NATIONAL ACADEMIES Sciences Engineering Medicine

TRB TRANSPORTATION RESEARCH BOARD

TRB Webinar: Pavement Performance—Fundamentals and New Technologies

May 31, 2022

1:30 – 3:00 PM

NOVEMBER 2022 UPDATE

Learning Objectives

- Identify new technologies that can improve pavement construction
- Determine individual technologies and combinations of technologies to improve construction quality

PDH Certification Information

1.5 Professional Development Hours (PDH) – see follow-up email

You must attend the entire webinar.

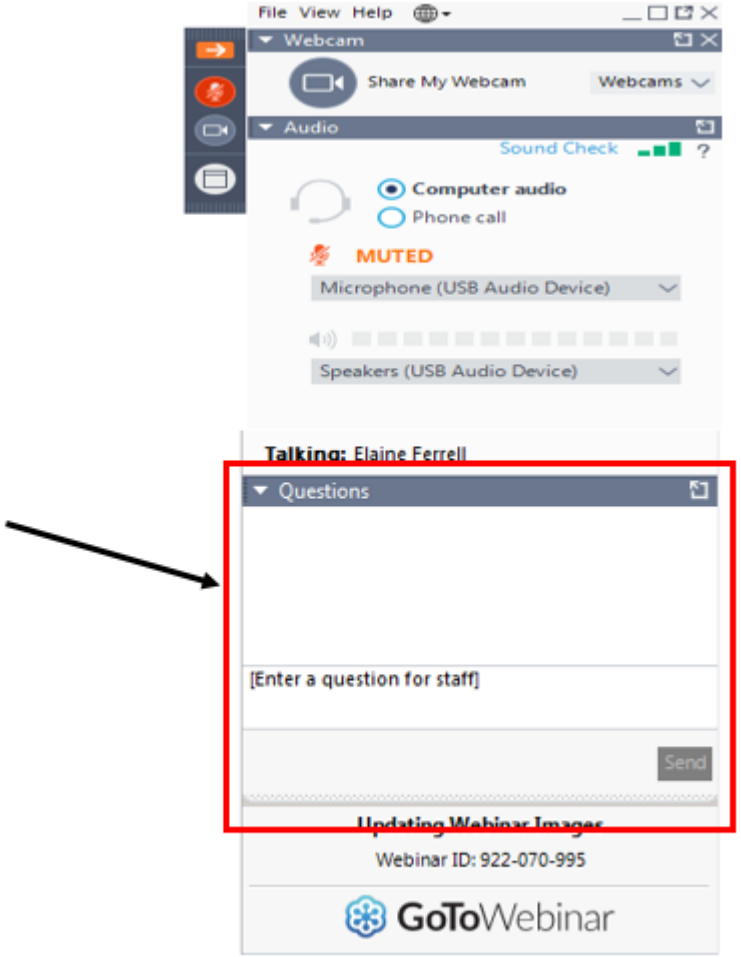
Questions? Contact Beth Ewoldsen at Bewoldsen@nas.edu

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.

RCEP
REGISTERED CONTINUING EDUCATION PROGRAM

Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



Today's presenters

Trenton Clark
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Todd Mansell
Caterpillar
tmansell_todd@cat.com

Tim Kowalski
Wirtgen Group
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The University of Texas at El Paso
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Fundamentals of Quality Paving Practices

Presented by: Todd Mansell

mansell_todd@cat.com

Paving Fundamentals – Top 5

1. Paver setup and takeoff
2. Temperature
3. Continuous Paving
   - ❑Balanced Paving & Compaction operation
   - ❑Smoothness
     - ❑Quick starts & stops
     - ❑Head of Material
     - ❑Automatic Grade & Slope Controls
4. Segregation
5. Compaction
   - ❑Longitudinal Joints

1. Paver Setup & Take Off

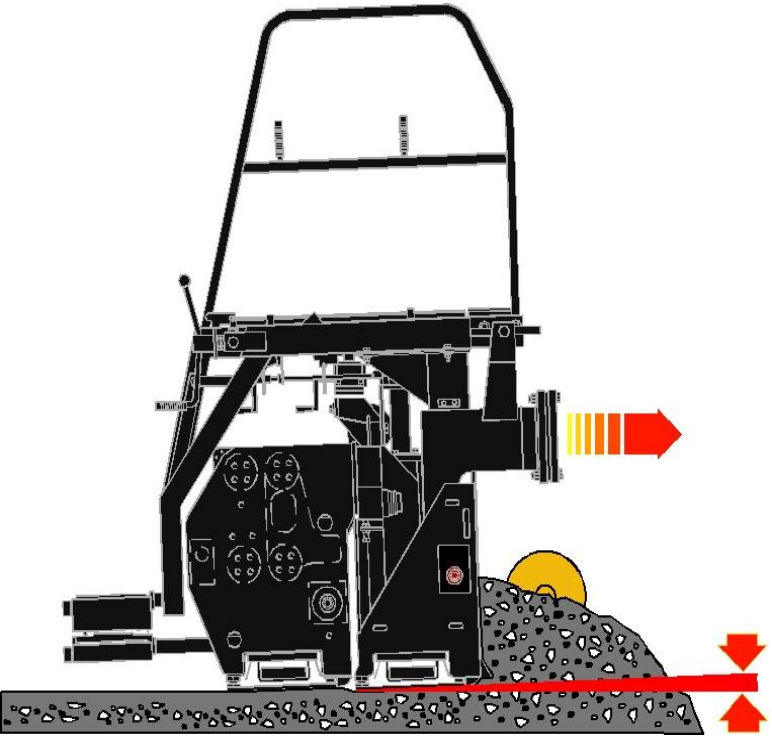
PAVING BY THE NUMBERS

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

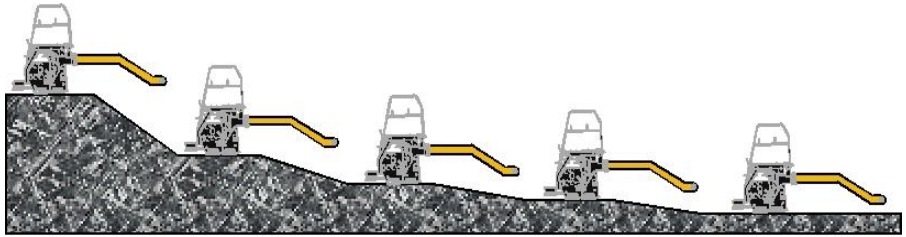
CAT

QEXQ1403-04
(Replaces QEXQ1403-03)

Angle of Attack



- Angle of attack is the relationship between the nose of the screed & the trailing edge of the screed
- Nose up attitude
- Screed reaches equilibrium



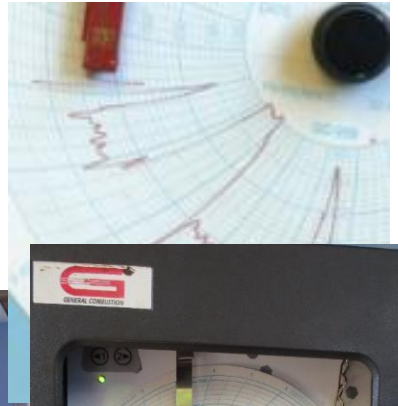
Erratic Screed Behavior – lack of control

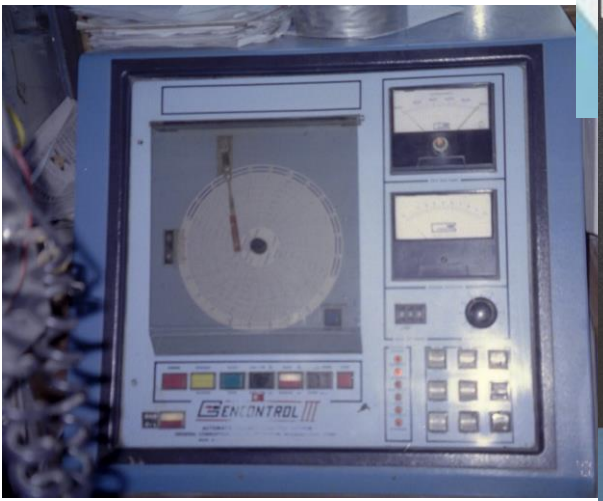
- Chatter in the mat
- Affects smoothness
- Affects density (compaction)

Variable Mat Texture

- Shiny or open texture
- Match height lines

2. Managing Temperature





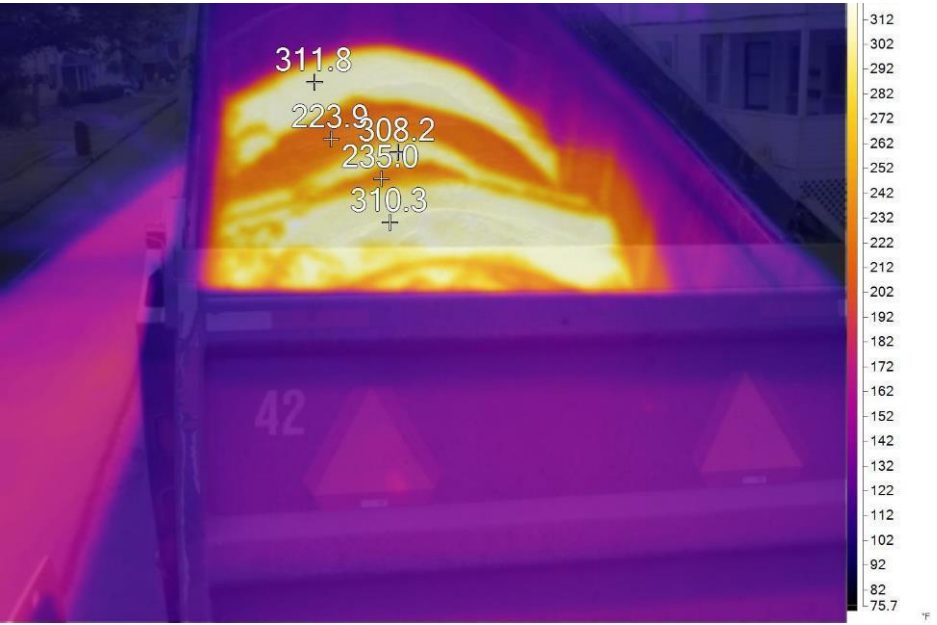
- At the plant
- During the haul
- Through the paver
  - smoothness
- During compaction
  - Uniformity of compaction

CONSISTENCY!

Managing Temperature - silos

Batchers working?

Managing Temperature



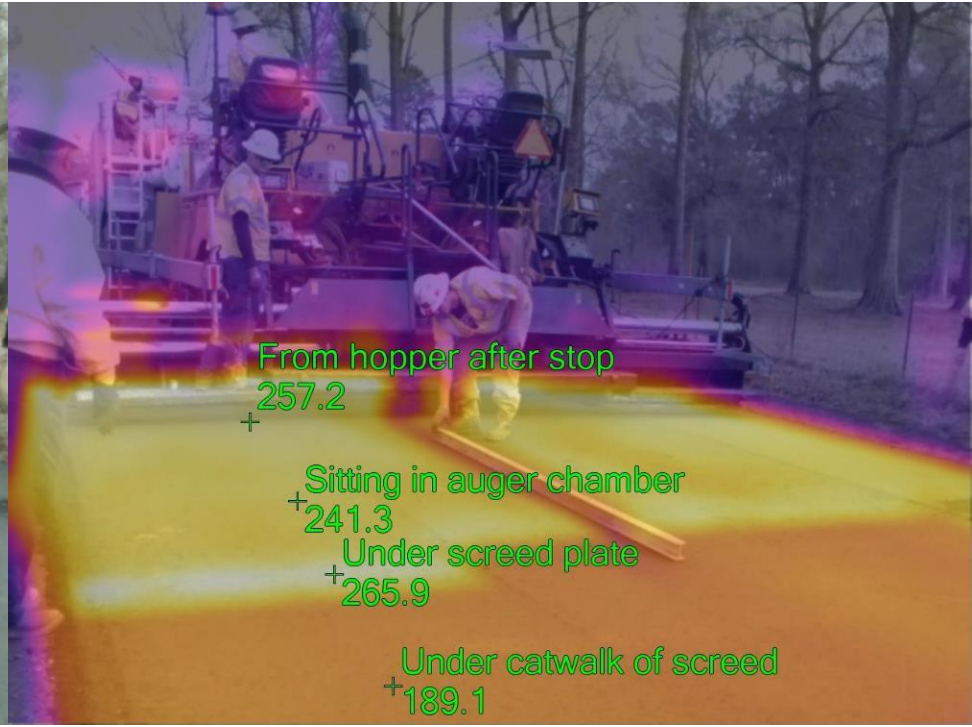
3. Continuous Paving

- MTVs can help
  - Windrow elevators
  - Re-mixing type
- Approximately 15% improved smoothness

Paver Stops & Starts…

- Smoothness issue
- Non-uniform compaction
  - Temperature differentials
- Inefficient trucking

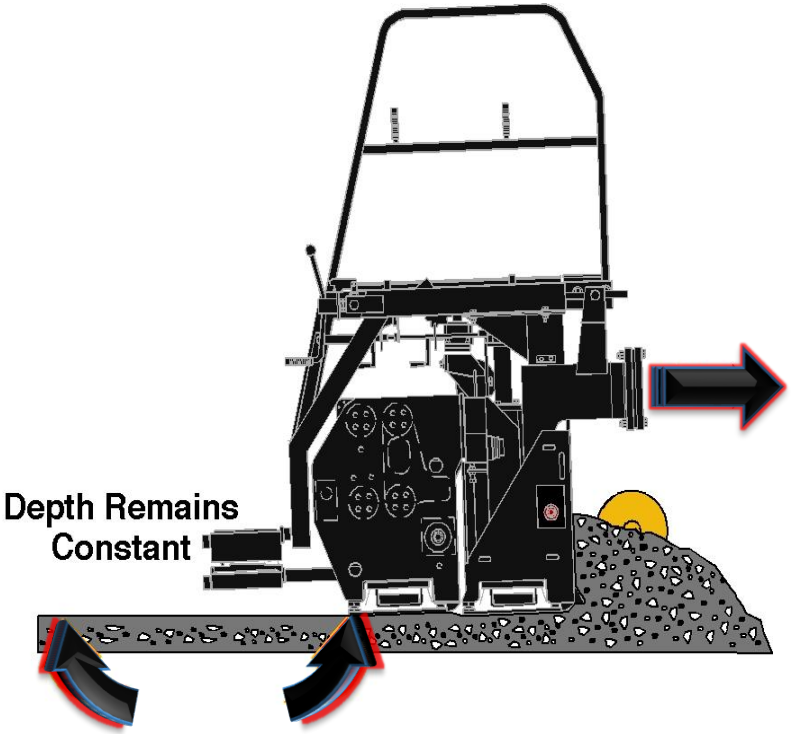
Paver Stops - density & smoothness



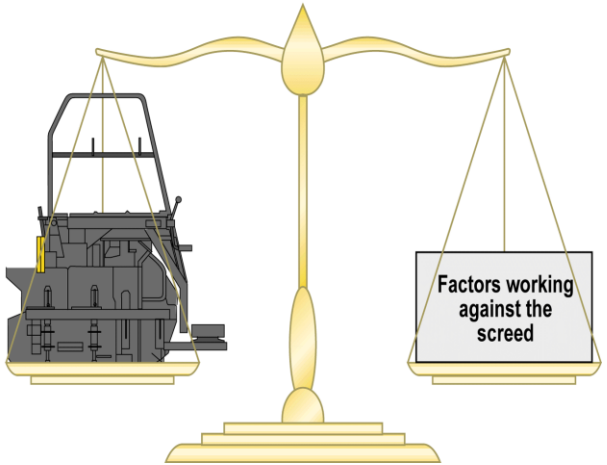
Planning a Balanced Paving Operation

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

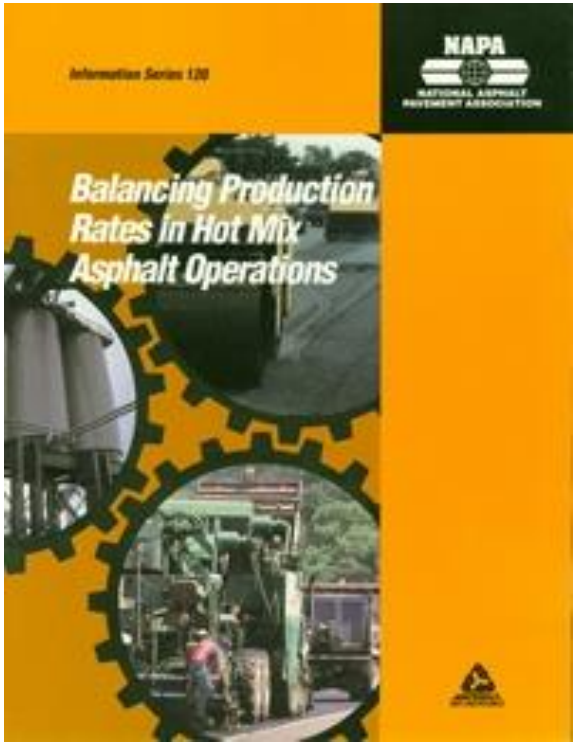
Pavement Smoothness



- Shear factor is constant
- Depth remains constant



Planning ≈ 20 minutes



Pre- paving planning

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

Tools available

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

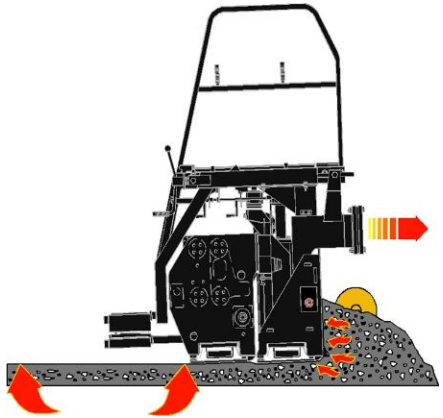
Paver Speed - Real World Paving

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

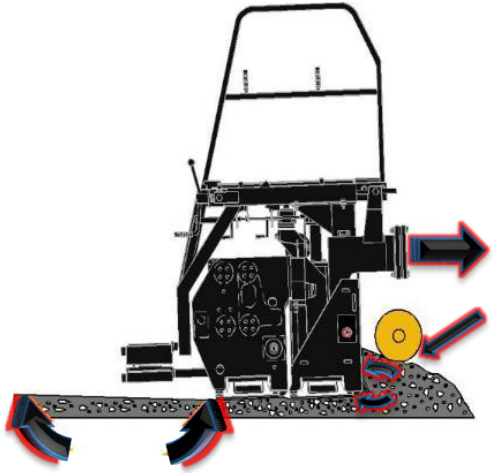
Managing Head of Material @ ½ Auger

85-95% of all mat defects are related to head of material!!

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

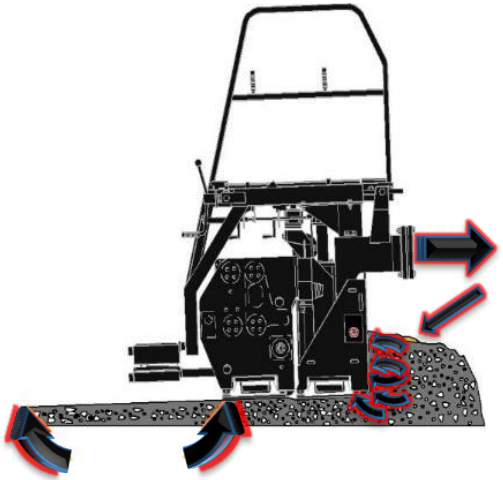


Changes in Head of Material



Head of Material Decreases

- Resistance decreased
- Depth decreases

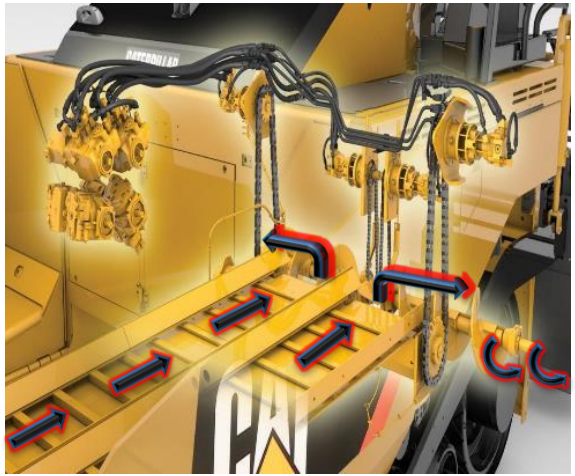


Head of Material Increases

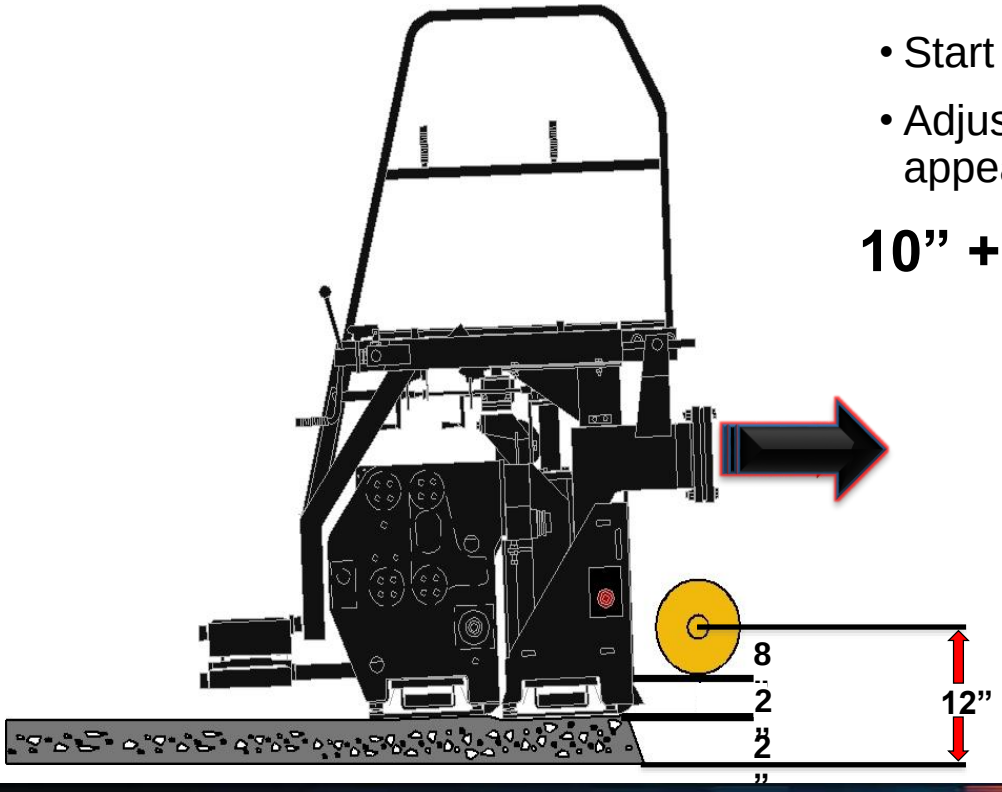
- Resistance increased
- Depth increases

Controlling Head of Material

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



Controlling Head of Material: Auger Height



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

10” + mat thickness = auger height

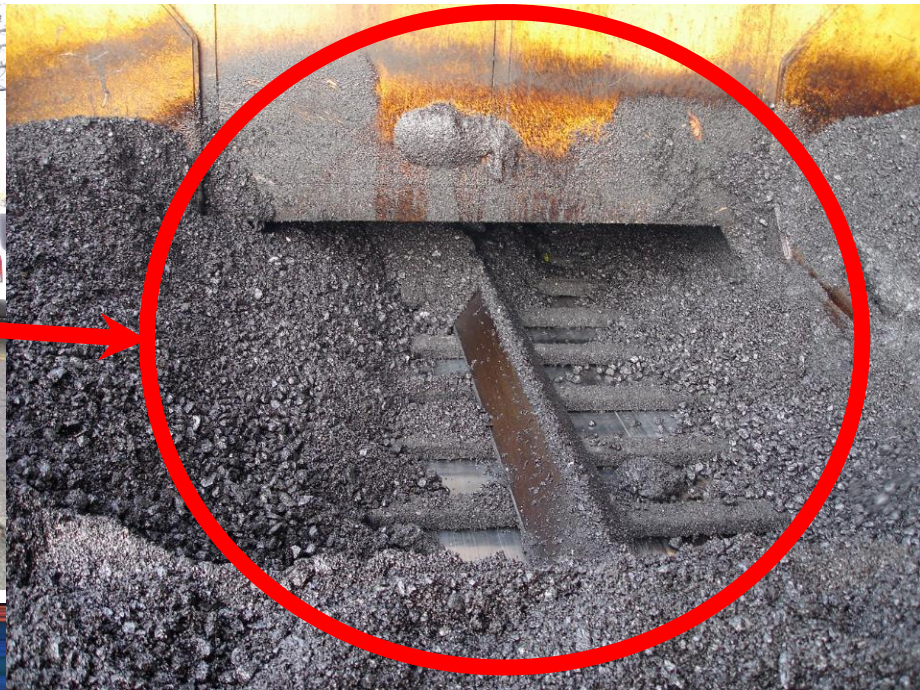
Controlling Head of Material: Auger Speed

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

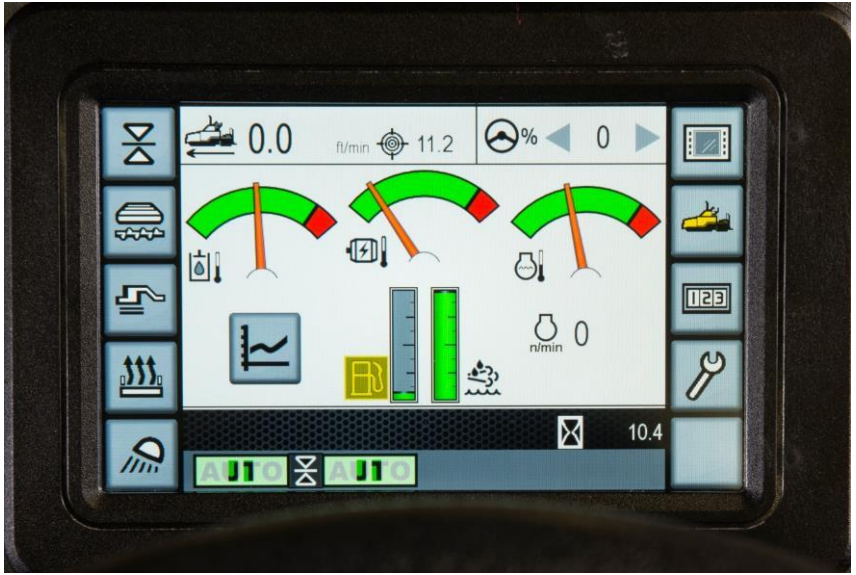
Aiming Sonic Feed Sensors

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

Truck Exchange – HoM – Bumps & Dips



Quick Starts & Stops



4. Managing Segregation

Managing Segregation – Truck Exchange

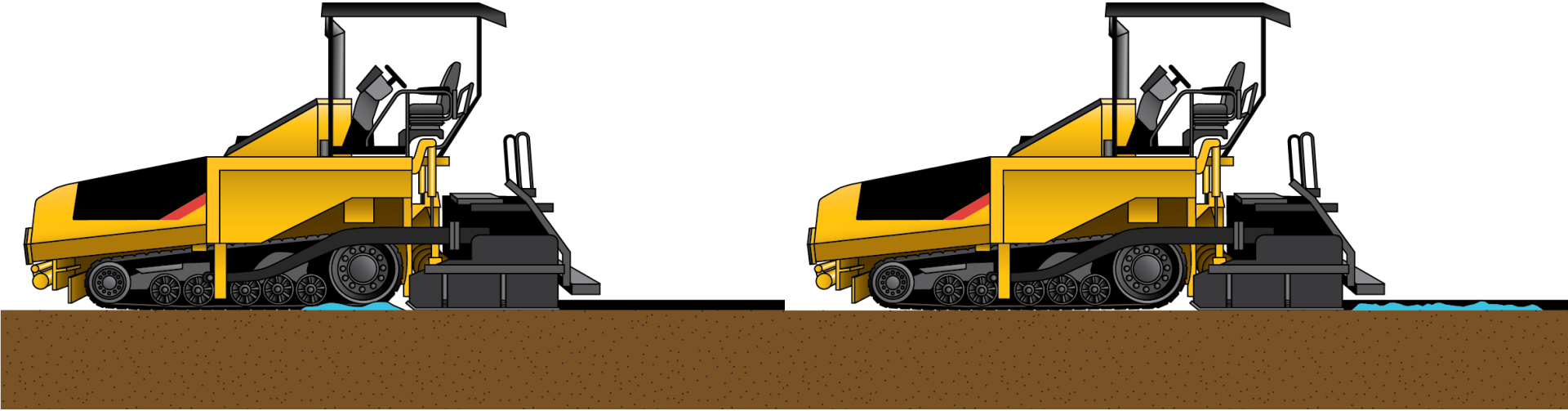
Four step procedure

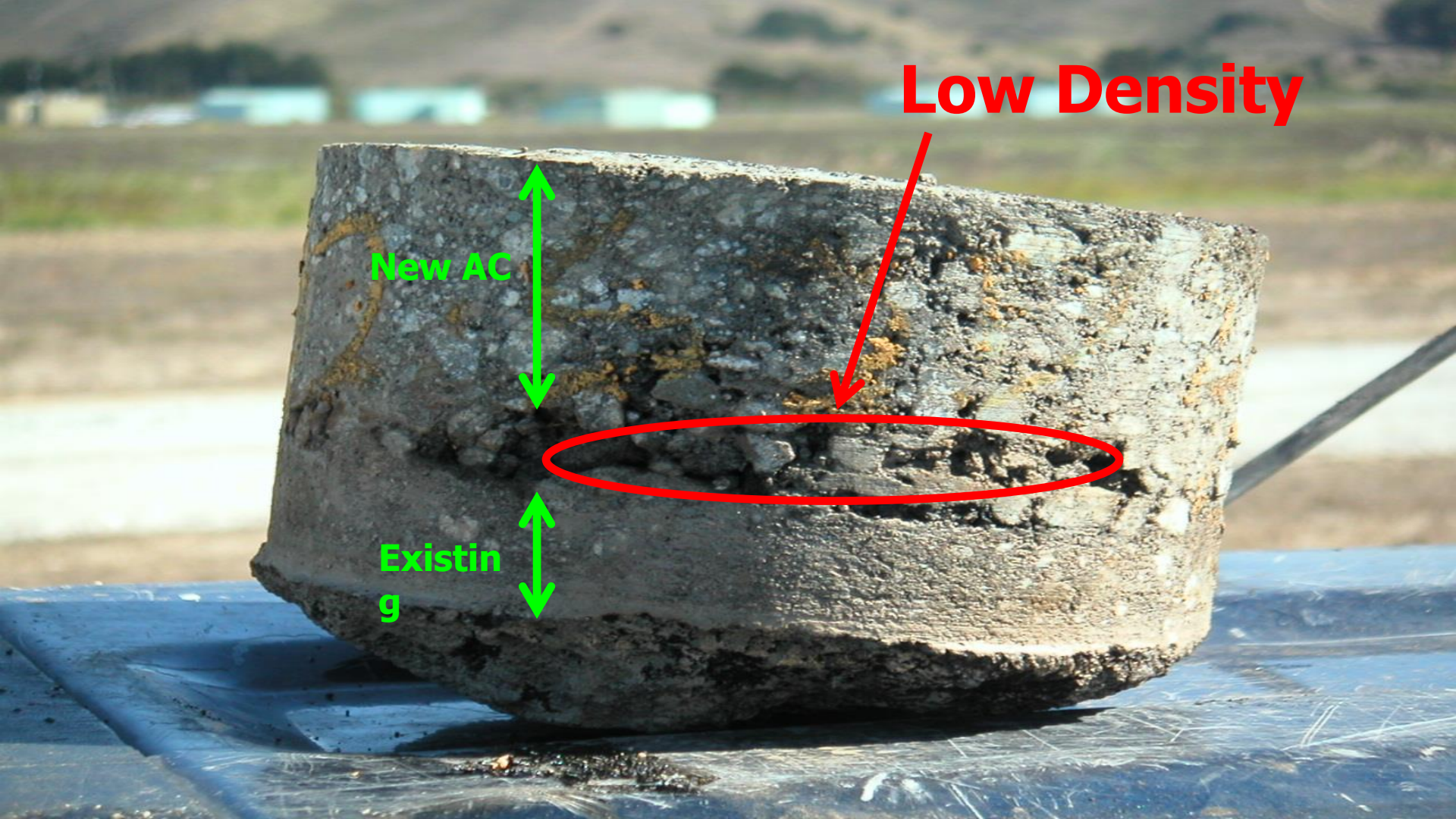
1. Release truck
2. Continue paving
3. Pave & fold hopper wings
4. Stop quickly

Managing Segregation – Truck Exchange

Defects Related to Truck Exchange

Spills on grade are BIG mistakes!




Low Density
New AC
Existin
g

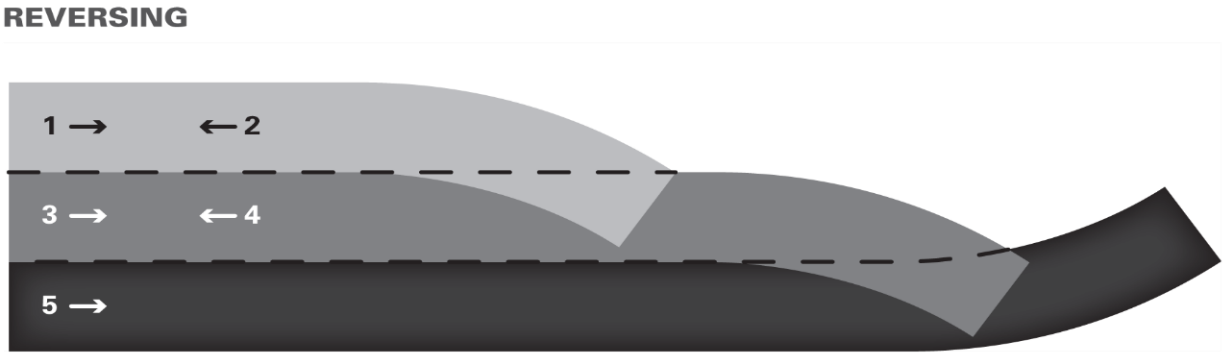
5. Compaction & Rolling Patterns

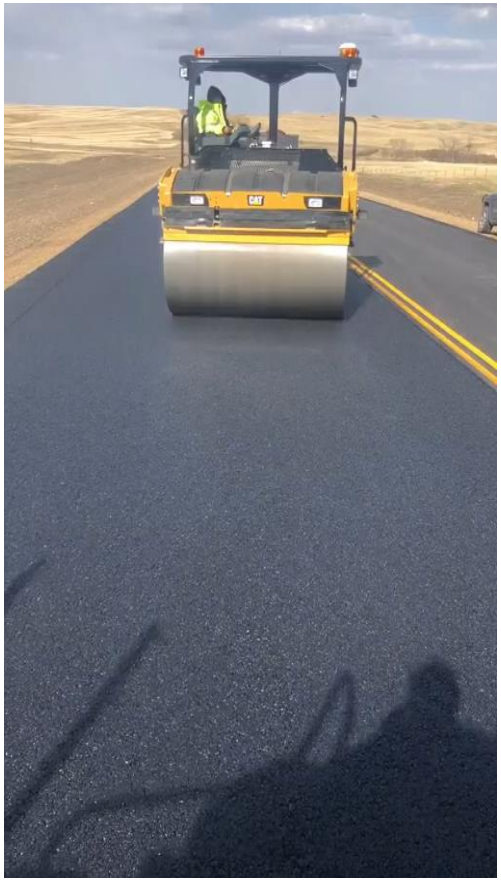
	Breakdown	Intermediate	Finish
%TMD	**90-92%**	**92-94%**	**94%** + take out marks
				
Temp	**280-252˚F (138-122˚C)**	**252-230˚F (122-110˚C)**	**200-163˚F (93-73˚C)**
Coverage	**2** (5-pass pattern)	**3** (7-pass pattern)	**2** (1 vibe/1+ static)
Settings	**High A, Low F**	**90 psi**	**Low A, High F, static**
Distance	**120 feet**	**200 feet**	**200 feet**
Speed	**252 fpm**	**300 fpm**	**350 fpm**

10 – 14 Impacts per Foot (ipf)

Stop at an angle to the mat

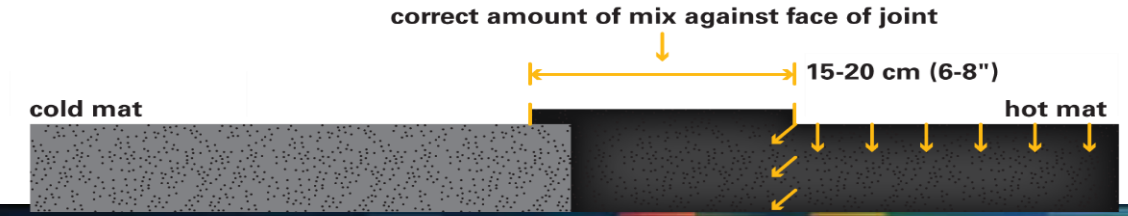
- Roller stops at an angle
- Turn off vibration before roller turns out
- Next pass rolls through stop mark
- Stop marks are staggered





Don’t Stop Square to the Mat = Bump

Longitudinal Joints



CONSISTENCY is the Key to Success!

1. Paver setup and takeoff
2. Temperature
3. Continuous Paving
   - ❑Balanced Paving & Compaction operation
   - ❑Smoothness
     - ❑Quick starts & stops
     - ❑Head of Material
     - ❑Automatic Grade & Slope Controls
4. Segregation
5. Compaction

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

Thank-you for your attention!

What technologies do we have to help us measure, track and do a better job “doing the fundamentals right?

Types of Technologies Available Today

Presented by: Tim Kowalski
Application Support Manager
Wirtgen America, Inc.
Tim.Kowalski@wirtgen-group.com

Outline

- Bomag
  - Intelligent Compaction Solutions
- Moba
  - Pave IR
  - MOBA Matic & Big Ski
  - 3D-Matic
- Trimble
  - 2D & 3D Asphalt, Milling & Concrete
  - IC
  - Thermal Imaging
- Topcon
  - Intelligent Paving Products
    - Smooth Ride
    - MMGPS Paving
    - IC
    - Thermal Imaging
- CAT
  - eROUTES
    - Paving Process Monitoring System
- Wirtgen
  - Milling for smoothness
- Vogele
  - Roadscan (Thermal Imaging)
  - WITOS Paving Plus / Docu
- HAMM
  - IC
  - WITOS HCQ
  - Gateway Portal

BOMAG intelligent compaction solutions

BOMAG
FAYAT GROUP

BOMAG intelligent compaction solutions

BOMAG FAYAT GROUP

Indicate	Control	Document
ECONOMIZER	ASPHALT MANAGER 2 E VIB	BOMAP
TERRAMETER E VIB	VARIOCONTROL E VIB	JOBLINK

ECONOMIZER

Looking at compaction from a different perspective:

BOMAG ECONOMIZER - The navigator for optimal compaction

- ECONOMIZER measures the stiffness of material
- ECONOMIZER indicates optimal compaction

Available for:

Reversible vibratory plates, trench compactors, light and heavy articulated tandem rollers, single drum rollers

TERRAMETER

TERRAMETER for soil compaction

- Shows compaction progress and EVIB value
- displays “***EVIB***” in MN/m² (EVIB is the soil stiffness)
- ”Finished message” for roller operator
- Optional printer available

Available for:

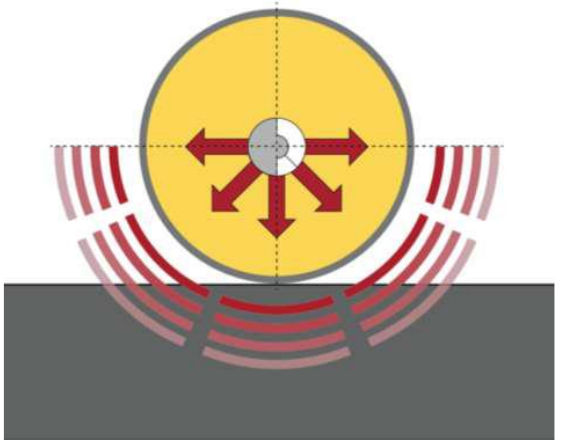
single drum rollers

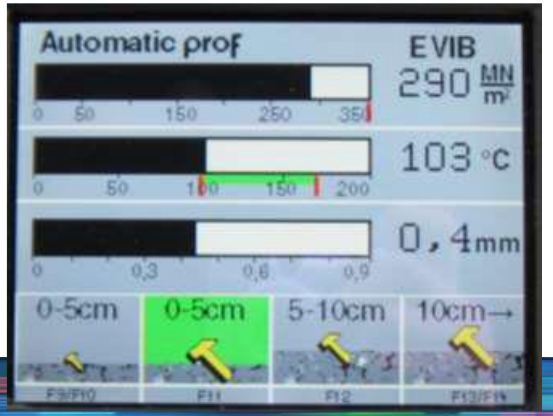
ASPHALT MANAGER

<u>Intelligent</u> compaction

The unique features of ASPHALT MANAGER:

- Infinitely adjustable amplitude
- Automatic control
- Linear oscillation (manual oscillation mode available)
- Shows compaction progress and EVIB value
- As powerful as possible, as sensitive as needed





Available for:

Heavy tandem rollers, articulated and pivot steered

ASPHALT MANAGER 2 EVIB

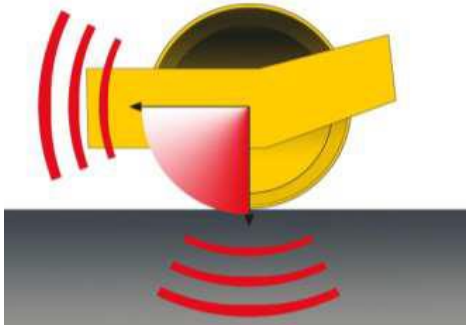
VARIOCONTROL (BVC)

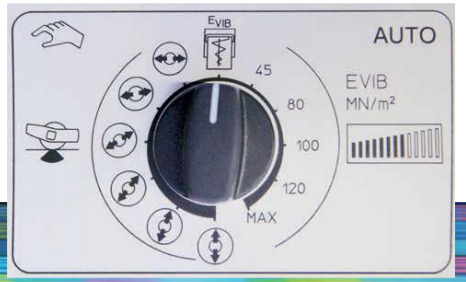
Efficient and cost-effective compaction
Basically *ASPHALT MANAGER* for soil compaction

- Setting the specified compaction value
- Automatically controlled compaction
- Sensitive compaction close to buildings

Available for:

Single drum rollers

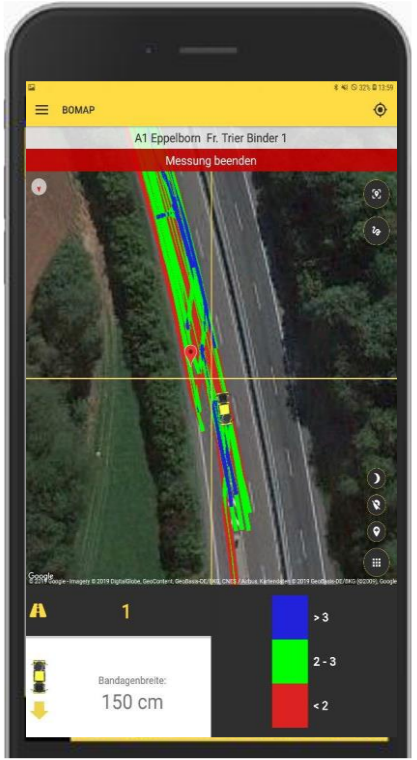




BOMAP

Basic IC mapping for free

- Download the Android App for free
- Compatible with tablet or smartphone.
- GPS positioning via tablet/ smartphone(internal GPS).
- Works with any roller, not only BOMAG roller
- Plug & Play expandability:
- External GPS precision antenna (works also with 3rd party rollers)
- Connect to BOMAG machine data
- No expensive hardware needed.



BOMAP Connect (coming soon)

BOMAP Connect

- Connect multiple rollers on the jobsite
- Let’s operators see where other rollers have been already
- Offsite/remote project setup possible but not necessary
- Remote live monitoring
- Affordable licensing
- Extensive reporting capabilities
- **VETA** compatible

JOBLINK

JOBLINK – The BOMAG IC Interface

Full scope of data. Now wire less.

- Displays all process relevant measurements for BOMAP.
- Automatic configuration of BOMAP.
- Works ECONOMIZER and upwards.
- Automatic connection setup to BOMAP.
- JOBLINK Dashboard shows all measurement values at a glance.
- Compatible with **Third Party Mapping** systems (Topcon, Trimble, Leica, Moba…)
- Currently available for Heavy Tandem Rollers, Single Drum Rollers and Pneumatic Tired Rollers

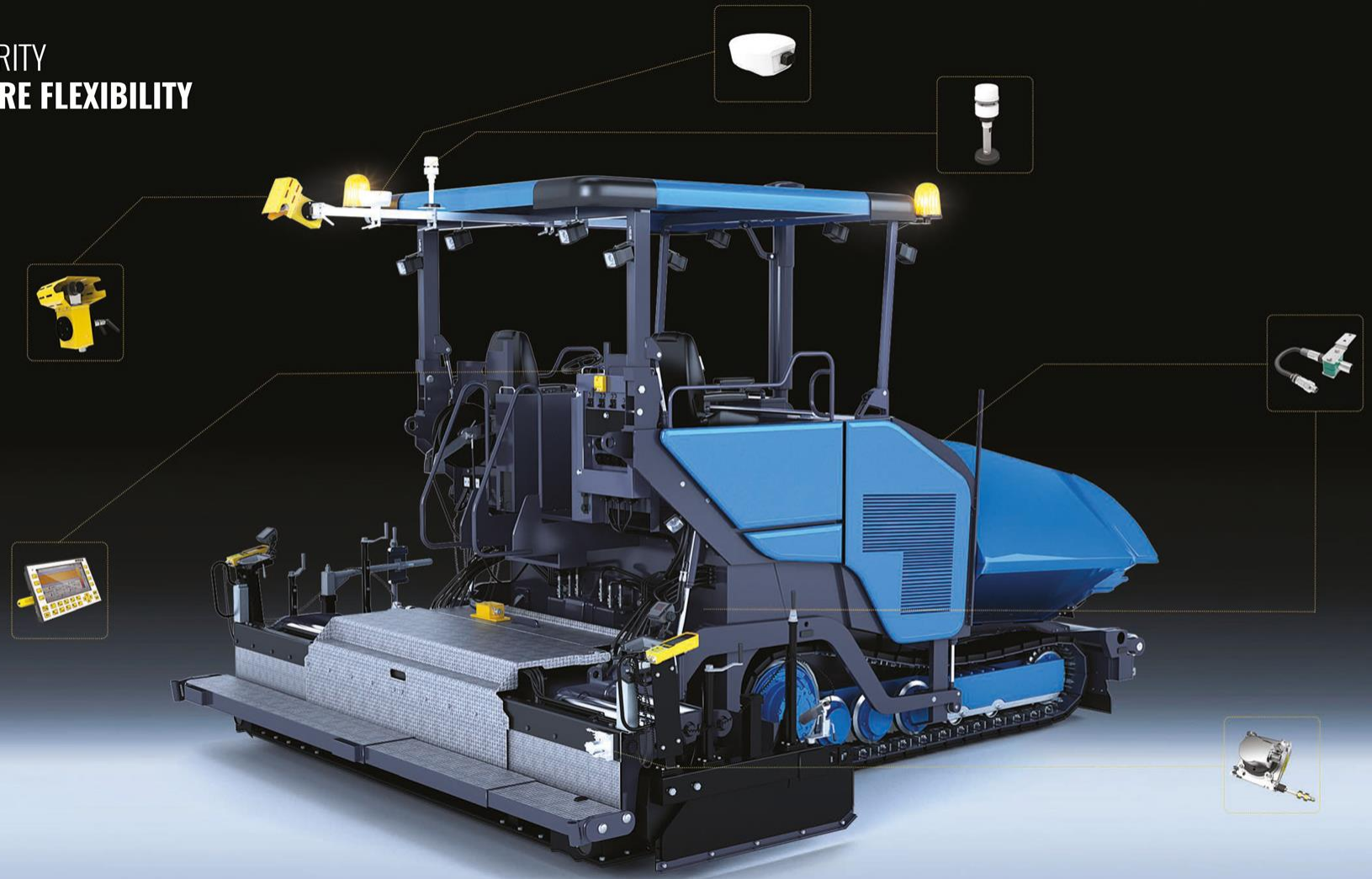
MOBA®

MOBILE AUTOMATION

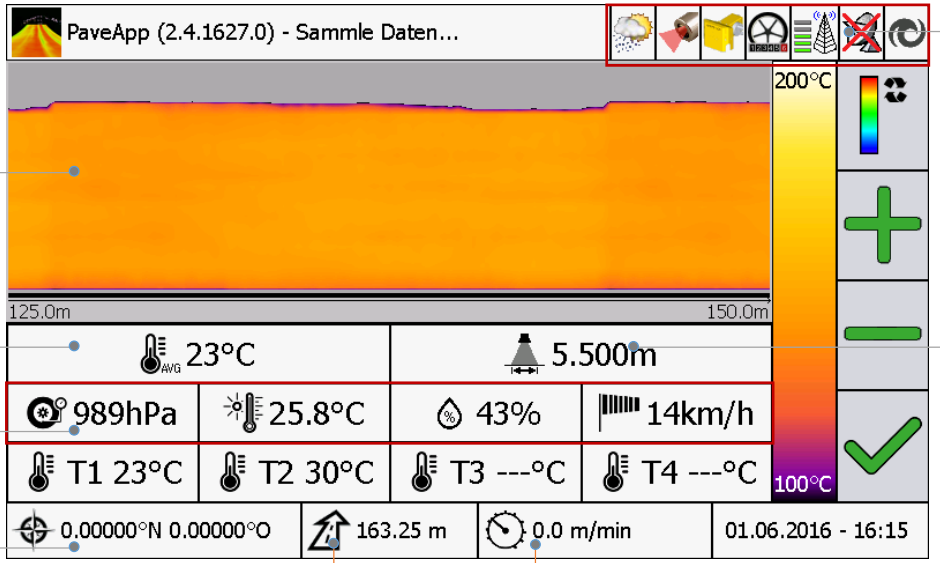
INSPIRING MOBILE AUTOMATION - FOR MORE THAN 40 YEARS


PAVE-IR
THERMAL PROFILE SYSTEM

MODULARITY
FOR MORE FLEXIBILITY



MEASUREMENT



STATUS BAR

THERMAL PROFILE IN REAL-TIME

ASPHALT SURFACE TEMPERATURE

SCREED WIDTH

AMBIENT CONDITIONS

POSITION GPS

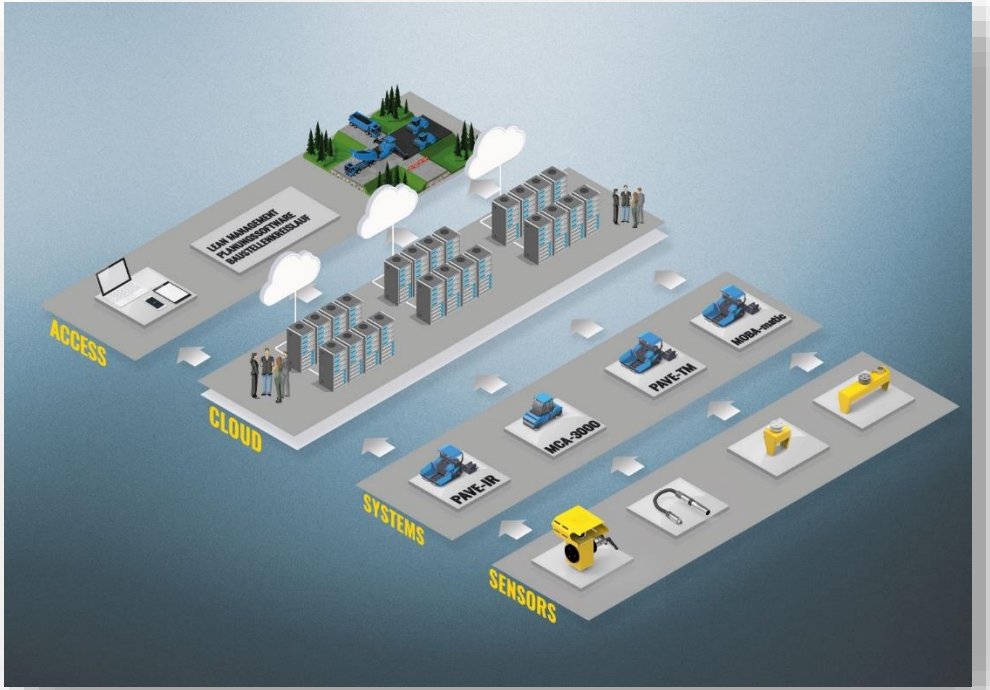
CURRENT SPEED

JOB DISTANCE

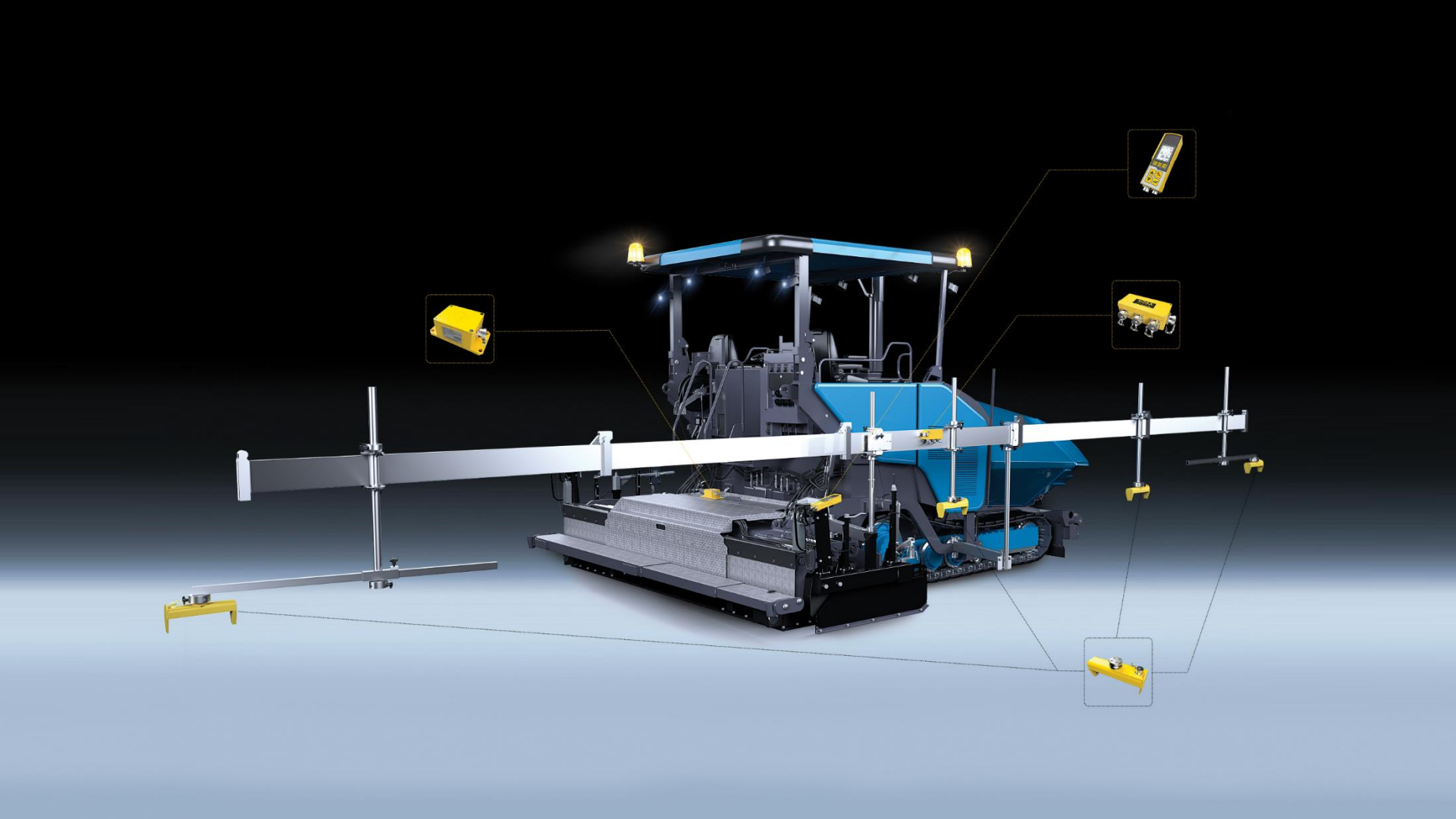
TELEMATICS & INTERFACE

PAVE-IR CLOUD SOLUTION

- Easy and automatic data storage via MOBA Cloud
- MOBA Cloud solution allows real-time data-exchange with other systems
- With automatic data transfer activated, you can retrieve and archive project data in the office in real-time
- Pave Project Manager allows in-depth analysis
- Create reports for optimization and improvement for the next construction site




MOBA MATIC &
BIG SONIC SKI
Build Smoother Roads

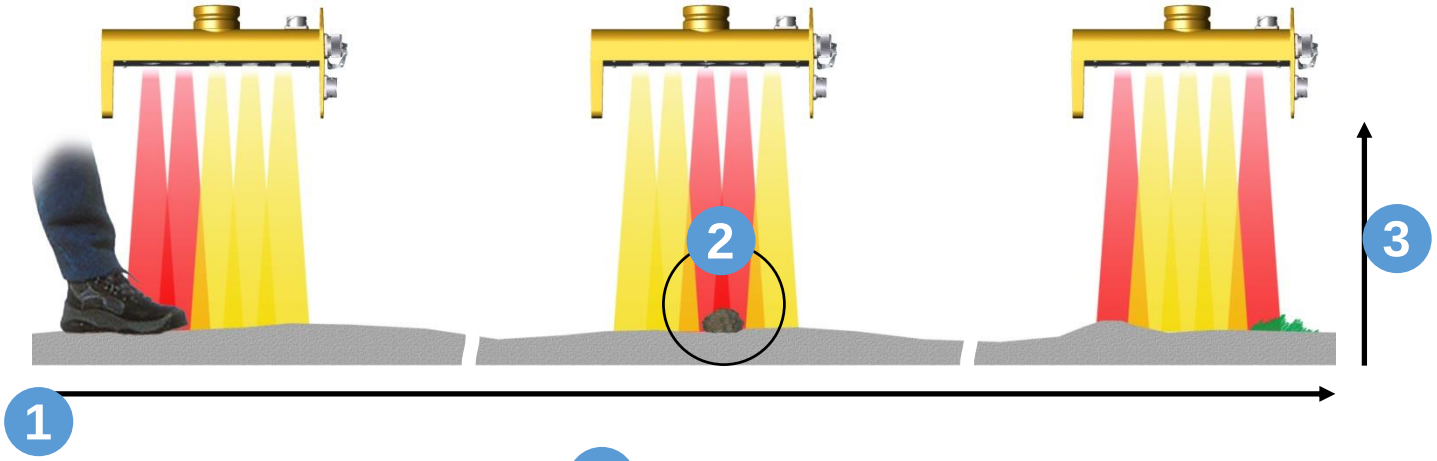


COMPONENTS

MOBA-MATIC II

- 3,5“ COLOR DISPLAY
- INTUITIVELY CONTROLLABLE THROUGH SYMBOL LANGUAGE
- BACKLIT KEYS FOR NIGHT WORKS
- WORKS WITH A SECOND MOBA-MATIC
- MODULARITY ALLOWS INDIVIDUAL ADAPTION

MEASUREMENT – Intelligent Measurement Algorithm

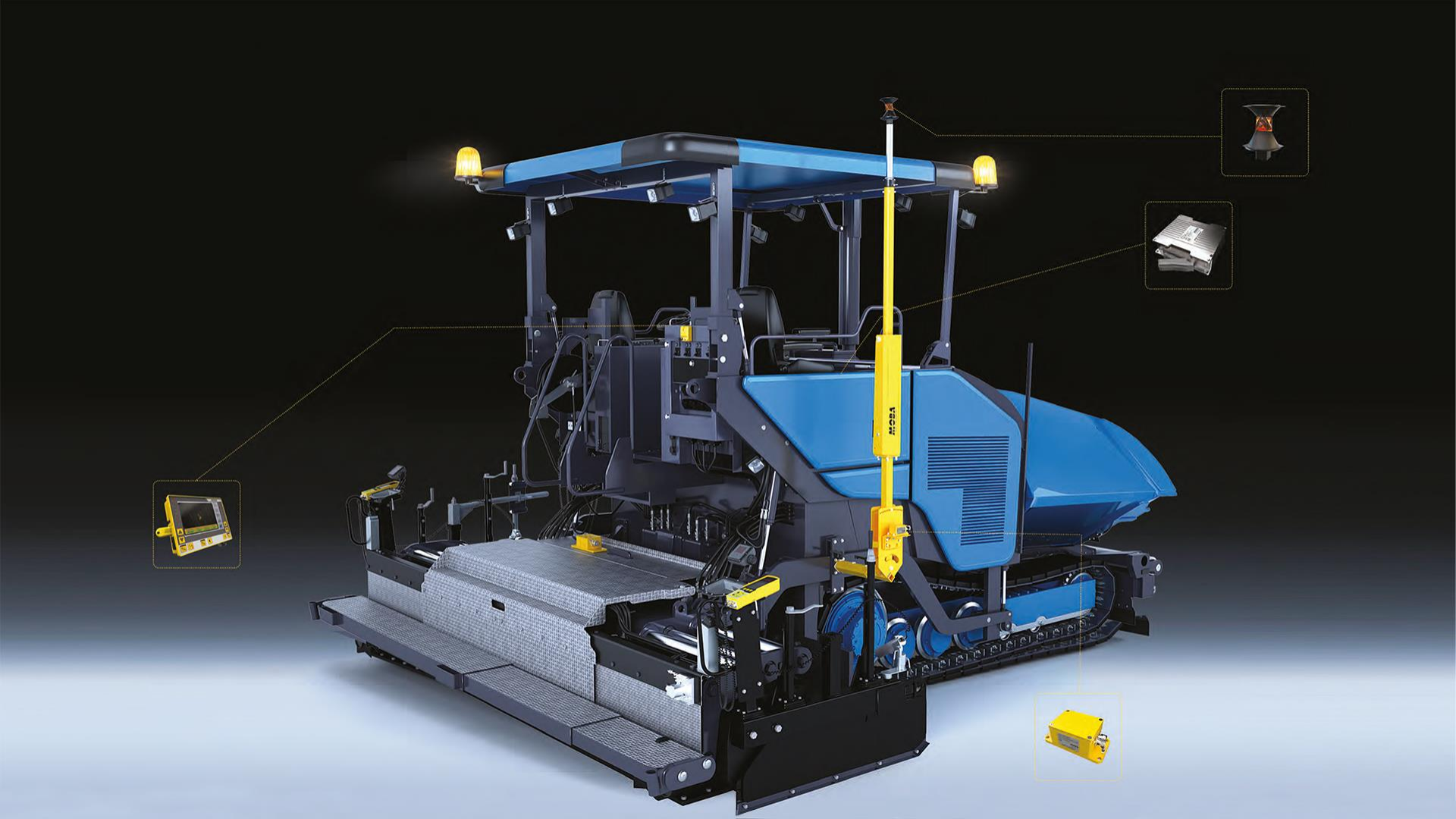


MEASUREMENT OF

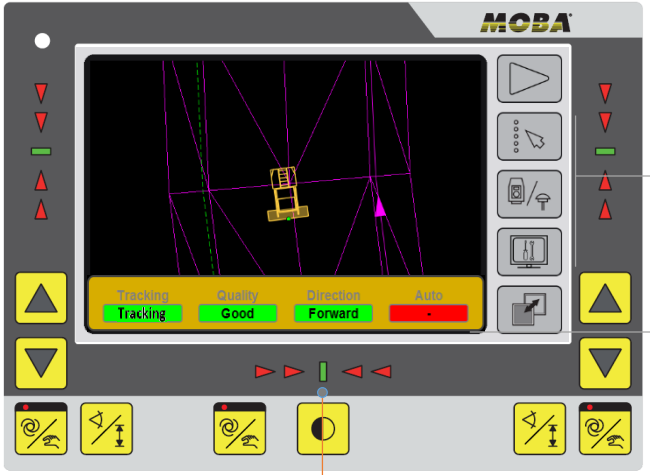
1. ROAD SURFACE
2. Automatic measurement faults
3. HEIGHT

MOBA 3D-Matic

Paving & Milling System



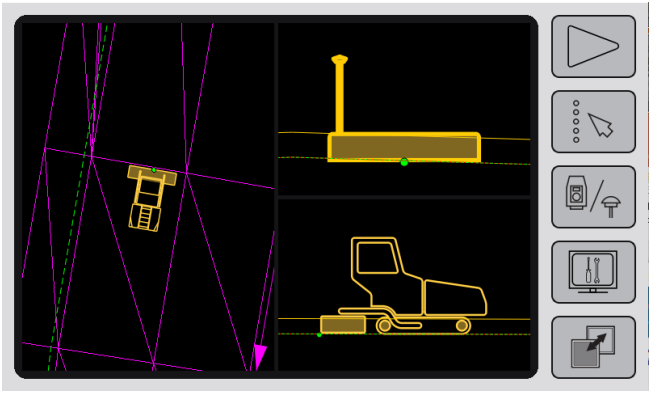
User interface



CONFIGURABLE KEYS

STATUS BAR

LED INDICATORS - DEVIATION



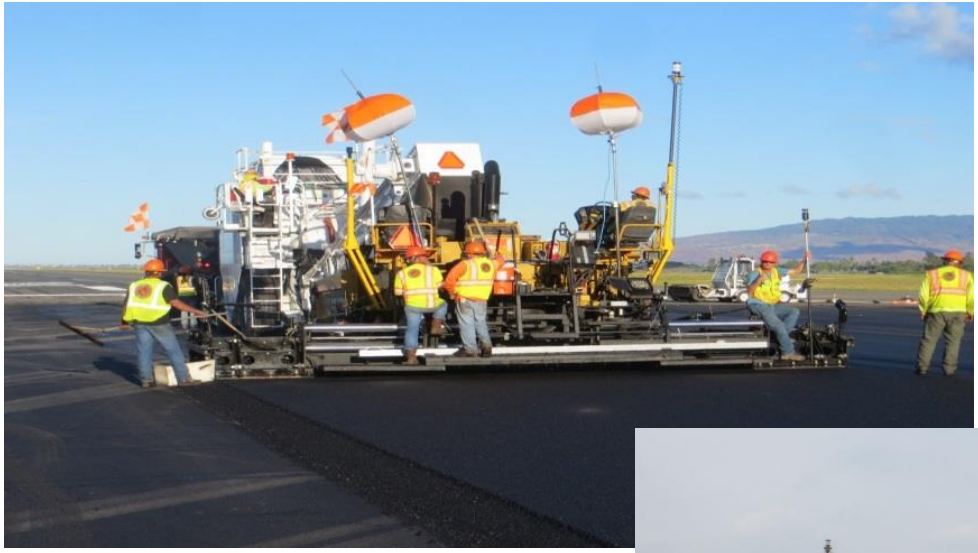
Trimble Paving Technologies

2D Asphalt Paving Solutions

- Reference the existing surface
- Pave a constant thickness
- Grade match to curb or subsurface
- Constant cross slope

Trimble

3D Asphalt Paving Solutions



- Variable depth and slope paving
- Runways, interstate highways, race tracks
- Universal Total Station 3D guidance
- +/- 3mm vertical accuracy
- Utilizes 3D designs - does not use the existing surface for guidance

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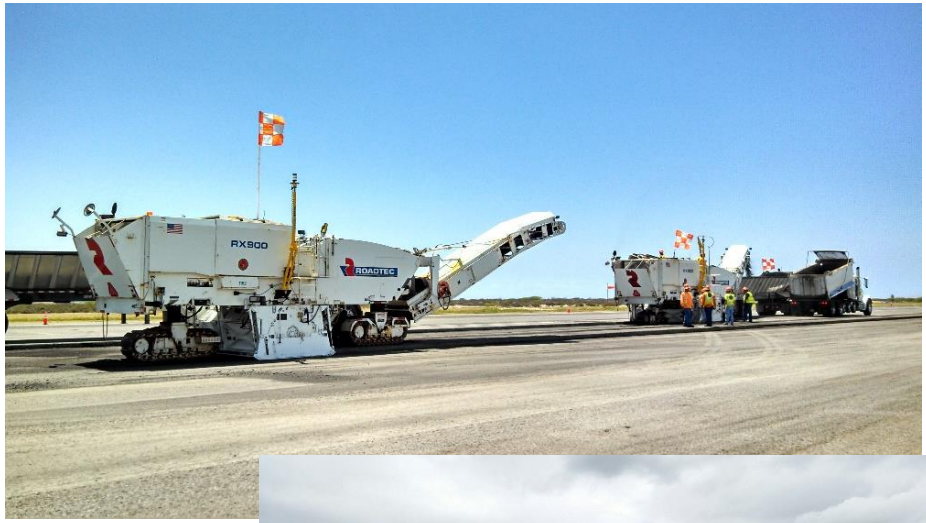
3D Milling Solutions



- Variable depth and slope milling
- Runways, interstate highways, race tracks
- Universal Total Station 3D guidance
- +/- 3mm vertical accuracy
- Utilizes 3D designs - does not use the existing surface for guidance

Trimble

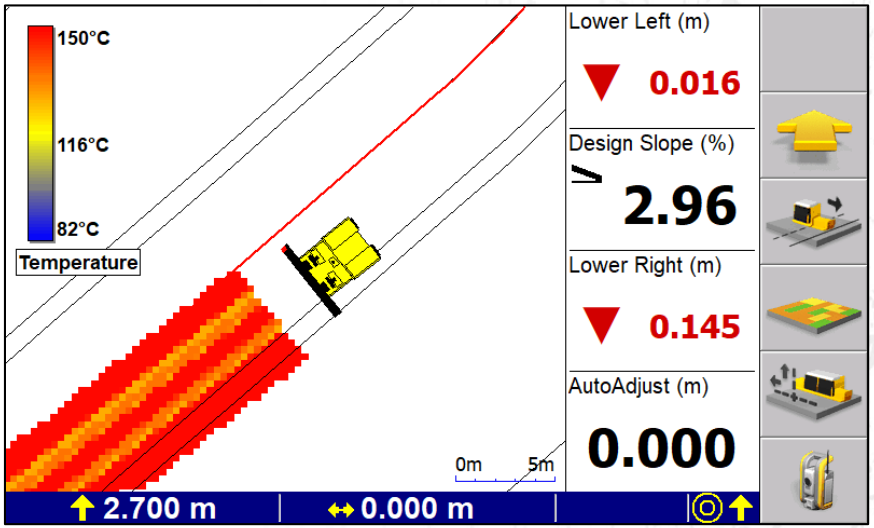
Intelligent Compaction Solutions

- Meets all Intelligent Compaction specifications
- Veta compatible
- Soil, asphalt, and landfill solutions
- Customizable systems for individual needs

Trimble

Pavement Thermal Profile Solutions

- Veta output capable
- +/-2°C (+/-3.6°F) or +/-2% for ambient temperatures near room temperature
- Calibrated for 60°C to 400°C (140°F to 752°F)



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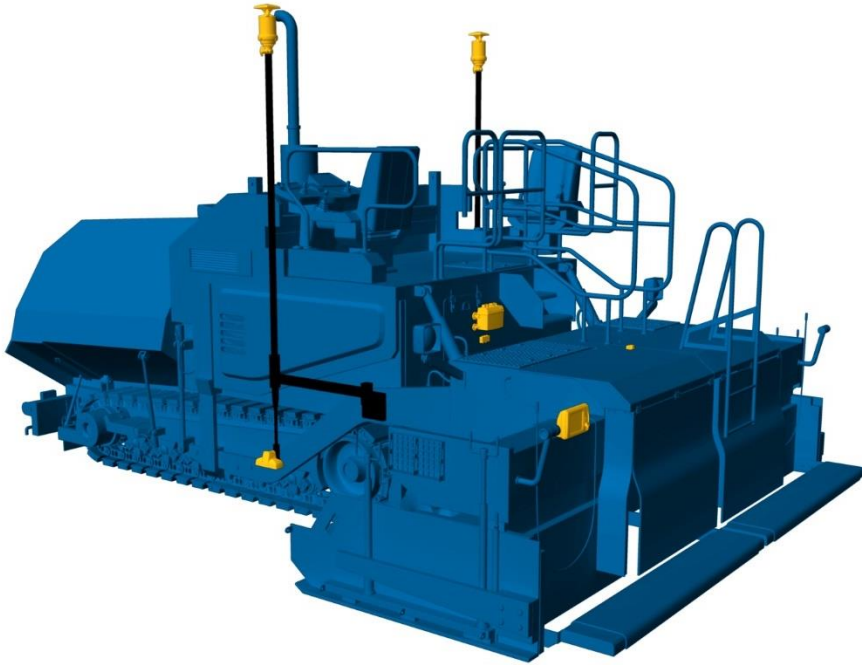
Intelligent

Paving Products

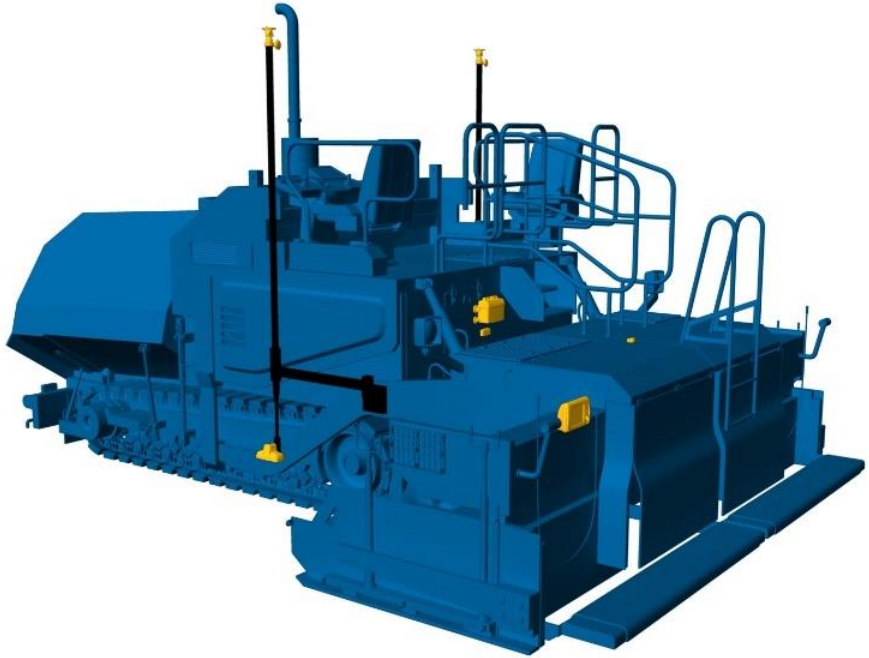
TOPCON

MMGPS HMA Paving

P-63 Millimeter Paving



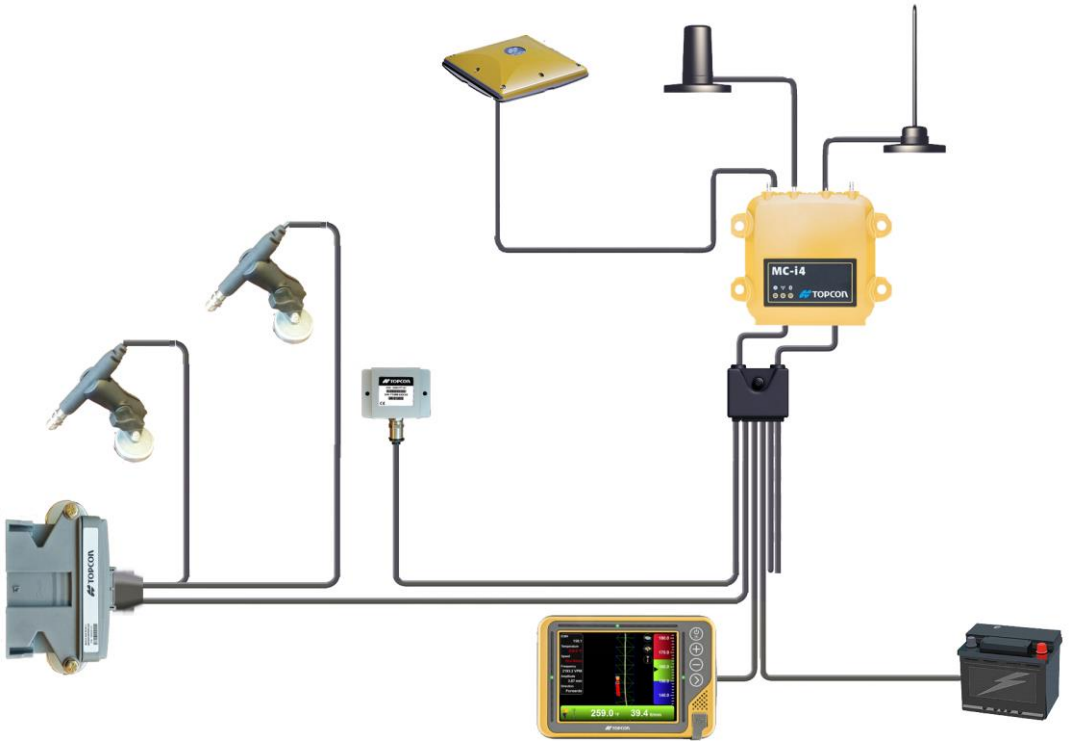
Paver LPS Option



Intelligent Compaction

Compaction kit

- MC-i4
  - GNSS included
  - Radio included (DUHF / FH9
  - Cell included (Sitelink)
- Display
  - GX-55
  - GX-75
- Sensor kit
  - IR temperature sensors
  - Accelerometer



Thermal Mapping

eRoutes

Paving Process monitoring system

eROUTES: ASPHALT - Plant, Truck and Paver

Plant arrival time
Load time
Ticket capture
Plant depart time

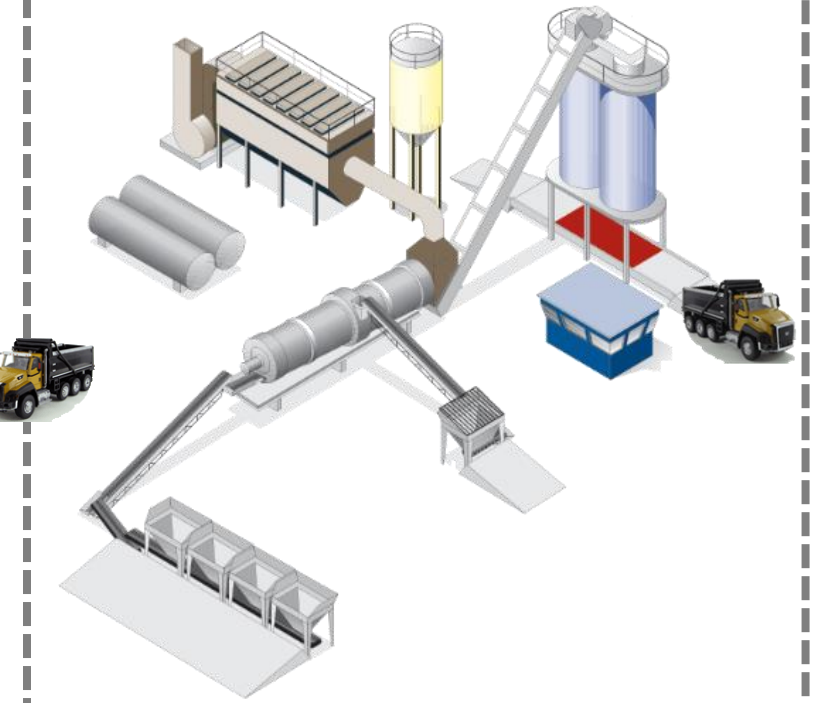
MOBILE GEOFENCES

22 meters

400 meters

Truck route
Truck
location

Jobsite arrival time
Dump time
Jobsite depart time

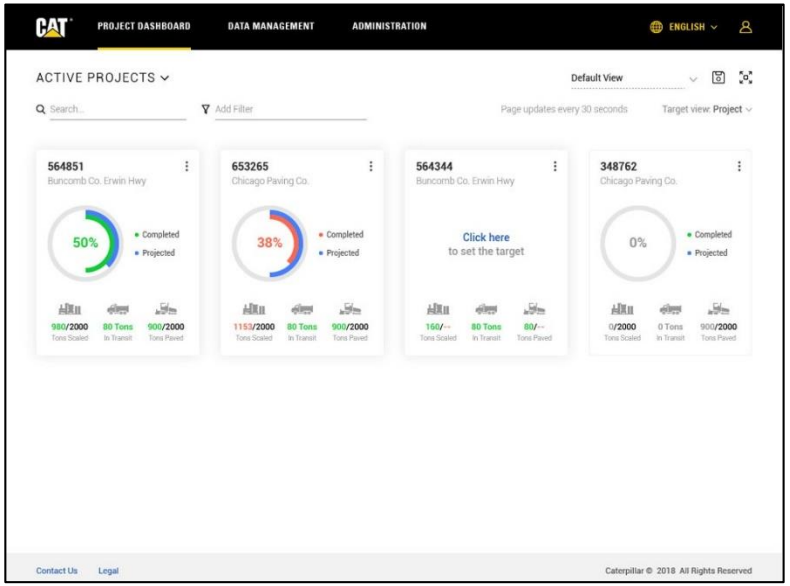


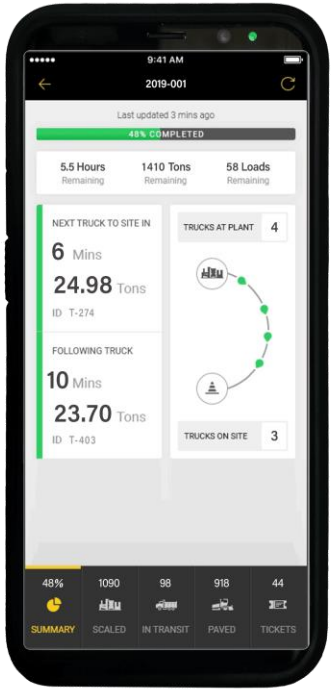
PLANT GEOFENCE

User Defined

eRoutes User Interfaces

Web-based user interface primarily for management employees to monitor realtime information as well as post-process jobsite data.





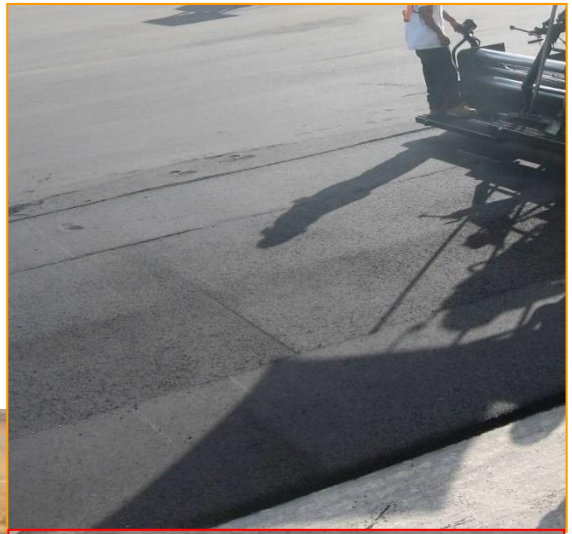
Mobile application primarily for paving foremen and paving crew members giving them the information they need to do their jobs better.

WIRTGEN
GROUP

Vogele - Paving Solutions

RoadScan – Integrated System:

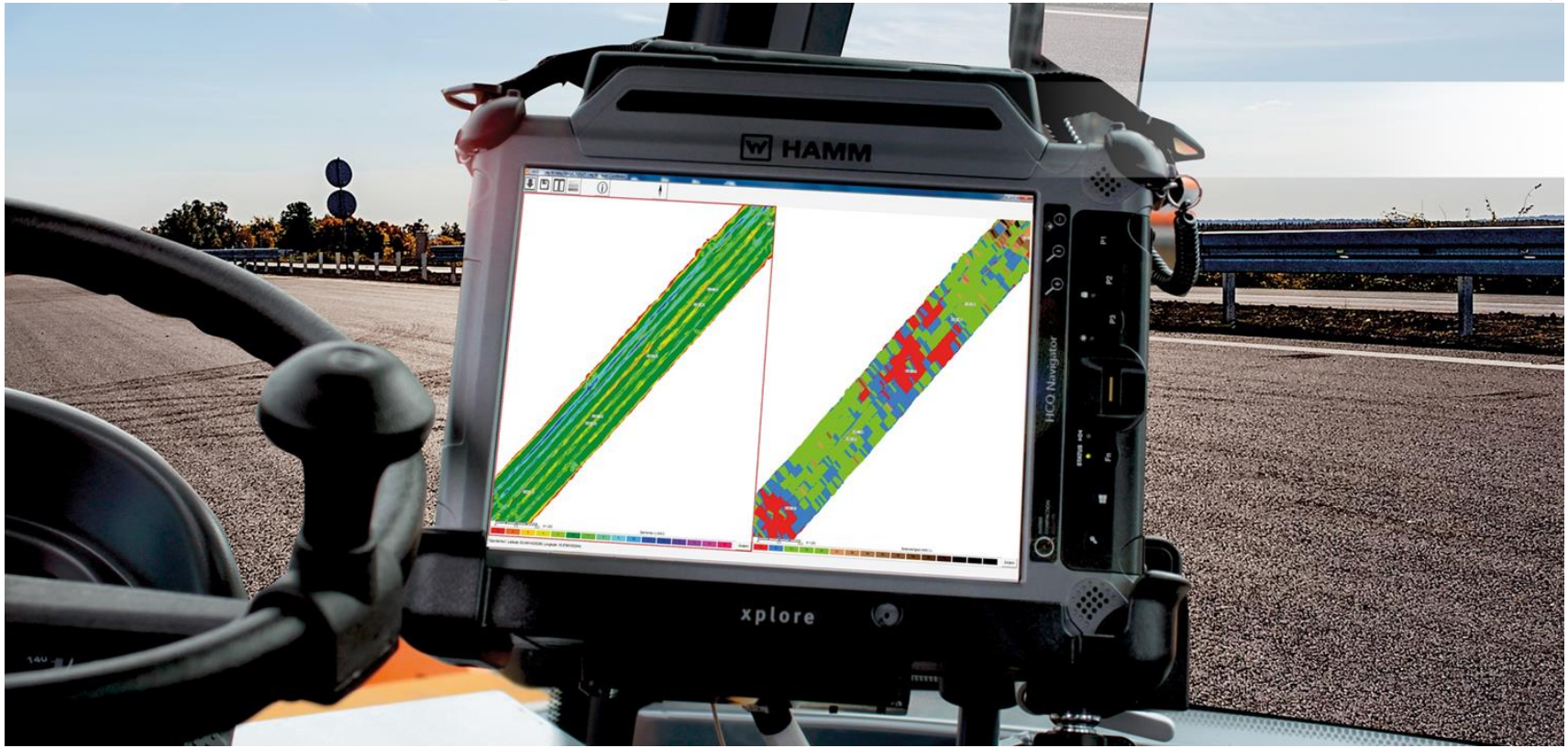
- ***Camera Scan 10 m at all time***
- ***Camera Easily mounted on a Designed Location***
- ***All connections part of Paver Electrical System***



Vogele – WITOS Paving Plus

WITOS Paving Plus –
New perspectives for asphalt paving

HAMM – HCQ (Hamm Compaction Quality)



HAMM – WITOS HCQ Portal

Live Monitor

- Simple data filtering options
  - Compaction mode
  - HMV
  - Double jump
  - Temperature
  - Height
  - Driving direction

HAMM – Gateway Portal

TOPCON

Trimble

Leica

Thank-you for your attention!

How can these technologies address obstacles to quality paving practices?

How these technologies address obstacles to quality paving practices

Presented by: Dr. Miguel Montoya

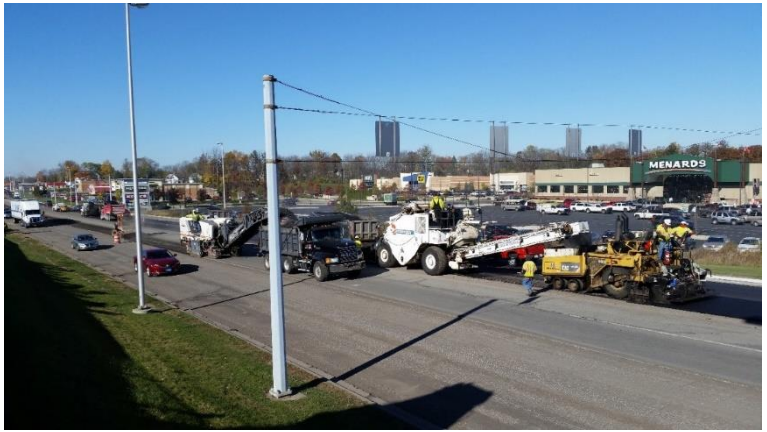
mamontoyaro@utep.edu

Obstacles to Quality Paving Practices

- Issues: construction complications
- Obstacles: factors hindering progress
- Technology: application of scientific knowledge for practical purposes
- Can new technologies help?

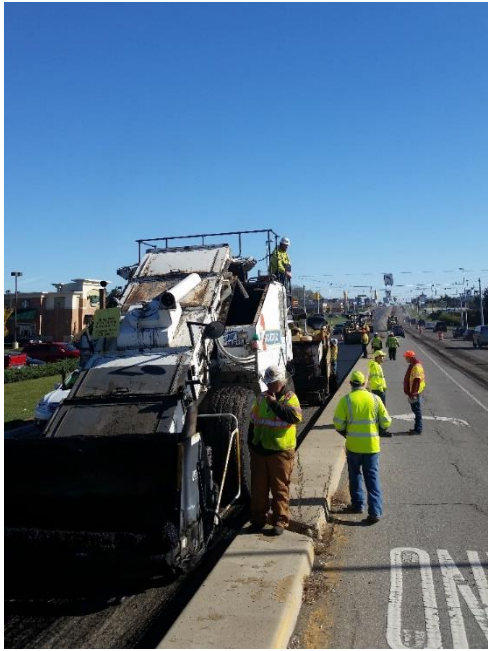
Obstacles from a Field Operations Perspective

- Three major obstacles:
  - Unbalanced paving operations
  - Lack of experienced or well-informed personnel
  - Equipment performance



Unbalanced Paving Operations

- Coordination in terms of following a paving plan
- Time constraints
- Existing conditions
- Hauling distances
- Quality assurance feedback loop
- Balance between production and quality



Lack of Experienced or Well-informed Personnel

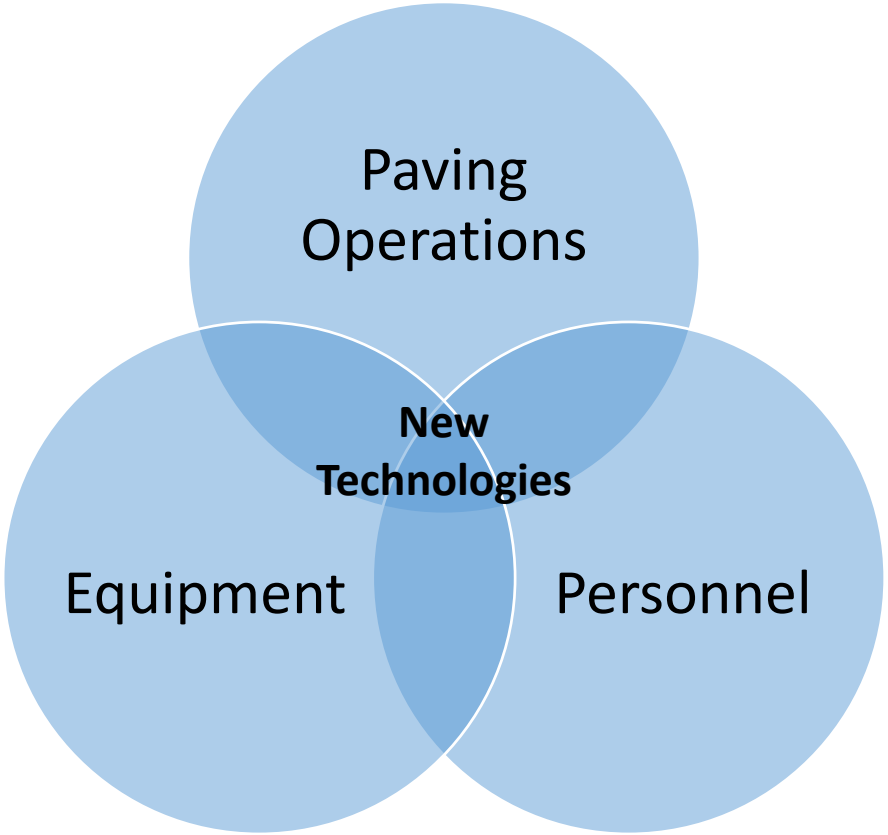
- Training in the field
- Lack of knowledge of specifications
- Few motivation for field staff to follow best practices
- Short supply of qualified personnel (i.e., equipment operators)
- Personnel turnover

Equipment Performance

- Equipment maintenance
- Equipment usage (i.e., speed)
- Equipment breaking down
- Plant operations

New Technologies

- Connectivity
- Automation
- Digitalization
- Electrification



New Technologies

- Must produce quality in all the paving components
- Overall quality is no stronger than the weakest link

Challenges

- Keeping up with the changes in technology
- Consistently utilize new technology
- New technology awareness
- Adoption from different stakeholders

Different Perspectives

- Contractor: How do new technologies impact paving practices? Do they lead to quality?
- Agency: QC or QA tool? How can an agency appropriately incentivize contractors to take advantage of new technologies?
- Equipment Manufacturer: How to keep up with training customers and make sure new technologies are used as intended?
- Other Stakeholders: What new paradigms these new technologies will develop?

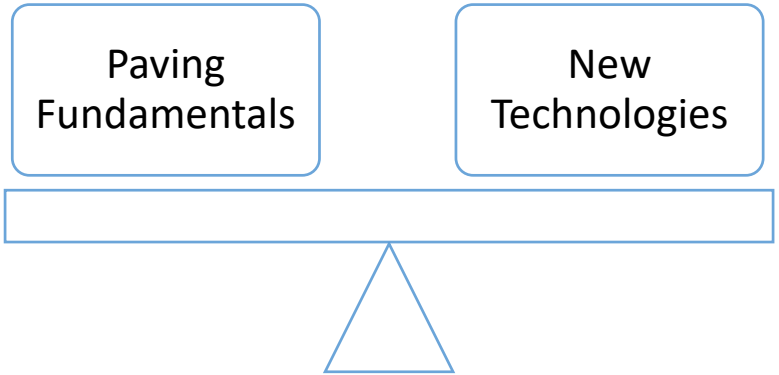
New Technologies

- Will
  - Address paving issues/obstacles if used effectively
  - Help to quantify the impact of using best construction practices

- Will not
  - Provide quality without applying the fundamentals correctly
  - Substitute paving fundamentals, planning, experience, training, etc.

Path to New Technologies

- Equilibrium between paving fundamentals and new technologies
- Incremental changes rather than disruptive transitions
- Implementing new technologies will take effort
- The path to new technologies is paving fundamentals



Thank you!

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Update Events for you

May 21 – June 2, 2022

Conference on Sustainability and Emerging Transportation Technology

August 29-31, 2022

TRB's Tools of the Trade Conference

https://www.nationalacademies.org/trb/events

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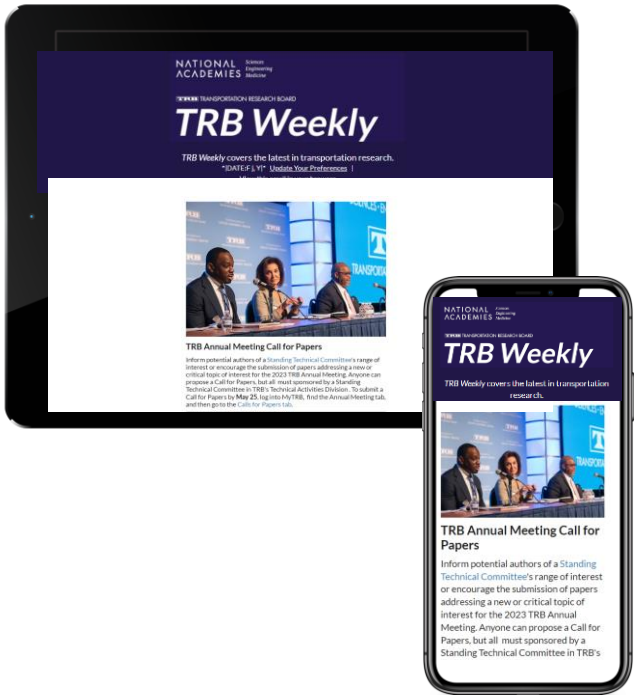

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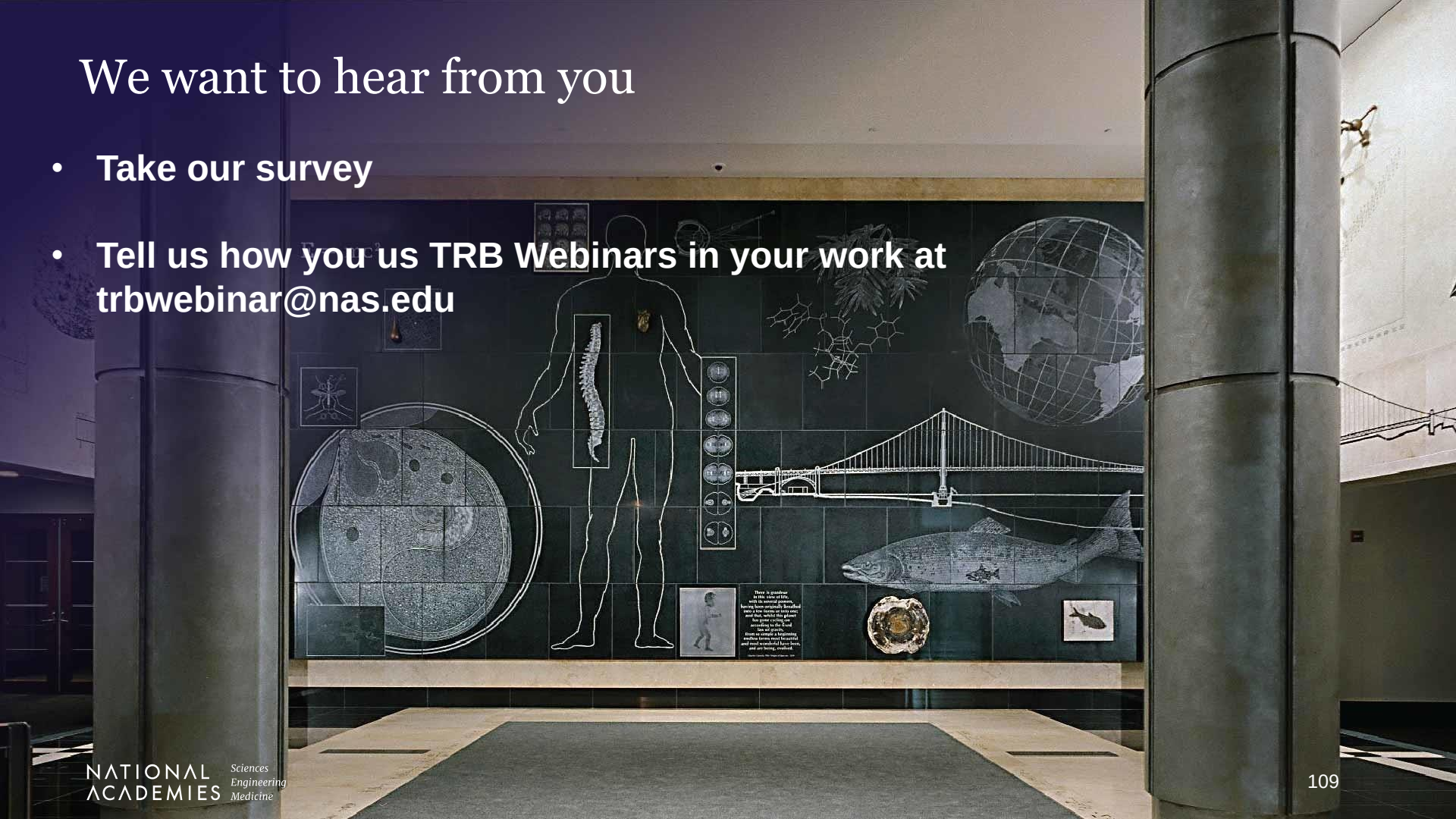

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