Intelligent Compaction
I 39 – A Case Study
HMA overlay of Rubbilized PCC

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Civil Integrated Management (CIM)
Lake Buena Vista, FL
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Presentation

- Project Overview
- Testing unique to this project
- Setting Up
- Construction
- Pavement performance
- Summary
- Conclusions

Project Overview

- Project location: Mosinee, WI
- Project description:
  - Mill and remove existing HMA
  - Rubbilize or crack-and-seat PCC
  - Overlay with HMA
- Project constructed: May 2010

Project Overview

- WisDOT Proj. No. 1166-00-76
- Net Centerline Length: 5.7 mi
- Start: Maple Ridge Road
- Finish: Sth 34 (Balsam Rd)
- NB lanes constructed: 2009
- SB lanes constructed: 2010

Site Conditions - 2009

Cat-tails and patching....

Site Conditions - 2006

Cat-tails and patching....

Site Conditions - 2009

And joints

Site Conditions - 2006

And joints

Pavement Condition - 2006

- Minor to severe Transverse and Longitudinal cracking.
- 1993 HMA – 3 in. overlay over 8 in. CRCP placed 1973
- 1998 HMA - 3 in. overlay over 8 in. JRCP placed 1958
- Other concerns:
  - Water
  - Frost heave

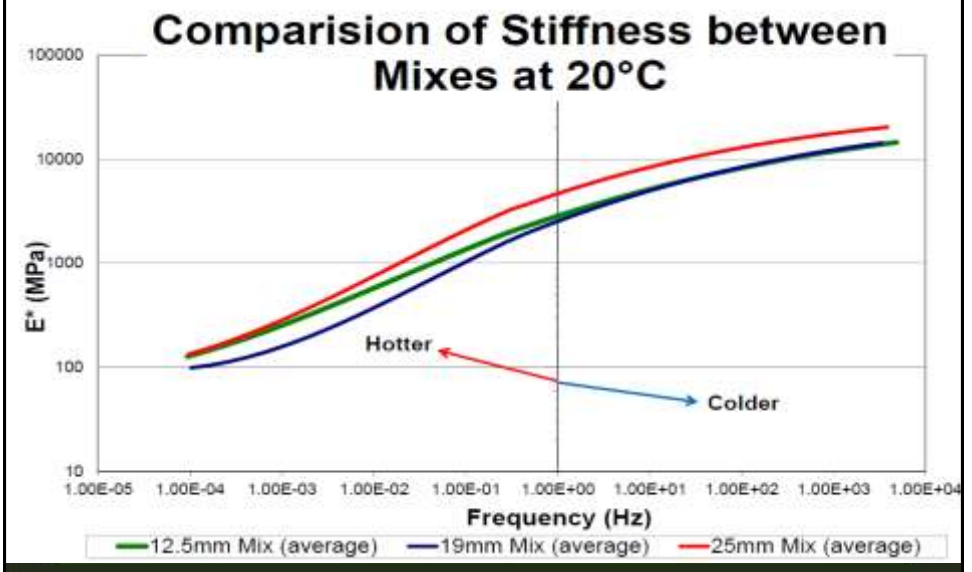
	PDI	IRI, mm/m	PSI
1993 HMA	28 to 73	1.26 to 1.55	3.4 to 4.0
1998 HMA	55 to 68	1.14 to 1.77	3.1 to 4.2
1964 PCC	66	2.16	3.2

Project Overview

HMA Designed as E10, N_{dsn} = 100, V_a = 4%

Type	Base	Binder	Surface
NMAS	25 mm	19 mm	12.5 mm
P_b	3.8	4.6	5.1
VMA	12.3	14.4	14.8
VFA	67	72	73
RAP	30%	15%	16%
BR	28%	13%	12%
Binder	PG 58-28	PG 58-28	PG 64-28

Mix Testing



Unique Testing

- Part of FHWA/TPF on Intelligent Compaction (IC)
- Mapping of each pavement layer using:
  - IC rollers
  - FWD
  - LWD
  - Nuclear Density Gauge (Typical for WI)

Unique Testing

- First IC demo on rubbilized and crack-and-seated PCC.
- First IC demo to use IC roller from “ground-up”
- First IC demo to use IC rollers from the manufacturer for:
  - breakdown/intermediate and
  - finish compaction
- First IC demo to perform FWD and LWD from “ground-up”

Intelligent Compactors

- Sakai SW880 part of FHWA/TPF
- used for:
  - mapping rubbilized and crack-and-seat PPC
  - finish rolling of HMA Base and intermediate lifts
- Sakai SW990 rented for project by Mathy
- used for:
  - intermediate rolling of base lift
  - breakdown rolling of intermediate and surface lifts.

Intelligent compactors - IC

- Measured CCV (continuous compaction value)
- Mapped passes and temperature
- Real-time display for roller operators
- IC roller locations determined by
  - Trimble Navigation Limited base station for SW880
  - Topcon Positioning Systems base station for the SW990

IC - setup

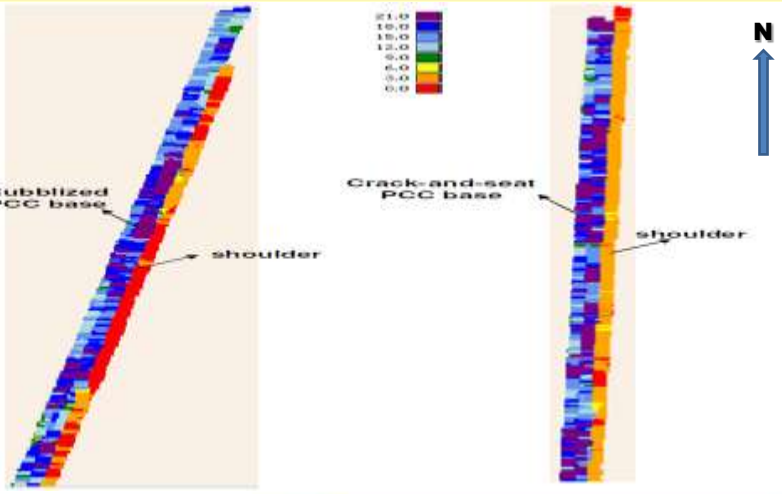
- Each GPS system had it own base station
- GPS needs coordinate system set
- Line of sight needed between IC and base station
- Multiple base stations maybe needed
- Training needed for:
  - IC operators
  - Project management: Agency and Contractor

Mapping the Rubbilized PCC

Mapping the Rubbilized PCC

What the roller operator sees.

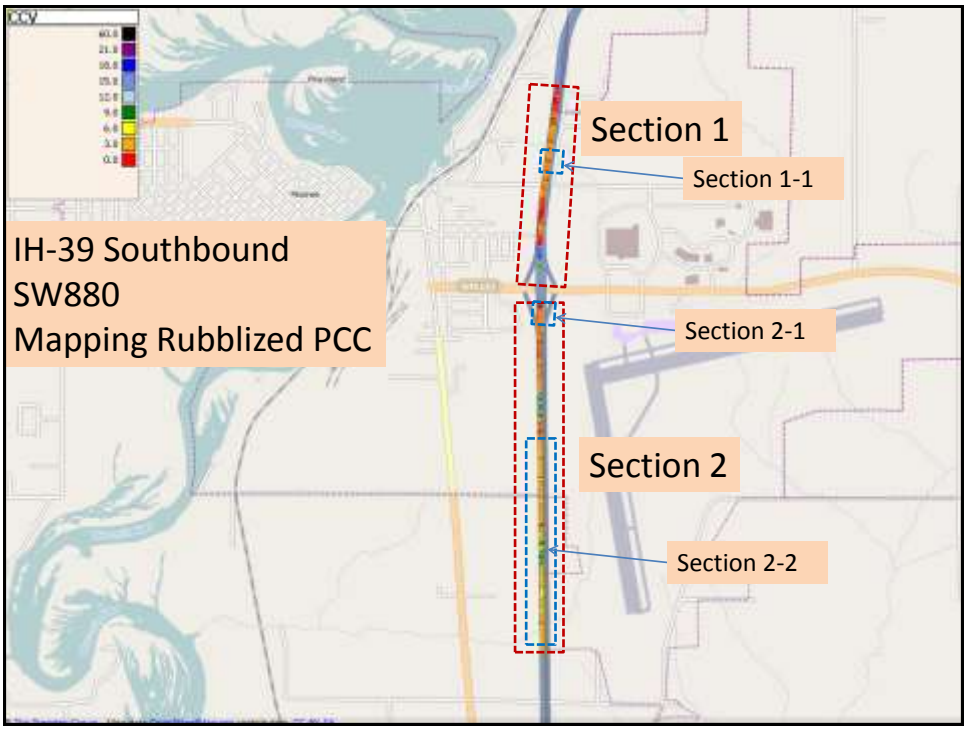
CCV – Continuous Compaction Value



Joints

After rubbilization or crack and seat...

Transverse joints still visible.



Rolling

- Practice parking at angle to direction of paving.

Rolling

- Wedge joints

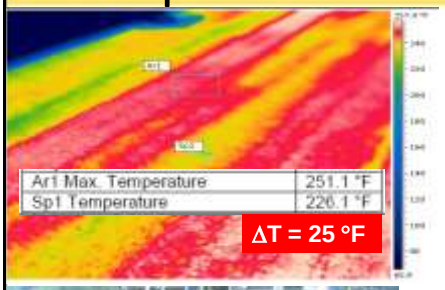
Paver

- Hopper before first load and at the end of day.
- Consistent head of material in hopper
- Consistent mix temperature
- Consistent speed

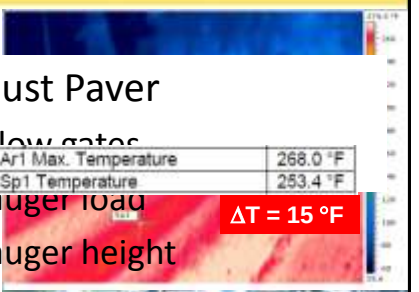
Paving

- Paver stopped.
- Hopper full!

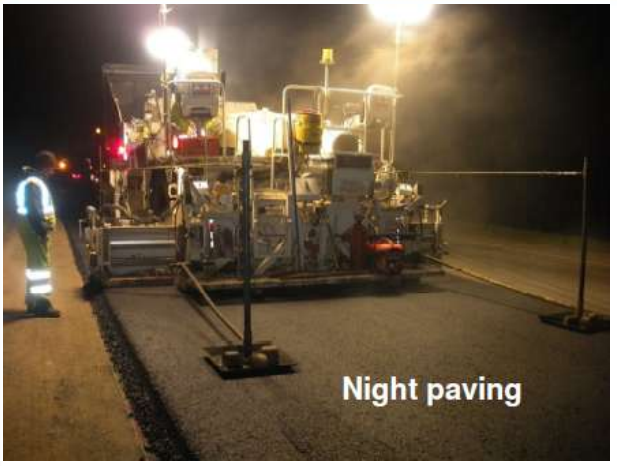
Temperature control



- Adjust Paver
  - flow gates
  - auger load
  - auger height



Paving Intermediate Lift

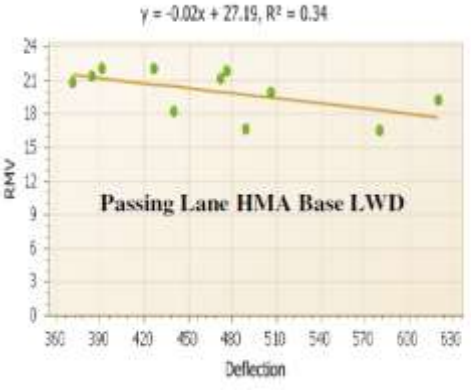


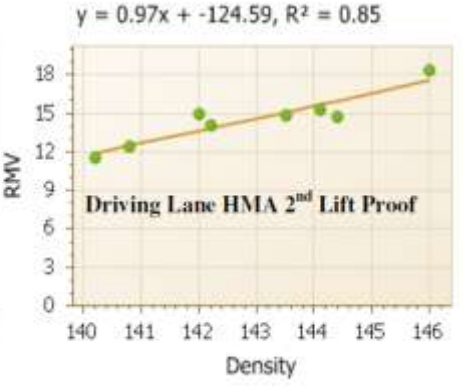
Drain

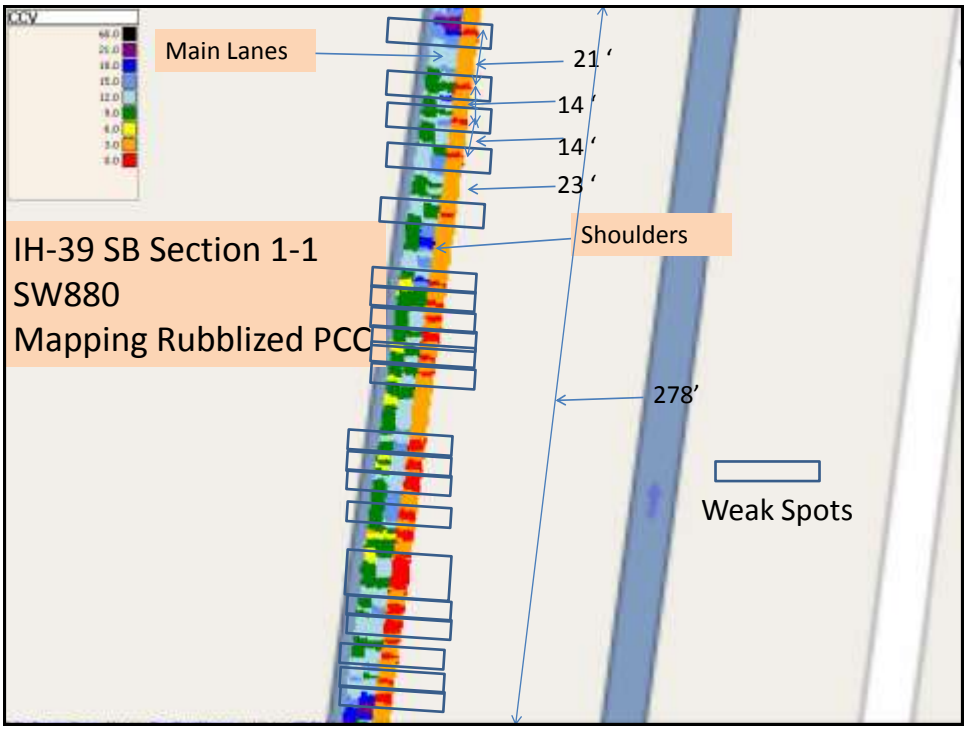
- Next Morning after rain event.

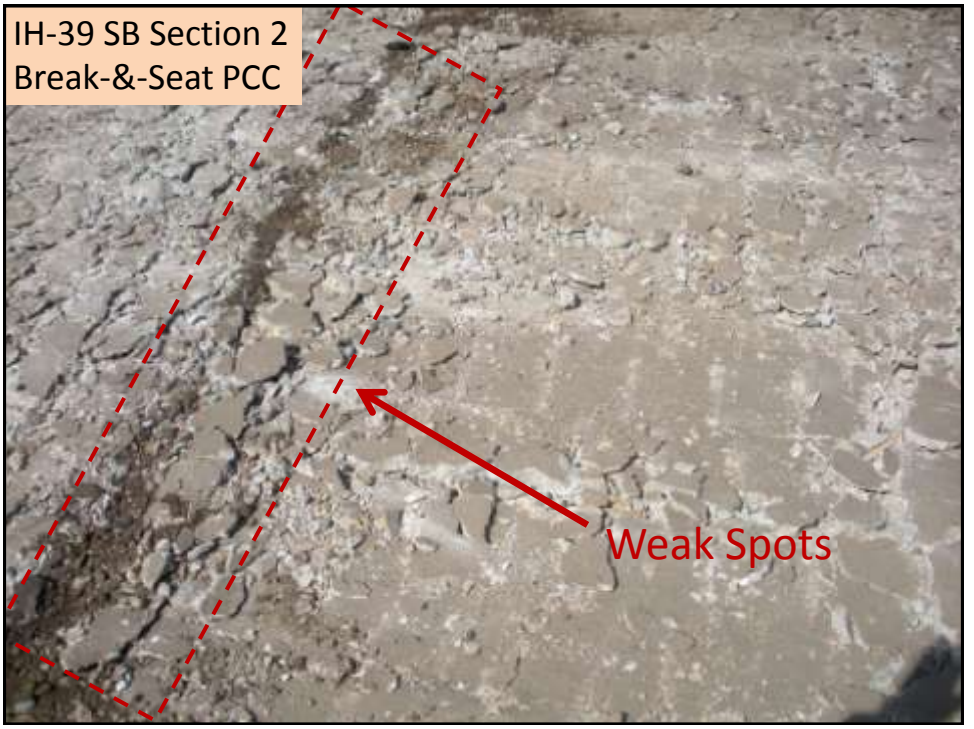
LWD and FWD

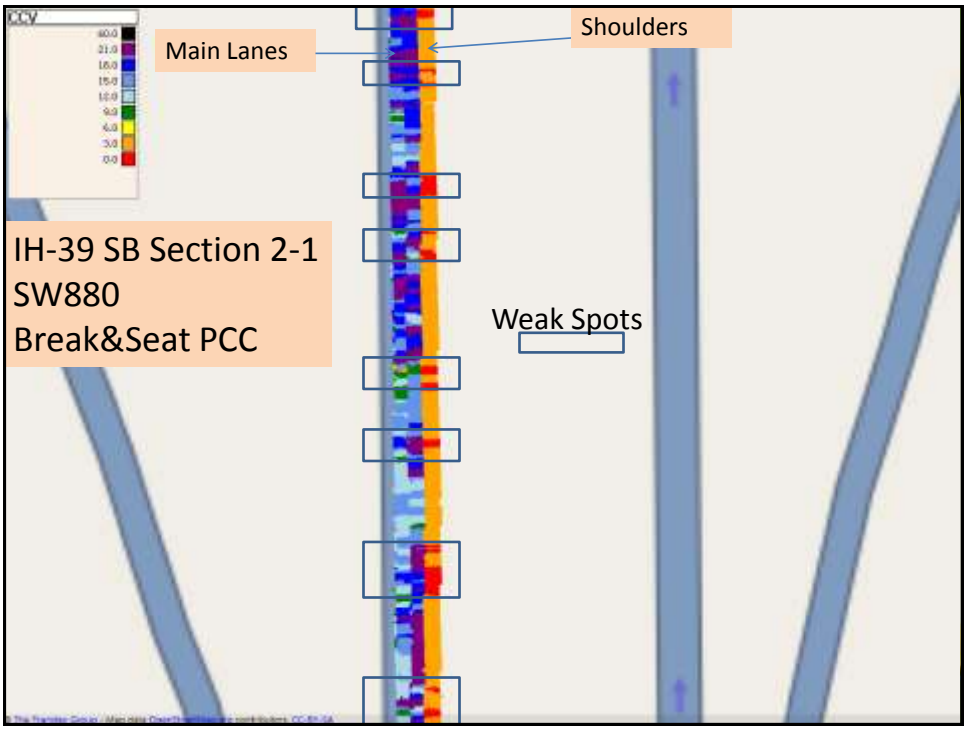
Compaction Results

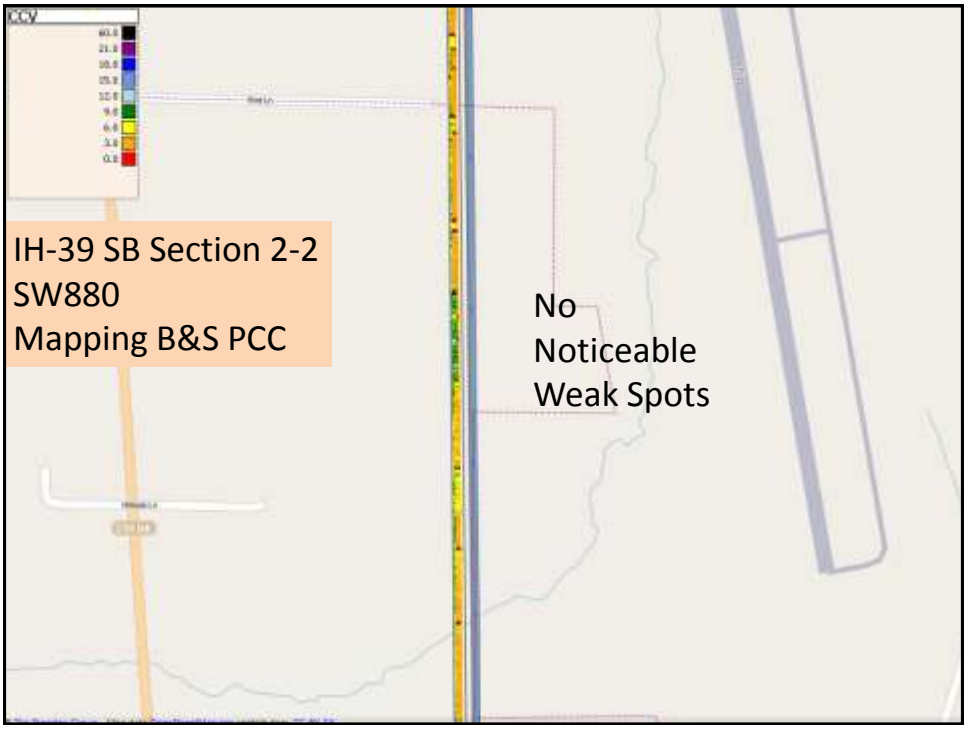





CCV
Main Lanes
21 '
14 '
14 '
23 '
Shoulders
IH-39 SB Section 1-1
SW880
Mapping Rubblized PCC
278'
Weak Spots

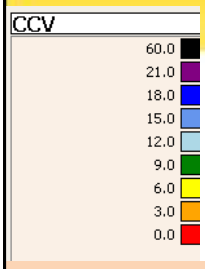

IH-39 SB Section 2
Break-&-Seat PCC
Weak Spots


CCV
Main Lanes
Shoulders
IH-39 SB Section 2-1
SW880
Break&Seat PCC
Weak Spots


CCV
IH-39 SB Section 2-2
SW880
Mapping B&S PCC
No
Noticeable
Weak Spots

Rubblized PCC

Wearing Course

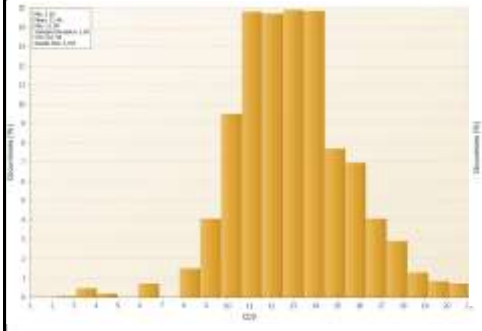


IH-39 SB Section 1-1
SW880 Mapping

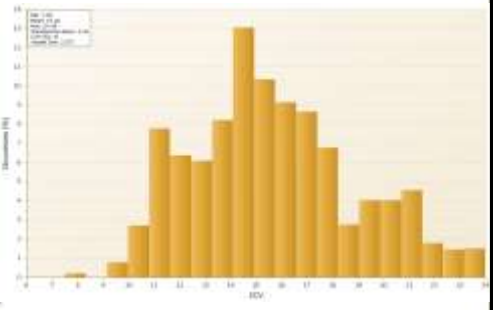
Not all
Weak spots
are "bridged"
by surface layers

Mapping Main Lanes Section 1-1

Rubblized PCC



HMA Surface Course



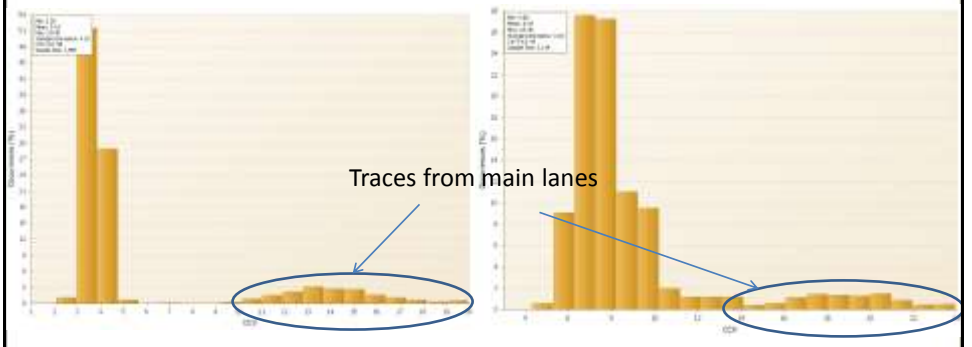
Mean CCV = 12.5 → Mean CCV = 15.3

CCV Increases from ground up

Mapping Shoulders Section 1-1

Rubblized PCC

HMA Surface Course



Mean CCV = 5.1 → Mean CCV = 8.4

CCV Increases from ground up

WisDOT Ride Specification

HMA I	
Initial IRI (inches/mile)	Pay Adjustment[1] (dollars per standard segment)
< 30	250
≥ 30 to < 35	1750 – (50 x IRI)
≥ 35 to < 60	0
≥ 60 to < 75	1000 – (50/3 x IRI)
≥ 75	- 250

WisDOT Ride Specification

Localized Roughness IRI (in/mile)	Pay Reduction[1] (dollars)
> 175	(Length in Feet) x (IRI - 175)

- Measured each wheel path
- Max. $250 pay reduction for ≤ 25ft length
- Max. $10/ft pay reduction for IRI > 185 in/mile

Profiler

SSI System

Dual lasers

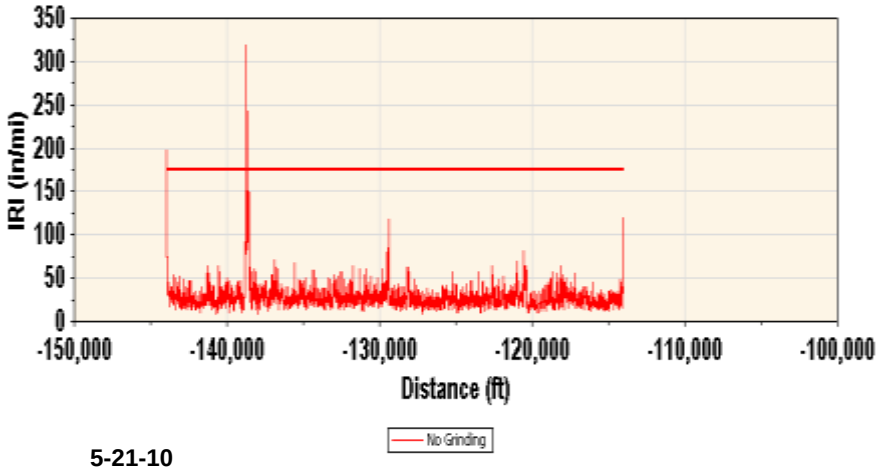
Analysis Software:

ProVal 3.2

Ride Data - 2010

Date	Lift	LWP	RWP	Ave-IRI	%Change
5-6-10	Pre-const.	97.7	117.1	107.4	
5-14-10	19 mm	43.3	46.4	44.8	58% dec
5-21-10	12.5 mm	26.5	28.8	27.6	38% dec

ProVal Analysis-Localized Roughness

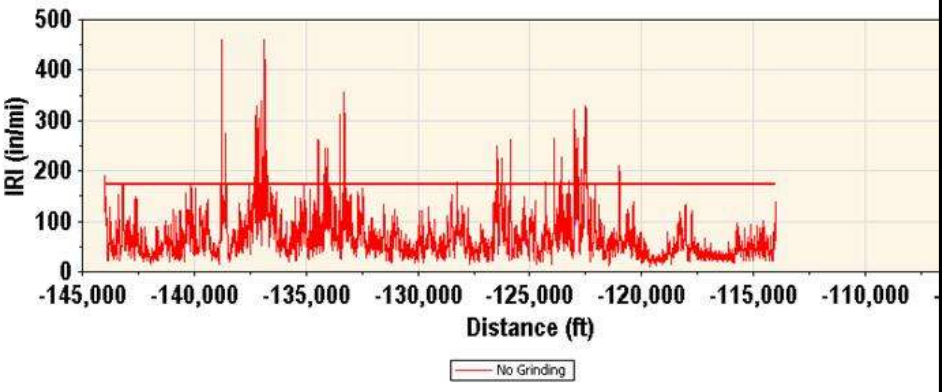


5-21-10

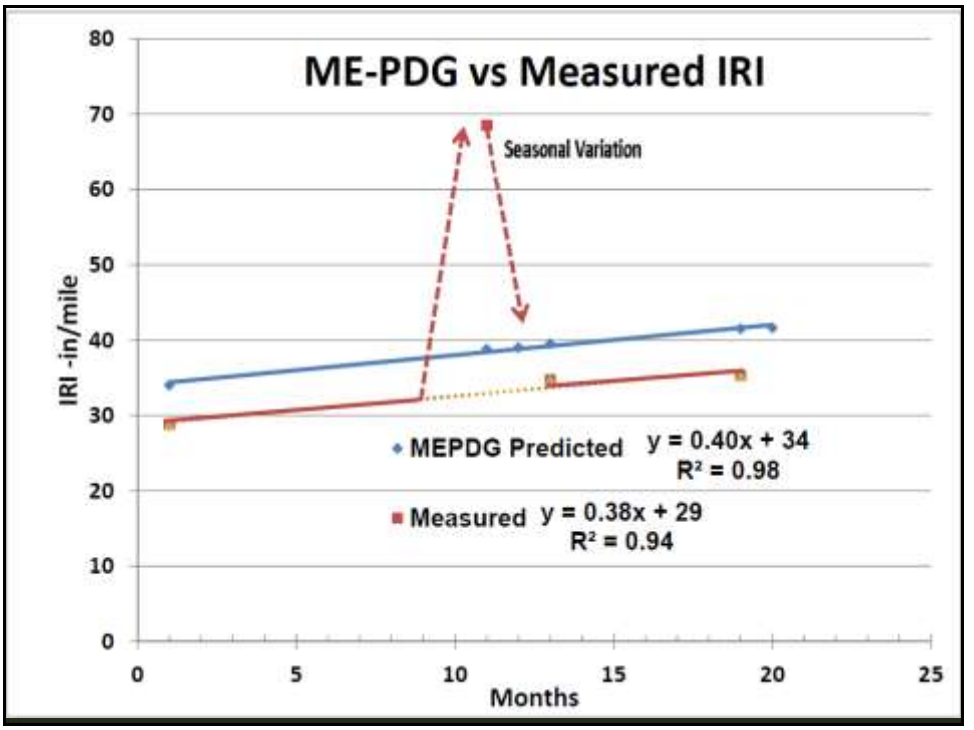
Ride Data - 2011

Date	Lift	LWP	RWP	Ave-IRI	%Change
5-21-10	12.5 mm	26.5	28.8	27.6	38% dec
3-11-11	12.5 mm	65.1	70.6	67.8	143% inc

ProVal Analysis-Localized Roughness



- 3-11-11



Ride Data - 2011

Date	Lift	LWP	RWP	Ave-IRI	%Change
3-11-11	12.5 mm	65.1	70.6	67.8	143% inc
5-13-11	12.5 mm	32.6	34.6	33.6	50% dec

Ride Data - 2011

Date	Lift	LWP	RWP	Ave-IRI	%Change
3-11-11	12.5 mm	65.1	70.6	67.8	143% inc
5-13-11	12.5 mm	32.6	34.6	33.6	50% dec
11-30-11	12.5 mm	33.5	36.1	34.8	3% inc

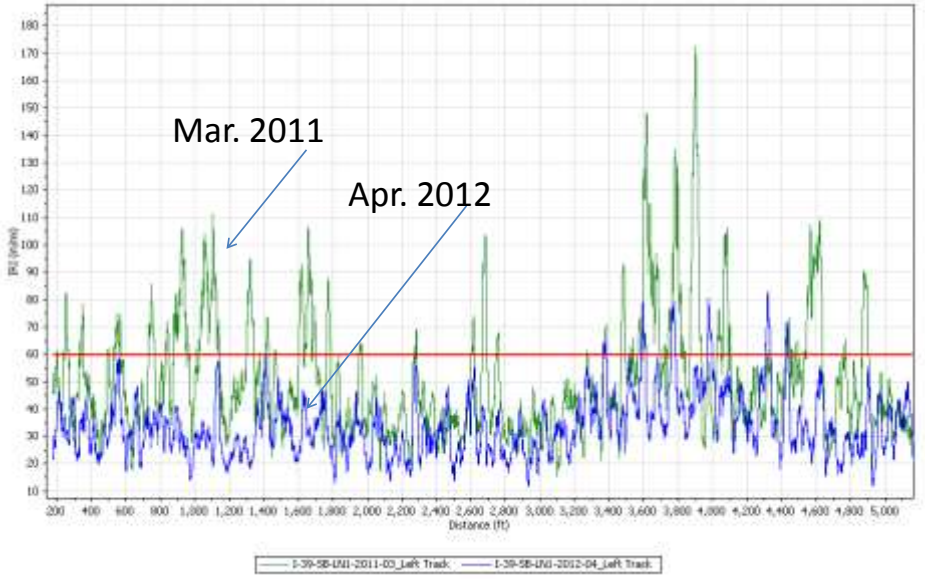
Ride Data – Driving lane summary

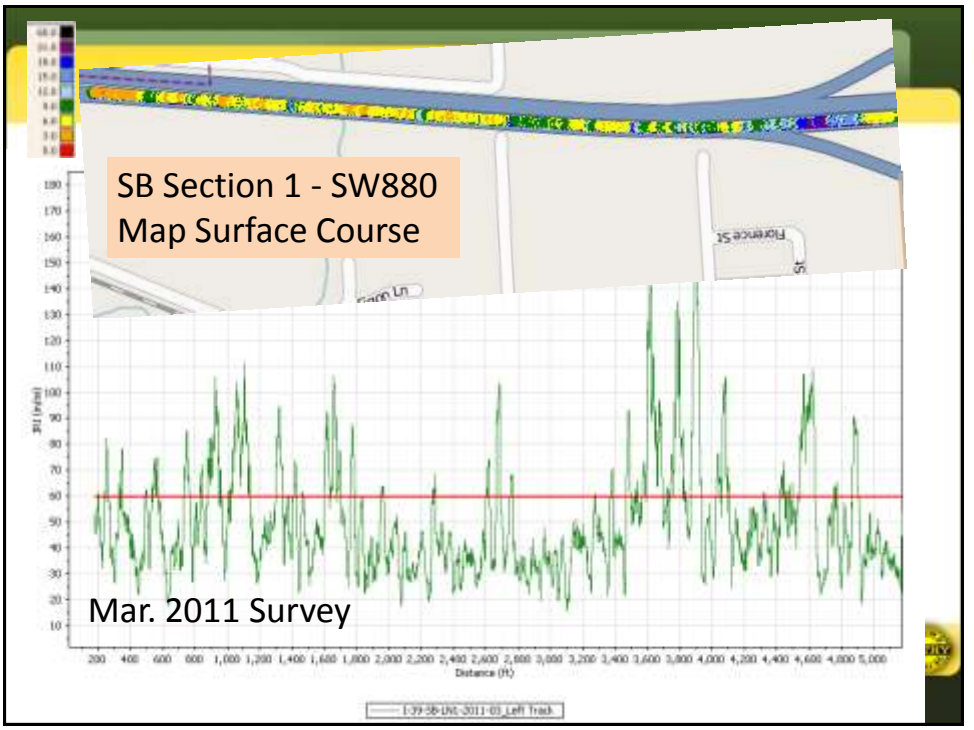
Date	Lift	LWP	RWP	Ave-IRI	%Change
5-6-10	Pre-const.	97.7	117.1	107.4	
5-14-10	19 mm	43.3	46.4	44.8	58% dec
5-21-10	12.5 mm	26.5	28.8	27.6	38% dec
3-11-11	12.5 mm	65.1	70.6	67.8	143% inc
5-13-11	12.5 mm	32.6	34.6	33.6	50% dec
11-30-11	12.5 mm	33.5	36.1	34.8	3% inc

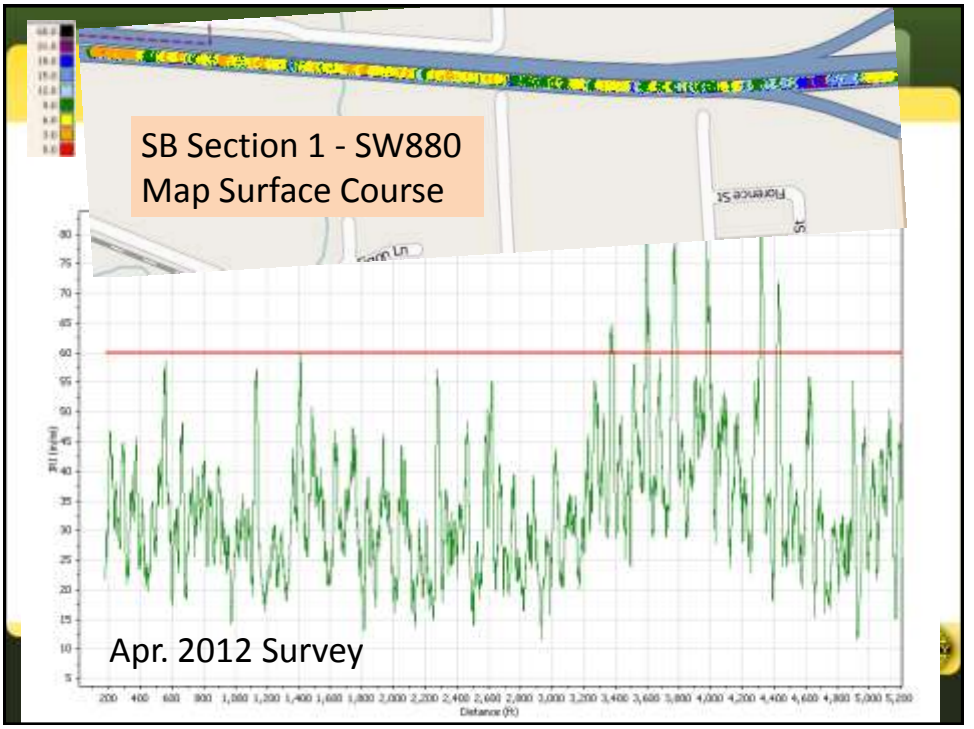
Ride Data – Passing lane summary

Date	Lift	LWP	RWP	Ave-IRI	%Change
5-6-10	Pre-const.	97.7	117.1	107.4	
5-14-10	19 mm	44.3	57.0	50.7	53% dec
5-21-10	12.5 mm	29.2	30.5	29.8	41% dec
3-11-11	12.5 mm	69.7	67.6	68.7	130% inc
5-13-11	12.5 mm	33.7	38.0	35.9	48% dec
11-30-11	12.5 mm	33.6	38.0	35.8	0% inc

IRI Localized Roughness

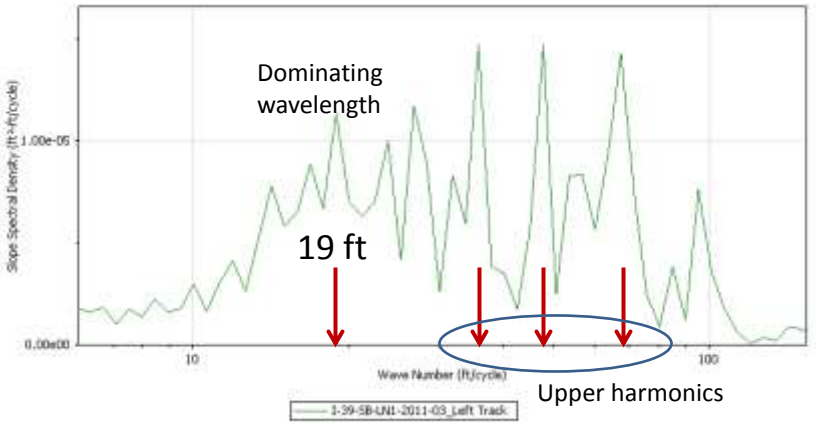



SB Section 1 - SW880
Map Surface Course
Mar. 2011 Survey


SB Section 1 - SW880
Map Surface Course
Apr. 2012 Survey

PSD – ID Profile Features

Section 1-1 (approx)



Mar. 2011 Survey

Summary

- IC rollers can map pre-existing pavement distresses and
- monitor CCV improvement with each additional lift.
- LWD results correlated the best with the IC rollers
- Failed PCC joints must be repaired to prevent the distress from being reflected through the HMA overlay.

Conclusions

Intelligent Compaction can be used for:

- Pre-paving site surveys.
- Quality Control.
- For use as HMA Quality Management (acceptance)
  - Subgrade and
  - Base need to meet IC in-place stiffness specifications.

Conclusions

The road on top

will only perform

as well as

the base below.