

# Implementing IC On A Project

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APA of Indiana  
Winter Conference  
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Indianapolis IN



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Asphalt Institute  
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**INTELLIGENT COMPACTION** One-stop shop for IC

**Many Systems ...**

**VEDA - A STANDARDIZED IC TOOL**

**LEARN IC** **VEDA**

- FUNDAMENTALS
- DOCUMENTS AND RESOURCES
- WORKSHOPS
- NEWS

**IC Support** **Veda 2.1 Upgrade** **Learn IC in a Day**

View helpful info and contact us [intelligentcompaction.com/learn/](http://intelligentcompaction.com/learn/) Technical  
Download the latest version of Veda, the IC data management  
Attend an IC workshop and learn how to use IC to ensure

We're driv

# Discussion Items

- Training – IC Workshops
- Generic Specifications (Asphalt)
  - Downloading Specifications
  - Goals of Specifications
  - Components of Specifications
    - IC/GPS equipment requirements
    - QC Plan for using IC
    - Technical support/On-site training
- IC Data Management and Analysis (Veda software)



# FHWA IC Workshops

- Two different IC Workshops are now available free to agencies
  - IC Overview Workshop
    - Typically 4-5 hours
    - For agencies that want to learn more about IC
  - IC Data Management (ICDM) Workshop
    - One day workshop
    - For agencies that have upcoming IC projects
    - Hands on training with Veda software
    - Optional half-day equipment demo



# Requesting IC Workshops



- Agencies can request a free IC Workshop through their FHWA Division Office



# Specifications



# Specifications

- Generic Specifications are available for download by agencies on [www.intelligentcompaction.com](http://www.intelligentcompaction.com)
  - Generic IC Specification for Asphalt Materials
  - Generic IC Specification for Aggregate Base Materials
  - Generic IC Specifications for Soils
- Generally, specification recommend use of IC for quality control only (not acceptance)





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### Software Tool



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Specifications

View and download asphalt and  
soils IC specifications.

# Downloading The Specifications

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## INTELLIGENT COMPACTION

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## IC Specifications

### Projects

FHWA IC and In-Place  
HMA Density Projects

FHWA and TPF IC  
Projects

Other US State DOT  
and FLHD IC Projects

### IC Specifications

Asphalt IC Specifications

Soils IC Specifications

Since IC is equipment-based technology, new specifications must be developed in order to take full advantage of IC's benefits. These specifications must also be flexible enough to handle the varied capabilities of IC rollers and properties of compacted materials. Additionally, an IC roller is just one type of roller needed to compact road materials—this must also be addressed by compaction specifications.

[Asphalt Specifications →](#)

[Soils Specifications →](#)

IC Specifications



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# National and State IC Specs.

## United States National Guidelines

- [FHWA Generic Asphalt IC Specification](#) (2010-2013)
- AASHTO IC specification (for both soils and asphalt—2013 draft)

## United States DOT Specifications

- [Alaska DOT](#) (2013 Sitka airport project)
- California (2013)
- [CFL HD](#) (2012)
- [EFL HD](#) (2013)
- [Georgia DOT](#) (2012 special provision)
- [Iowa DOT](#) (2010-2013 special provision)
- [Minnesota DOT](#) (2007-2013)
- [Pennsylvania DOT](#) (2013 draft special provision)
- [Rhode Island DOT](#) (2013 draft)
- [Tennessee DOT](#) (2013)
- [Utah DOT](#) (2013 draft special provision)
- [Vermont Agency of Transportation](#) (2011 special provision)

# Goals of IC Specifications

- Use IC technology to obtain:
  - Contractor/vendors fully responsible
  - Improved compaction process
  - More comprehensive QC (process control)
  - Increased construction efficiency
  - Improved pavement performance
  - Long Term Goal: Develop a link to modulus based thickness design?



# Components of Specification

- Approval of IC Equipment
- Technical Support
- On-Site Training
- IC Data Requirements
- Quality Control Plan
- GPS/ Datum Requirements
- Test Sections and Target Values
- QC/QA for Production Areas
- IC Data Submittal
- Payment and Measurements



# IC Capabilities - Asphalt

- Vibratory roller equipped with IC technology that provides the following capabilities:
  - Real Time Kinematic (RTK) GPS
  - Color Coded Display in roller cab
  - Thermal Surface Temperature Readings (tandem drum only)
  - Continuous IC measurement value
  - Export of Data to Veda Software
    - Editing, viewing, analysis



# IC Capabilities - Asphalt

- FHWA Generic Specs. provide comprehensive approach using “full” IC
- Agency can specify which capabilities are required:
  - “Coverage”
    - Roller passes and surface temperature only
  - “Full IC”
    - Roller passes and surface temperature
    - Use of ICMV for QC/QA



# Approval of IC Equipment

- Continuous Measurement System
- RTK, high precision GPS
- Onboard documentation system
- Color coded display in roller cab
- Surface temperature measurement (asphalt only)
- Data exportable from vendors software to Veda software





# IC Roller Suppliers

Manufacturer	Bomag	Sakai	Wirtgen / Hamm
Measurement System (ICMV)	Vibration Modulus; $E_{vib}$	Compaction Control Value; CCV	Hamm Compaction Quality; HMQ
ICMV Unit	MN/m <sup>2</sup>	Unit less	Unit less
GPS?	Yes	Yes	Yes
Surface Temperature?	Yes	Yes	Yes



# Technical Support

- Technical support is essential to ensure success
- The Contractor will arrange for tech support
- Technical support provided by vendor
  - GPS
  - IC Roller/ IC Retrofit supplier
- Initial setup and until project is running smoothly; immediately available to address issues throughout project



# On-Site Training

- Practical training that includes instructions on “in the trenches” day to day operations is essential to ensure success
- Contractor is responsible for setting up
- Personnel to be trained:
  - Contractor’s IC Field Manager, Technician and roller operator’s
  - Agency personnel that will be involved with project oversight and inspection



# Minimum Training Topics

- Background information for the specific IC and GPS systems to be used
- Daily - Setup and checks for IC systems, GPS receiver, base-station and hand held rovers
- Daily - Operation of the IC system(s) on the roller; i.e.. setup data collection, start/stop of data recording and on-board display options
- Daily - Transferring raw IC data from the rollers); i.e., via USB (manual) or wireless (automatic) methods



# Minimum Training Topics

- Operation of vendor's software to open and view raw IC data files and exporting all-passes and proofing data files in Veda-compatible format
- Operation of Veda software to import the above exported all-passes and proofing data files, inspection of IC maps, input point test data, perform statistics analysis, and produce reports for project requirements
- Coverage and uniformity



# IC Quality Control Plan

- Contract-Specific IC Quality Control Plan (ICQCP)
- Submitted by Contractor
- Approval by DOT
- Implementation of ICQC Plan
  - IC QCP Field Manager
  - IC Quality Control Technician
  - IC Roller Operator





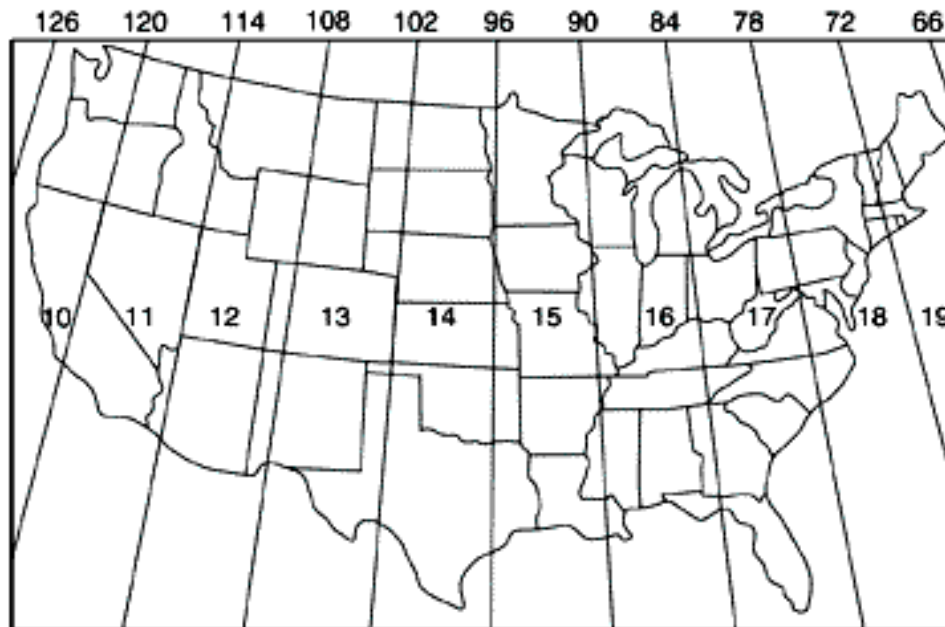
# IC QC Technician - Duties

- Daily setup, take down and secure storage of GPS and IC components
- Daily GPS validation (prior to paving)
- Daily download and analysis of IC data
- Quality Control testing (in situ point test)
- Oversight of test section construction
  - Optimum compaction pass count
  - ICMV target value



# GPS/Datum Requirements

- Datum Designation/Conversion
  - Sitka project -Alaska State Plane Zone 1
- GPS Checks



# GPS Setup and Checks

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Both roller and rover receiver  
tied into same base station



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# GPS Accuracy

- Prior to the beginning of production each day, verification that GPS precision meets specified limit
  - This step is needed to ensure that all GPS components are operating properly
  - Comparison of roller and rover locations for x and y coordinates (z is not needed)
    - Option #1: equal or less than 50 mm (2 inches)
    - Option #2: equal or less than 150 mm (6 inches)





# GPS Onsite Verification

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# Test Sections/Target Values

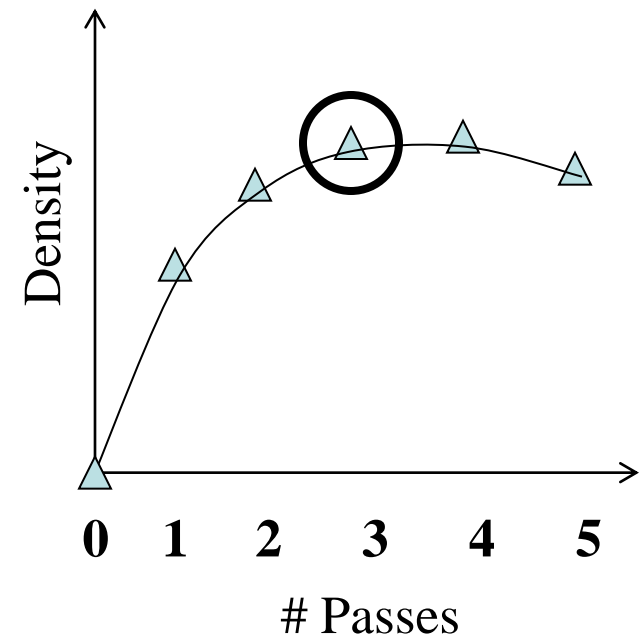
- Test Section performed on mainline location
- Dimension of test sections
  - Approx. 300 tons
- A separate evaluation for each lift
- Fixed settings and speed on IC roller
- Determination of optimum # of roller passes and ICMV target value



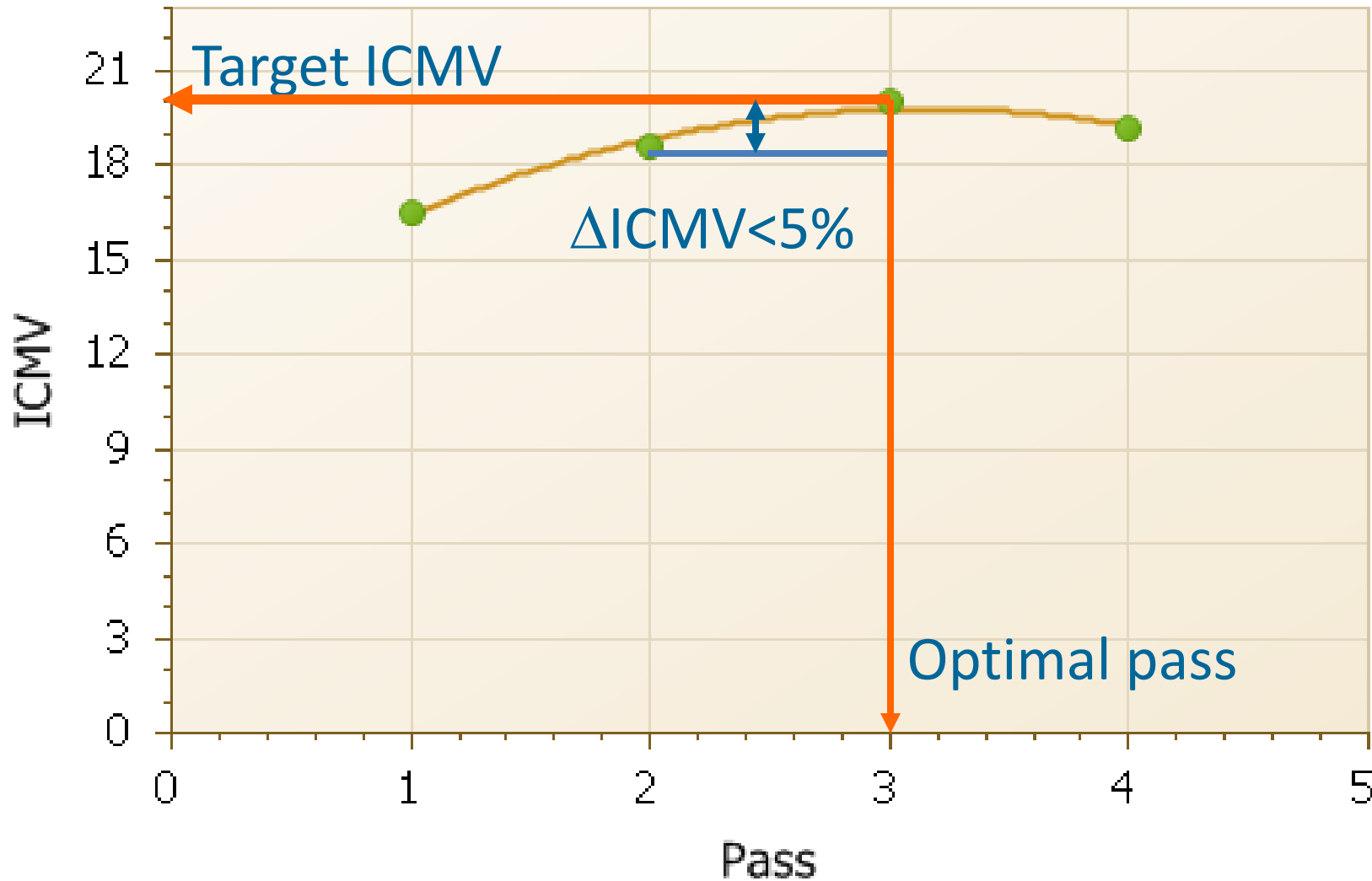


# Establishing Rolling Pattern

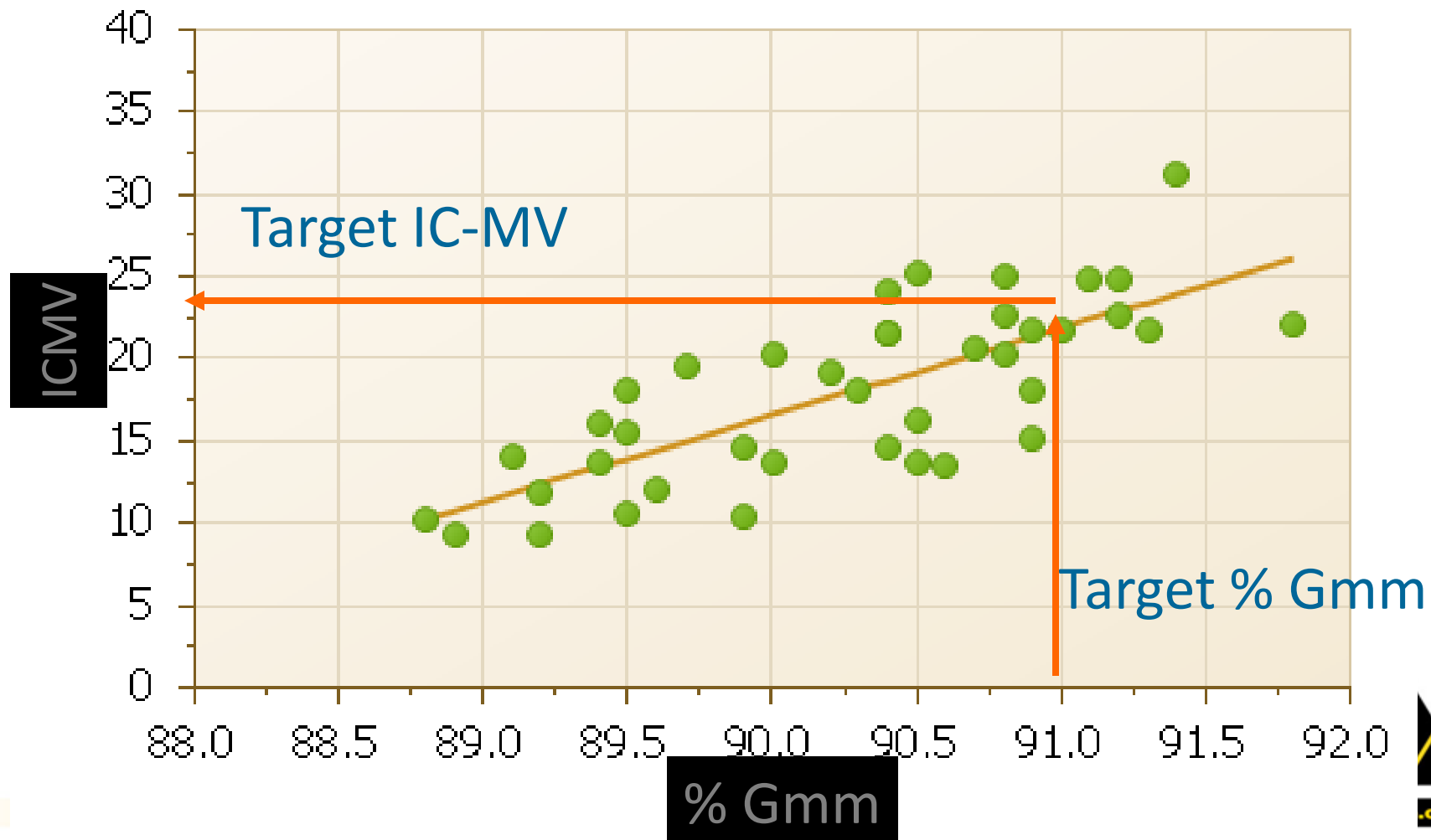
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# QC Target Values



# Calibration Tests and Target Values



# QC/QA for Production Areas

- Pre-paving mapping of underlying material
- QC for Production Compaction
  - Coverage
  - Percent Requirements Meeting Target Values
- QA for Production Compaction
  - Based on Agency's Current Requirements



# IC Mapping Prior to Paving

- Purpose is to identify weak area in test section and/or selected areas in the project
- Research found that IC mapping seemed to be effective in identifying soft spots in all underlying materials including milled and unmilled asphalt pavements
- Mapping performed before tack coat
- Typical settings were low amplitude and 2500 vpm frequency





# Mapping Rubblized PCCP (WI)

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# In-Situ Tests - Asphalt

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NG



LWD-a



NNG



PSPA



# Uses of In Situ Testing

- In Situ test results are referred to as “point test data” for analysis purposes
- Point test data locations are determined by GPS rover
- Point test results and locations are recorded and stored and exported to Veda
- During IC data viewing and analysis, point test data can be used at the user’s discretion



# IC Data Management



# IC Data Submittal

- Daily Data Submittal
- Native IC Data
  - Raw data obtained from roller hard drive
  - Raw data imported into vender software
  - Formatted data then exported to Veda software
- Exported IC Data
  - All passes data
  - Proof data



# IC Data Collection Methods

There are two basic methods of collecting IC data in the field:

- Manual
  - USB data collection
  - Printer - In-field reports through text file/print out
- Automatic/Wireless (cloud) data collection
  - WiFi
  - Cell (CDMA and GSM)

Courtesy Trimble



# USB Data Collection

- USB data port on front of display
- Automatic sync capability



Courtesy Trimble

# Printer In-field Report

asph

- In-field reporting
  - Get real-time summary of work completed
  - Three ways to deliver file:
    - On-screen for operator to see
    - Print in-field with thermal printer for sign-off and approval
    - Text file to export to USB stick

**In-Field Report**

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**CCS900 In-Field Report**

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Machine : compactor  
 Start Time : 12:17:55  
 Start Date : 2011/02/23  
 End Time : 10:52:22  
 End Date : 2011/03/09  
 Duration : 20074 Minutes  
 Site Design : Training Road 2  
 Start Station :  
 End Station :



**CCS900 In-Field Report**

Machine : COMPTST23  
 Start Time : 00:05:10  
 Start Date : 2010/04/08  
 End Time : 01:10:19  
 End Date : 2010/04/08  
 Duration : 65 Minutes  
 Site Design : Compactor Alley Road Def  
 Start Station : 0+100.0  
 End Station : 0+150.0  
 Total Area Covered : 319.9 m<sup>2</sup>  
 Layer : 8

Target Lift Thickness: 0.200 m  
 Average Lift Thickness: 0.232 m  
 Max. Lift Thickness: 0.418 m  
 Min. Lift Thickness: -0.532 m  
 Over Lift Ratio ( 10%): 69%

Target Pass Count: 8  
 Average Pass Count: 6.6

Pass Count Percentages:

=1 Pass(es):	5%
=2 Pass(es):	7%
=3 Pass(es):	5%
=4 Pass(es):	6%
=5 Pass(es):	5%
=6 Pass(es):	13%
=7 Pass(es):	8%
=8 Pass(es):	12%
>8 Pass(es):	39%

Target CMV: 50  
 Average CMV: 48.0

CMV Percentages

<10:	3%
10-30:	5%
30-40:	15%
40-65:	31%
>65:	48%

Weak Areas

Low CMV Areas: (2.0 m<sup>2</sup>)

Station Offset	Average CMV
1. 0+113.8 -0.2	6.8
2. 0+113.7 -1.2	7.4
3. 0+113.7 -0.7	7.4
4. 0+113.4 -0.9	10.8
5. 0+113.5 -0.4	10.9

Low Pass Count Areas: ( <=5, 2.0 m<sup>2</sup> )

Station Offset	Average Passes
1. 0+136.2 5.6	1.8
2. 0+100.5 0.0	1.8
3. 0+100.0 0.1	1.9
4. 0+100.2 -0.2	2.1

Approval

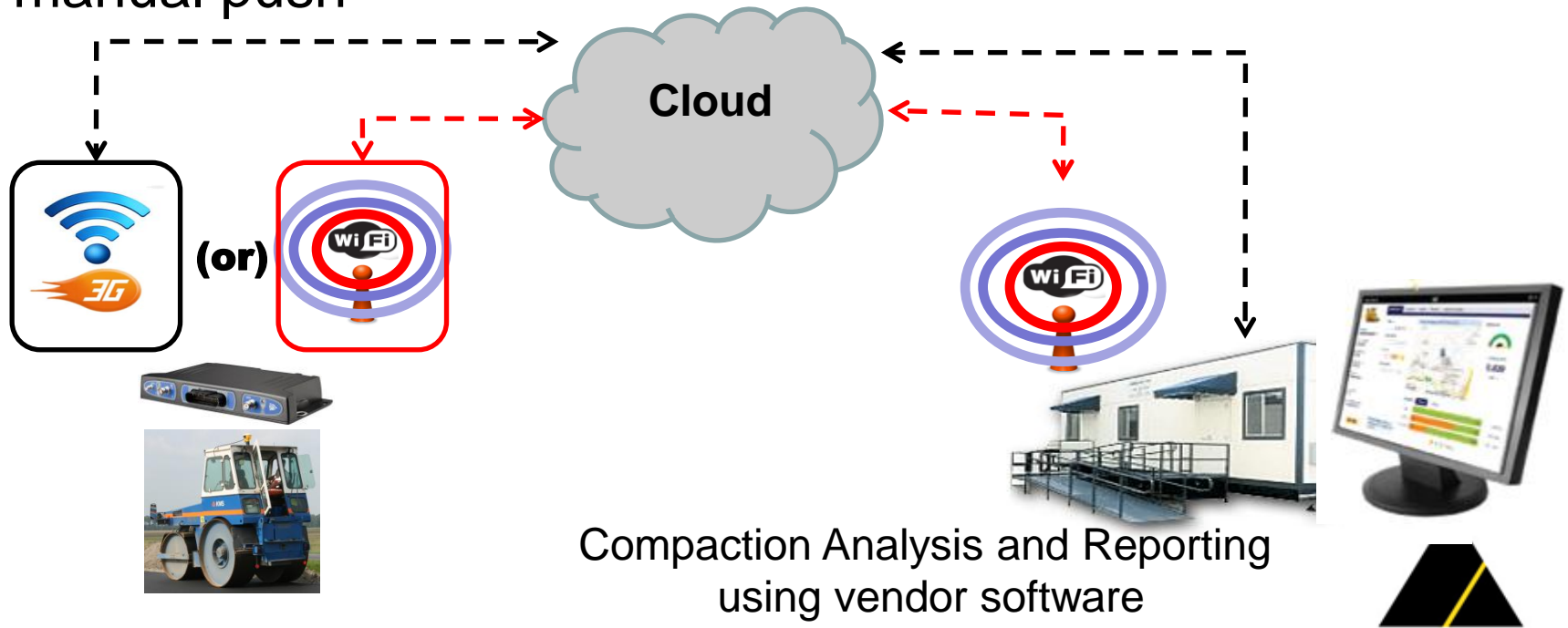
Construction Unit  
 Date

Supervisor Unit  
 Date

Owner  
 Date

# Wireless Data Collection

- Wireless Data Synchronization using:
  - Cellular connection (3G)
  - Wi-Fi connection
- Two ways to synchronize data to the cloud, automatic or manual push





# IC Data Collection

- What is best method?
  - Both manual and automatic (wireless) data collection can be used effectively
    - Proper protocol must be followed
    - Data security is essential
      - MnDOT reported up to 40% data loss using manual method
      - MnDOT now requires automatic wireless data acquisition



# IC Data Flow

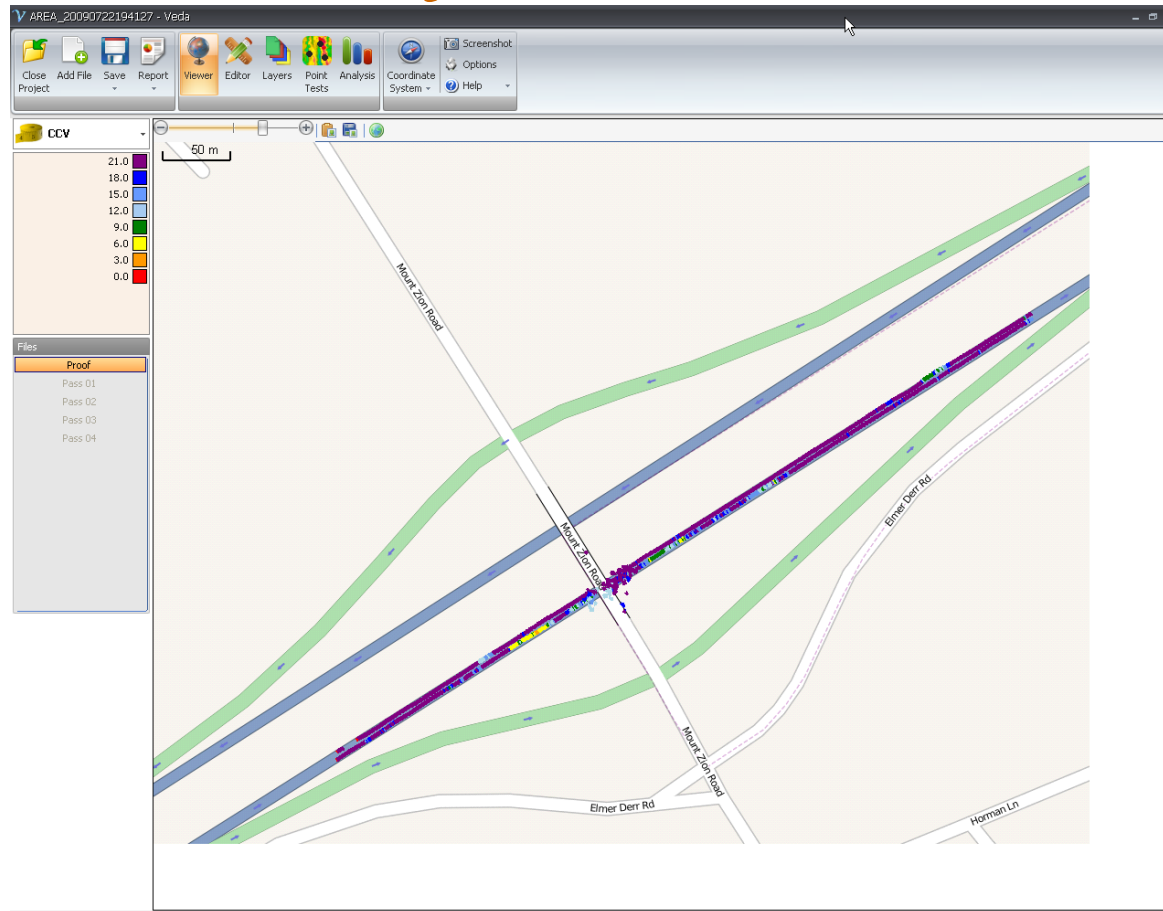
- Data from IC roller
  - Typically, USB drive used to transfer data files
  - “Cloud” technology available from one vendor
  - Data is transferred to computer with vendor software and formatted to be Veda compatible
  - Data is exported to Veda software
- Point Test Data
  - Point test data (i.e density, LWD, etc)
  - Point test location recorded using GPS rover
  - Data/location is exported into Veda



# FHWA Specs Require Use of Veda

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## IC Analysis with Veda



# Veda Software

Available for free download at  
[www.intelligentcompaction.com](http://www.intelligentcompaction.com)



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### ONE Software Tool



#### IC Support

View helpful info and contact us for support at our IC Technical Support Service Center.

#### Veda 2.1 Upgrade

Download the latest version of Veda, the IC data management and analysis software.

#### Learn IC in a Day

Attend an IC workshop and learn how to use IC to ensure longer pavement lives.

#### Specifications

View and download asphalt and soils IC specifications.

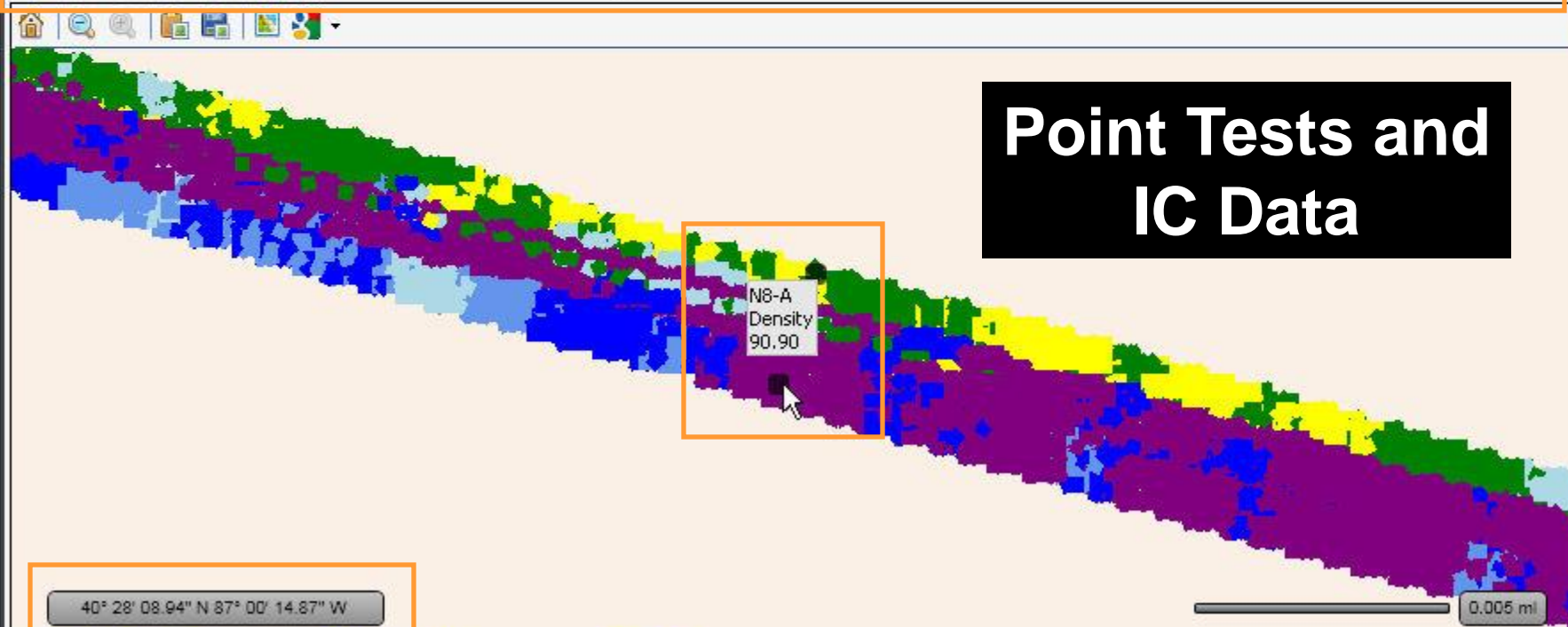
### Intelligent Compaction News

[View all IC news →](#)



File Pass 03

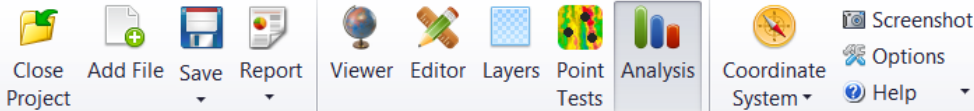
Name	Date	Time	Easting (m)	Northing (m)	Test Type	Value
N6-A	Nov 14, 2011	2:06 PM	499203.813	4479954.904	Density	90.3
N6-B	Nov 14, 2011	2:06 PM	499204.258999999	4479956.562	Density	91.2
N6-C	Nov 14, 2011	2:06 PM	499204.386	4479958.391	Density	90.5
N7-A	Nov 14, 2011	2:06 PM	499534.580999999	4479862.543	Density	91.1
N7-B	Nov 14, 2011	2:06 PM	499535.027	4479864.112	Density	91.3
N7-C	Nov 14, 2011	2:06 PM	499535.207000002	4479865.836	Density	90.6
N8-A	Nov 14, 2011	2:06 PM	499649.810000002	4479830.242	Density	90.9



# Veda - Summary of ICMV

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IN\_TB04\_2 - Veda



[Setup](#)

CCV

Proof

[Statistics](#)

[Fixed Interval](#)

All Passes

[Compaction Curves](#)

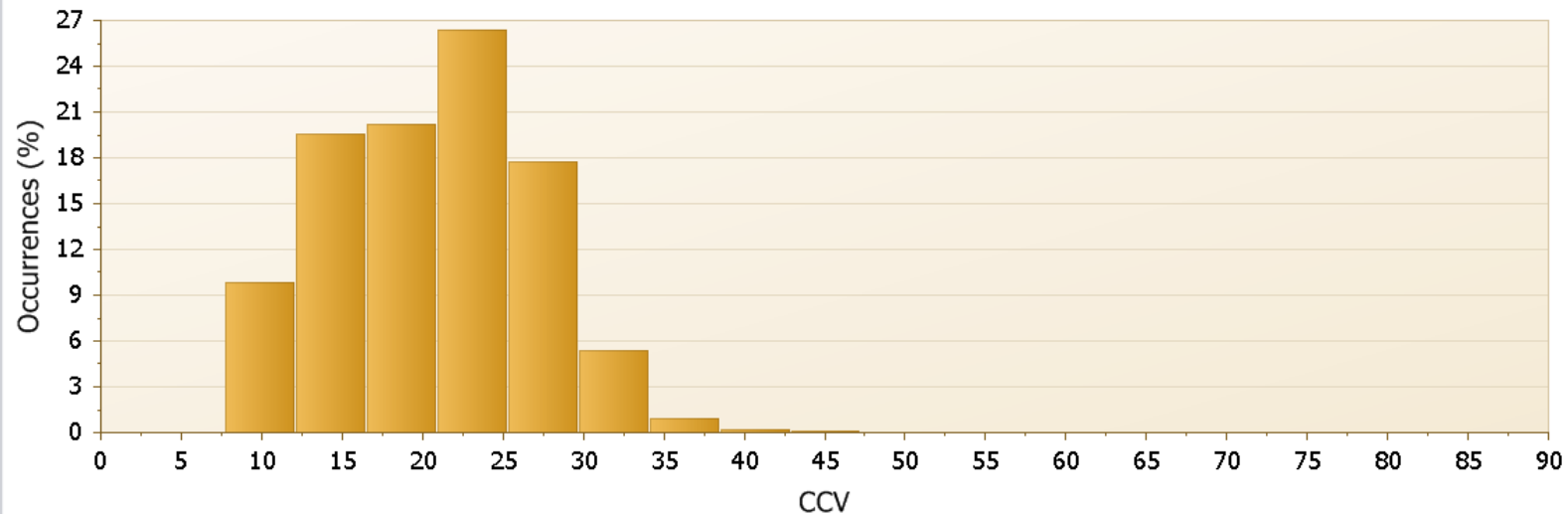
[Correlation](#)

[Statistics](#)

Single Passes

[Correlation](#)

Min	5.50	Standard Deviation	6.21
Mean	18.37	CoV (%)	34
Max	93.40	Sample Size	308,243

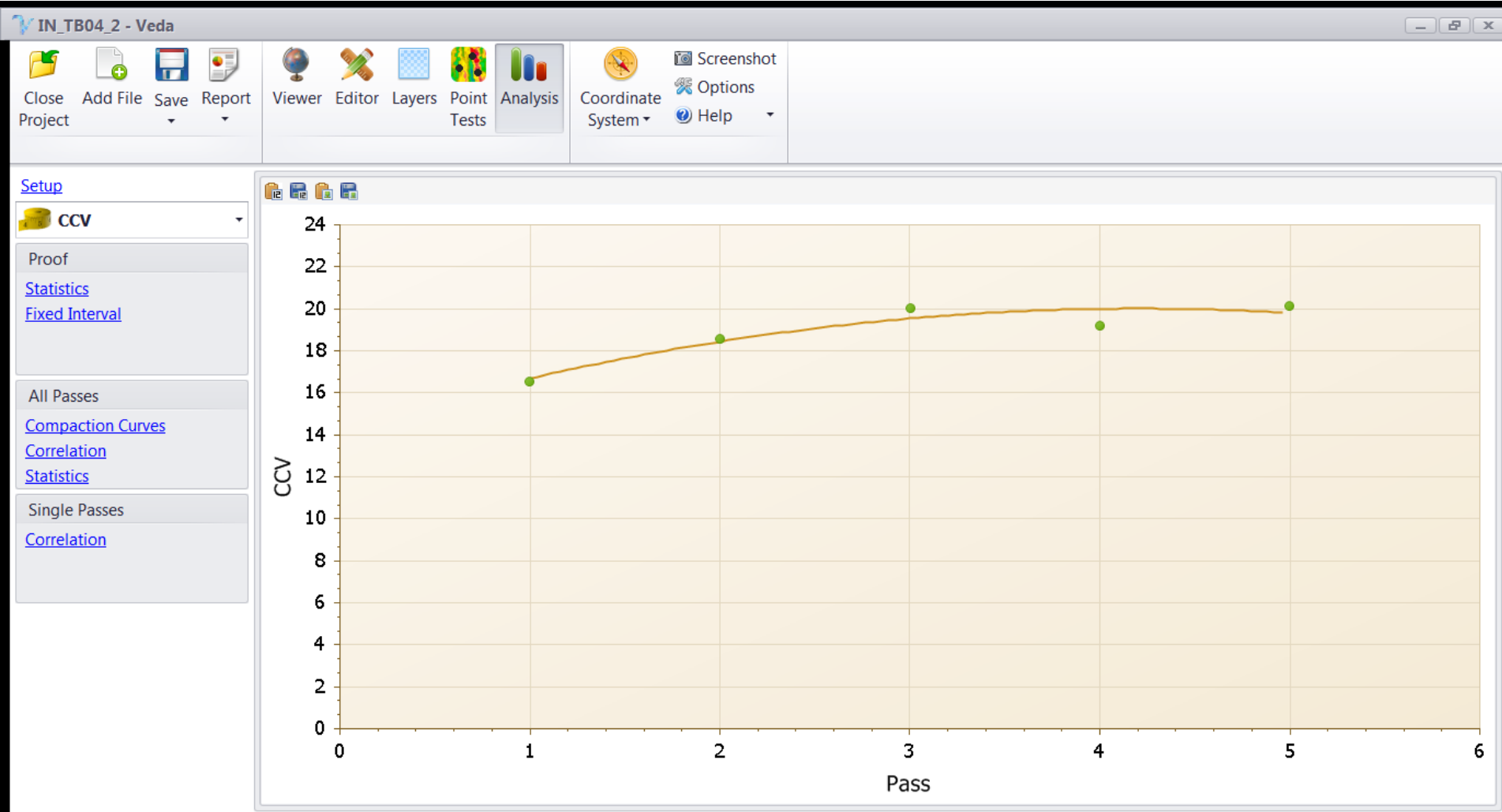


11:25 AM



# Veda - Compaction Curves

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# Summary - Veda Software

- Veda Software is a free, user-friendly software tool that can be downloaded for the IC Website
- However, training on data management and operation of Veda is necessary prior to the project
- Recommend that agencies schedule a ICDM workshop and ask contractors that have IC projects and agency project management staff to attend



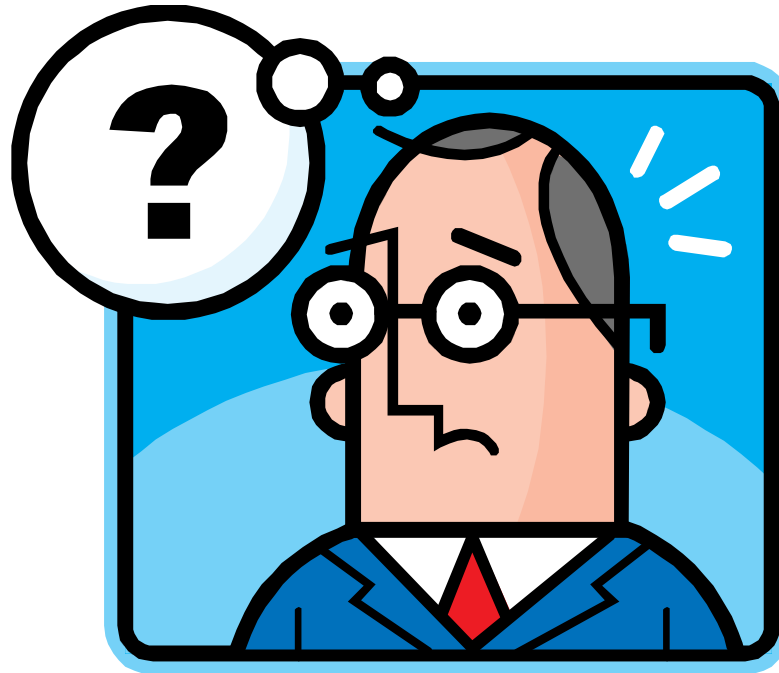
# Payment and Measurements

- Lump Sum Payment
- Itemized Payment
  - Weekly IC Equipment Rental
  - Hourly Rate for Roller Operator
- Measurement
  - No. of calendar weeks roller furnished
- Based on Meeting Specified IC-Related Criteria
  - % of Target Roller Passes
  - % of Target ICMV



# Using IC for QC (Part One)

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## Questions? Discussions?



# Downloading the Specifications



Browser address bar: [www.intelligentcompaction.com/index.php?q=node/17](http://www.intelligentcompaction.com/index.php?q=node/17)

Search bar:  Search

Navigation links: Home, Games, Speed Up Your PC

## Specifications

Since IC is equipment-based technology, new specifications must be developed in order to take full advantage of IC's benefits. These specifications must also be flexible enough to handle the varied capabilities of IC rollers and properties of compacted materials. Additionally, an IC roller is just one type of roller needed to compact road materials – this must also be addressed by compaction specifications.

-  **Compaction of Soils and Subbase**
-  **Compaction of Asphalt Pavement Materials**

[Printer-friendly version](#)

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  - Asphalt
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### User login

Username: \*

# Background Sync

- Background wireless sync of machine data
  - Allows an operator to manually initiate a wireless sync, then leave the sync dialog, and continue working
- No loss of productivity waiting for files to upload/download



# Automatic Sync

- System will perform an automatic full wireless sync each time a new tag file is created
  - typically every 5 - 60 minutes, depending on various factors
- Configured on/off
  - *it cannot be configured to synchronize data at specific times (e.g. 10:00 am)*

