

# ASPHALT PAVING TODAY AND FUTURE INNOVATIONS

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Global Sales Consultant  
Caterpillar Inc.

# TECHNOLOGY TRENDS FOR CONSTRUCTION

- Current Technology - Integrated in the iron
- Asphalt Paving
  - 3D Paving or 3D Milling
  - Temperature Measurement / Mapping
  - Pro/Cons of material delivery methods
  - Material delivery coordination/synchronization
- Intelligent Compaction
  - Asphalt and base materials
  - Oscillation – What it is and when to use
  - Smart compaction systems
- Future technologies
  - The path to Autonomy



# TECHNOLOGY

## The age of smart iron



LINK

## CAT LINK



CAT® CONNECT TECHNOLOGY





# LINK DELIVERS THE INSIGHT YOU WANT

*Cat Product LINK™ is a comprehensive remote monitoring and asset management solution, with remarkably intuitive web interfaces that transform data from a customer's entire fleet of equipment into the essential information required to boost productivity, reduce costs and manage risks.*

## ➤ Manage Equipment with Real-Time Data

- Equipment Data including machine hours, performance information and more.
- LINK technologies enabling you to monitor the health and status of your machines.

## ➤ Operators Work More Efficiently

- Operators immediate feedback about machine performance and job progress.
- Operators can monitor payloads, load counts, progress to grade and compaction.


## ➤ Track Job Progress, Production and Costs – without Guesswork

- VisionLink gives you timely, actionable information.
- Detailed information about each job, such as production totals, time, and job costs.



Search

Groups > Fleet > 11 Results

Fleet	Alerts	Health	Maint
Fleet Summary			
	Asset ID	S/N	Ma
	LOADER 3 C	AB410001	CA
	LOADER 2 SS	AC73001	CA
	TRACTOR 5	EF000432	CA
	LOADER 6	GW432	JCE
	LOADER 1 MT	LU000532	CA
	TRAILER 1	SY034550	CA
	LOADER 10 W	TP023498	CA
	MIXER 1	XQ000378	CA





## CAT PAYLOAD



CAT® CONNECT TECHNOLOGY



# PAYLOAD HELPS DELIVER VALUE

*Cat Production Measurement brings on-the-go weighing to the cab to help operators hit precise load targets and load trucks to optimum payload capacity - increasing the productivity of your entire fleet.*

## ➤ Work Productively

- Integrated into machine display; operator can easily view payload information and make final load adjustments before loading the truck.
- Tip Off allows operator to make final-pass estimated payload adjustments and quickly view adjusted weights in real time.

## ➤ Work Efficiently

- Fill trucks to capacity without overloading; increase payload potential; use fewer trucks to move more material.
- Live Weigh provides a quick, real time estimate of payload without swinging.

## ➤ Improve Operator Performance

- Operators at all experience levels work with confidence and perform at a higher level, producing consistent, accurate loading of materials.

## ➤ Manage Your Business

- Analyze load times, number of passes and daily payload to determine: operator productivity; jobsite changes to optimize efficiency; incentives to meet fuel burn and production targets.







## CAT GRADE



CAT® CONNECT TECHNOLOGY





# GRADE FOR EARTH MOVING

*Cat **GRADE Technologies** combine digital design data, in-cab guidance, and automatic controls to enhance **grading accuracy** brings cut and fill information into the cab to help operators hit elevation and location - **increasing the productivity** of your entire fleet.*



## ➤ Work Productively

- Integrated into machine; operator can easily view grade information on the display, grade control buttons built into joysticks, works with current machine integrated systems

## ➤ Improved Safety

- Removes grade checkers from the job site, out of harms way, improved visibility, theft prevention improved, reduces need to remove components at night

## ➤ Improve Operator Performance

- Operators at all experience levels work with confidence and perform at a higher level, producing consistent, more accurate grades

## ➤ Increase Profitability

- Move more material in fewer trips correctly once, save time, fuel and labor costs; reduce machine wear, minimize sites costs

## ➤ Improved Reliability

- Move components to protected locations, fewer parts, standard design/installation reduces downtime.



# GRADE FOR PAVEMENT

*Cat **GRADE Technologies** combine easy to use controls with precision to enhance milling accuracy enabling the ultimate **smoothness and uniformity** to the asphalt paving process.*

## ➤ High Accuracy

- Easily performs the work to specifications consistently.

## ➤ Application Flexibility

- Modular grade inputs based on application
  - Sonic sensors, 3D, contact sensors, beams, inboard contact ski's
  - Coming soon Thermal Mapping on asphalt pavers

## ➤ Improve Operator Performance

- Ease of operation with clear feedback on actual grade performance

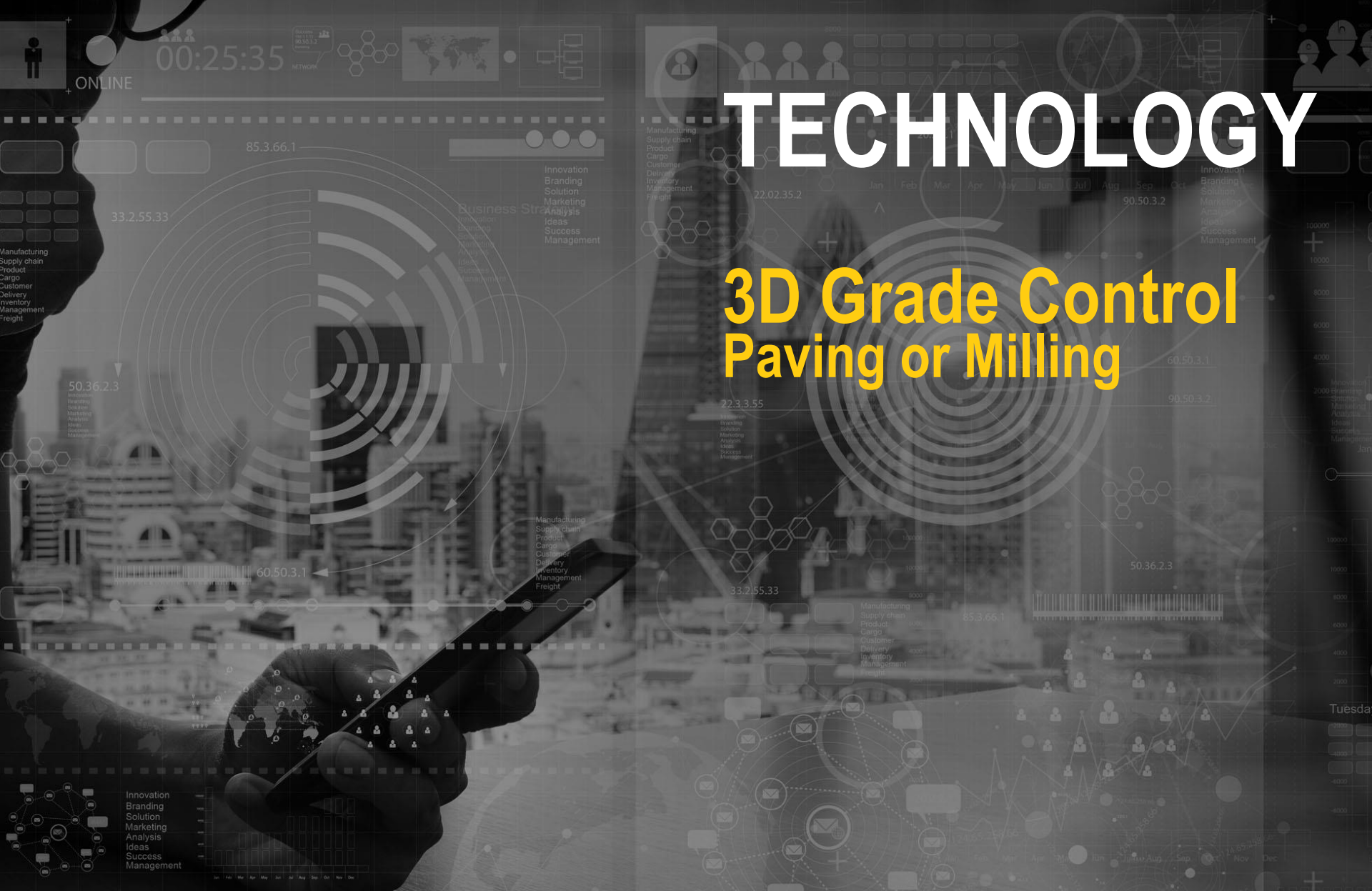
## ➤ Advanced features

- Cold planer ramp in/out and jump hold features for added application efficiency/productivity
- Asphalt Paver auto material loading

## ➤ Optimize Your Business

- Increased efficiency, Improved smoothness, 3D as-built designs





# TECHNOLOGY

## 3D Grade Control Paving or Milling



# WHAT ARE THE STAKEHOLDER GOALS?

## Owner

- Road quality (smoothness, road lifetime, minimal thickness of layers) at minimal cost

## Main Contractor Paving Contractor

- Minimize material usage
- Meet smoothness and minimal thickness specs
- Meet completion deadline

## Milling Contractor

- Often paid by square meter/yard and then wants productivity
- Meet completion deadline

# ADVANTAGE OF 3D MILLING

- Only mill where needed – Increased production
  - Higher productivity is less Milling cost
- Increased Smoothness – custom mill pattern
  - Remove longitudinal road waves and longitudinal high and low spots
    - No stakes required!
- Variable depth and slope milling enables milling of:
  - Transitions
  - Super-elevated curves
  - Variable drainage slopes
  - Removal of longitudinal waves in the road

# PAVING 2D OR 3D TERMINOLOGY

- 2D Paving – guidance to grade (elevation-thickness) and/or slope
  - 2D is from the ground-up
  - 2D Systems typically place a constant thickness over the base
  
- 3D Paving – guidance to grade and slope at a known position using a design/model
  - 3D is from a Design-down
    - Does not use the existing surface for guidance



# ADVANTAGE OF 3D PAVING



- Achieve the highest accuracy and smoothness levels
  - Better material management/yields
- Eliminate the string lines:
  - Reduce staking labor, downtime and errors
  - Reduce costly rework
  - Finish the project faster
- Pave complex designs





## CAT DETECT

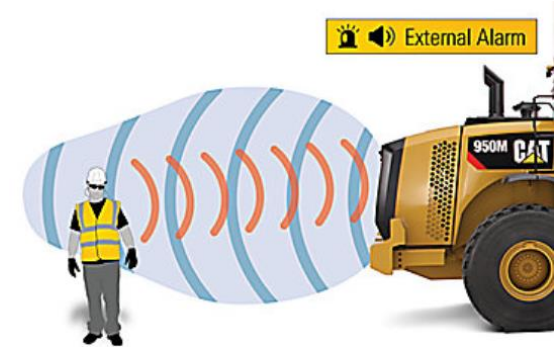


CAT® CONNECT TECHNOLOGY



# DETECT DELIVERS SAFETY

*Cat DETECT technologies combine safety and monitoring systems to enhance operator awareness. By expanding your view of the working environment around your equipment, you can keep your people and assets safe.*



## ➤ Safely Home. Everyone. Every Day. <sup>TM</sup>

### ➤ Work Safely

- Vest or Hard hat RFID alerts driver to presence.
- Integrated machine job site cameras output to an operator's display make job sites safer.

### ➤ Work Efficiently

- Live camera views increase efficiency while keeping all personnel safe.

### ➤ Improve Operator Performance

- Operators at all experience levels work with confidence and perform at a higher level, producing consistent, safely loaded trucks.





# TECHNOLOGY

## Asphalt Paving Temperature Measurement / Mapping

# PAVING TECHNOLOGY

## ASPHALT PAVERS



**Machine Telematics**



**Asphalt Thermal Mapping**

**Eco Mode**

**Integrated 2D Grade Control  
3D ready**

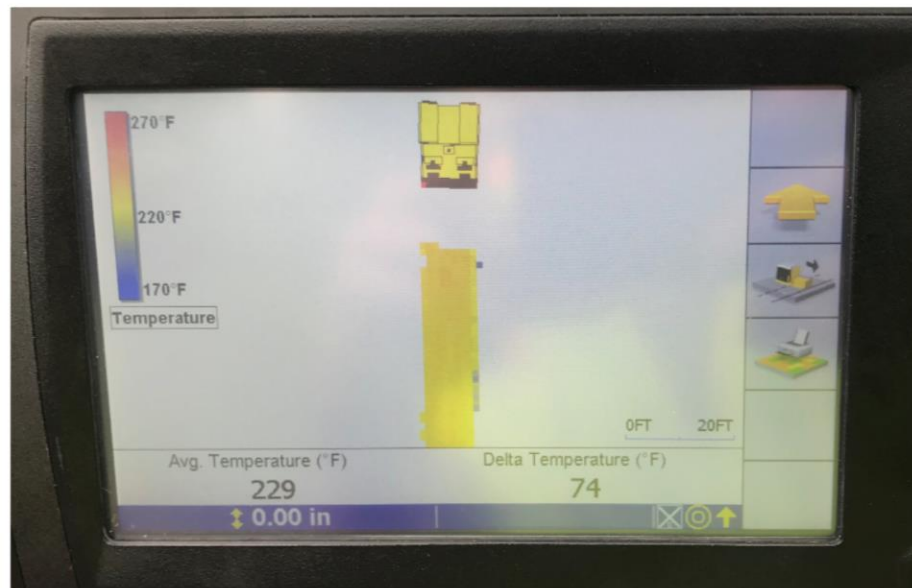
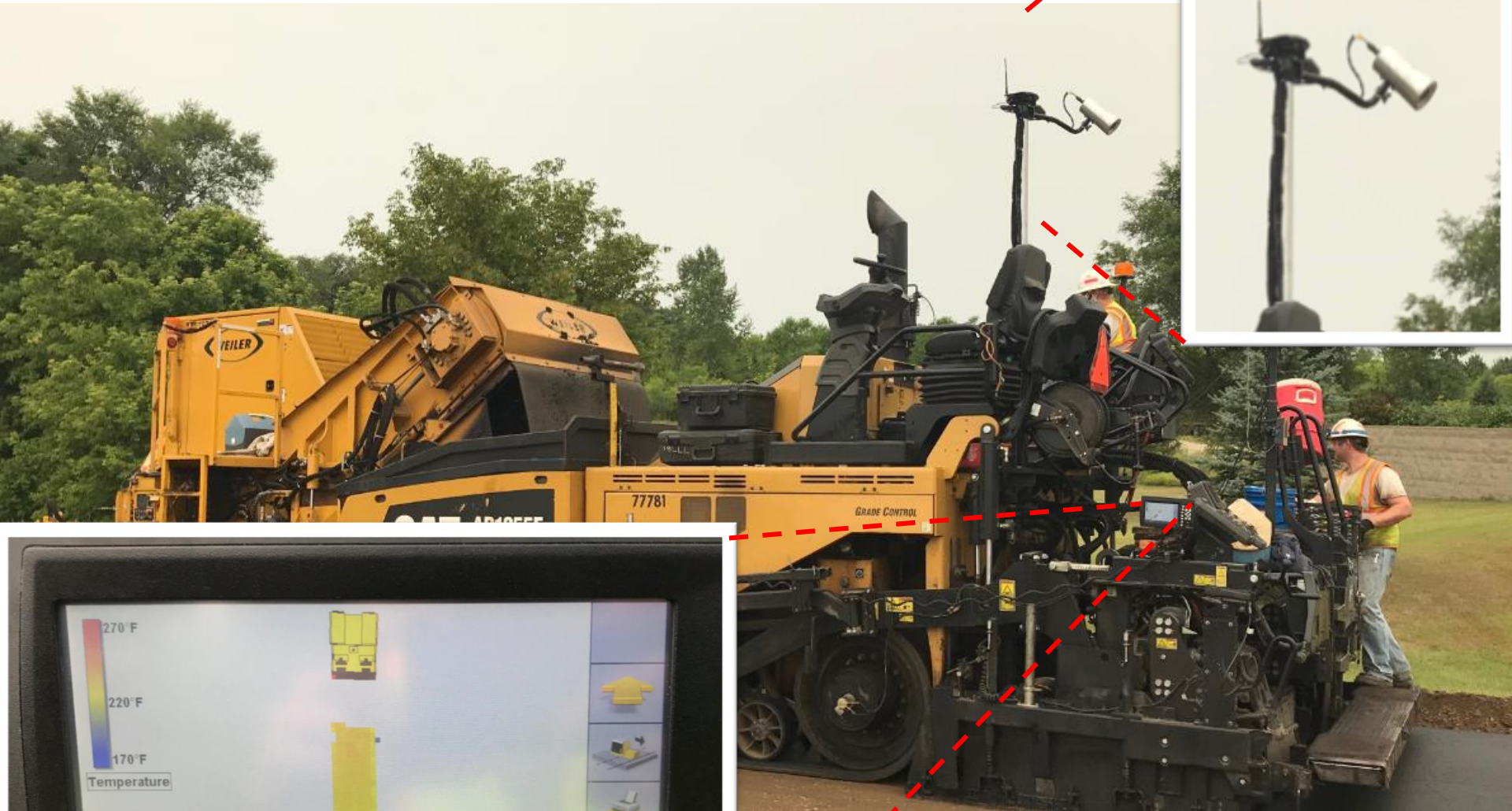


**Integrated Electric Generator  
w/Diagnostic Capability**

**Auto-fill Feeder System**

# PAVING TECHNOLOGY

## THERMAL MAPPING





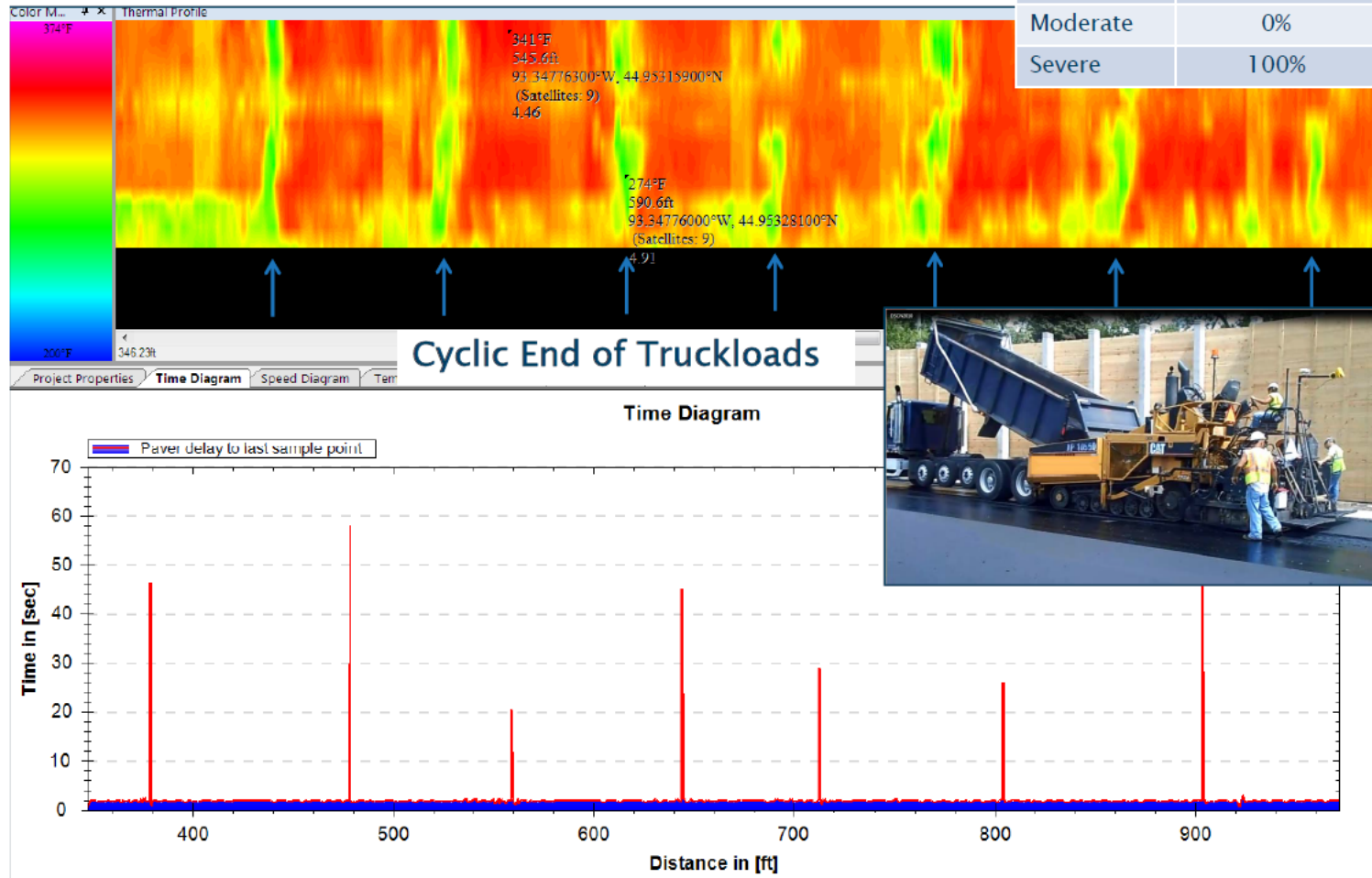
# VALUE OF TEMPERATURE MAPPING

Courtesy of MN DOT

## Thermal Segregation – End Dump

Project C

Thermal Segregation Category	Percent of Sublots
Low	0%
Moderate	0%
Severe	100%



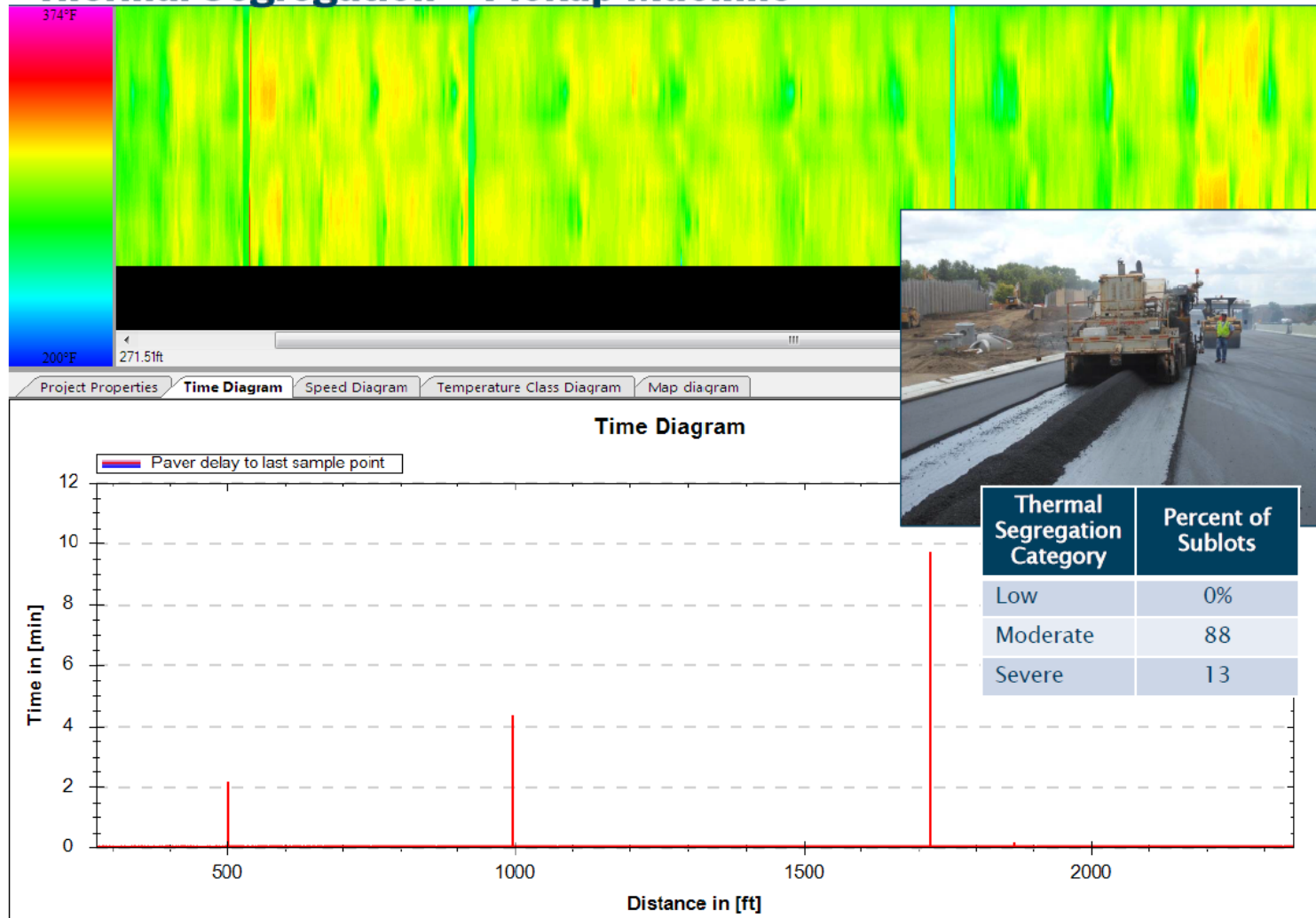


# VALUE OF TEMPERATURE MAPPING

Courtesy of MN DOT

Project C (Cont.)

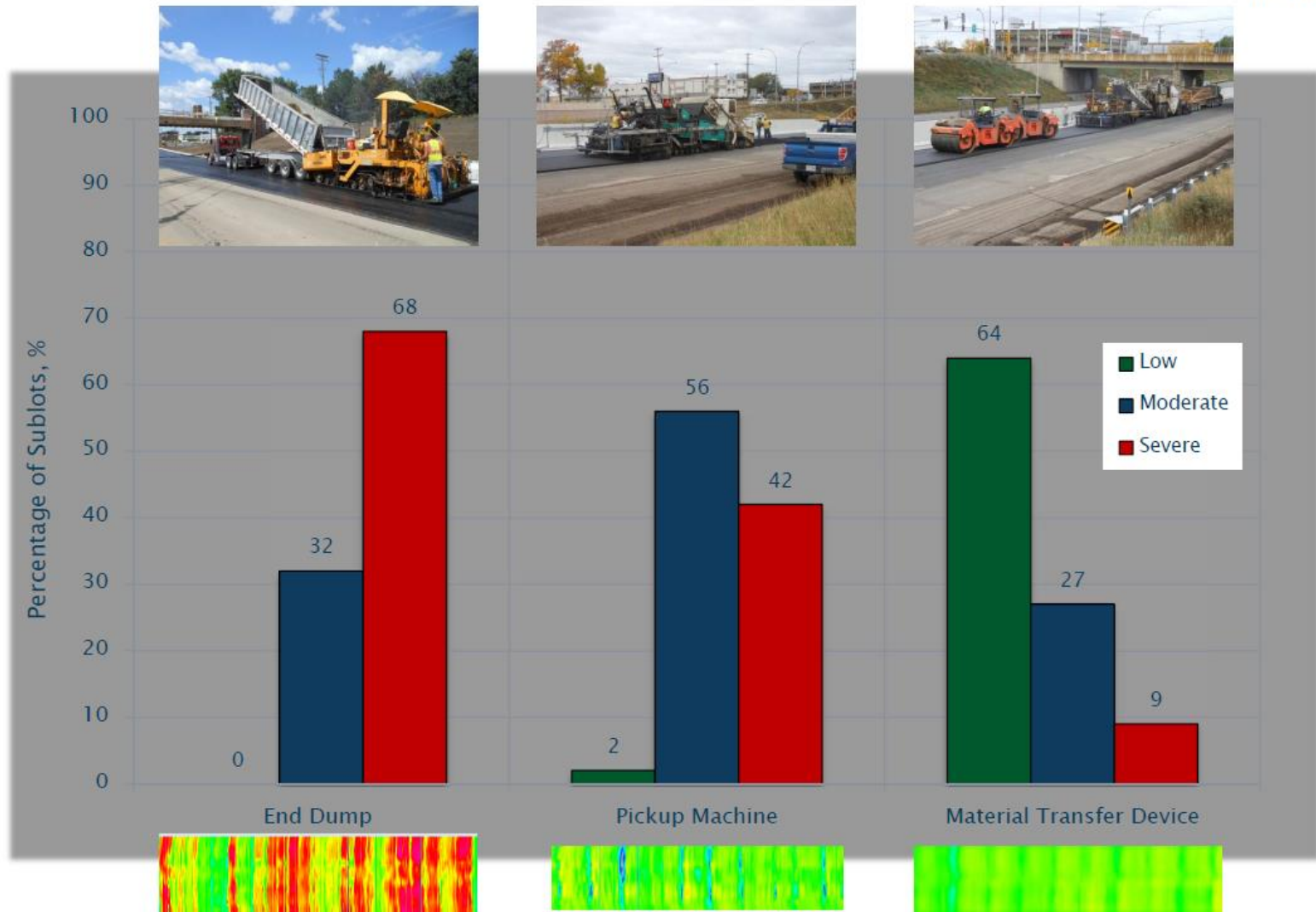
## Thermal Segregation – Pickup Machine



# VALUE OF TEMPERATURE MAPPING

*Courtesy of MN DOT*

Project D



# TECHNOLOGY

## Material Delivery Coordinated and Synchronized

# ENABLING THE PAVING ECOSYSTEM

*Information In The Hands Of Those Who Need It Most*

## **Timing By Truck And Job**

- *Cycle Times*
- *Waiting Times By Job, Truck*

## **Timing By Truck And Job**

- *Cycle Times*
- *Waiting Times Per Job, Truck*

## **Trucking**

- *Hauler/Driver Performance*

## **Production (Tonnage)**

- *Produced*
- *Loaded*
- *In-Transit*
- *Paved*

## **Reports**

- *By Truck/Job*

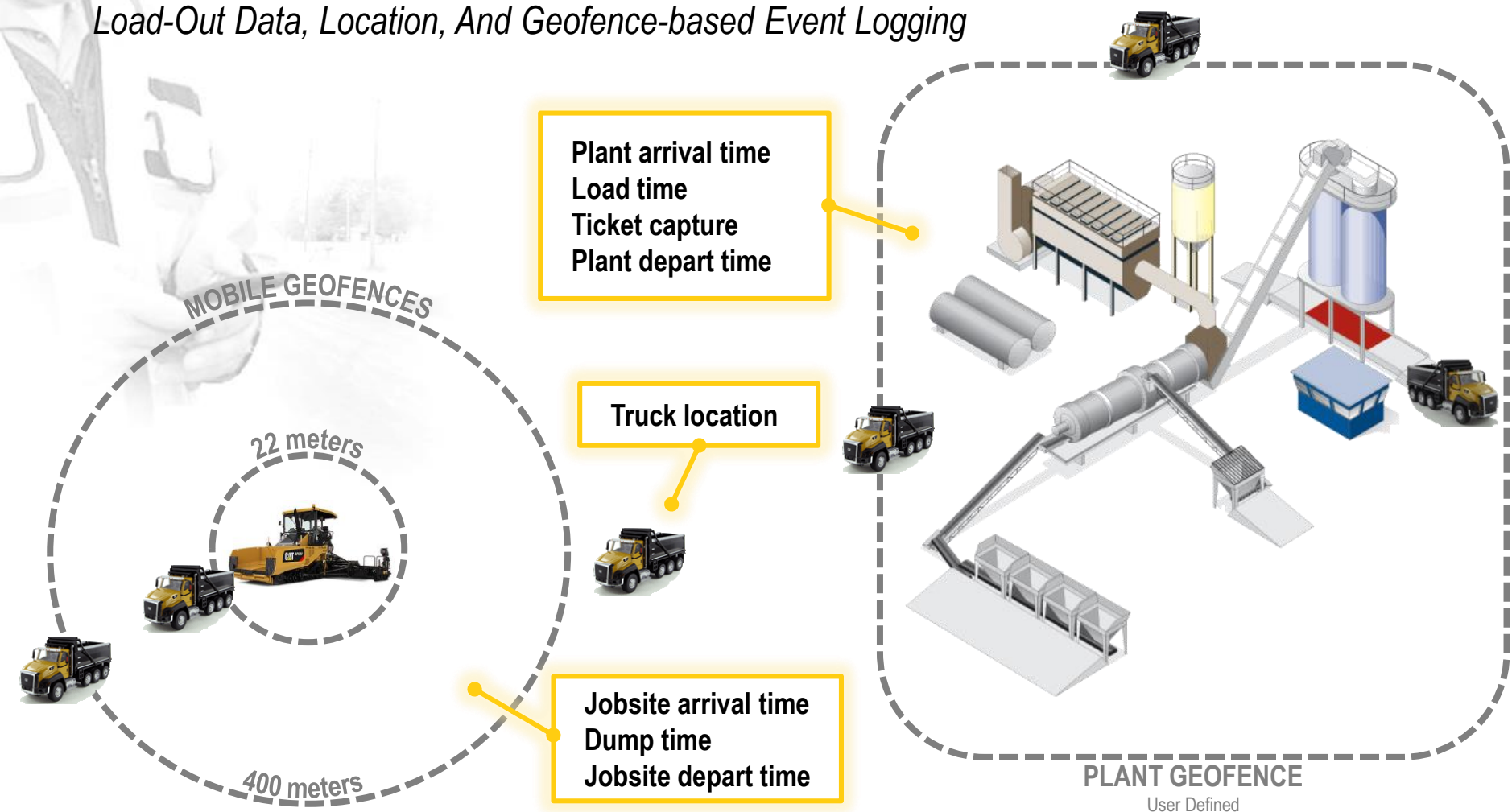
## **Archived Data**

- *For Future Estimating/Bidding*



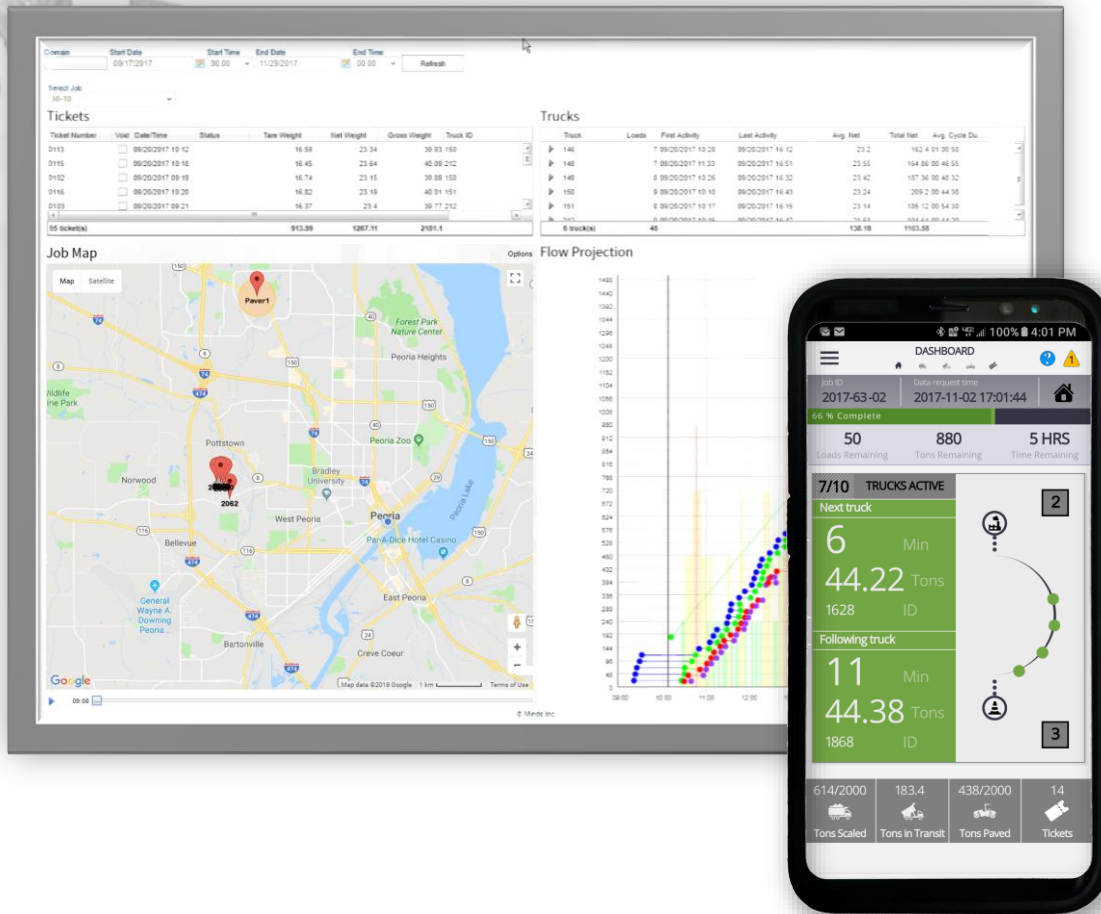
# HOW IT WORKS

*Load-Out Data, Location, And Geofence-based Event Logging*



# CREATING VISIBILITY TO THE PAVING PROCESS

*..... And The Opportunity To Influence It*



***Mobile & Web-based applications intended for management and/or paving crews that offers ....***

***.... Real-time production & delivery data throughout the paving process***

# TECHNOLOGY

## Intelligent Compaction





## CAT COMPACT



CAT® CONNECT TECHNOLOGY



# COMPACT HELPS DELIVER VALUE

*Cat® COMPACT technologies combine advanced compaction measurement, in-cab guidance and reporting capabilities to help you consistently meet compaction targets faster, more uniformly, and in fewer passes—saving on fuel and reducing rework and material costs in both soil and asphalt applications.*

## ➤ Uniformity + Confidence = Quality

- Empowers operators with documentation of the work completed.

## ➤ Measure

- Measurement for base compaction; CMV and/or MDP
- Measurement for asphalt compaction; CMV and/or Temperature

## ➤ Document – GNSS Mapping

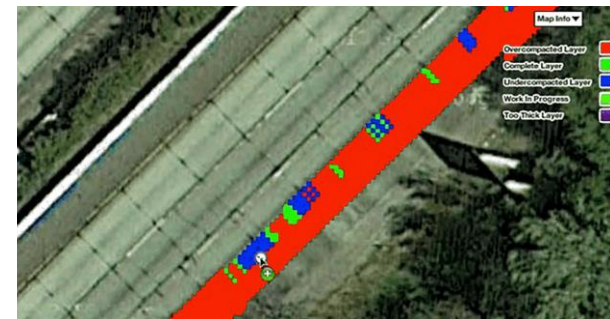
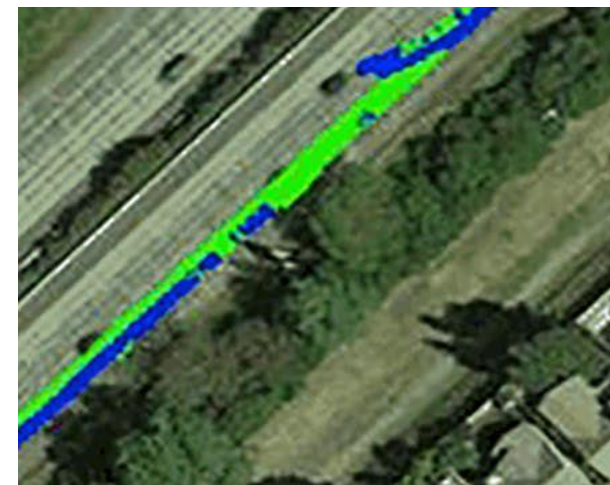
- Measurement types and Pass Count connected to machine position

## ➤ Analyze

- Meet target pass count
- Compaction performed at a temperature where compaction can be achieved.
- CMV – indicates where vibratory system was used and where it is not used.

## ➤ Make every pass count

- Increased efficiency and Improved layer smoothness
- Documentation of compaction process ensures uniformity



# PAVING TECHNOLOGY

## ASPHALT COMPACTION



Machine Telematics

Cat Compaction Control  
GPS Temperature, Pass Count  
and Compaction Mapping



Compactor to Compactor  
Data Communication



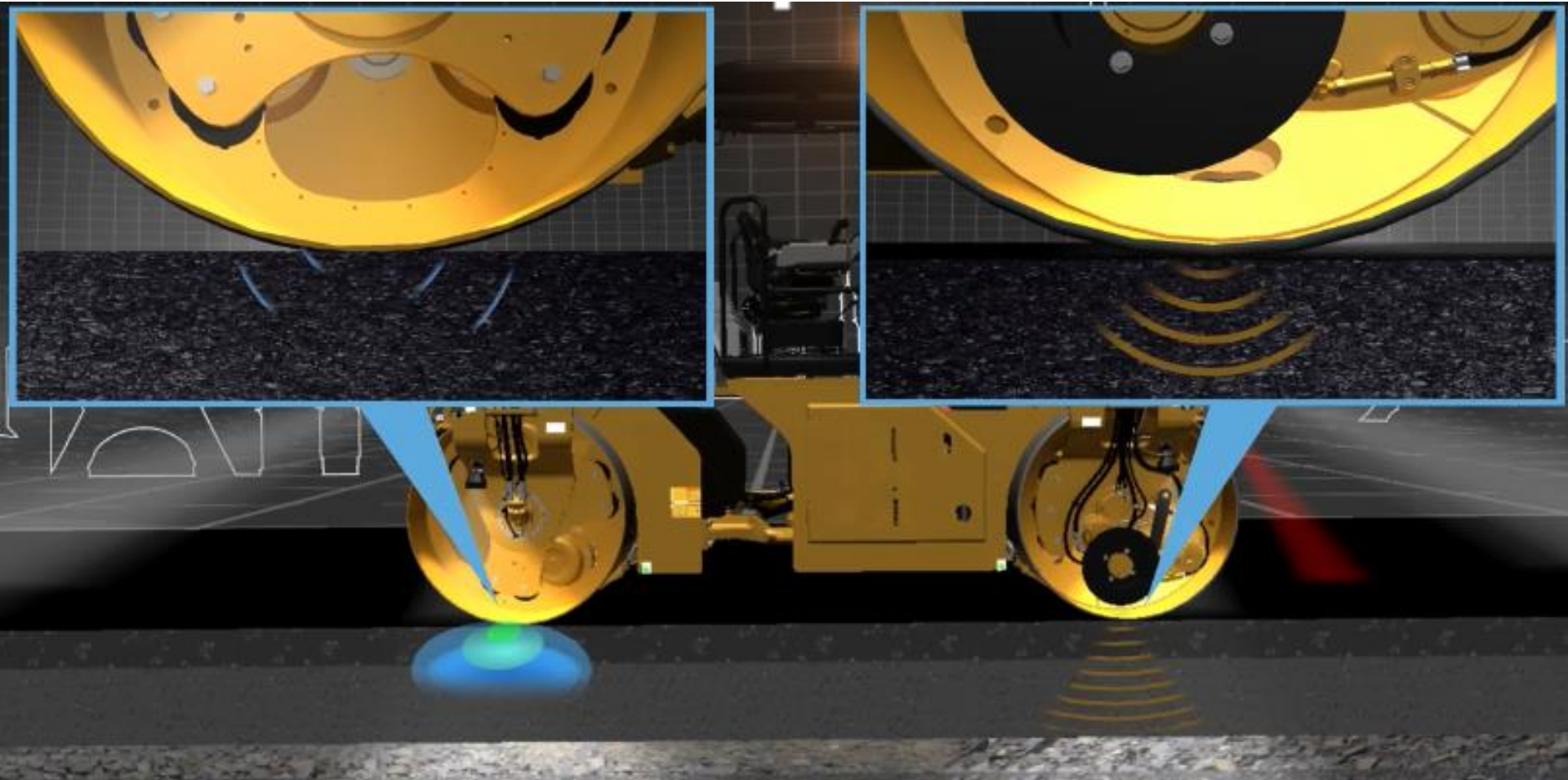
Oscillation Compaction

Automatic Adjustable Compaction



# COMPACTION TECHNOLOGY

## OSCILLATION COMPACTION



# COMPACTION TECHNOLOGY

## OSCILLATION APPLICATION

### ■ Primarily application uses

- On thin asphalt layers – less than 2" ( 5 cm )
- Compaction of materials with sensitive substructure or buildings
  - Next to buildings, on bridge decks or overpasses
  - Urban city vibration sensitive areas
- Joint compaction
  - Longitudinal joints – prevents damage to existing pavements while pressing the joint between lanes tightly
  - Transverse joints – massaging action creates tight joint

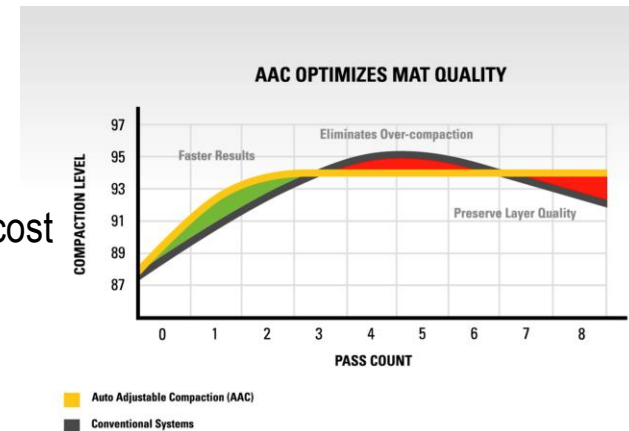
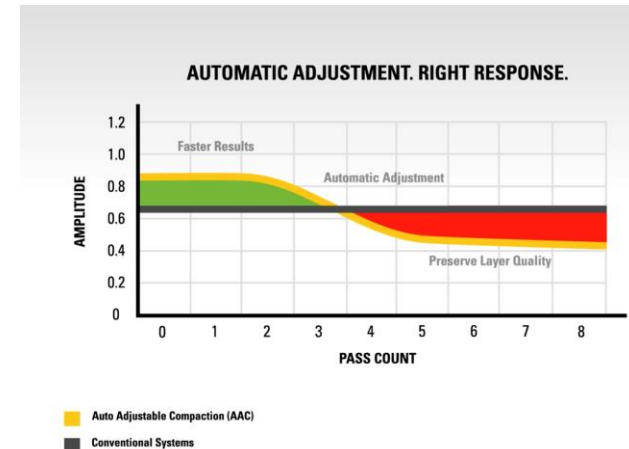
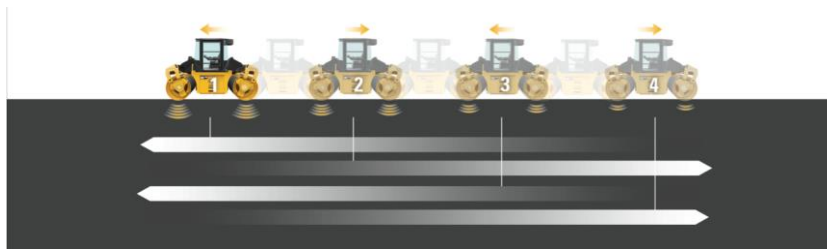
### ■ Intermediate or finish rolling position

- Highly recommend the use of conventional vibration in the breakdown compaction position.
- Oscillation should be used in the intermediate or finish rolling positions.
- Machine speed should not exceed 12-14 impacts/foot
  - High Frequency speed limits 210 - 250 feet/min ( 3.8 - 4.5 k/h )
  - Low Frequency speed limits 140 - 170 feet/min ( 2.5 – 3.1 k/h )

# COMPACTION TECHNOLOGY

## AUTOMATIC ADJUSTABLE COMPACTION

- Operational Simplicity - Automatic control
  - Ensures the amplitude is optimized
  - Easy to use for all operators – Simple operation
  - Operators see the system value immediately
  - Ensures inexperienced operators do not damage the asphalt.
- Increased Productivity - Do More
  - Intelligent compaction next to sensitive structures
  - The system prevents decoupling / damage to asphalt
  - Sensitivity customized for different bitumen stiffness.
- Quality Compaction
  - Homogeneous, uniform compaction creates compaction with less cost
  - Reduced risk of over-compaction





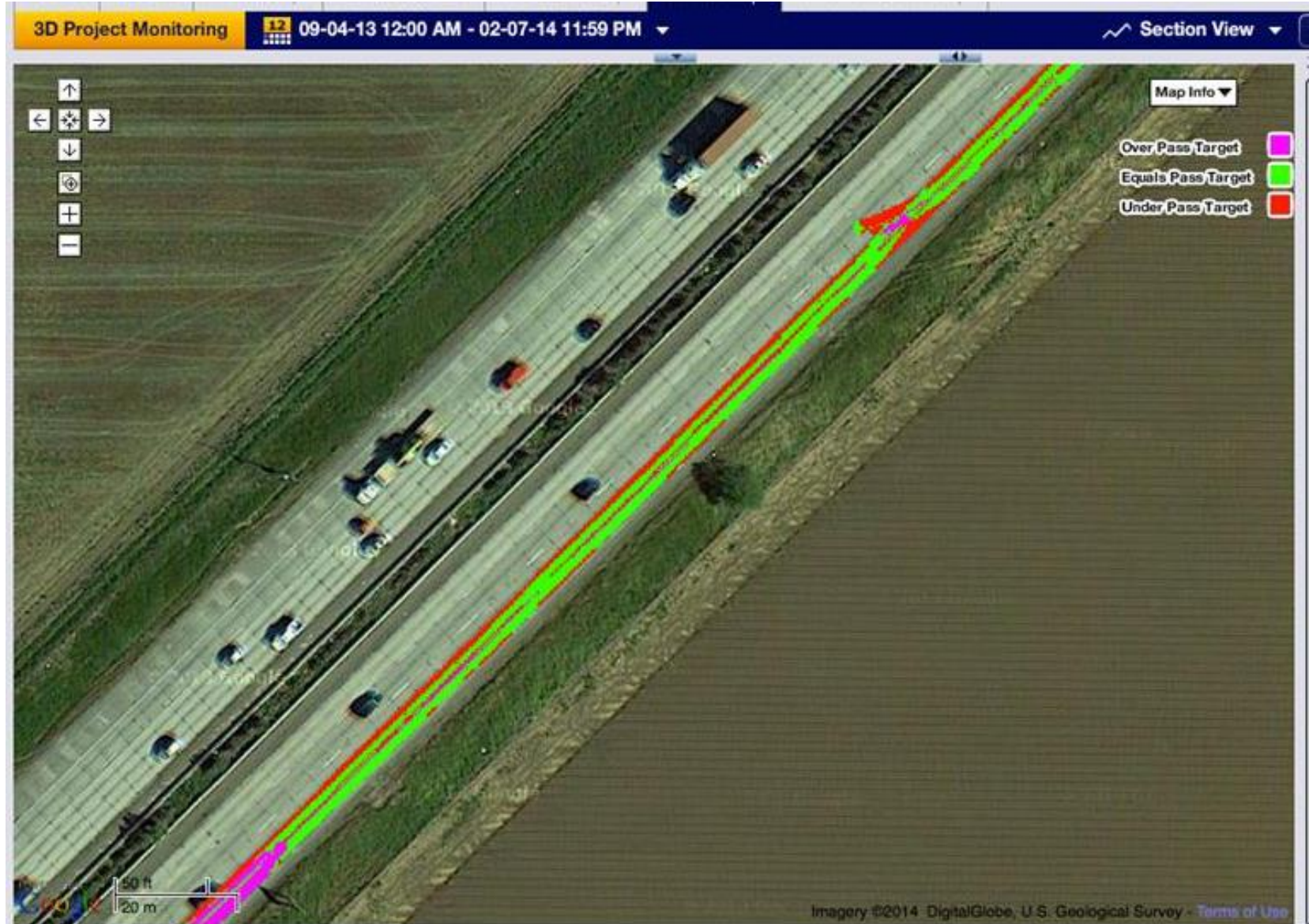
# VALUE OF ROLLER MAPPING – INTELLIGENT COMPACTION

## *Rolling Pattern Analysis*



# VALUE OF ROLLER MAPPING – INTELLIGENT COMPACTION

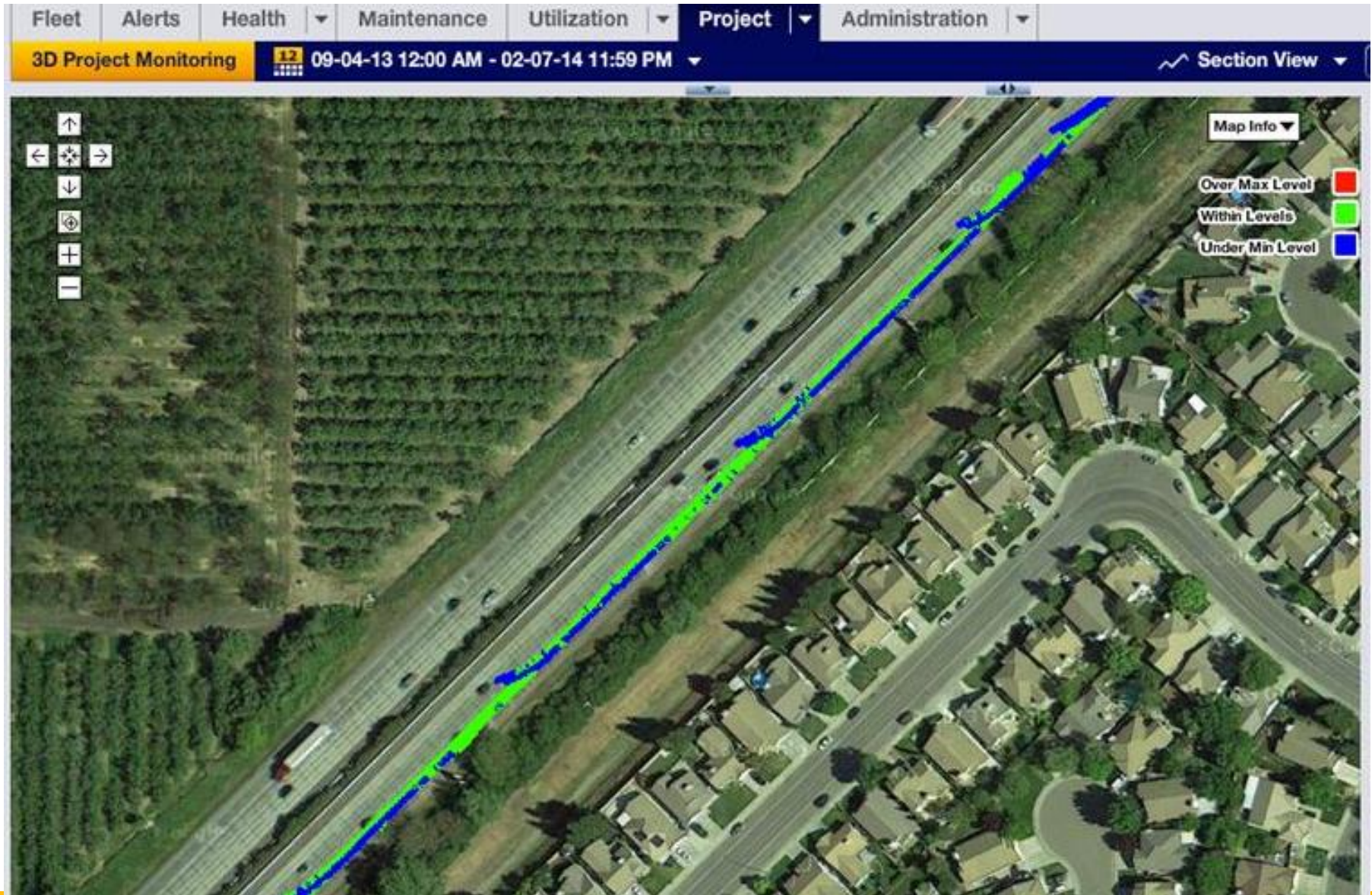
## *Rolling Pattern Analysis*





# VALUE OF ROLLER MAPPING – INTELLIGENT COMPACTION

*Temperature Variation*



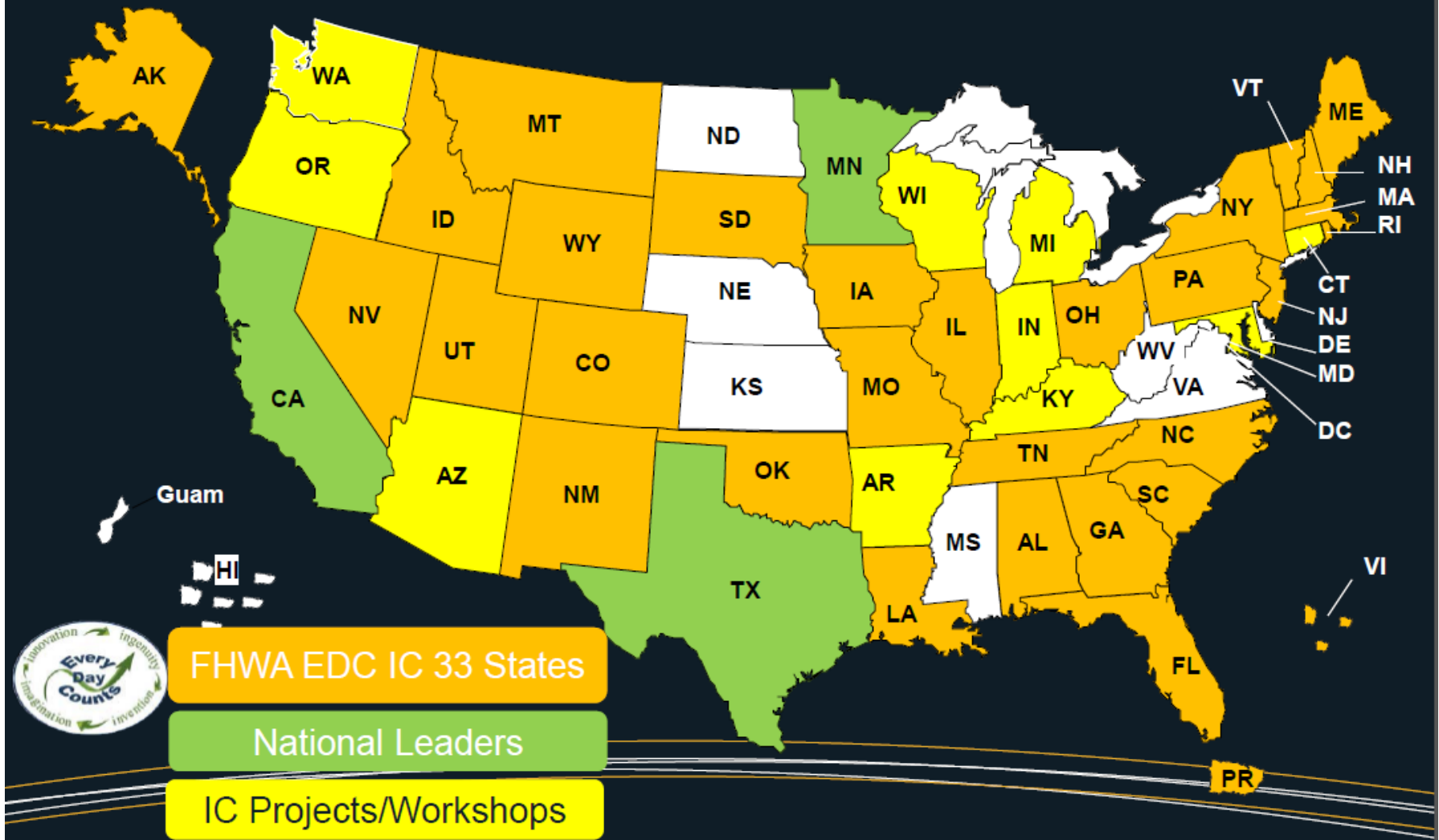


# VALUE OF ROLLER MAPPING – INTELLIGENT COMPACTION

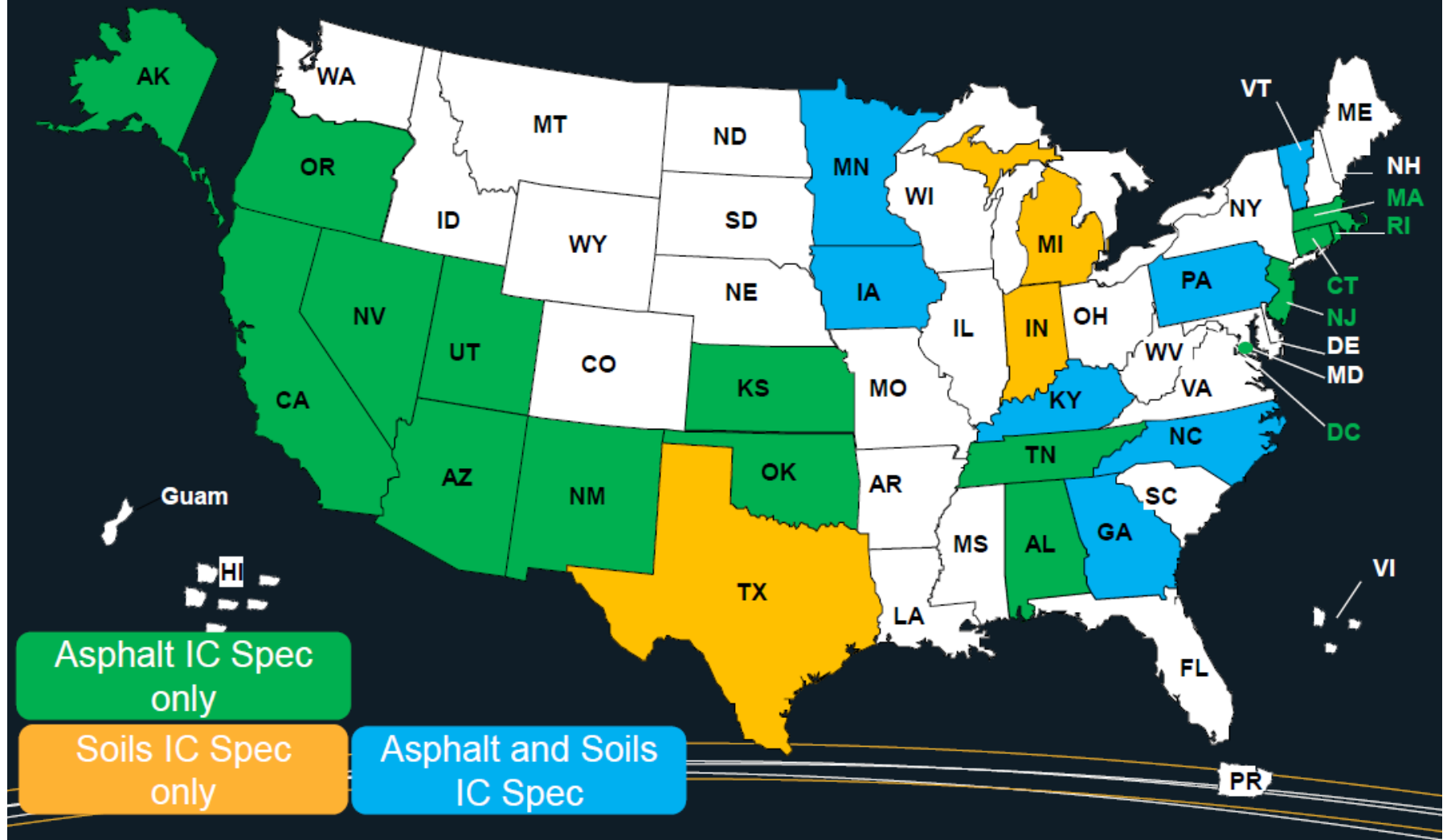
## CMV Analysis



# IC National Deployment



# State DOT IC Spec







# TECHNOLOGY

## Future Development

# ROAD TO AUTONOMY



CELLULAR



SATELLITE



WI-FI



BLUETOOTH



CONVENTIONAL  
CONSTRUCTION



## 1. AUTOMATION

OPERATING OR CONTROLLING A PROCESS BY  
HIGHLY INDEPENDENT MEANS, REDUCING  
HUMAN INTERVENTION AT THE SITE LEVEL



## 2. SEMI-AUTONOMY

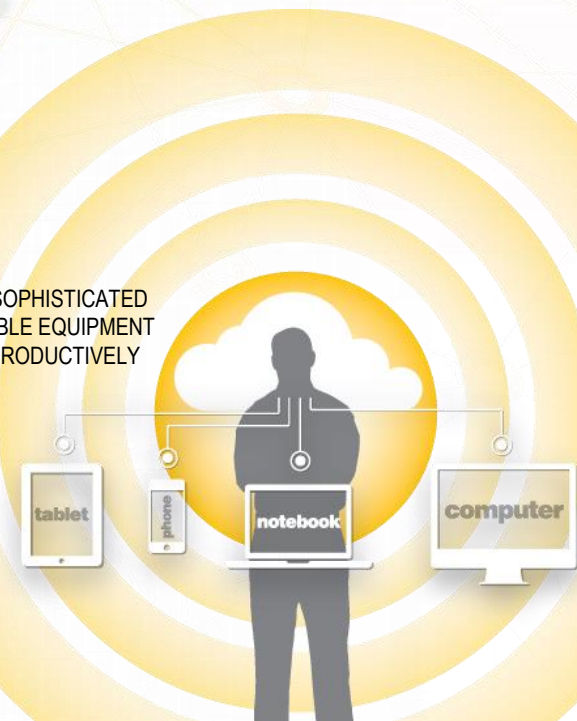
REMOTE CONTROL OF EQUIPMENT AND OPERATIONS  
FROM AN OFFICE OR OFF-SITE LOCATION



## 3. AUTONOMY

TAKES ADVANTAGE OF SOPHISTICATED  
TECHNOLOGIES TO ENABLE EQUIPMENT  
TO WORK SAFELY AND PRODUCTIVELY  
WITH MINIMAL INPUT

JOBSITE  
OF THE  
FUTURE



CATERPILLAR®



Thank you for your business and for building great infrastructure that enables a better life for all.

**RIGHT THERE WITH YOU**

**Thompson CAT**

**SITECH**

**QUESTIONS OR COMMENTS?**