

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

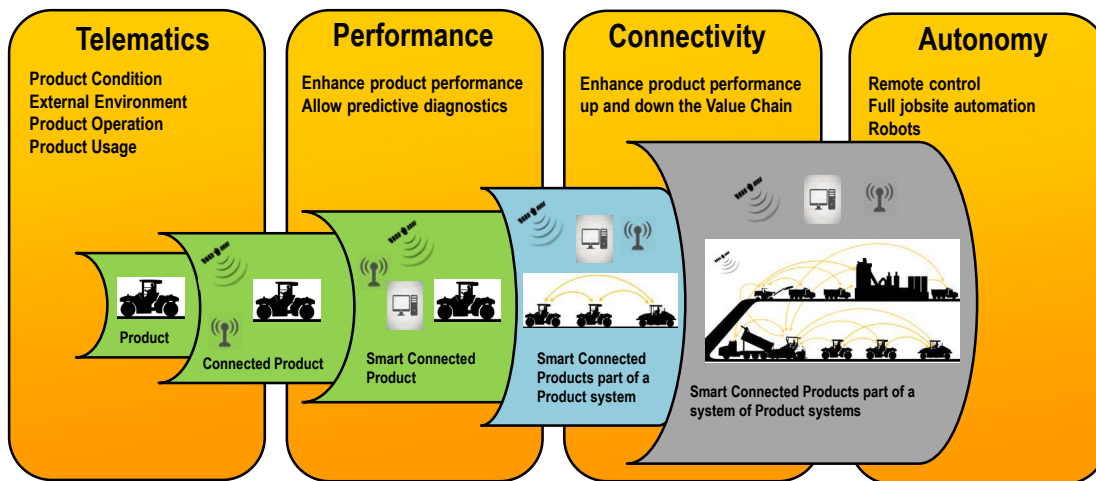


Presented by: Todd Mansell, Caterpillar



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Technology is... Redefining industry standards



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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



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Paver Hopper Temperature & Level



Normal mounting location

- Process control



Read-out in Material Feed Menu

Optional mounting location



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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

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Cleanout / warm up mode – safety



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



Folding Hopper Apron

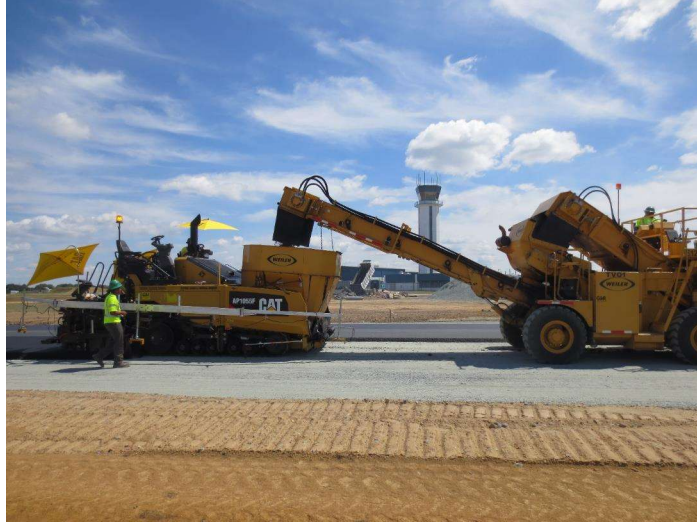


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Radar for MTV Spacing



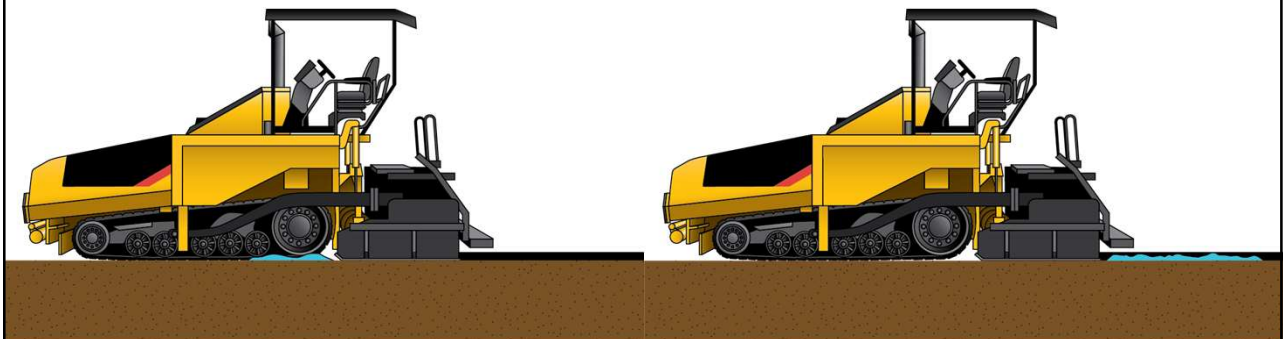
- Keeps distance between paver and MTV
- Reduces potential for paver and/or MTV stop
- Safety - collisions

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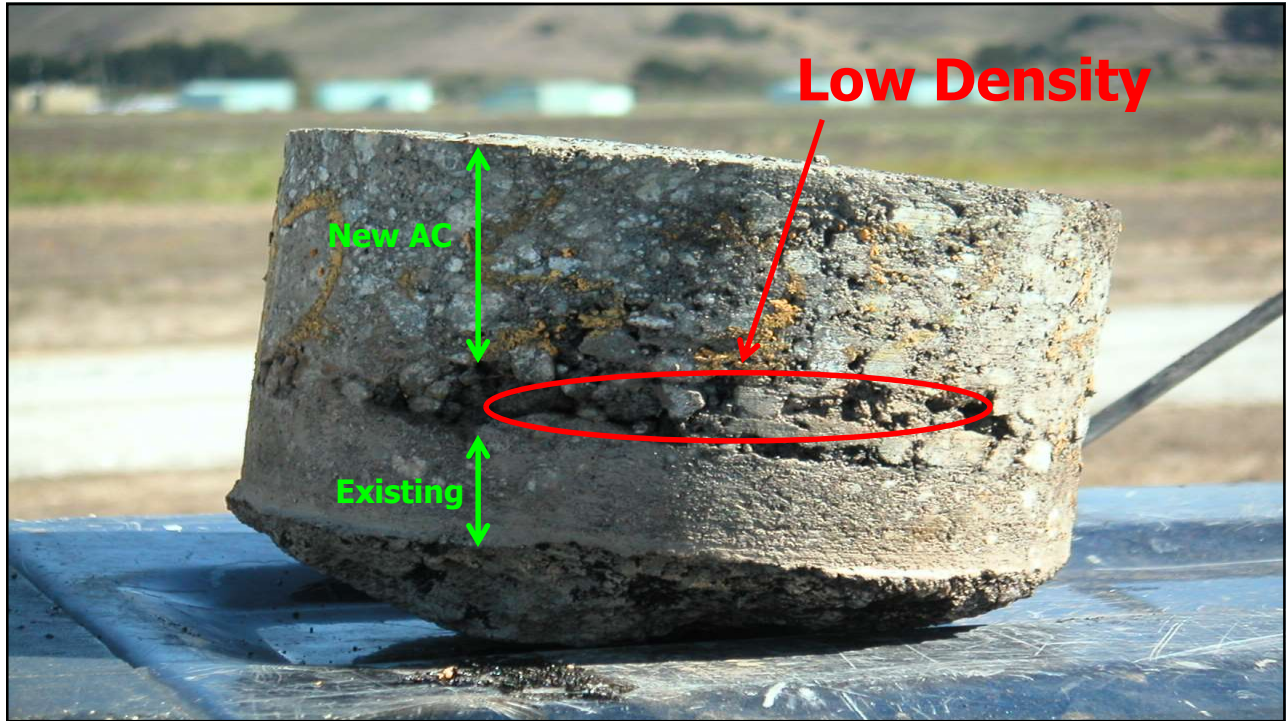
Spills on grade are BIG mistakes!



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Paving Speed – Quick Starts / Stops

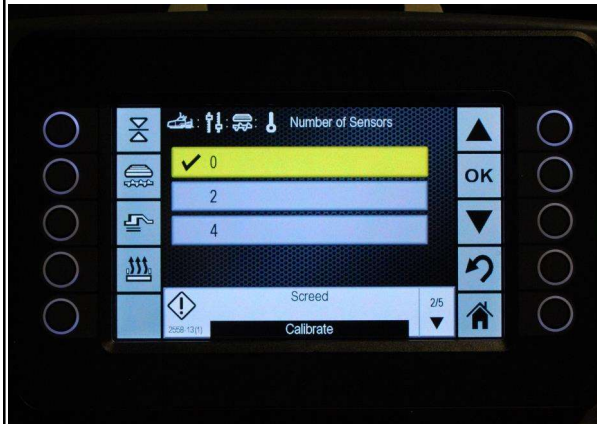
The image shows three components related to paving speed control:

- Dashboard:** A digital display showing various metrics. A green circle highlights a value of 11.2. A green arrow points from this circle to the control knob.
- Control Knob:** A physical knob with a textured surface, used for adjusting paving speed. It is located next to gear shift buttons (F, N, R) and a parking button (P).
- Graph:** A line graph showing paving speed data. The y-axis has a value of 0.12. The x-axis has a value of 169+00. The graph shows a relatively flat line with a slight dip.

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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



CAT

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Pave Start Assistant



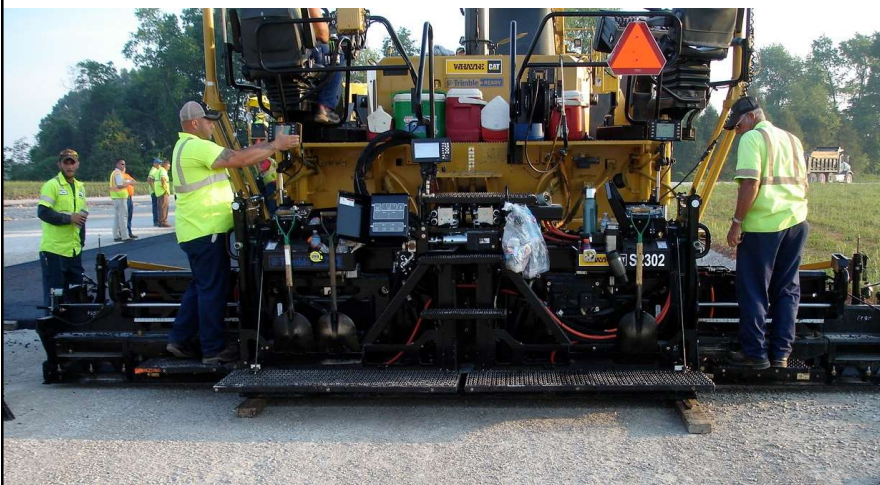
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- Create/Save profiles
- Stores many machine settings for quick recall / paving setup
- Facilitate quick/easy pickup and restarts, such as parking lot applications
- Also great for production/highway paving
- Area paved – great for determining material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



DEX01403-04
(Replaces DEX01403-03)

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Pave Start Assistant



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Textured Screed Plates



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- 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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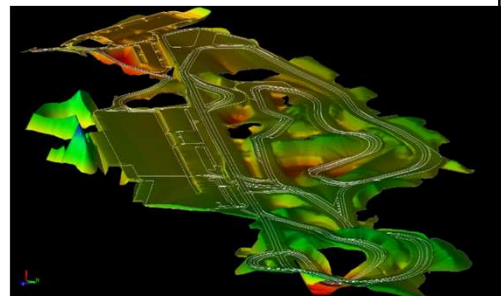


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3D Paving



- 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

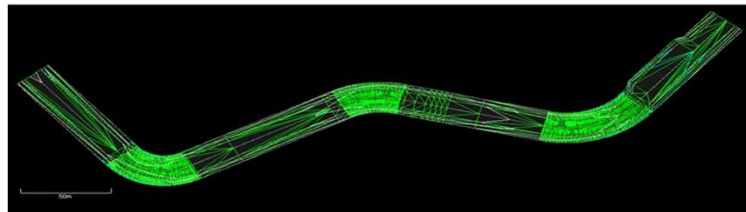
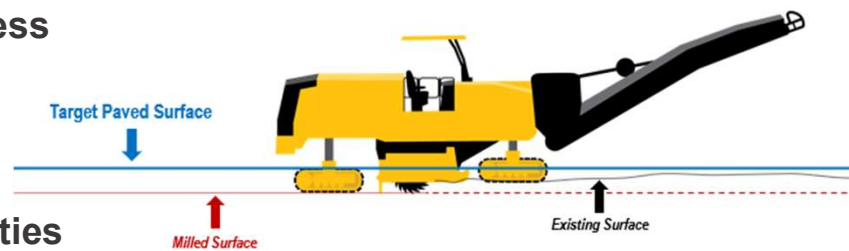
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Cold planers – 3D

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

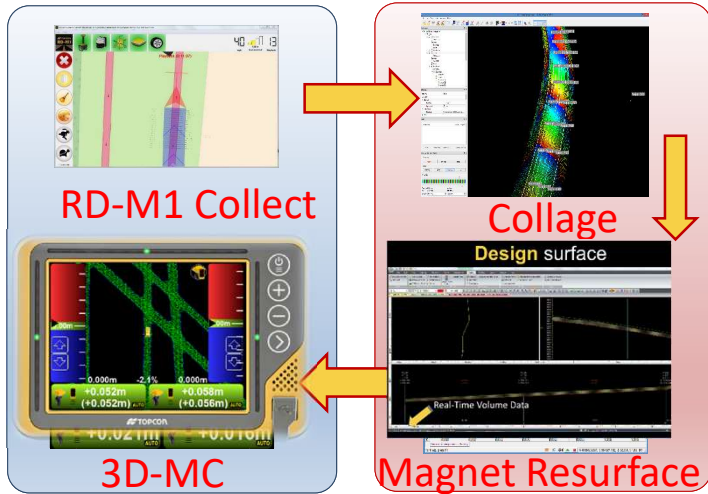


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Topcon Smoothride™ - Relative Surface



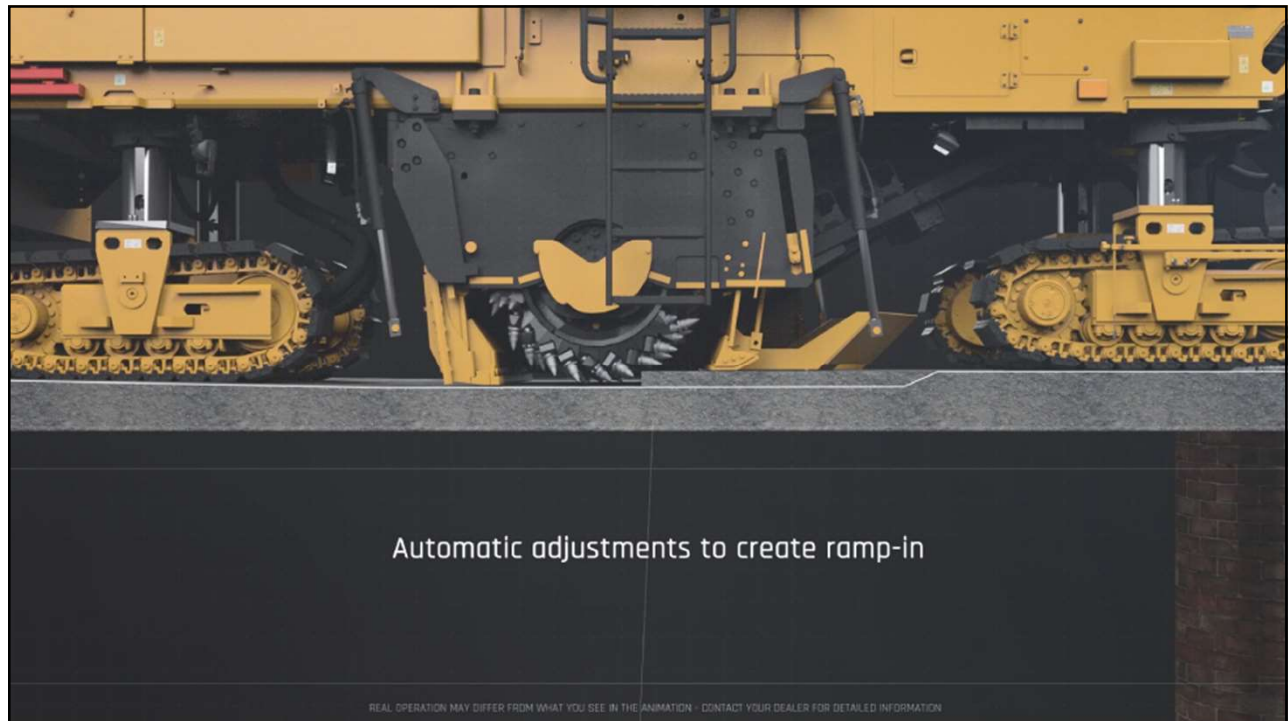
- Scan existing surface
- Load file on mill or paver
- Relative milling or paving



Courtesy of Topcon

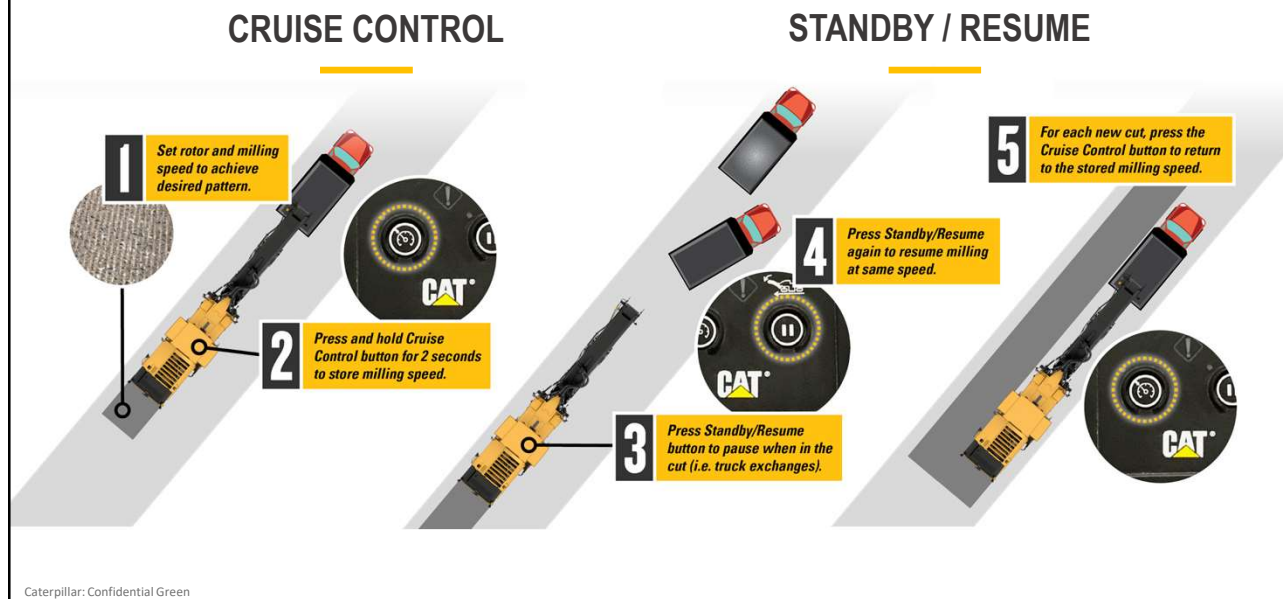
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Cold Planers – Pattern Control



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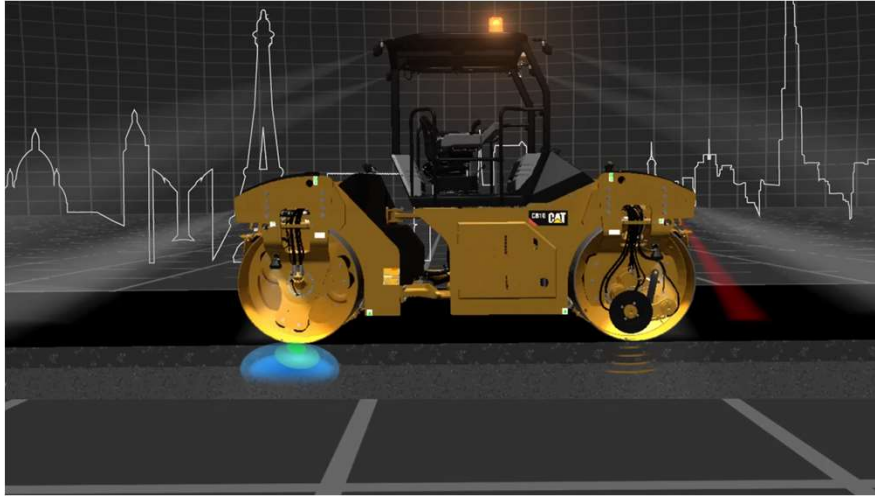
Technology - Compaction

- 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



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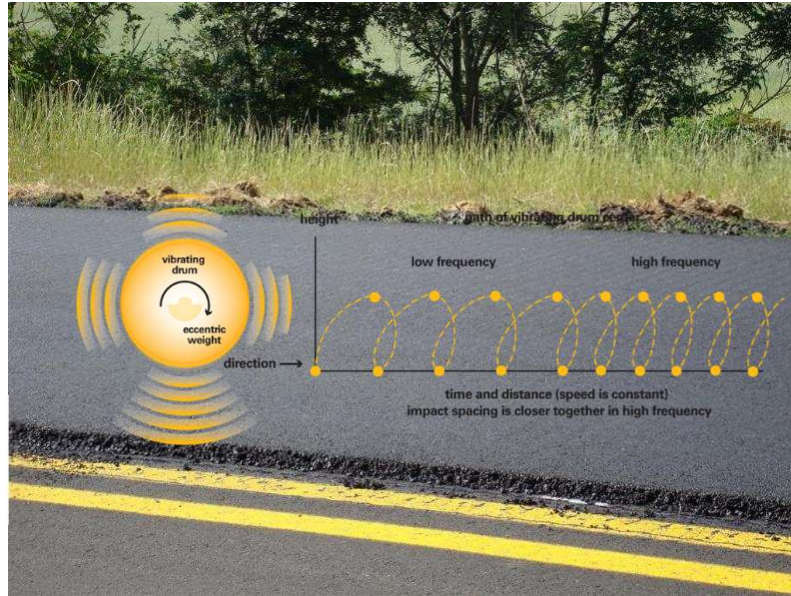
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Roller speed 10-14 ipf



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

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



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Automatic Speed Control 12 ipf

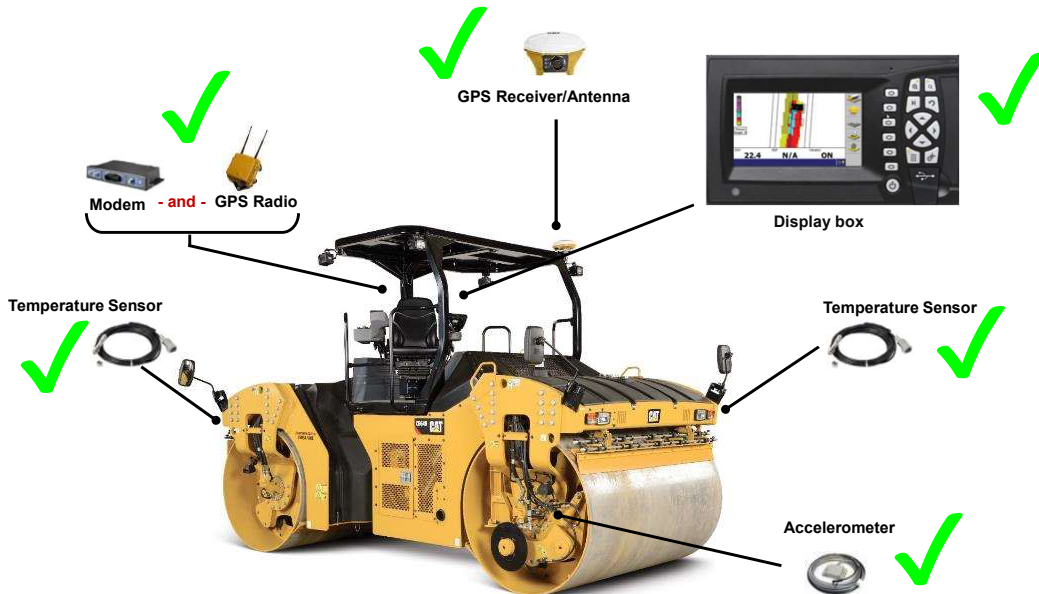


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Intelligent Compaction (IC) Roller



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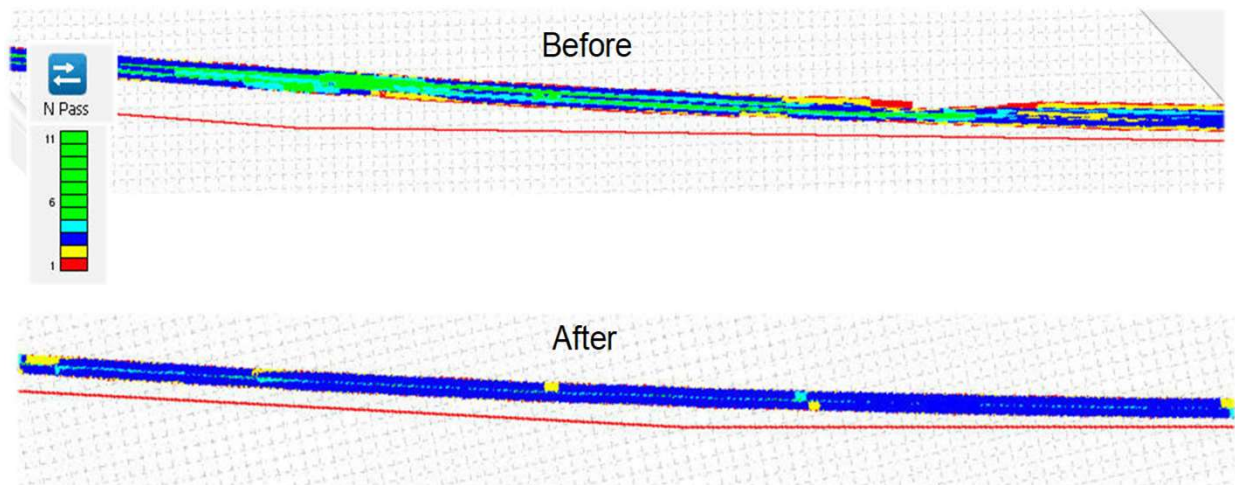
Color-coded Video Display - all data!



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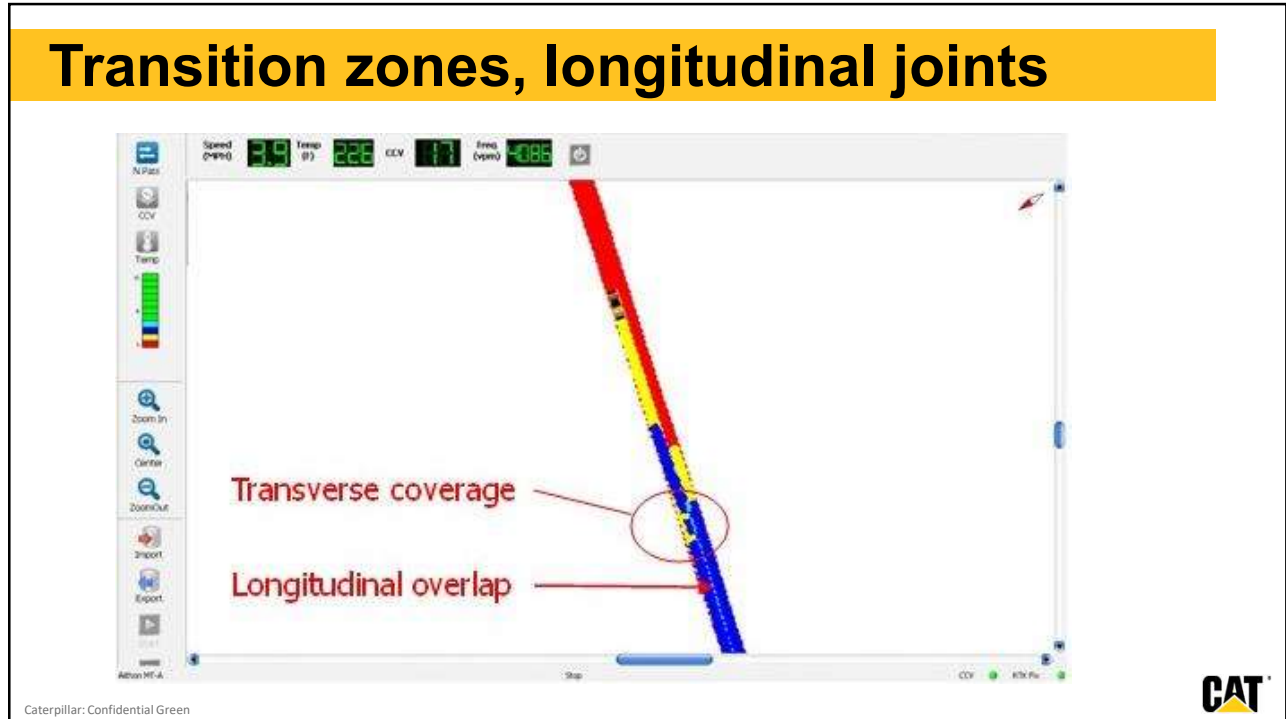
Before & After – Pass Count Consistency!!



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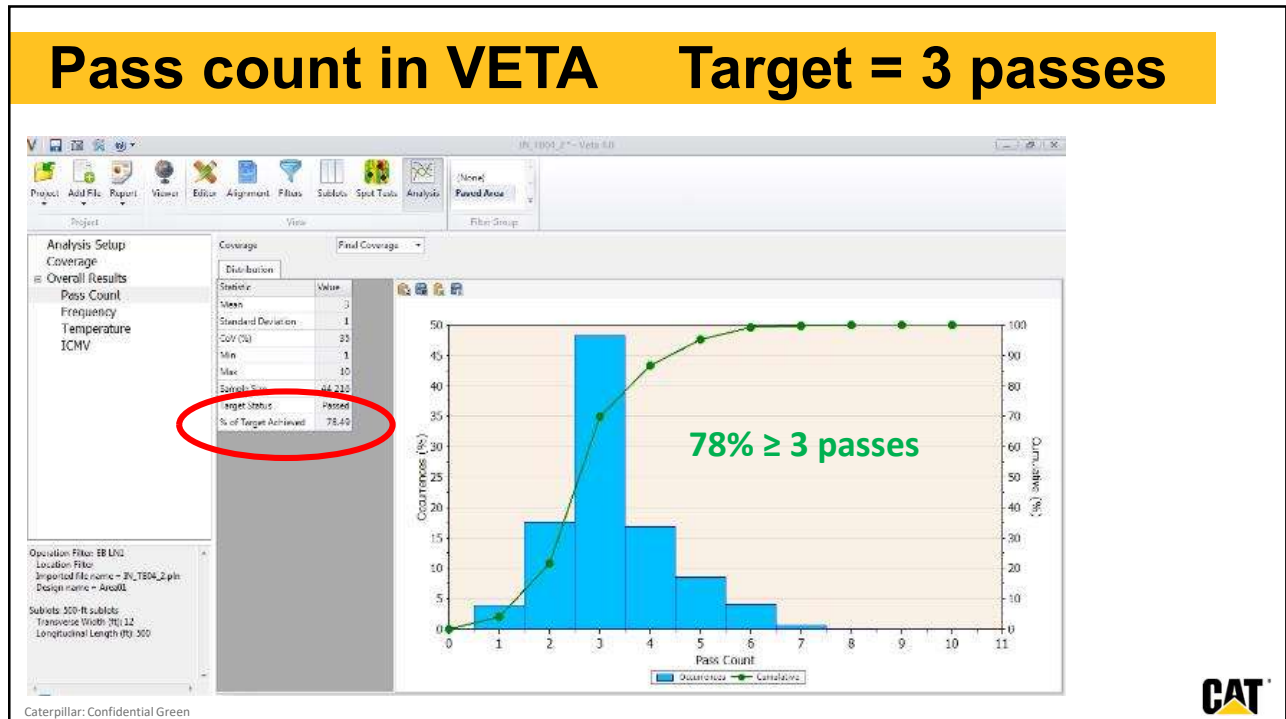
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Transition zones, longitudinal joints



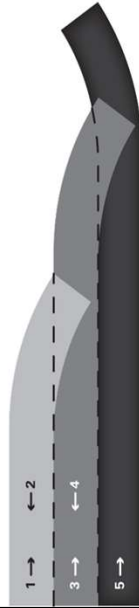
33

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

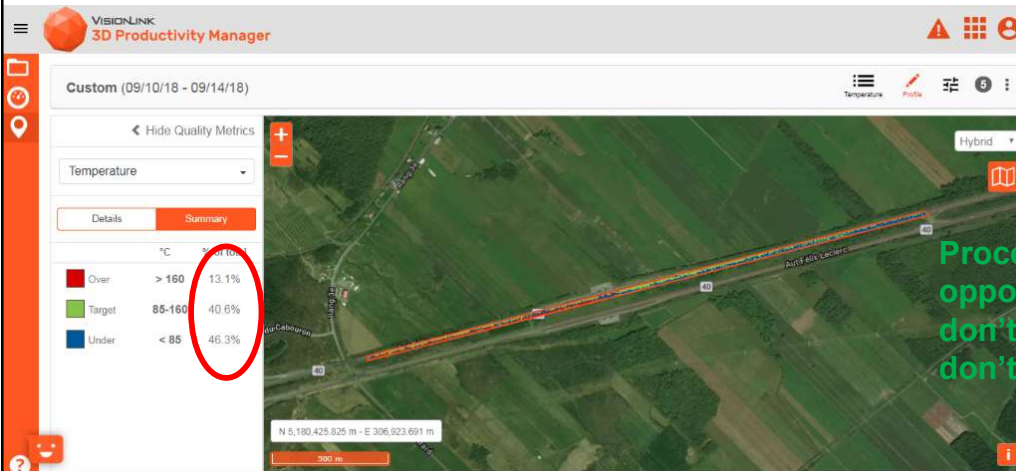


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Temperature: 1st pass breakdown



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

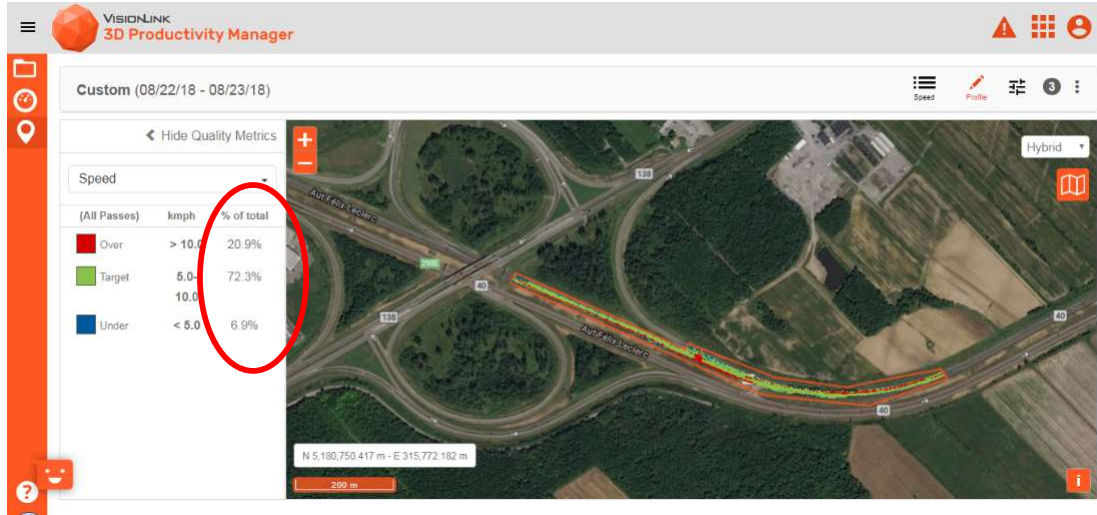
- Data indicates long breakdown passes
- Difficult to know without being on site and without plan file

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Speed: Smoothness & Density






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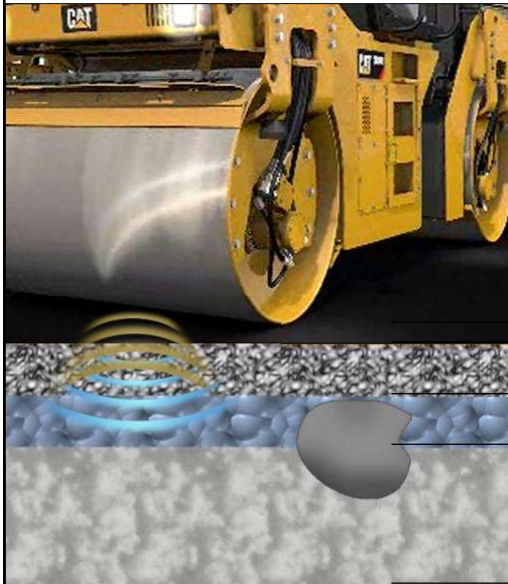
Final Rolling Pattern

	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 vibrate/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.

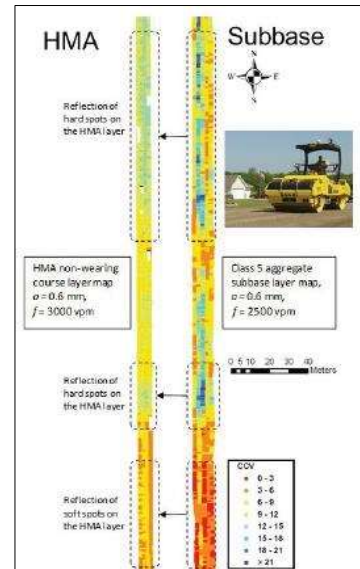
Mat being compacted
 Existing HMA lift
 Sub-base
 Subgrade material

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Pre-mapping to find soft areas



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ICMV (accelerometer) – find weak areas



Soft base (Autoroute 40)

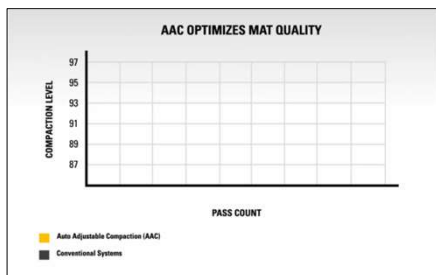


PCC Joints (I-80)

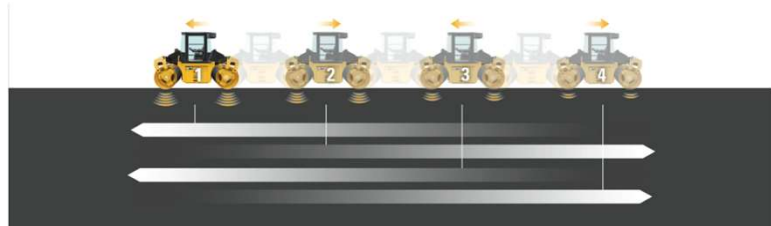
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Auto-Adjustable Compaction



- 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



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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

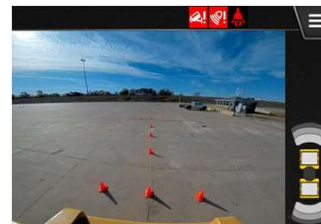
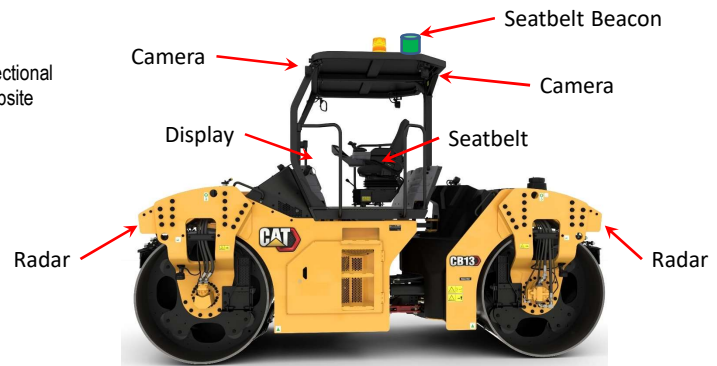
The ACOM Safety Kit is an aftermarket system that provides bi-directional camera views, bi-directional radar object detection and operator, jobsite and back-office seatbelt indication.

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)



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

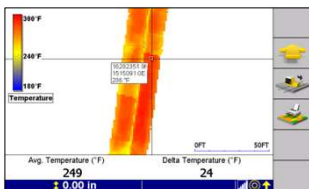
» SPECIFICATIONS AND DIMENSIONS



TECHNICAL SPECIFICATIONS	
Temperature Mapping Range	80° - 200° C (140° - 380° F)
Temperature Accuracy	±0.5° C or 2%
DIMENSIONS	
Camera Eye Height	A 2.96 m (10')
Minimum Camera Height	- 4.27 m (14')
Minimum Camera Height	- 2.80 m (9' 2")
Calibration Zone	B 2.44 m (8')
Distance from Spread Plate - Minimum	C 3.66 m (12')
Distance from Spread Plate - Maximum	C 3.66 m (12')
Maximum Mat Width	D 6.1 m (20')

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PMPT Benefits



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THERMAL DATA HELPS ENSURE PROCESS CONTROL

Drive consistency for better quality and longer lasting roads

EARLY DETECTION ENABES 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 FT ²
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 FT ²)		
Northing		Easting
1. 1075954.6	1760971.7	111°F
2. 1075953.4	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

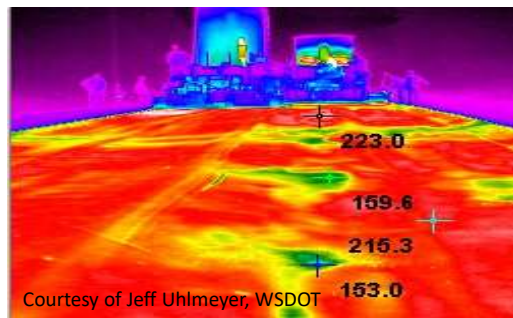


Courtesy of Jeff Uhlmeyer, WSDOT

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



Courtesy of Jeff Uhlmeyer, WSDOT



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“Eye” on Paving Equipment & Operations

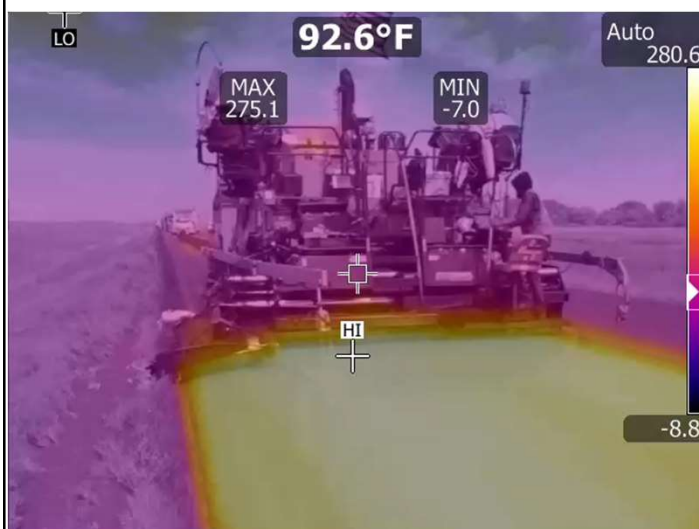
- Consistent mat temperatures = consistent compaction = better smoothness = extended pavement life
- Identify areas of improvement in process and equipment
 - Plant operations
 - Plant repairs
 - Mix segregation
 - Paving equipment setup & operation
 - Paving equipment repair

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Thermal Patterns: What do they Mean?



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- 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

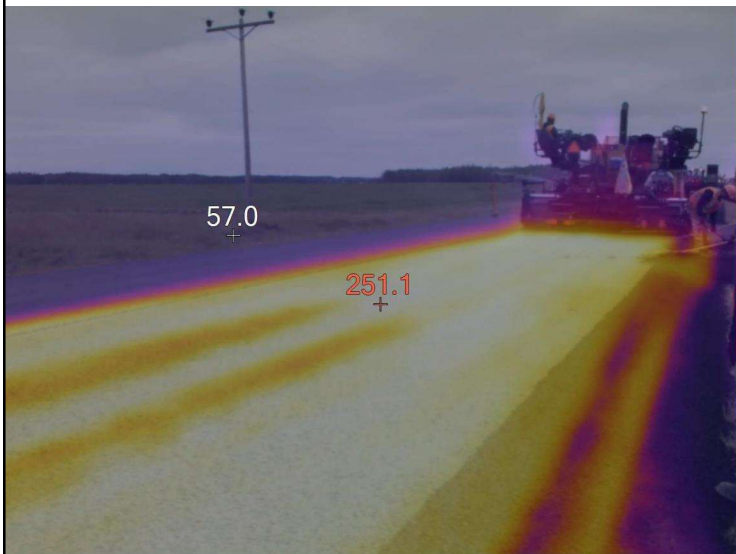


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Conveyor Speed



- 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

Project D

Courtesy of MnDOT

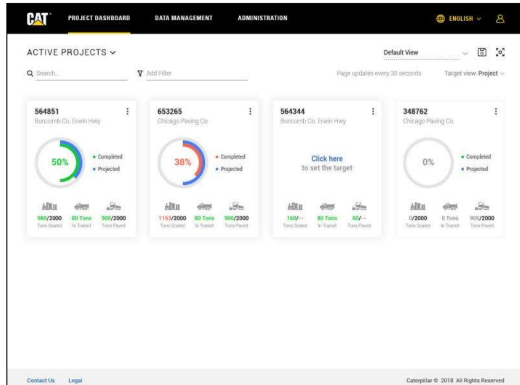
Device	Low (%)	Moderate (%)	Severe (%)
End Dump	0	32	68
Pickup Machine	2	56	42
Material Transfer Device	64	27	9

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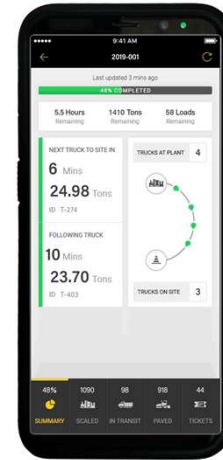
eRoutes (MDMS)

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



Not currently available

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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.



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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

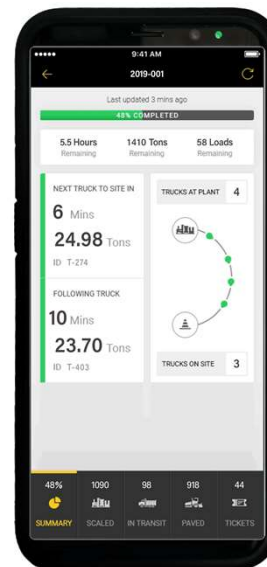
- Hire trucks/Company trucks? (Performance you expect?)
- "Where are my trucks!" (mystery solved!!)

BALANCE PLANT PRODUCTION FOR MULTIPLE CREWS

- The right mix produced at the right time
- Reduce plant wait times

TRACK YOUR MILLINGS

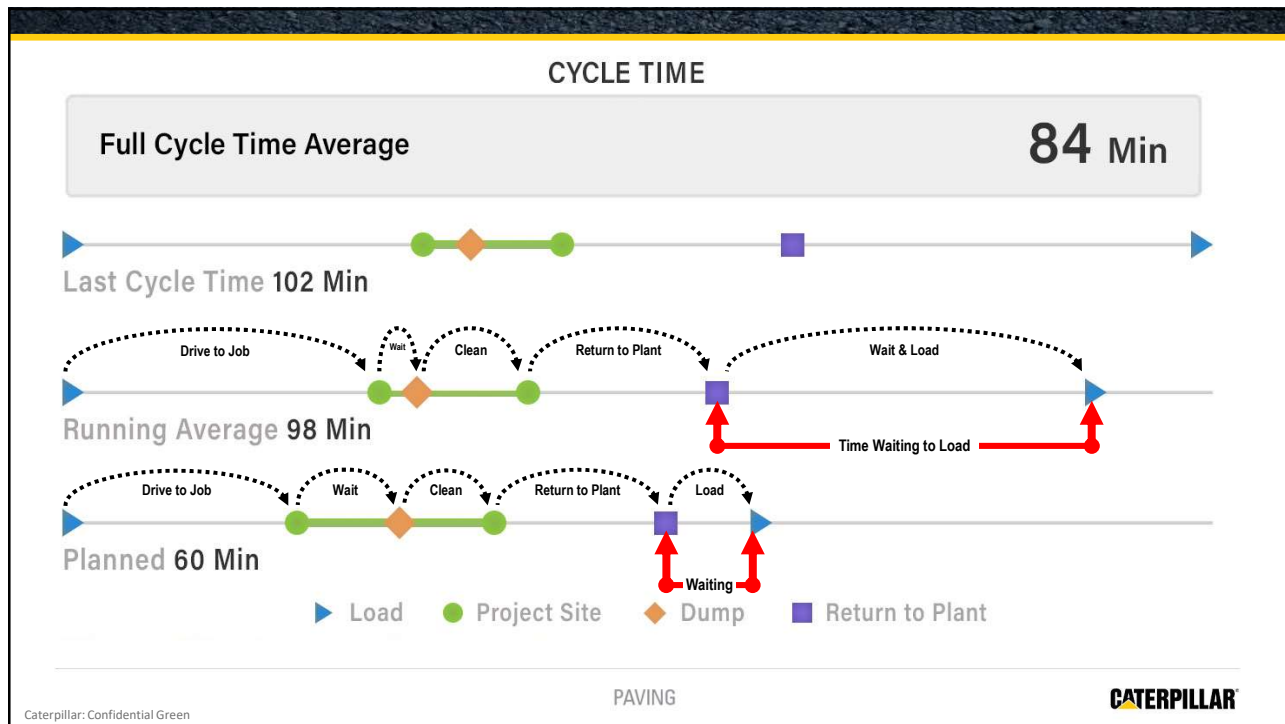
- Great way to monitor backhaul



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eTickets

CAT PROJECT DASHBOARD DATA MANAGEMENT ADMINISTRATION

TICKETS

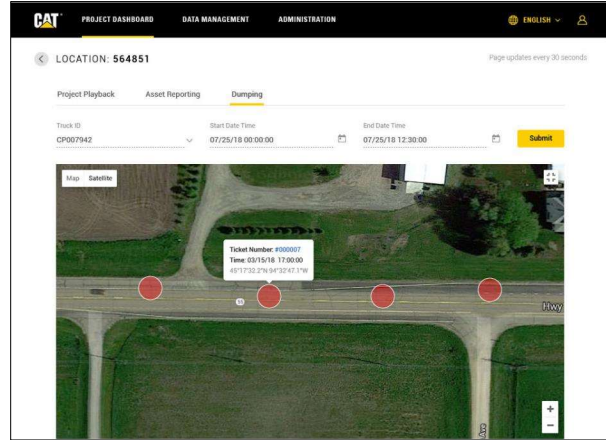
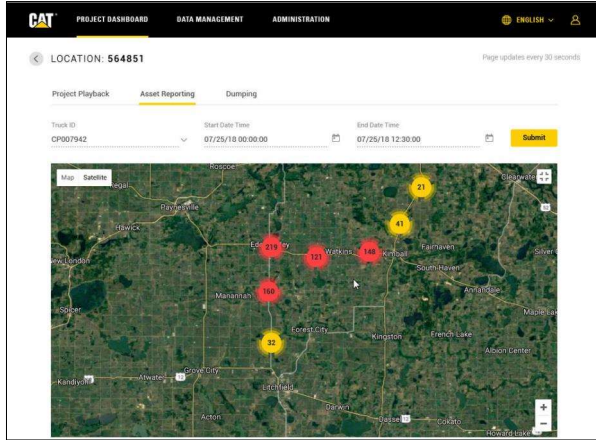
Q Search... Add Filter

Plant ID	Truck ID	Ticket Number	Ticket Date/Time	Material ID	Customer ID	Action
BP Plant	CP007291	000007	03/15/18 17:00:00	320-350	8765432	ABC123
BP Plant	CP007292	000006	03/15/18 17:00:00	320-350	8765432	ABC123
BP Plant	CP007293	000005	03/15/18 17:00:00	320-350	8765432	ABC123
BP Plant	CP007294	000004	03/15/18 17:00:00	320-350	8765432	ABC123
BP Plant	CP007295	000003	03/15/18 17:00:00	18.95	G14520-350	8765432
BP Plant	CP007296	000002	03/15/18 17:00:00	19.55	G14520-350	8765432
BP Plant	CP007297	000001	03/15/18 17:00:00	19.2	G14520-350	8765432

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eRoutes Desktop



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Virtual Training

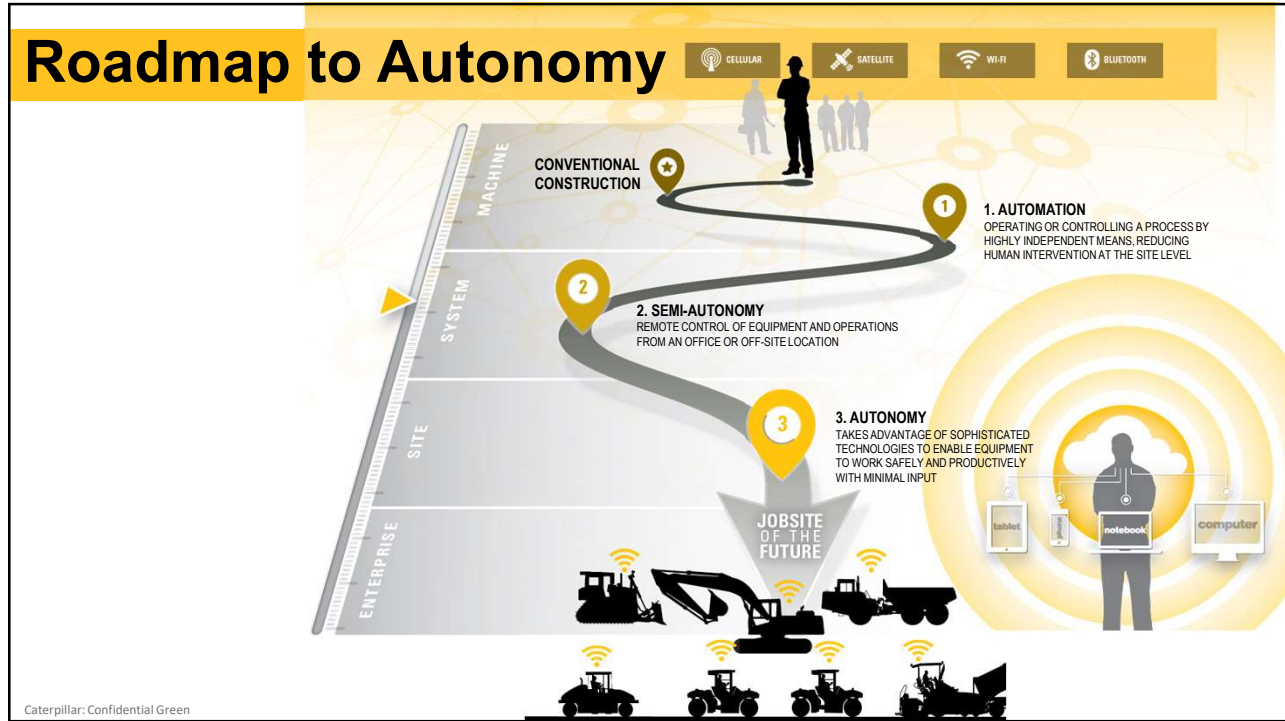


- Portable, on-demand
- Safe
- Cost-effective
- Tracks individuals' progress

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Semi-autonomous Soil Compaction

1. Where
2. How
3. Press "Auto"

00:21:21
Status: Ready

00:18:36
Status: Ready
Compaction Settings
Number of Passes
High: 0, Low: 5, Off: 6
Ground Speed
3.5 km/h
Overlap
15 cm

CATERPILLAR

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Semi-Autonomous - Command for Compaction



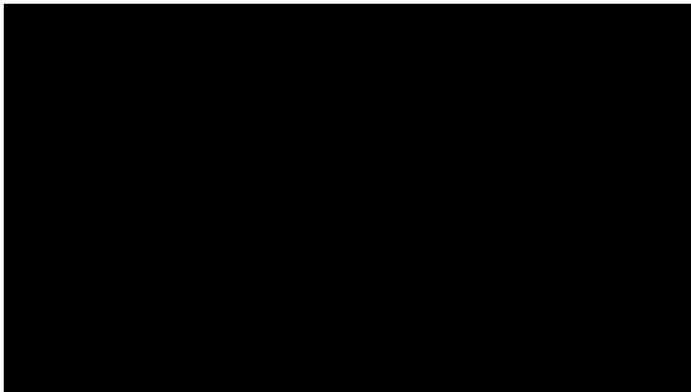
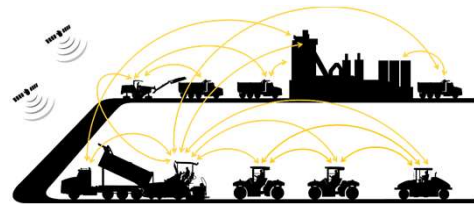
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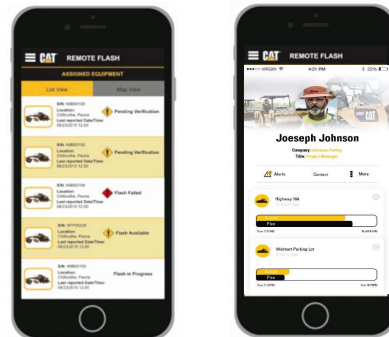
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Paving Connected Worksite

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 in hazardous conditions
 - More controlled environment for the operator.
 - Operator could switch between multiple machines.
 - Production tracking and monitoring



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One Operator, Many Machines!



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Fully Autonomous Paving site

ROBOTICS-WORLD
09.01.21 VOLUME 1 - ISSUE 17
Published by Kerwell Media Group

Accurate navigation in tunnels
MicroStrain® Sensing Systems Parker LORD

EDITOR MESSAGE
Could Driving be Illegal in 2050?

As autonomous car companies continue their stride towards mass adoption, an interesting new report suggests that self-driving technologies will get so much better than humans, that by 2050 driving could be banned in the interest of safety. That's the thinking of IDTechEX, which produced a report suggesting that autonomous technologies will match humans' ability in driving by 2024, and then surpass it by 2050 to about one collision per year. When you compare that with humans, the report suggests that cities will adopt "autonomous only" zones, with driving being outlawed eventually (other for sport / racing, etc.) It's an interesting idea, but I'm sure there will be some pushback from humans who still like to get behind the wheel and follow a road somewhere. One other quick note - don't forget that we are still looking for readers to fill out our survey to tell us the types of content they want to see on [Robotics-World.com](https://www.surveymonkey.com/r/SSP35EM). Head here (<https://www.surveymonkey.com/r/SSP35EM>) to fill out the survey before the end of the week (Sept. 3, 2021). Thanks in advance!

INPUTS
3D DESIGN
OR
ROAD SCAN

Δ Width
Depth
 Δ Time
 Δ Temp
 Δ Distance

HMA temperature, °C

Time, minutes

cooling curve
start temperature
stop temperature

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Thank-you for your attention! Questions?

ALABAMA ASPHALT PAVEMENT ASSOCIATION

BUILT FOR IT.

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