

# 28th Annual RPUG Conference

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## Certifying a 3D Pavement System as an Inertial Profiler

By

Michael Richardson, PE – Senior Product Engineer

Mandli Communications, Inc.

## Overview

- Background in Pavement Data Collection
- Background in Certification
- Why Upgrade to 3D System for Profiling?
- Standard Review (AASHTO R56)
- Certification Site Details
- Certification Results
- Future Improvements

## Background in Pavement Data Collection

- 2001
  - Began network-level profiling
  - Distress analysis from ROW imaging
- 2005
  - Started experimenting with line-scan pavement imaging
- 2006
  - Purchased LRIS and LRMS to begin network-level collection of pavement images and transverse profiles

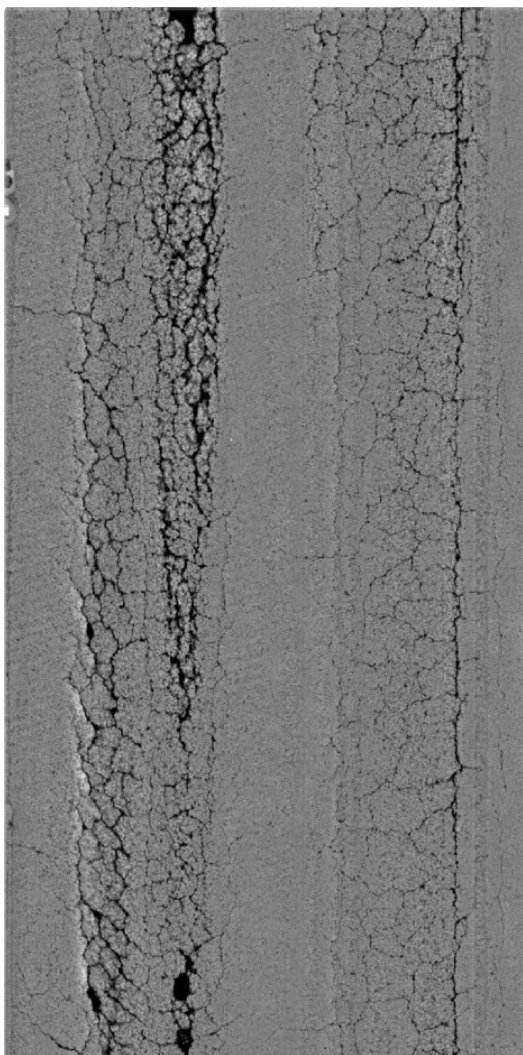
## Background in Pavement Data Collection, Cont'd.

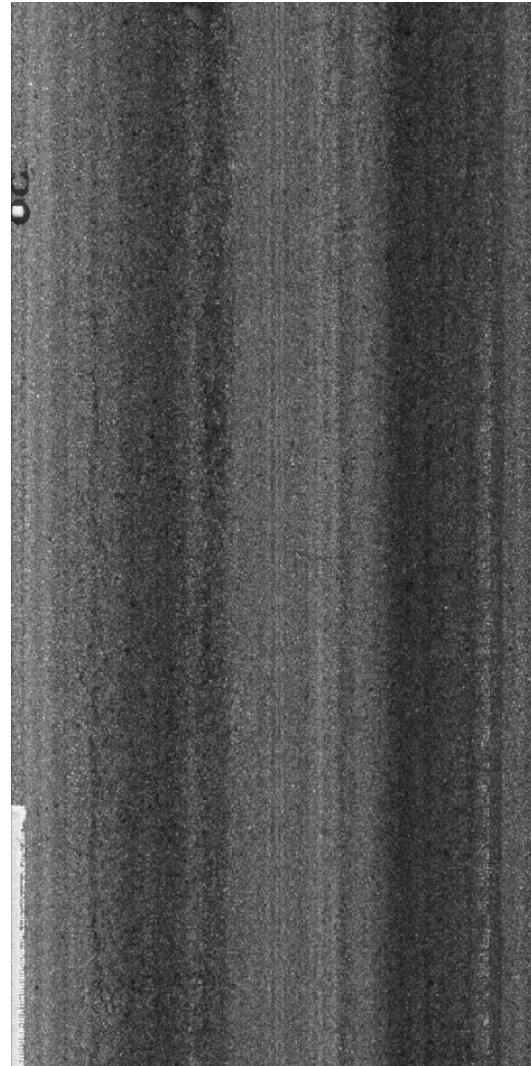
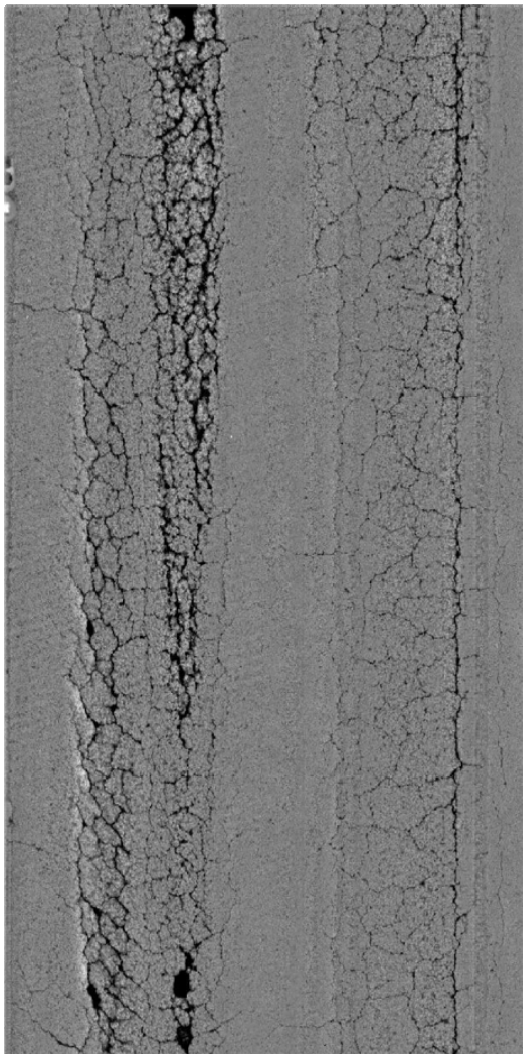
- 2009
  - Purchased LCMS and started network-level collection of 3D pavement data
- 2015
  - Purchased IMUs for LCMS and began extracting longitudinal profiles from 3D pavement data

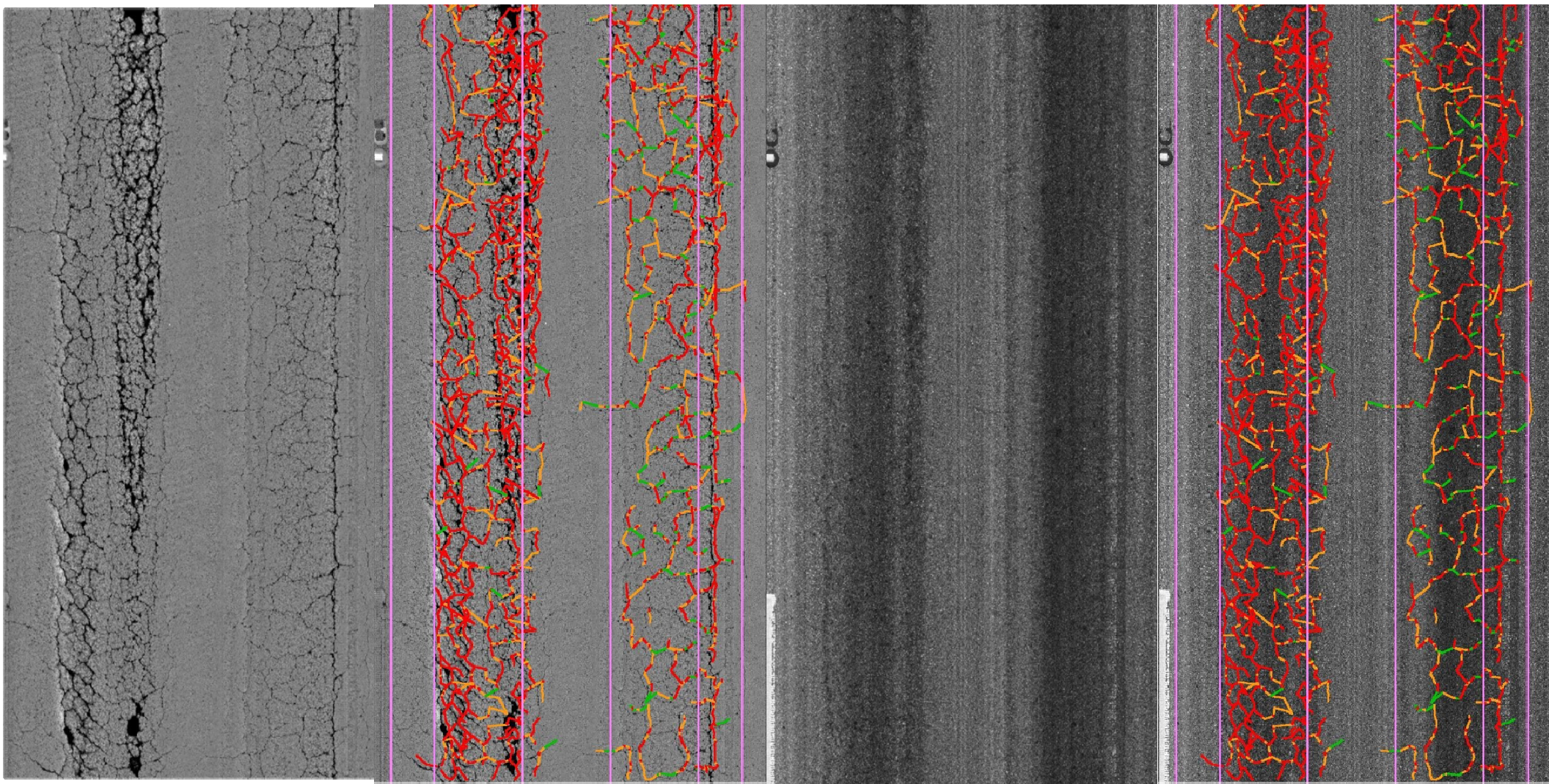




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## Background in Certification

- 2010
  - Began working with walking profilers
- 2011
  - Set up our first SurPRO site near Stoughton, WI with rented equipment
  - Had number of issues passing on this site due to rutting and other distresses
  - Valuable learning experience
  - Created internal certification process





## Background in Certification, Cont'd.

- 2013
  - Purchased SurPRO 3500
  - Set up new site in Fitchburg, WI
  - New road with two lanes in each direction
- 2015
  - Certified RSP at NCAT
  - Certified LCMS at Fitchburg, WI site
- 2012 – 2016:
  - Set up SurPRO sites in AK, DE, KS, KY, OK, and UT

## Why Upgrade to 3D System for Profiling?

- Streamline pavement collection vehicle
- Single source of pavement data
- System has proven to be repeatable
- Accounts for most driver-wander
- Ability to extract longitudinal profile from anywhere across the detected lane
- Offers option to use a bridging filter transversely and longitudinally

## Standard LCMS Deliverables

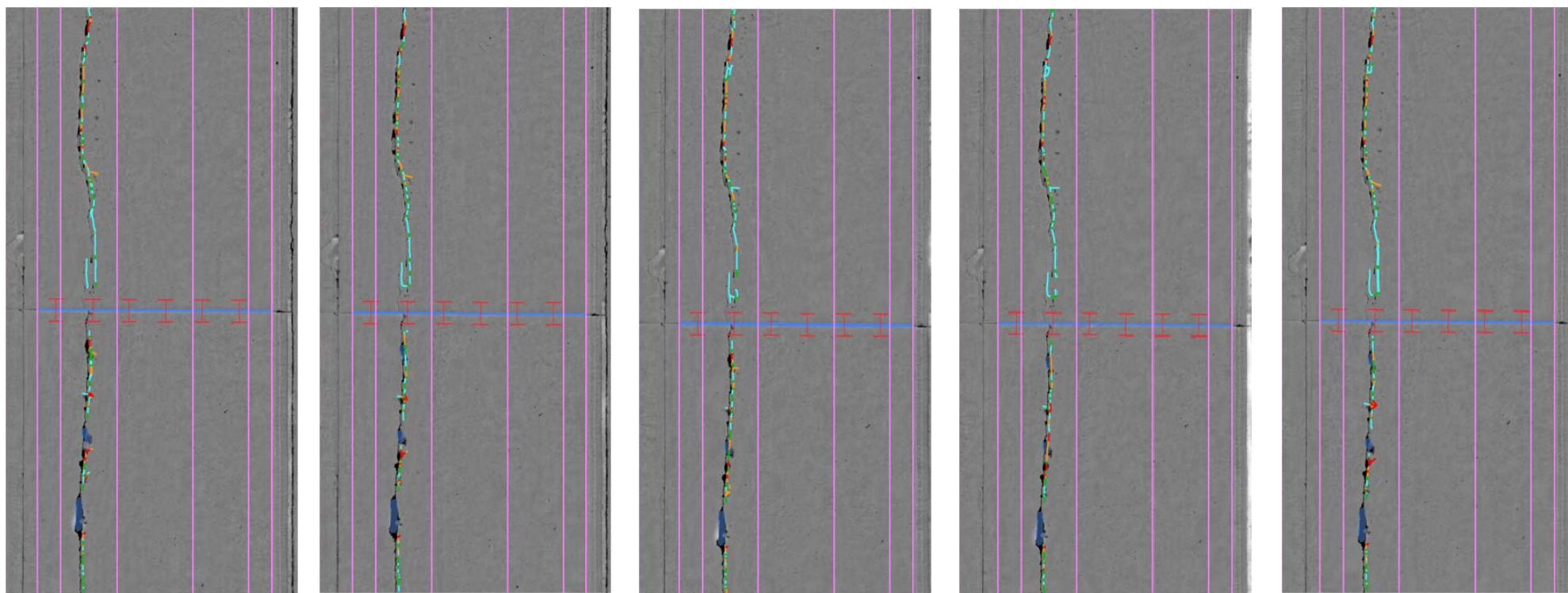
- Crack detection
- Transverse Profiles
- Rutting
- Transverse Joint Detection
- Faulting
- Longitudinal Joint Detection
- Macrotexture Evaluation (MPD, MTD)
- Detection of Raveling
- Pothole and Delamination Detection
- Bleeding Detection

## Deliverables Added with IMUs

- Longitudinal Profile
- IRI
- Curve and Grade
- Cross Slope
- Water Entrapment Depth



# Crack Detection Repeatability



Run 1

Run 2

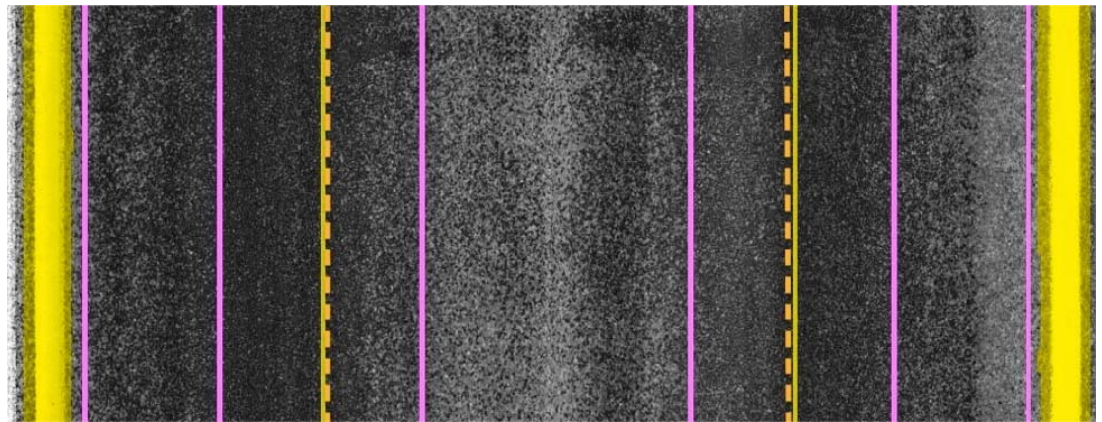
Run 3

Run 4

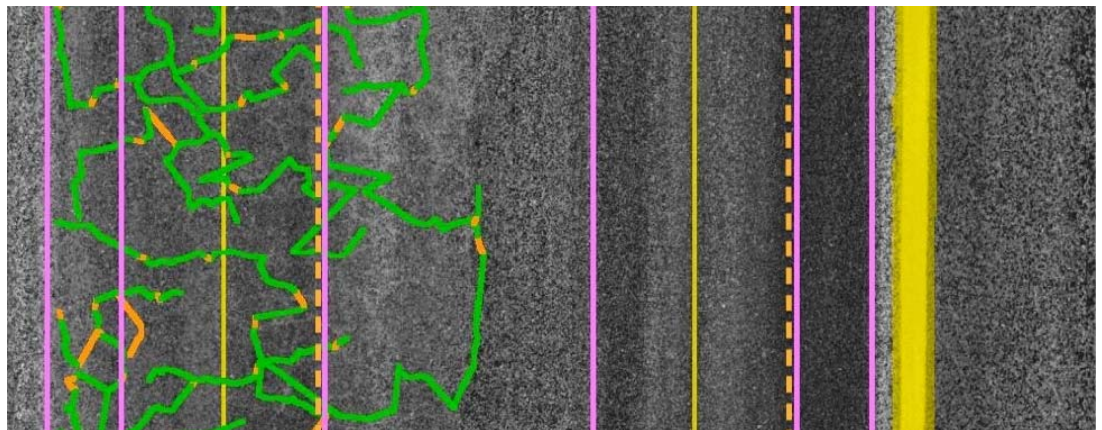
Run 5

## Accounts for Driver-Wander

Ideal conditions:  
Centered on lane



Not ideal conditions:  
Driver wanders to  
the right



## Full Lane of Profiles

Single  
Point



4,000  
Points



## Standard Review: AASHTO R56

- Equipment (Section 5)
- Equipment Calibration Verification (Section 6)
- Operator Certification (Section 7)
- Equipment Certification (Section 8)



# Required Equipment

- AASHTO M328 is referenced for the required equipment

*“The longitudinal pavement profile shall be measured using equipment in which three primary transducers are used. These transducers include:*

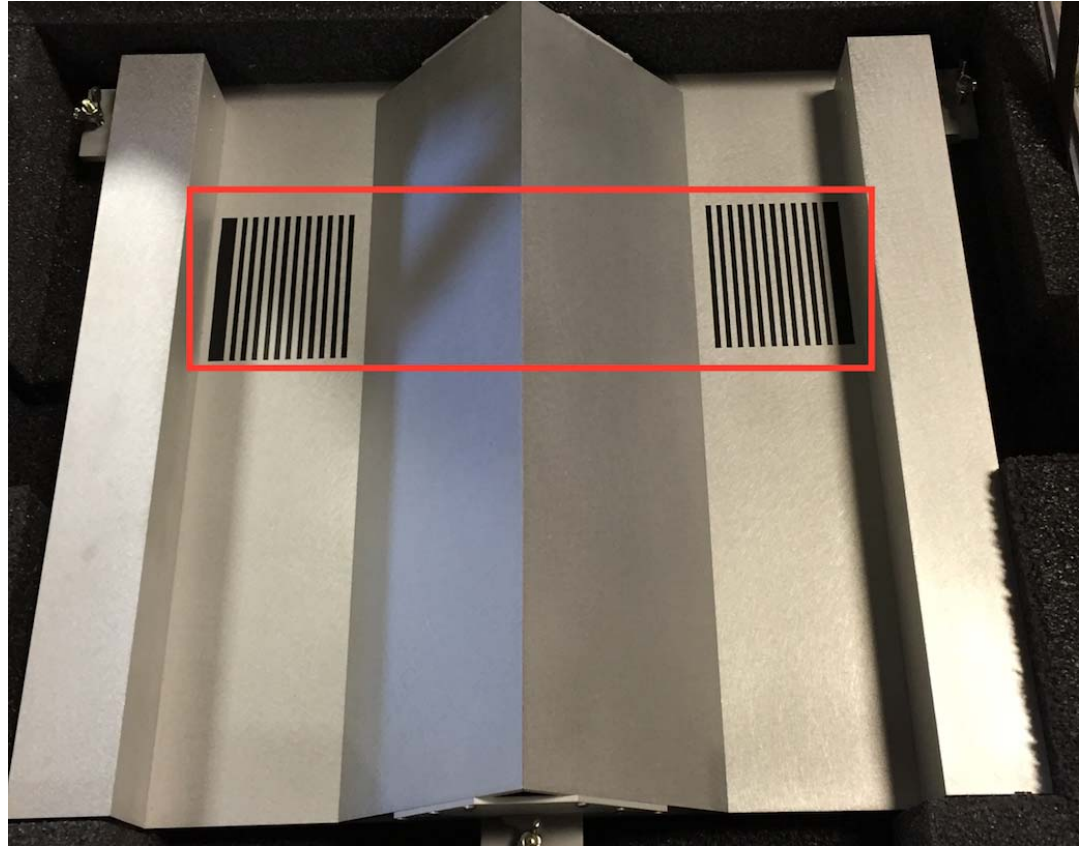
- 1. A height sensor that measures the distance between a vehicle reference point and the pavement while the vehicle is traveling*
- 2. An accelerometer that measures the vertical acceleration of the vehicle as it moves vertically in response to the pavement profile*
- 3. A distance sensor that provides a location reference for the vehicle as it travels.”*

# Equipment Calibration Verification

- Must execute successful bounce test and block check per R57 prior to moving on to equipment certification
  - Bounce Test
    - Simulate 2,184 feet of collection; 828 feet static, 528 feet bouncing, 828 feet static
    - Static sections should be less than 3 in/mi and bounce section less than 8 in/mi (ignoring first and last 300 feet as lead-in and lead-out)
  - Block Check
    - Must measure plate, 1-inch block, and 2-inch block
    - Measurements must be within 0.01 inches of known heights

## Static Validation

- Known dimensions
- Vertical and horizontal measurements
- Focus check
- Measured 6 times
  - Left, center and right for each pod



## Operator Certification

- Operation of an inertial profiler should only be performed by a certified operator.
- Operator certification should include the following:
  - Completion of a training course
  - Written examination
  - Practical examination
  - Documentation of certification

# Equipment Certification

- Test Sections
  - Should be at least 528 feet
  - Should be flat and without curvature
  - Should test on multiple sites with range of IRI values
    - Smooth: 30 – 75 in/mi
    - Medium-Smooth: 95 – 135 in/mi
    - Medium-Rough: <200 in/mi

## Equipment Certification, Cont'd.

- Reference Profiles
  - Reference device must collect at 1-in intervals or better
  - Collect 3 repeat runs in each wheel path
  - Average repeatability of the 3 runs should be at least 98%

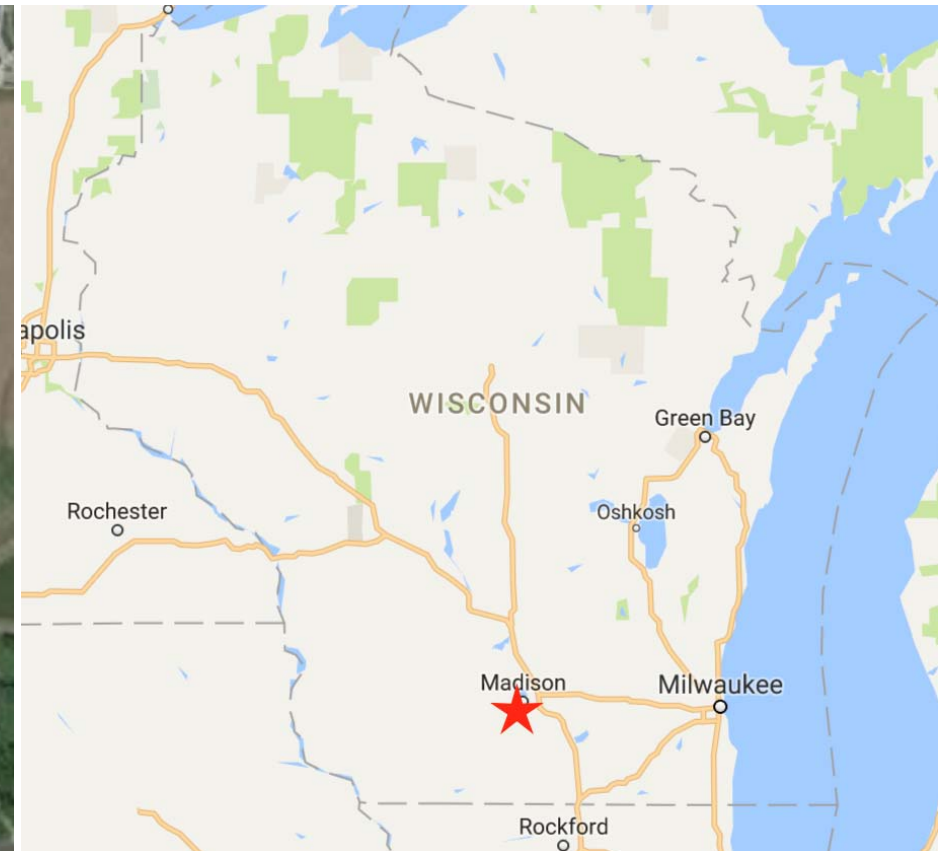


## Equipment Certification, Cont'd.

- Van Profiles
  - Collect 10 runs, 5 runs at 2 different speeds
- Equipment Repeatability
  - Comparing 10 van runs to themselves should have an agreement score of 92% with ProVAL certification module
- Equipment Accuracy
  - Comparing 10 van runs to reference profiles should have an agreement score of 92% with ProVAL certification module

## Local Certification Site

- Located in Fitchburg, WI on Lacy Road
- 2 lanes in each direction
- 35 mph speed limit
- IRI of ~80 in/mi
- 528 feet long











## Future Plans

- Establish new sites in Madison area to include various pavement types and range of IRI values
- Work in various speeds to van runs
- Work on getting reference profile repeatability to 98%
- Update collection procedure to output profile at end of run by processing in real time



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