Illinois Asphalt Pavement Assn.
iapa

IAPA 86th Annual Conference

PAVING INDUSTRY

TODAY AND FUTURE INNOVATIONS

Dave King
Caterpillar Inc.

CAT
LET'S DO THE WORK.

Caterpillar: Confidential Green

TECHNOLOGY IS… REDEFINING INDUSTRY STANDARDS

Telematics

Product Condition
External Environment
Product Operation
Product Usage

Product

Connected Product

Performance

Enhance product performance
Allow predictive diagnostics

Smart Connected Product

Connectivity

Enhance product performance up and down the Value Chain

Smart Connected Products part of a Product system

Autonomy

Remote control
Full jobsite automation
Robots

Smart Connected Products part of a system of Product systems

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PAVER SOLUTIONS

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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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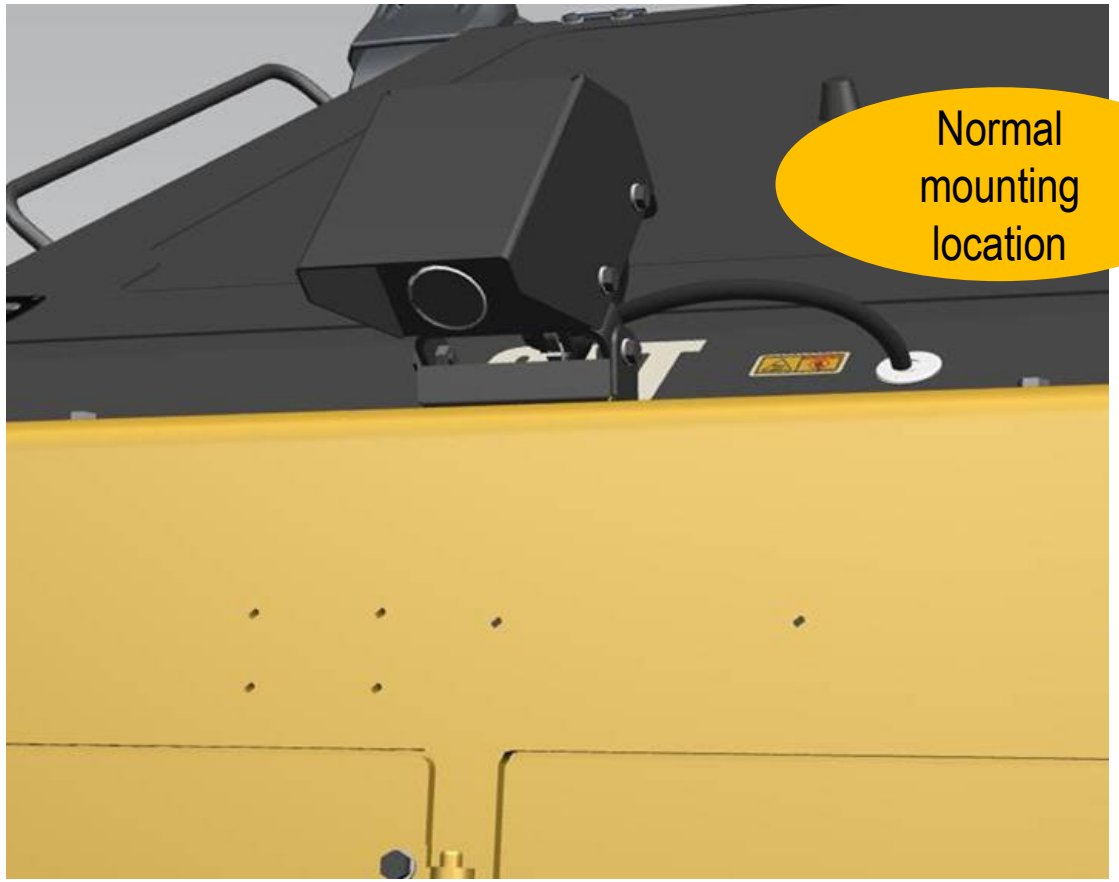
PAVER HOPPER TEMPERATURE & LEVEL



- **Process control**

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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

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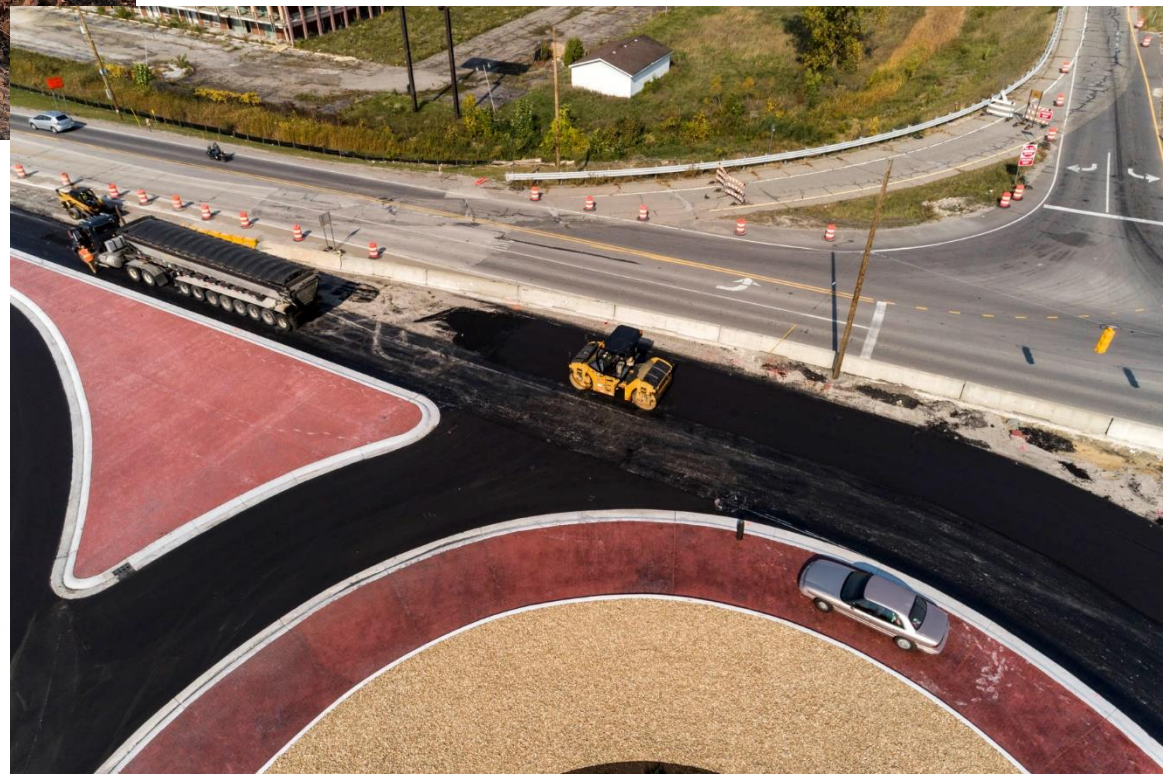
FRICTION STEER

- Friction maintains a constant turning radius - eliminating ‘human error’



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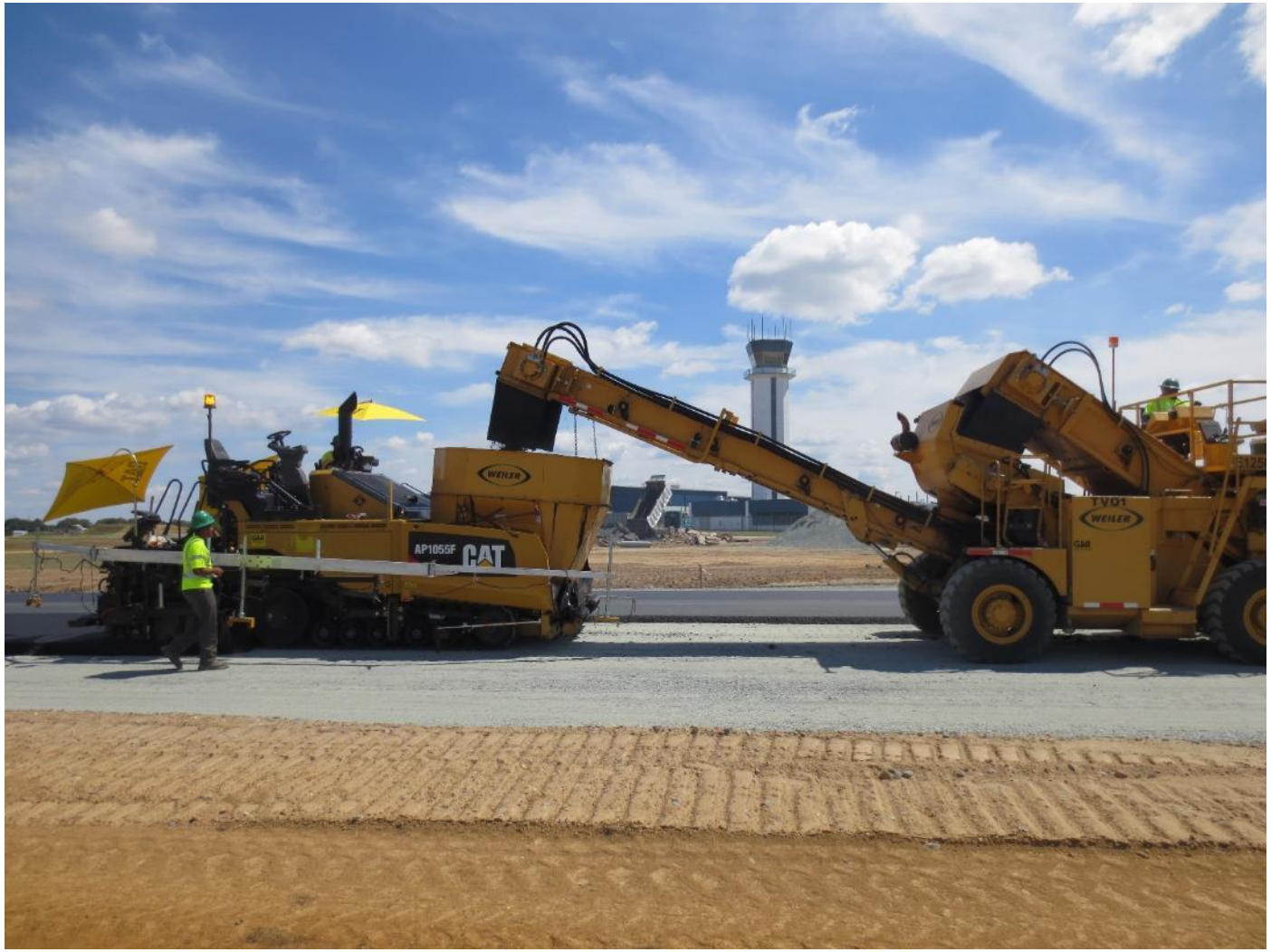
RADAR FOR MTV SPACING



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

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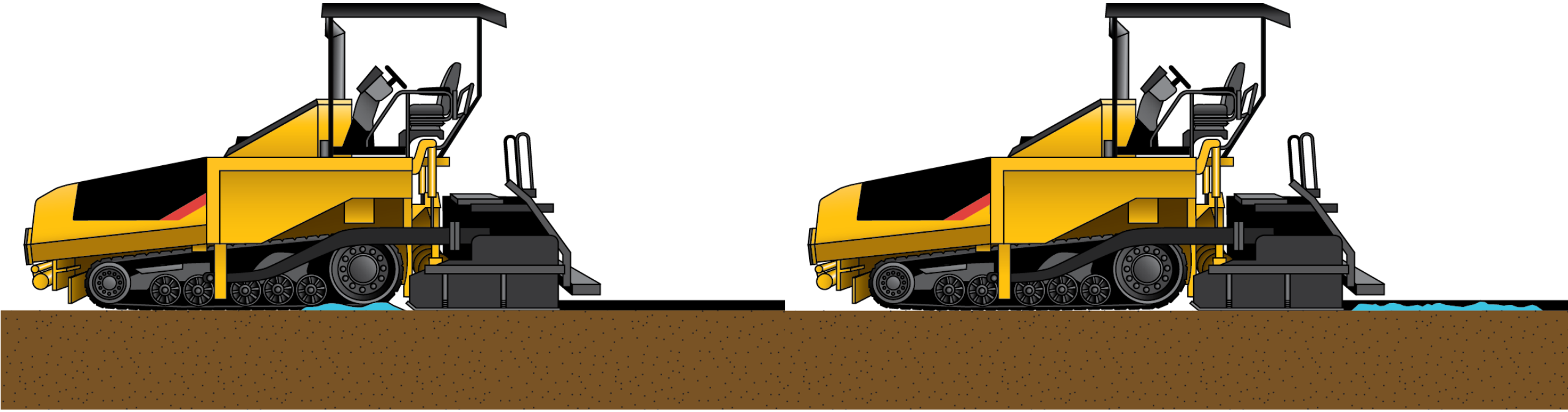
SPILLS ON GRADE ARE BIG MISTAKES!



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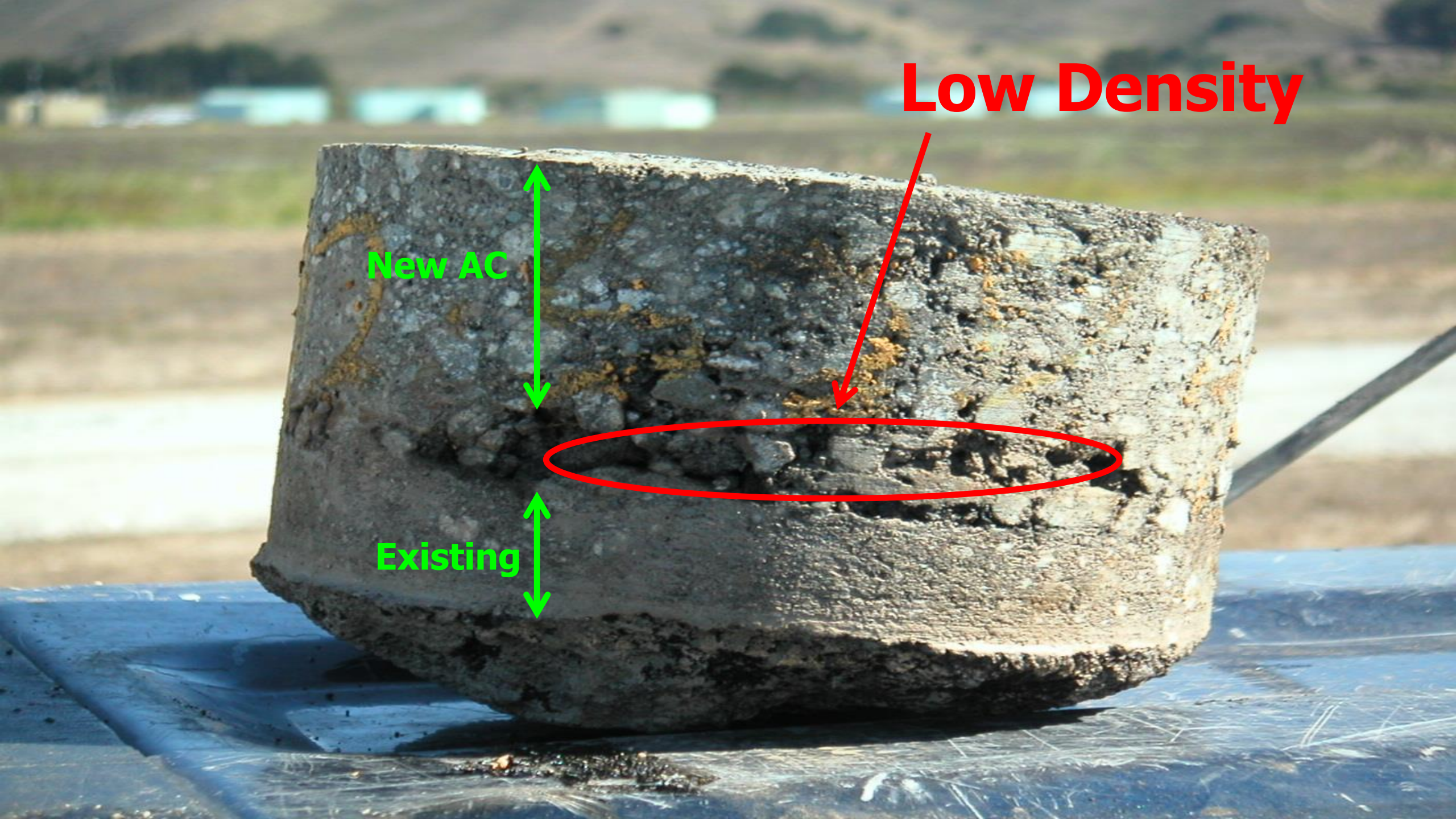
Low Density
New AC
Existing

PAVING SPEED – QUICK STARTS / STOPS

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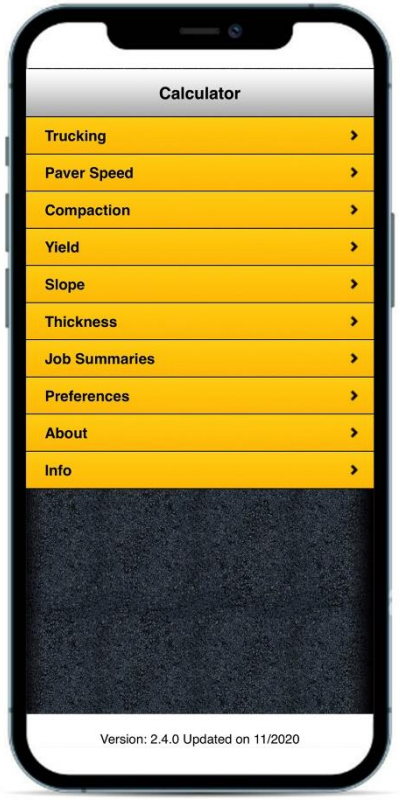
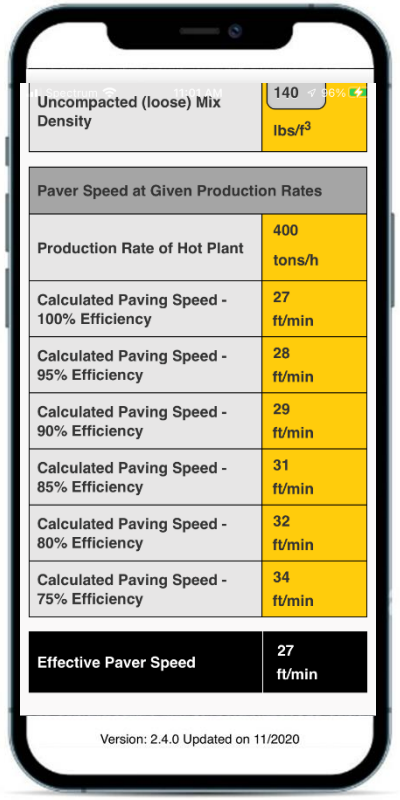
CATERPILLAR PAVING PRODUCTION CALCULATOR





Apple iOS

Google Play

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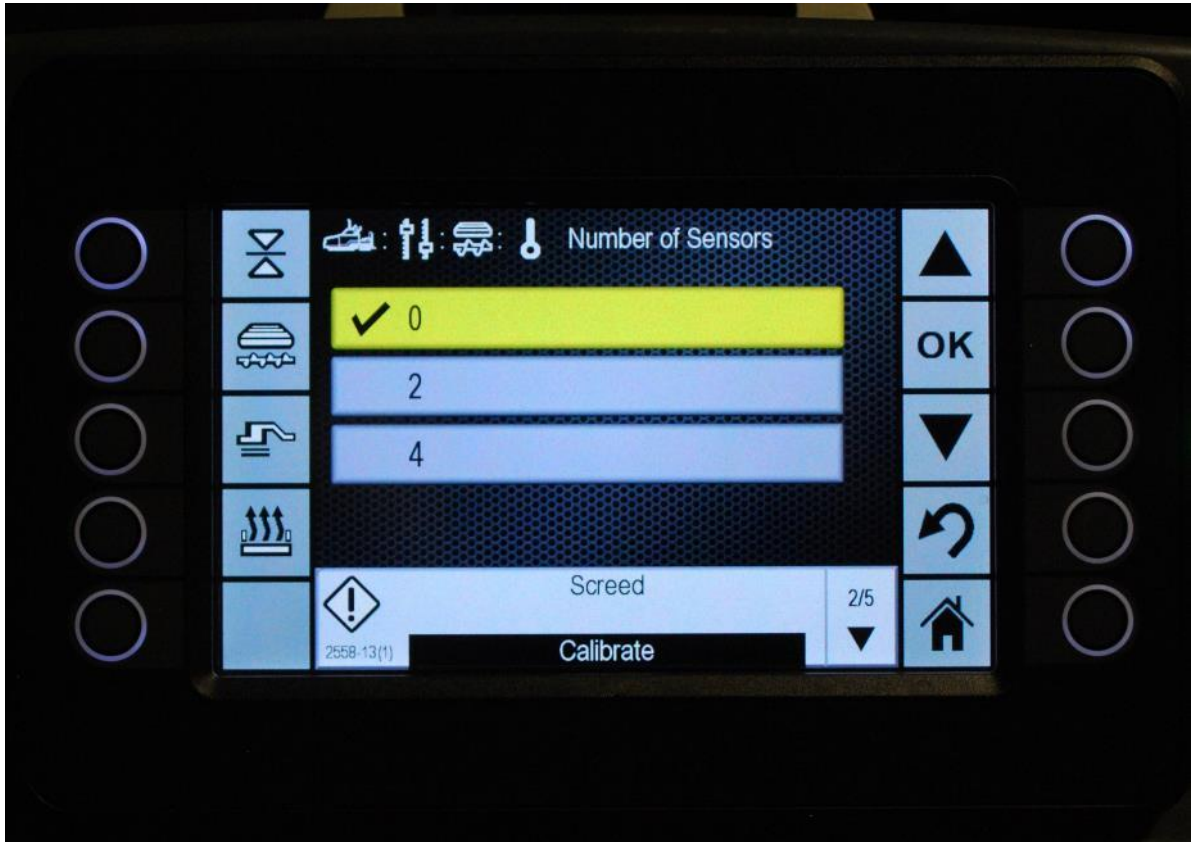
FEED SENSORS: 0, 2, OR 4



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

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CONFIGURABLE MANUAL OVER-RIDE FEEDS

- Every bump of the manual over-ride feed system ~ 3mm (1/8”) IRI
- 3-speeds and selectable % of each speed range on manual over-ride control on augers & conveyors

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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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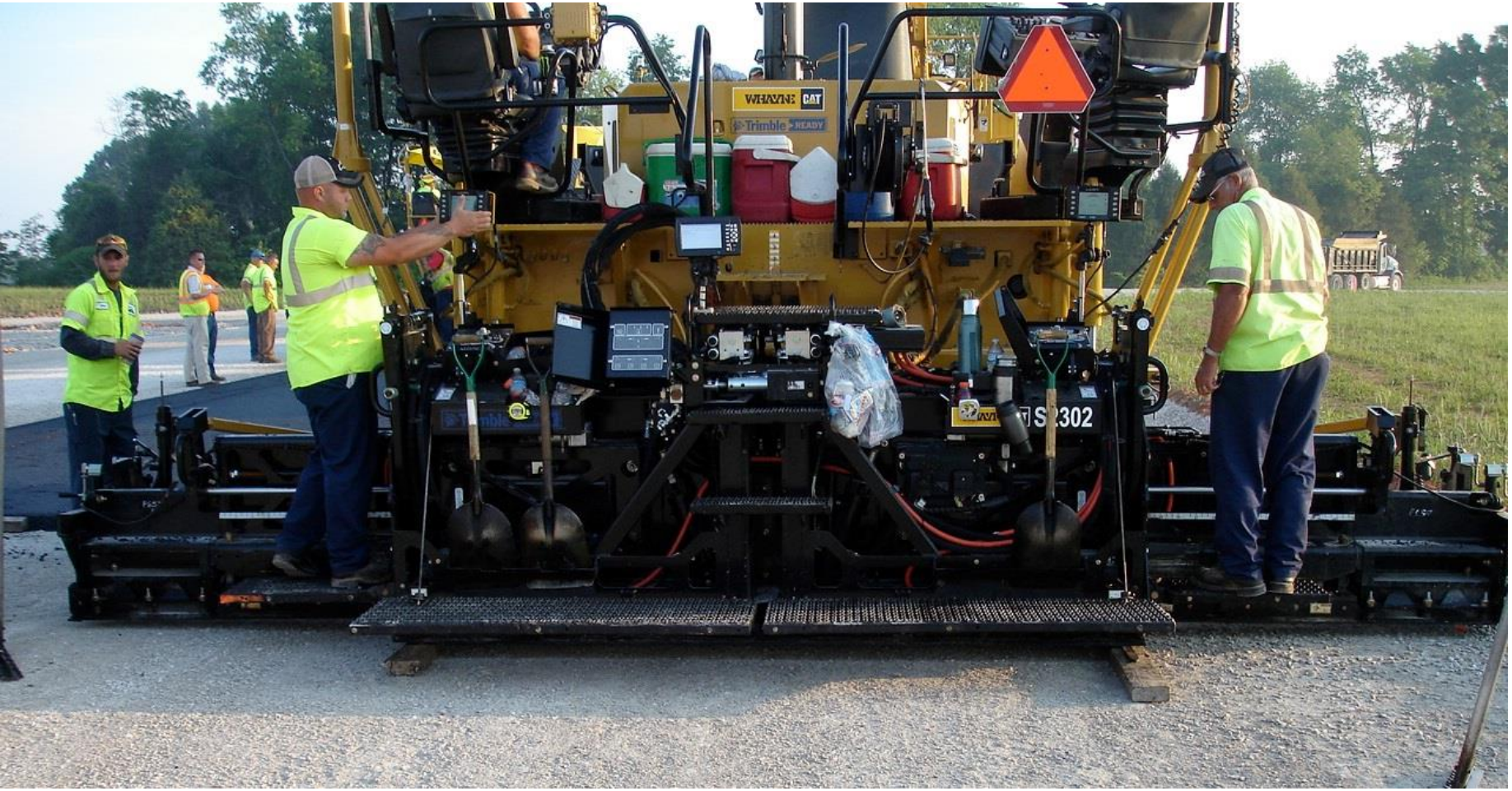
PAVER SETUP & TAKE OFF



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

QEXQ1403-04
(Replaces QEXQ1403-03)

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PAVER SOLUTIONS PAVE START ASSISTANT

REPEATABLE PERFORAMNCE
Save tractor and screed setting profiles

QUICK ACTIVATION
Simple selection

FAST SETUP
Machine automatically adjusts

CONSISTENCY DRIVES QUALITY
Keep doing what works

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PAVER SOLUTIONS CAT® GRADE AND SLOPE

INTEGRATED CAT® GRADE CONTORLS

- Reduces the number of displays
- Enables adjustment from any of the 2 tractor or 2 screed consoles
- Constant communication

SCREED CONTROLS

- Two speed proportional screed control
- Conveyor ratio adjustment
- Full reversing control of auger and conveyor

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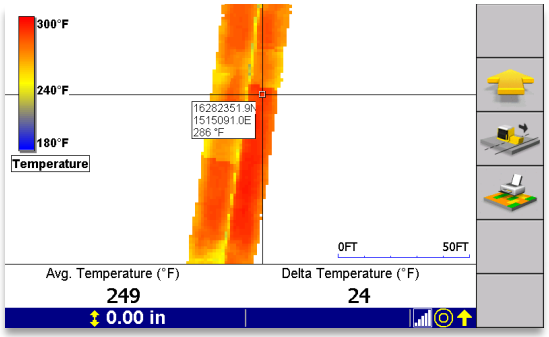
PAVER SOLUTIONS TEMPERATURE MEASUREMENT & MAPPING

THERMAL DATA HELPS ENSURE PROCESS CONTROL

Drive consistency for better quality and longer lasting roads

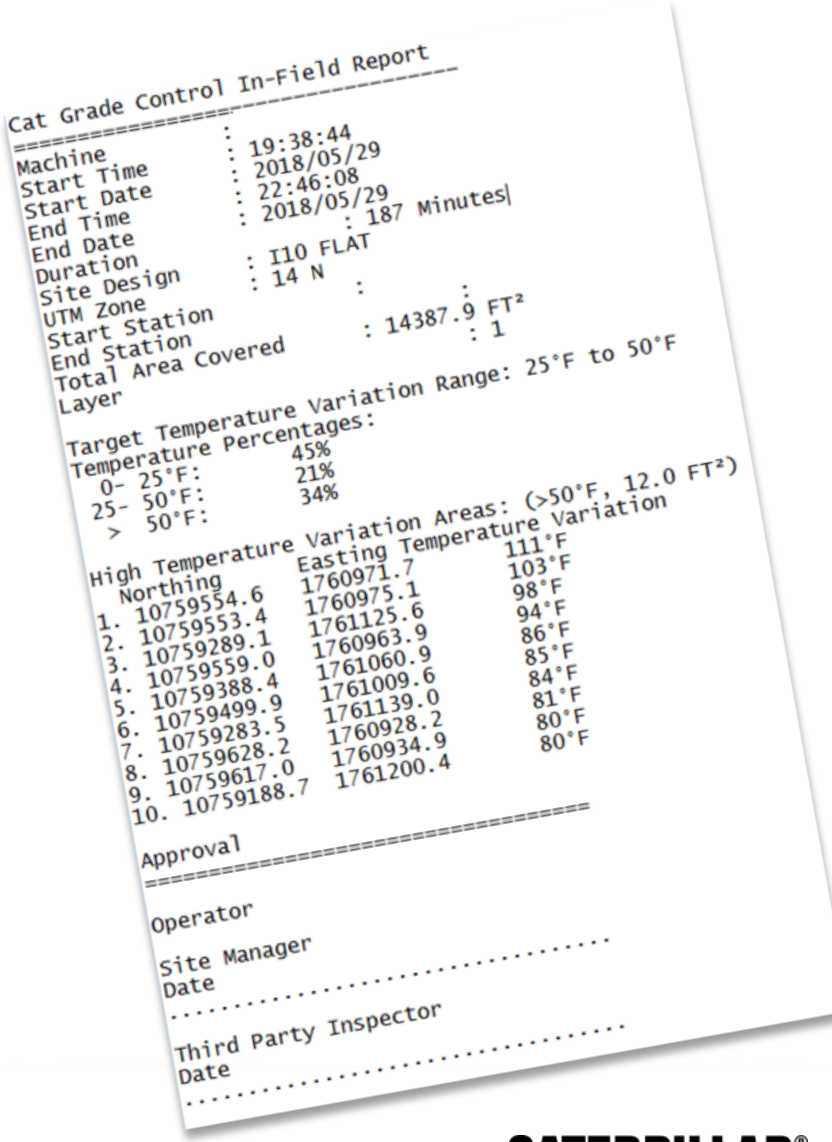
EARLY DETECTION ENABLES PROCESS ADJUSTMENT

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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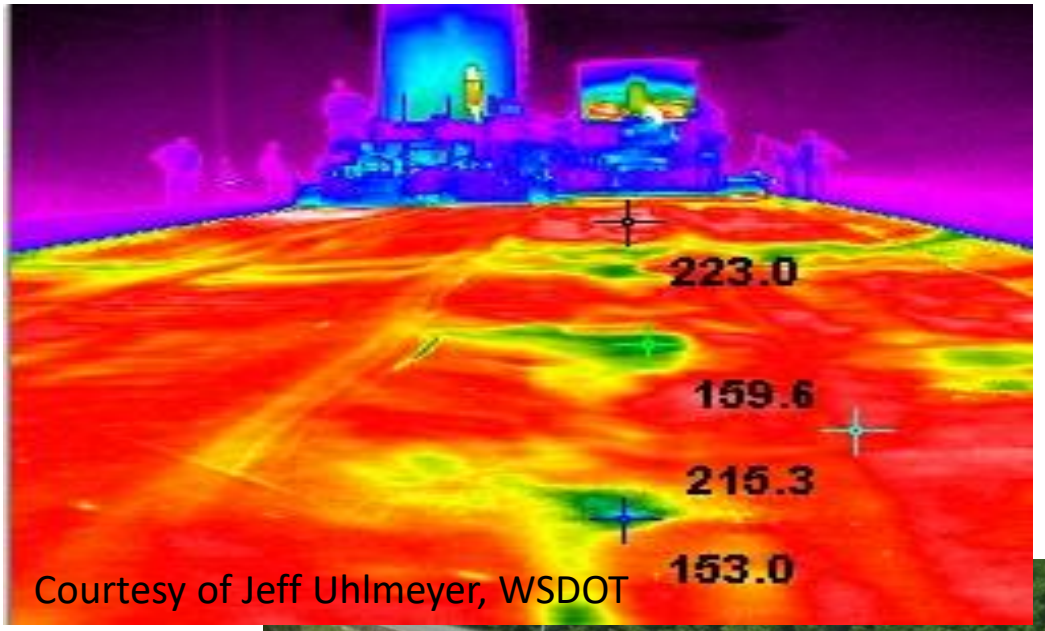
THIS....BECOMES....THIS....



Courtesy of Jeff Uhlmeyer, WSDOT

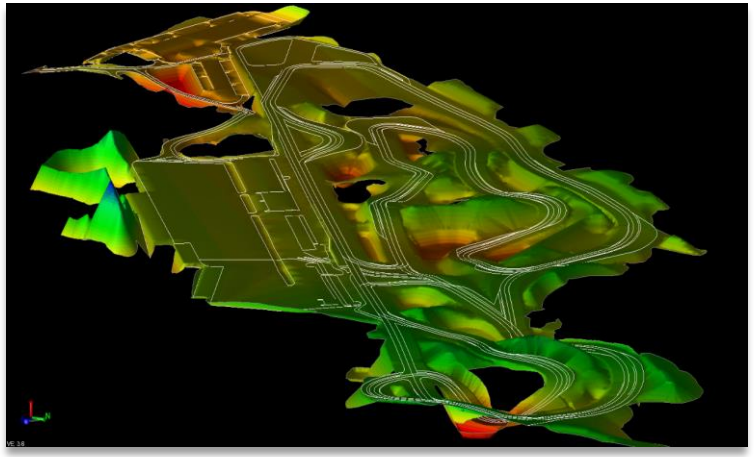
PAVER SOLUTIONS CAT® 3D GRADE & SLOPE

PRECISION CONTROL OF MATERIAL
Precise control of elevations and profile (1-3 mm)

LESS CHANCE OF ERROR ON COMPLEX JOBS
Transitions, Super-elevated curves, Cross slopes

IMPROVED SMOOTHNESS
Less screed adjustments delivers smoother asphalt

ELIMINATE STRING LINES
Less labor, less errors, more accuracy



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MILLING SOLUTIONS

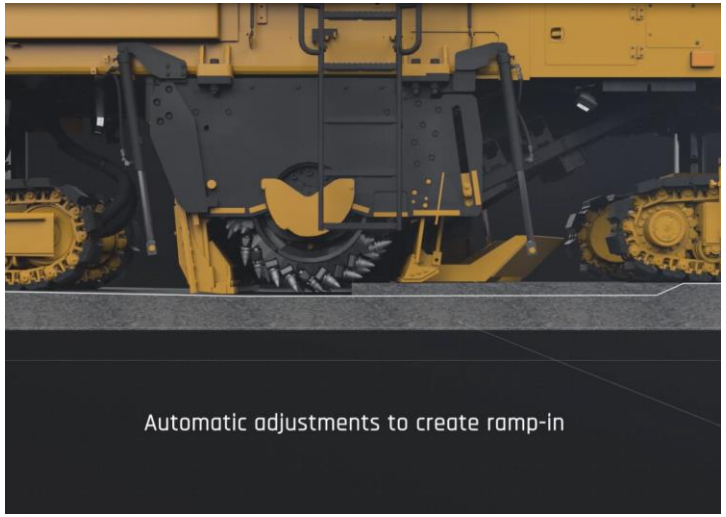
Caterpillar: Confidential Green

CATERPILLAR®

STANDARD INTEGRATED 2D SYSTEM

INTUITIVE SETUP & OPERATION

CUSTOMIZABLE FEATURES



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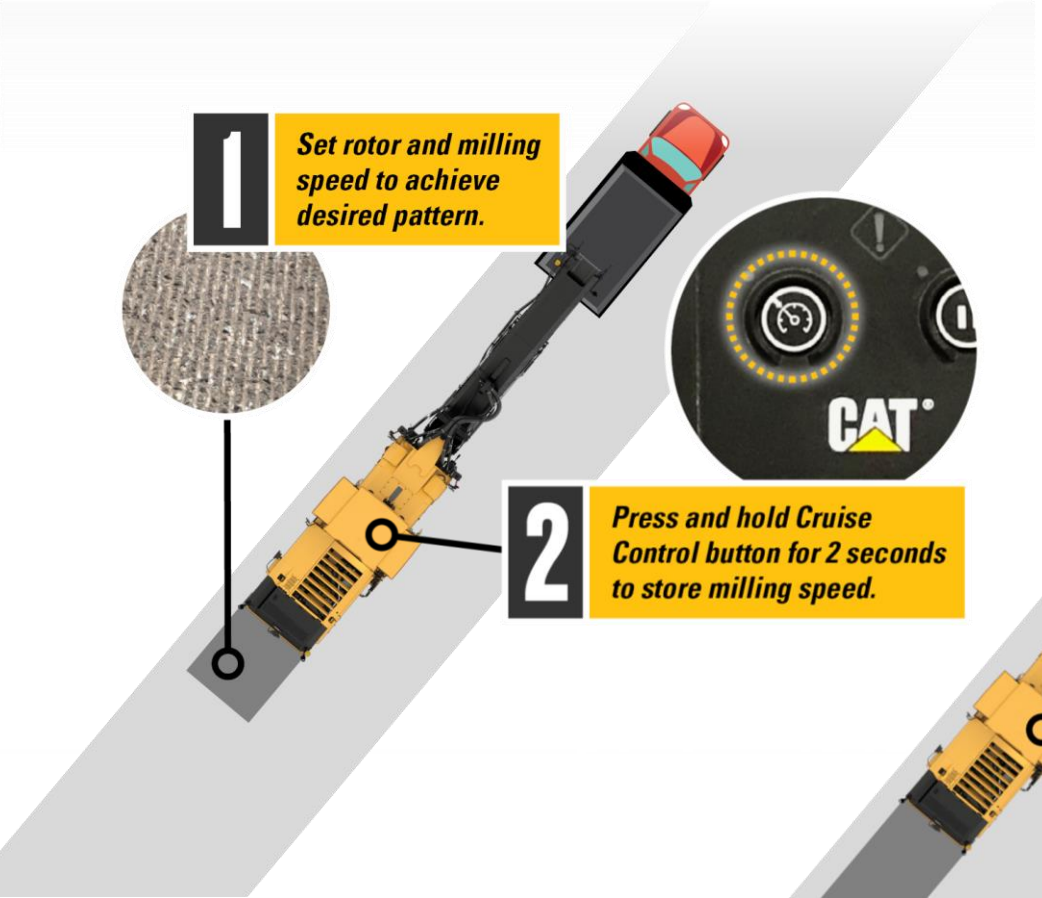
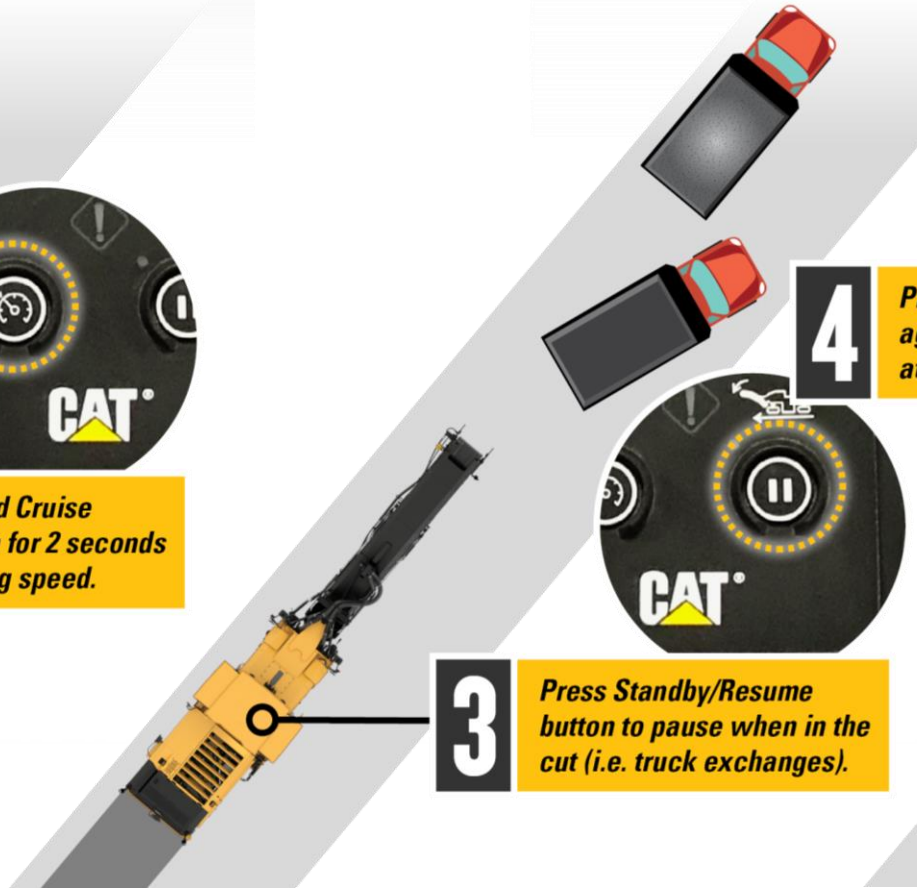
MILLING PATTERN CONTROL

CRUISE CONTROL

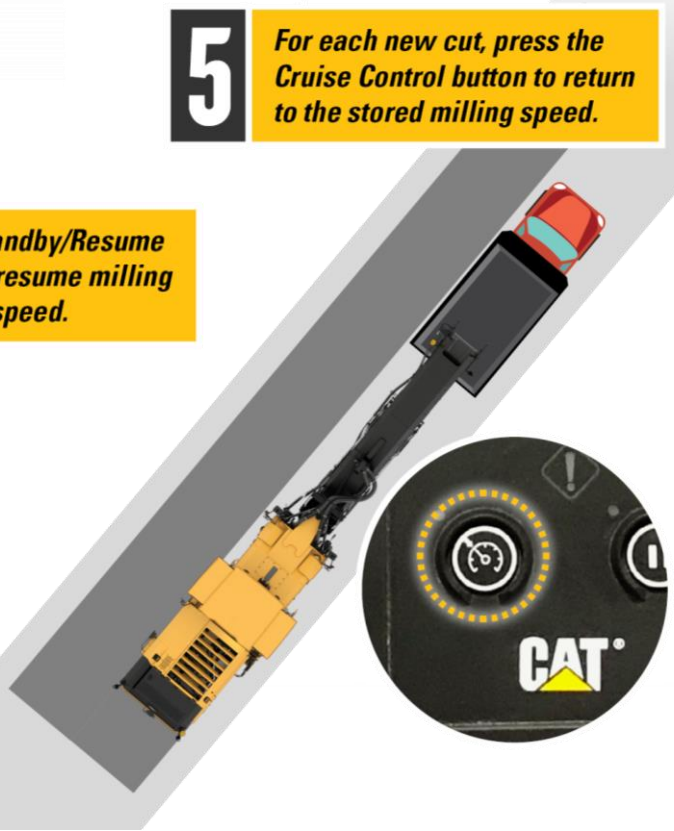


1. Set rotor and milling speed to achieve desired pattern.
2. Press and hold Cruise Control button for 2 seconds to store milling speed.

STANDBY / RESUME



3. Press Standby/Resume button to pause when in the cut (i.e. truck exchanges).
4. Press Standby/Resume again to resume milling at same speed.
5. For each new cut, press the Cruise Control button to return to the stored milling speed.



MILLING INTEGRATED 3D MILLING

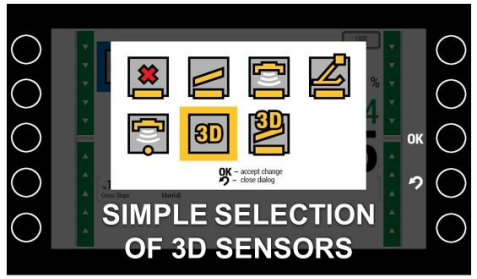
INCREASED PRODUCTION, LOWER COST
Only mill where needed

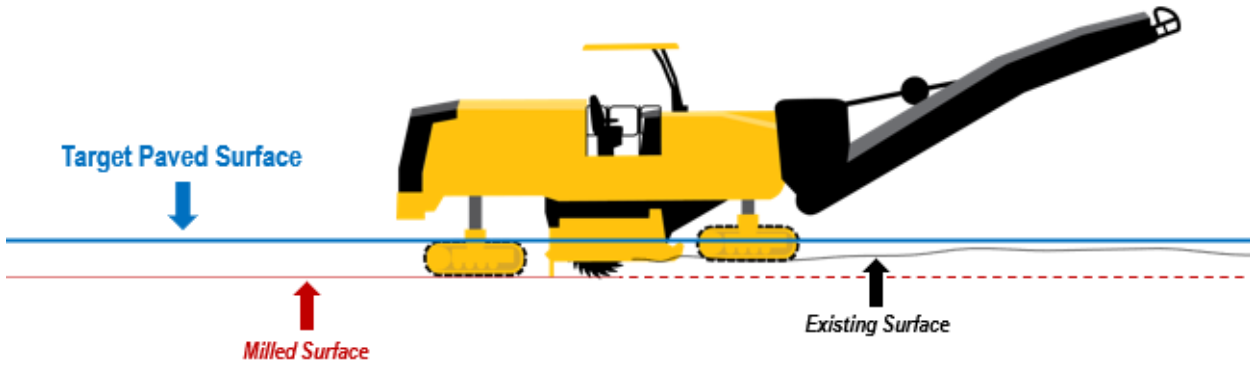
INCREASED SMOOTHNESS
Remove longitudinal waves

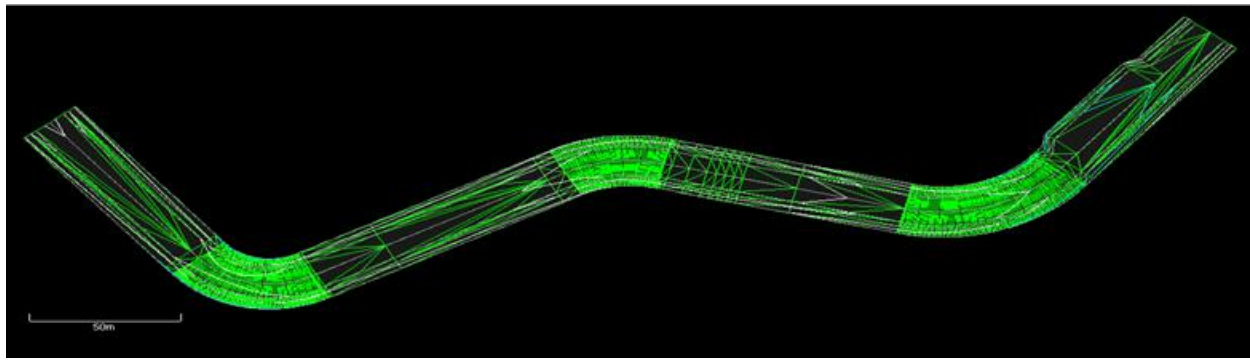
CHANGE/FIX CROSS-SLOPES
New State/Federal Specs

MILL ACCURATE DESIGNS
Transitions, supers, drainage, flight decks etc.

NO STRINGLINES
Reduce costs, easier truck/traffic management, safer







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Automatic adjustments to create ramp-in

REAL OPERATION MAY DIFFER FROM WHAT YOU SEE IN THE ANIMATION - CONTACT YOUR DEALER FOR DETAILED INFORMATION

COMPACTION SOLUTIONS

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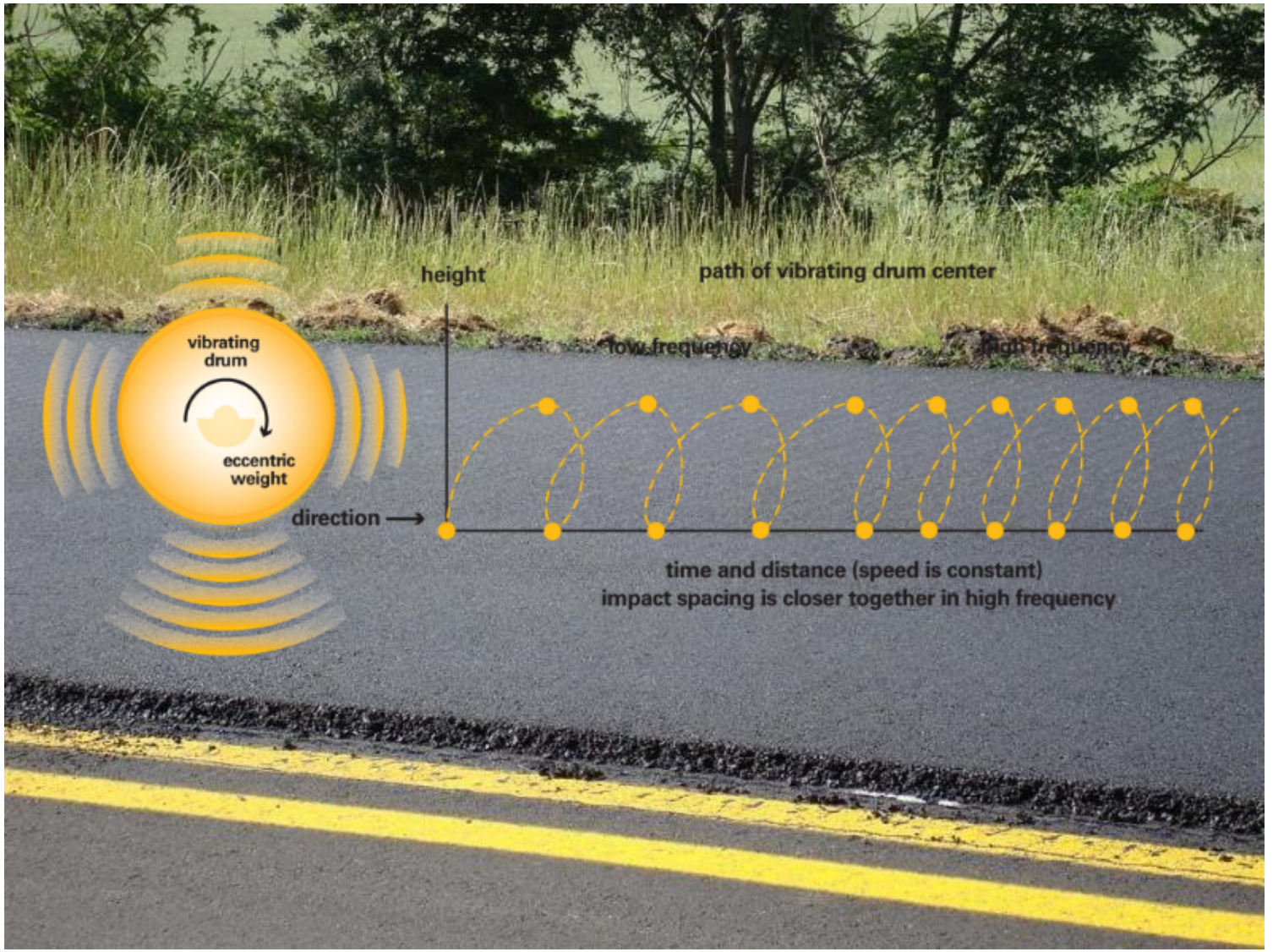
ROLLER SPEED 10-14 IPF



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

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

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COMPACTION SOLUTIONS

AUTO-VIBE

What it does:

- Automatically turns the vibration system on and off based on propel handle position

Why it's important:

- Avoids over compaction while slowing the machine to change directions
- Avoids decoupling while the machine is stopped

Benefit to you:

- Higher quality compaction
- Component life (iso-mounts, etc.)

AUTO SPEED CONTROL (ASC)

What it does:

- Allows operator set and maintain a specific speed

Why it's important:

- With compaction, consistency is key
- Inconsistent speed causes varying impact spacing and can lead to inconsistent compaction results

Benefit to you:

- More consistent process leading to more predictable results

COMPACTION SOLUTIONS TEMPERATURE MEASUREMENT

INFRA-RED SENSORS
Realtime reading of mat temperature

TEMPERATURE DISPLAYED TO THE OPERATOR
No more guessing

IMPROVED CONSITENCY
Compaction at the proper temperatures

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COMPACTION SOLUTIONS CMV-COMPACTION METER VALUE

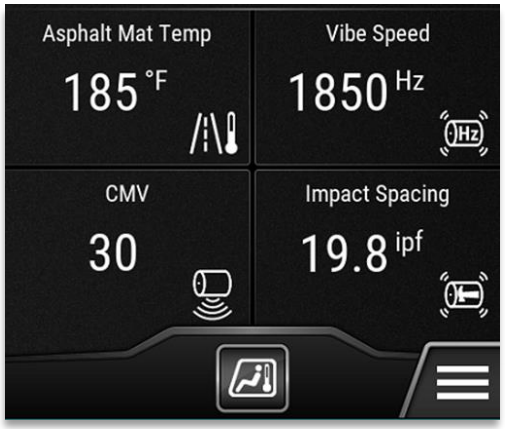
ACCELEROMETER-BASED MEASUREMENT
Composite stiffness value

BASE AND SUB-BASE EVALUATION
Find soft spots

IN PROCESS QUALITY CONTROL
Value displayed to the operator

Vibratory energy is imparted on the material by the vibrating drum

The material vibrates in response, which is detected and measured by the accelerometer



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COMPACTION SOLUTIONS MAPPING AND DOCUMENTATION

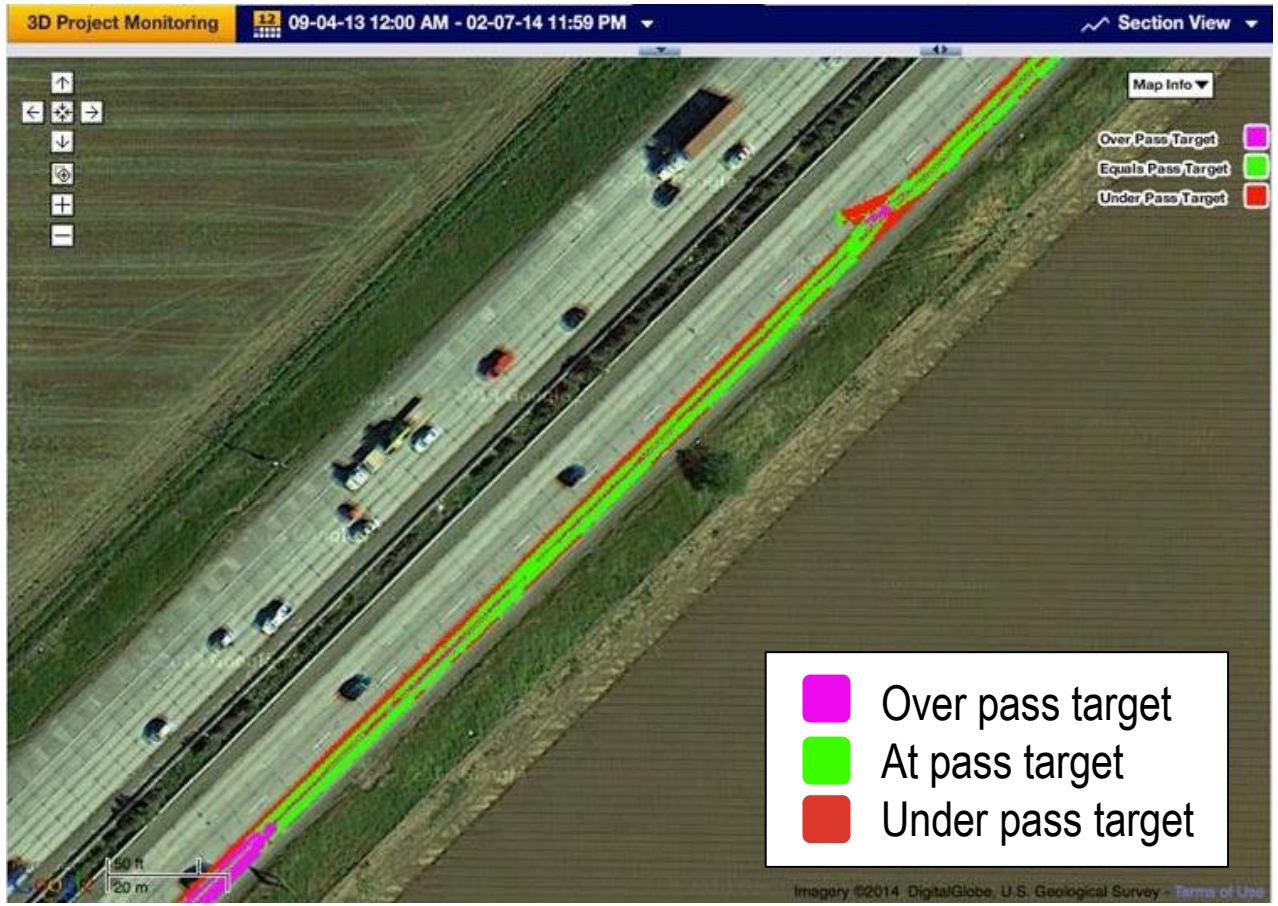
PROCESS DOCUMENTATION
GNSS mapping of data – SBAS or RTK

DOCUMENTS WHAT WAS DONE
Real time or back-office processing

CORRELATES MEASUREMENTS TO LOCATION
CMV, MDP, Temperature, Pass Count and Coverage

PROCESS ACCOUNTABILITY
Documentation can show where other contractors were not consistent

Conventional measurement only covers 1% of the job



PROCESS IMPROVEMENT

PASS COUNT MAPPING

- Helps identify rolling pattern issues
- Helps identify issues with overlap
- Maximize coverage
- Easier for night-time operation

MAP INSIGHT

- Turnout area is not optimized and missing coverage

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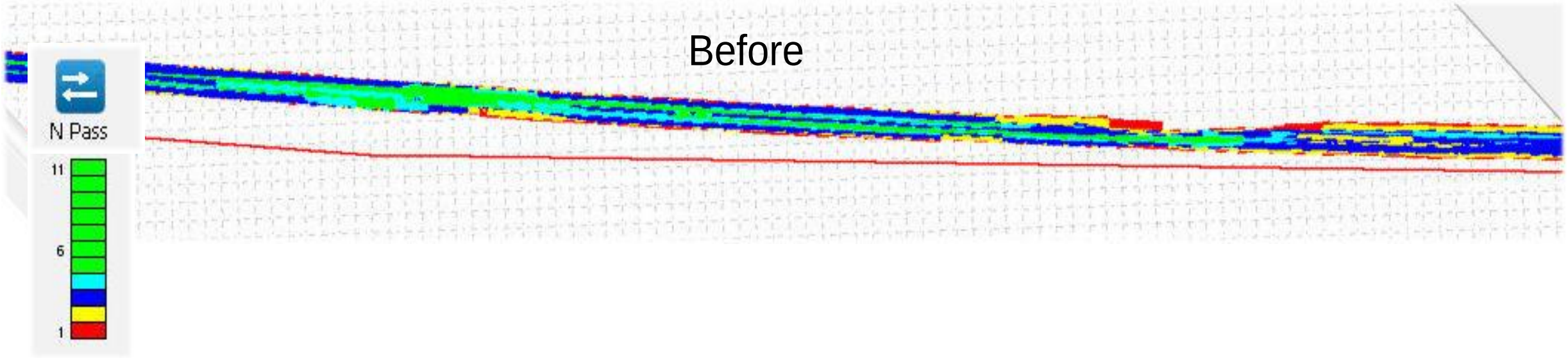
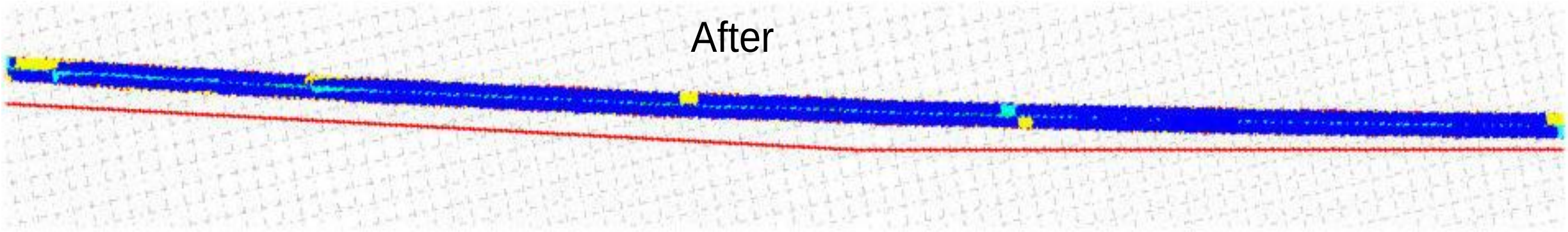
BEFORE & AFTER – PASS COUNT CONSISTENCY!!





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PROCESS IMPROVEMENT

TEMPERATURE MAPPING

- Available with each roller pass
- Identify where cold loads were placed
- Identify if rollers are being used at the correct time

MAP INSIGHT

- One compaction lane is within temp, and one is under which means the roller is not keeping up and changes need to be made
- Compaction during the blue pass may not have been effective

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PROCESS IMPROVEMENT

CMV MAPPING

- Helps find issues with the road structure beneath the asphalt layer
- Helps identify areas where vibe was not turned on soon enough based on rolling pattern
- CMV is not a direct measure of density

MAP INSIGHT

- Areas in blue show potential issues with the sub structure that could lead to lower density and future issues

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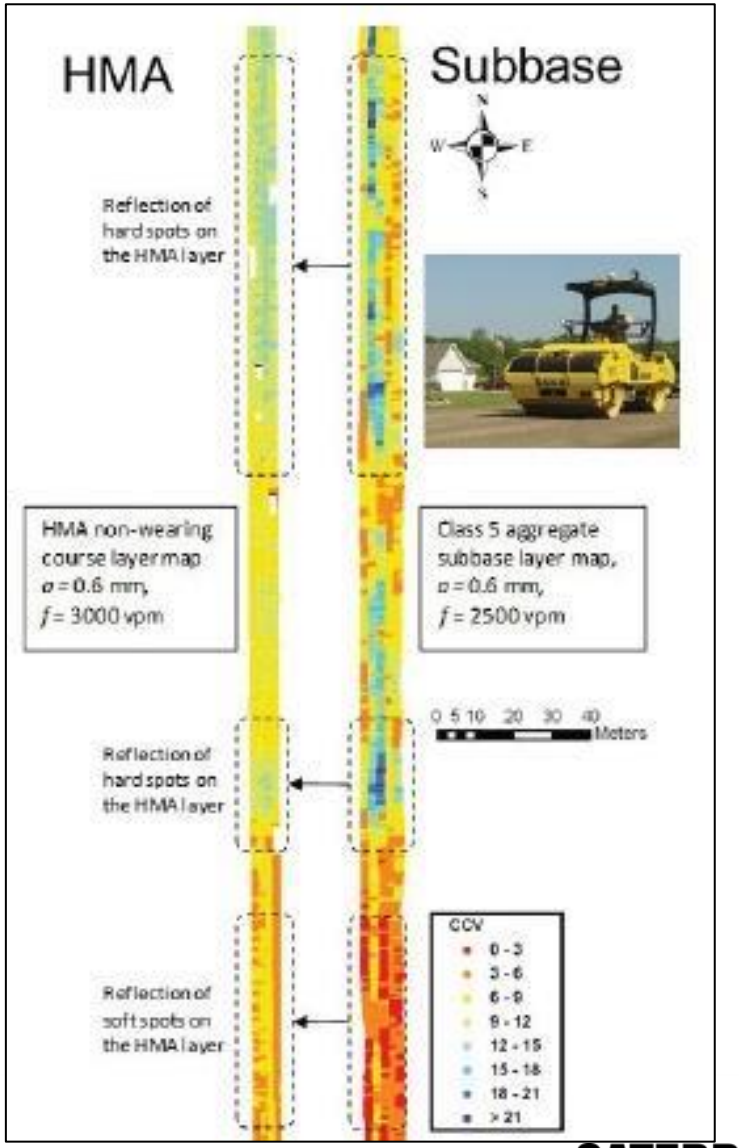
PRE-MAPPING TO FIND SOFT AREAS



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BOOST CONSISTENCY, COVERAGE, AND SAFETY WITH SEMI-AUTONOMOUS CAT COMMAND FOR COMPACTION

COMPACTION IS OFTEN OVERLOOKED

- Entry level operators
- Multiple operators using same machine
- Lots of opportunity for inconsistency – vibration settings, speed, coverage, pass count

ELIMINATE SKILL GAPS

- Controls speed, direction, steering and vibe system
- Achieve consistent and efficient quality compaction

TECHNOLOGY MADE SIMPLE

- No design files or back-office needed
- Connects to commonly used base stations
- Allows a first step towards a more automated jobsite

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COMPACTION SOLUTIONS COMMAND FOR COMPACTION

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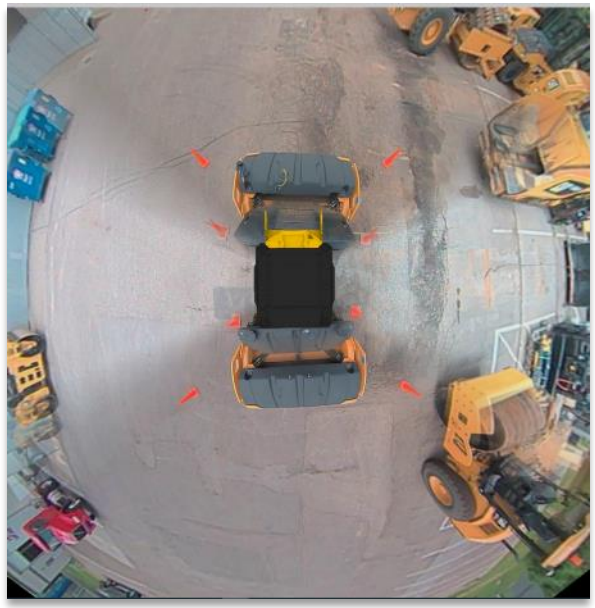
VISIBILITY & SAFETY



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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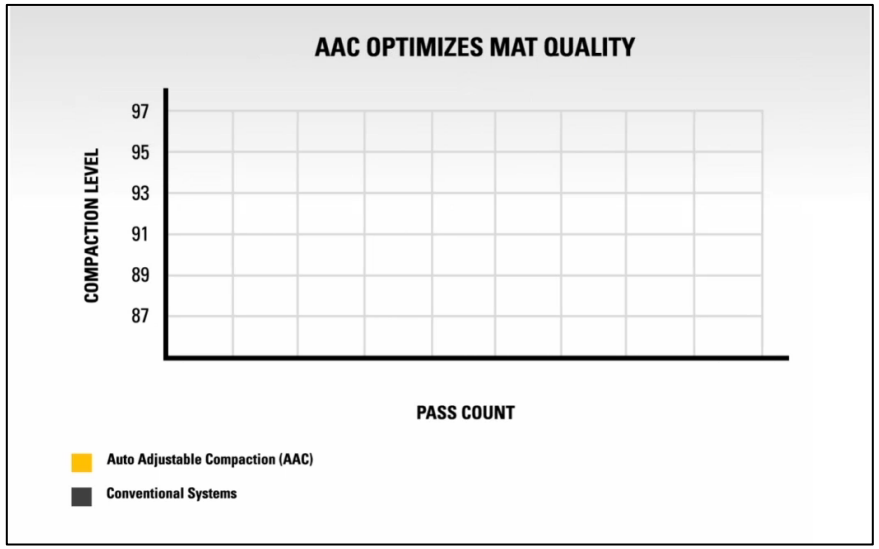
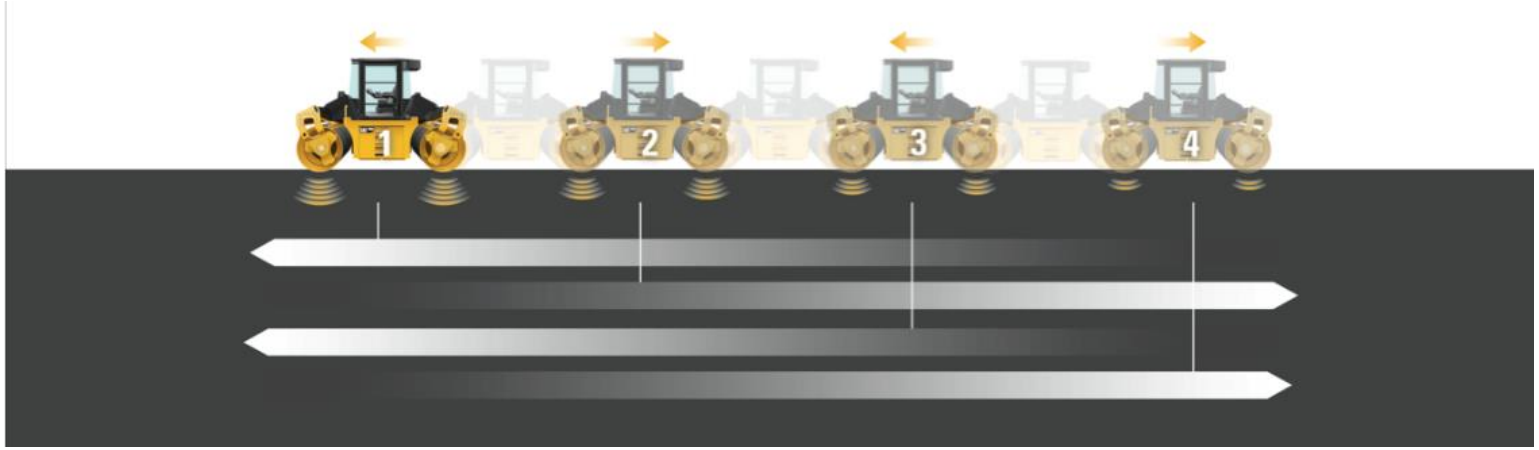
AUTO-ADJUSTABLE COMPACTION



- 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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JOBSITE DATA SOLUTIONS

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TELEMATICS MULTIPLE SOLUTIONS

EQUIPMENT MANAGEMENT

BASIC IS STANDARD WITH NEW MACHINE PURCHASE

BASIC – EQUIPMENT MANAGEMENT
- MY.CAT.COM or the Cat app
- Hours, location, faults and fuel
- Maintenance schedules

ADVANCED – EQUIPMENT AND SITE MANAGEMENT
- VisionLink®
- Asset operation
- Projects and Geofences
- Notifications and special reports

EXPERT – EQUIPMENT AND SITE MANAGEMENT WITH ADVANCED DIGITAL CAPABILITY
- Customized support
- Condition monitoring
- API access

CAT® PRODUCTIVITY

- ✓ Digital productivity monitoring
- ✓ Efficiently manage jobsites using machine data
- ✓ Track:
  - Material
  - Map view
  - Utilization
  - Cost

REMOTE SERVICES

- Enables real time remote diagnostics on connected machines
- Reduces service calls
- Minimizes machine downtime
- Maximizes uptime with remote software updates

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VIRTUAL TRAINING

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

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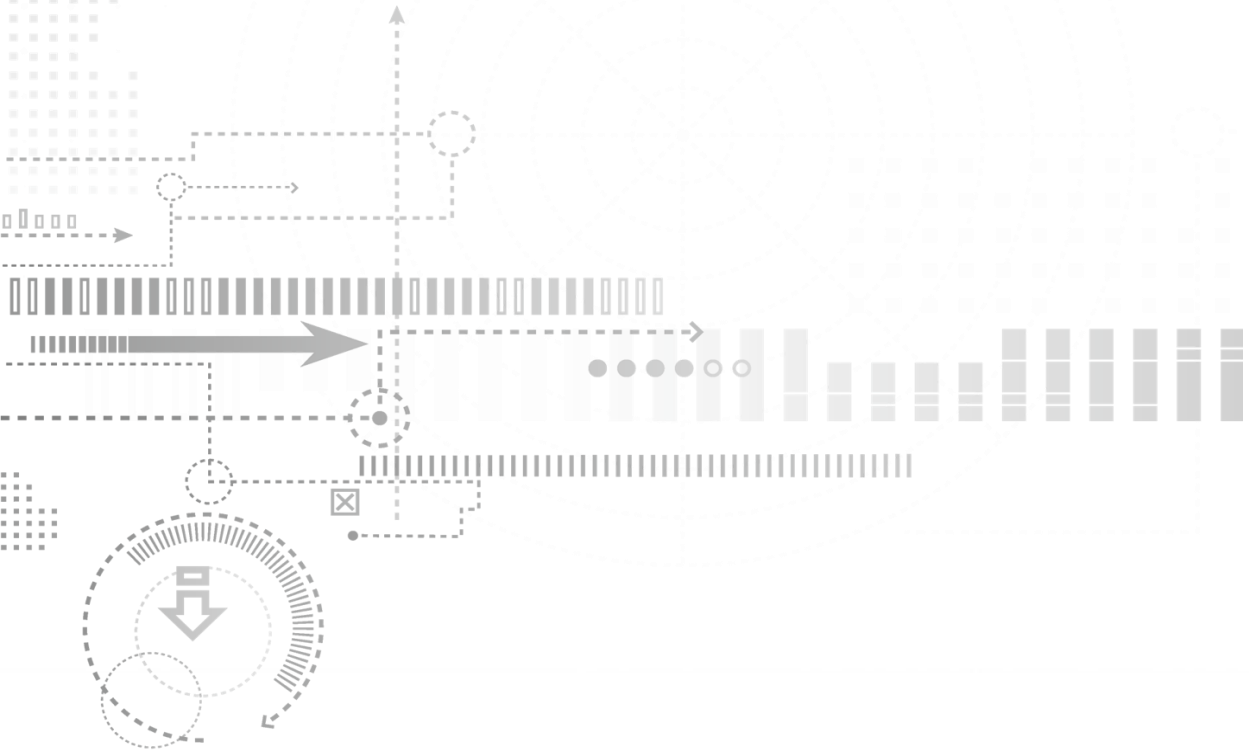
THE FUTURE



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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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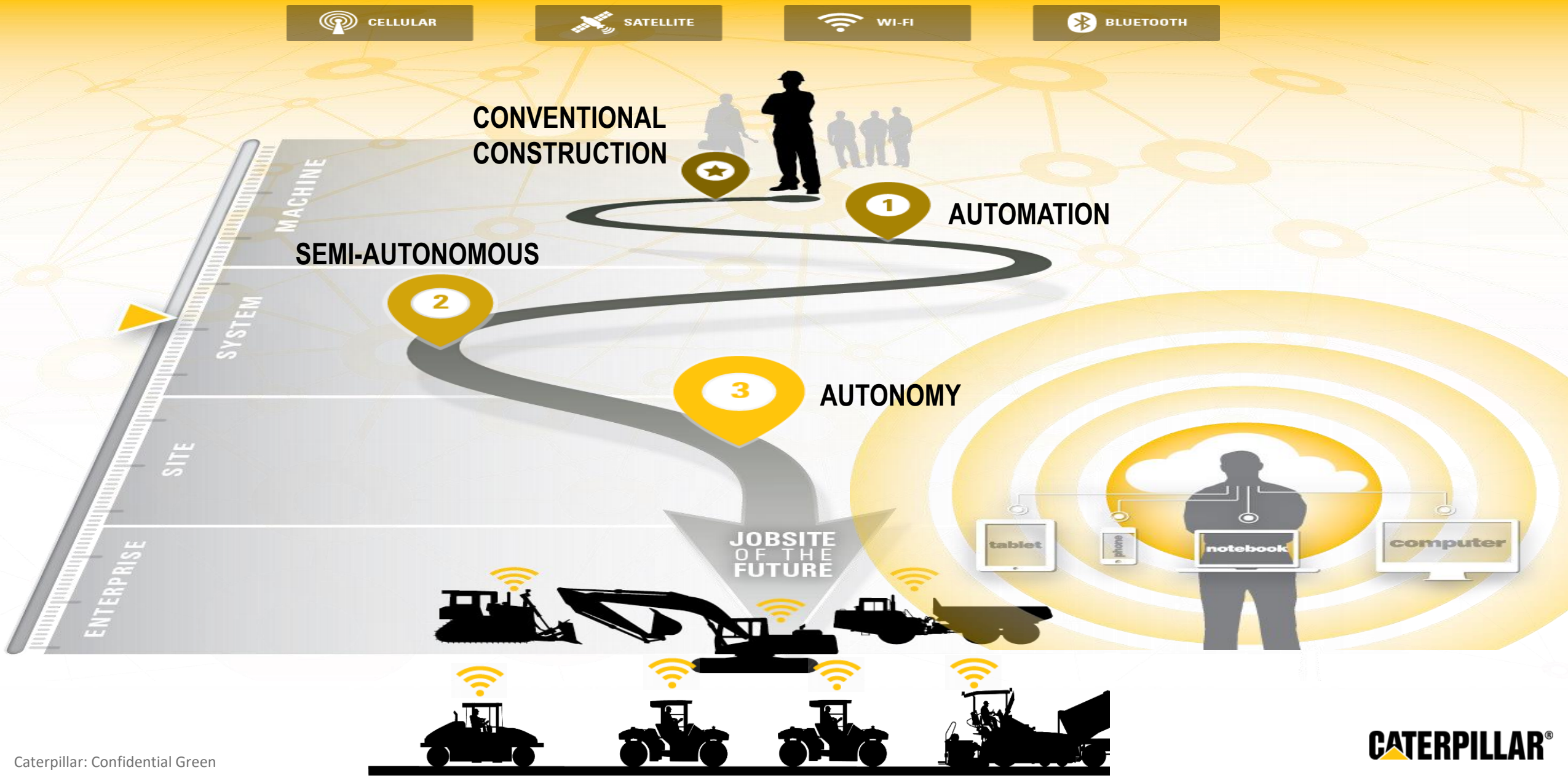
ROAD TO AUTONOMY



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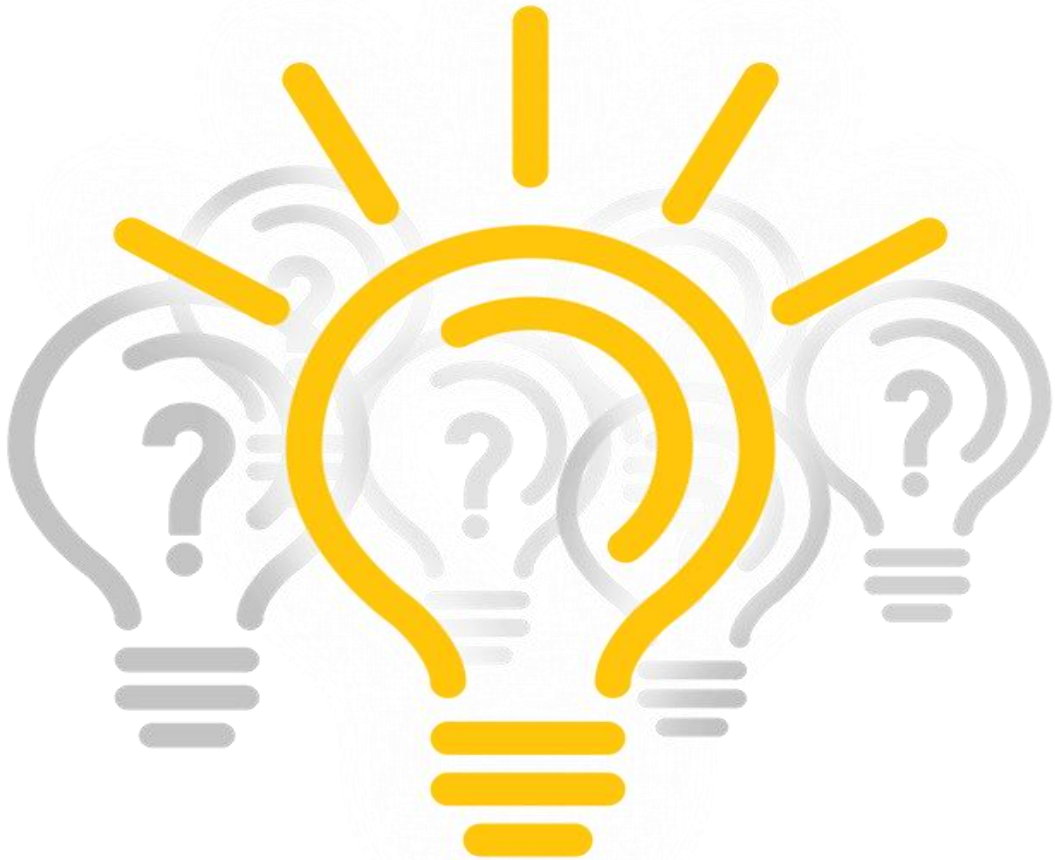

QUESTIONS OR COMMENTS?

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