Network Level Structural Evaluation with the TSD Device

Overview of TSD testing in Seven State DOTs

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Acknowledgements

- Pooled Fund Effort
  - FHWA (lead)
  - CALTRANS, GDOT, IDOT, NDOT, NYDOT, PennDOT, SCDOT

- Project Team
  - Engineering & Software Consultants, Inc. (ESCINC)
    - Project management
  - Virginia Tech Transportation Institute (VTTI)
    - Lead research team
  - Transport Research Laboratory (TRL): Brian Ferne
    - Expert advice and consulting support
  - Greenwood Engineering
    - Testing
Project Objective

- Demonstration of Network Level Structural Evaluation with the Traffic Speed Deflectometer
- 2 years duration (started in October 2013)
Project Tasks

- Demonstrate the use of the TSD
- Assess methods to incorporate TSD structural information in a PMS
- Conduct exploratory data analysis
- Use results of “Pavement Structural Evaluation at the Network Level”
TSD testing

- Two rounds of testing (2 years)
- Each round of testing consists of two days
- First day
  - Device calibration (if needed): morning
  - 30 to 50 miles: afternoon
- Second day:
  - At least 100 miles
- In practice, more was tested
Project Status

- First round of testing completed in all participating agencies
- Obtaining auxiliary pavement data
  - e.g. pavement thickness, condition, FWD testing...
- Some analysis of the data has been performed
- Upcoming 6 months
  - Focus on data analysis
  - Get ready for second round of testing (spring): what we learned from first round and from the data analysis
  - Incorporate the results of FHWA project
TSD
What does it measure?
What does it measure

- Deflection slope **NOT** deflection
  - 100, 200, 300, 600, 900, and 1500 mm

What can we get from it:

- Deflections (integrate)
- Surface Curvature Index (SCI): difference in deflection
- Area Under Pavement Profile (AUPP)
- Effective Structural Number (SN): need pavement thickness

Data is collected at 1,000 Hz (20 mm) and summarized at 10 m
Exploratory Data Analysis
What the data looks like

Distance (Miles)

Deflection Slope (mm/m)

- 100
- 200
- 300
- 600
- 900
- 1500
SCI 300 of Tested Sections

 SCI300 (mils)

Test ID
Evaluating Repeatability

0.035 mm/m
Filtering/Denoising

- Distance (miles)
- Deflection Slope (mm/m)

Charts showing the relationship between distance and deflection slope across different sections.
Why Filter?

The graph shows the AUPP (inches) over Mile Post for different runs and their denoised versions. The plots include:
- Run 1 denoised
- Run 2 denoised
- Run 3 denoised
- Denoised average

The graph compares the raw data with the denoised data to illustrate the effectiveness of filtering in reducing noise and improving the accuracy of the measurements.

The y-axis represents the AUPP in inches, ranging from 0.004 to 0.016, while the x-axis represents Mile Post from 239 to 240.
Why Filter?

![Graph showing Deflection Slope (mm/m) vs Distance (miles) with data for First Day and Second Day.]
1. Structural Health Index (cont.)

Effective Structural Number

\[ SN_{eff} = k_1 SIP^{k_2} H_p^{k_3} \]

\[ SIP = D_0 - D_{1.5H_p} \]

Where:

\( D_0 \) = peak deflection under the 9,000 lb load (microns)
\( D_{1.5H_p} \) = deflection at 1.5 times the pavement depth (microns)

Rhode et al. (1994)
Structural Number (Original)

Mile Post

- Jameson's Method
- Rohde's Method
- Howard's Method
- Robert's Method
Back to Main Objective

- Incorporate TSD test results into PMS
  - What is the right index?
    - FHWA project “Pavement Structural Evaluation at the Network Level”
    - Input from DOTs
    - SN, remaining service life, SCI, strain in asphalt layer
    - What about CRCP, JCP

- Other PMS data
  - Functional condition
Thank you... Questions?