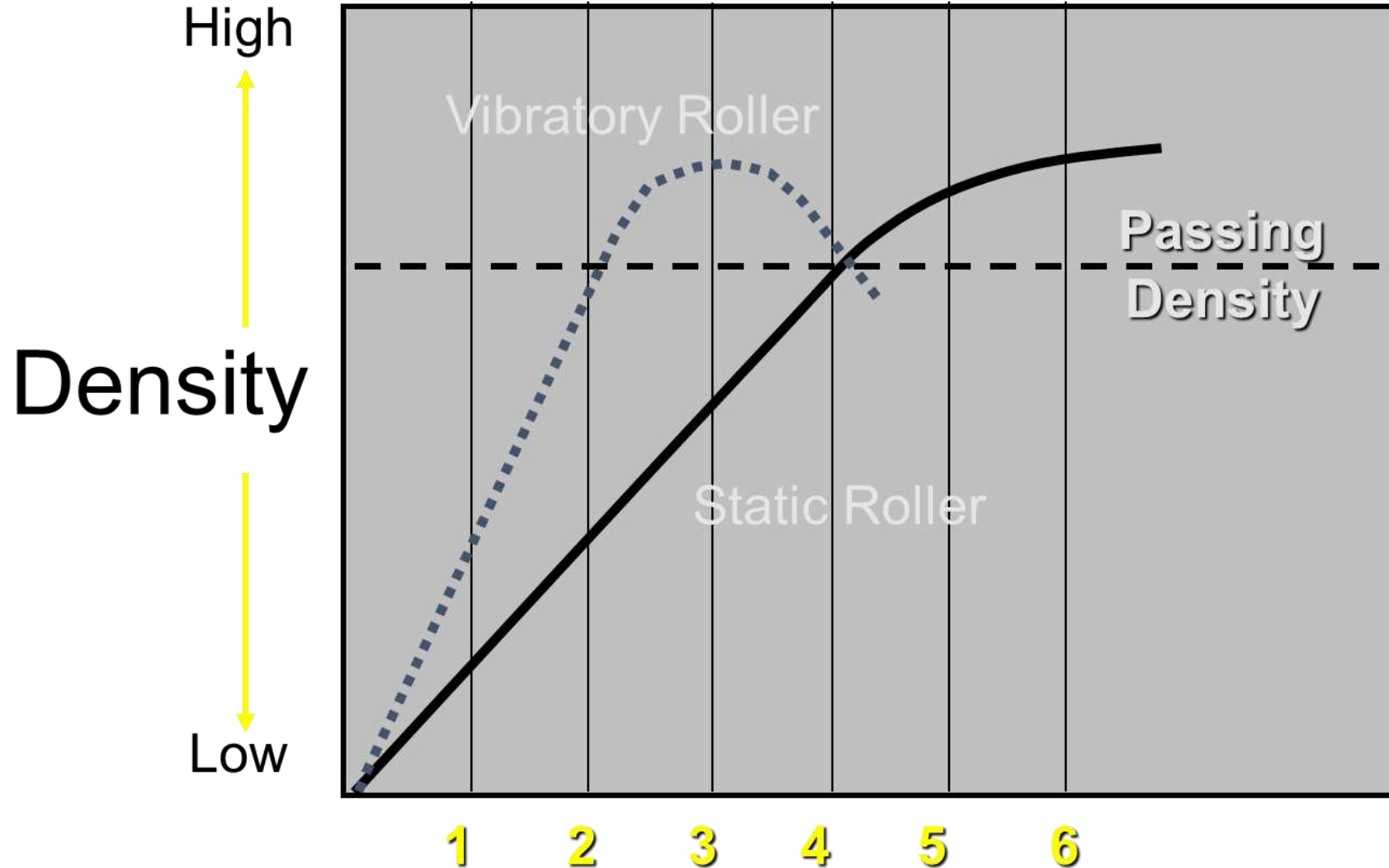


**IMPORTANT:** Temperature Zones vary significantly by mix type, binder type, and thickness.  
Temperature zone significantly impacted by environment and may change throughout shift.

# In-Place Density/Air Voids



# Control / Test Strip






# Environmental Factors

**Several factors come into play regarding how fast the mix cools onsite, affecting time available for compaction:**

- ✓ **Ambient air temperature**
- ✓ **Temperature of the existing surface**
- ✓ **Wind speed**
- ✓ **Lift thickness**
- ✓ **As-delivered mix temperature**
- ✓ **What do you do when they change?**



# Use Cooling Rates to determine TAC.



## PaveCool

Bruce Tanquist Tools

★★★★★ 5

Everyone

This app is compatible with all of your devices.

Installed

Input Results

Project Title: Highway 15 North of Fairmont

Start Date: 11/5/2015 Time: 11:25 AM

Set to Current Time

Sky: Humid & Hazy

Air Temp: 50 °F Wind Speed: 5 mph Latitude: 45

Material Type: Dry Surface Temp: 50 °F

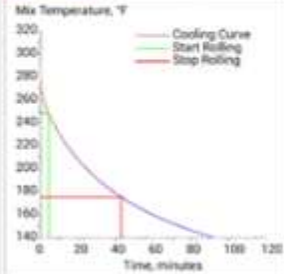
Granular Base: Unfrozen

Mix Type: Fine/Dense Asphalt Thickness: 3.00 in.

Binder Grade: PG 58 -34 Delivery Temp: 275 °F

Calculate

Mix Temperature, °F



Time, minutes

— Cooling Curve

— Start Rolling

— Stop Rolling

Input Results

Project Title: Highway 15 North of Fairmont

Start Date: 11/5/2015 Time: 10:48 AM

Set to Current Time

Sky: Humid & Hazy

Air Temp: 50 °F Wind Speed: 5 mph Latitude: 45

Material Type: Dry Surface Temp: 50 °F

Granular Base: Unfrozen

Mix Type: Fine/Dense Asphalt Thickness: 3.00 in.

Binder Grade: PG 58 -34 Delivery Temp: 275 °F

Calculate

### MultiCool 3.0 - Multilayer Pavement Cooling Program

File View Help

Start Time (24-hour clock)

Hour: 15 Minutes: 17

DATE

Month: 1 Day: 13 Year: 2020

Environmental Conditions

Ambient Air Temp: 50 °F

Average Wind Speed: 5 mph

Sky Conditions: Clear & Dry

Latitude (Deg North): 38

Update to Current Time

Mix Specifications

Number of Lifts: 1

Lift Number: 1

Next Lift

Mix Type: Dense Graded

PG Grade: 58 -34

Lift Thickness: 3 in.

Delivery Temp: 300 °F

Stop Temp: 175 °F

Existing Surface

Material Type: Granular Base

State of Moisture: Unfrozen

Moisture Content: Dry

Surface Temp: 50 °F

Units: SI English

Calculate

Export Formatted Data

Model Output

Lift#	Thickness in.	Time, min Lift	Time, min Total	Temp(F)
1	3.	0	0	0

Existing Layer

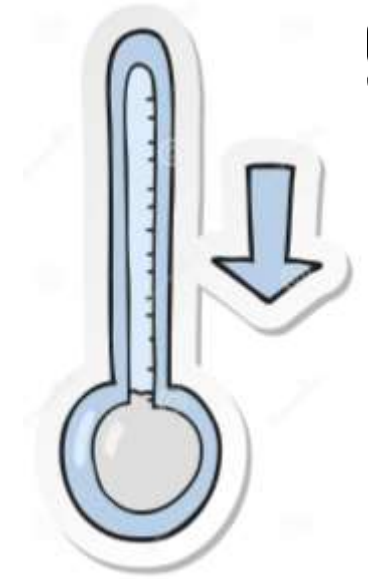
Tabular Output Graphical Output

Google “Pavecool” or “Multicool”



# Compaction

- Use enough roller(s)
- Monitor your temps – use an infrared thermometer – a lot!
- Understand how much time you have to compact.
- Keep tight to the paver.
- Pinch the joint.
- Roller patterns change with weather and temp.



**KAPA**  
nt Pavement Association

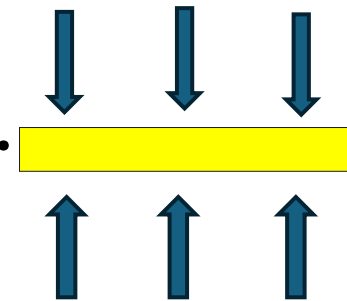


# Checking Transverse Joint - Before Compaction

Direction of Paving



- Place 10ft straightedge with ~2 ft overlapping on joint.
- Area underneath straightedge should be uniform thickness.
- Check in several locations across the width of mat.
- Indicates screed setup properly and parallel new mat.



# Checking Transverse Joint - After Compaction

Direction of Paving



10Ft Straightedge

Cold Mat

Newly Compacted Mat

- Slide the 10ft straightedge from cold mat to compacted mat.
- Check in several locations across the width of mat.
- Little to no gap underneath straightedge indicates smooth joint.



# Compaction Interactions

- Design and Operation impact ultimate performance
- Variable thickness versus density
- Variable thickness versus initial and ultimate ride

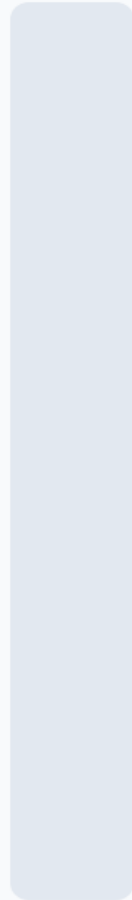
# What's More Important?

- Let's do some Attribute comparisons and see which you think is more important?
- Attributes:
  - In Place AV
  - Temperature
  - Ride/Smoothness/IRI
  - Thickness
  - Cross Slope
  - Spread rate
  - Texture



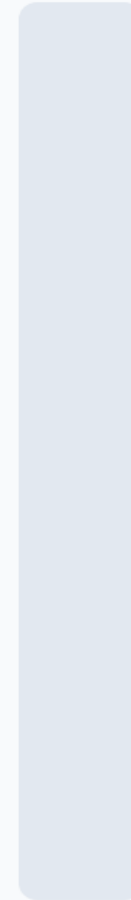
## What's More Important? In place Air Voids or Temperature?

0%



In Place Air Voids

0%



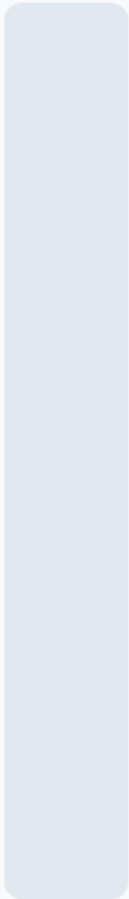
Mix Temperature

Start the presentation to see live content. For screen share software, share the entire screen. Get help at [pollev.com/app](https://pollev.com/app)



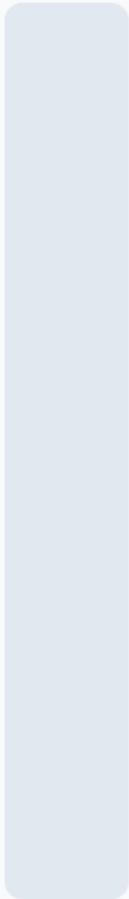
What's More Important? Ride or Thickness?

0%



Ride

0%

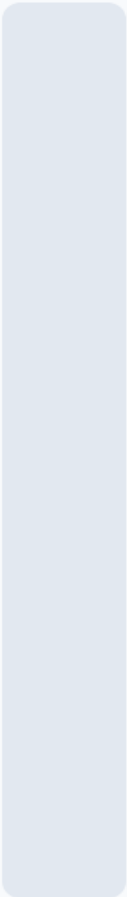


Thickness

Start the presentation to see live content. For screen share software, share the entire screen. Get help at [pollev.com/app](https://pollev.com/app)

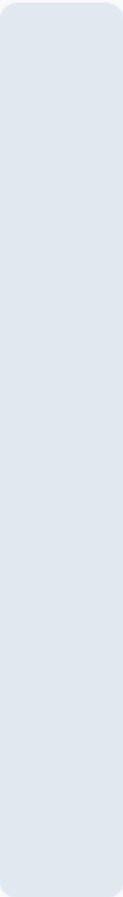
# What's More Important? Thickness or Cross Slope?

0%



Thickness

0%

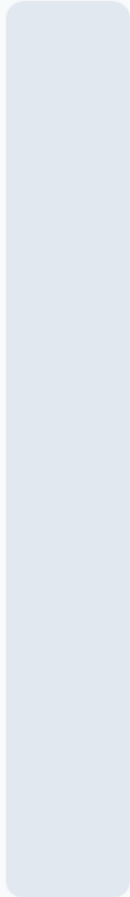


Cross Slope

Start the presentation to see live content. For screen share software, share the entire screen. Get help at [pollev.com/app](https://pollev.com/app)

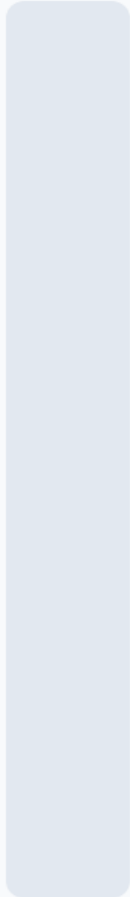
# What's More Important? Texture or Ride?

0%



Texture

0%



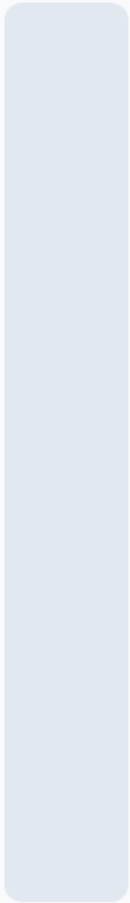
Ride

Start the presentation to see live content. For screen share software, share the entire screen. Get help at [pollev.com/app](https://pollev.com/app)



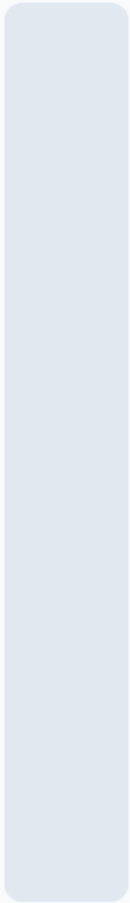
# What's More Important? In Place Air Voids or Ride?

0%



In Place Air Voids

0%



Ride/Smoothness

Start the presentation to see live content. For screen share software, share the entire screen. Get help at [pollev.com/app](https://pollev.com/app)

# What's More Important?

- Let's do a **Constraint comparison** and see which you think is more important?
- Sort your constraints top to bottom. *Choose Wisely...*
- Constraints?
  - Improving Performance
  - Quick Fix
  - Putting Tools in the Toolbox
  - On Time
  - On Budget
  - PMIS Score Card Goals

# What Constraint is more Important?

A - Improving Performance

B - Staying on Budget

C - Staying on Time

D - Achieving PMIS Targets

E - Putting Tools in the Project Toolbox

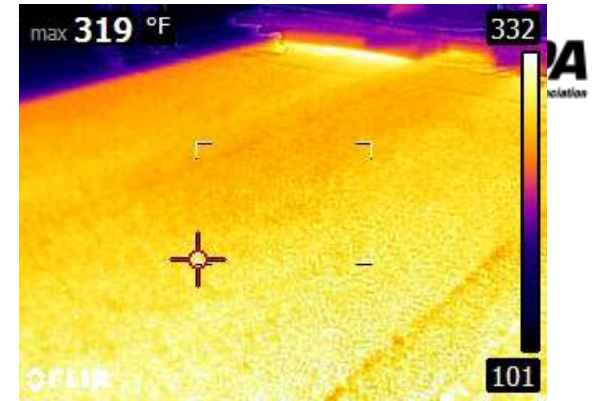
Start the presentation to see live content. For screen share software, share the entire screen. Get help at [pollev.com/app](https://pollev.com/app)



# Good Practices

*How can I tell if good practices are being followed?*

- ☐ Paving off a stringline or longitudinal reference.
- ☐ Continuous paving operations and uniform paver speed – minimal paver stops.
- ☐ Mainline paving, thickness and slope adjustments should be made with electronic grade and slope control. Not screed thickness control screws.
- ☐ Head of material in auger chamber held consistent.
- ☐ Feed augers turning slowly and consistently (not stop/start)
- ☐ Minimal raking/luting on the mat and joints.
- ☐ Minimal paver stops. Paver/MTV pickup truck on fly.
- ☐ Rollers move in a continuous fashion and only stop on cooler portion of mat transversely.



# Take-A- Ways



- Paver paves, Screed shapes, Grade Control delivers ride and thickness.
- Rollers Compact, Preserves ride, & Create final air void structure
- Many parts interact – choices have to be made.
  - Do you want ride?, thickness?, density/air voids?
- Competing Constraints cause conflicts.
  - *Know what impacts the other.*
  - *Provide tools to improve construction, ride, density. Lower your maintenance costs and improve your PMIS score card.*

