

Intelligent Compaction overview

IDAHO ASPHALT CONFERENCE
October 23rd 2014
Caterpillar Paving Territory Manager
Steven Ryan



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Asphalt IC roller

Equipped with a video display box that is capable of continuously recording, storing, and wirelessly transmitting data while displaying 4 color-coded maps in real time:

1. Roller position, number of roller passes & total coverage area
 2. Mat temperature
 3. Compaction Meter Value (CMV)
 4. Percent change in CMV between passes
- Other machine operating parameters such as speed, direction of travel, frequency and amplitude settings, are displayed and recorded
 - VisionLink web-based software is used for viewing and analyzing data

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CAT IC roller hardware



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IC roller



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Equipment required

1. Positioning system

- GPS – global positioning system (RTK or SBAS)
- UTS – universal total station - Good for obstructed views
- VRS – virtual reference station - No base stations
- IBSS – internet based satellite system – Uses internet to extend coverage

2. Asphalt roller with color-coded display, temp sensors, accelerometer, positioning system antenna/radios

3. Office software

- VisionLink (Caterpillar/Trimble) – web-based with subscription
- VEDA-compatible (data must be imported to VEDA)

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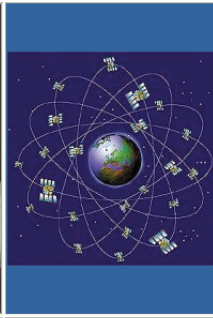
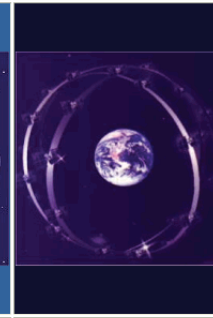
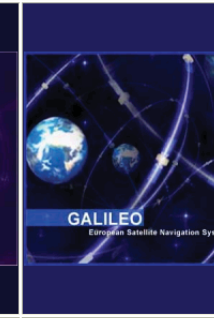
Introduction to GNSS



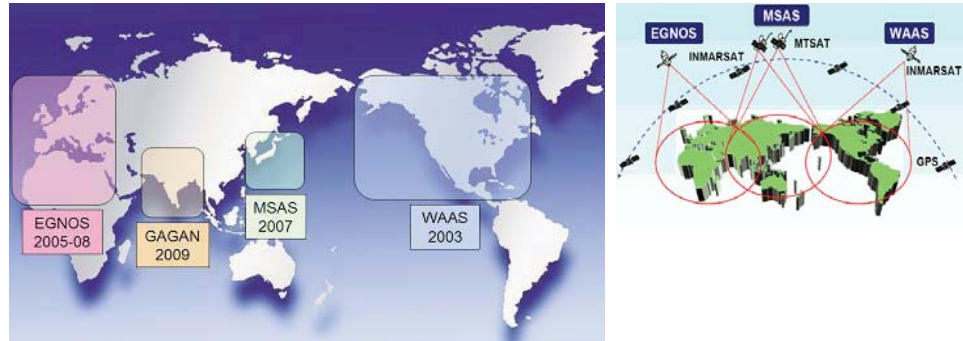
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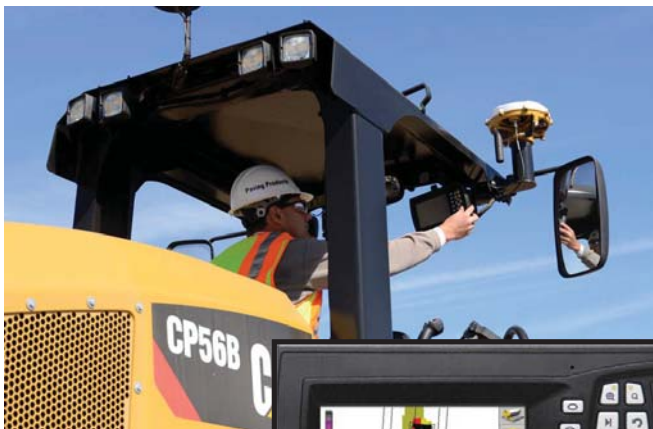
Navigation Systems

System	GPS	GLONASS	GALILEO
			
Owner	USA	RUSSIA	UE

Augmentation Systems- SBAS

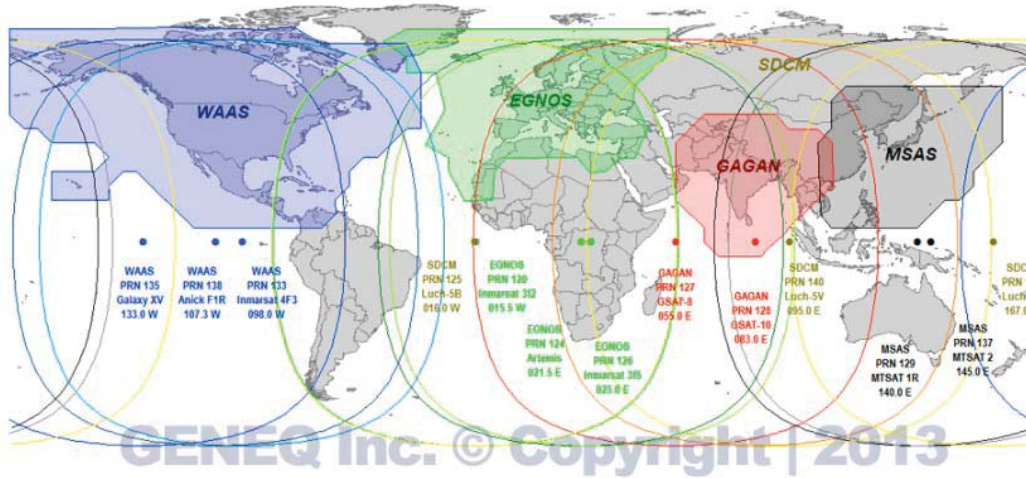


Positioning: GPS



- Utilizes US Global Positioning System
- Correlates all measurements to latitude/longitude
- Choice of position accuracy
 - RTK (1 to 3mm accuracy)
 - SBAS (1 to 3m accuracy)

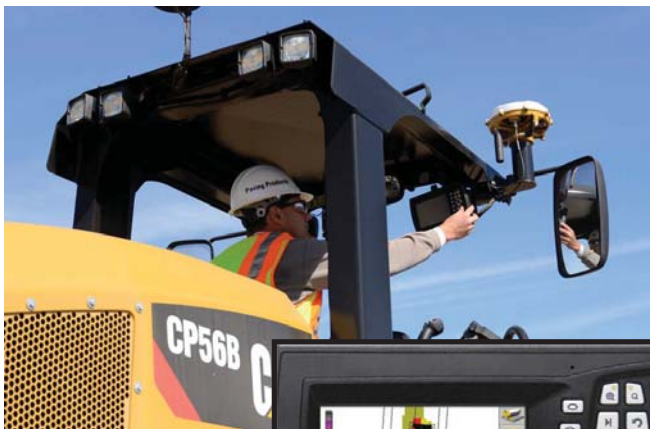
Satellite-Based Augmentation Systems



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Positioning: Universal Total Station



- Reads directly via laser
- Correlates all measurements to a location
- 1 to 3mm accuracy



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Universal Total Station



- Accurate to 3mm



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Asphalt compactor



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Asphalt compactor

Intelligent Compaction on asphalt is currently used as a process control tool and is ***not a direct measure of compaction***.

1. Count and record the number of passes over the entire job
2. Measure and record the temperature of the mat
3. Measure and record a Compaction Meter Value (CMV) which is an accelerometer-based Integrated Compaction Measurement Value (ICMV)

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Operator display



- Real-time pass-count
- Real-time mat temperature
- Real-time location information
- Operator can determine when to begin rolling and when to end, based on mat temperature and CMV value
- Visible and audible warnings alert the operator if the asphalt temperature exceeds or falls below the target temperature

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Data collection



- Position
- Pass count/coverage
- Compaction Meter Value (CMV)
- Vibration on/off
- Frequency
- Amplitude
- Roller speed
- Direction (forward/reverse)



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In-field reporting: Printer option



```
CB54XW_ILM00885_CompactorReport_2014...
AccuGrade In-Field Report
=====
Machine : CB54XW_3LPM0005
Start Time : 12:59:19
Start Date : 2014/08/26
End Time : 14:02:23
End Date : 2014/08/26
Duration : 1:02 Minutes
Site Design : CAT Day 23
UTM Zone :
Start Station :
End Station :
Total Area Covered : 10543.7 FT²
Layer : 13

Target Lift Thickness: 8.888 FT
Average Lift Thickness:
Max. Lift Thickness:
Min. Lift Thickness:
Over Lift Ratio (%): 0%

Target Pass Count: 3
Average Pass Count: 3.2

Pass Count Percentages:
<= 1 Passes: 11%
= 2 Passes: 10%
= 3 Passes: 11%
> 3 Passes: 68%

Target CMV: 30
Average CMV: 42.6
CMV Percentages:
< 41: 0%
41- 43: 0%
43- 45: 1%
45- 47: 1%
47- 49: 1%
49- 51: 96%

Minimum Temperature: 90°F
Maximum Temperature: 262°F
Average Temperature: 203°F
Temperature Percentages:
< 100°F: 10%
100-240°F: 73%
> 240°F: 17%

Wet Areas:
Low CMV Areas: (<10.0 FT²)
None.

Low Temp. Areas: (<=100°F, 10.0 FT²)
None.

Low Pass Count Areas: (<=1, 10.0 FT²)
None.

Approval:
-----
```

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Accelerometer – front drum only

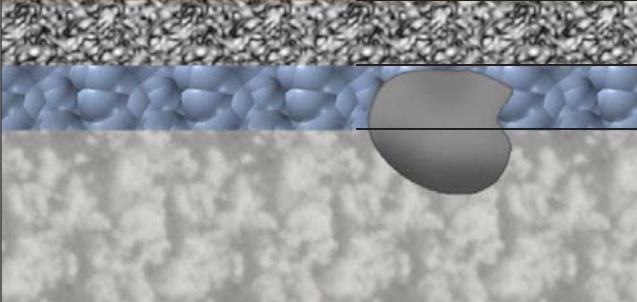


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Accelerometer based technology measures deeper than the freshly laid lift of asphalt.

CMV value is a **composite of the current lift and the layers below it.**



Current Mat being compacted

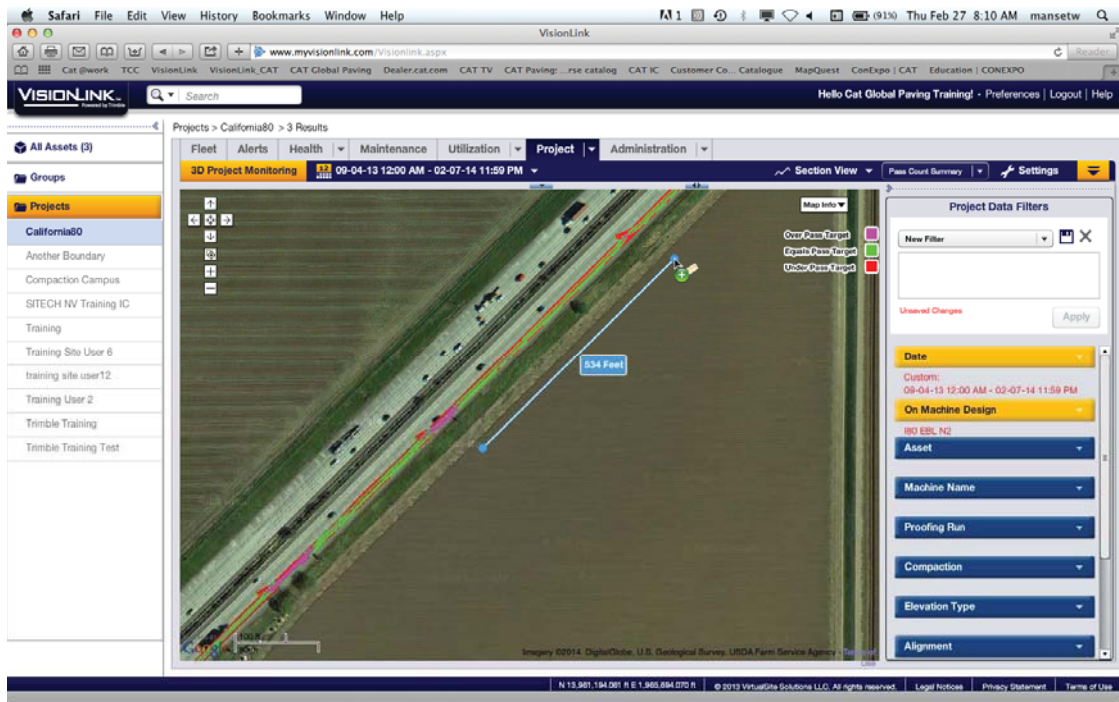
Previous HMA layer

Sub-base layer

Portland cement slab/embankment material, etc.

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Satellite map view of pass count



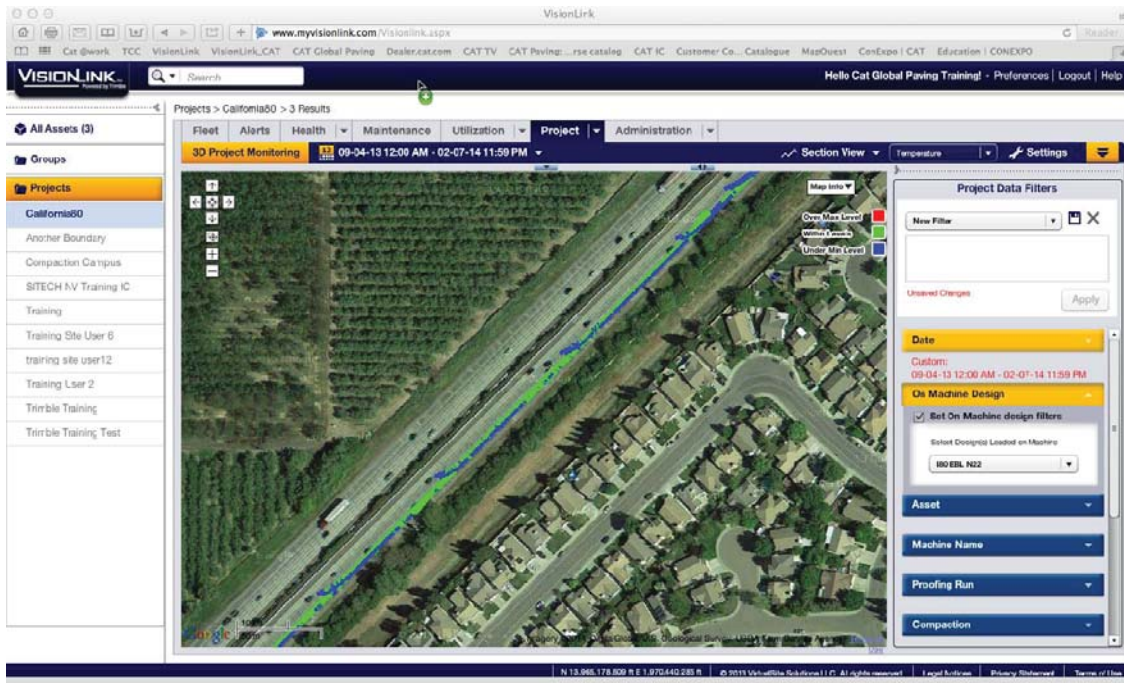
Pass count map



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Satellite map view of temperature



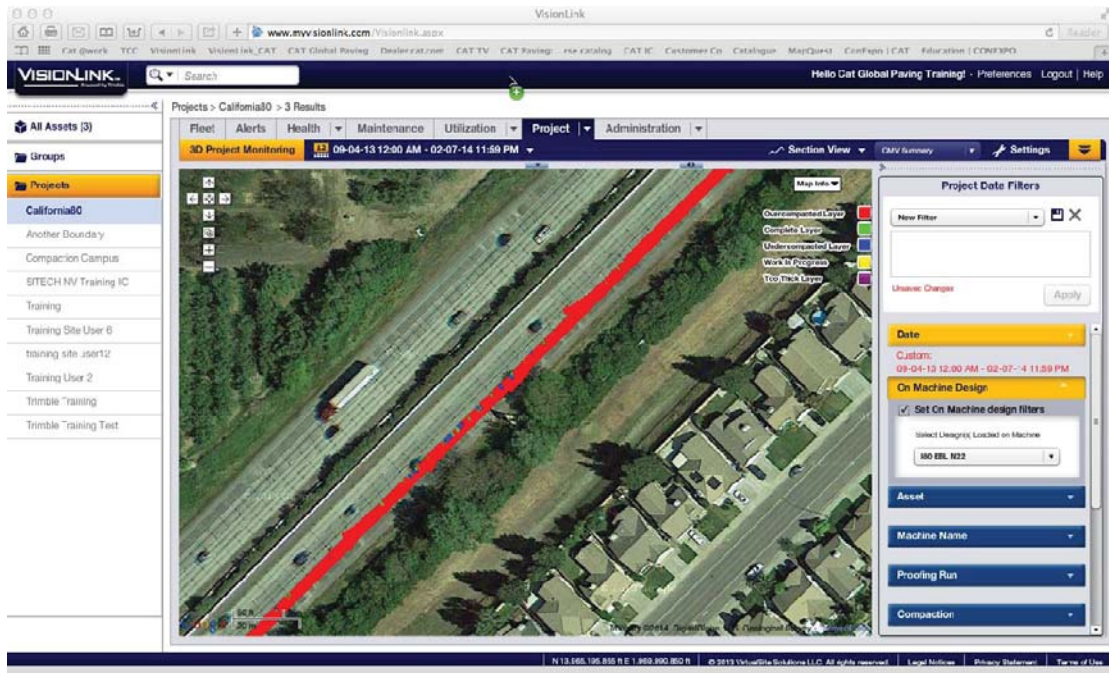
Temperature map



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Satellite map view of CMV



CMV map



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What are the benefits of IC?

- **Increased Operator Awareness**
 - Real-time compaction, temperature, pass count data providing the operator the ability to make changes in real-time while asphalt is hot
- **Improved Density & Smoothness (asphalt)**
 - improved uniformity of compaction
- **Night-time operation (asphalt)**
 - coverage on back pass
- **Lower Operating Costs**
 - Optimized pass coverage, better efficiency
- **Documentation**
 - Quality control and post-process data analysis
 - View opportunities for improvement



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Data Management

What do we do with all the valuable data that we have created and collected?



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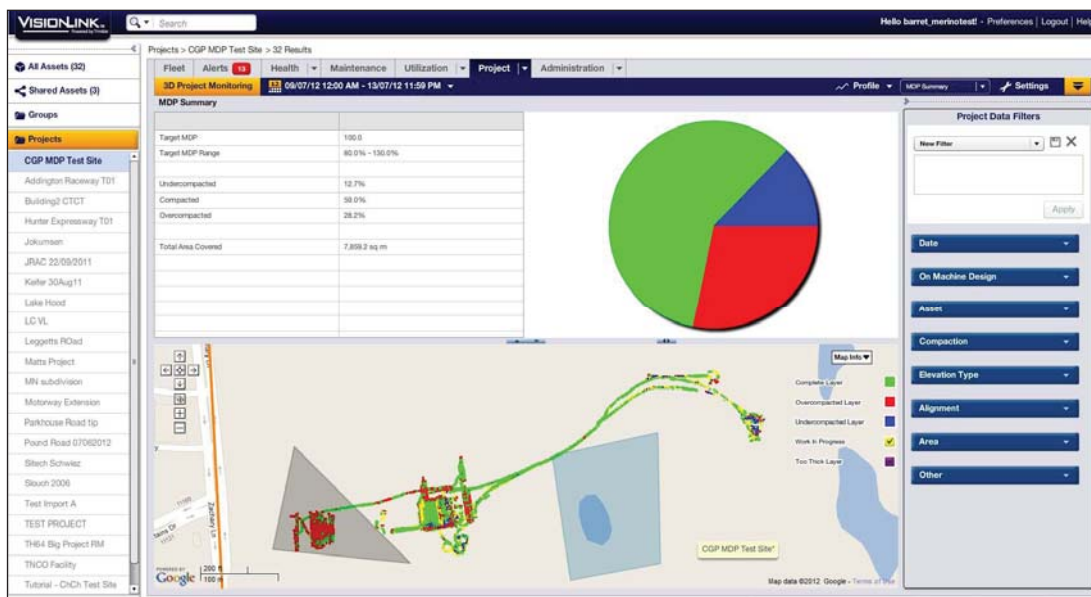
VisionLink Software

- Compaction module called “3D Project Monitoring”
- Internet-based software program
- Data can be uploaded wirelessly from machine or via USB drive
- Must have a paid subscription and user-account and register each machine
- Login at www.myvisionlink.com

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Data: VisionLink



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Data: VisionLink

Data can be exported in *.csv (MS Excel) format

#	*ATime	CEIN	CEIE	PassCount	LastMod	DesignName	Machine	Speed	LastGPSMod	GPSAccTot	TargPassCts	TotalPasses	Layers	LastCMV	TargCMV	LastMOP	TargMOP	LastRVR	LastReq
1	2013/Aug/08	14153748.34	1029921.853	1	0	080813TEST1	6.54E+14	2.8mph	RTX	Fixed	Medium (D.1)	3	1	1	7	35	7	50	7
2	2013/Aug/08	14153748.34	1029921.853	1	0	080813TEST1	6.54E+14	1.8mph	RTX	Fixed	Medium (D.1)	3	1	1	7	35	7	50	7
3	2013/Aug/08	14153750.56	1029921.853	1	0	080813TEST1	6.54E+14	1.3mph	RTX	Fixed	Medium (D.1)	3	1	1	7	35	7	50	7
4	2013/Aug/08	14153751.77	1029921.853	1	0	080813TEST1	6.54E+14	1.9mph	RTX	Fixed	Medium (D.1)	3	1	1	7	35	7	50	7
5	2013/Aug/08	14153752.97	1029921.853	1	0	080813TEST1	6.54E+14	2.2mph	RTX	Fixed	Medium (D.1)	3	1	1	7	35	7	50	7
6	2013/Aug/08	14153753.17	1029921.853	1	0	080813TEST1	6.54E+14	1.9mph	RTX	Fixed	Medium (D.1)	3	1	1	7	35	7	50	7
7	2013/Aug/08	14153754.38	1029921.853	1	0	080813TEST1	6.54E+14	1.8mph	RTX	Fixed	Medium (D.1)	3	1	1	7	35	7	50	7
8	2013/Aug/08	14153755.58	1029921.853	1	0	080813TEST1	6.54E+14	2.1mph	RTX	Fixed	Medium (D.1)	3	1	1	7	35	7	50	7
9	2013/Aug/08	14153756.79	1029921.853	1	0	080813TEST1	6.54E+14	1.7mph	RTX	Fixed	Medium (D.1)	3	1	1	7	35	7	50	7
10	2013/Aug/08	14153757.99	1029921.853	1	0	080813TEST1	6.54E+14	1.8mph	RTX	Fixed	Medium (D.1)	3	1	1	7	35	7	50	7
11	2013/Aug/08	14153759.20	1029921.853	1	0	080813TEST1	6.54E+14	2.1mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
12	2013/Aug/08	14153760.40	1029921.853	2	0	080813TEST1	6.54E+14	2.3mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
13	2013/Aug/08	14153761.61	1029921.853	2	0	080813TEST1	6.54E+14	2.0mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
14	2013/Aug/08	14153762.81	1029921.853	2	0	080813TEST1	6.54E+14	1.9mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
15	2013/Aug/08	14153764.02	1029921.853	2	0	080813TEST1	6.54E+14	2.0mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
16	2013/Aug/08	14153765.22	1029921.853	2	0	080813TEST1	6.54E+14	2.3mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
17	2013/Aug/08	14153766.43	1029921.853	2	0	080813TEST1	6.54E+14	2.1mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
18	2013/Aug/08	14153767.63	1029921.853	2	0	080813TEST1	6.54E+14	2.1mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
19	2013/Aug/08	14153768.84	1029921.853	2	0	080813TEST1	6.54E+14	2.2mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
20	2013/Aug/08	14153770.04	1029921.853	2	0	080813TEST1	6.54E+14	2.0mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
21	2013/Aug/08	14153771.25	1029921.853	2	0	080813TEST1	6.54E+14	2.3mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
22	2013/Aug/08	14153772.45	1029921.853	2	0	080813TEST1	6.54E+14	2.1mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
23	2013/Aug/08	14153773.65	1029921.853	2	0	080813TEST1	6.54E+14	2.1mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
24	2013/Aug/08	14153774.86	1029921.853	2	0	080813TEST1	6.54E+14	1.9mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
25	2013/Aug/08	14153776.06	1029921.853	2	0	080813TEST1	6.54E+14	1.9mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
26	2013/Aug/08	14153777.27	1029921.853	2	0	080813TEST1	6.54E+14	1.9mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
27	2013/Aug/08	14153778.47	1029921.853	2	0	080813TEST1	6.54E+14	1.9mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
28	2013/Aug/08	14153779.68	1029921.853	2	0	080813TEST1	6.54E+14	1.9mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
29	2013/Aug/08	14153780.88	1029921.853	2	0	080813TEST1	6.54E+14	1.9mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
30	2013/Aug/08	14153782.09	1029921.853	2	0	080813TEST1	6.54E+14	2.1mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
31	2013/Aug/08	14153783.29	1029921.853	2	0	080813TEST1	6.54E+14	2.3mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
32	2013/Aug/08	14153784.50	1029921.853	2	0	080813TEST1	6.54E+14	2.1mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
33	2013/Aug/08	14153785.70	1029921.853	2	0	080813TEST1	6.54E+14	2.0mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
34	2013/Aug/08	14153786.91	1029921.853	2	0	080813TEST1	6.54E+14	2.3mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
35	2013/Aug/08	14153788.11	1029921.853	2	0	080813TEST1	6.54E+14	2.0mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
36	2013/Aug/08	14153789.32	1029921.853	2	0	080813TEST1	6.54E+14	2.0mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
37	2013/Aug/08	14153790.52	1029921.853	2	0	080813TEST1	6.54E+14	2.0mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
38	2013/Aug/08	14153791.73	1029921.853	2	0	080813TEST1	6.54E+14	1.9mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
39	2013/Aug/08	14153792.93	1029921.853	2	0	080813TEST1	6.54E+14	1.9mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7
40	2013/Aug/08	14153794.14	1029921.853	2	0	080813TEST1	6.54E+14	1.9mph	RTX	Fixed	Medium (D.1)	3	2	1	7	35	7	50	7



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toddmansell

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One-Stop Shop for Intelligent Compaction (IC)

IC is an EDC 2 Innovation


The Federal Highway Administration (FHWA) has rolled out a second wave of innovations for its **Every Day Counts (EDC) initiative**, an effort focused on shortening the time needed to complete highway projects through the use of new technologies and innovative processes. Intelligent Compaction (IC) is among the 13 innovations to state, local, and regional transportation agencies, as well as to the design and construction industries. IC was also featured at the FHWA Center for Accelerated Innovation booth during the TRB annual meeting in January, 2013. Check out the **IC flyer with Veda-IC workshop information** and the **IC presentation** during EDC 2 Summits.

Manage IC Data with Veda

Veda 1.0 has been released! Data management is critical when implementing **intelligent compaction (IC)**. The data collected by IC is new to most people and tends to be large in size and complex in nature. The free **Veda data management tool** is the solution: Veda is powerful enough to manage data collected from any IC-capable system. Veda analyzes the data and then displays the compaction information in easy-to-read formats. Take a quick look at how Veda can help **improve pavement performance** and save you money and time! Check out the **ICDM-Veda workshop brochure and workshop schedule!**

Learn IC through Field Projects

Check out **IC field projects** around the US: view project information, YouTube videos, photos, reports, and more. Learn about how IC works in the real world!



March 2013

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Veda

ICDM-Veda Workshop at MnDOT

March 28, 2013 at 6:30 AM

MnDOT Training and Conference Center - Conference Rooms AH 6 and AH 7

MnDOT Training and

Online Training powered by Cvent

IC Summary

1. Intelligent Compaction (IC) provides benefits over traditional testing methods:
 - i. Increased operator awareness – “self training”
 - ii. Improved density & smoothness – real time actionable info
 - iii. Improved rolling pattern – real time
 - iv. Lower operating costs by more efficient rolling patterns
 - v. Documentation – for the Owner and the Contractor
2. IC includes:
 - i. Compactor integrated data measurement
 - ii. GPS positioning tied to collected data
 - iii. Ability to analyze & document data
3. IC on Soils is more a direct measure of compaction
4. IC on Asphalt is more process control at this point



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Thank you for your attention.
Discussion...
Questions??



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