Paving Equipment Innovations: What's Available, What's Coming!

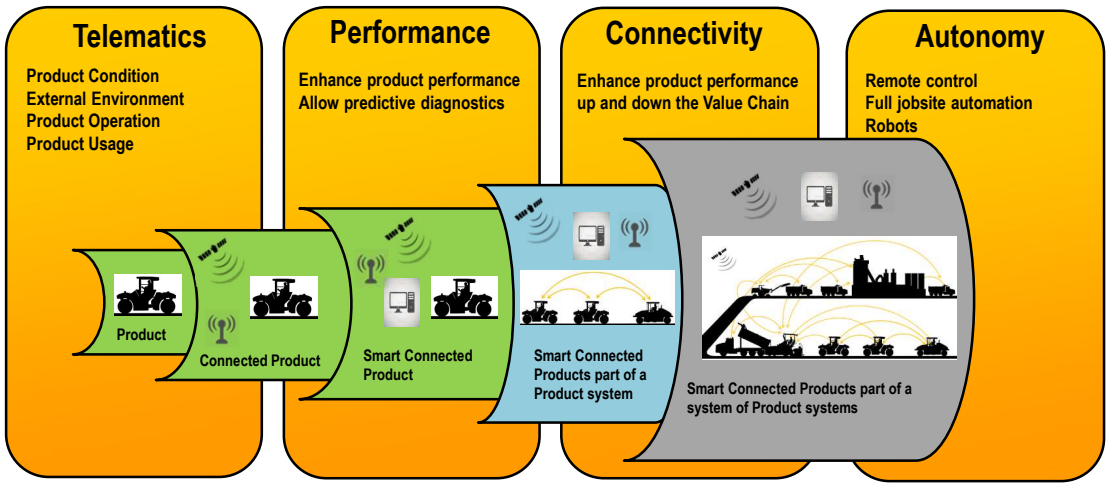
Thompson CAT

Presented by: Todd Mansell, Caterpillar

CAT

1

Technology is… Redefining industry standards



CAT

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Technology & Innovation - Pavers

- Hopper level & temperature
- Lockout screed controls
- Folding apron
- Clean out / warm-up mode
- Friction steer
- Radar for MTV spacing (spills)
- Pre-set paving speed
- Production calculator
- Feed sensor settings/configuration
- Hill hold feature
- Screed assist (counterbalance)
- Auto-fill
- Pave Start Assistant
- Integrated G&S control
- 3D screed control

- Eco-mode – engine control
- Telematics
- Grade & Slope easy diagnostics
- Grade & Slope calibrations automated
- Configurable manual over-rides
- Anti-segregation kits

3

Paver Hopper Temperature & Level

- Process control

4

Lock-Out Selected Screed Controls

- Screed functions and feed system locked out in travel mode or maneuver mode
- Lock out during paving
  - Crown
  - Slope
  - Height
  - Auger height
  - Tow-points

5

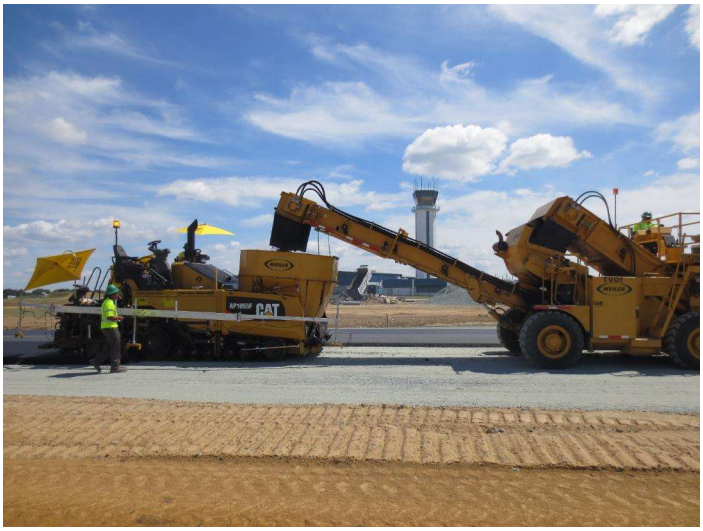
Cleanout / warm up mode – safety

1. One-button auto-feed system
2. Auto fill
3. Cleanout / Warm Up mode

Folding Hopper Apron

6

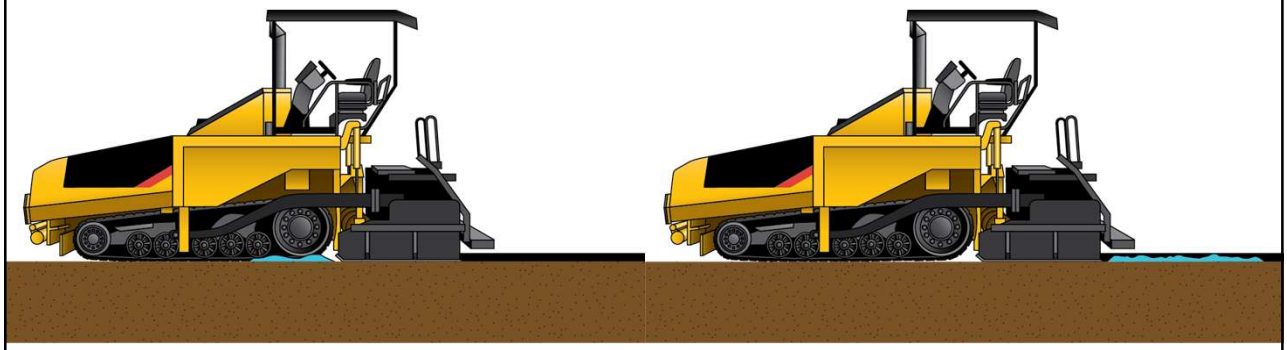
Radar for MTV Spacing



- Keeps distance between paver and MTV
- Reduces potential for paver and/or MTV stop
- Safety - collisions

7

Spills on grade are BIG mistakes!



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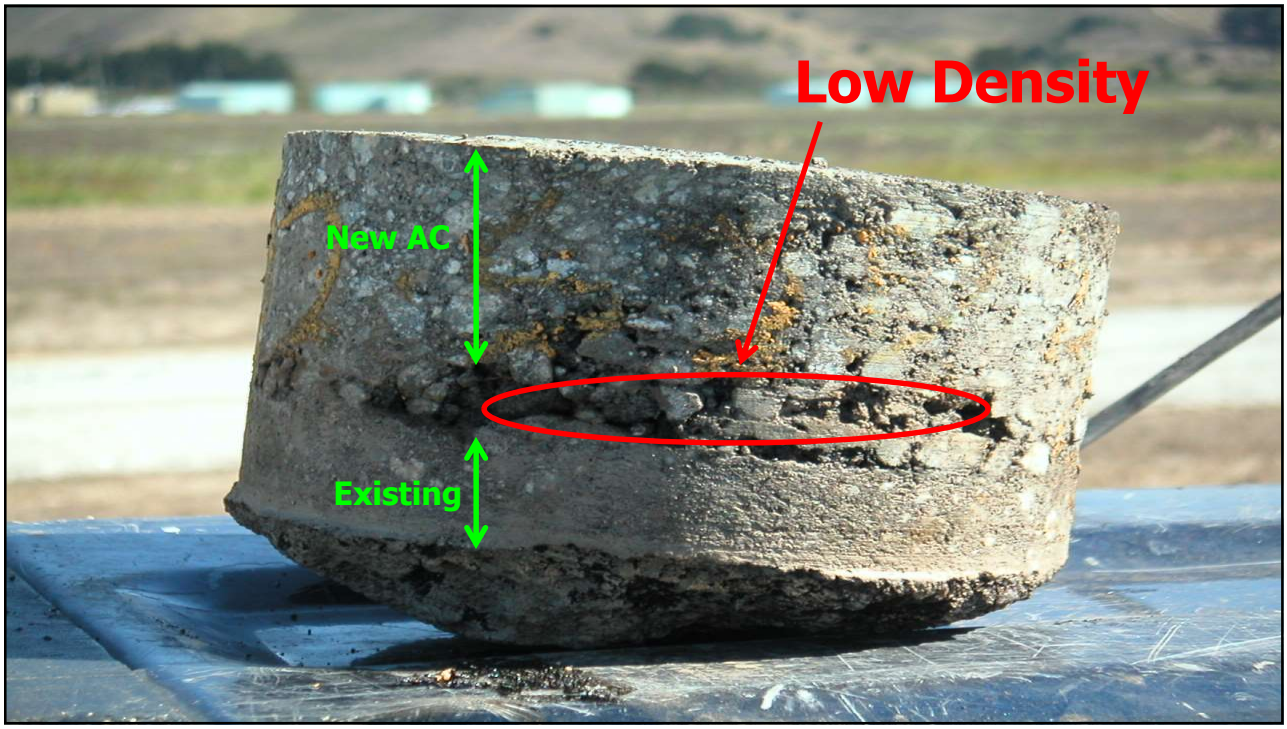

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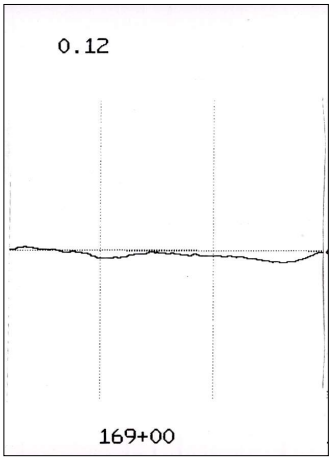
Paving Speed – Quick Starts / Stops



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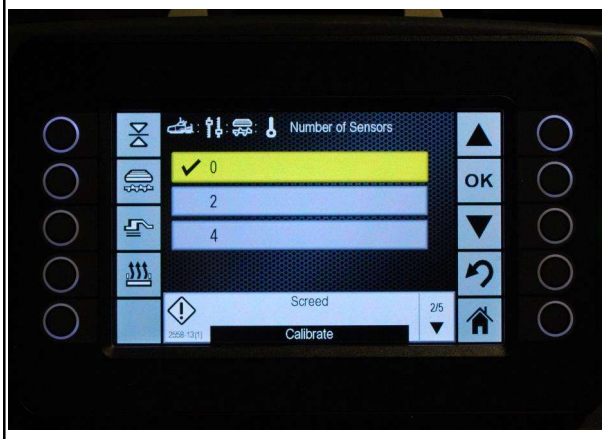
Feed Sensors: 0, 2, or 4



- Can set to “0” feed sensors and manually set feeds if a feed sensor gets broken or damaged

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Hill Hold – Prevents Paver Rollback

- Brake stays engaged until propel system current exceeds valve cracking limit, or brake is engaged more than 2 seconds after propel lever leaves neutral

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Pave Start Assistant

- Create/Save profiles
- Stores many machine settings for quick recall / paving setup
- Facilitate quick/easy pickup and restarts, such as parking lot applications
- Also great for production/highway paving
- Area paved – great for determining material yield

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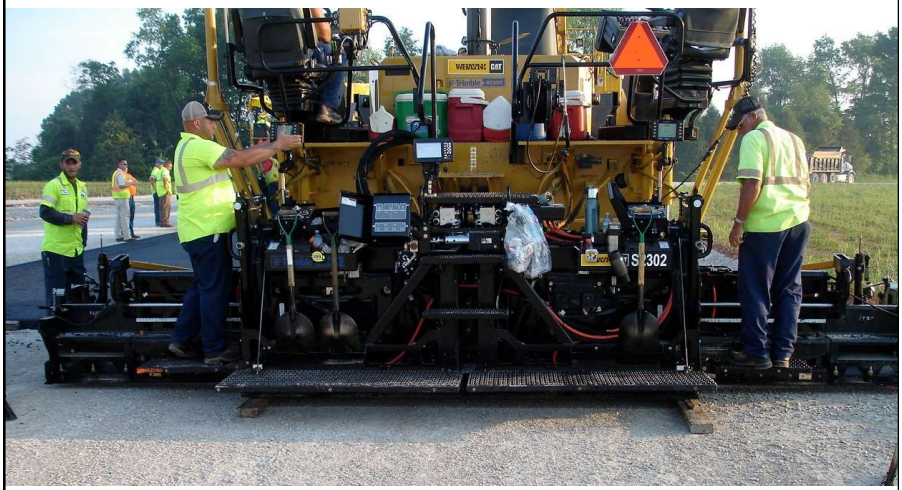
Paver Setup & Take Off



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

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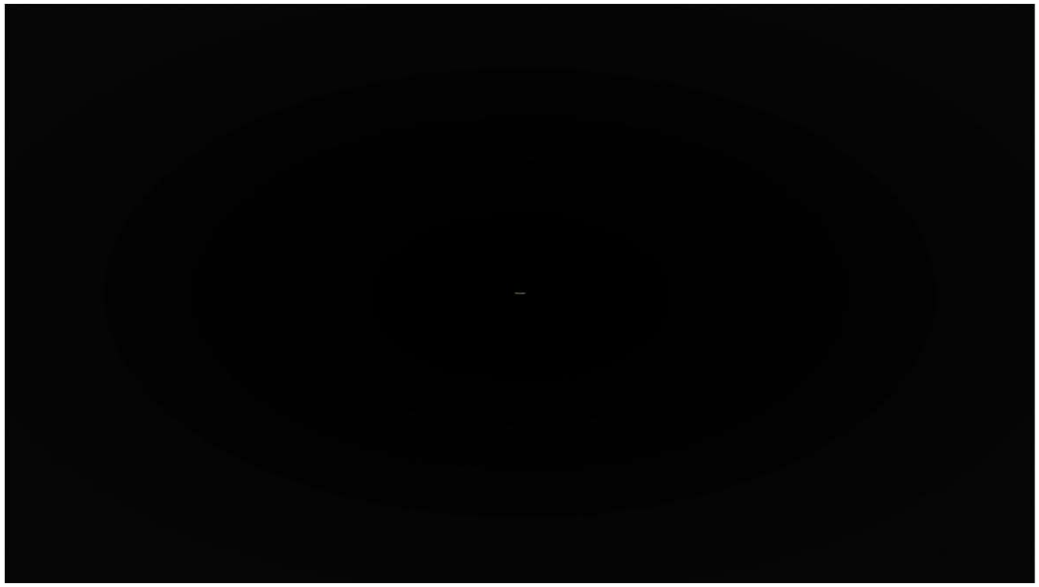
Pave Start Assistant



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Textured Screed Plates

- Being field tested in some regions in USA – Alabama
- Channelization pattern
- Higher initial density
- Longer wear life
- Quick change
- 12” sections

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Textured Screed Plates

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Textured Screed Plates

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3D Paving / Milling

- Upgrade existing 2D system to 3D

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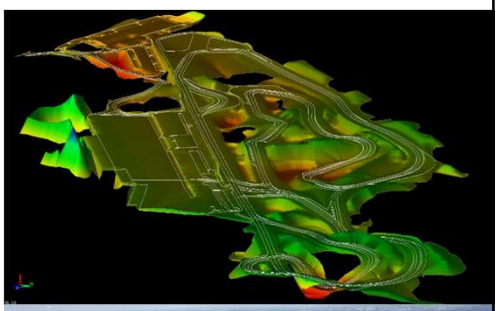
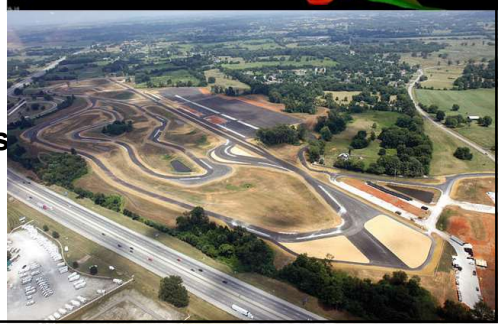
3D Paving

- Accurate within 1/24”–1/8” (1-3 mm)
- Smoothness
  - Precise control of elevations and profile
- Complex designs
  - Transitions, super-elevations, cross-slopes
- Elimination of stringlines, staking
- Precise material quantities





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Technology & Innovation - Milling

- 2D & 3D grade control
- "Ramp in / Ramp out"
- Obstacle jump
- Pattern control
- Load control
- Eco-mode
- Telematics

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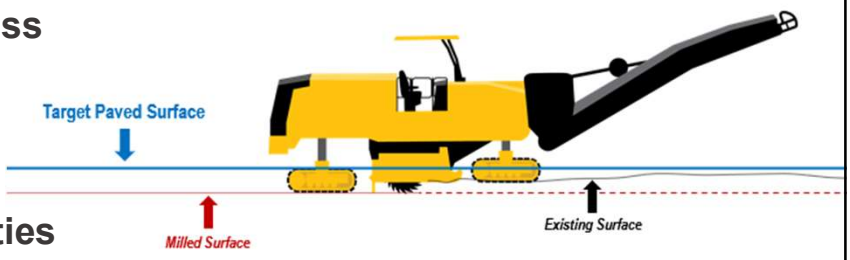
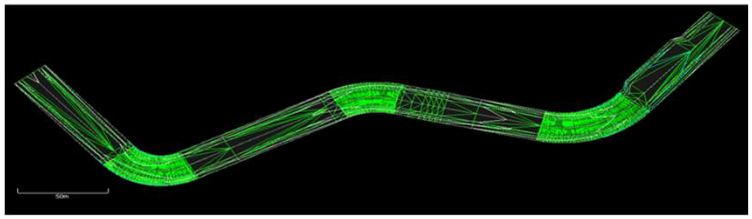
Cold planers – 3D

- Elevation/Smoothness
- Change fix cross-slopes
- Precise HMA quantities
- Complex transitions, supers, drainage
- No stringlines





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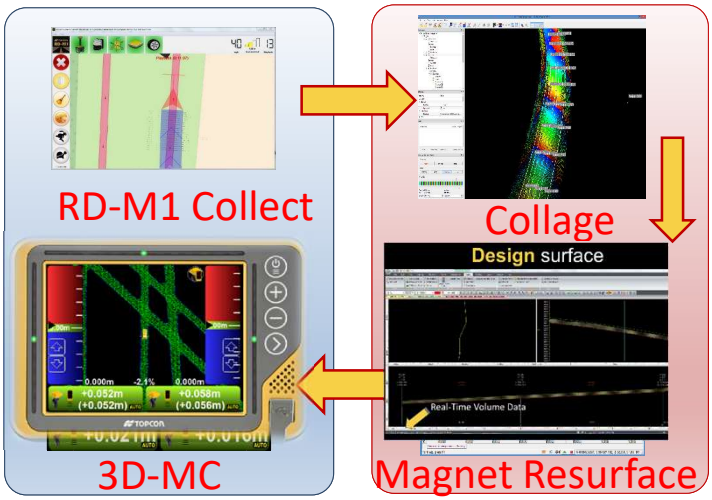
Topcon Smoothride™ - Relative Surface



- Scan existing surface
- Load file on mill or paver
- Relative milling or paving

Courtesy of Topcon

Caterpillar: Confidential Green

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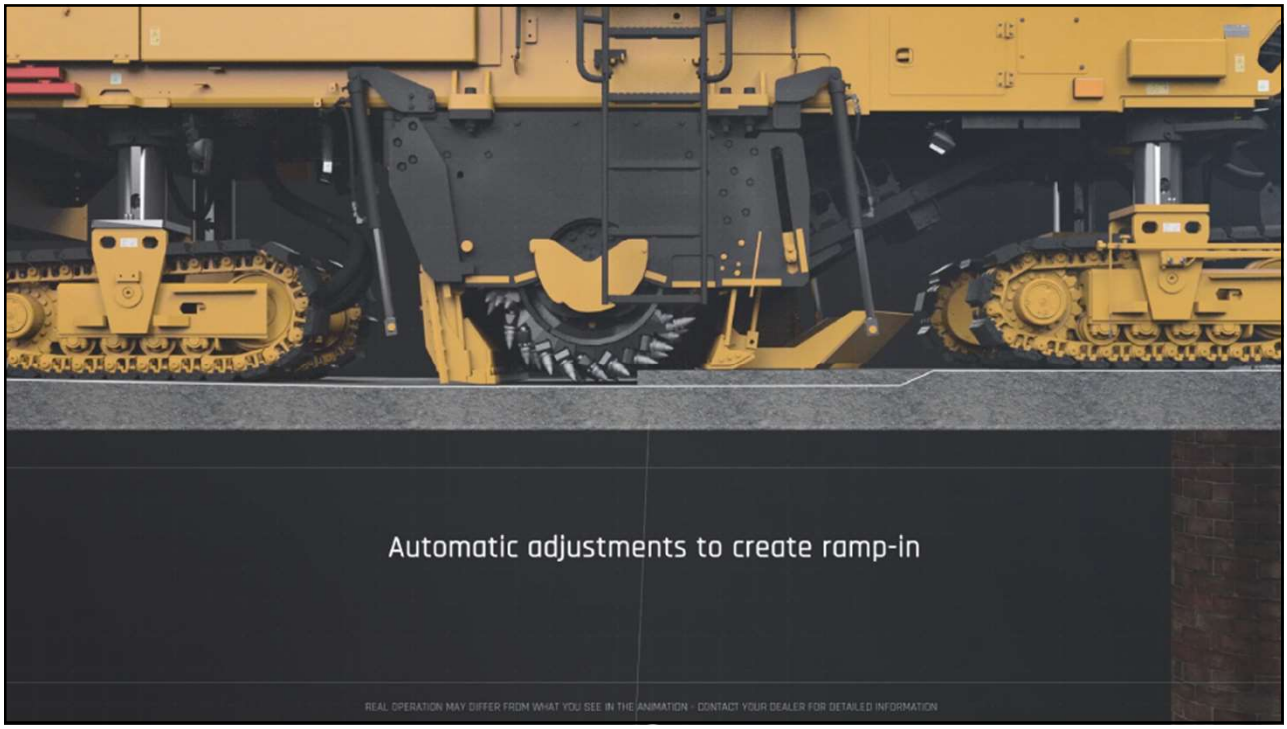

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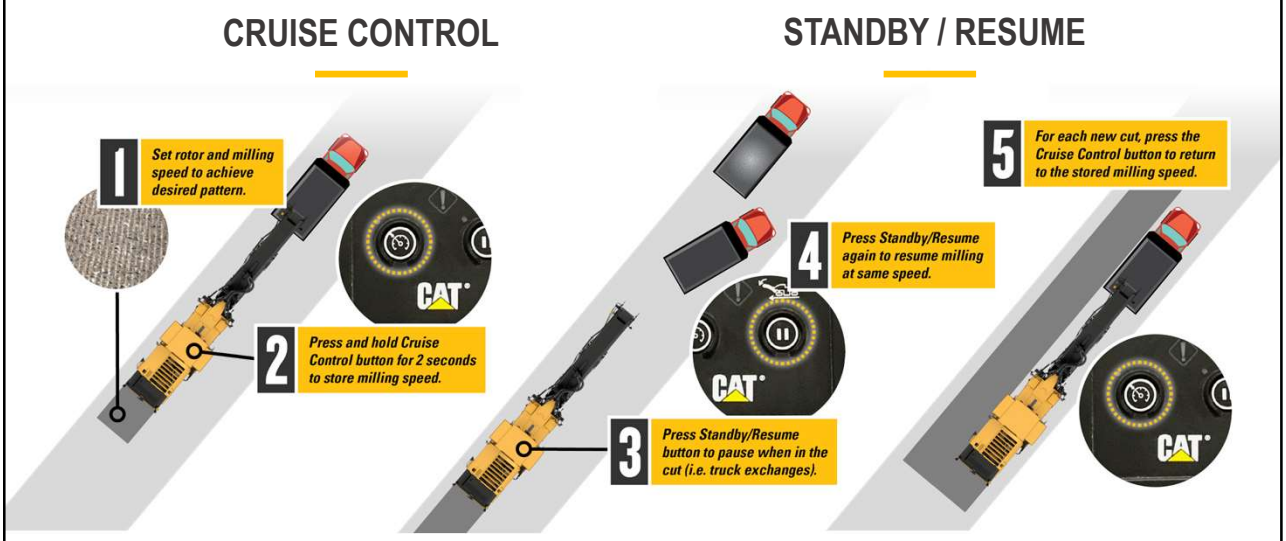
Cold Planers – Pattern Control



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Technology - Compaction

- Conventional and oscillation vibration
- Vibratory pneumatic
- Automatic Speed Control (ASC) – impacts per foot
- Intelligent Compaction (IC)
- Auto-Adjustable Compaction (AAC)
- Cameras & Safety (passive & active systems)
- Eco-mode (engine speed)
- Telematics

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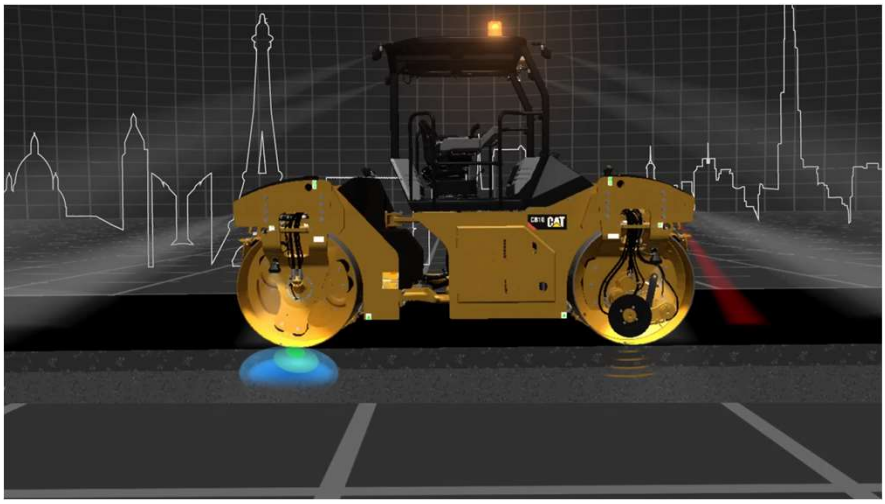
Oscillation vs. conventional vibration

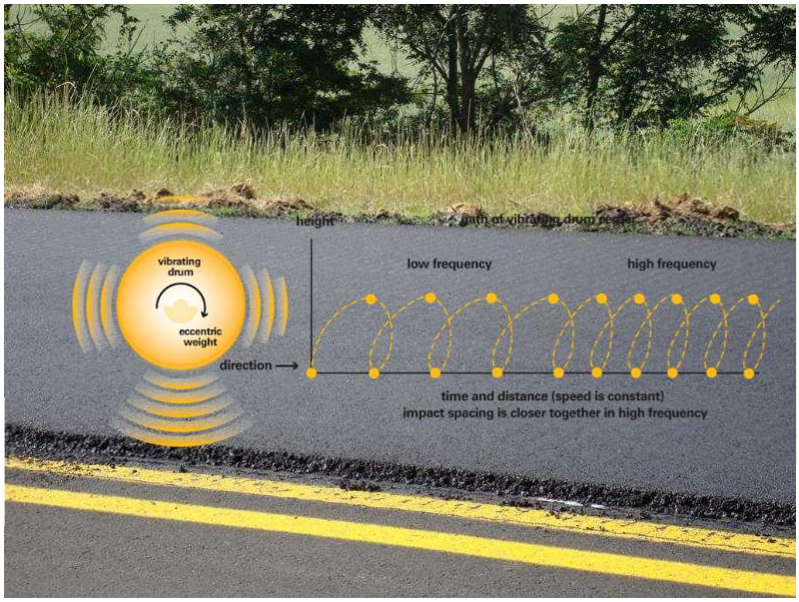


- Intermediate or finish rolling
- Less risk of damage
- Less aggressive

Roller speed 10-14 ipf

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

$$\text{Speed} = \frac{3{,}000 \text{ vpm}}{10 \text{ ipf}} = 300 \text{ feet per minute}$$



Automatic Speed Control 12 ipf

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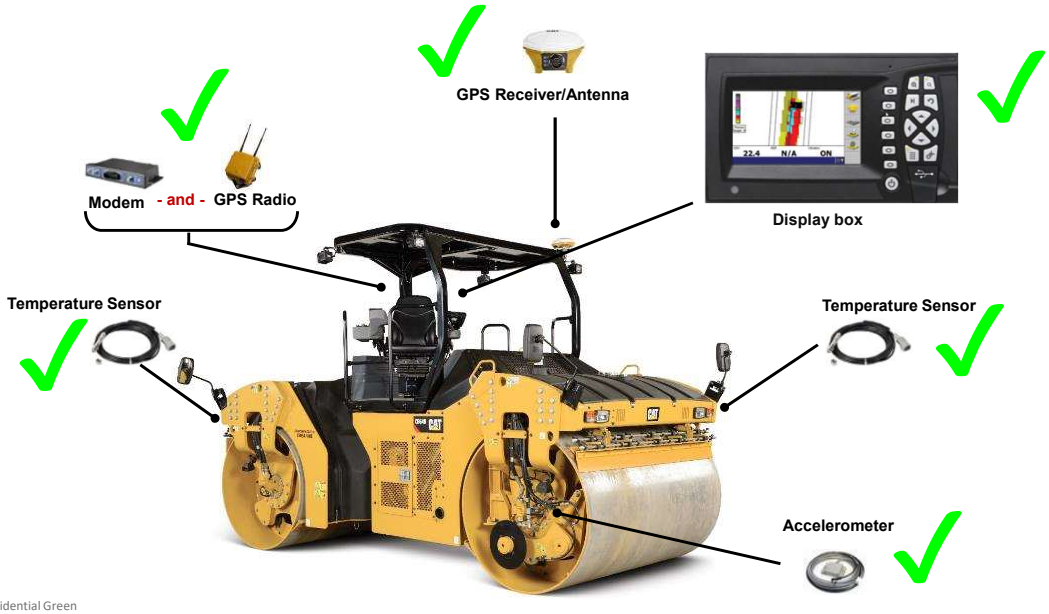
Intelligent Compaction (IC) Roller



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Color-coded Video Display - all data!

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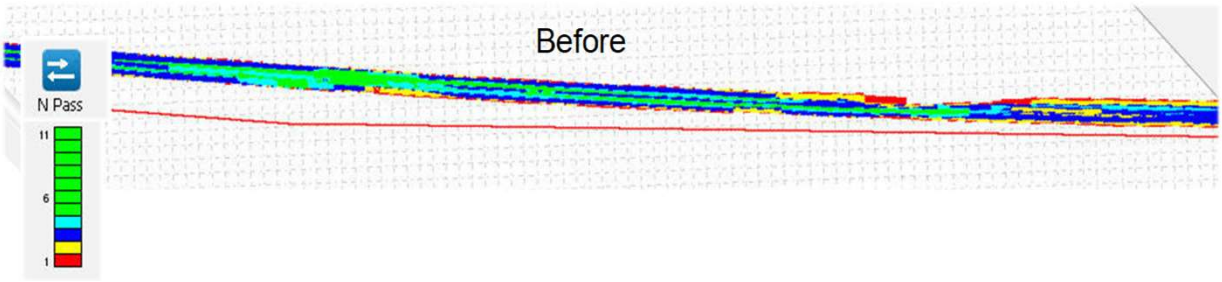
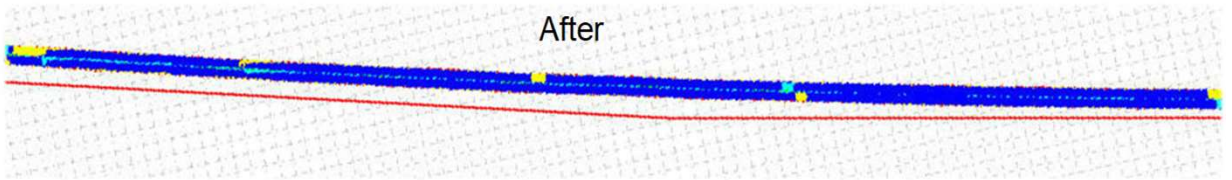
Before & After – Pass Count Consistency!!





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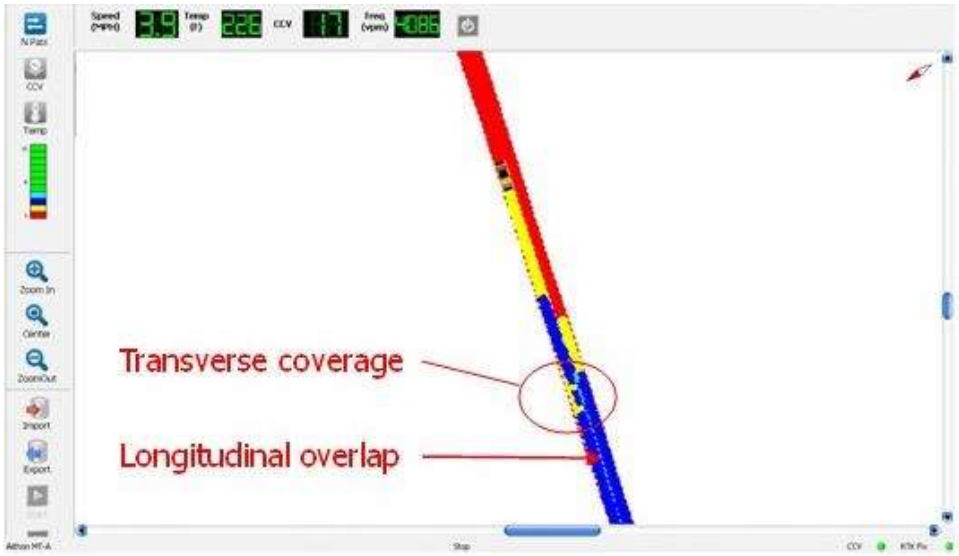
Transition zones, longitudinal joints



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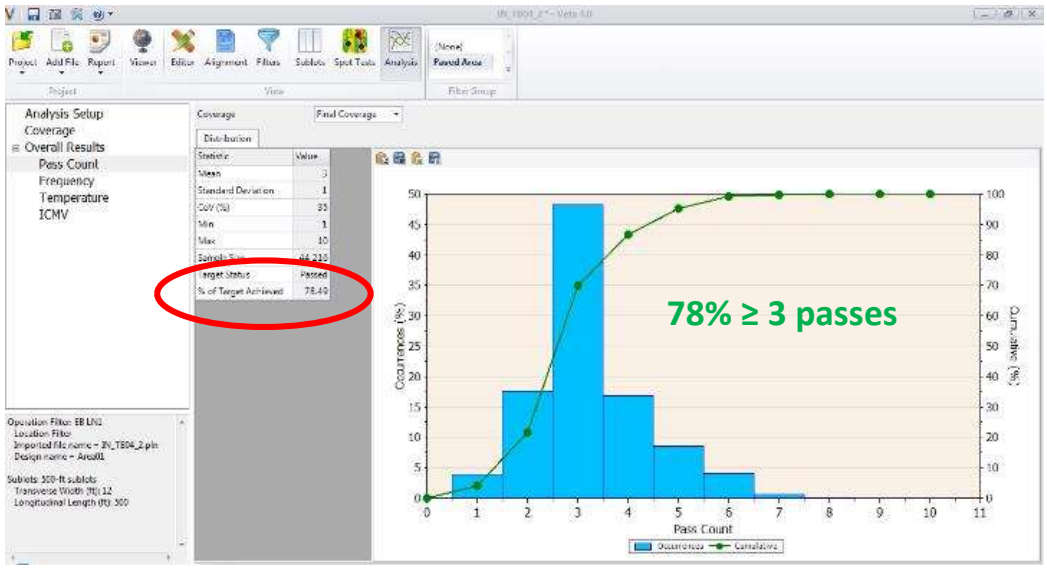
Pass count in VETA Target = 3 passes



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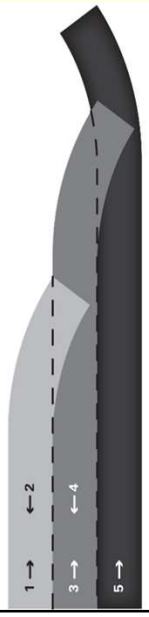
Training Tool: Stop at an angle to the mat



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Night vision - “the back pass”

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Drum overlap

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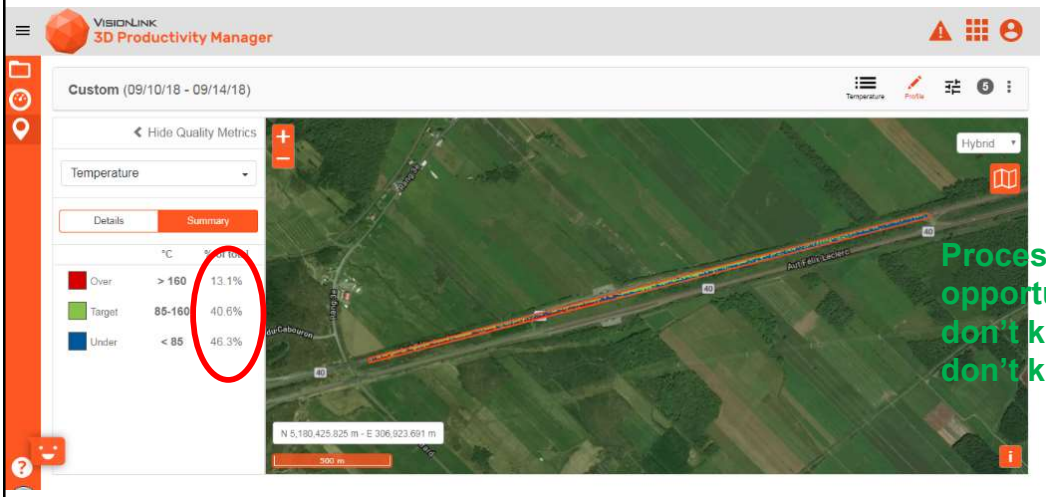
Temperature: 1st pass breakdown



Process control opportunity – you don't know what you don't know!!

- **Data indicates long breakdown passes**
- **Difficult to know without being on site and without plan file**

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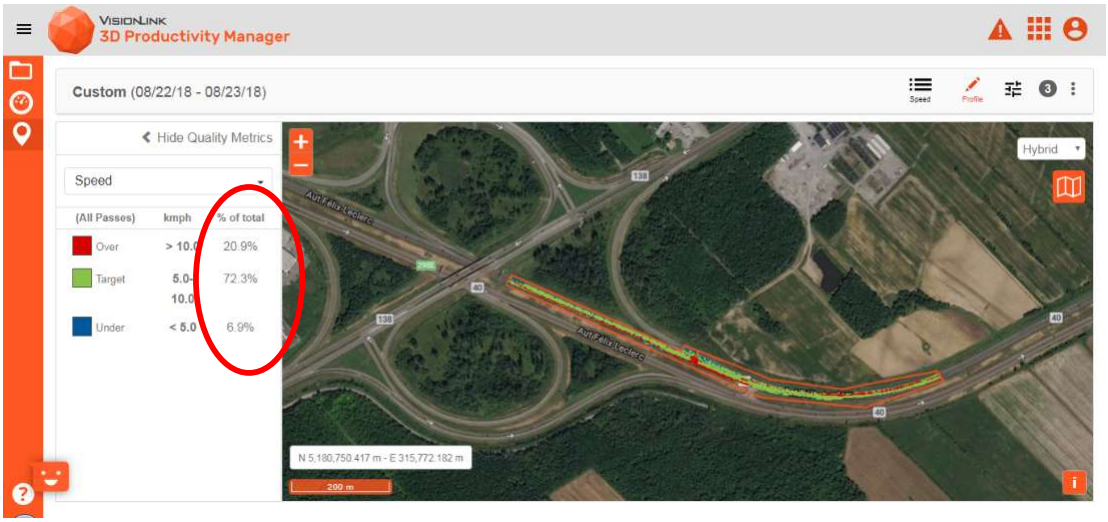
Speed: Smoothness & Density



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Final Rolling Pattern

	Breakdown	Intermediate	Finish
%TMD	**90-92%**	**92-94%**	**94%** + take out marks
				
Temp	**280-252˚F**	**252-230˚F**	**200-163˚F**
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**

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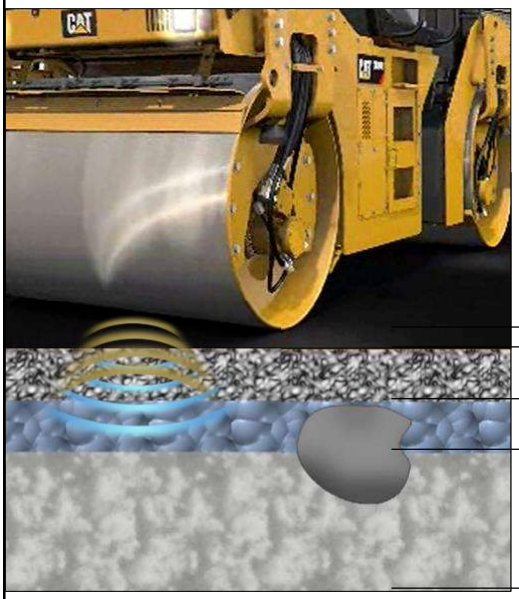
Accelerometer measures deep…



- Accelerometer technology measures deeper than the freshly paved lift of asphalt
- CMV value is a *composite* measurement
- Affected by amplitude, speed, direction, etc.

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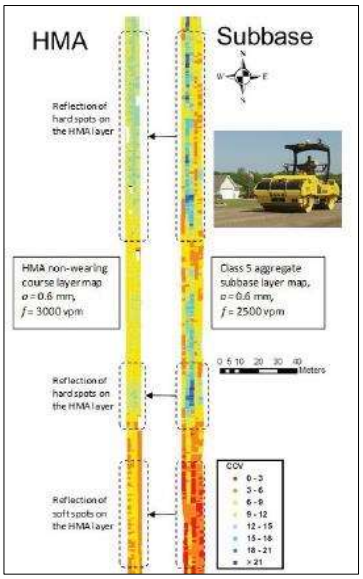
Pre-mapping to find soft areas



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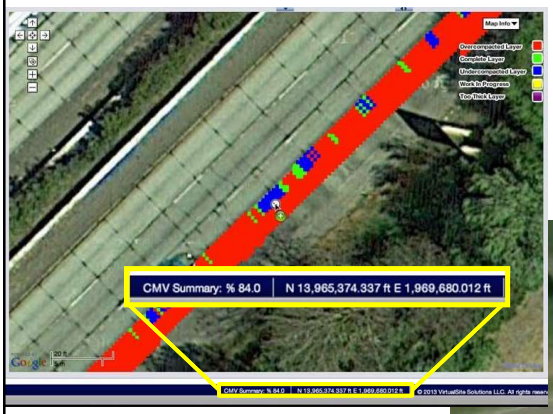
ICMV (accelerometer) – find weak areas



PCC Joints (I-80)

Soft base (Autoroute 40)

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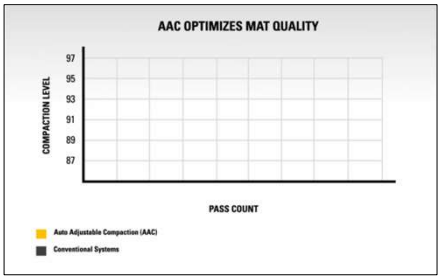
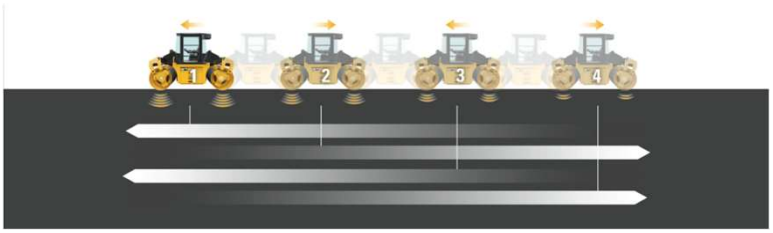
Auto-Adjustable Compaction



- Ensures the amplitude is optimized
- Good for inexperienced operators
- Good for consistency (PWL)
- Reduced risk of over-compaction



Not currently in production

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Visibility & Safety

Fore/Aft Cameras

- Improve visibility of the operating path of the machine
- Integrated into the machine display

360° Cameras

- Improve visibility of the entire work area around the machine
- Separate, dedicated display
- First fit & Retrofit Kits

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Safety Kits

Description

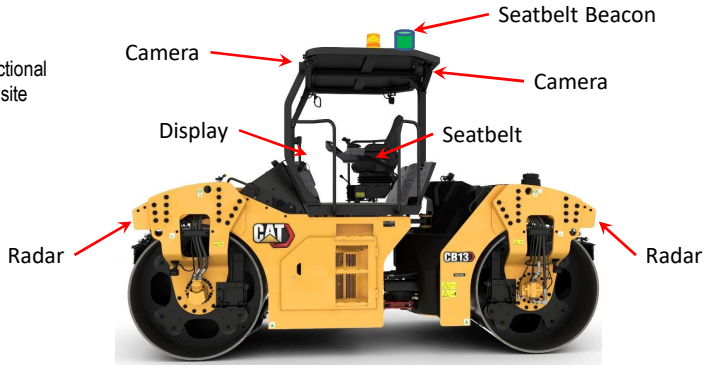
The ACOM Safety Kit is an aftermarket system that provides bi-directional camera views, bi-directional radar object detection and operator, jobsite and back-office seatbelt indication.

Scope

- Bidirectional Camera Views
  - Based on seat direction
- Bidirectional Radar Object Detection
  - Based on propel direction
- Seat Belt Usage Indication
  - Audible
  - Visual
  - Jobsite
  - VisionLink

Value

- Improved operator visibility of the worksite
- Alerts operator to objects in path of travel to prevent collisions
- Reminds operators to wear seatbelt
- Jobsite visibility to operator seatbelt usage
- Back Office seat belt use tracking & communication



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Paver-Mounted Thermal Profiling (PMTP)

- Continuous
- Real-time on paver
- Stationary infrared camera
- Variable width
- Compatible direct upload to Veta software

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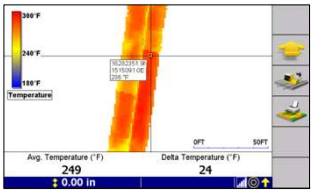
PMPT Benefits



THERMAL DATA HELPS ENSURE PROCESS CONTROL

Drive consistency for better quality and longer lasting roads

EARLY DETECTION ENABLES PROCESS ADJUSTMENT

Thermal segregation is one of the leading causes of road failure

YOU DON'T KNOW WHAT YOU DON'T KNOW

Another quality measure to help ensure compaction values are met

```
Cat Grade Control In-Field Report
=================================
Machine              :
Start Time           : 19:38:44
Start Date           : 2018/05/29
End Time             : 22:46:08
End Date             : 2018/05/29
Duration             : 187 Minutes
Site Design          : I10 FLAT
UTM Zone             : 14 N
Start Station        :
End Station          :
Total Area Covered   : 14387.9 FT²
Layer                : 1

Target Temperature Variation Range: 25°F to 50°F
Temperature Percentages:
  0- 25°F:    45%
 25- 50°F:    21%
  > 50°F:     34%

High Temperature Variation Areas: (>50°F, 12.0 FT²)
   Northing      Easting Temperature Variation
1. 10759554.6  1760971.7        111°F
2. 10759553.4  1760975.1        103°F
3. 10759289.1  1761125.6         98°F
4. 10759559.0  1760963.9         94°F
5. 10759388.4  1761060.9         86°F
6. 10759499.9  1761009.6         85°F
7. 10759283.5  1761139.0         84°F
8. 10759628.2  1760928.2         81°F
9. 10759617.0  1760934.9         80°F
10. 10759188.7 1761200.4         80°F

Approval
=================================

Operator

Site Manager
Date
.....

Third Party Inspector
Date
.....
```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Temperature Differentials = Density Differentials

Courtesy of Jeff Uhlmeyer, WSDOT

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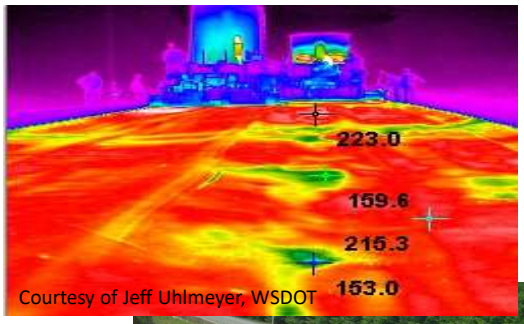
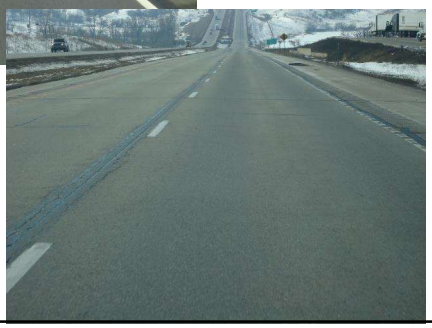
This....becomes....this....



Courtesy of Jeff Uhlmeyer, WSDOT



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"Eye" on Paving Equipment & Operations

- Consistent mat temperatures = consistent compaction = better smoothness = extended pavement life
- Identify areas of improvement in process and equipment
  - Plant operations
  - Plant repairs
  - Mix segregation
  - Paving equipment setup & operation
  - Paving equipment repair

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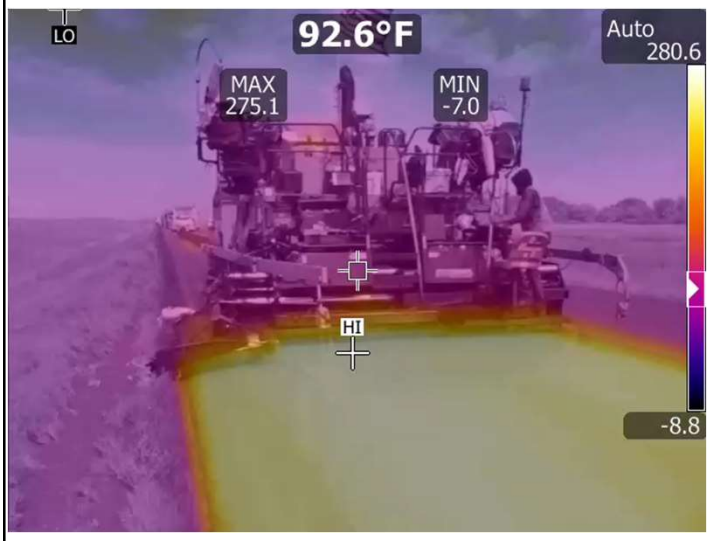
Thermal Patterns: What do they Mean?



- What temperature pattern am I seeing?
- What is this pattern telling me?
- What can I do to reduce temperature differentials?

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Truck Exchange – hopper level

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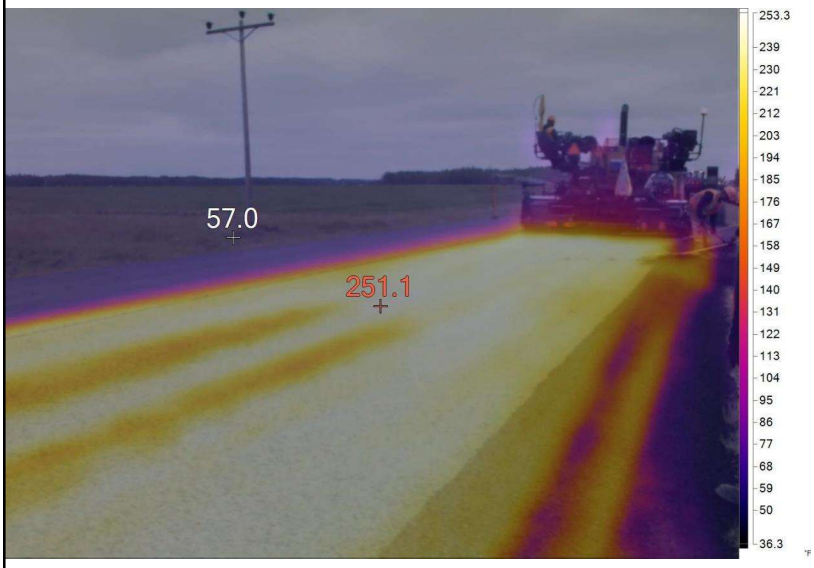
Conveyor Speed



- Streaks after take off could be conveyor speed
- Low hopper and feed system starts quickly, then slows

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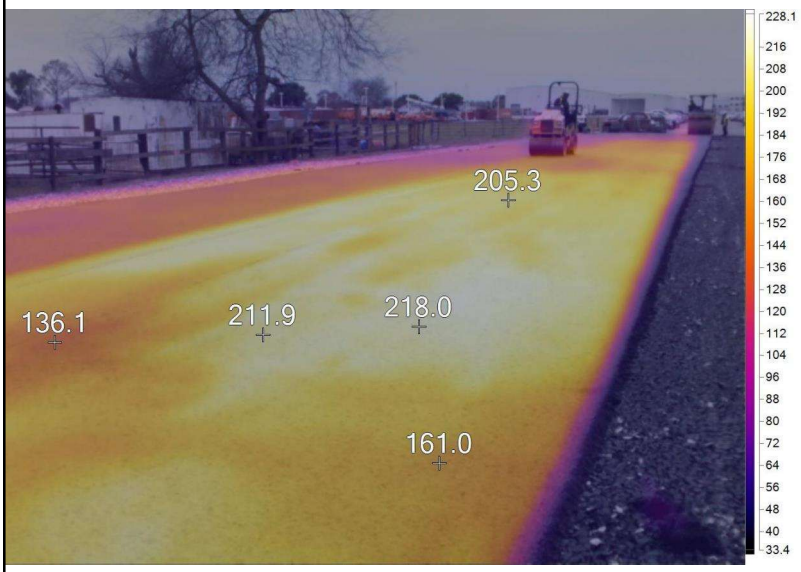
Feeds Sensor position - on/off augers



- Feed sensor position (aim) causing augers to go on/off

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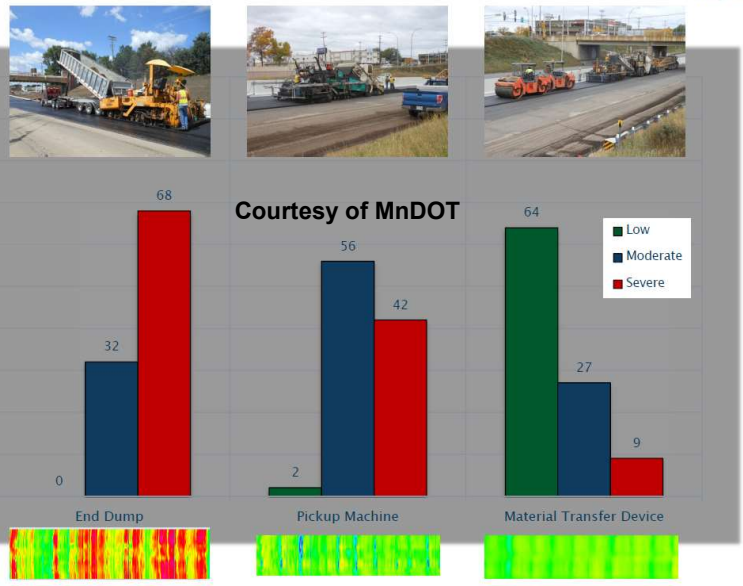
Material Transfer Device



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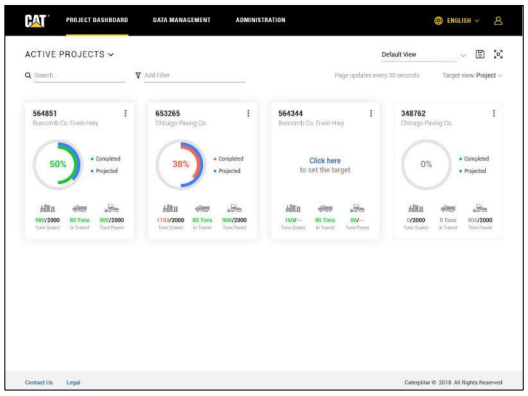
eRoutes (MDMS)

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



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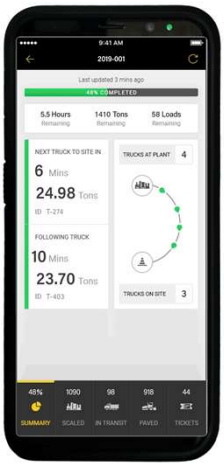


Mobile application primarily for paving foremen and paving crew members giving them the information they need to do their jobs better.

Why eRoutes ??

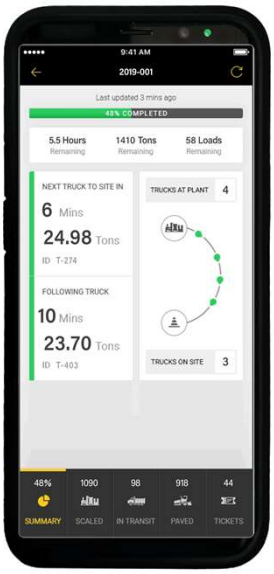
QUICKLY SEE THE WHOLE PROCESS
- Merge paver/truck/ticket data into real-time information
  - Cycle times/waiting times per job/truck/plant
  - Tons loaded, in-transit, and paved

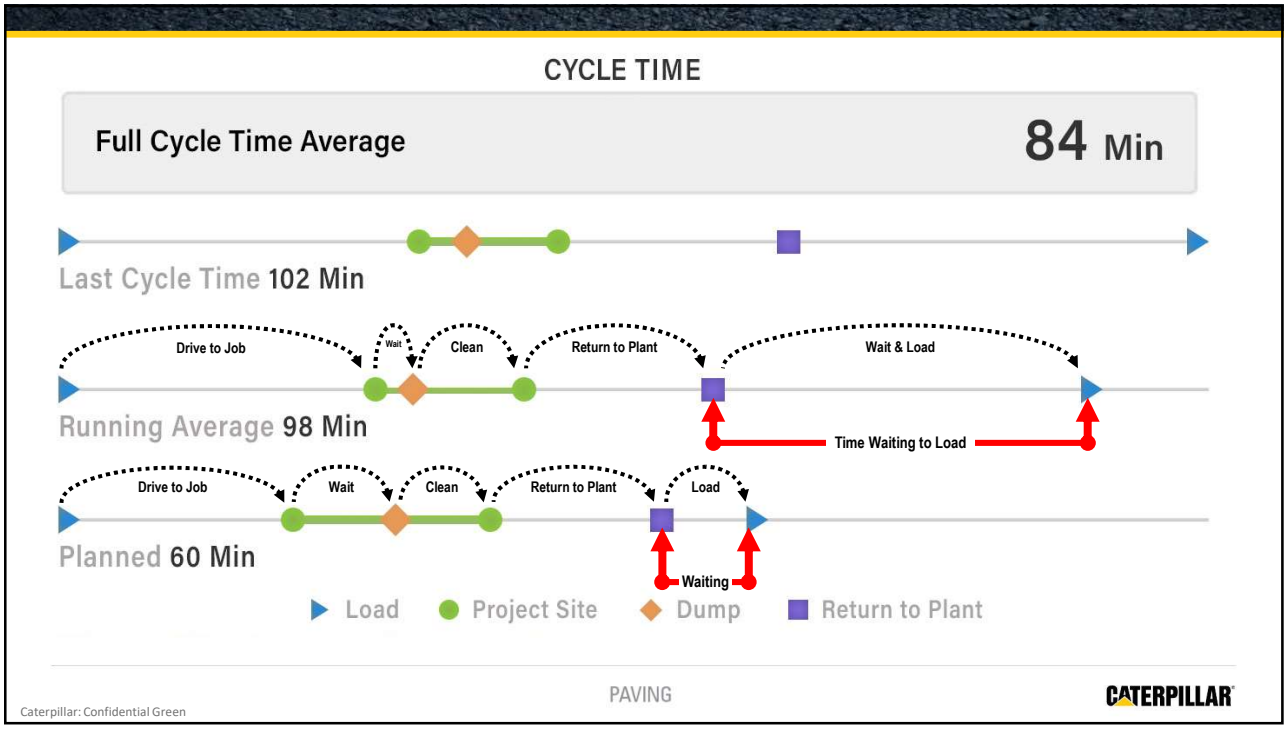
HELP ELIMINATE PAVER STOPS
- Your bonus depends on it!
- Balance laydown and delivery

DRIVER PERFORMANCE COMPARISON
- Hire trucks/Company trucks? (Performance you expect?)
- "Where are my trucks!" (mystery solved!!)

BALANCE PLANT PRODUCTION FOR MULTIPLE CREWS
- The right mix produced at the right time
- Reduce plant wait times

TRACK YOUR MILLINGS
- Great way to monitor backhaul





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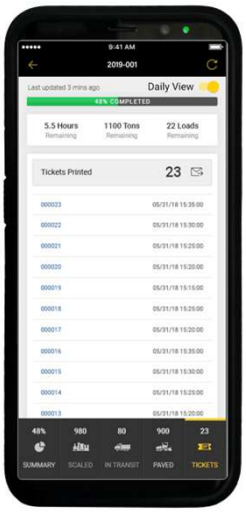
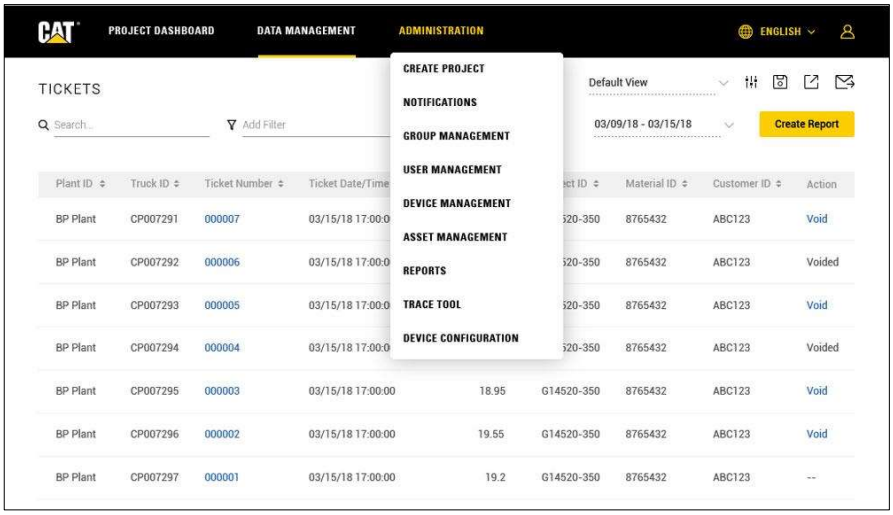
eTickets





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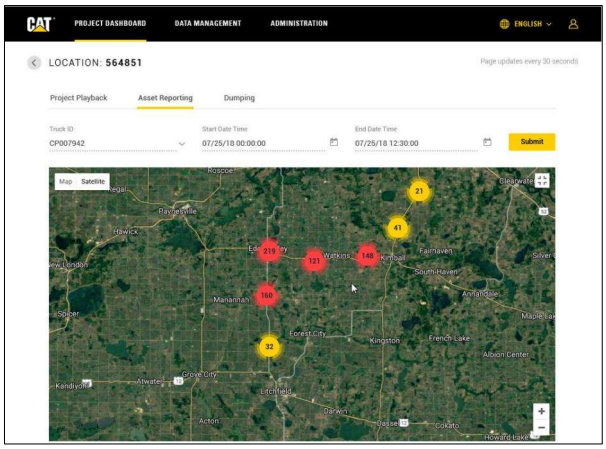
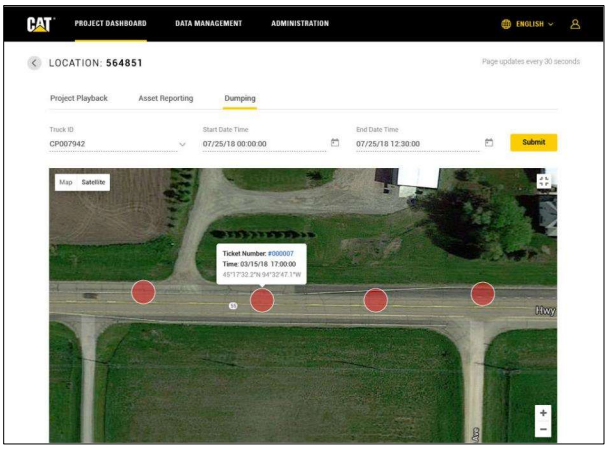
eRoutes Desktop





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Virtual Training

- Portable, on-demand
- Safe
- Cost-effective
- Tracks individuals' progress

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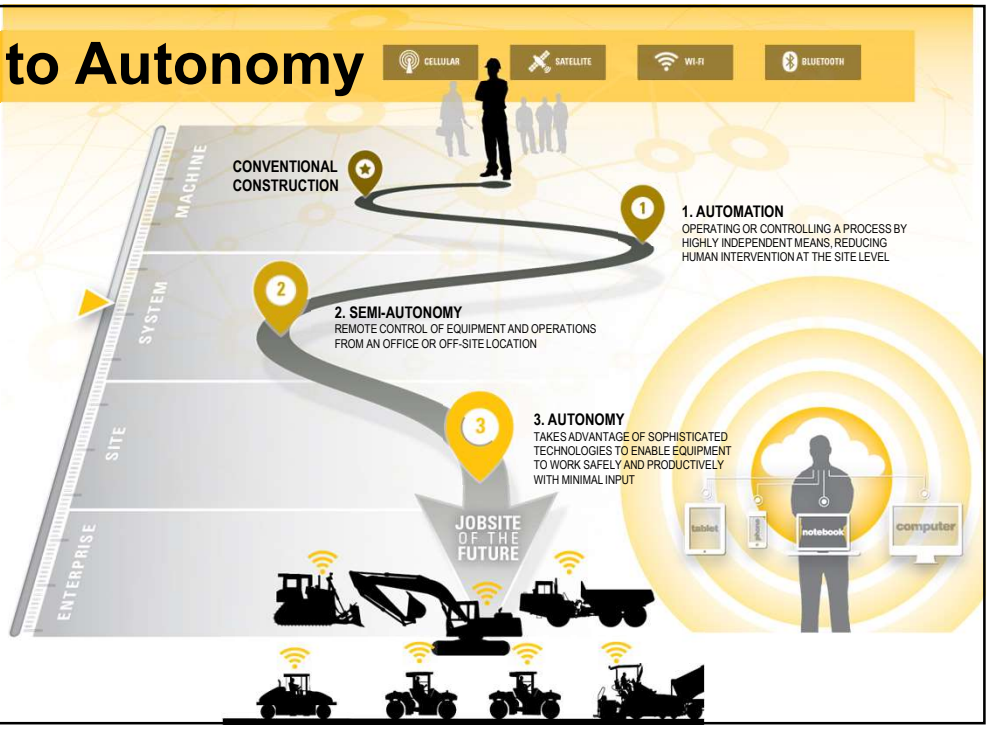
Roadmap to Autonomy



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Semi-autonomous Soil Compaction

1. Where
2. How
3. Press “Auto”

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Semi-Autonomous - Command for Compaction

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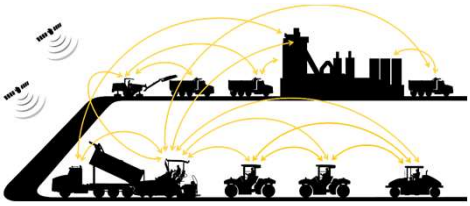
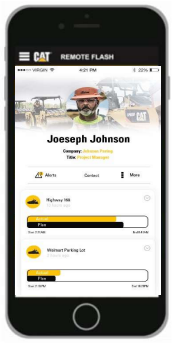
Paving Connected Worksite

Goal: Increase customer value by achieving asphalt road density, smoothness (**quality, efficiency**) in the shortest possible time (**cost**) with no waste (**sustainability**) through a connected worksite.





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Remote Operation

- This operation is running a Cat D5 dozer (and wheel loader & excavator)
- Potential Applications
  - Working is hazardous conditions
  - More controlled environment for the operator.
  - Operator could can switch between multiple machines.
  - Production tracking and monitoring

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One Operator, Many Machines!

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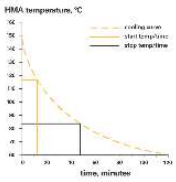
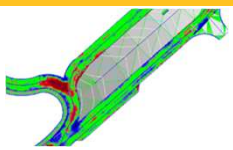
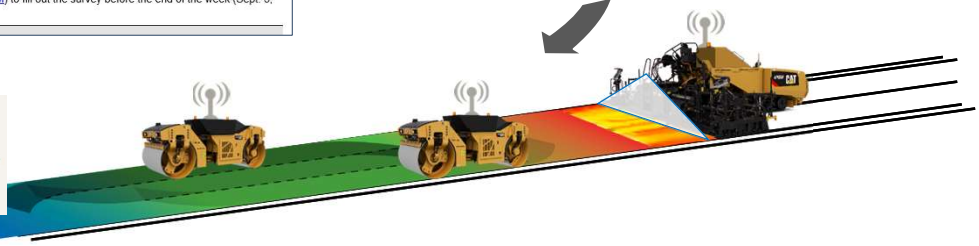
Fully Autonomous Paving site





INPUTS
3D DESIGN
OR
ROAD SCAN

Δ Width
Depth
Δ Time
Δ Temp
Δ Distance



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Thank-you for your attention! Questions?

AAPA
ALABAMA ASPHALT PAVEMENT ASSOCIATION

Thompson CAT

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