Integrating the Rolling Wheel Deflectometer (RWD) into Pavement Management to Support an Effective Pavement Preservation Program

Curt A. Beckemeyer, P.E.
Sr. Vice President
Applied Research Associates, Inc. (ARA)

Presentation Outline

Background

Study Objectives and Purpose

Data Collection

Pavement Management Analysis

Findings

Conclusions

New Developments

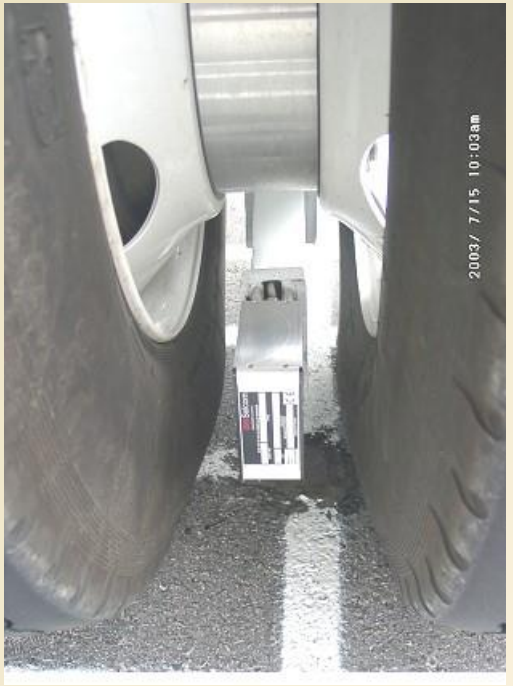
The RWD

- System
  - Laser-based system
  - 18-kip, single-axle, dual-tire
- Operation
  - Operates at posted speeds
  - No lane closures
- Measurements
  - Spatially-coincident method
  - Averages deflections over 0.1-mile intervals

Key Design Features

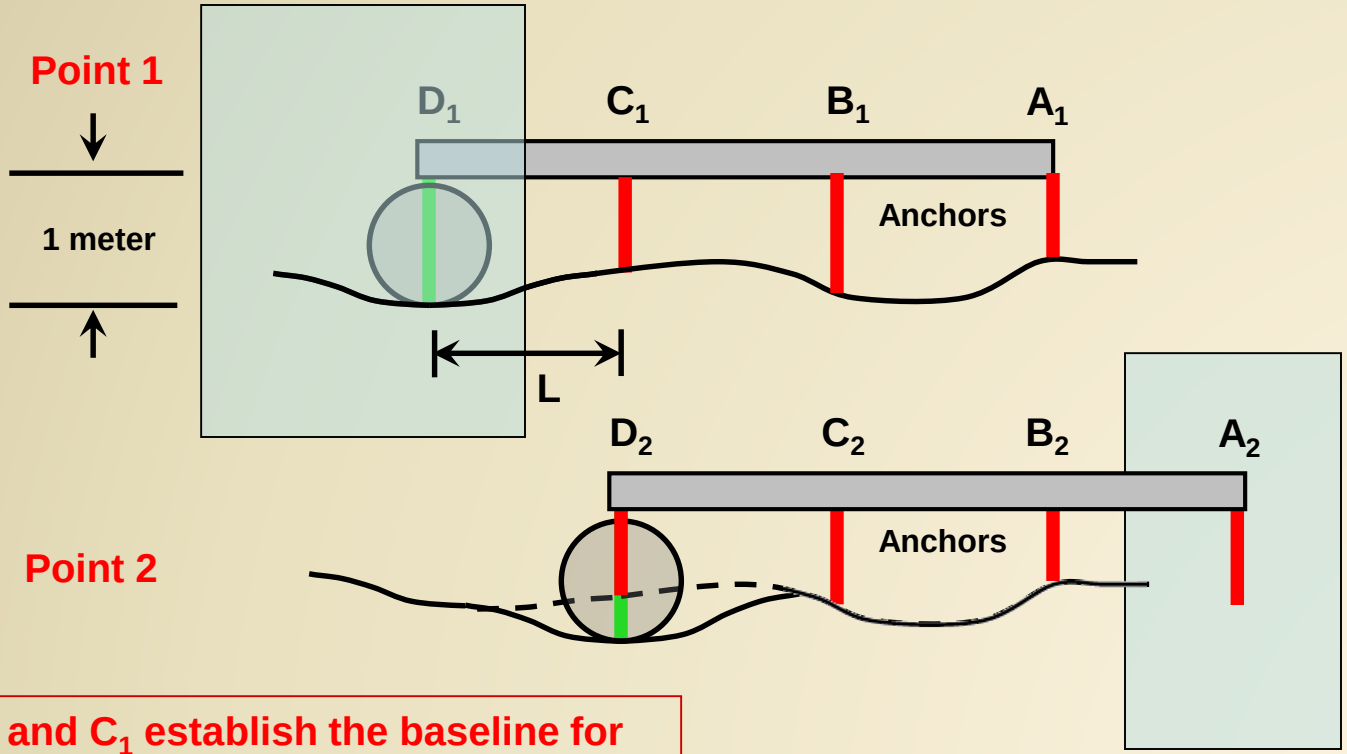
- Trailer
- Wheels
- Beam
- Lasers
- Calibration
- Software

Reference beam and spot lasers



Laser between dual tires

Spatially Coincident Methodology



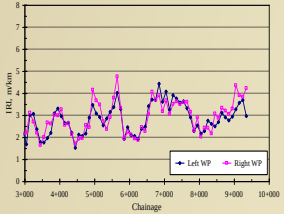
A_1, B_1 and C_1 establish the baseline for comparison to B_2, C_2 and D_2

RWD Role in Pavement Management

Network-Level

PQI

IRI



RWD

1,000s of lane-miles

Preservation

Rehabilitation or Reconstruction

Project-Level

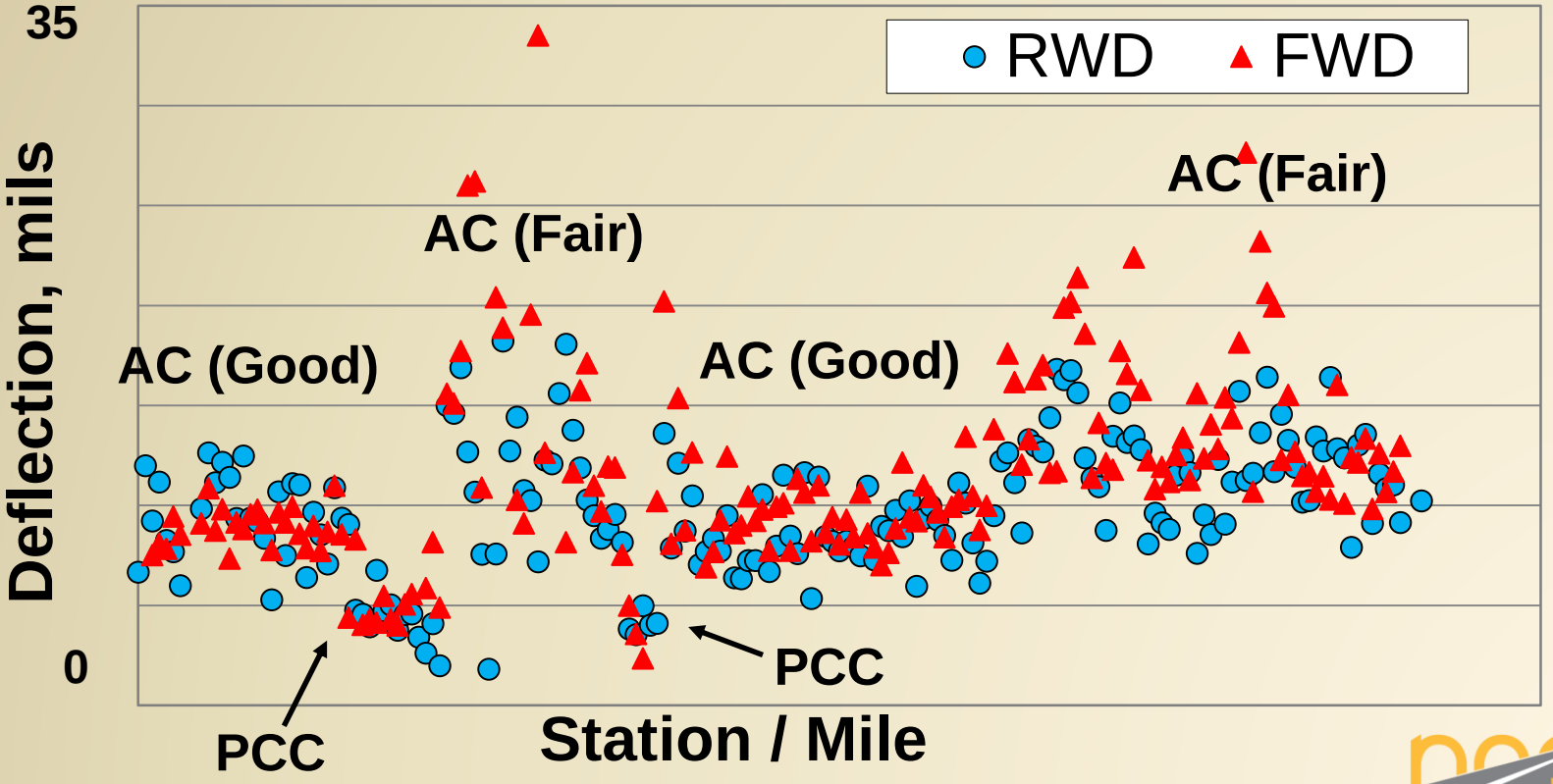
Dozens of lane-miles

FWD

Coring

Lab

Sample Deflection Profile

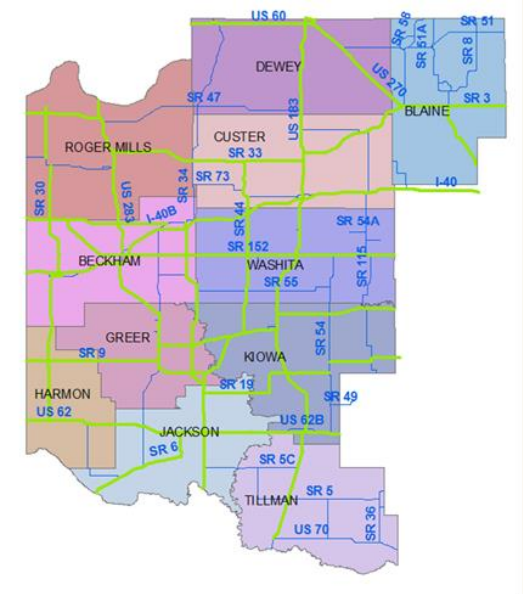


FHWA Case Study - *Oklahoma*

- ***Evaluate*** the benefits of integrating RWD data into PMS
- ***Compare*** results with and without RWD data
  - Treatment selection
  - Costs
  - Performance

Test Roads

- **Test Network**
  - 1,000 miles (ODOT D-5)
  - Primarily flexible pavements
  - Wide range of functional classifications/traffic
- **Data Collection**
  - Continuous data collection
  - Averaged data at 0.1-mile intervals
  - Testing duration: 4.5 days



Agency PMS Data

- Condition
  - Pavement Quality Index (PQI):
    - Ride quality
    - Rutting
    - Distress
  - Structural condition
    - FWD data (interstate only)
    - Structural rating (subjective)
- Composition / Use
  - Pavement age
  - Layer types and thicknesses
  - Classification, traffic (ADT)

Agency PMS Methodology

- Software
  - Deighton software (dTIMS)
- Performance Modeling
  - Defined sectioning
  - Performance models for each pavement type
- Decision Models
  - Decision trees → PQI, traffic, and structural condition
  - 3 Treatment categories → Preservation, rehab, replacement

Approach

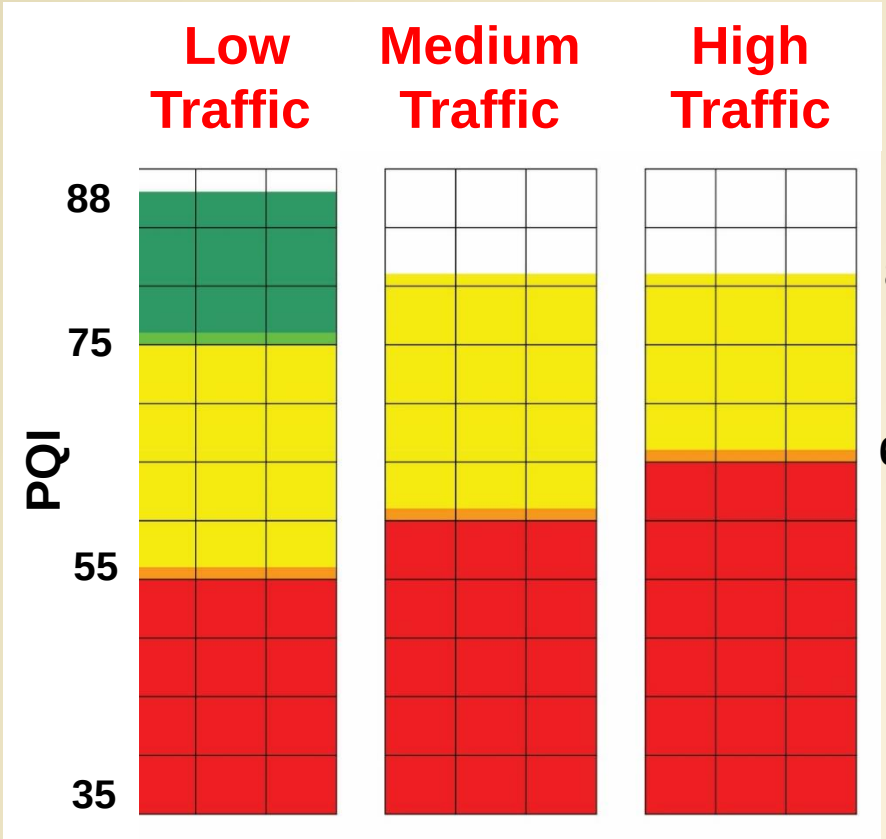
- Evaluate multiple M&R treatment strategies
  - Base strategy: PQI only
  - Two modified strategies: add RWD data
- Compare results
  - Costs
  - Performance (in terms of PQI)

PQI Only – Treatment Matrix

PRESERVATION

REHABILITATION

REPLACEMENT

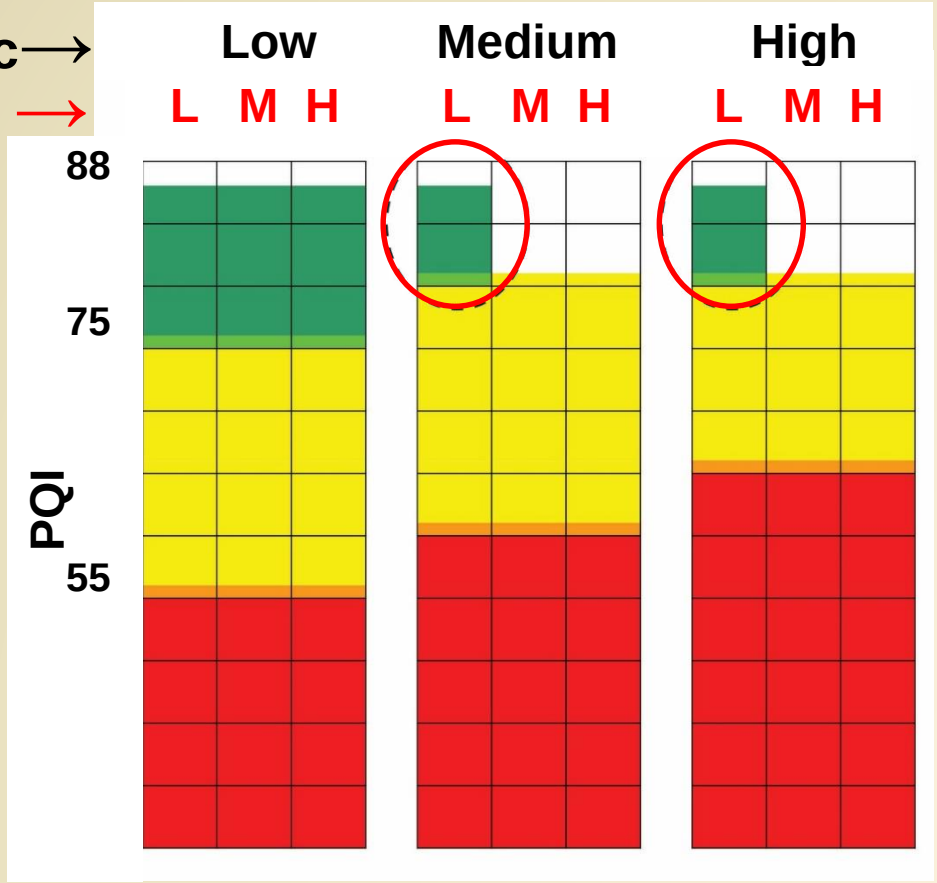


RWD #1 – Treatment Matrix

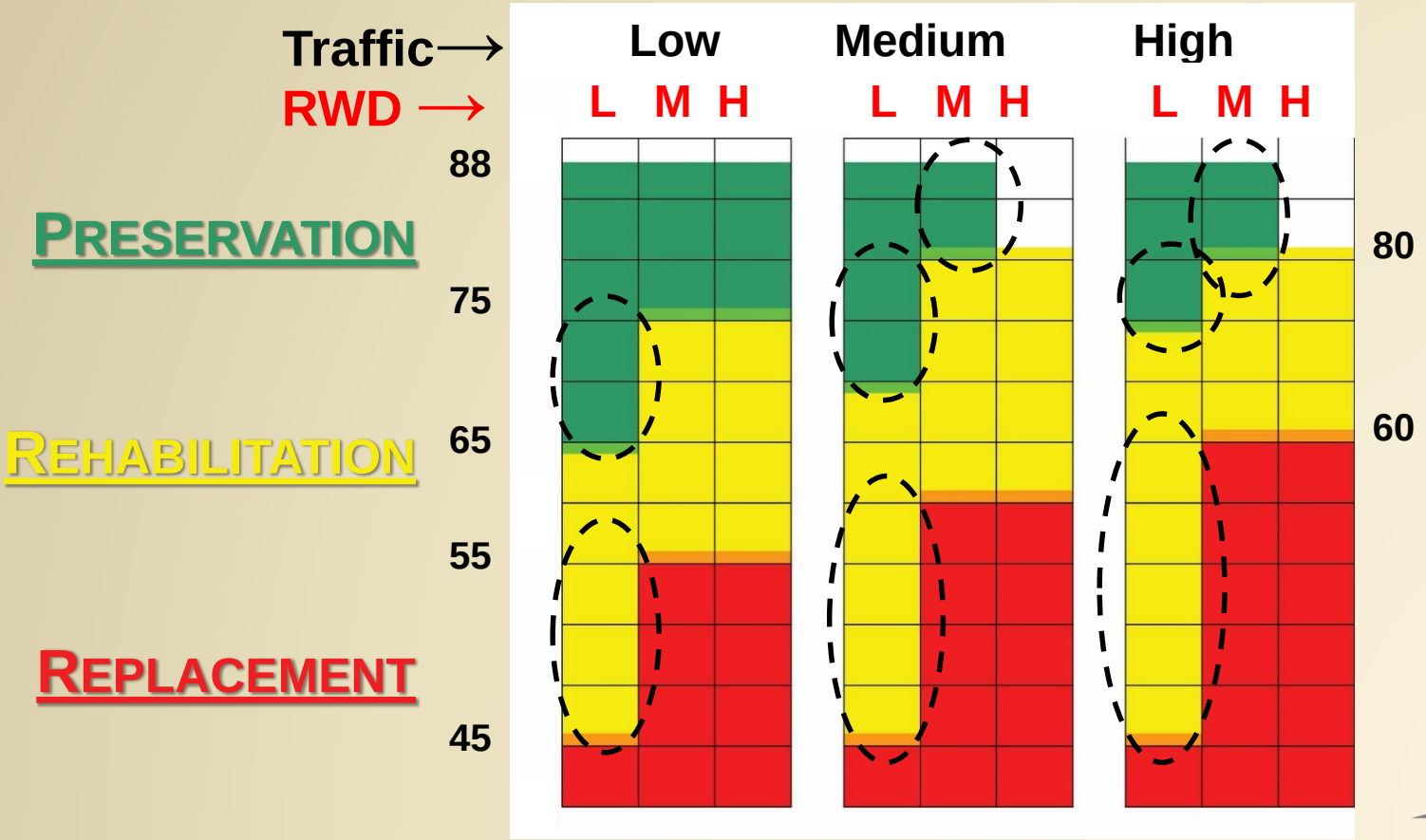
PRESERVATION

REHABILITATION

REPLACEMENT



RWD #2 – Treatment Matrix



Results

Budget Scenario	Percent change in cost (relative to “PQI Only” base case)		
	PQI Only	RWD Option 1	RWD Option 2
Target PQI = 92	0.0%	-10.6 %	-11.5 %

Conclusions

- RWD allows broader, more reliable use of pavement preservation
  - Identifies roads in ***GOOD*** & ***FAIR*** structural condition
  - Prevent PP use on roads in ***POOR*** structural condition
- Cost savings can be significant
  - In the range of 5 to 10%, in many cases
  - Depends on agency's current strategy and road conditions

Recent Advancements in RWD Technology

RWD-Vision (cameras vs lasers)

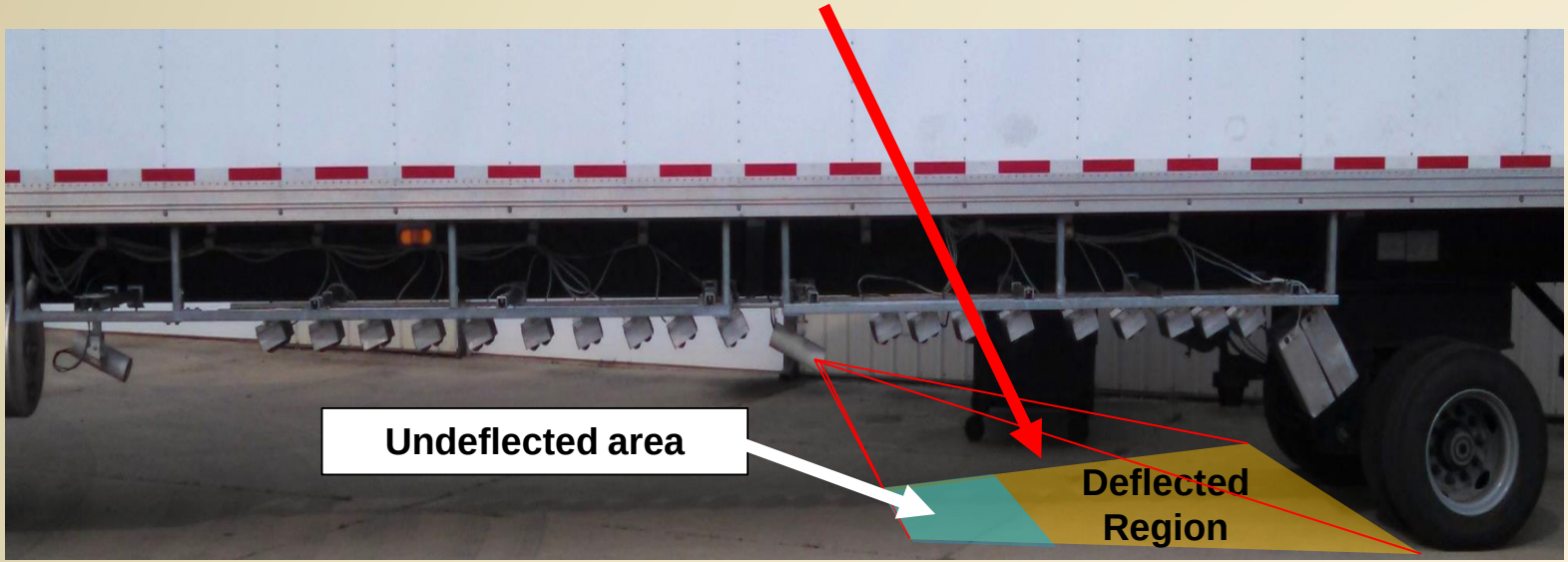
RWD-Vision, cont.

- Right Wheel Path - Laser RWD (old)
- Left Wheel Path – RWD-Vision (new)
  - High Speed LED based Flash
  - 2 Camera Positions

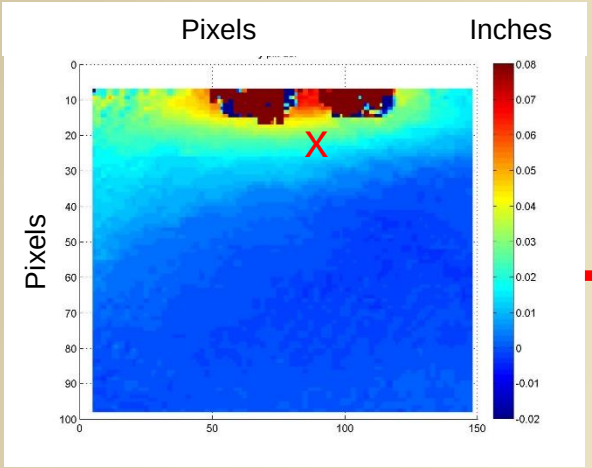
Basic Methodology

Methodology, cont.

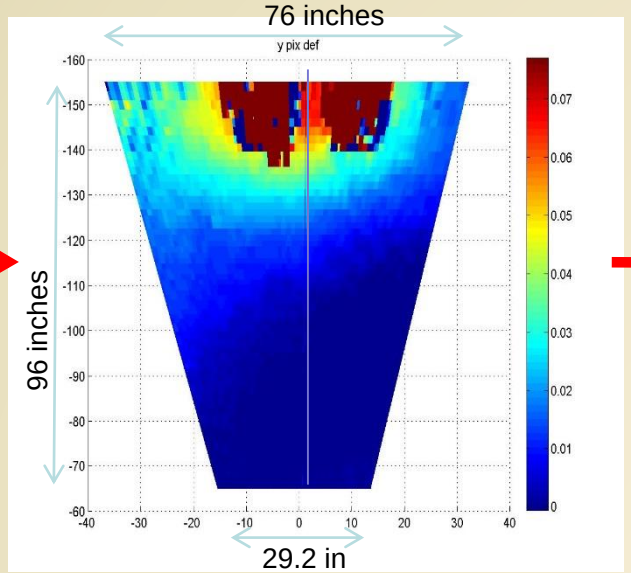
Image 2 (same location as image 1, but under load)



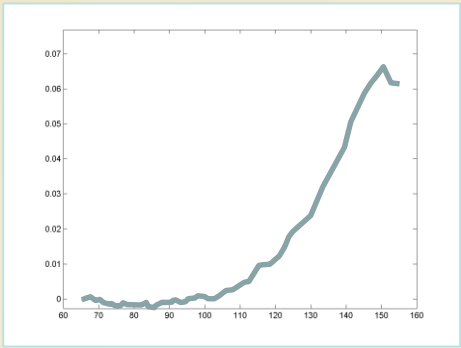
Stereo-Pair Image Processing



RWD-Vision deflection measurements (in camera images)

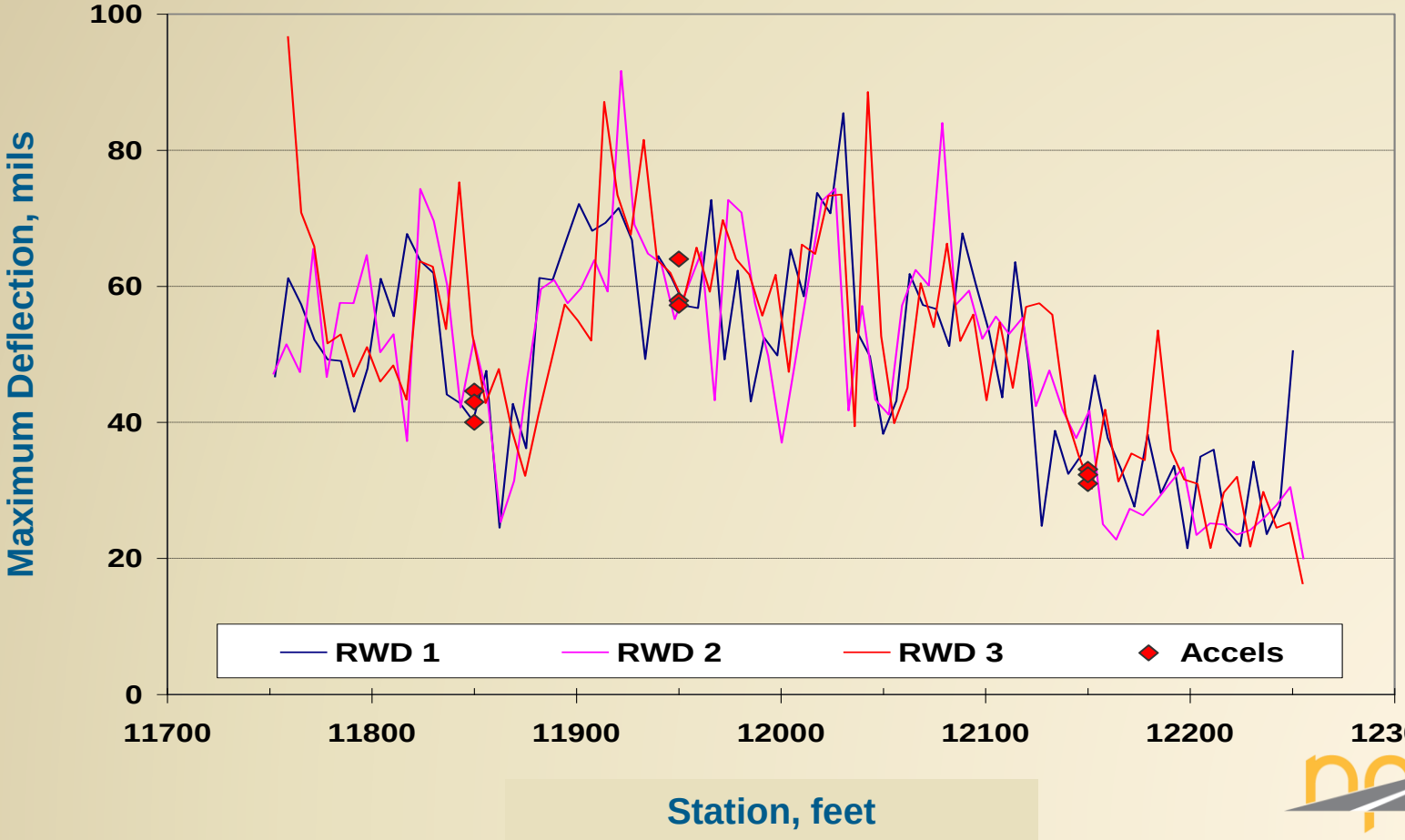


RWD-Vision deflection contour (on pavement surface)
Area = 3.9 ft^2



RWD-Vision deflection profile along wheel path centerline

Comparison with in-Pavement Sensors



Thank You!