Meeting Minutes: TPF-5 (334) Veta Enhancements & Technology Exchange (Meeting No. 7)

Date: May 22, 2018
Minutes prepared by: Rebecca Embacher and George Chang
Location: WebEx and In-Person (NRRA Conference Attendees)

Attendance

Pooled Fund State Contacts:

Participated	State	State Contact
☒	Alaska	Richard Giessel
☒	Alaska	Dan Gettman
☐	California	Ebi Fini
☐	California	Chuck Suszko
☐	California	Blair Anderson
☐	Connecticut	Dave Howley
☒	Connecticut	John Henault
☐	Georgia	John Martin
☒	Illinois	Brian Hill
☒	Maine	Ulrich Amoussou-Guenou
☒	Maine	Dale Peabody
☐	Maine	Casey Nash
☒	Minnesota	Rebecca Embacher
☒	Minnesota	Curt Turgeon
☒	Mississippi	Alex Middleton
☒	Missouri	Bill Stone
☐	Missouri	Dan Oesch
☒	New York	Zoeb Zavery
☒	New York	Michael Heim
☒	Ohio	Craig Landefeld
☒	Oregon	Larry Illg
☐	Oregon	Mike Stennett
☒	Pennsylvania	Dan Clark
☐	Pennsylvania	Sheri Little

Additional Attendees: Julia Miller, Ross Adam (Kentucky), Soheil Nazarian (UTEP)

FHWA:

Participated	Contact
☒	Michael Arasteh
☒	Steven Cooper
☒	Richard Duval
☐	Kevin Kliethermes
☐	Antonio Nieves

The Transtec Group:

Participated	Contact
☒	George Chang
☒	Jason Dick

Decisions Made

- None

Action items

- Transtec and MnDOT | Generate draft list of tasks for SHRP2 funding related to the paver mounted thermal profile method and dielectric profile method (i.e., RDM).
- Pooled Fund Participants | Review draft task list and provide feedback.
- MnDOT | Schedule more in-depth drive through of the latest features in Veta (i.e., Live Veta Demonstration).
- Steve Cooper | Send Embacher information on the next RDM peer exchange meeting to share with pooled fund.

Agenda

- FHWA Update
- Pooled Fund Participants and Budget
- AASHTO Provisional | Standardized File Format
- Veta 5+ Enhancements
- Veta Filter Group Export
- LandXML and Stationing
- Thermal Segregation Index (TSI)
- NYDOT | Pass Counts – Double Drum Roller

- State Updates

Next Meeting

Date: TBD
Time: TBD
Location: WebEx
Agenda items: Live Veta Demonstration of Latest Features

Meeting Notes

FHWA Update

Richard Duvall:

- FHWA BIM for Infrastructure (formerly CIM) is underway. Tried to be in-line with BIM for Bridges.
- Funding is unknown to support TPF (Veta), probably in FY19.
- Look into connection between IC and BIM via Veta.

Mike Arasteh

- Veta is under FHWA's radar.
- FHWA is looking into ICT to cover all intelligent construction technologies.
- Identified gaps: ROI, field parameters, Veta implementation, forensic ID.
- Mike is the FHWA liaison for the NCHRP 24-45 soils IC project.

Stephen Cooper

- FHWA keep funding SHRP 2 R06C – probably until March 2019.
- Have planned 6 (of 10) more PMTP workshops to go. Contact FHWA if any interests.
- The SHRP2 returned fund ($50k) has been provided to this TPF study.
- $75k more for technical transfer.
- AKDOT wants more funding on GPR/RDM. Stephen will visit AKDOT soon.

Pooled Fund Participants and Budget

Embacher: See attached slides for additional details. Discussed the following:

- 13 States participating
- SP&R Fund Transfer Report
- SPR&R Budget Summary
- SHRP2 transfer of funding to TPF-5 (334) - $50,000
- Completion of phase I tasks.

Peabody (Maine): would like to analyze RDM data using Veta.

Embacher will work with Transtec to generate a road map for use of the current SHRP2 funds and future funds as they become available. Pooled fund participants are requested to review this draft and provide feedback.

Embacher explained dielectric constants and RDM.

AKDOT has been conducting pilot RDM projects (with calibration strip, demo, and training) and may use RDM for acceptance in the future. Defect parameters and etc. (e.g., >= 500 ft or >= 8 sq. ft. will map areas in google earth).

MEDOT also has one RDM unit. Data management is tough. Will look forward to using Veta for RDM analysis. Piloting RDM system on 500 ft test sections.

Stephen Cooper will send Rebecca the information on the next RDM peer exchange meetings to share with Pooled Fund.

AASHTO Provisional | Standardized Format

Embacher / Turgeon: The AASHOT Provisional for standardized file formats has been submitted to the AASHTO Committee. The following is the scheduled of the process, with the assumption that the ballot passes.

Step in Process	Date
Final Draft Submitted	March 2018
Tech Section Ballot Closes	May 30, 2018
Full Committee Ballot	September 2018
Publication	February / March 2019

Veta 5+ Enhancements

Chang: Discussed the latest enhancements in Veta 5.0 and 5.1 and discussed upcoming features in 5.2. See attached slides for details.

Veta Filter Group Export

Embacher discussed how the new report for export of "Data lot filter group settings" can be used to complete quality control and/or quality assurance on completed Veta projects. MnDOT has created a excel workbook that imports these exported reports and provides feedback on potential review items within the project. See attached slides for additional details.

The link to the latest version of the above referenced workbook can be found at:

http://www.dot.state.mn.us/materials/amt/icdocs/forms/ICT-101-102-103%2003.12.18.xlsm

A flow chart of recommended review items can be found at:

http://www.dot.state.mn.us/materials/amt/icdocs/Veta-Forms%20Submittal%20Review%20Workflow%2005.02.18.pdf

LandXML and Stationing

Embacher: (see attached slides for snapshots within Veta) MnDOT added additional funds to the TPF-5 (334) contract to pay for the ability to import LandXML files into Veta, to allow for use of stationing (in the location filter) for trimming of data and to allow use of stationing and offset distances with spot test data. These features were included to address the large gap in deployment efforts that have repeatedly been encountered in Minnesota and other states. These issues are the following:

- Design Files: The complexity, for designers, to create complex shape files for use in trimming of IC data. There is often drifting associated with complex shapes from the centerline alignment, how to deal with tapers and other oddities encountered on projects. Additionally, any changes to the paving operation, may require the need to immediately re-create complex shapes during construction operations (e.g., 18 ft paving instead of 12 ft paving, etc.).

- Rover Coordinates: Inspectors labeling the data lot boundary coordinates correctly using the AASHTO standardized naming convention. Feature code libraries were created, however, the state still encountered significantly labeling issues for 95 percent of the projects. These errors required extensive time to create in order that users would know which coordinate went with a given data lot within Veta. Additionally, due to these errors, the turn-around time for providing these rover coordinates to the individual(s) creating the Veta projects was unreasonable. Often one to two weeks later.

- Spot Tests: It is dangerous for inspectors to capture coordinates for the core locations, as often traffic control is minimal during the marking of cores and it is extremely late in the day after paving efforts have concluded for the given work day. Consequently, the use of station and offset would allow for import of spot test data without the need of rover coordinates.

Thermal Segregation Index

MnDOT has encountered numerous instances where the range statistic was not adequately capturing thermal segregation that occurs in the form of longitudinal streaks. This type of segregation can be caused by the hoppers not being 50 percent or more filled, extension augers not being used during the paving operation, inadequate delivery methods (e.g., windrows not overlapping) and more. Consequently, there were instances where the department was paying a monetary price adjustment in the form of an incentive for thermal profiling, while there was severe material segregation present in the freshly paved mat. Therefore, MnDOT has developed a new geo-spatial statistic using PMTP data from 2014 to 2017 (131,000 sublots) for the identification of thermal segregation in lieu of the current, univariate statistic using maximum and minimum temperatures (range / differential statistic). This statistic, the thermal segregation index (TSI), has been incorporated into Veta. (see slides for additional details) and is being piloted in Minnesota during the 2018 construction season.

NYDOT | Pass Counts – Double Drum Roller

Chang: NYDOT is interested in obtaining roller coverage results using either one or two drums from double drum steel rollers. Chang discussed how Vendors currently collect drum locations and calculate pass counts. See attached slides for additional details.

State Updates

AK: Provided RDM update earlier in minutes.

CA:

CT:

GA:

IL:

- Just started IC implementation. Will have an update on IC spec and will consider the usage of Veta.

OH:

- Use of PMTP and Veta on 4 pilot projects this summer.
- Purchasing RDM system.

OR:

- Increase coverage % criteria in 2019.
- Industry pressure on ORDOT to show value of use of technology.
- Will do some research.
- Project Selection for when to consider using IC: >= 40,000 tons of asphalt, but avoiding projects with many bridges and no cell coverage.

ME:

- Back off IC. Struggle to work with industry. Working with industry for value.
- Excited about PMTP and RDM.

MS:

MO:

- We did successful IC-IR projects and great feedback from industry in 2017 (with FHWA AID).
- We will continue IC-IR programs in 2018 target large projects (on MoDOT funding). Tweaked IC and IR specifications.
- 13 projects through October 2018 lettings.
- Looking at tweaking spec. to look at temperature of when to roll.

NY:

- 10 IC projects in 2018. Simple spec.
- Goal: to understand complexity.

PA:

MN:

- See above updates.
- Pilot TSI in 2018.
- Partner meetings on workmanship issues.
- eTicketing of tracking asphalt trucks.
- Full implementation PMTP-IC in 2018. (projects >= 4 lane miles)
- Take IC-PMTP spec. to the next levels.
- Also keep trying RDM.

TPF-5 (334) On-Line Meeting #8

Rebecca Embacher | Advanced Materials and Technology Engineer

May 22, 2018

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AMT Website | http://www.dot.state.mn.us/materials/amt/index.html

Meeting Agenda

- FHWA Update
- Pooled Fund Participants and Budget
- AASHTO Provisional | Standardized File Format
- Veta 5+ Enhancements
- Veta Filter Group Export
- LandXML and Stationing
- Thermal Segregation Index (TSI)
- NYDOT | Pass Counts – Double Drum Roller
- State Updates

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FHWA Update

TPF-5 (334) IC VETA Pooled Fund

- FHWA Initiative on “BIM-Infrastructure” formerly CIM – Connie Yew – FHWA HQ
- Richard Duval - FHWA TFHRC, Pooled Fund Liaison
  - FHWA Funding is still unknown – To be discussed in FY-19 FHWA PAL Meeting
  - FHWA has supported VETA over the years
  - FHWA does see the connection to GIS & LandXML or similar schemas for data usage for performance and potential of data gathered by IC for BIM….A-04, A-16
- Mike Arasteh – FHWA RC
  - Lead on IC Technical Support
- Steve Cooper – FHWA RC
  - SHRP 2 R06C –GPR RDM
  - Funding

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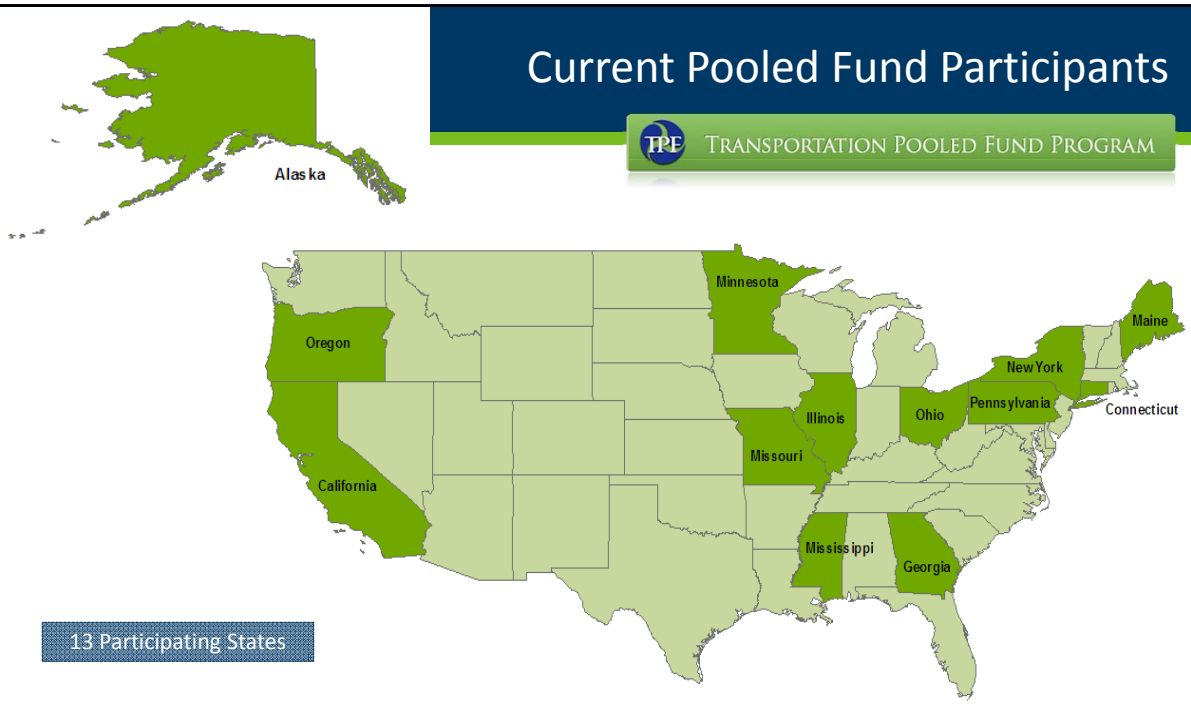
Pooled Fund Participants and Budget

Current Pooled Fund Participants

TPF TRANSPORTATION POOLED FUND PROGRAM



13 Participating States

SP&R Fund Transfer Report

State	Received	Date Received
Alaska	$20,000	2017
California	$25,000 $25,000	03/21/16 01/10/17
Connecticut	$10,000 $10,000	06/06/16 02/27/17
FHWA (SHRP-2)	$50,000	05/11/18
Georgia	$25,000 $25,000 $25,000	02/27/17 08/21/17 05/11/18
Ohio	$25,000	05/11/18
Illinois		
Maine	$17,500	02/27/17

State	Received	Date Received
Minnesota	$50,000 $50,000 $50,000 $84,090	02/10/16 02/13/17 01/03/18 Non-SRC Funds
Mississippi	$25,000	02/27/17
Missouri	$25,000 $25,000 $25,000	03/21/16 02/27/17 05/11/18
New York	$4,000 $25,000	2017 01/03/18
Oregon	$25,000	01/10/17
Pennsylvania	$10,000 $25,000 $25,000	02/10/16 08/30/16 01/03/18

SP&R Budget Summary

Total Commitments	$	824,000
Total Received	$	621,500

Expenditures	Encumbrances	Actual Paid
Transtec Group, Inc.	$451,189.94	$208,438.15
IICTG Workshop	$16,023.60	$16,023.60
Totals	$467,213.54	$224,461.75

Available Balance	$	154,286.46

Pool Fund through 2020

Action Item

- SHRP2 Funding
  - PMTP Method
  - Dielectric Profile Method (i.e., RDM)
- Action Items:
  - Proposed tasks for $50,000
  - Future tasks (upcoming funding when available)

Tasks A

Task	Hours Budget	Hours Accrued This Period	Total Hours Accrued To Date	% of Budget Hours Used
1	7	8	9	10
A.1: Reporting (F-06)	214	0	214	100.0
A.2: Data Management (A-11)	270	0	270	100.0
A.3: Filtering (C-02)	65	0	65	100.0
A.4: Analyses (E-09)	67	0	67	100.0
A.5: Spot Tests (D-01)	156	0	156	100.0
A.6: Mapping (B-01)	166	0	166	100.0
A.7: Data Management (A-12)	48	0	48	100.0
A.8: Mapping (Phase 7)	35	0	35	100.0
A.9: Analyses - Tabular Listing (Phase 7)	9	0	9	100.0
A.10: Analyses - Quality Control Chart (Phase 7)	108	0	108	100.0
A.11: Reporting (Phase 7)	34	0	34	100.0
A.12: Bug Repairs	86	0	86	100.0

All tasks **completed** prior to contract end date of February 28, 2018

Tasks B
% of Budget Hours Used

Task	Hours Budget	Hours Accrued This Period	Total Hours Accrued To Date	% of Budget Hours Used
1	7	8	9	10
B.1: Data Management: Store/Export Original Alignment Files	232	15	46	19.7
B.2: Data Management: Import/Export Data	210	15	43	20.3
B.3: Data Management: Add Station Support	400	30	85	21.3
B.4: Mapping: Display Multiple Maps	166	13	35	21.4
B.5: Mapping: Enhance the Ruler	20	1	4	17.7
B.6: Mapping: Load Different Types of Data	558	43	121	21.6
B.7: Filtering: Sublot Filters	85	6	18	20.9
B.8: Filtering: Filter Group Manager	182	14	39	21.4
B.9: Filtering: Custom Lifts	66	5	14	21.5
B.10: Filtering: Crop Exclusion Filters	25	3	7	28.4
B.11: Analyses: Creation of Override Filter Groups	107	8	21	19.9
B.12: Analyses: Calculate Impacts Per Foot	47	3	7	15.1

Invoiced through April 30, 2018

DEPARTMENT OF TRANSPORTATION

File Format of Intelligent Construction Data

AASHTO Provisional

AASHTO Committee

Step in Process	Date
Final Draft Submitted	March 2018
Tech Section Ballot Closes	May 30, 2018
Full Committee Ballot	September 2018
Publication	February / March 2019

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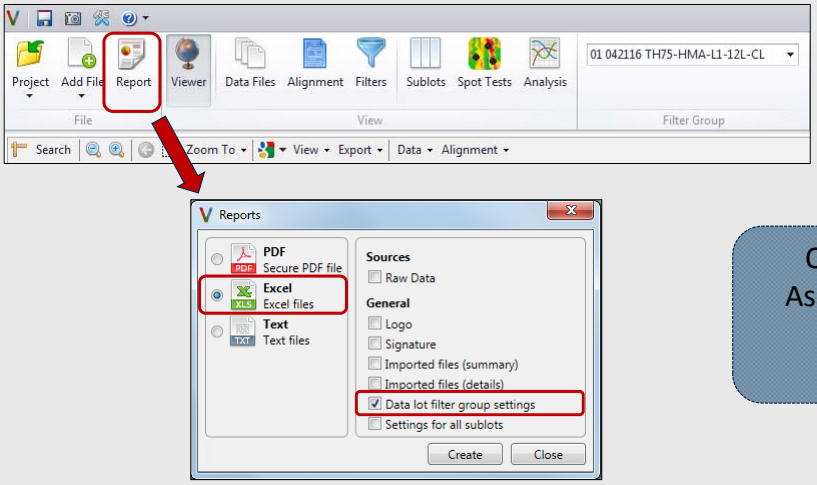
Veta 5+ Enhancements - Update

George Chang

Veta Filter Group Export

Report Export

Filter Group Settings Export



Quality Control/Quality Assurance of Veta Projects
Data Filters
Operation Filters

Form ICT-101
Potential Review Items

Minnesota Department of Transportation (MnDOT) — Form ICT-101
(2016) Quality Management - Paver Mounted Thermal Profile Method — 3/12/2018
(2016) Quality Management Special - Intelligent Compaction Method

Review of Veta Filter Group Settings

Veta Export File: SP4567-89 TH75 PMTP V5.1.7 - Data Lot Filter Groups - 20180306 - 113521.xlsx
Veta Version: 5.1.7 - BETA
File Name: SP4567-89 TH75 PMTP V5.0
Generator: MnDOT
Total Data Lot Filter Group Names: 8

☐ Filter Group Settings Review Completed and Approved

Count	Data Lot Filter Group Name	Review Items
1	01 042116 TH75-HMA-L1-12L-CL	None
2	02 042216 TH75-HMA-L1-CL-12R	None
3	03A 042316 TH75-HMA-L1-12L-CL	Location Source = Custom
4	03B 042316 TH75-HMA-L1-12L-CL	Location Source = Custom
5	04A 042616 TH75-HMA-L1-CL-12R	Location Source = Custom
6	04B 042116 TH75-HMA-L1-CL-12R	Time does not match FG Name Location Source = Custom
7	05 042716 TH75-HMA-L1-CL-12R	None
8	06 042916 TH75-HMA-L1-CL-12R	None

Form ICT-102
Paving / Compaction Dates

Minnesota Department of Transportation (MnDOT) — Form ICT-102
(2016) Quality Management - Paver Mounted Thermal Profile Method — 3/12/2018
(2016) Quality Management Special - Intelligent Compaction Method

Review for Potentially Missing Data

Veta Export File: SP4567-89 TH75 PMTP V5.1.7 - Data Lot Filter Groups - 20180306 - 113521.xlsx
Veta Version: 5.1.7 - BETA
File Name: SP4567-89 TH75 PMTP V5.0
Generator: MnDOT
Total Paving Dates: 6

☐ Percent Coverage Review Completed and Approved (Form: IC-108 / PMTP 101)
☐ Compaction/Paving Dates Review Completed and Approved

Count	Dates	Data Lot Filter Group Names		
1	4/21/2016	01 042116 TH75-HMA-L1-12L-CL	04B 042116 TH75-HMA-L1-CL-12R	
2	4/22/2016	02 042216 TH75-HMA-L1-CL-12R		
3	4/23/2016	03A 042316 TH75-HMA-L1-12L-CL	03B 042316 TH75-HMA-L1-12L-CL	
4	4/26/2016	04A 042616 TH75-HMA-L1-CL-12R		
5	4/27/2016	05 042716 TH75-HMA-L1-CL-12R		
6	4/29/2016	06 042916 TH75-HMA-L1-CL-12R		

Form ICT-103 – Department QA
Random Review of 25% of Filter Groups

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Minnesota Department of Transportation (MnDOT) — **Form ICT-103**
(2016) Quality Management - Paver Mounted Thermal Profile Method — **3/12/2018**
(2016) Quality Management Special - Intelligent Compaction Method

Random Review of Start/End Limits and Analyses

Veta Export File: SP4567-89 TH75 PMTP V5.1.7 - Data Lot Filter Groups - 20180306 - 113521.xlsx
Veta Version: 5.1.7 - BETA
File Name: SP4567-89 TH75 PMTP V5.0
Generator: MnDOT
Random Filter Group Names Selected: 2

☐ **Random Review of Start/End Limits and Analyses Completed and Approved**

Count	Random Filter Group Name	Comments
4	03B 042316 TH75-HMA-L1-12L-CL	
7	05 042716 TH75-HMA-L1-CL-12R	

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LandXML & Stationing

MnDOT Funded Amendment

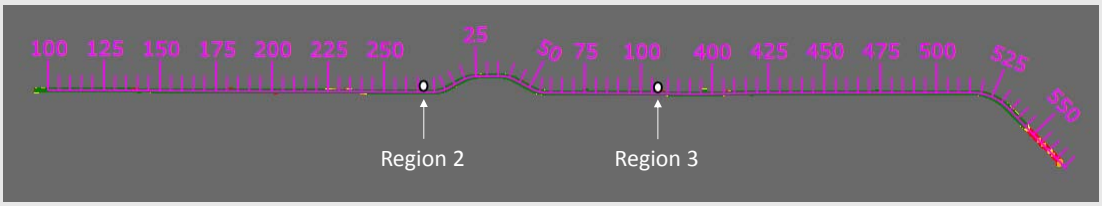
Addresses gap in deployment of IC technology
→ requiring use of rover coordinates for boundary limits.

Category	Task Description	Task Cost
Data Management	Add ability to store and export the original alignment files. Draw alignments and stations from LandXML.	$31,495.76
Data Management	Add station support as an alternative to coordinates throughout software	$52,593.80

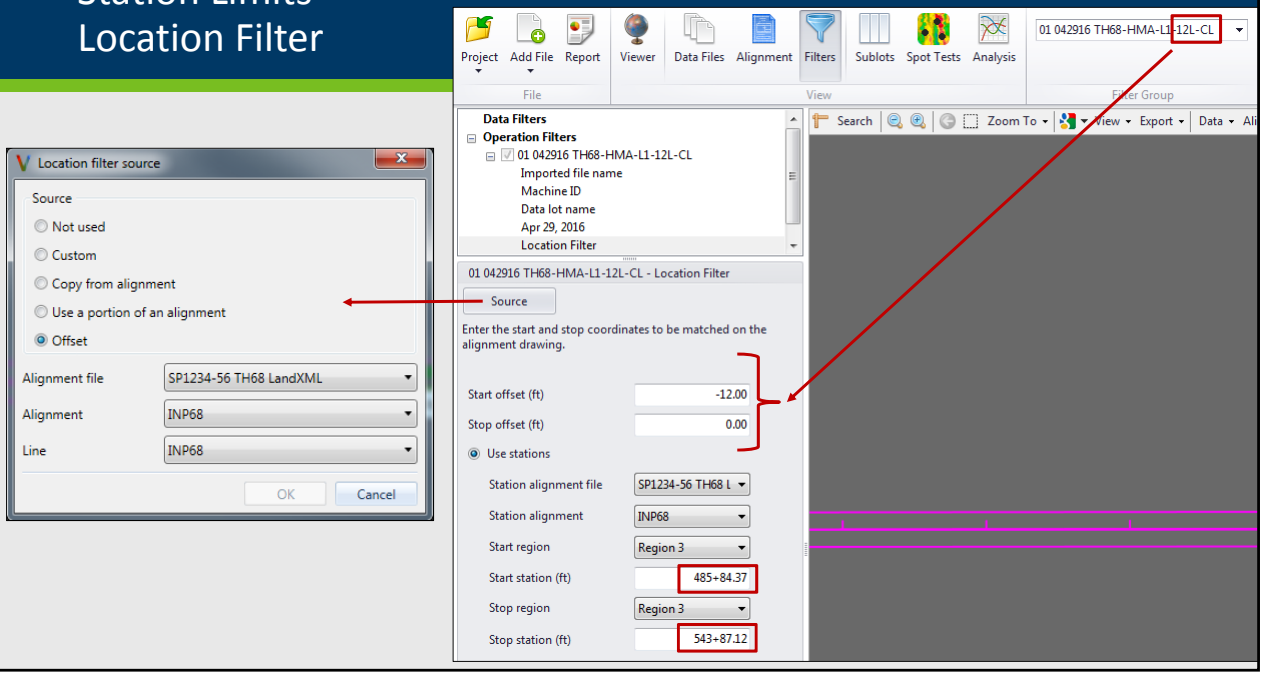
Import LandXML File
Veta 5.2+

Station Regions

Name	Direction	Region location (ft)	New station (ft)	Change (ft)
Region 1	Increasing	100+00.00	100+00.00	0.00
Region 2	Increasing	267+67.14	0+01.02	-26766.13
Region 3	Increasing	375+67.20	375+65.82	-1.37



Station Limits Location Filter



Spot Tests Station and Offset

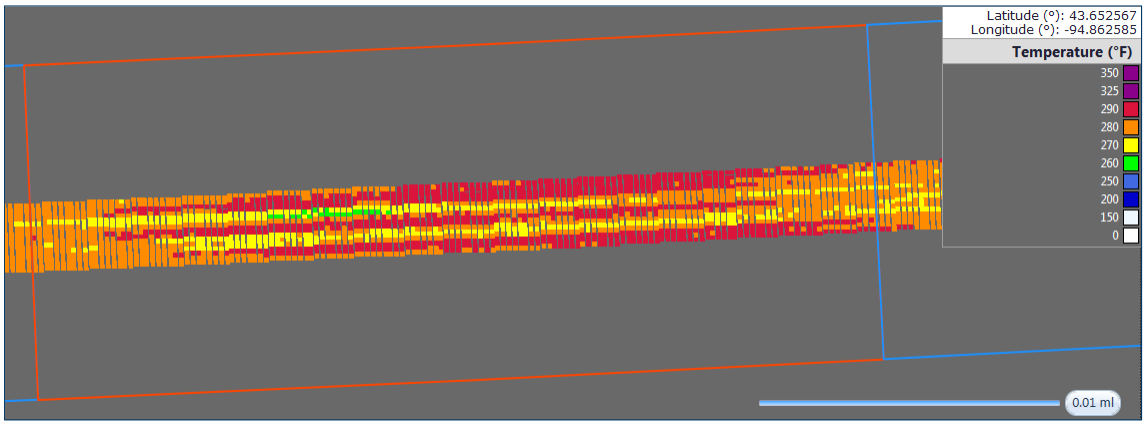
- Part of Task
- To be completed at a later date
  - after file standardization task complete

DEPARTMENT OF TRANSPORTATION

Thermal Segregation Index (TSI)

Why Piloting TSI?

Range = 23.9°F | TSI = 100 | Field Visual = Severe Material Segregation



Thermal Segregation Index (TSI)

Calculated Per Sublot

TSI

Sublot Uniformity (2D)

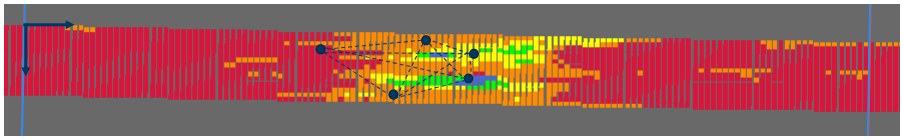
+

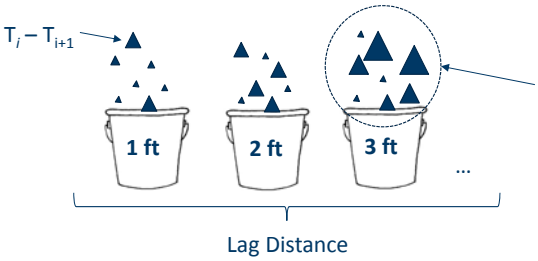
Lateral Uniformity (Streaking)

Sublot Uniformity

"…closer things are more predictable and have less variability…while distant things are less predictable and are less related…"

A semivariogram considers all points and their **distance** with respect to **temperature variance**.





Variance is calculated for each lag distance = **semivariogram**

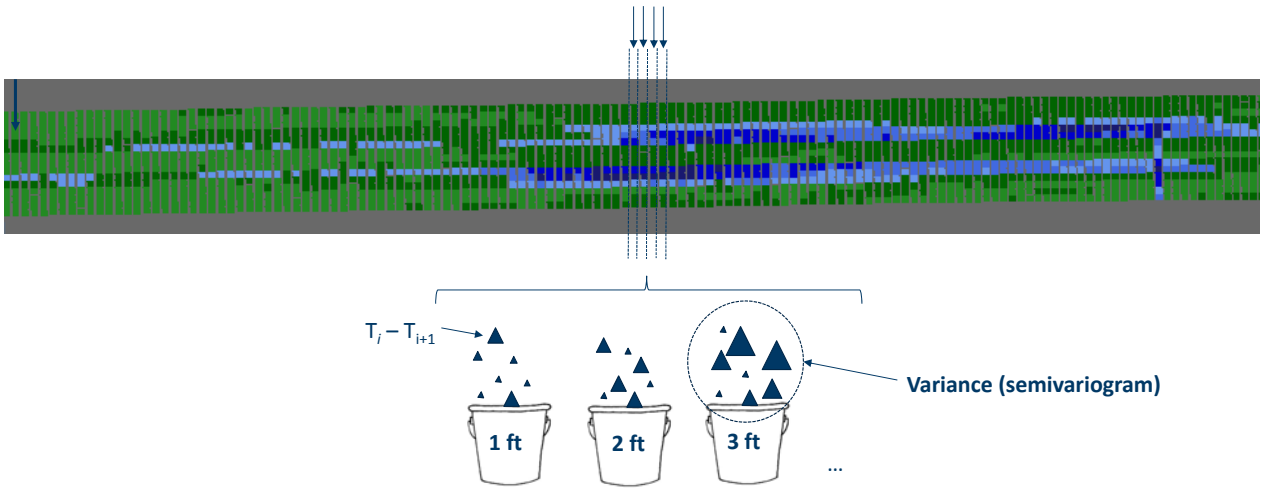
Sublot Uniformity

Found:

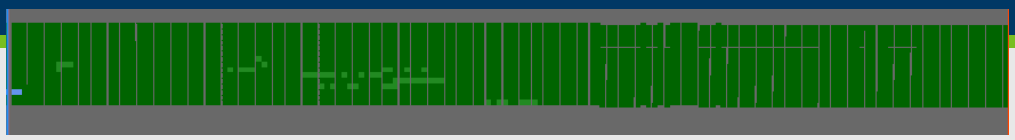
Sublot Uniformity → Standard Deviation

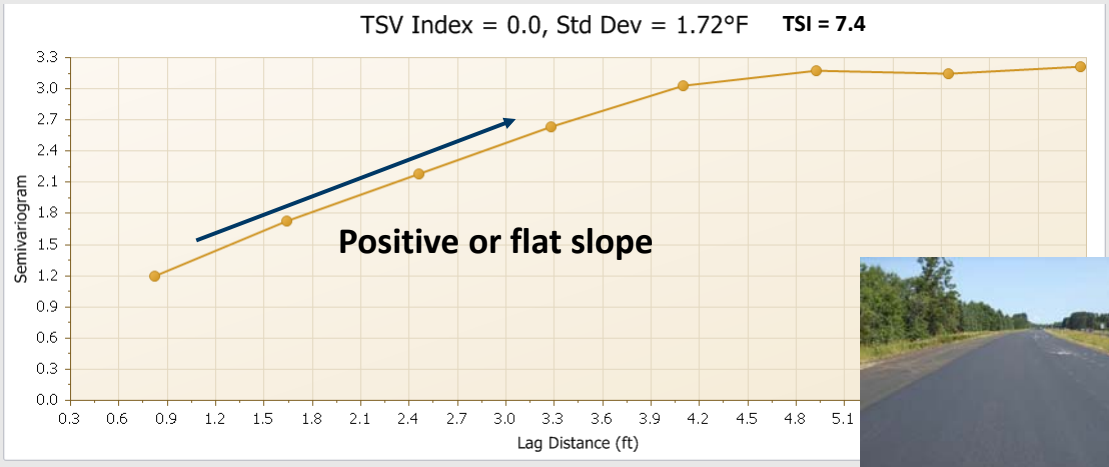
Standard Deviation ≅ Sill *(semivarogram when variance plateaus)*

Lateral Uniformity (Streaking)

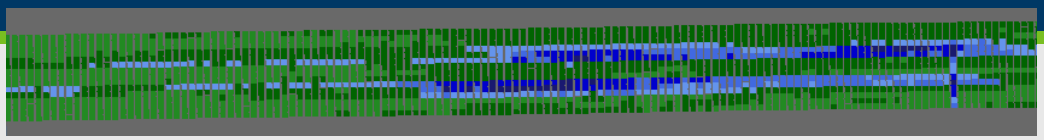


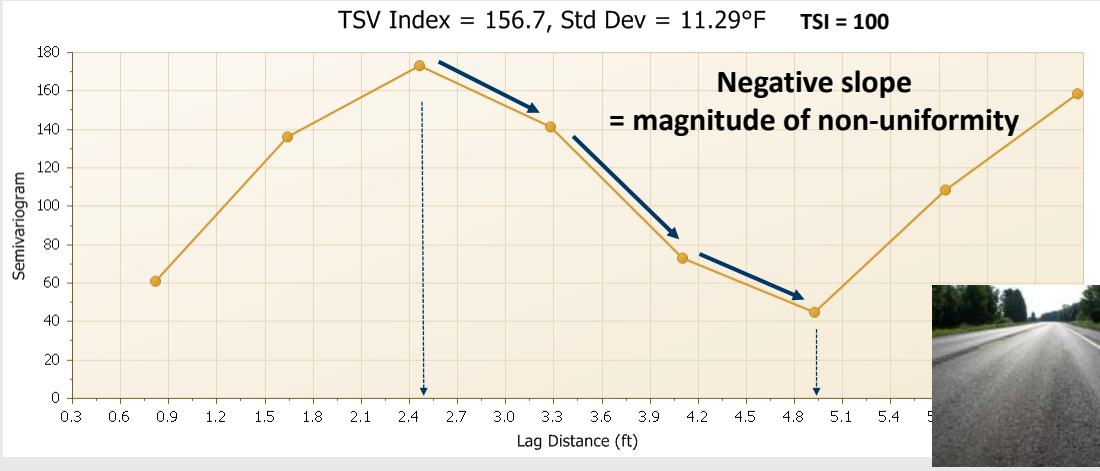
Lateral Uniformity (Streaking) – Low Severity





Lateral Uniformity (Streaking) – High Severity





Lateral Uniformity

Found:

Lateral Uniformity → Transverse Semivariogram (TSV) Index

TSV Index = Sum of the Negative Semivariogram Slopes

TSI Equation

Equation 2016-1 (PMTP):

$$TSI_0 = 0.77\left[C \times \left(\frac{StDev}{StDev_{Severe\ Start}}\right) + (100 - C) \times \left(\frac{TSV}{TSV_{Severe\ Start}}\right)\right]$$

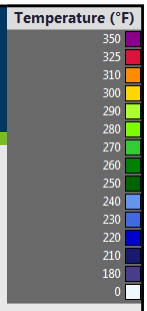
Equation 2016-2 (PMTP):

$$TSI = \begin{cases} TSI_0\ when\ TSI_0 < 100 \\ 100\ when\ TSI_0 \geq 100 \end{cases}$$

Where:

c = percent contribution of *Standard Deviation* to TSI_{Total} (ranges from 0 to 100, default = 50)

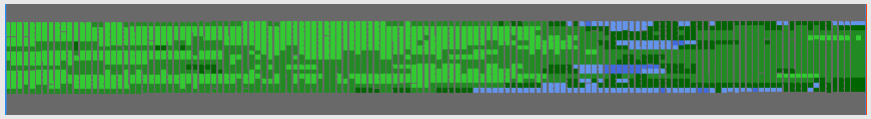
Thermal Segregation Index (TSI) Severity Levels



TSI = 20.9

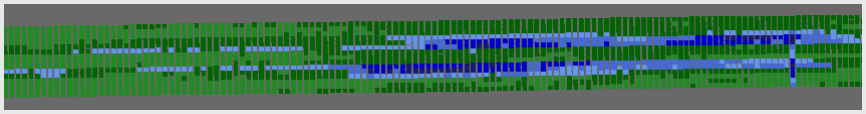
Low < 30

TSI = 53.4



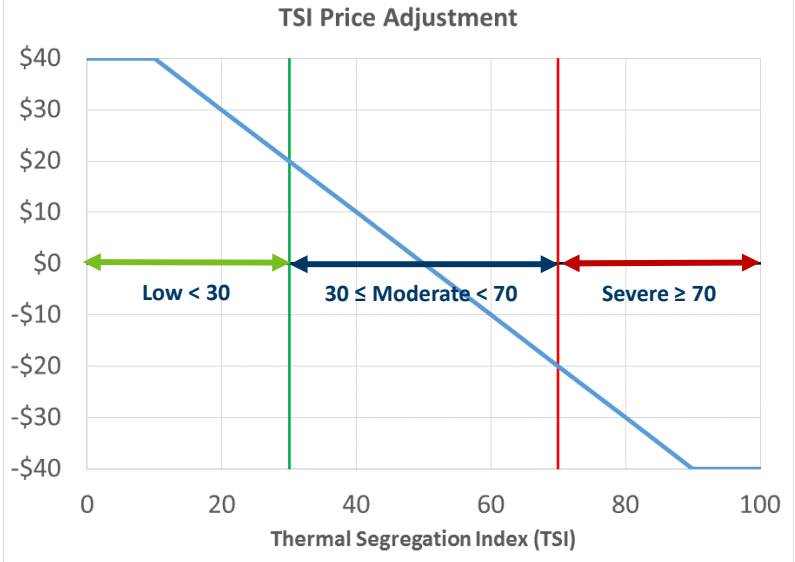
30 ≤ Moderate < 70

TSI = 100



Severe ≥ 70

Monetary Price Adjustments



$$MPA_{TSI_0} = (50\text{-}TSI) \times 0.025 \times \$40$$

$$\text{MPA}_{\text{TSI}} = \begin{cases} (\$\mathbf{40}) \text{ when } MPA_{TSI_0} \leq (\$40) \\ \boldsymbol{MPA_{TSI_0}} \text{ when } (\$40) < MPA_{TSI_0} < \$40 \\ \$\mathbf{40} \text{ when } MPA_{TSI_0} \geq (\$40) \end{cases}$$

Thermal Segregation Classifications
Indicator of Type of Workmanship Issue

Sublot Uniformity – Std. Dev.

- Plant Temperature Changes
- Stockpile Moisture Conditions
- Material Segregation
  - Truck Loading
  - Delivery
  - No Auger Extensions
  - Paver Wings
  - Stockpiles

Lateral Uniformity – TSV Index

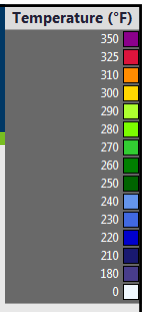
- Windrow Placement
- Hopper Level
- No Auger Extensions

Distribution | Mean | Differential | Semivariogram

Statistic	Low	Low (%)	Moderate	Moderate (%)	Severe	Severe (%)	Last sublot Length (ft)	Last sublot Thermal Segregation Category
Standard Deviation	1	1.1	64	70.3	26	28.6	134.7	Severe
Transverse Semivariogram Index	13	14.3	43	47.3	35	38.5	134.7	Severe
Thermal Segregation Index	1	1.1	51	56.0	39	42.9	134.7	Severe

Start distance (ft)	Length (ft)	Standard Deviation (°F)	Std. Dev. Category	TSV Index	TSV Index Category	Thermal Segregation Index	Thermal Segregation Category
0	150	11.51	Severe	50.7	Severe	100.0	Severe
150	150	10.94	Severe	20.7	Moderate	78.7	Severe

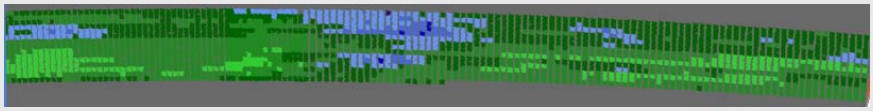
Sublot Uniformity – Standard Deviation Severity Levels



Standard Deviation = 4.47 °F

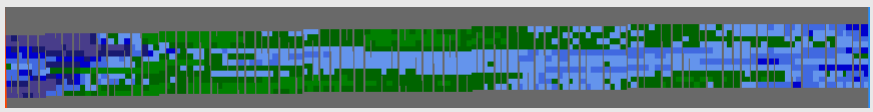
Low < 4.5

Standard Deviation = 8.80 °F



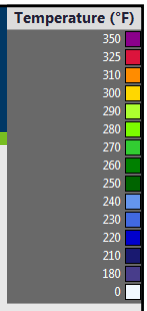
4.5 ≤ Moderate < 9.0

Standard Deviation = 14.15 °F

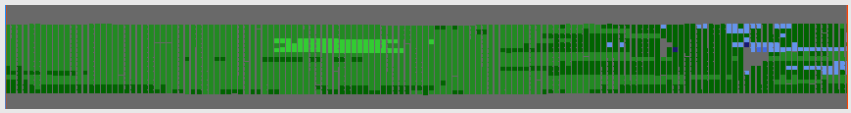


Severe ≥ 9

Lateral Uniformity (Streaking) – TSV Index Severity Levels

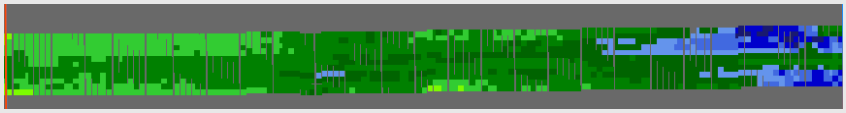


TSV Index = 5.9



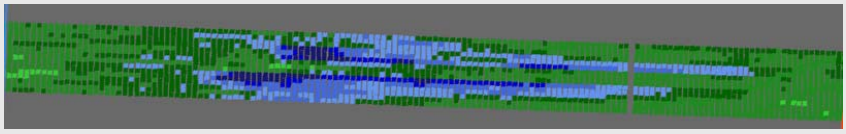
Low < 10

TSV Index = 18.0

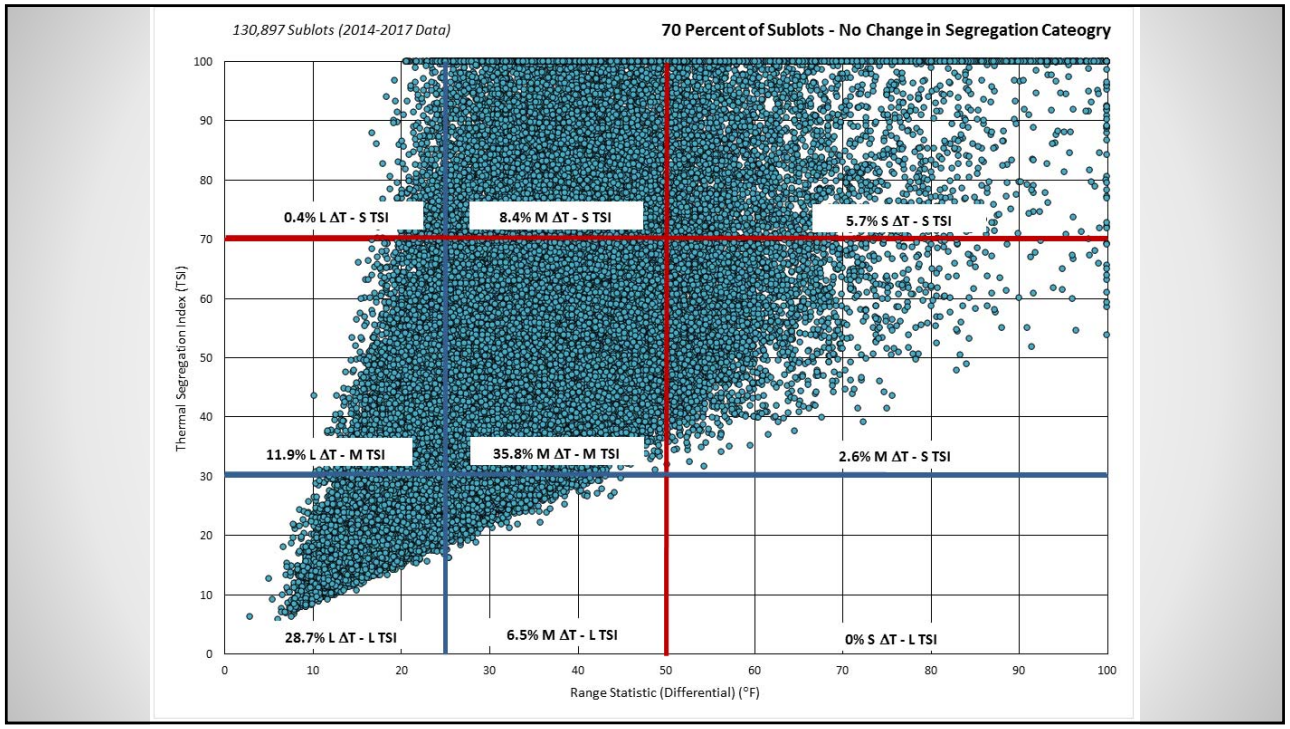


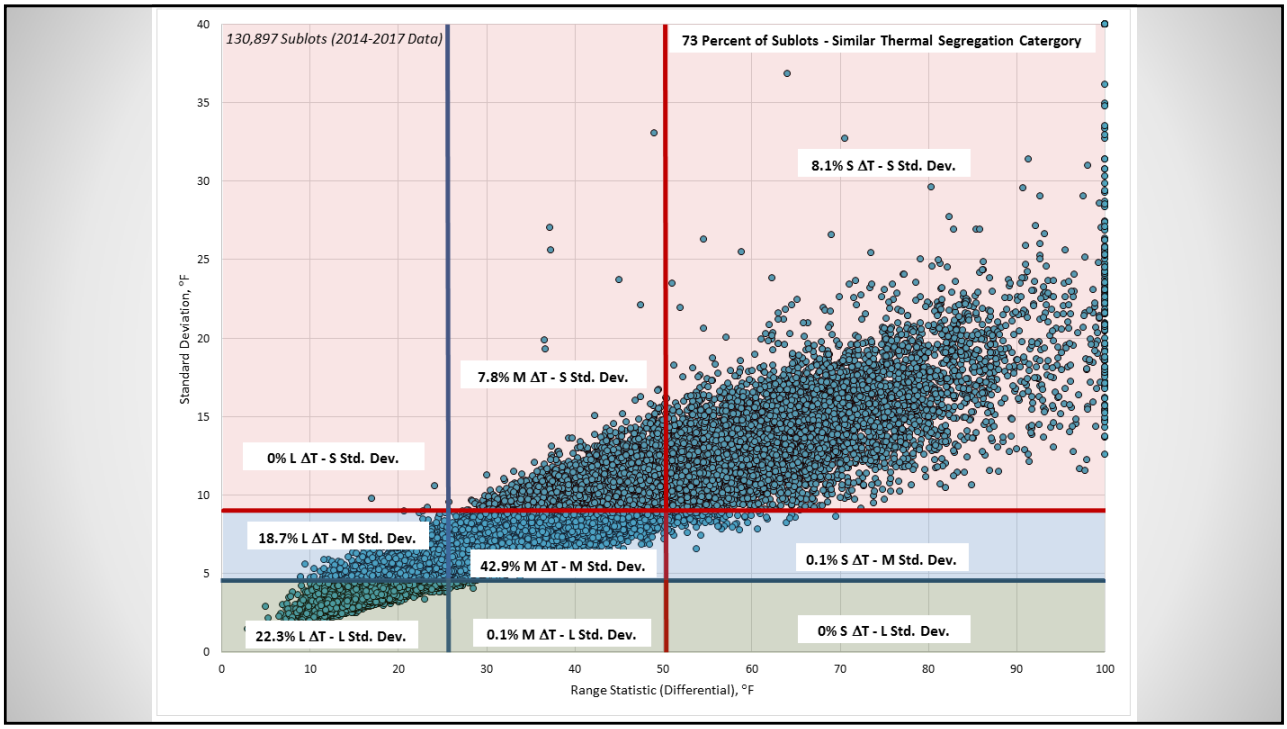
10 ≤ Moderate < 25

TSV Index = 123.4

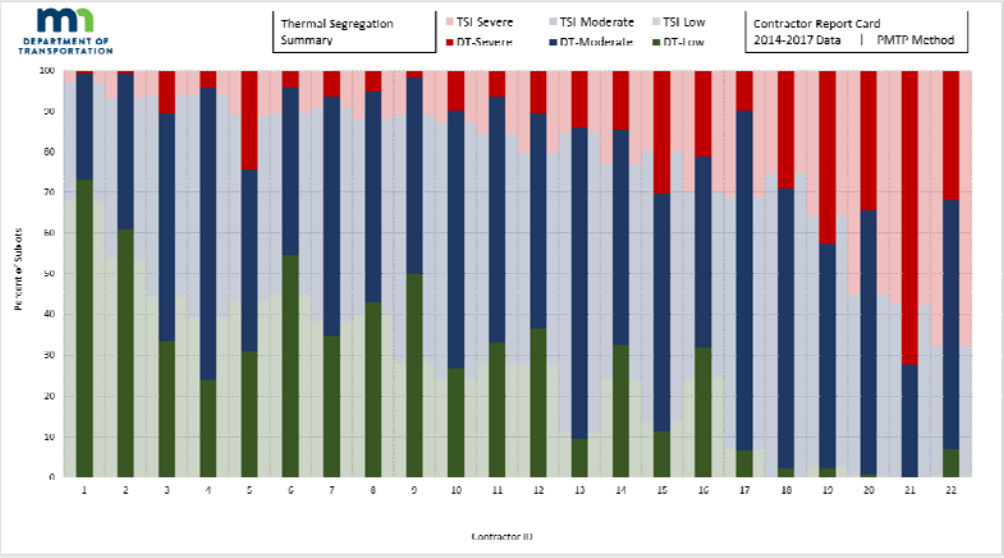


Severe ≥ 25





Contractor Thermal Segregation



NY DOT | Pass Counts – Double Drum Roller

George Chang

State Updates

DEPARTMENT OF TRANSPORTATION

Thank you again!

Rebecca Embacher

rebecca.embacher@state.mn.us

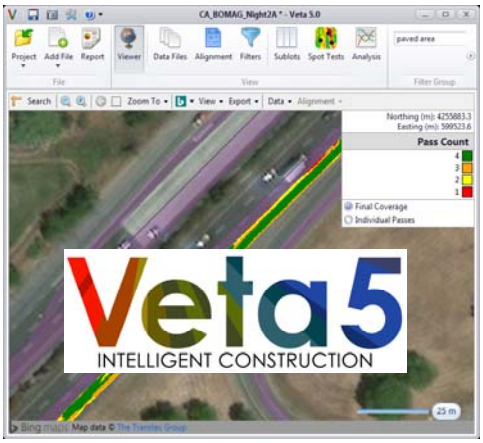
651-366-5525

AMT Website | http://www.dot.state.mn.us/materials/amt/index.html

Veta 5+ Features

Veta 5
INTELLIGENT CONSTRUCTION

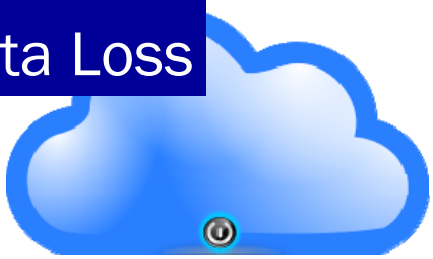
Many Systems ONE SOFTWARE



Veta 5.0 Features

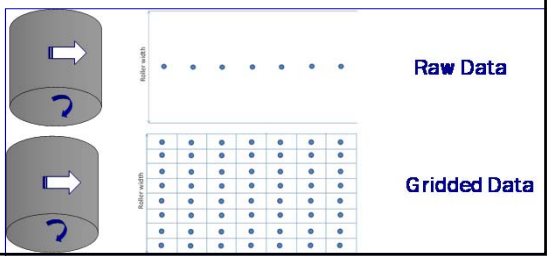
Data Import

Save Time
Avoid Data Loss

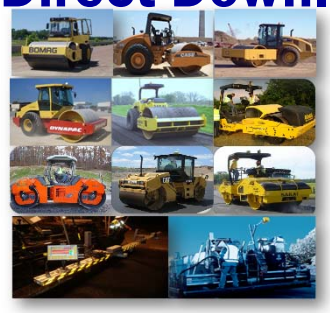


- Direct Download from Cloud
  - MOBA thermal profile data
  - TOPCON raw ungridded IC data

- Import Raw Ungridded Data
  - Veta 5.0- : BOMAG and Old SiteVision Office IC data
  - Veta 5.0 : TOPCON IC Data
  - Maximum flexibility for analysis



Direct Download from Cloud to Veta



IC/PMTP data

Automatic
Wireless
Transmission

Manually
"Push"

Project and Machines IDs
setup

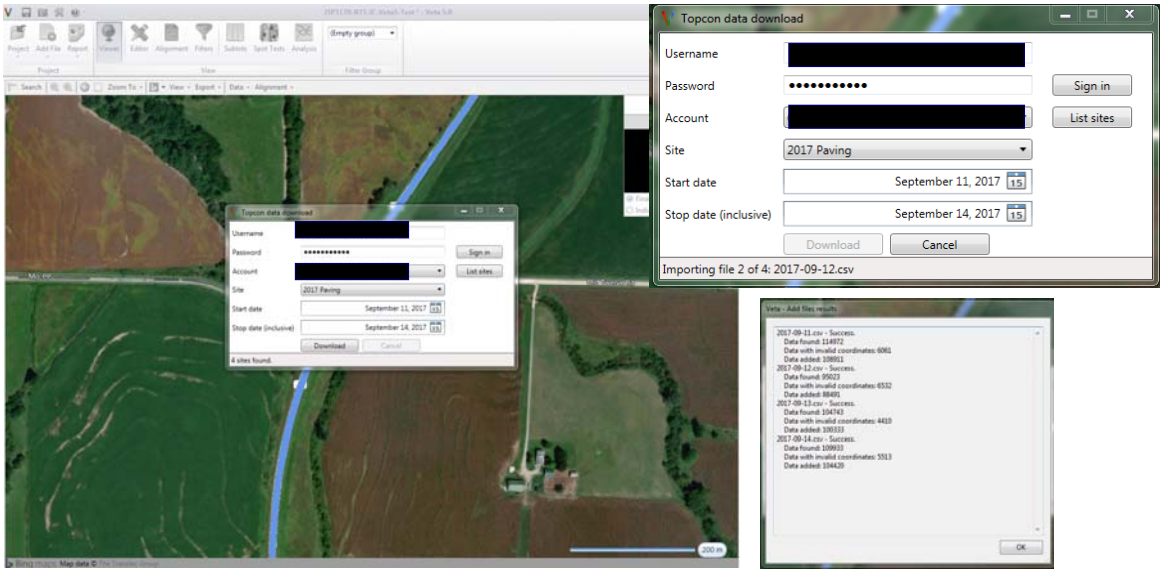
Vendor's
cloud Server

Ungridded
or gridded
data files

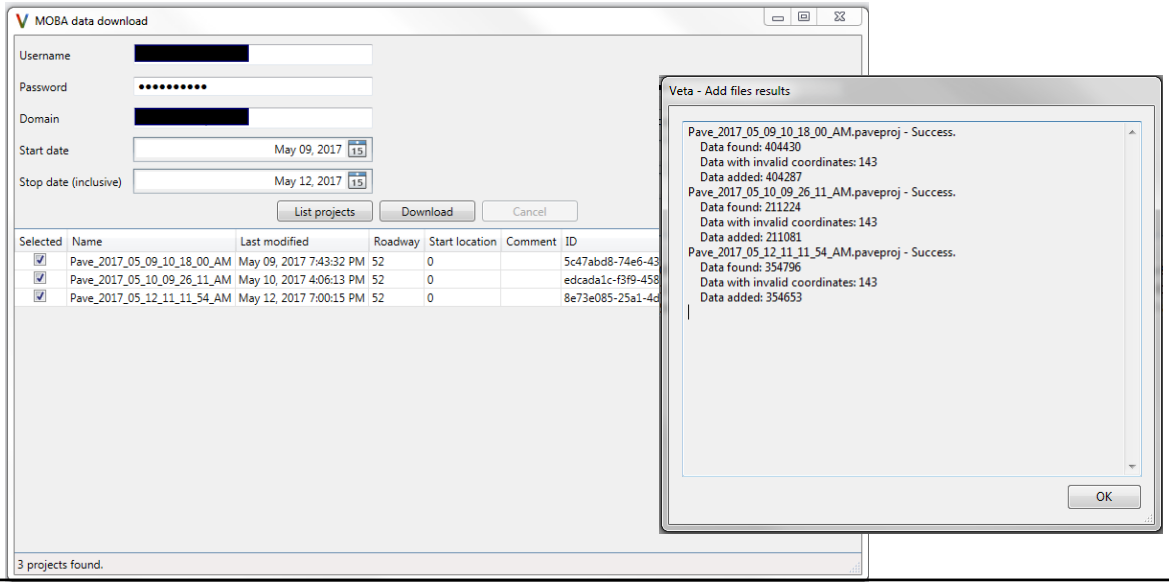
Storage
time

user
log-in for
access

Example Direct Download - TOPCON

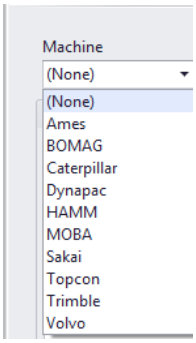


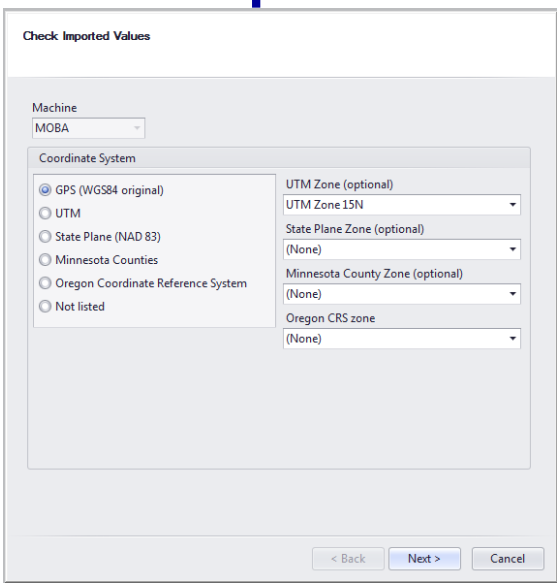
Direct download – MOBA PAVE-IR



Re-Designed Data Import Wizard

List of Machines





Data Import

- Re-processing of All-Passes Data
  - Passes are recounted.
  - Final-coverage data may be different in some cases.
  - The maximum pass count is limited to 20.

RECOUNT

- Limits of Imported Files
  - The limit of 100 files is lifted.

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Map – Filters - Sublots

- Map

Fix: At most zoom levels, correct the display of edges of IC data map.

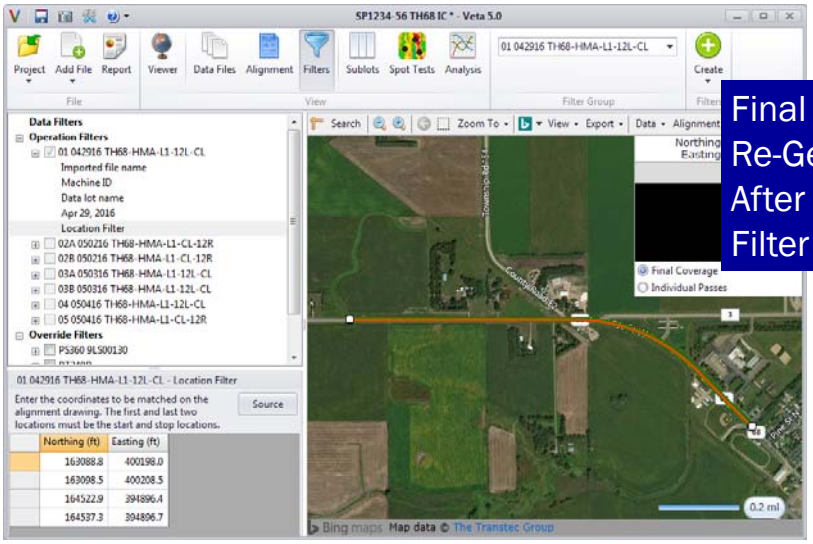
- Filters

New: Add cold central plant recycling (CCPR) as a material for the MnDOT template.

- Sublots

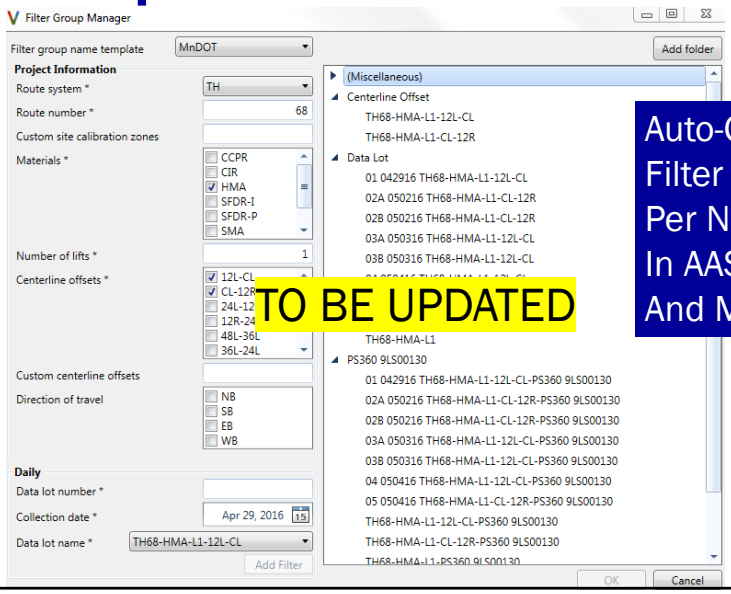
Fix: Clear the sublots after changing the start or stop locations without using the map.

Re-Designed Filters



Final Coverage Re-Generated After Each Filter Application

Filter Group Generator



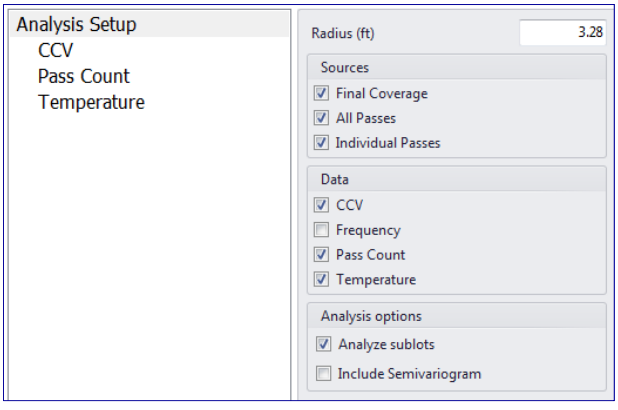
TO BE UPDATED

Auto-Generated
Filter Groups
Per Naming Convention
In AASHTO PP81
And MnDOT specs

Analysis

Flexible Analysis Options

- New: Choose items to analyze.
- New: List Cumulative Specification lower-left of screen for easy reference.
- New: Add a table for paver stops.
- Change: Specifications and setup have been rearranged to improve usability.



Analysis (Cont'd)

- Fix: Add Speed Analysis for sublots analyses.
- Fix: Fix the crashes when an Operation Filter did not match any data.
- Fix: Allow negative numbers in Specification Values.
- Fix: Exclude Transverse Semi-variogram table when the Semi-variogram analysis is not selected.

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Analysis (Cont'd)

- Fix the crashes when the current filter group is deleted while viewing analysis results.
- Fix the crashes during sublot thermal differential analysis when there was not enough data (< 2 points).
- Fix the crashes when one of the analyses failed.

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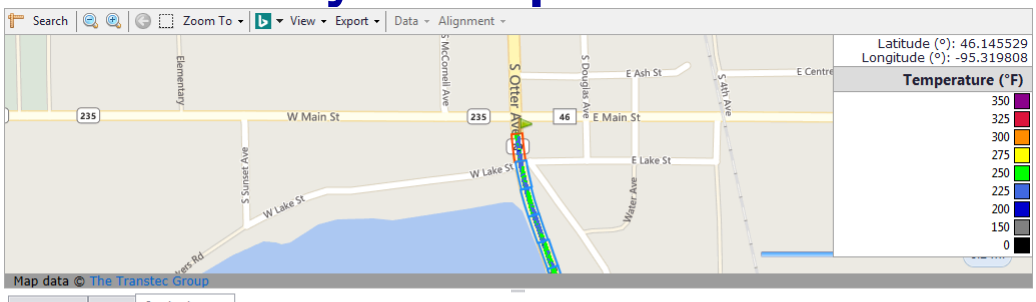
New Temperature Segregation Index (TSI)

Semivariogram Index Specification

☑ Use semivariogram target		Std. Dev. contribution (%)	50	TSV Index contribution (%)	50
TSI moderate start	30	Std. Dev. moderate start (°F)	4.5	TSV Index moderate start	10
TSI severe start	70	Std. Dev. severe start (°F)	9.0	TSV Index severe start	25
Moderate: At least 30 and less than 70. Severe: At least 70.		Moderate: At least 4.5 and less than 9.0 °F. Severe: At least 9.0 °F.		Moderate: At least 10 and less than 25. Severe: At least 25.	

Improved Segregation Index

New TSI Analysis Outputs



Distribution | Mean | Semivariogram

Statistic	Low	Low (%)	Moderate	Moderate (%)	Severe	Severe (%)	Last sublot Length (ft)	Last sublot Thermal Segregation Category
Standard Deviation	23	20.0	89	77.4	3	2.6	160.2	Low
Transverse Semivariogram Index	112	97.4	2	1.7	1	0.9	160.2	Low
Thermal Segregation Index	103	89.6	12	10.4	0	0.0	160.2	Low

Start distance (ft)	Length (ft)	Standard Deviation (°F)	Std. Dev. Category	TSV Index	TSV Index Category	Thermal Segregation Index	Thermal Segregation Category
0	150	8.91	Moderate	26.2	Severe	68.3	Moderate
150	150	5.96	Moderate	0.0	Low	22.2	Low
300	150	5.83	Moderate	0.0	Low	21.7	Low
450	150	3.85	Low	6.9	Low	23.6	Low
600	150	6.48	Moderate	11.7	Moderate	39.8	Moderate
750	150	5.59	Moderate	2.6	Low	24.3	Low

Temperature Segregation Index (TSI)

$$TSI = \begin{cases} c \times TSI_{StDev} + (100 - c) \times TSI_{TSV}, TSI < 100 \\ 100 \qquad\qquad\qquad\qquad\qquad\qquad\quad , TSI \geq 100 \end{cases}$$

where

$$TSI_{StDev} = 0.77 \times \frac{StDev}{StDev_{SevereStart}}$$

$$TSI_{TSV} = 0.77 \times \frac{TSV}{TSV_{SevereStart}}$$

$c = \%\ contribution\ of TSI_{StDev} to\ TSI,$
typical value = 50

Report Features

Versatile Reports

- New: Cumulative specification is now listed in the PDF report for easy reference.
- New: Add feature to allow choosing of what items to report.
- New: Add ability to include a logo and signature line in a report.
- Fix: Add Semivariogram charts in the PDF report.

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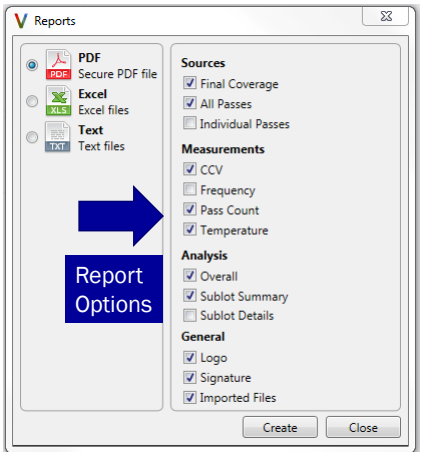
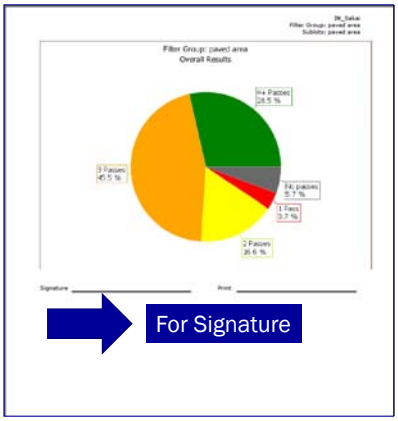
Report Features





Other Changes

Small Changes Big Impacts

- New: Add a button to clear temporary files.
- New: Add ability to recover project files if file saving after a crash.
- Change: For an existing project, the files won't be saved unless users explicitly save them.
- Performance Improvements. Allow to handle HUGE Project Files!

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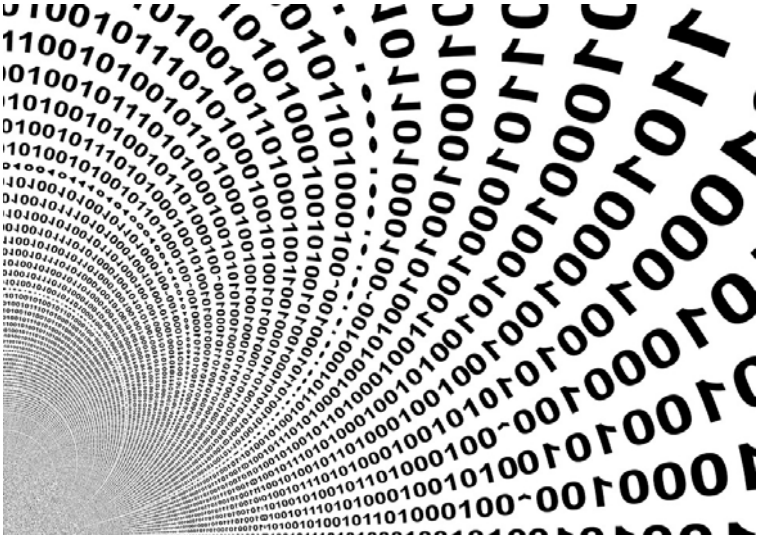
Veta 5 Performance Enhancements



Change
Files I/O
Management

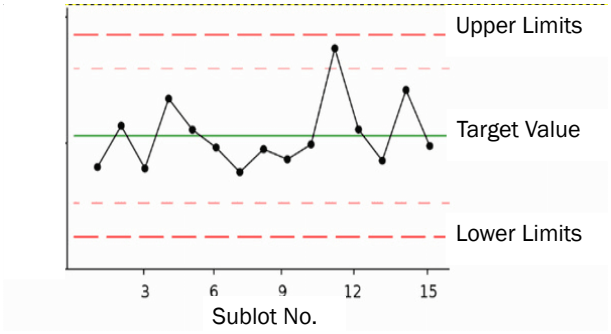
FASTER for
EVERY FUNCTION!

Veta 5.1 Features

Import MOBA Compaction Assist IC Retrofit (MCA-3000) Files

Veta 5.1+ Features

Mean Pass number, Temperature, etc.



Quality Control Charts

Offset lines to form new alignment

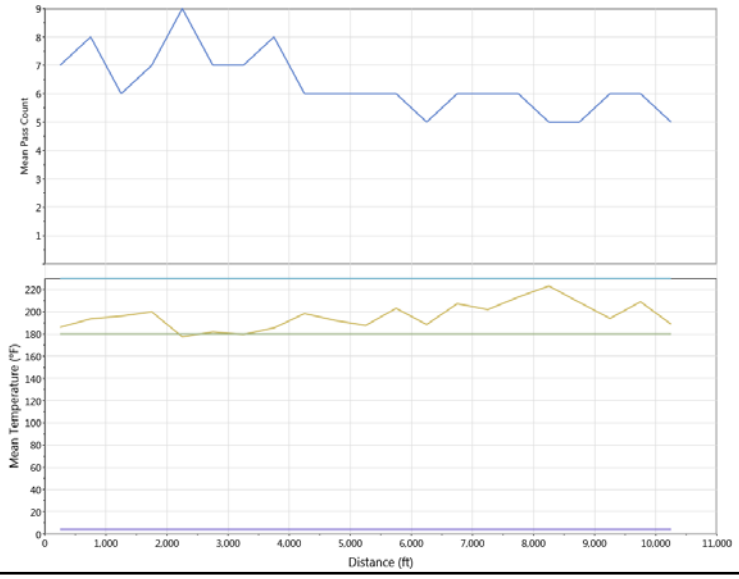
Example QC Charts (Passes, Temperature)

Quality control thresholds

Use quality control thresholds

Minimum (°F)	>	180.0
Maximum (°F)	<	230.0

Data must be > 180.0 °F and < 230.0 °F.



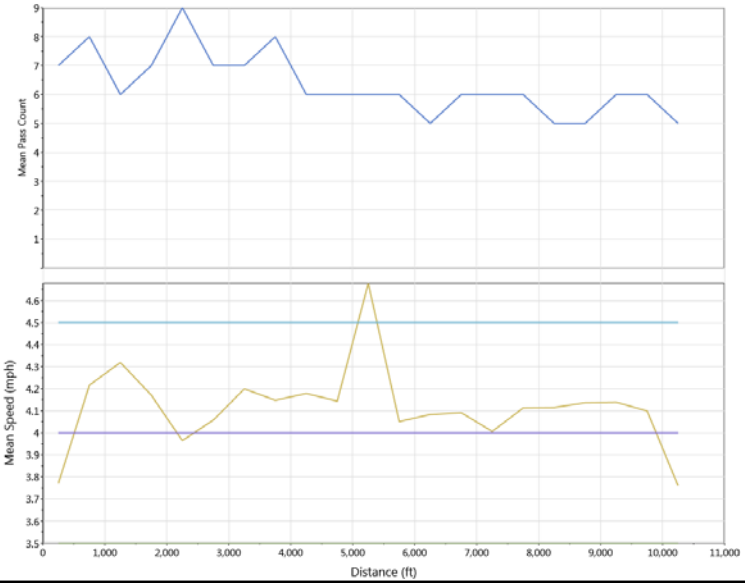
Example QC Charts (Passes, Speed)

Quality control thresholds

Use quality control thresholds

Minimum (mph)	>	3.5
Maximum (mph)	<	4.5

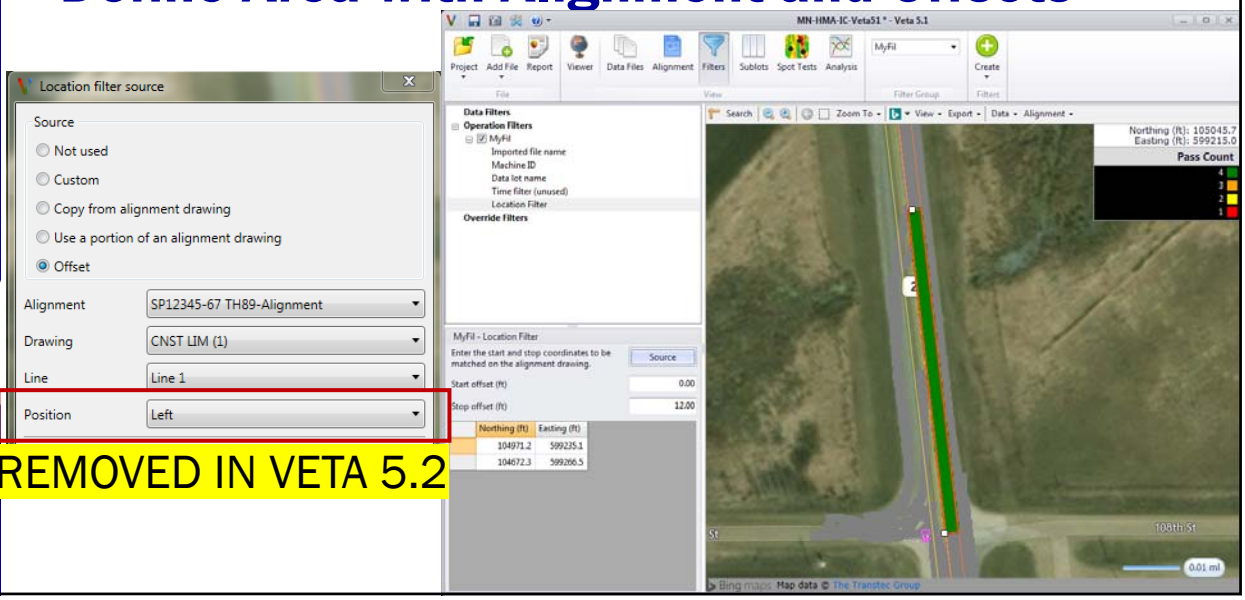
Data must be > 3.5 mph and < 4.5 mph.



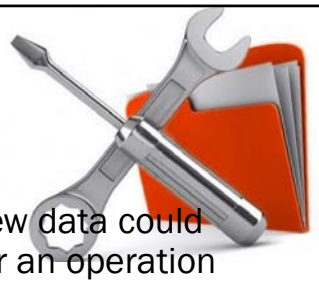
New Location Filter

- Added a new location filter that be created using only one line from an alignment and offsets.
- For example, 12 to 24 feet from the centerline. This allows the use of alignments that do not have all lanes defined.

Define Area with Alignment and Offsets



Fixes



- Import: Adding a data file that did not contain any new data could cause a crash when viewing “Imported file name” for an operation filter.
- Sublot: Changing most of the values did not clear the sublots.

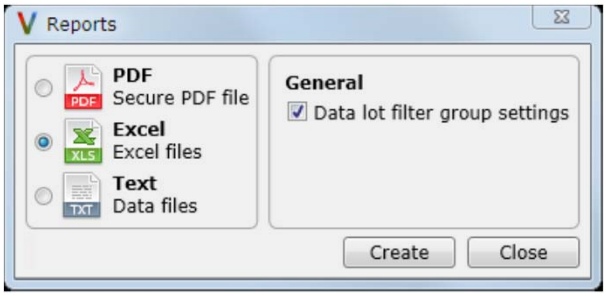
New Report Features

- Created a new report that lists all filter settings for data lot filter groups.
- This provides an easier way to check for filter groups that may not have the correct settings.

```
Filter Group: 20170424-IC

Operation Filter: 20170424-IC
  Location Filter (Custom)
  Imported file name = J1P1234-2017042
  Machine ID = CB64 304 RTK
  Data lot name = CAT1 042417, CAT1 42

Sublots: 20170424-IC
  Longitudinal length (ft): 500

Pass Count
  70% of data must be >= 4.
```

Changed Report Features

- The screen now attempts to only show the options that are applicable and will disable the “Create” button if the selected options will not produce a report.
- Note there are still some rare scenarios that will not create a report, but these should only be scenarios that are not practical.



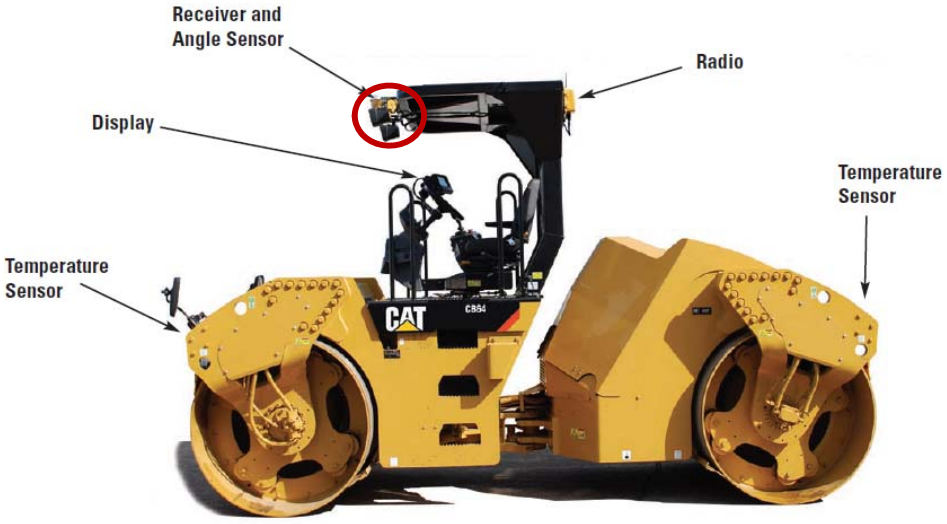
Veta 5.2 Features

Veta 5.2 New Features

- LandXML Support for Alignment Files
- AASHTO ICT Standard (TDS) File Support
- More to Come

IC Roller Passes Tracking

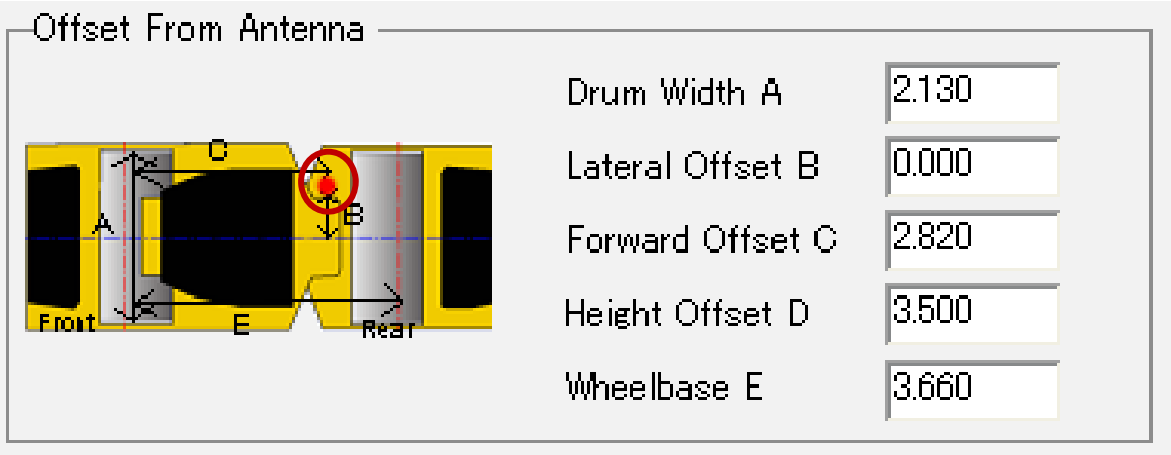
GNNS Position - Double Drum IC Rollers



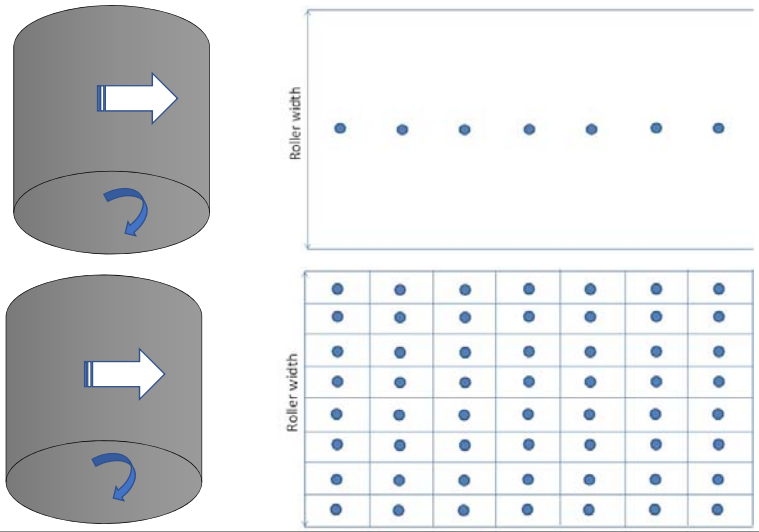
GNNS Position - Single Drum IC Rollers

GNNS Position – Pneumatic Rollers

GNNS Antenna Offsets to Front Drum Center



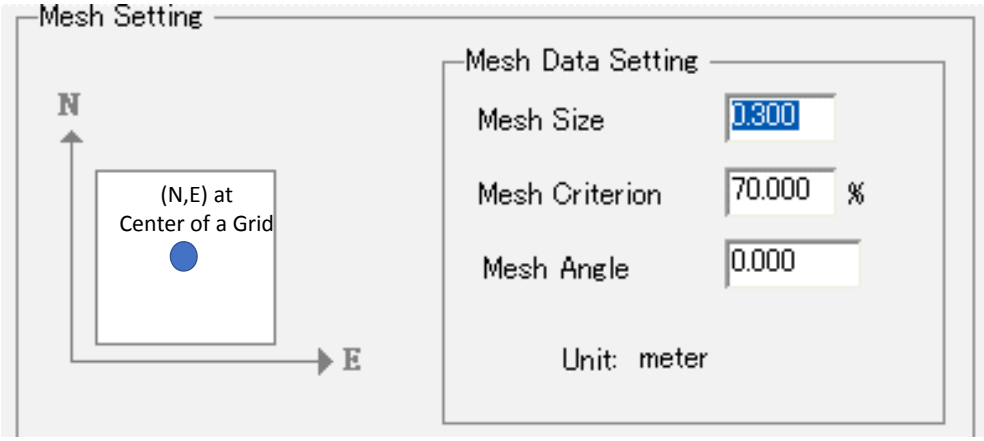
IC Raw and Gridded Data



Raw Data

Gridded Data

Grid Size and Pass Count Criteria



Vendors IC Data Formats

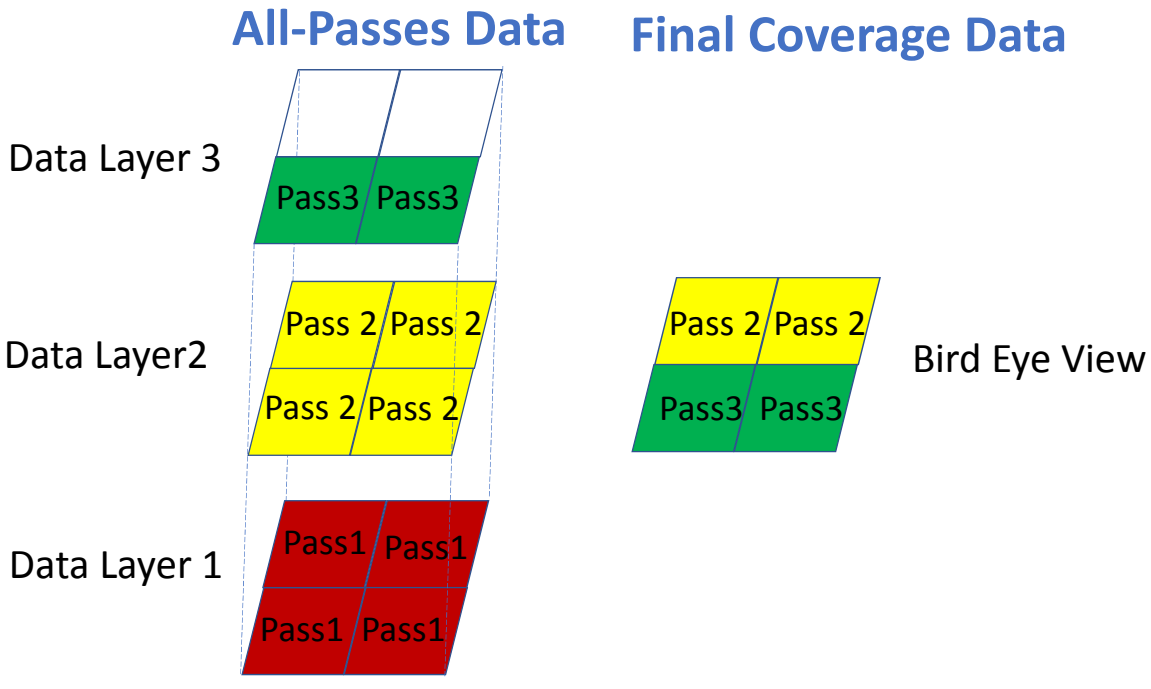
Features	BOMAG	Caterpillar/ Trimble	Dynapac	Hamm/ Wirtgen
Filename extension(s)	*.csva	*.csv	*.txt	*amd.vexp
Text/Binary	Text	Text	Text	Text
Raw Ungridded	✓			
Geographic GPS data (Long./Lat.)		✓	✓	✓
Grid data (Northing/Easting)	✓	✓	✓	
Coordinate zone in header	✓		✓	✓
Mesh size (horizontal)	0.3m X 0.3m	1.0m X 0.15m	0.4mX 0.4m	0.6m X 0.5m

Vendors IC Data Formats (cont'd)

Features	Sakai/ Topcon**	Volvo	MOBA***	Leica***
Filename extension(s)	*.pln	*.csv	*.csv	*.cgt
Geographic GPS data (Long./Lat.)	Text	Text	Text	Text
Raw Ungridded	✓			✓
Grid data (Northing/Easting)	✓	✓	✓	✓
Coordinate zone in header	✓		✓	✓
Mesh size (horizontal)	0.2m X 0.2m	0.3m X 0.3m	0.25m X 0.25m	?

** Direct Download from the Cloud to Veta 5.0+

*** Veta 5.1+



Vibration Types

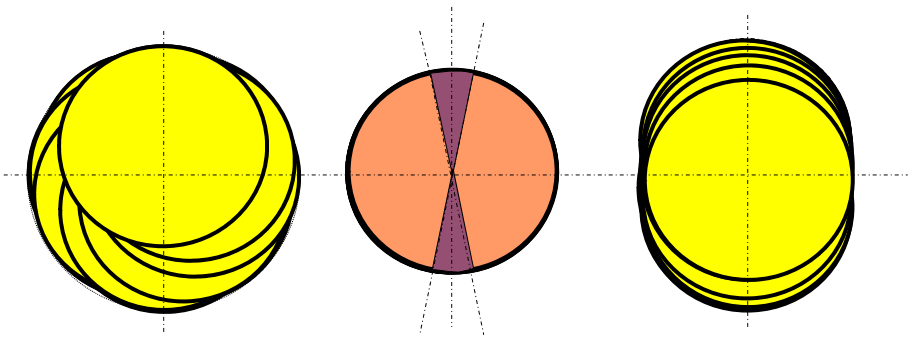
Rotary

Oscillation

Directed

Vibration Types

Rotary **Oscillation** **Directed**



Double Drum Rollers w/ Different Vibrations

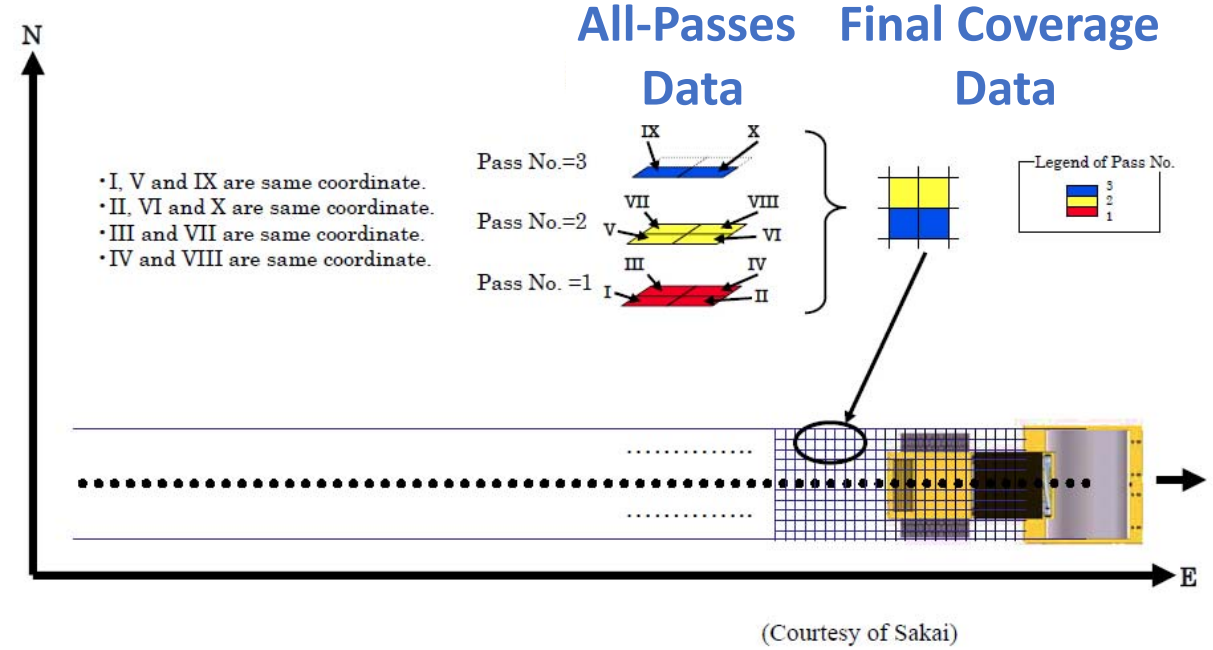
Oscillation Drum

Vibration Drum

Veta

- Import All Vendors' Gridded IC Data
- Record Vibration Modes: Static, Vibratory, Oscillation (Pneumatic).
- For Vibratory, not Yet Differentiate Rotary vs. Directed
- Import Ungridded IC Data (BOMAG, TOPCON) and Do Gridding Internally

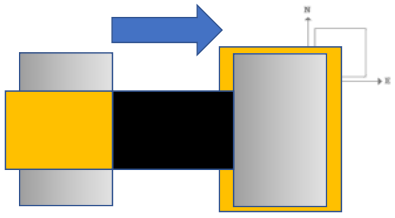
Roller Movements



(Courtesy of Sakai)

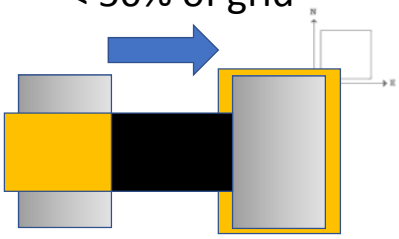
Pass Count Criteria – Front Drum Only

≥ 50% of grid



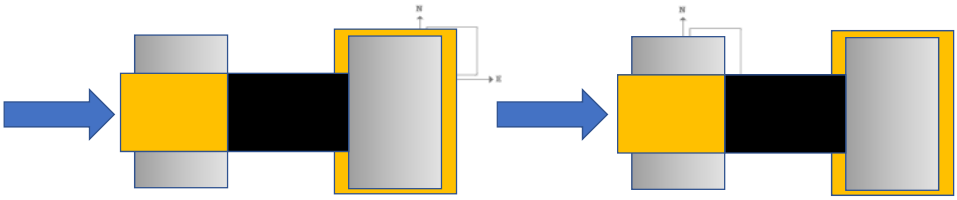
+ 1 Pass

< 50% of grid

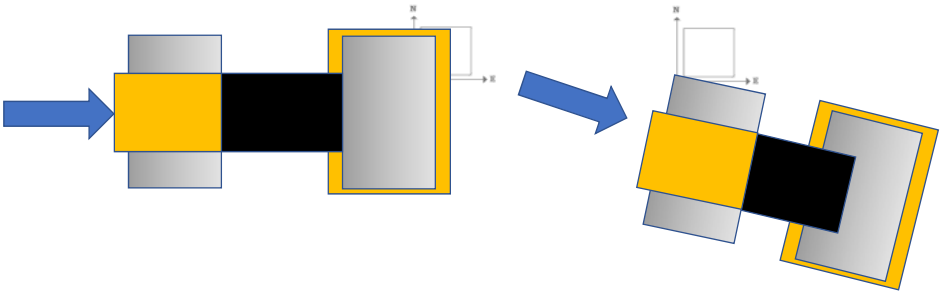


0 Pass

Pass Count Criteria – Sakai Machine Passes

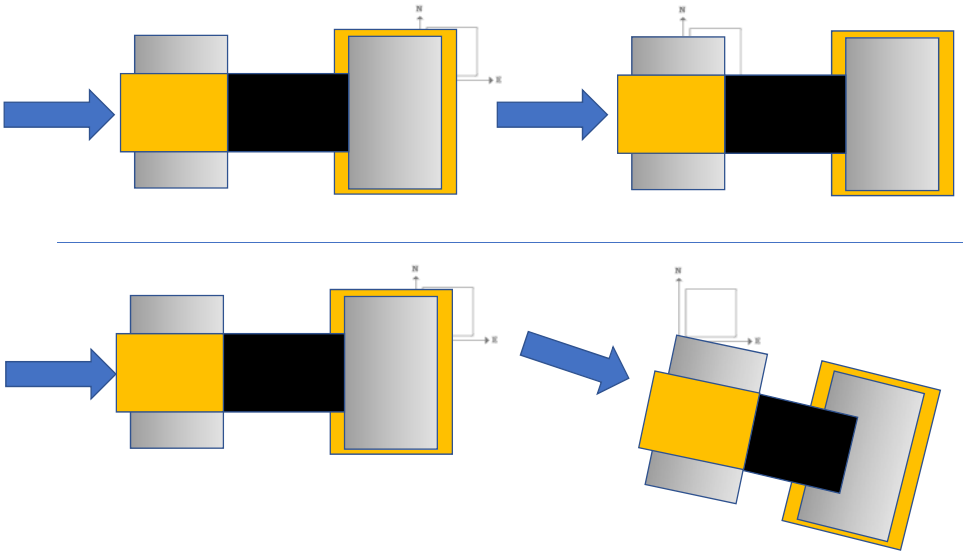


Machine
+ 1 Pass



Machine
+0.5 Pass

Pass Count Criteria – HAMM Drum Passes



Front Drum
+ 1 Pass

Rear Drum
+ 1 Pass

Front Drum
+ 1 Pass

Rear Drum
0 Pass

Summary

- IC Gridding Varies Among IC Vendors (Grid Size, % Mesh)
- Most IC Vendors Use Front Drum Passes as Machine Passes as Approximation (for both single drum and double drum)
- Veta Follow the Above Convention for Gridding (Mesh Size: 0.3 m, 50% Mesh) for BOMAG and TOPCON Raw Data
- Sakai Use Machine Passes (Use 0.5 Pass as one of the double drums covers < 70% of a Grid)
- HAMM Use Drum Passes (Only Front Drum is used for now)
- Standardization of Gridding Is Needed