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

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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
A₁, B₁ and C₁ establish the baseline for comparison to B₂, C₂ and D₂
RWD Role in Pavement Management

Network-Level

- PQI
- IRI
- RWD

1,000s of lane-miles

Project-Level

Preservation

- FWD

Rehabilitation or Reconstruction

- Coring
- Lab

Dozens of lane-miles

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

Traffic → RWD

PRESERVATION

REHABILITATION

REPLACEMENT

PQI

Low

Medium

High

L  M  H

L  M  H

L  M  H
RWD #2 – Treatment Matrix

Traffic →
RWD →

PRESERVATION

REHABILITATION

REPLACEMENT

Traffic

Low
L M H

Medium
L M H

High
L M H

45
55
65
75
88

80
60
## Results

<table>
<thead>
<tr>
<th>Budget Scenario</th>
<th>Percent change in cost (relative to “PQI Only” base case)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PQI Only</td>
</tr>
<tr>
<td>Target PQI = 92</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
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)

LED Lights

Lights Between Tires

18-kip load

Cameras
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

Image 1 (undeflected pavement)

Undeflected Region
Methodology, cont.

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

Undeflected area

Deflected Region
Stereo-Pair Image Processing

RWD-Vision deflection measurements (in camera images)

RWD-Vision deflection contour (on pavement surface)
Area = 3.9 ft²
Comparison with in-Pavement Sensors

Maximum Deflection, mils

Station, feet
Thank You!