2015
Alaska Asphalt Pavement Summit

Intelligent Compaction Introduction and Benefits

By
Dr. George Chang
Transtec Group

Outlines

1. Introduction to Intelligent Compaction (IC)
2. IC Measurement System (ICMV)
3. Veta IC Data Management
4. National IC Implementation

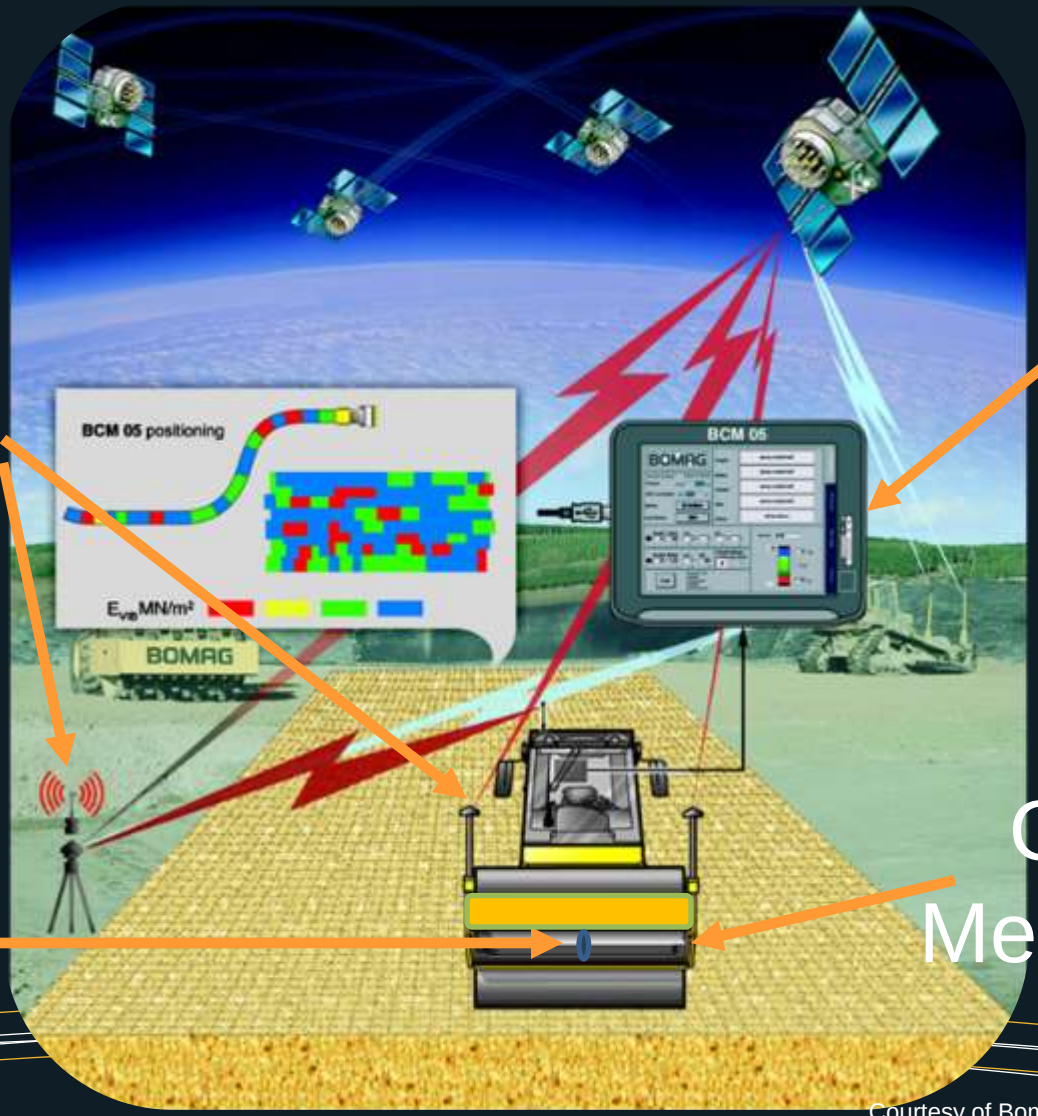
1.

Introduction to IC

IC Definition

Global Positioning System GPS

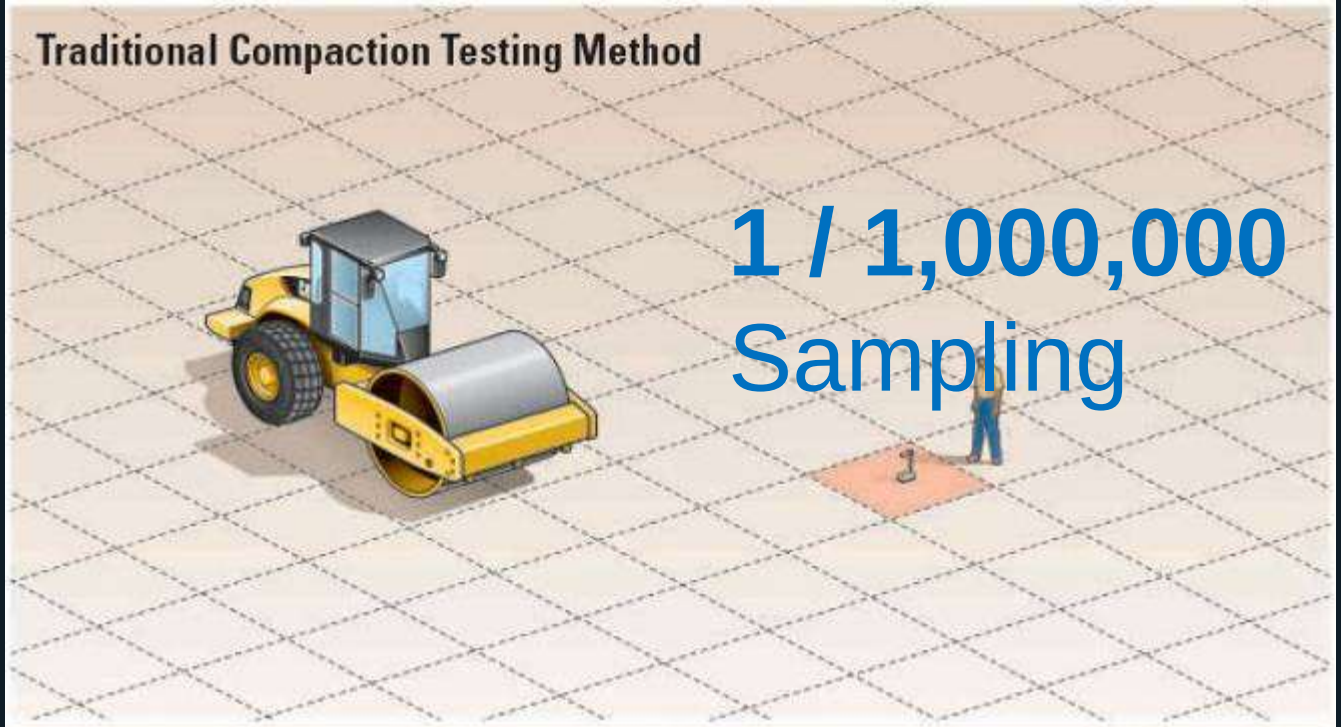
Onboard Report System



Temperature Sensors

Continuous Measurement System

Courtesy of Bomag



Courtesy of Caterpillar

Single Drum IC Rollers

Ammann-Case

Caterpillar

HAMM-Wirtgen

Soils and Subbase

BOMAG

Dynapac-Atlas Copco

Sakai

Double Drum IC Rollers

BOMAG

Hamm-Wirtgen

Dynapac-Atlas Copco

Asphalt

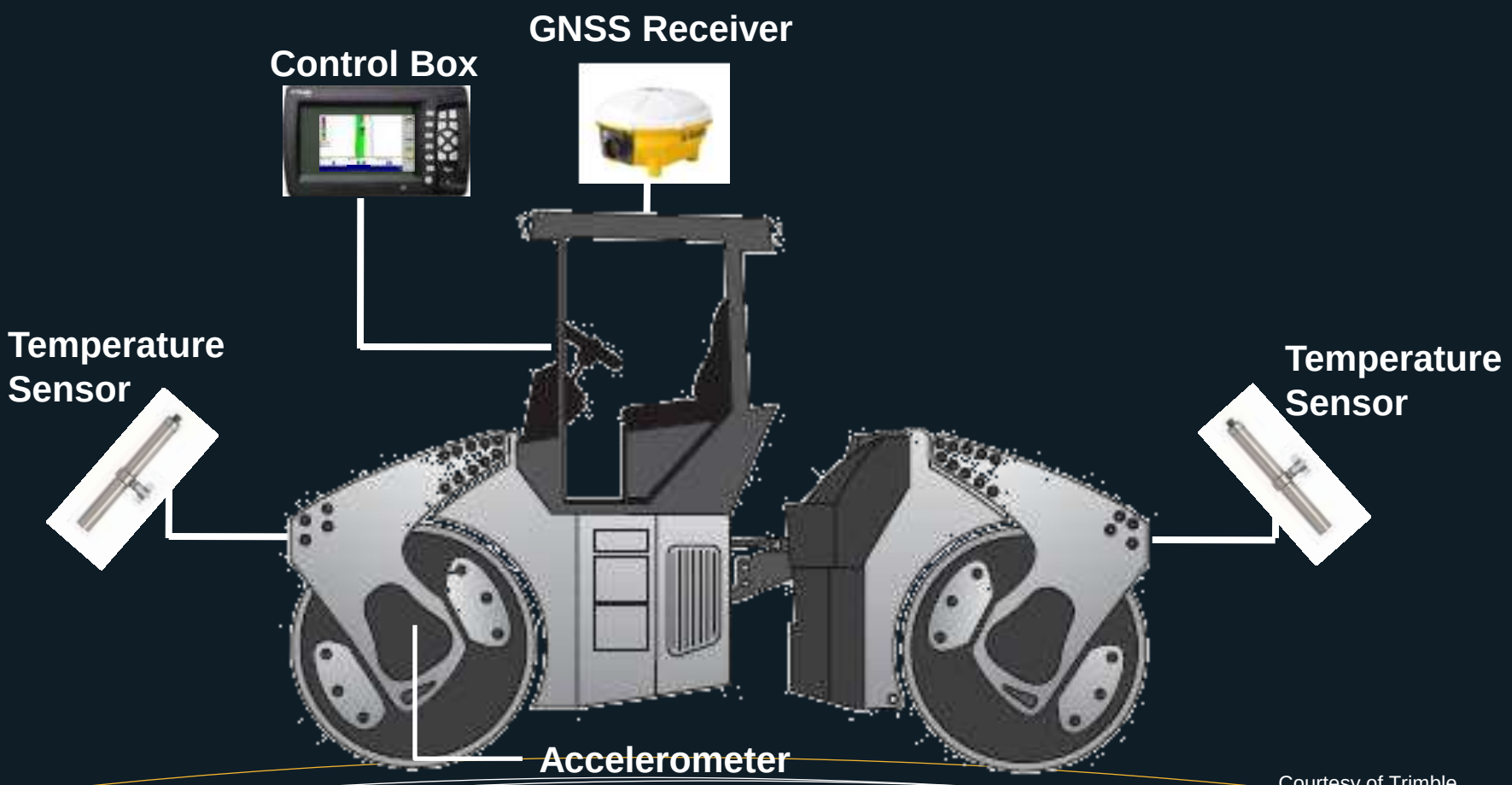
Caterpillar

Sakai

Volvo

IC Retrofit System

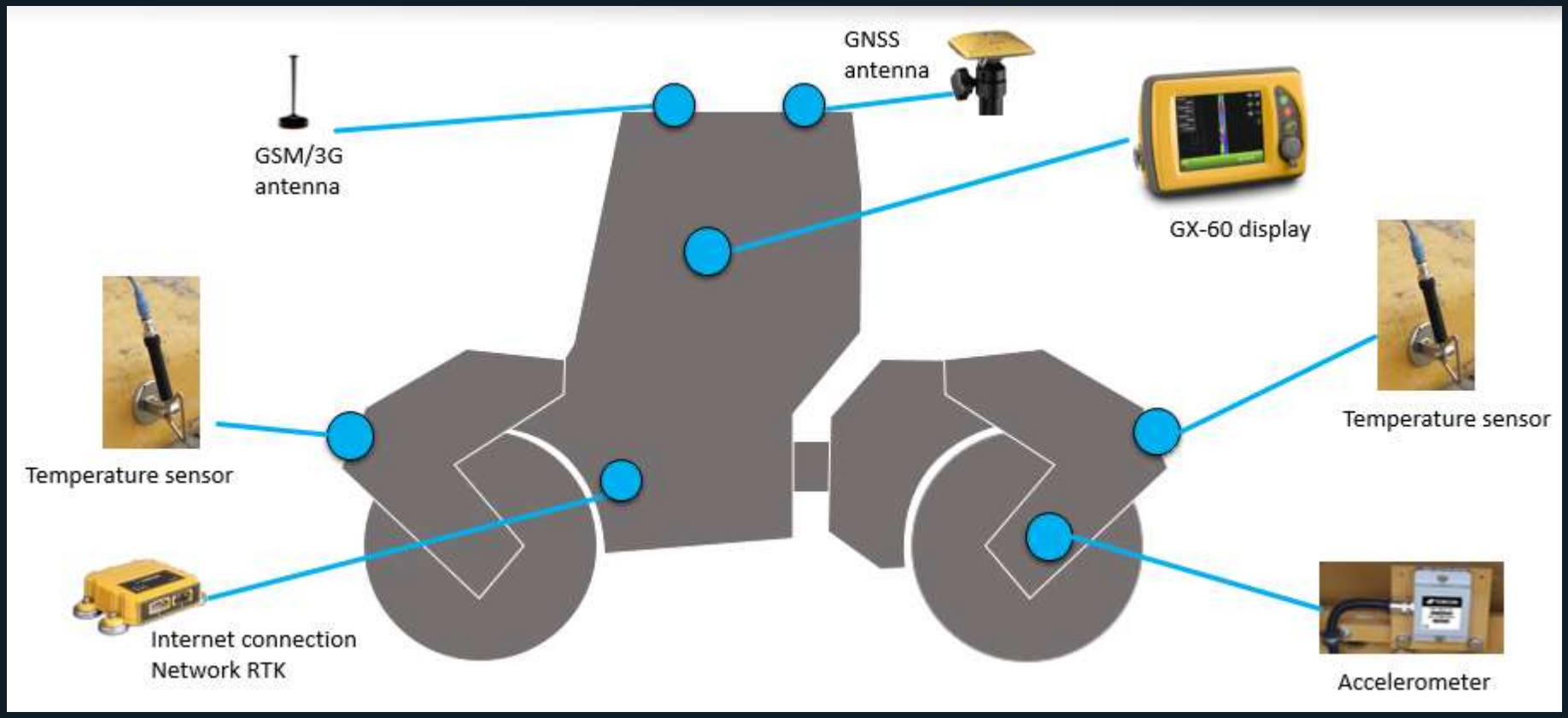
Trimble



Courtesy of Trimble

IC Retrofit System

Topcon



An Example IC System

HCQ GPS Navigator

GPS Receiver

Temperature Sensors

Accelerometer

Control Panel

Real Time Kinematic (RTK) GPS

GPS Base Station

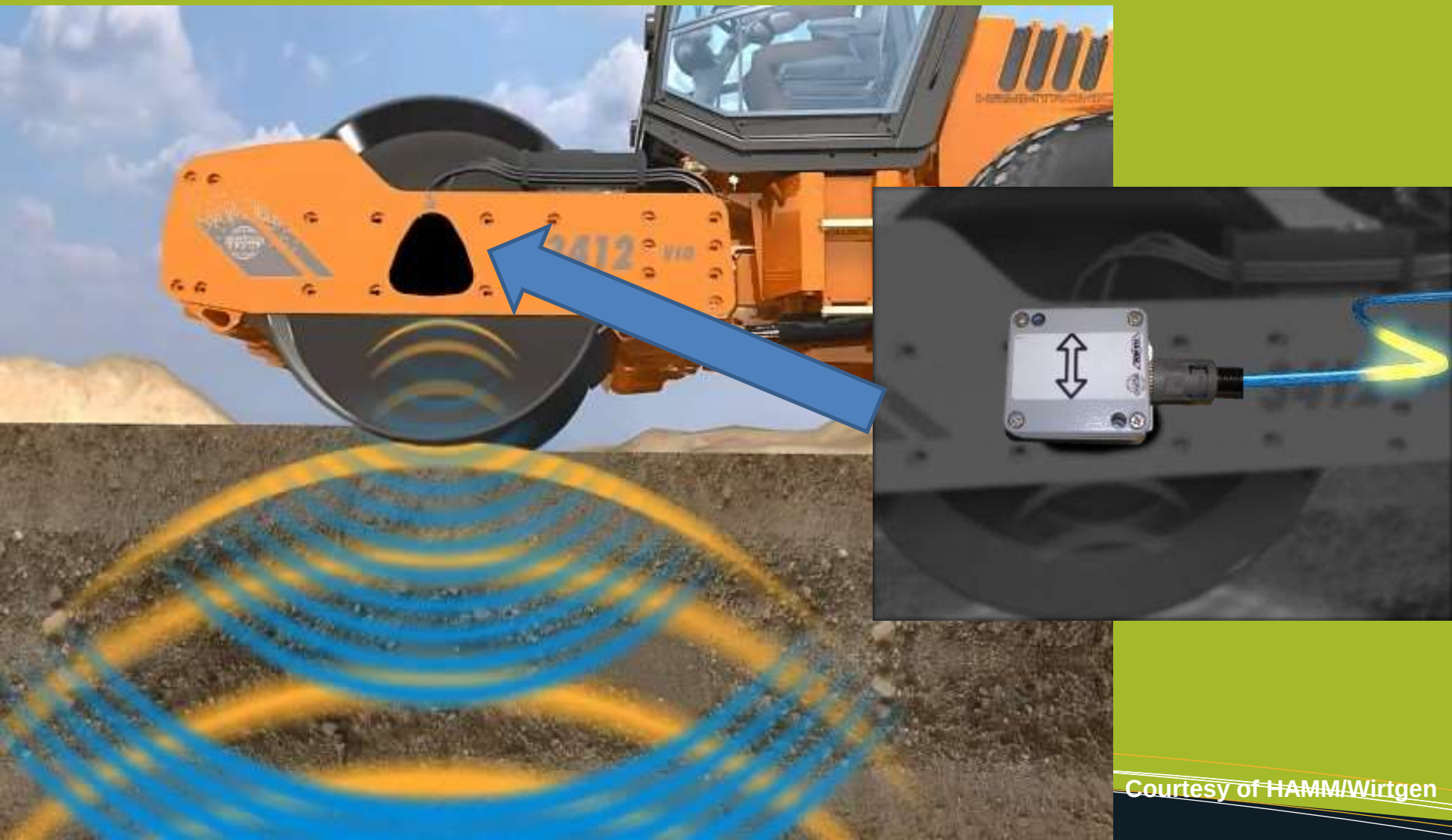
Connected by Radio Link

Roller GPS Radio/Receiver

GPS Rover

2.
IC Measurement Value – ICMV

Accelerometer-Based ICMV



Courtesy of HAMM/Wirtgen

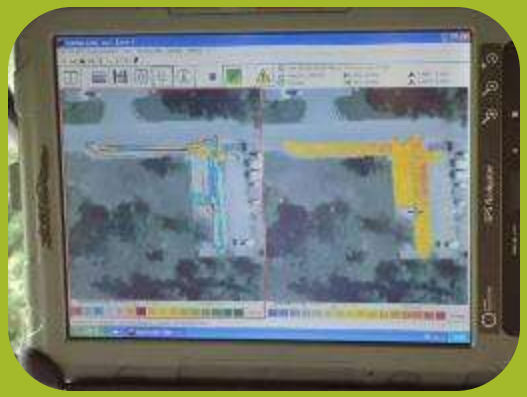
Various ICMVs

Ammann

k_b

Caterpillar/Trimble

CMV, MDP

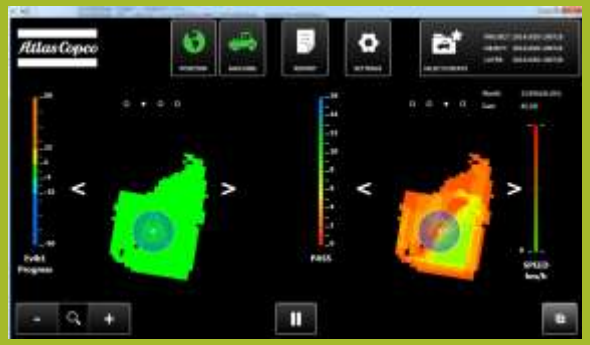


HAMM/Wirtgen

HMV

Bomag

E_{VIB}



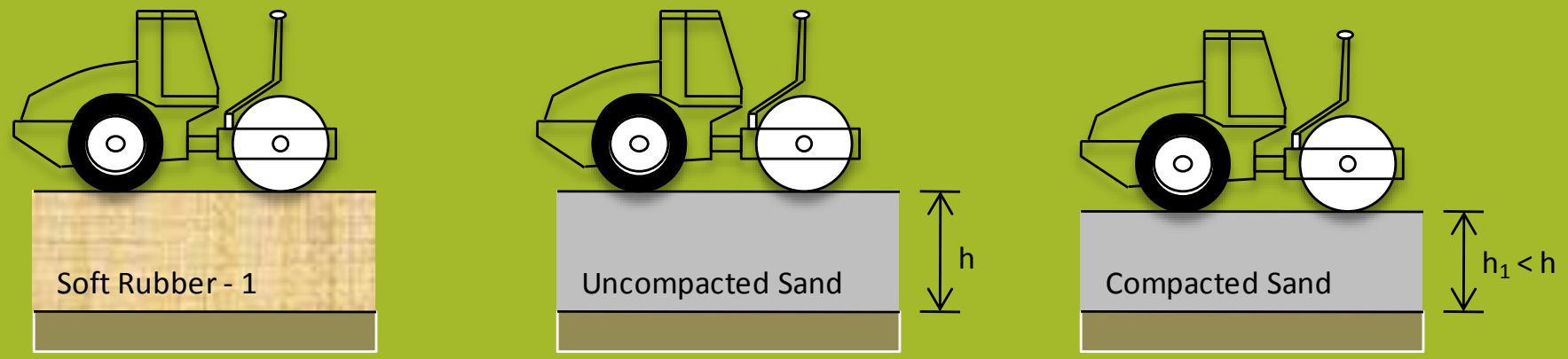
Dynapac

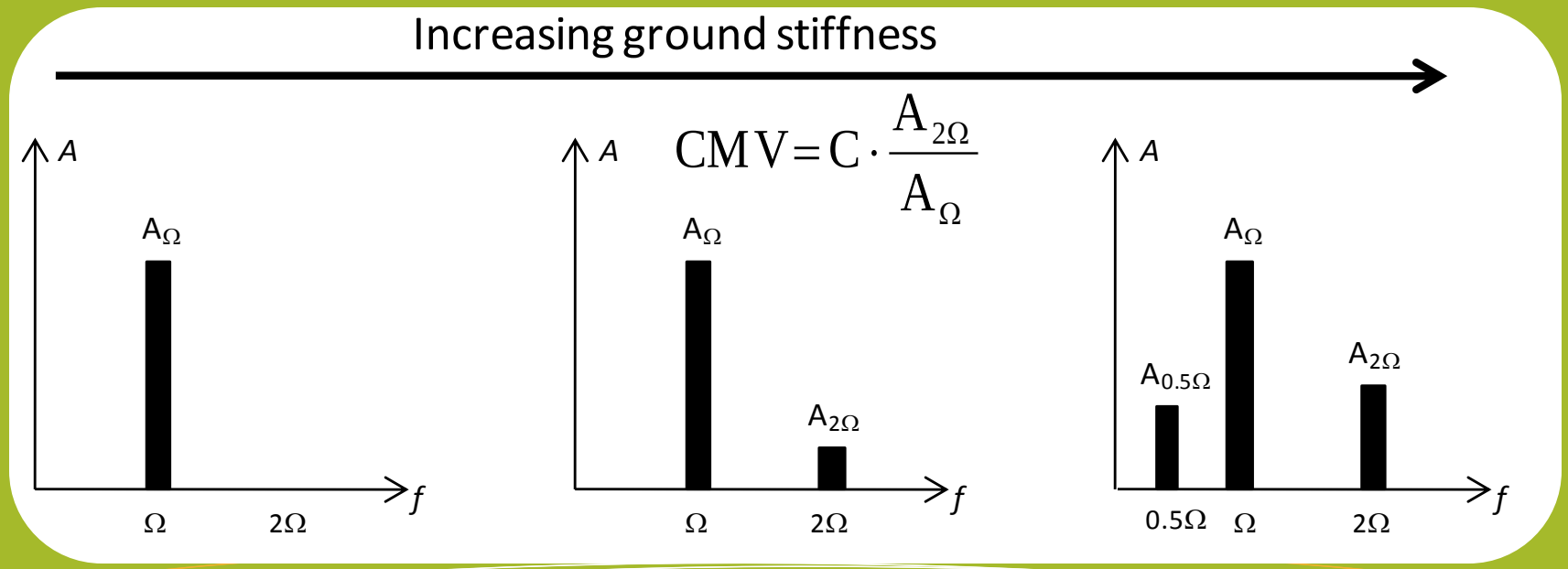
CMV, Evib

Sakai/TopCon

CCV

CMV - Compaction Meter Value

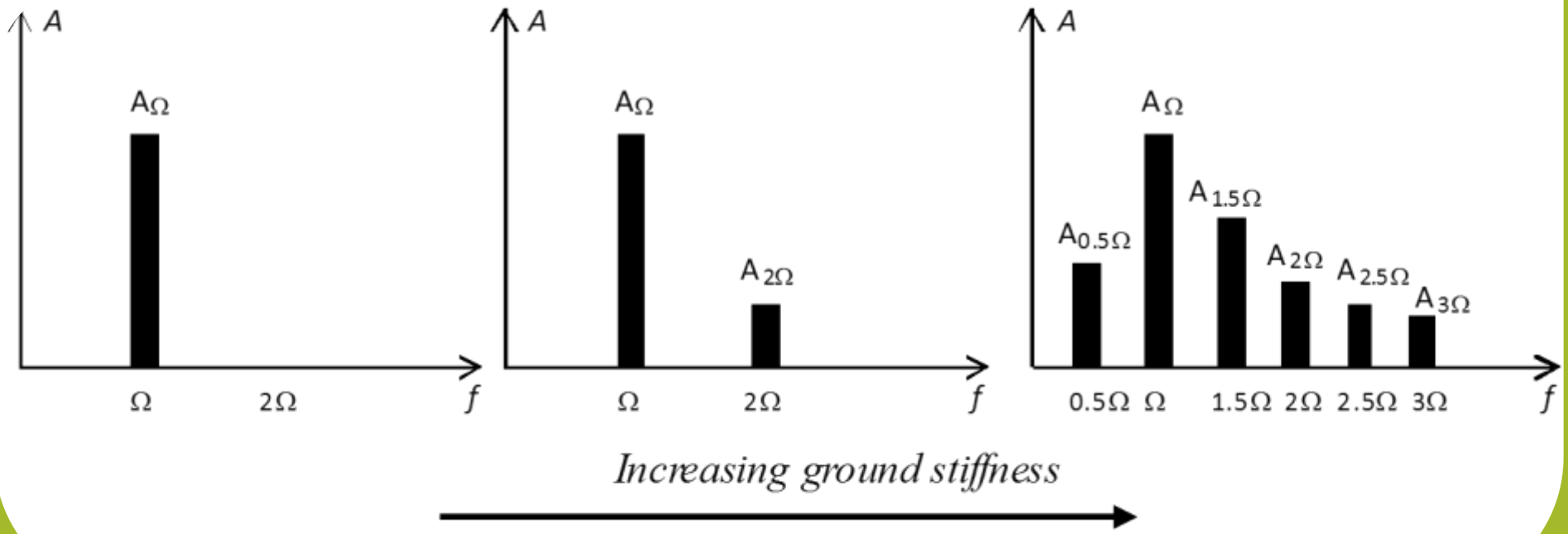




Modified from Thurner and Sandström 1980

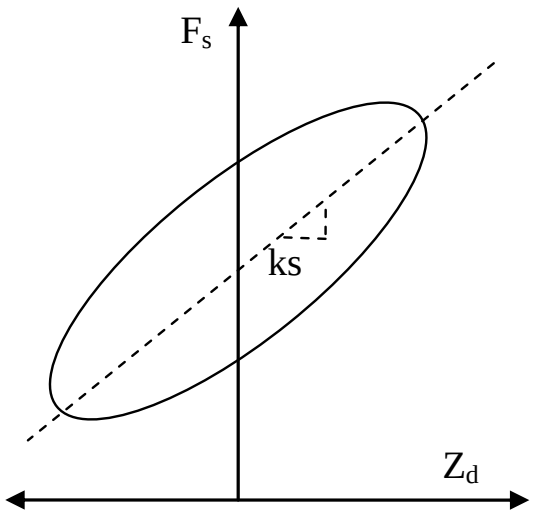
CCV - Compaction Control Value

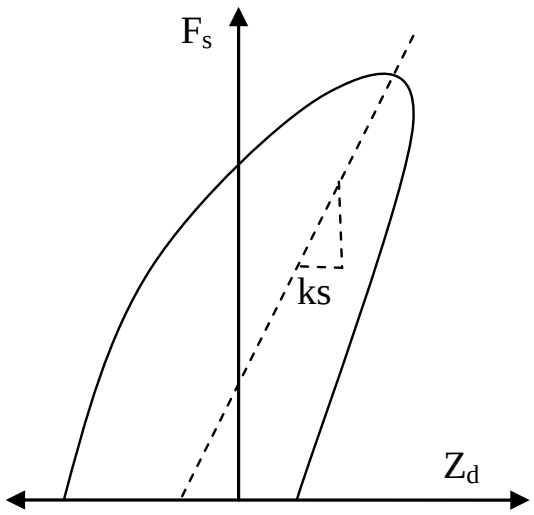
$$CCV = \left[\frac{A_{0.5\Omega} + A_{1.5\Omega} + A_{2\Omega} + A_{2.5\Omega} + A_{3\Omega}}{A_{0.5\Omega} + A_{\Omega}} \right] \times 100$$

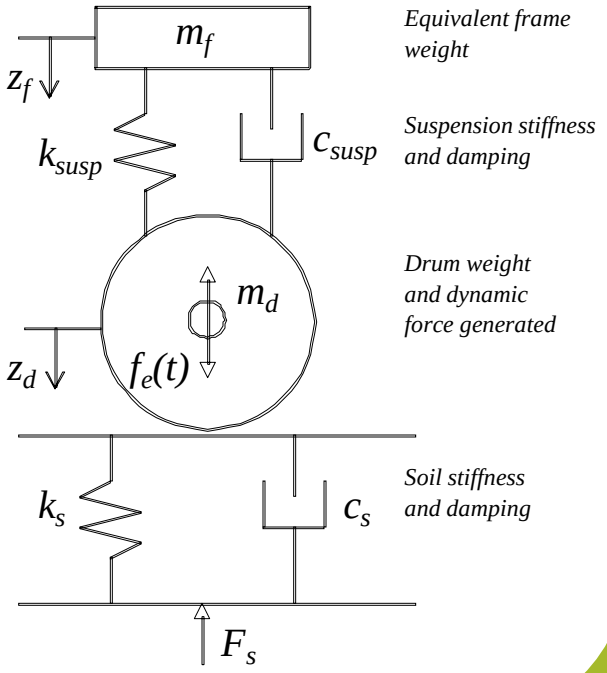


Courtesy of Sakai

Kb - Roller Integrated Stiffness

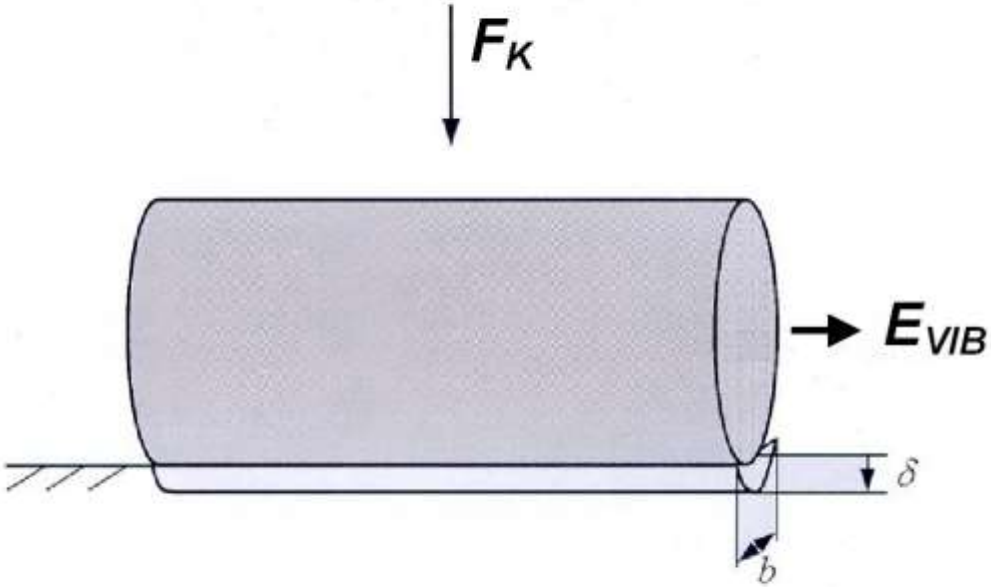


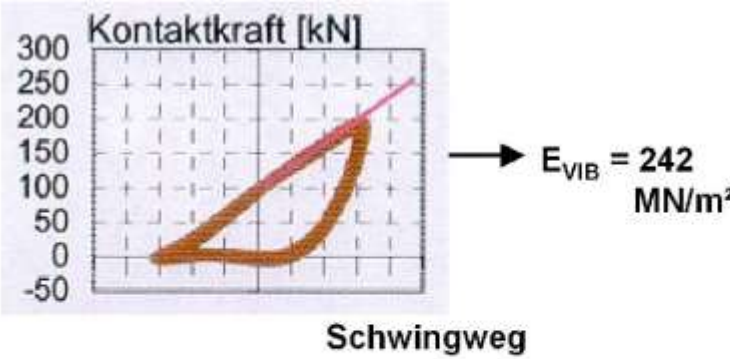


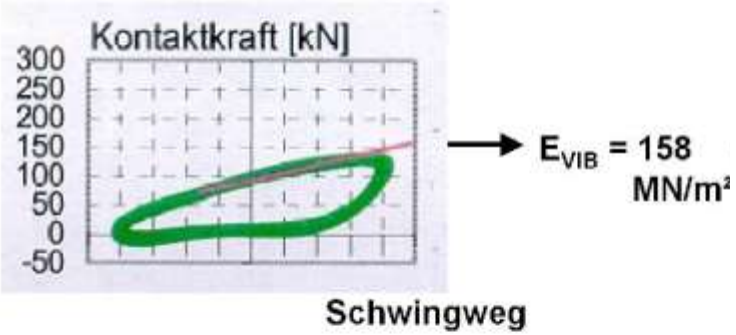


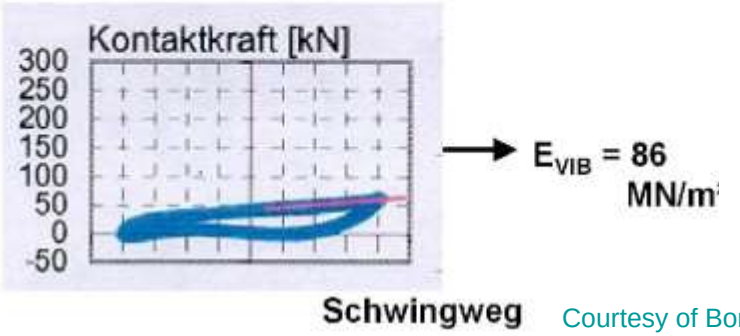
Courtesy of Ammann

Evib - Vibration Modulus



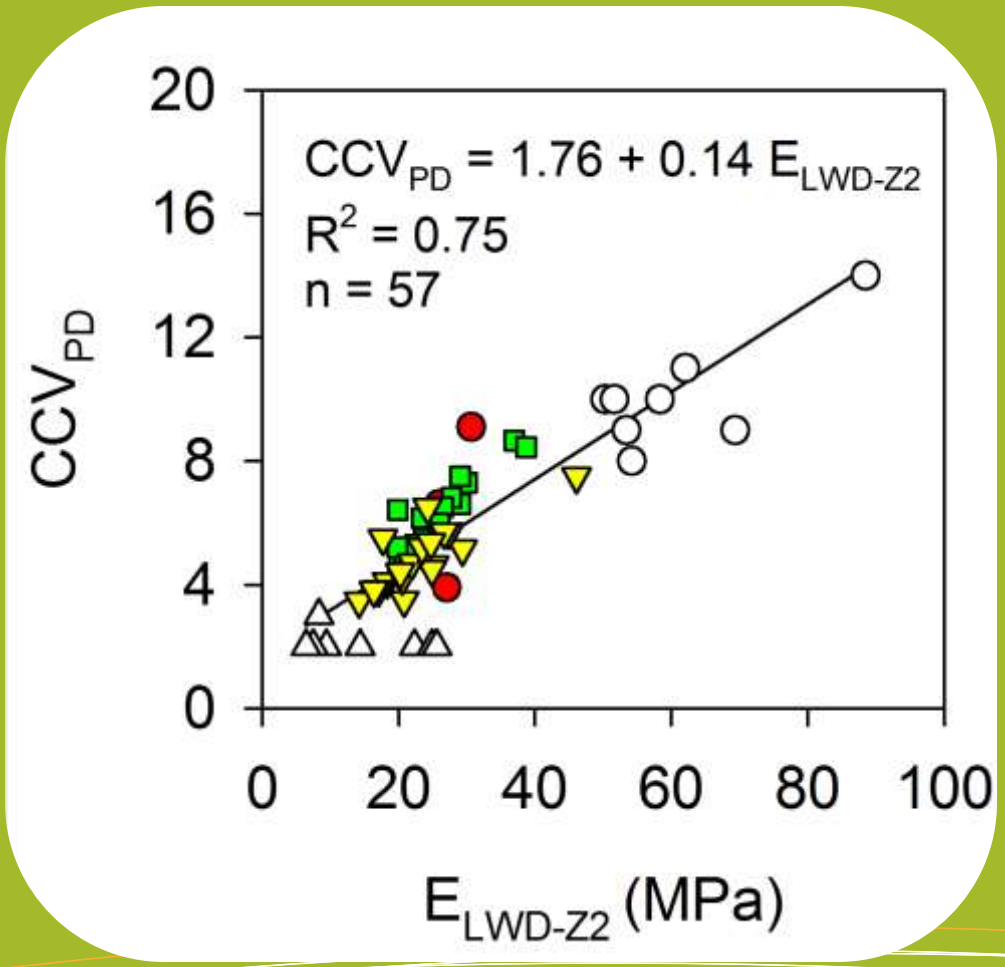




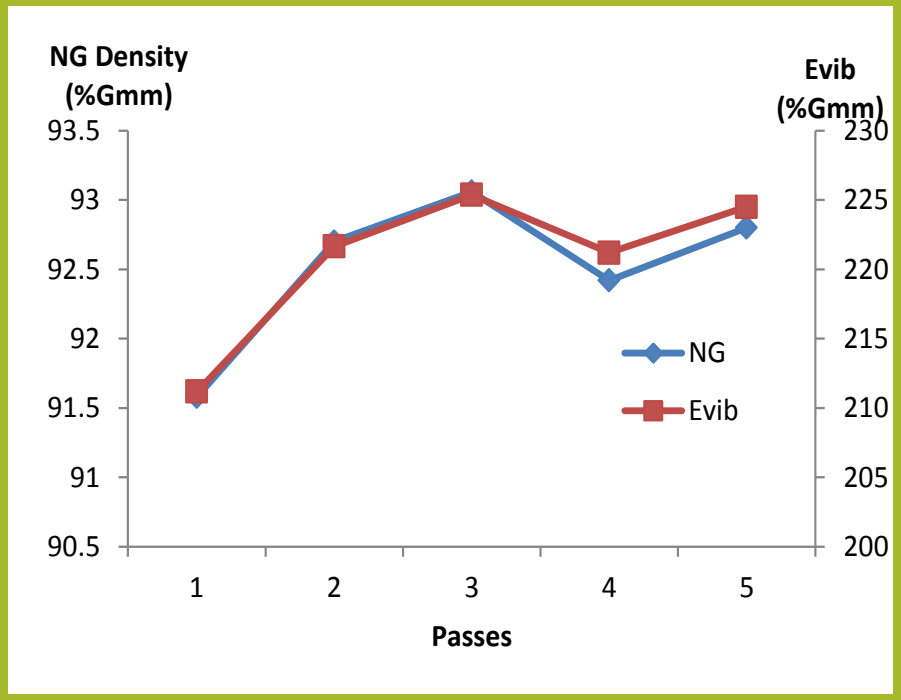


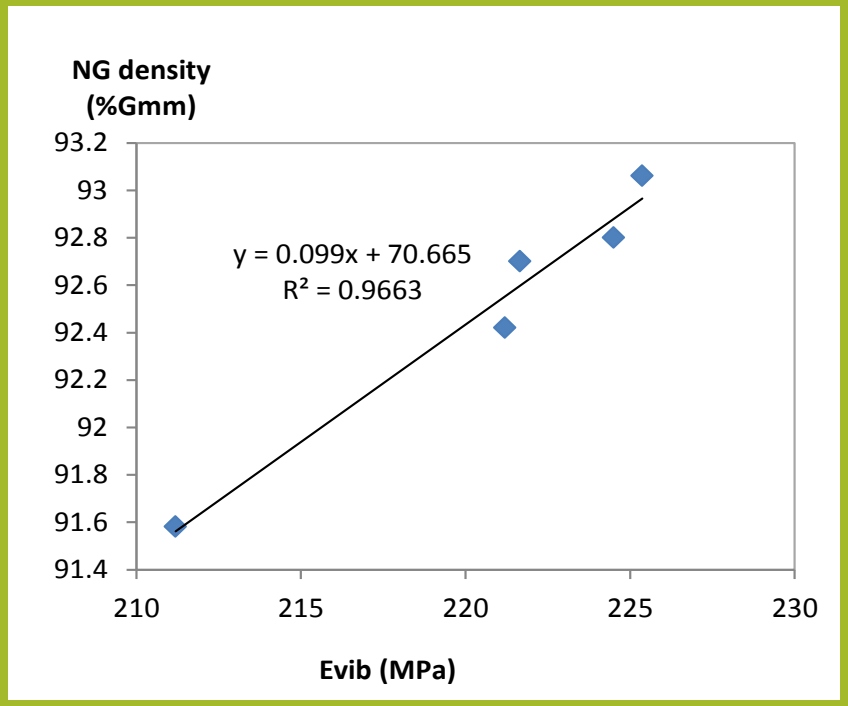
Courtesy of Bomag

Soils ICMV vs. LWD



Asphalt ICMV vs. Density



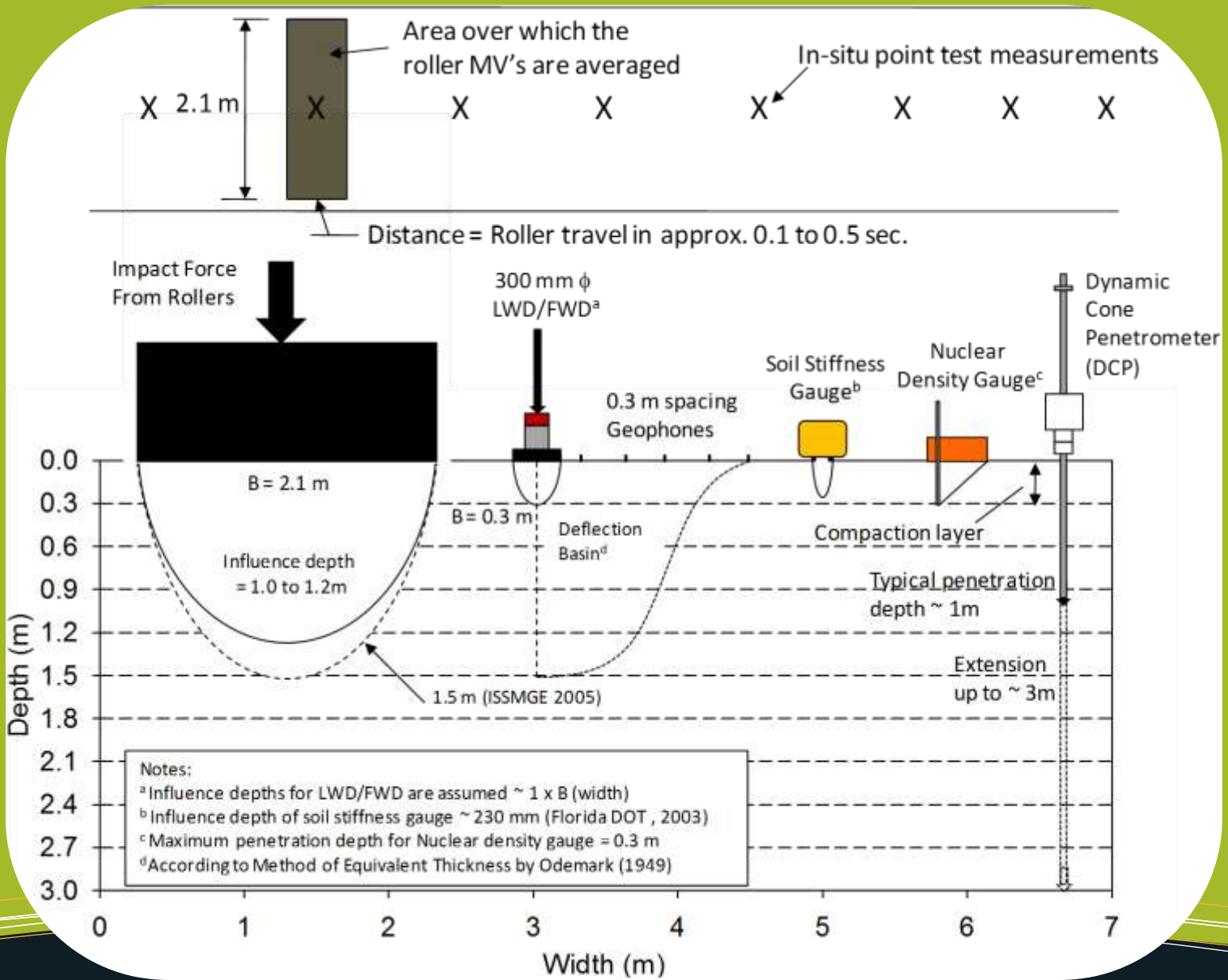


Bomag

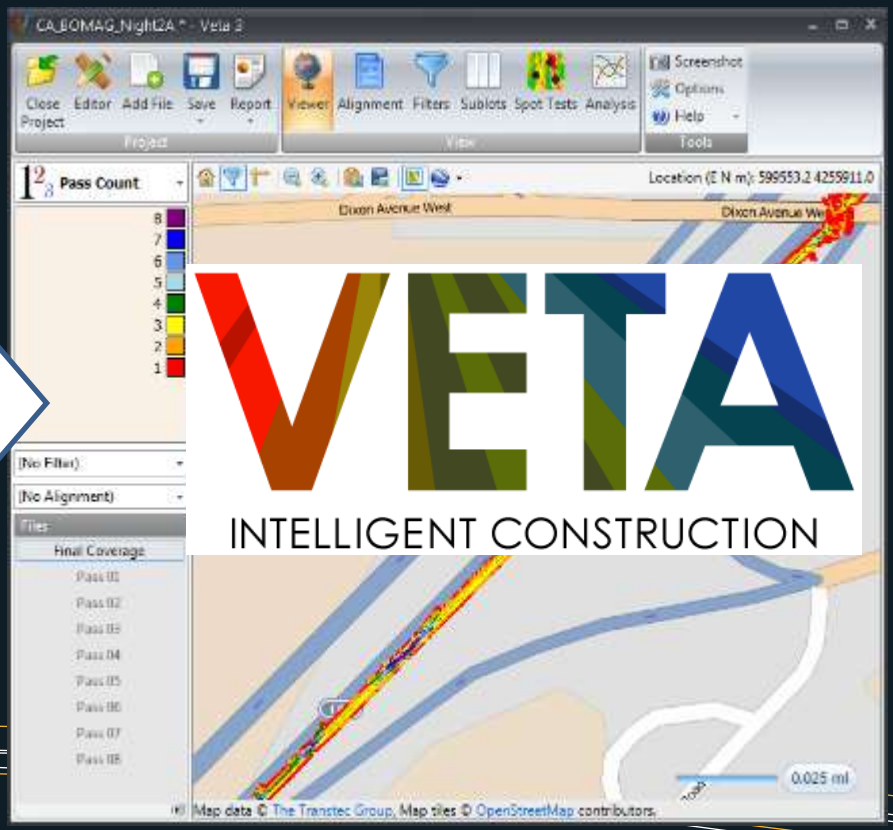
Only during breakdown or intermediate compaction

FHWA IC demo in CA

ICMV vs. In-Situ Tests



3.
Veta IC Data Management



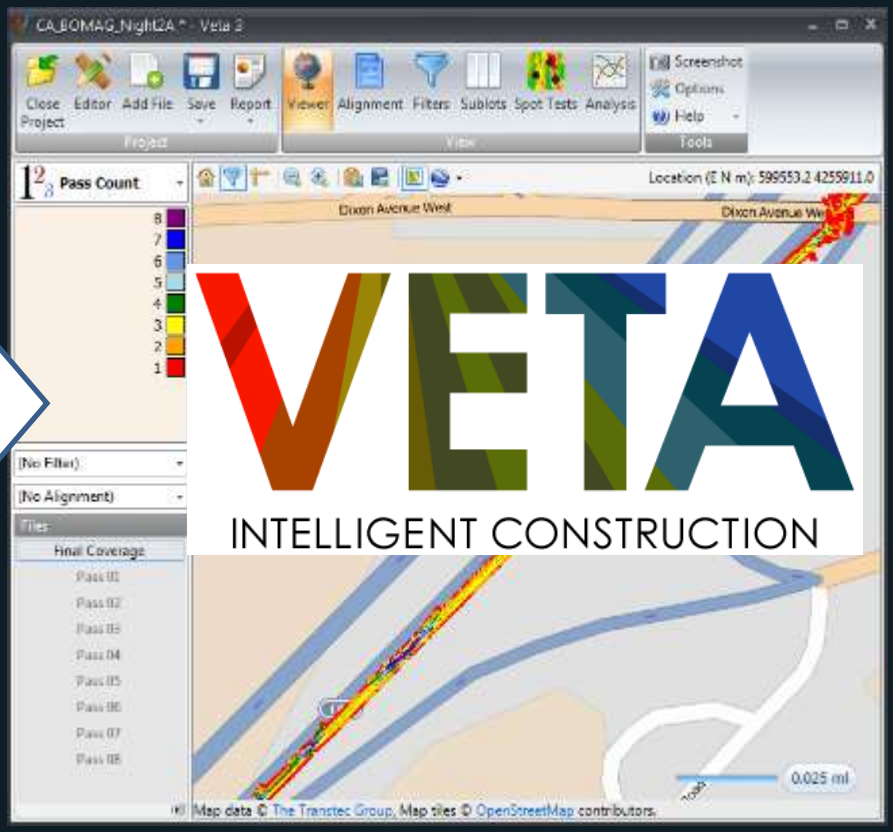
Instrumented Rolling Train

Stabilized / Un-stabilized Full Depth Reclamation (FDR)

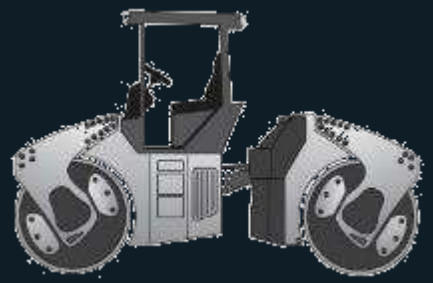
HMA Rolling Train

Courtesy of Rebecca Embacher, MnDOT

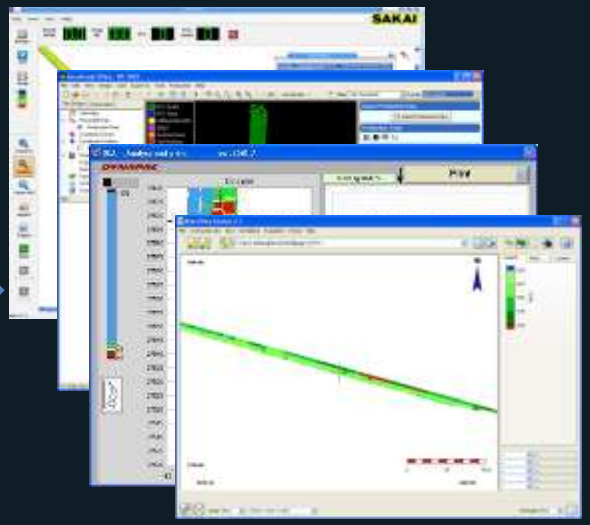
Many Systems ...One Software



IC Data Flow

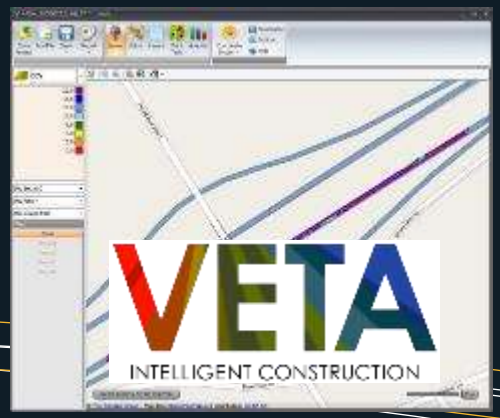


IC/TP data

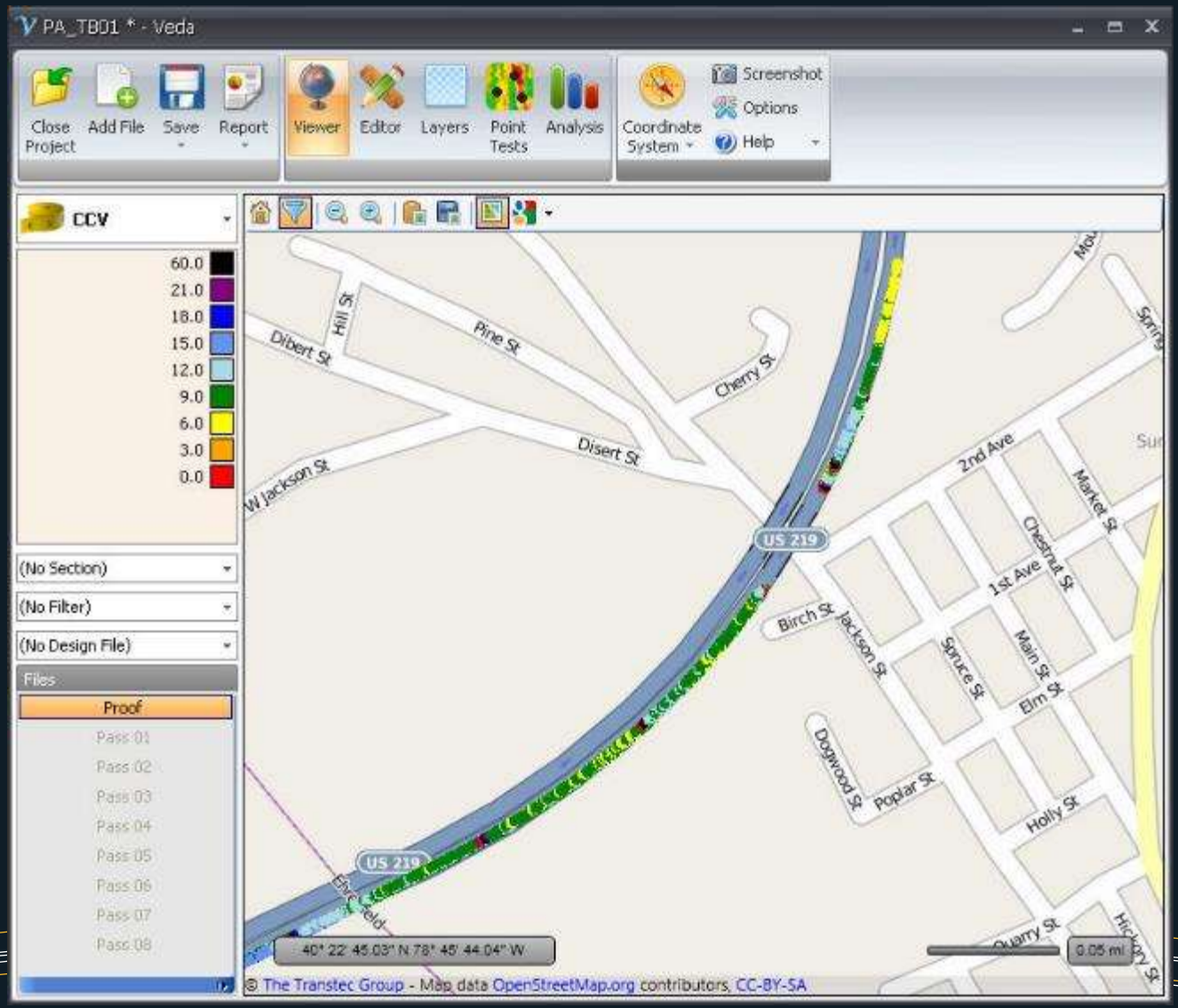


Data Export

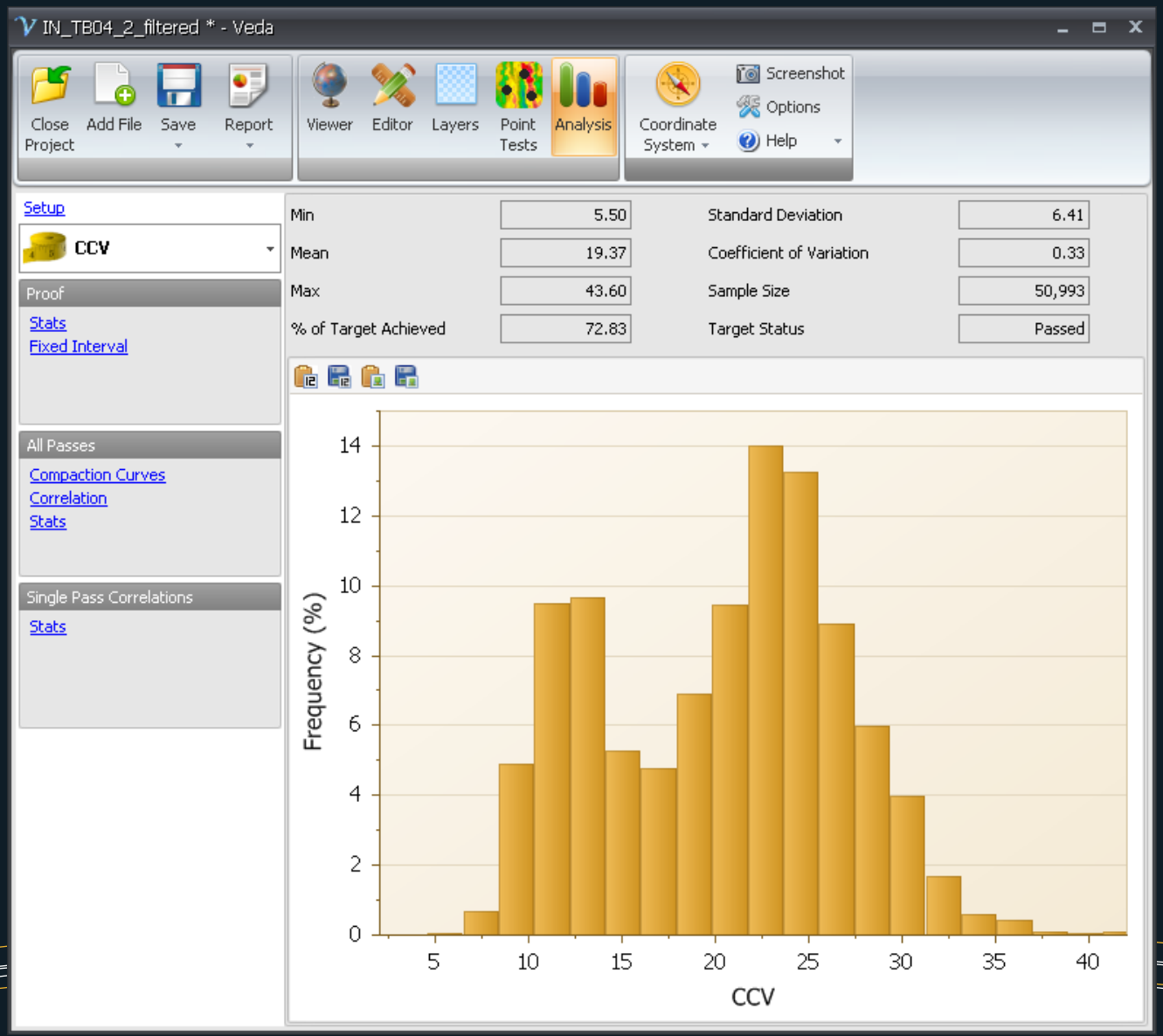
Spot Tests data



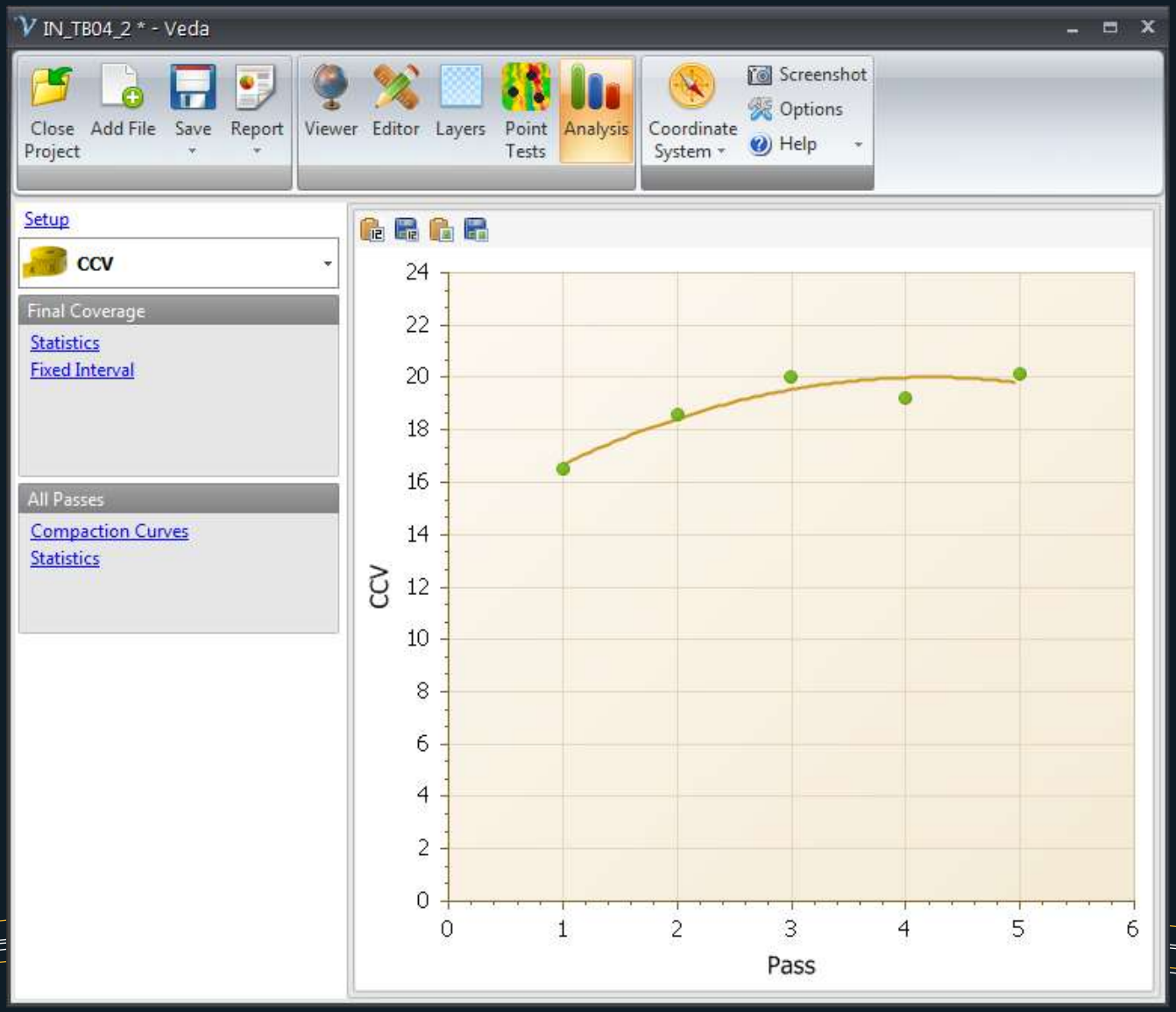
View IC Data Maps



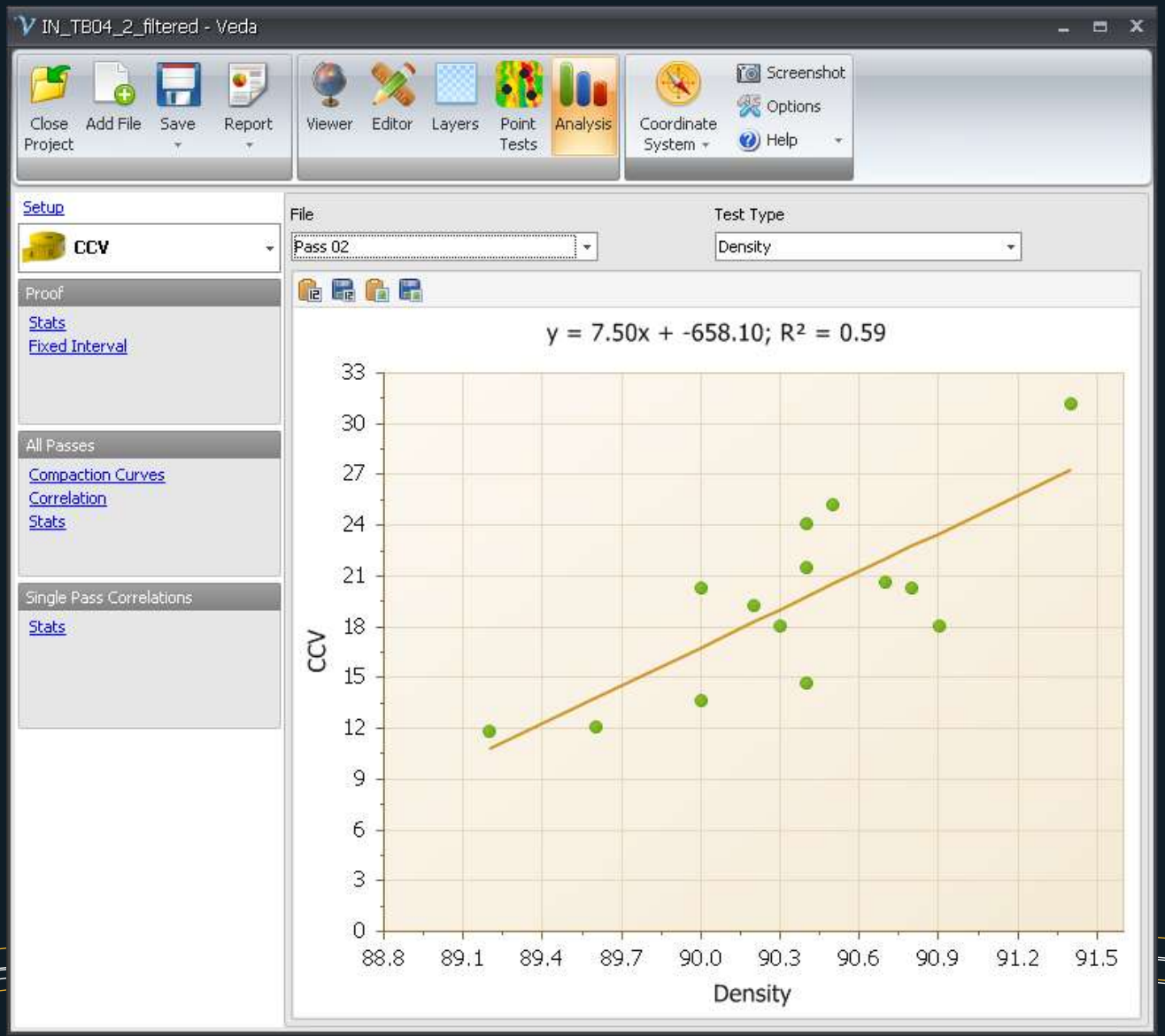
Analyze IC Data



Compaction Curve

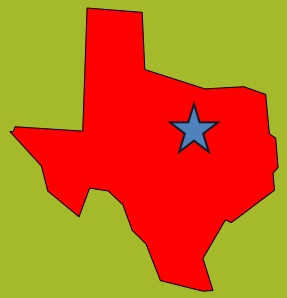


Correlation Analysis

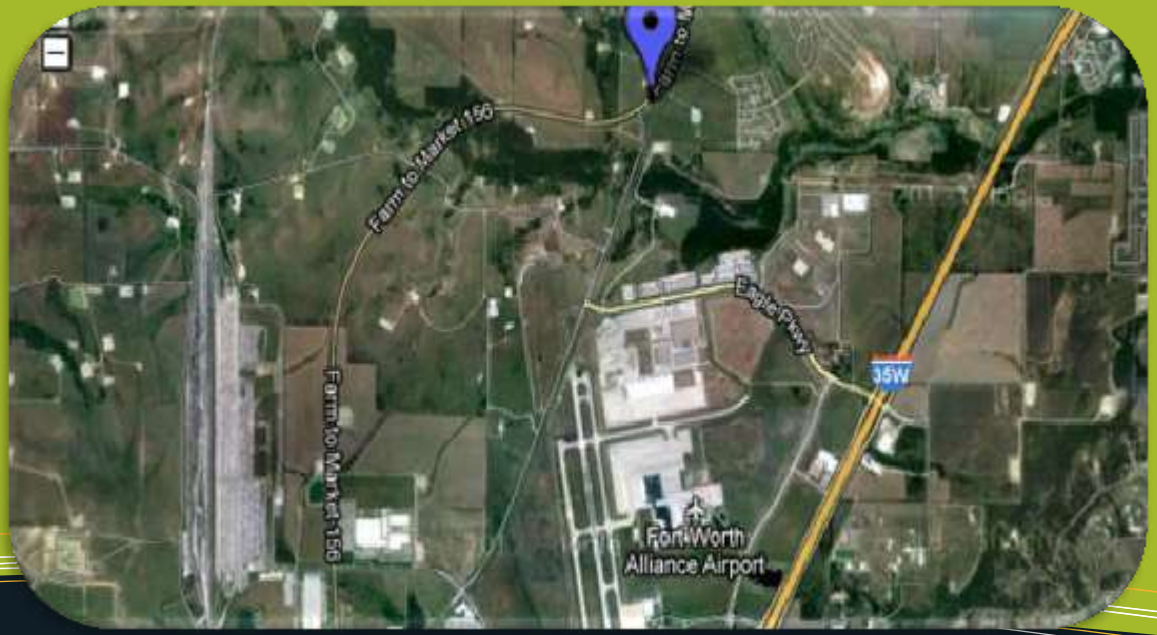


4.
National IC Implementation

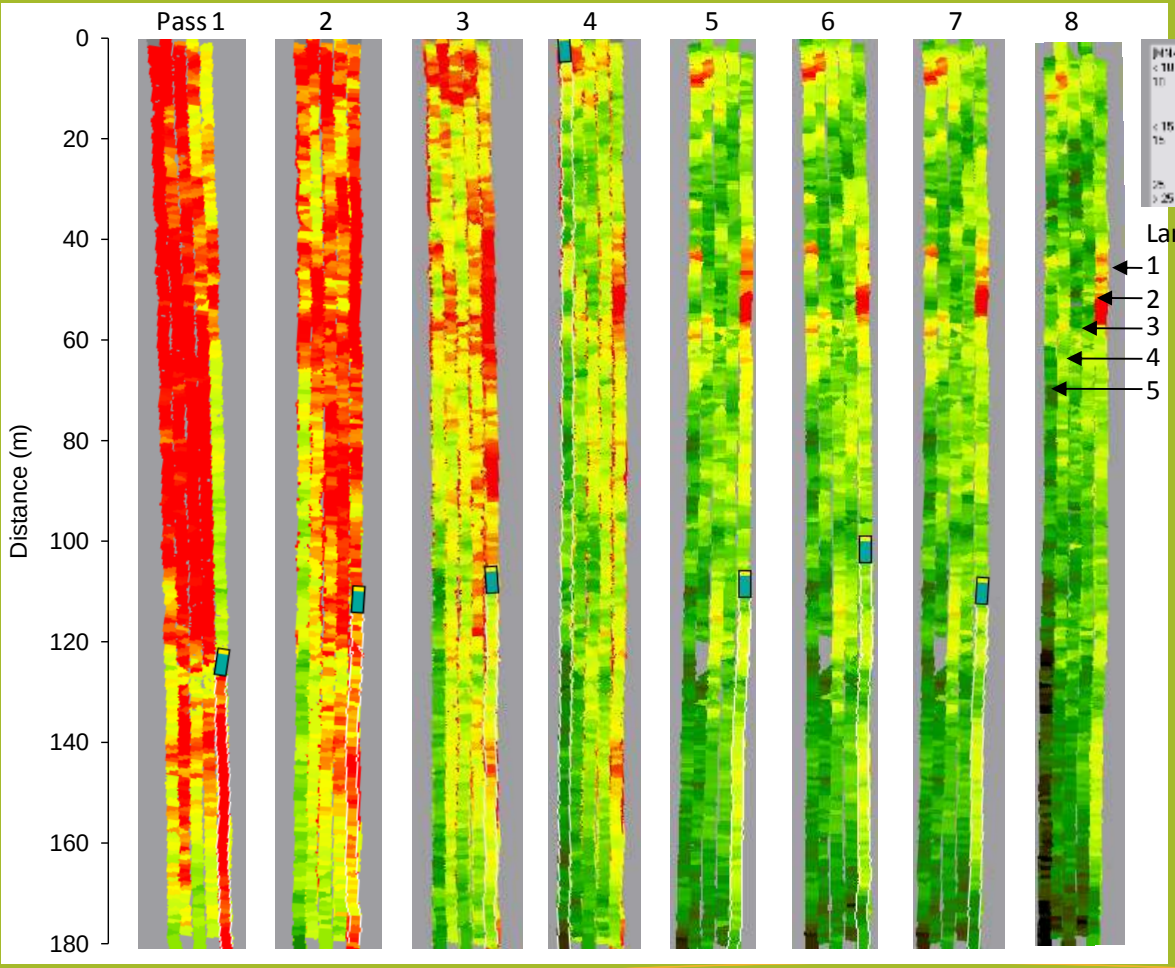
TxDOT IC Demo



- FM 156, Fort Worth, TX, 2008
- FHWA/TPF IC Study
- Cohesive SG, Lime Stabilized SG, and Aggregate Base

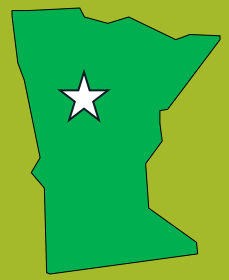


Identify Localized Weak Area

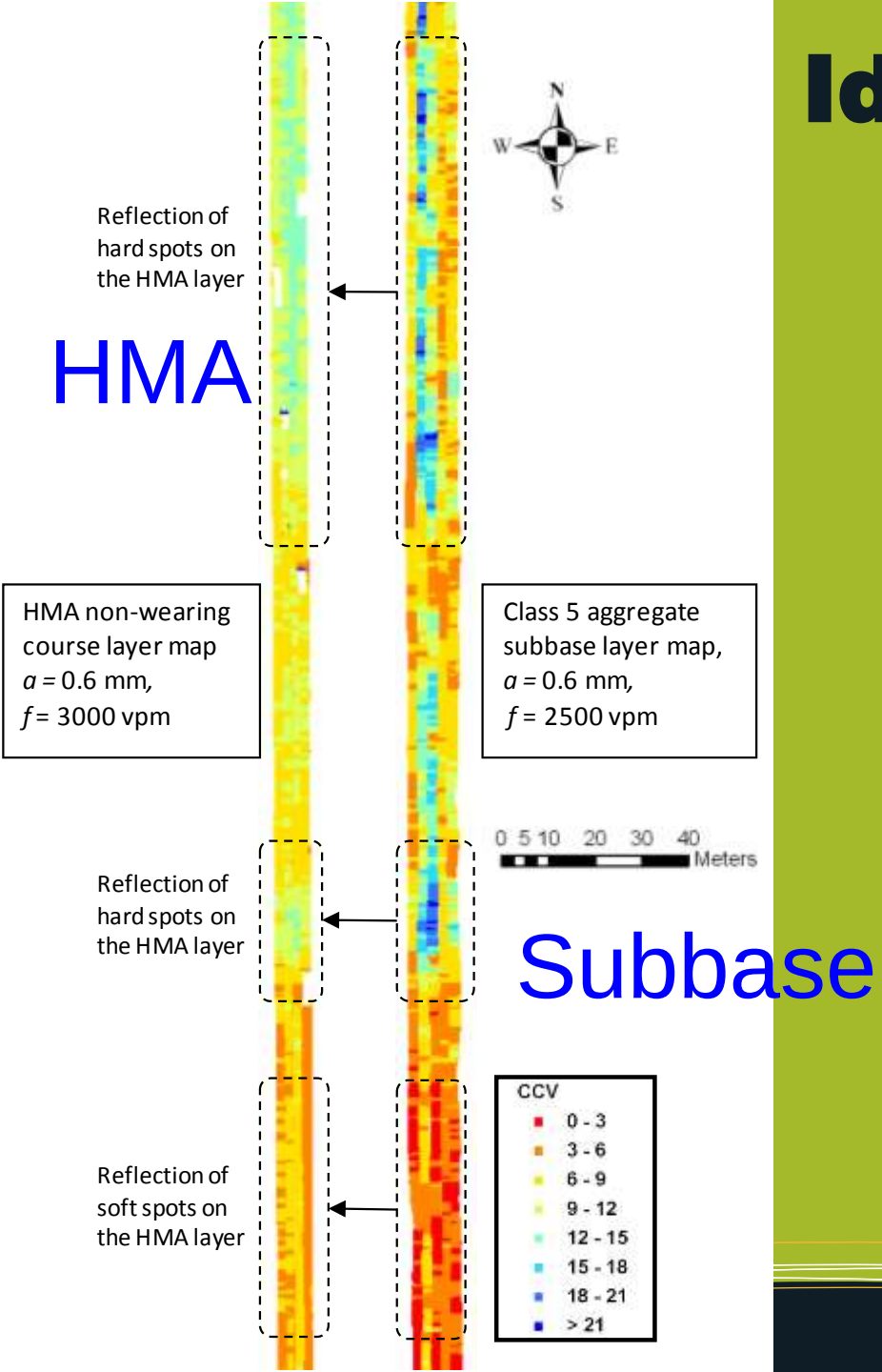


MnDOT IC Demo

- Route 4, Kandiyohi County, MN
- New asphalt construction
- Mapping existing subbase

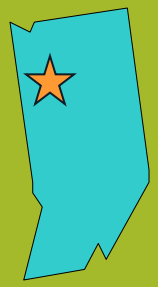


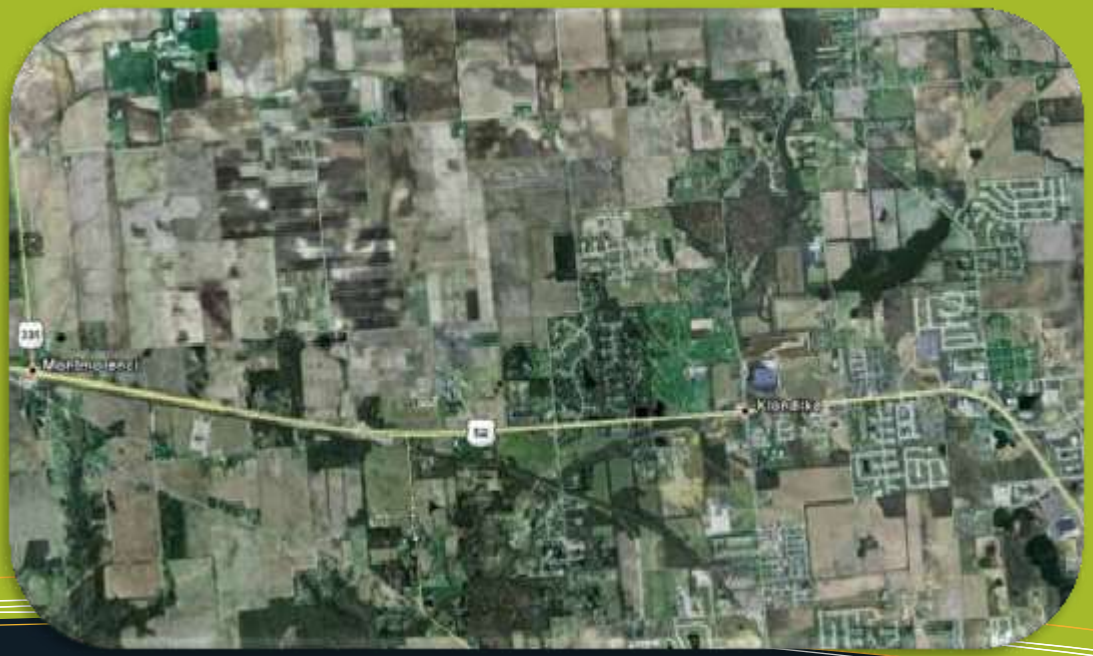
Identify Weak Spots



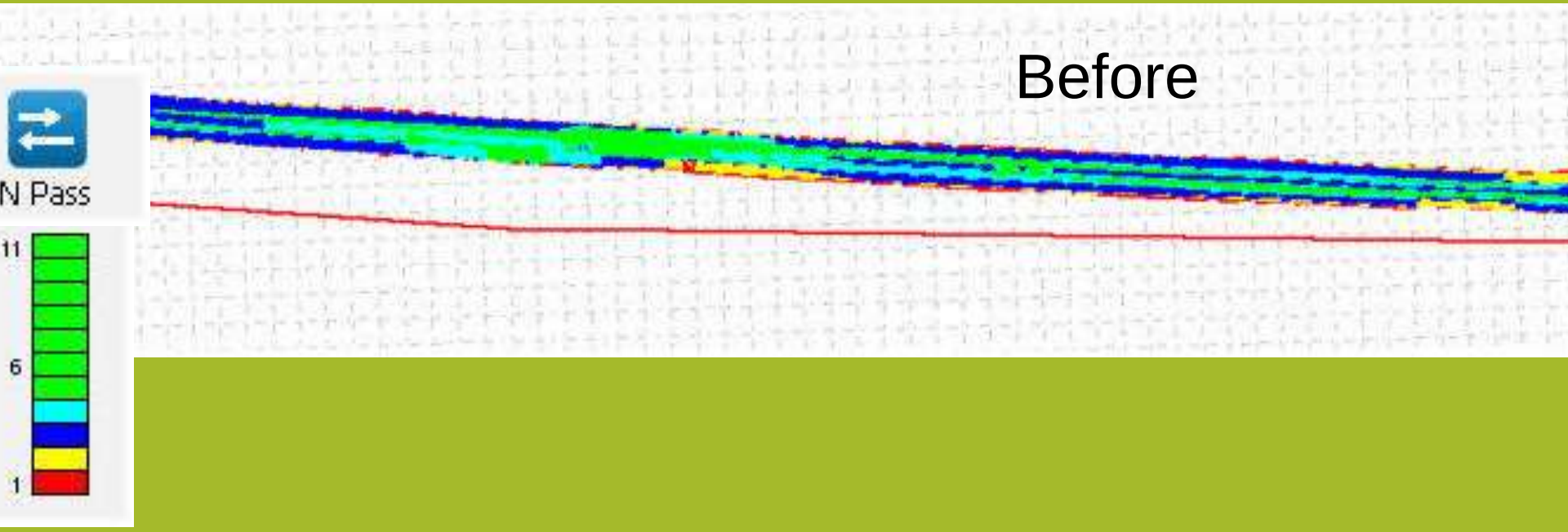
INDOT IC Demo

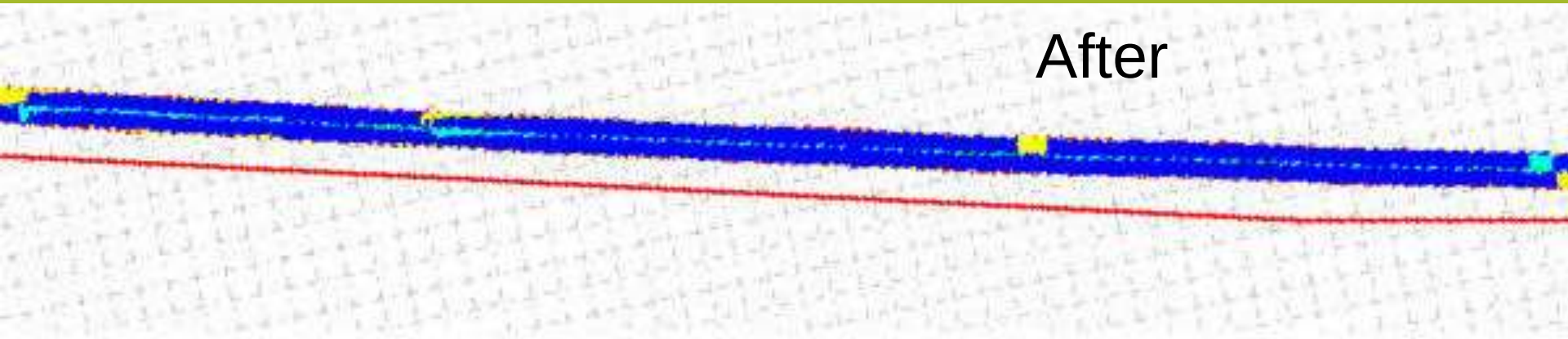
- US 52, West Lafayette, IN
- New HMA overlay





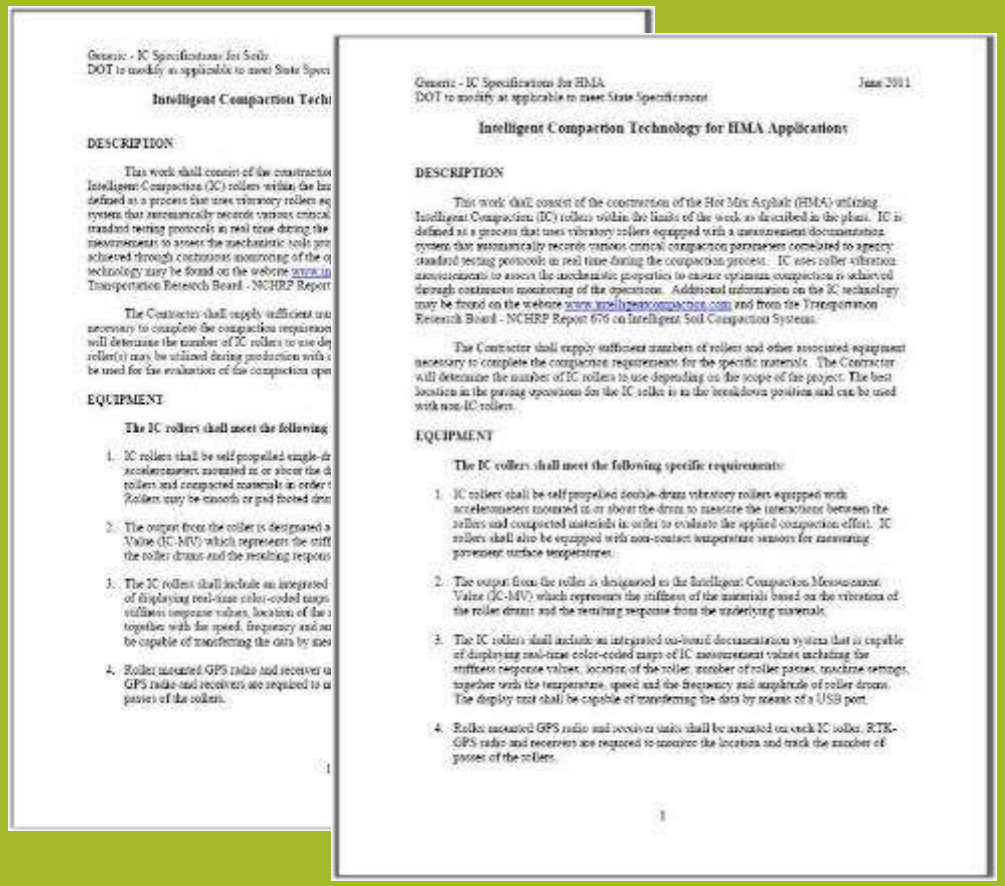
Improved Rolling Pattern





National IC Guide Specs

FHWA Soils/Asphalt IC



Generic - IC Specifications for HMA
DOT to modify as applicable to meet State Specifications

June 2011

Intelligent Compaction Technology for HMA Applications

DESCRIPTION

This work shall consist of the construction of the Hot Mix Asphalt (HMA) utilizing Intelligent Compaction (IC) rollers within the limits of the work as described in the plans. IC is defined as a process that uses vibratory rollers equipped with a measurement documentation system that automatically records various critical compaction parameters correlated to agency standard testing protocols in real time during the compaction process. IC uses roller vibration measurements to assess the mechanistic properties to ensure optimum compaction is achieved through continuous monitoring of the operations. Additional information on the IC technology may be found on the website www.intelligentcompaction.com and from the Transportation Research Board - NCHRP Report 676 on Intelligent Soil Compaction Systems.

The Contractor shall supply sufficient numbers of rollers and other associated equipment necessary to complete the compaction requirements for the specific materials. The Contractor will determine the number of IC rollers to use depending on the scope of the project. The best location in the paving operations for the IC roller is in the breakdown position and can be used with non-IC rollers.

EQUIPMENT

The IC rollers shall meet the following specific requirements:

1. IC rollers shall be self propelled double-drum vibratory rollers equipped with accelerometers mounted in or above the drum to measure the interactions between the rollers and compacted materials in order to evaluate the applied compaction effort. IC rollers shall also be equipped with non-contact temperature sensors for measuring pavement surface temperatures.
2. The output from the roller is designated as the Intelligent Compaction Measurement Value (IC-MV) which represents the stiffness of the materials based on the vibration of the roller drums and the resulting response from the underlying materials.
3. The IC rollers shall include an integrated on-board documentation system that is capable of displaying real-time color-coded maps of IC measurement values including the stiffness response values, location of the roller, number of roller passes, machine settings, together with the temperature, speed and the frequency and amplitude of roller drums. The display unit shall be capable of transferring the data by means of a USB port.
4. Roller mounted GPS radio and receiver units shall be mounted on each IC roller. RTK-GPS radio and receivers are required to monitor the location and track the number of passes of the rollers.

1

AASHTO PP 81-14

Standard Practice for

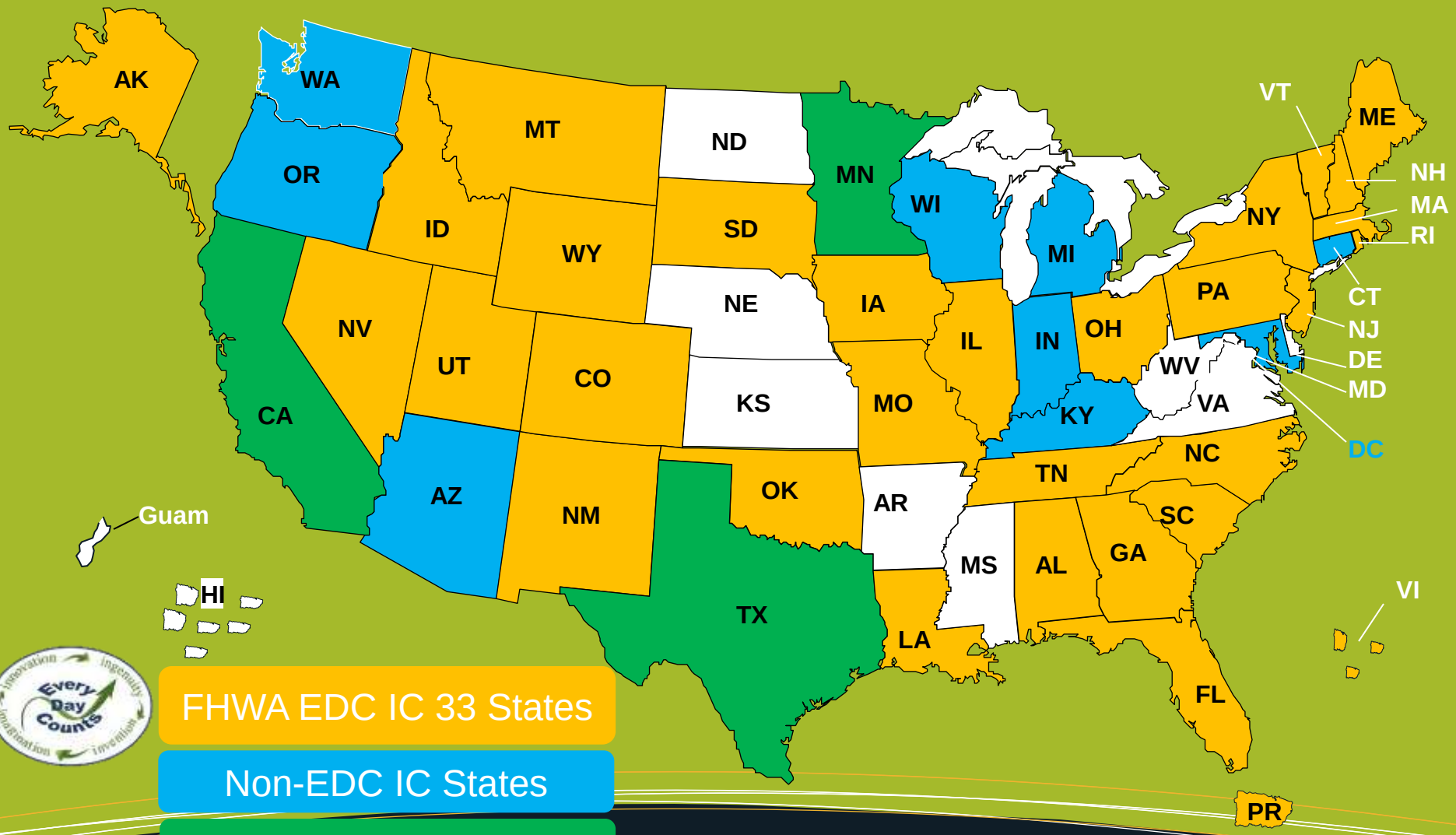
Intelligent Compaction Technology for Embankment and Asphalt Pavement Applications

AASHTO Designation: PP 81-14[1]

AASHTO
THE VOICE OF TRANSPORTATION

American Association of State Highway and Transportation Officials
444 North Capitol Street N.W., Suite 249
Washington, D.C. 20001

IC National Deployment



MNDOT IC Implementation

Percent of MnDOT Projects meeting project selection requirements.

(Earthwork and Asphalt Pavements)

2014
(10%)

2015
(10-15%)

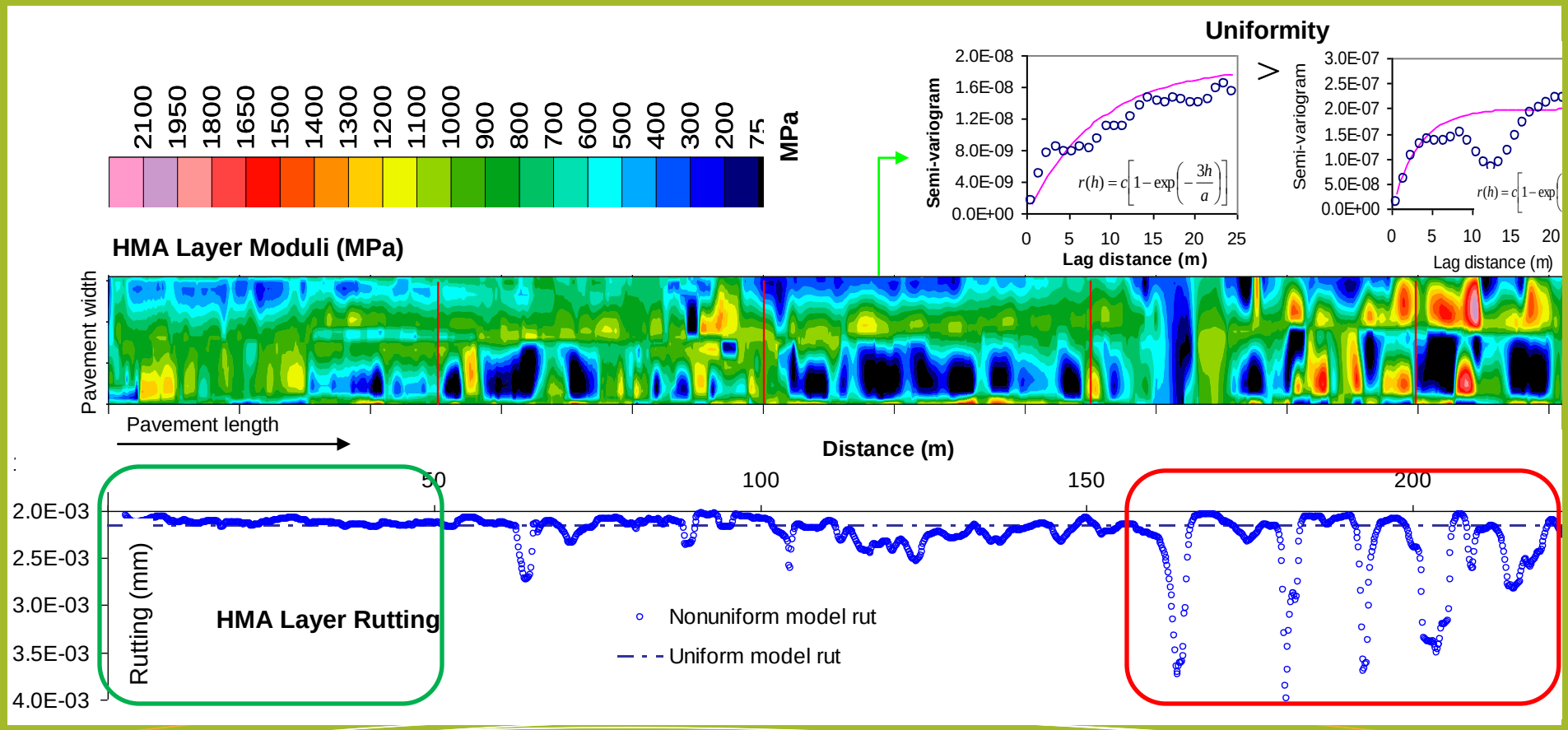
1st Year – Implementation of Veda

2016
(40-50%)

2017
(50-75%)

2018
(100%)

Uniformity and Performance



Xu et. al., J. Materials and Structures, RILEM (2012)

Benefits of IC

- Improve compaction…
  better performance
- Improve efficiency…
  cost savings
- Increase information…
  better QC/QA

Consistency & Uniformity

Further Info on IC

Website

IntelligentCompaction.com

Email

ICSupport@TheTranstecGroup.com

Phone

US +1 (512) 659-1231