

DRAFT

Kentucky Asphalt IC Demonstration Report

Contents

Kentucky Asphalt IC Demonstration Report	1
Project Site	3
Project Test Beds	5
IC Rollers	6
HAMM Double-Drum IC Roller	6
Caterpillar Double-Drum IC Roller	7
Global Positioning System (GPS).....	8
Test Plan	9
On-site Activities	9
Machines Settings	10
Day 1 & 3 – Test Plan.....	11
Day 2 – Test Plan.....	12
Analysis Results.....	14

Project Site

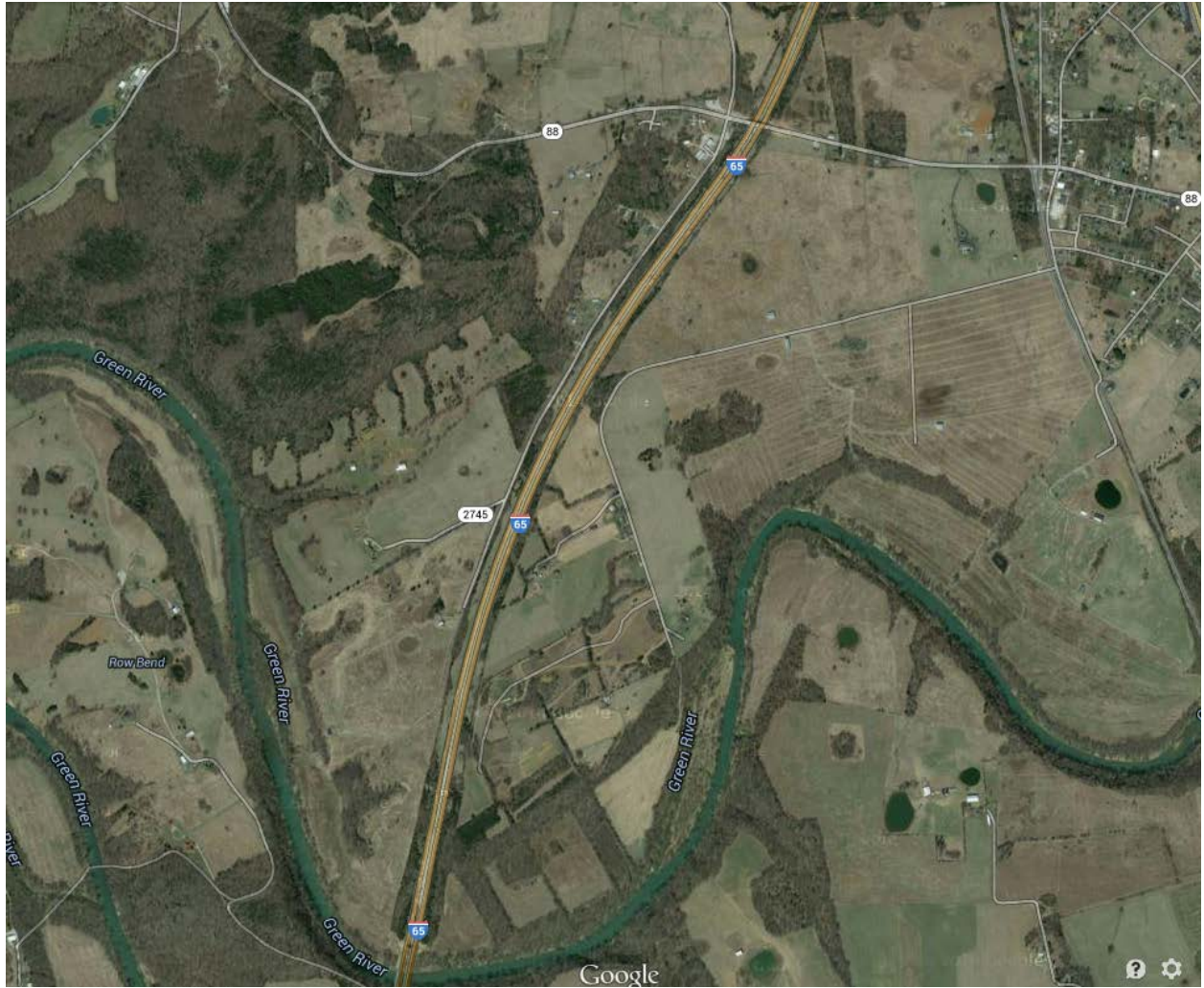
I-65 in Hart County, KY

July 14-17, 2014

The Kentucky site is located at I-65 in Hart County between Horse Cave and Munfordville (MP 58 – MP 65). The following is the typical section for this portion of the project. The focus was the 4.5” base course on top of asphalt stabilized granular base.

- 1.5” 0.38A CL4 76-22
- 3.0” 1.0D CL4 76-22
- 3.5” 1.0D CL4 64-22
- 4.5” 1.5D CL4 64-22
- 4.5” 1.5D CL4 64-22
- 6” ATDB
- 7” DGA

The Test Bed 1 location is on the northbound right lane. The Test Bed 2 location is on both the southbound right lane and northbound right lane. The Test Bed 3 location is on the northbound right lane. The Hamm IC roller (HD+ 120) was used as the breakdown roller. The Caterpillar IC roller (CB54 XW) was used as the intermediate roller.

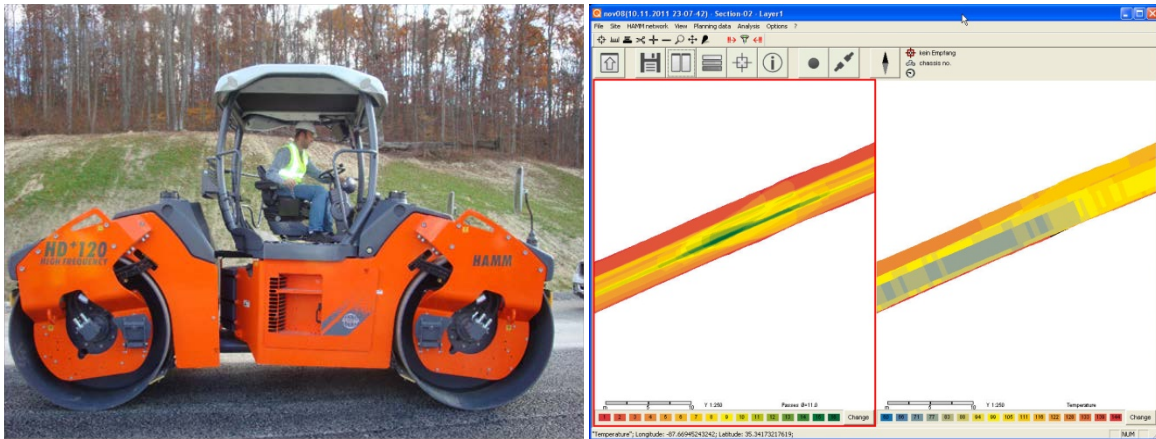


Project Test Beds

TB	Description	Date	Machine
1A	NB right lane - 4.5" base course	7/14	Hamm (breakdown)
1B	NB right lane - 4.5" base course	7/14	CAT (intermediate/finishing)
2A	SB/NB right lane - 4.5" base course	7/15	Hamm (breakdown)
2B	SB/NB right lane - 4.5" base course	7/15	CAT (intermediate/finishing)
3A	NB right lane - 4.5"/3" base course	7/16	Hamm (breakdown)
3B	NB right lane - 4.5"/3" base course	7/16	CAT (intermediate/finishing)

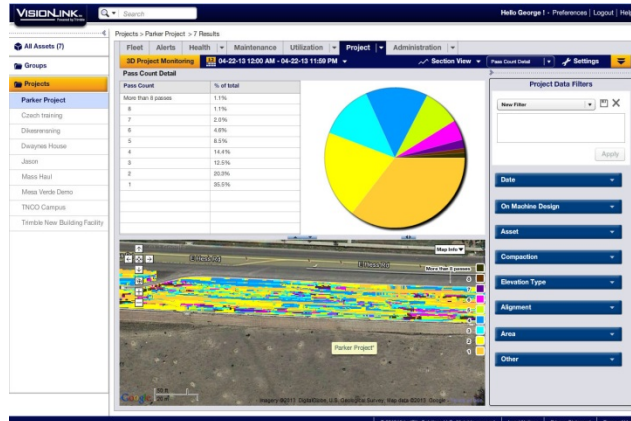
IC Rollers

HAMM Double-Drum IC Roller



Manufacturer/ Vendor	HAMM/Wirtgen
Model Name	HCQ (Hamm Compaction Quality)
Model Number	HD+ 90 / HD+ 110, HD+ 120 / HD+ 140
Drum Width	78" w/offset to 84.7"
Machine Weight	Operating wt. 27,569 lbs. w/max of 32,187 lbs.
Amplitude Settings	High/Low - .028/.011 in. (0.71/0.27 mm)
Frequency Settings	Variable from 2700 - 4020 vpm
Auto-Feedback	NA
Measurement System	HAMM Compaction Quality (HCQ)
Measurement Value	HMV, density estimator, temperature, passes
Measurement Unit	[unitless, % compaction, °C, color coded]
GPS Capability	Yes
Documentation System	HCQ with ability to export to Veda
Contact	Tim Kowalski (615) 594-4604 tkowalski@Wirtgenamerica.com

Caterpillar Double-Drum IC Roller



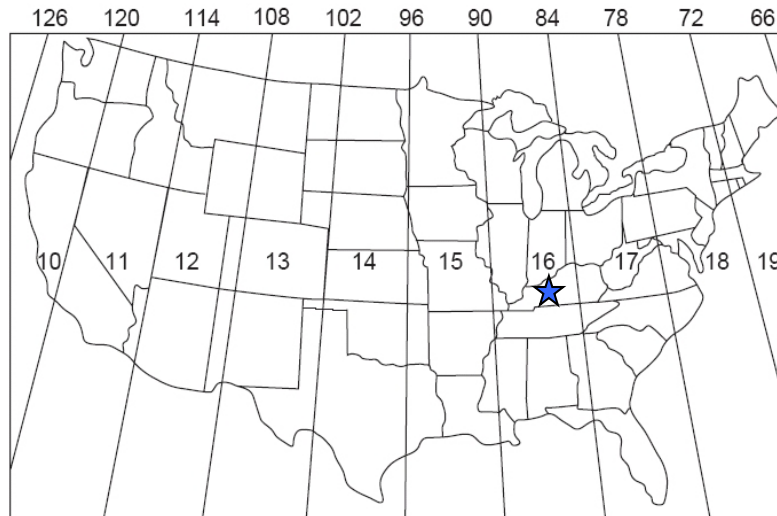
Manufacturer/ Vendor	Caterpillar
Model Name	Tandem vibratory rollers
Model Number	CB44B,CB54B,CD44B and CD54B
Drum Width	51" (solid or split drums)
Machine Weight	split drum: Operating wt. 20,569 lbs. w/max of 23,082 lbs. solid drum: Operating wt. 18,056 lbs. w/max of 19,709 lbs.
Amplitude Settings	0.024 – 0.012"
Frequency Settings	split drum: 2,520 and 3,200 vpm solid drum: 3,200 and 3,800 vpm
Auto-Feedback	NA
Measurement System	Compaction Meter Value (CMV)
Measurement Value	CMV
Measurement Unit	[unitless]
GPS Capability	Yes
Documentation System	VisionLink
Contact	Todd Mansell, 763-447-5695 Mansell_Todd_W@cat.com

A CB54 XW (26,300 lbs., 79") will be provided for this demo.

Global Positioning System (GPS)

Grid Reference

UTM-16N is the preferred coordinate reference for all devices.



Trimble GPS

- A Trimble GPS receiver and a radio will be mounted on the Caterpillar IC roller.
- A Trimble GPS base station will be setup to provide RTK correction signals.
- A hand-held Trimble GPS rover with both RTK and OmniSTAR capability will be used for in-situ point measurements.

OmniSTAR GPS

- A GPS receiver with OmniSTAR subscription will be mounted on the HAMM IC roller.

Test Plan

On-site Activities

Schedule	Activities
Day 0 Sunday (July 13)	<ul style="list-style-type: none"> Conduct IC rollers/GPS setup and trial runs (equipment vendors and FHWA IC team only) at the staging area. (2PM-4PM)
Day 1 Monday (July 14)	<ul style="list-style-type: none"> Set up the GPS base station and IC roller/GPS system (by 7AM). Conduct project briefing at the staging area and IC training for roller operators (7AM-8AM). Start paving with one IC roller at breakdown and another IC roller at intermediate position. Select a 500-ft section as a test strip to establish the rolling pattern. Conduct NG/GPS/LWD-a testing immediately behind the paver and at selected locations after each breakdown and intermediate roller pass within the test strip. Perform production compaction using the rolling pattern. Conduct NG/GPS/LWD-a at selected locations after the finishing rolling
Day 2 Tuesday (July 15)	<ul style="list-style-type: none"> Set up the GPS base station and IC roller/GPS system (by 7AM). Start paving with one IC roller at breakdown and another IC roller at intermediate position. Conduct NG/GPS/LWD-a testing immediately behind the paver and at selected locations after each breakdown roller pass within the 1500-ft section. Conduct NG/GPS/LWD-a testing at selected locations after each intermediate roller pass within the 1500-ft section. After the finishing rolling, mark 60 locations within the 1500-ft paved section. Conduct NG/GPS tests at marked locations. Conduct GPS and LWD-a tests at designated locations. Conduct coring at the marked locations.
Day 3 Wednesday (July 16)	<ul style="list-style-type: none"> Set up the GPS base station and IC roller/GPS system (by 7AM). Start paving with one IC roller at breakdown and another IC roller at intermediate position. Select a 500-ft section. Conduct NG/GPS/LWD-a testing immediately behind the paver and at selected locations after each breakdown and intermediate roller pass within the test strip. Perform production compaction using the rolling pattern. Conduct NG/GPS/LWD-a at selected locations after the finishing rolling.
Days 4 Thursday (July 17)	<ul style="list-style-type: none"> Conduct the Open House event including presentation and equipment demonstration.

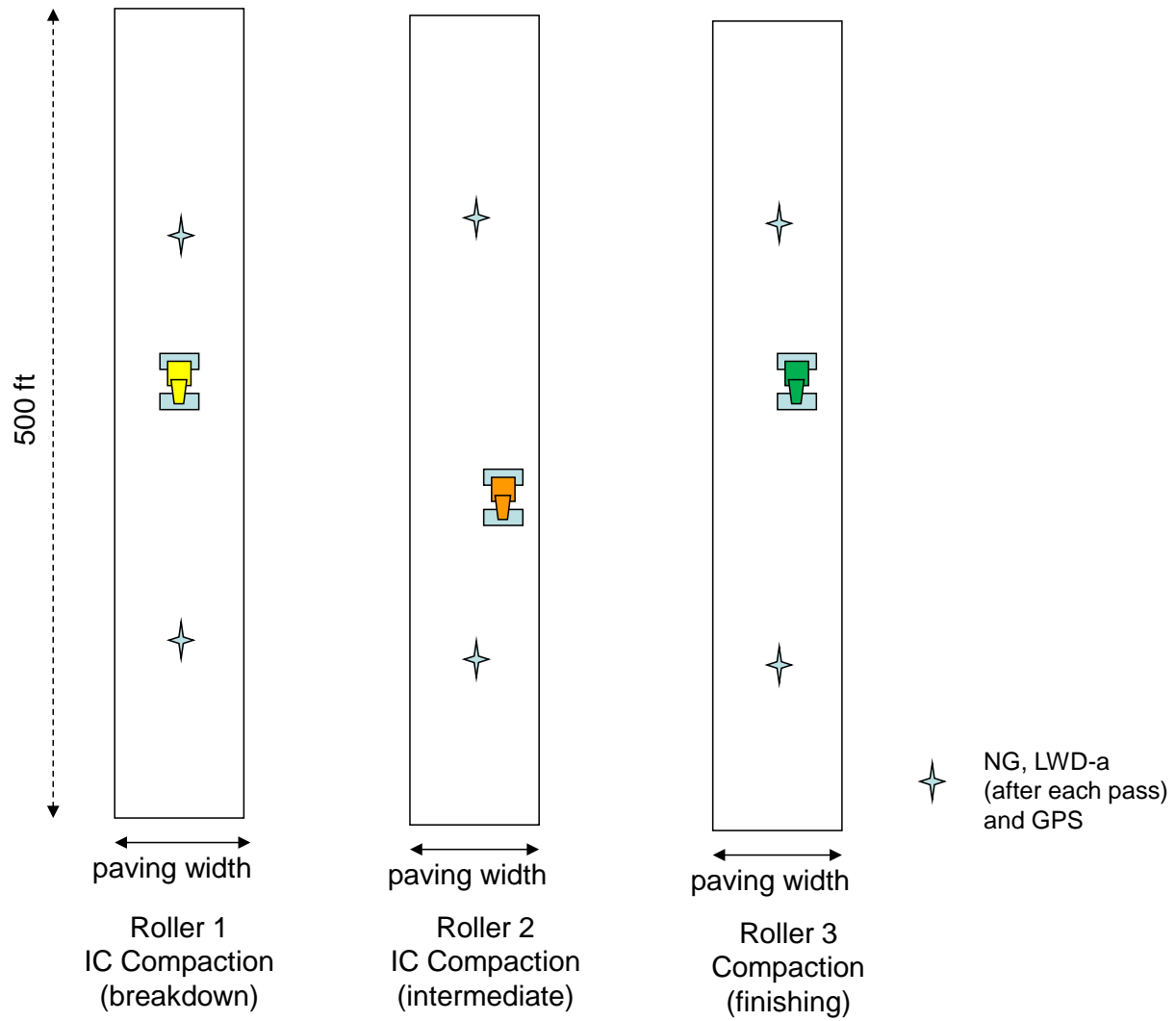
- GPS: Hand-held Global Positioning System rover will be provided by SITECH.
- NG: Nuclear density gauge and an operator will be provided by the KYTC.

- LWD-a: Lightweight deflectometer for asphalt tests will be provided by Kessler.
- Coring: 60 X 4" cores will be taken with two + coring rigs by Contractor and DOT.
- Core tests: Bulk density testing of cores will be performed by DOT.

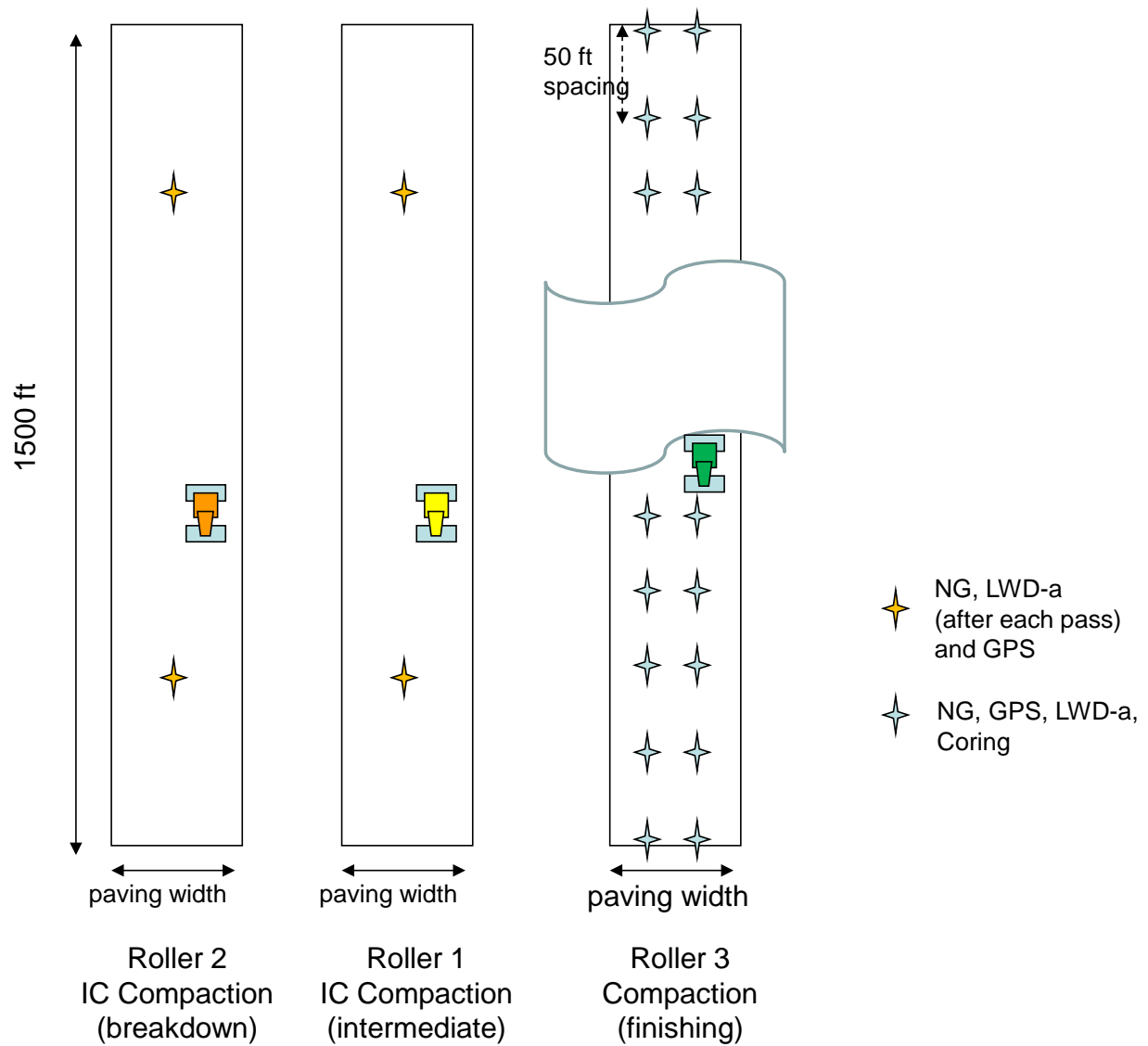
Machines Settings

Date	TB	Machine	Setting	Spot Tests	Notes/Comments
Day 1	1A	IC 1	0.3mm at 4000 vpm	NG, GPS, LWD-a	Breakdown compaction for asphalt base course. 1. Compact with normal roller passes. 2. NG/GPS/LWD-a tests after each roller pass at selected locations within the test section.
	1B	IC 2	Low amp at 4000 vpm	NG, GPS, LWD-a	Intermediate compaction for asphalt base course. 1. Compact with normal roller passes. 2. NG/GPS/LWD-a tests after each roller pass at selected locations within the test section.
	1C	Conventional Roller	Static	NA	Finishing rolling 1. Compact with normal roller passes.
Day 2	2A	IC 2	Low amp at 4000 vpm	NG, GPS, LWD-a	Breakdown compaction for asphalt base course. 1. Compact with normal roller passes. 2. NG/GPS LWD-a tests after each roller pass at selected locations within the test section.
	2B	IC 1	0.3mm at 4000 vpm	NG, GPS, LWD-a	Intermediate compaction for asphalt base course. 1. Compact with normal roller passes. 2. NG/GPS LWD-a tests after each roller pass at selected locations within the test section.
	2C	Conventional Roller	Static	NG, GPS, LWD-a, Coring	Finishing rolling 1. Compact with normal roller passes. 2. NG/GPS/LWD-a/Coring tests after the finishing rolling at marked locations within the test section.
Day 3	3A	IC 1	0.3mm at 4000 vpm	NG, GPS, LWD-a	Breakdown compaction for asphalt base course. 1. Compact with normal roller passes. 2. NG/GPS LWD-a tests after each roller pass at selected locations within the test section.
	3B	IC 2	Low amp at 4000 vpm	NG, GPS, LWD-a	Intermediate compaction for asphalt base course. 1. Compact with normal roller passes. 2. NG/GPS LWD-a tests after each roller pass at selected locations within the test section.
	3C	Conventional Roller	Static	NA	Finishing rolling 1. Compact with normal roller passes.

Day 1 & 3 – Test Plan



Day 2 – Test Plan



Analysis Results

The IC maps and statistics for the Hamm IC data (breakdown position) are presented in Figure 1 and Figure 2.

Comments on Hamm Data:

- ICMV: The mean HMT value is 55.8 with standard deviation of 15.3.
- Temperature: The mean surface temperature is 207°F with standard deviation of 55.6°F.
- Pass Counts: The recorded mean roller passes is 5.
- Frequency: The mean frequency is 2,381 vpm.
- Compaction curve: The curve grows monotonically without an apparent optimal value.

The IC maps and statistics for the Caterpillar IC data (intermediate position) are presented in Figure 3 and Figure 4.

Comments on Caterpillar Data:

- ICMV: The mean CMV value is 32 with standard deviation of 18.2. However, the CMV “pattern” appeared to be unusual.
- Temperature: The mean surface temperature is 157°F with standard deviation of 34°F.
- Pass Counts: The recorded mean roller passes is 11.
- Frequency: The mean frequency is 3,822 vpm.
- Compaction curve: The curve appeared to be in an unusual shape. Further investigation is warranted.

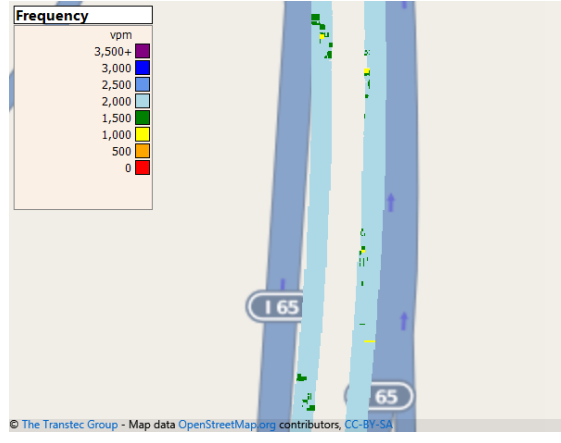
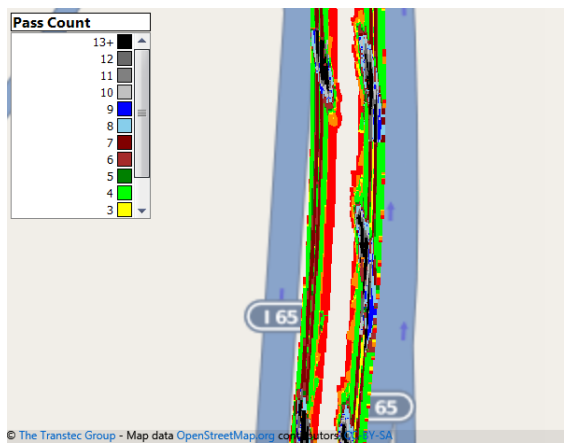
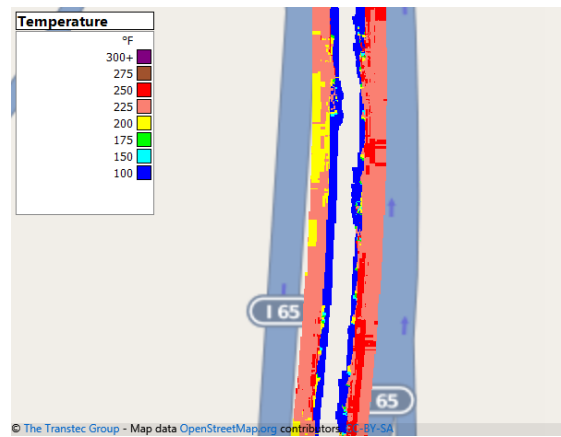
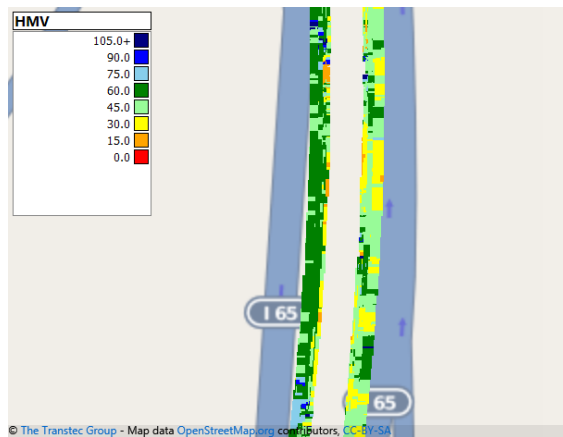
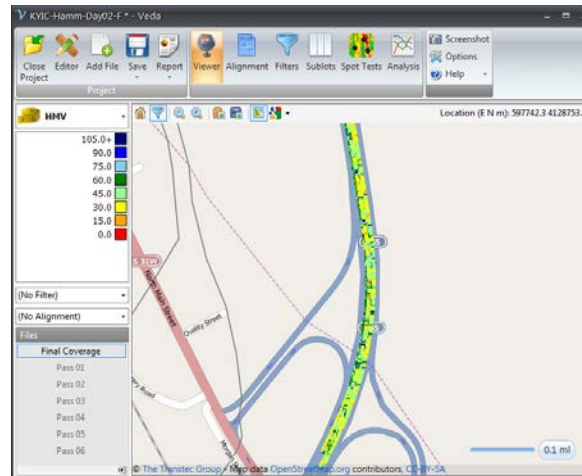


Figure 1. Hamm IC maps (breakdown), TB02A and TB02B, KY site.

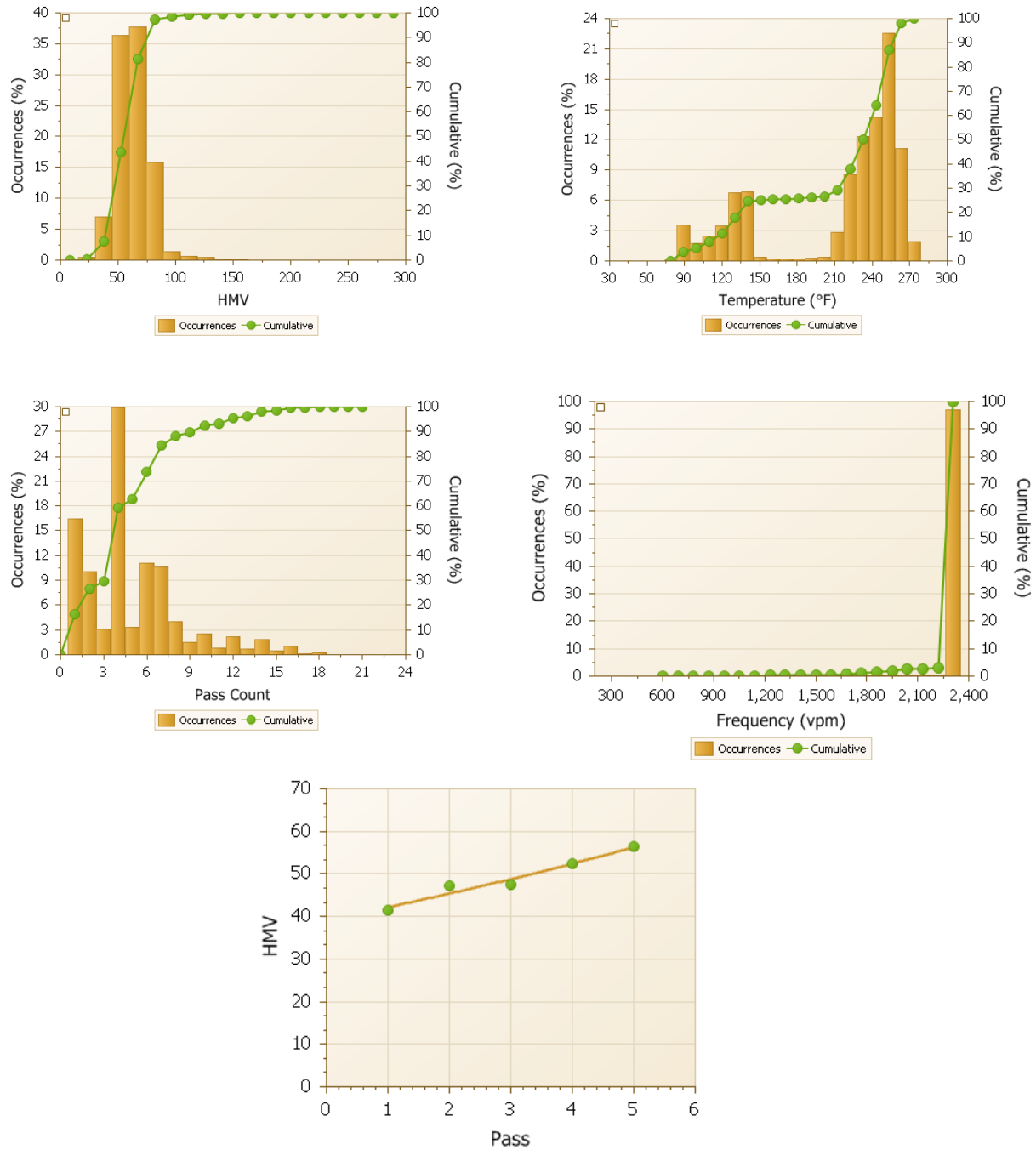


Figure 2. Hamm IC statistics (breakdown), TB02A and TB02B, KY site.

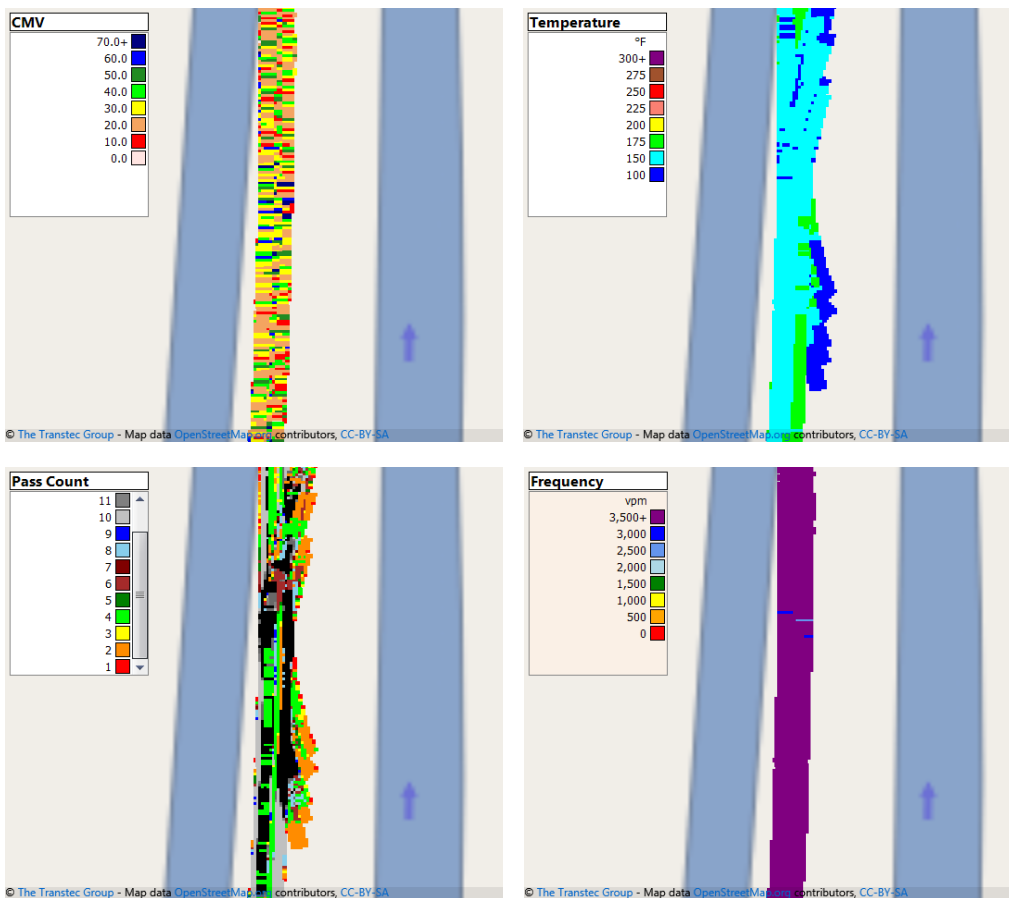
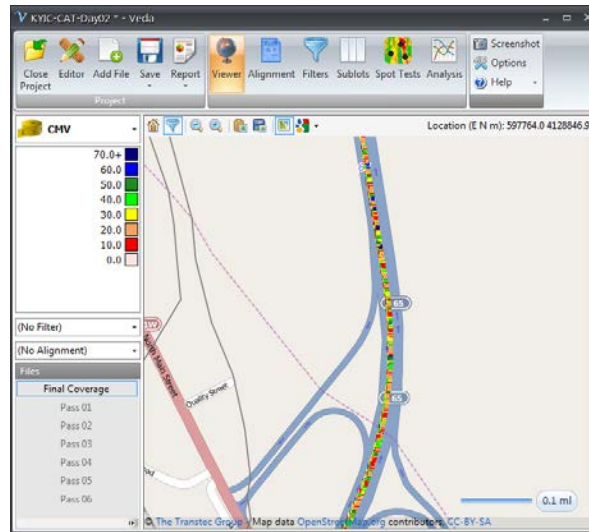


Figure 3. Caterpillar IC maps (intermediate), TB02A, KY site.

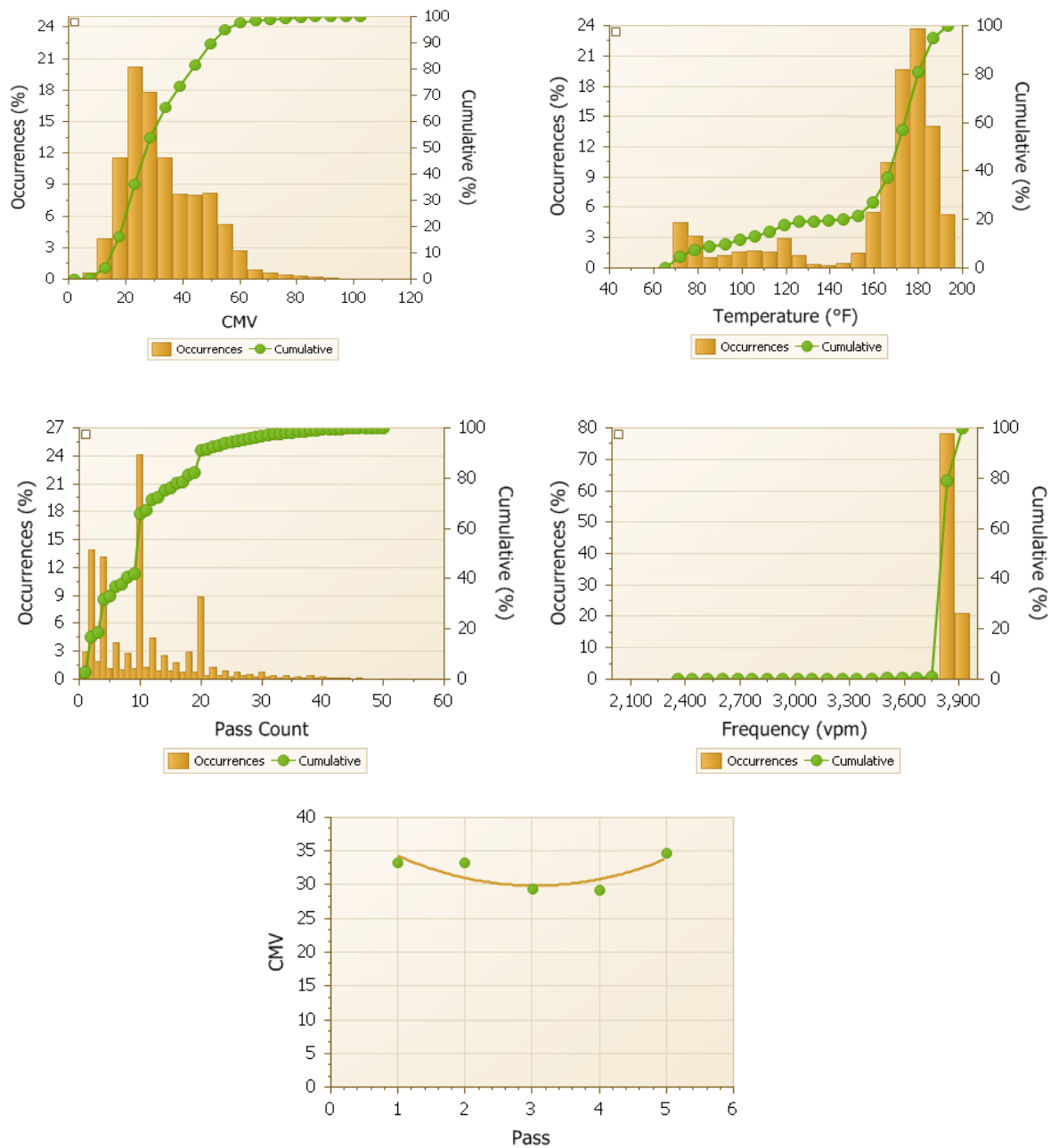


Figure 4. Caterpillar IC statistics (intermediate), TB02A, KY site.

The correlation analysis results are presented as follows.

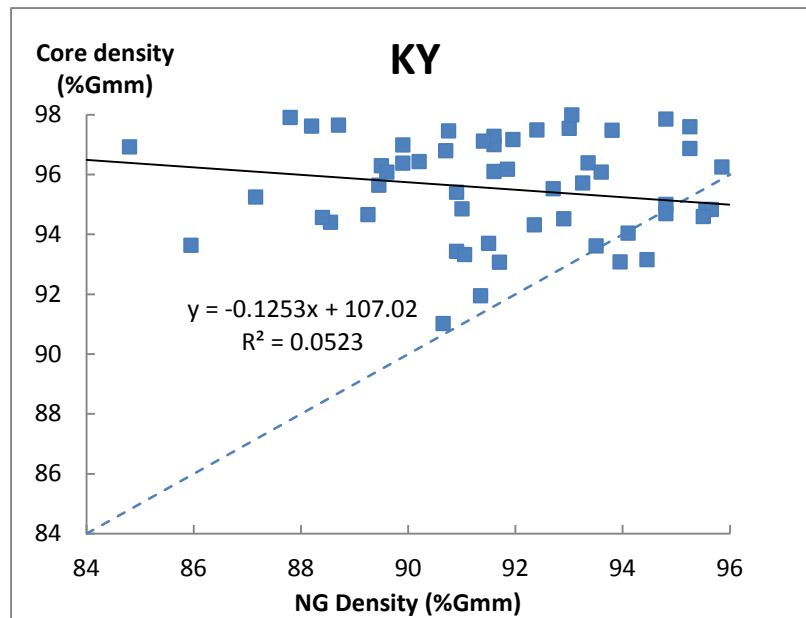


Figure 5. Correlation between core densities and NG measurements, KY site.

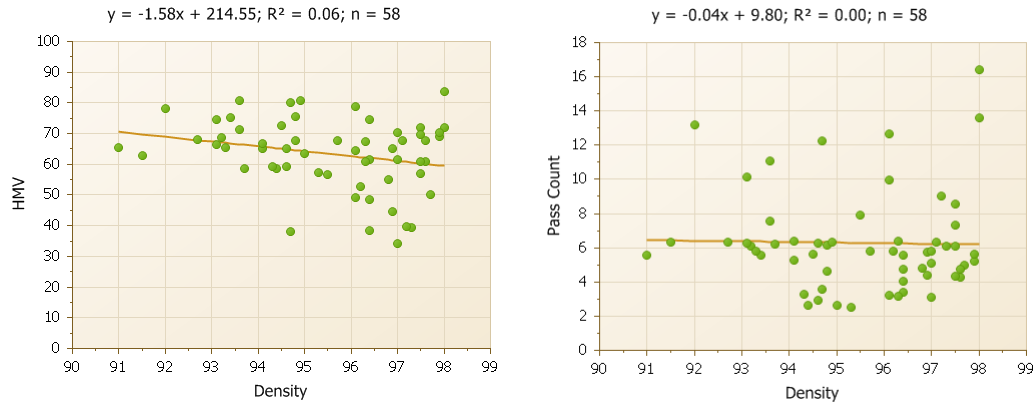


Figure 6. Correlation between core densities and Hamm IC measurements (breakdown roller), KY site.

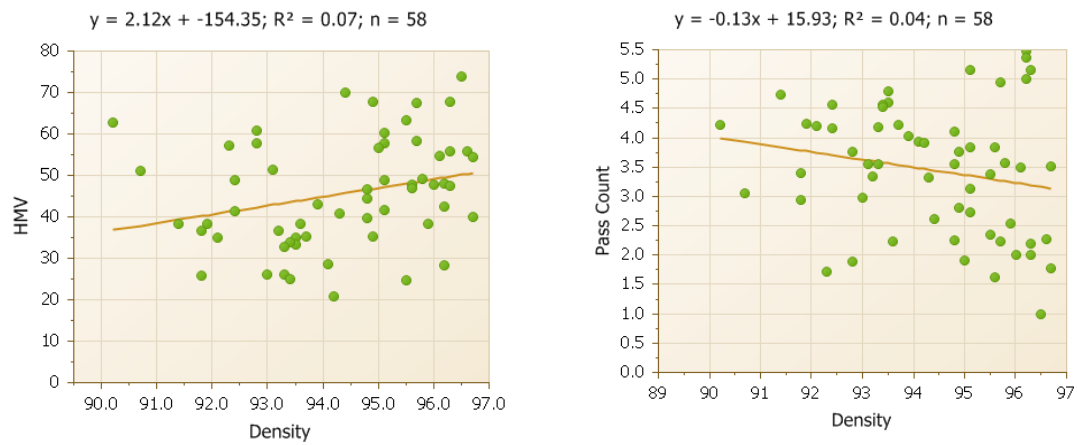


Figure 7. Correlation between core densities and Caterpillar IC measurements (intermediate roller), KY site.