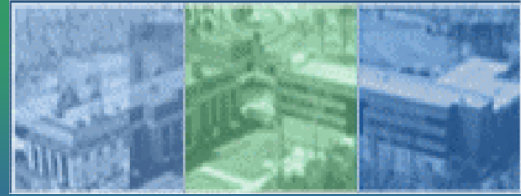


Network Level Pavement Structural Evaluations – A Way forward

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Infrastructure Analysis and Construction
Office Infrastructure R&D, FHWA

September 17, 2014
Structural Session 2: Future Applications
National Pavement Evaluation Conference 2014
Blacksburg, Virginia.





Outline

- FHWA research project
 - Network Level Pavement Structural Evaluation
- Transportation Pooled Fund Study TPF-5(282)
 - Demonstration of Network Level Pavement Structural Evaluation with Traffic Speed Deflectometer

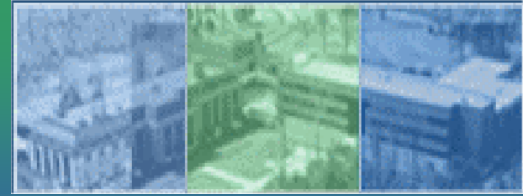




Traffic Speed Pavement Structural Evaluation

- Structural adequacy is important indicator to making rational pavement investment decisions
 - Incorporating deflection testing
- FWDs represent state-of-the-practice
 - Stop-and-go-operation, lane closures are required, safety hazard
 - Production is significantly less than continuous operation
- Network-level pavement management applications
 - Require information on large pavement network measuring thousands of miles.

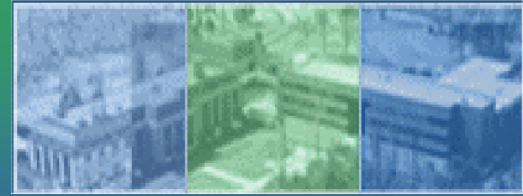




Project Goal

- To establish reliable measure of structural condition of bound pavement layers as it deteriorates over time under traffic and environmental loading, based on traffic speed (50-60 mph) pavement deflection-related measurements
- Measure needs to be robust enough to capture structural condition or deterioration of bound pavement layers notwithstanding seasonal and spatial variation in base and subgrade layers

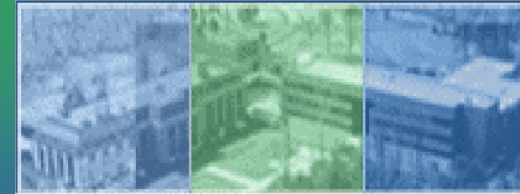




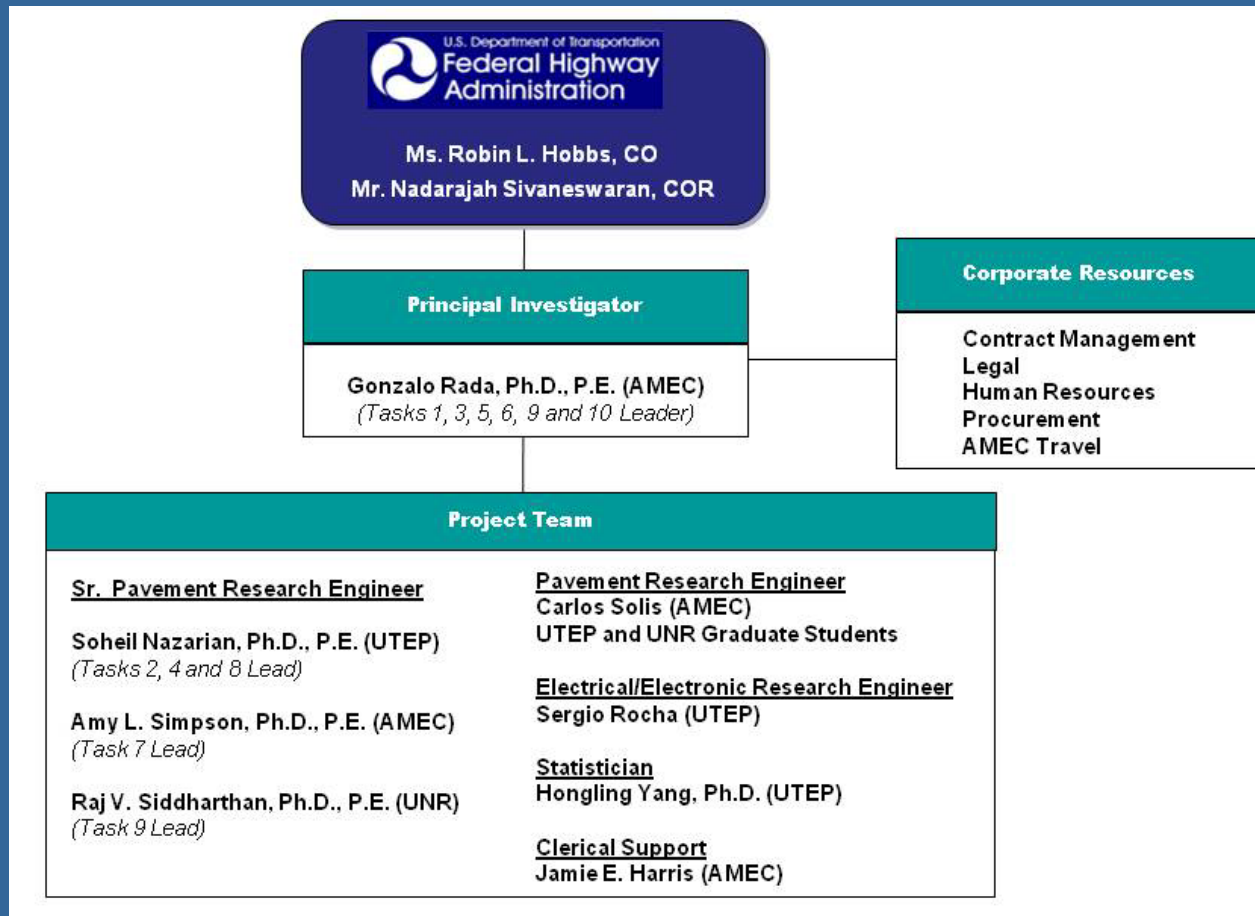
Project Objectives

- To assess, evaluate and validate the capability of traffic speed devices that measure deflection or other pavement responses for pavement structural evaluation at the network level for use in pavement management application and decision making.
- To develop analysis methodologies for enabling the use of the device(s) capable of meeting first objective in pavement management, or alternatively, to develop recommendations to further develop promising device(s) and/or technologies.





Research Project Team





Selection of Viable Devices

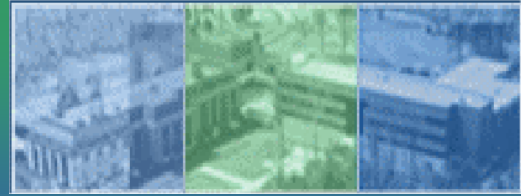
- Literature Review
- Manufacturer and Owners'/Users' Questionnaires
- Follow-up Interviews

Pavement Structural Evaluation at the Network Level
FHWA Contract No. DTFH61-12-C-00031

ARA RWD USERS' QUESTIONNAIRE

1. What were the specific reasons you considered and eventually participated in the evaluation of ARA RWD (please check all that apply)?
 - To assess the general structural capacity of the pavements in your network.
 - To help with the planning and budgeting major rehabilitation/reconstruction of your pavement network.
 - To help with the planning and budgeting preventive maintenance of your pavement network.
 - To delineate weak and strong pavement structures in your network.
 - To identify segments of your pavement network where more detailed structural evaluation using FWDs or other methods is required.
 - To develop structural deterioration models for use in pavement management applications.
 - Others:
2. For each of the applications listed in the response to the above question, please describe in as much detail as possible how the ARA RWD data were used (e.g., for structural capacity assessment the ARA RWD data are correlated to your agency's historic FWD or deflectograph results).
3. In terms of its intended purpose as detailed in the response to the first question, has the ARA RWD met, exceeded or fell short of your expectations (please describe in as much detail as possible)
 - a. In terms of operation?
 - b. In terms of data collection?
 - c. In terms of data analysis/interpretation?

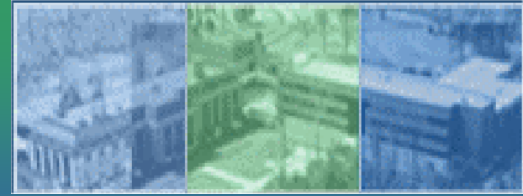




Viable Devices

- Greenwood TSD
- ARA RWD
- Dynatest RWD appears promising (no functional device at present)



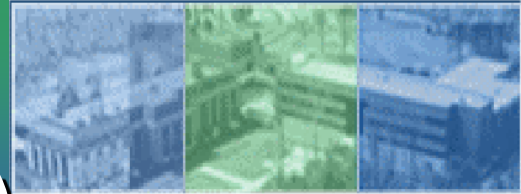


Rolling Wheel Deflectometer (RWD)

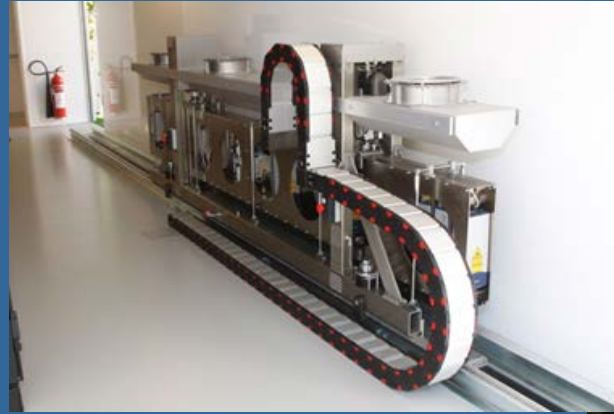


- 9 kip load, \leq 65 mph
- 5 triangulation lasers; 3 measure unloaded pavement surface and 2 between rear axle dual tires (7" and 8") measures deflected surface

 Based on spatially coincident methodology



Traffic Speed Deflectometer (TSD)



- 11 kip load, ~ 50 mph
- Up to 10 sets of lasers based on Doppler technique to measure deflection velocity, one used to measure undeflected pavement
- Velocity of sensors with respect to road and their angle is measured with 3 accelerometers/gyro sensors
- Recent enhancements included measurement of dynamic load exerted, optionally include profile and imaging system





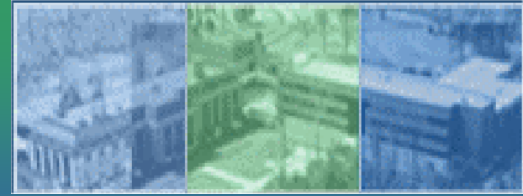
Euroconsult Curviameter



- 11 mph – limited evaluation based on FAA interest. 9 – 13 kips
- 50-foot chain with three sensors
- Deflection basin - 100 points along a basic length of 13ft



TURNER-FAIRBANK HIGHWAY RESEARCH CENTER

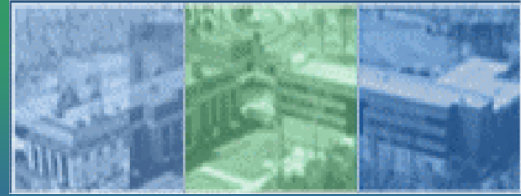


Devices at MnROAD Field Evaluation Trials



U.S. Department of Transportation
Federal Highway Administration

TURNER-FAIRBANK HIGHWAY RESEARCH CENTER



EVALUATION PLAN

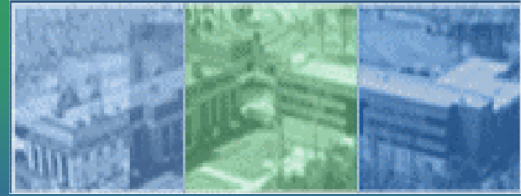




Evaluation Plan Objectives

- To confirm that traffic speed deflection devices (TSDD's) meet a minimum set of specifications related to structural evaluation of pavements at network level
- To propose processes to incorporate pavement structural information from TSDD's into network level Pavement Management System (PMS) applications

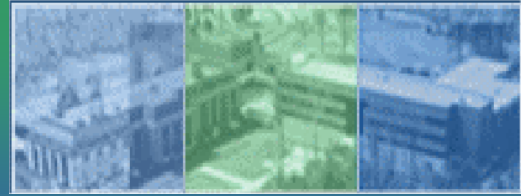




Factorial Parameters

- Pavement type (flexible, rigid, composite)
- Pavement surface texture (smooth and rough)
- Pavement thickness (thin to thick)
- Pavement condition (excellent to poor in terms of ride quality and/or distress)
- Horizontal curves
- Vertical gradients
- Temperature, device speeds





Field Evaluation of Devices

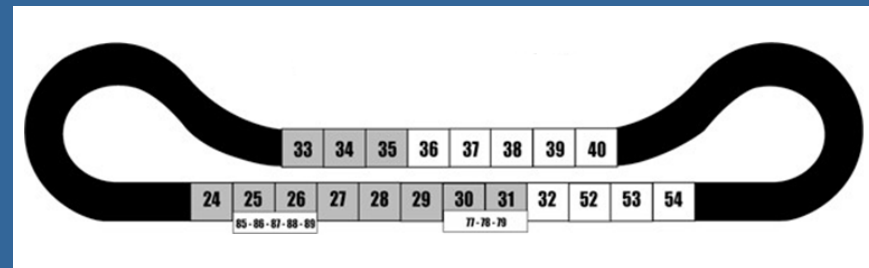
- Accuracy of deflection-related measurements
- Precision of deflection-related measurements
- Operational limitations of devices
 - Desirable reporting interval
 - Desirable operating speed
 - Temperature adjustment
 - Compatibility of devices
- Validation of 3D-Move using MnROAD Data





Filed Trials – September 23 – 26, 2013

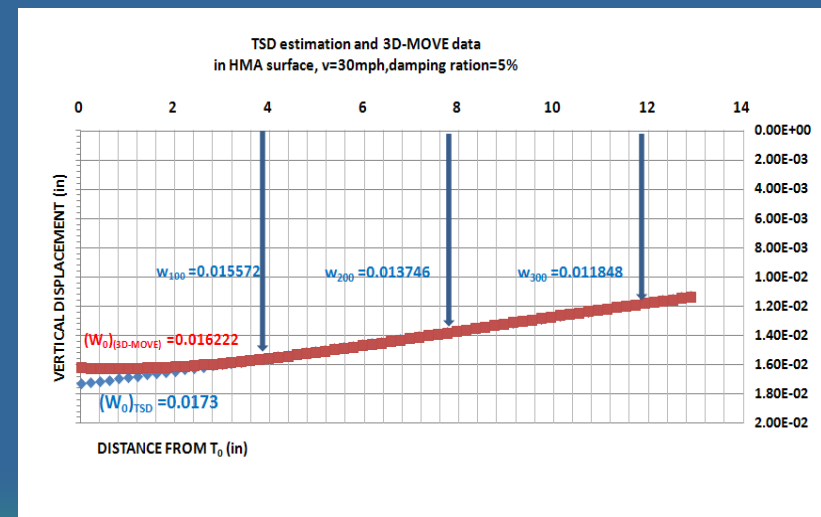
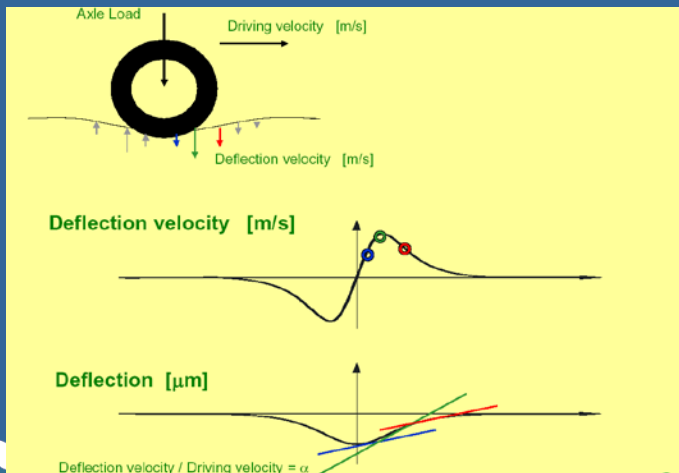
- MnROAD Facility
 - **3.5-mile mainline roadway**
45 sections with “live traffic”; each 500 ft long and varying pavement types
 - **2.5-mile closed-loop low volume roadway**
28 sections with “controlled loading”; each 500 ft long and varying pavement types
- **18-Mile Loop In-Service Road**
 - Wright County, MN
Provides longer test sections, tight turns and rolling hills





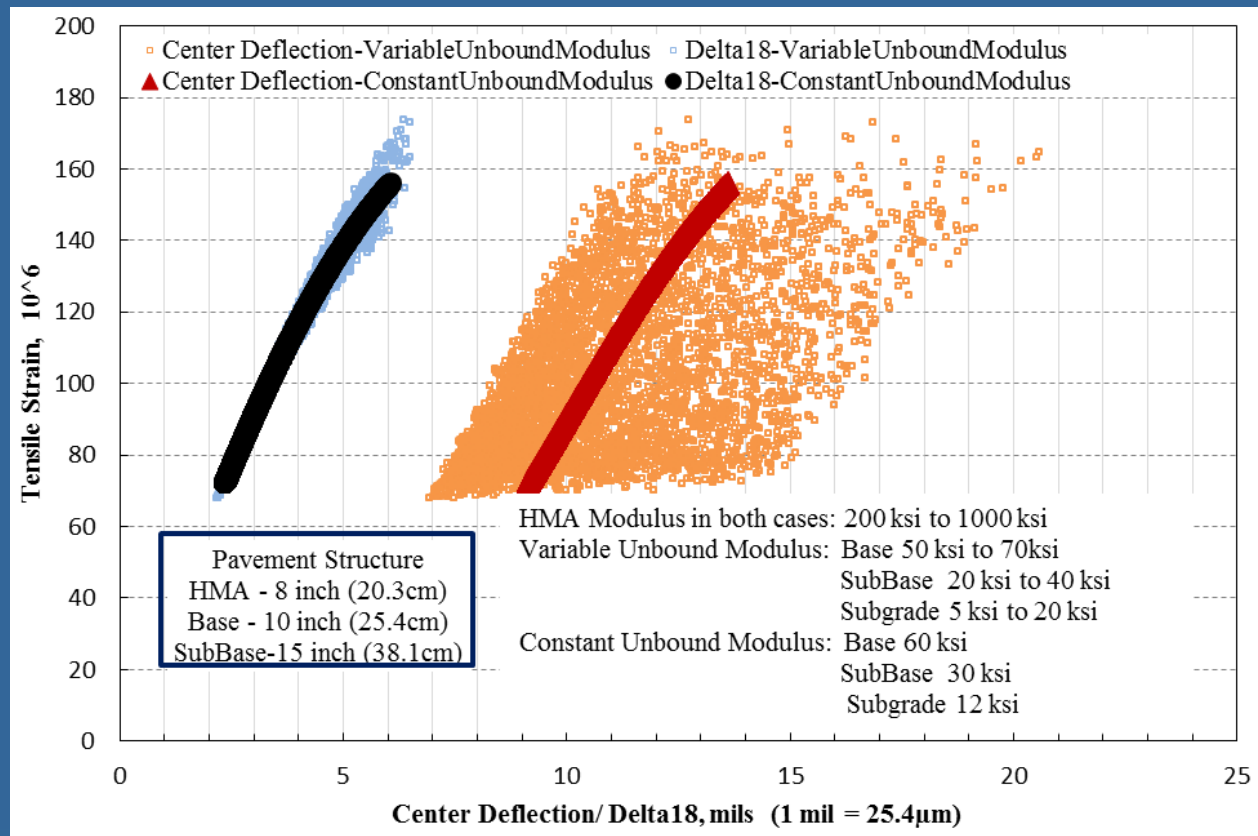
3D-Move

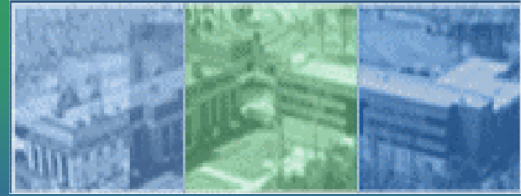
- What are essential measurements of devices: TSD and RWD?
- How theoretically TSD deflections obtained from velocity are related to 3D-Move pavement deflections?
- What is role of RWD measurement being made ahead of dual tires at distance of 10.9”?





Relate Structural-Related Responses to Deflection Parameters Measured with TSDDs

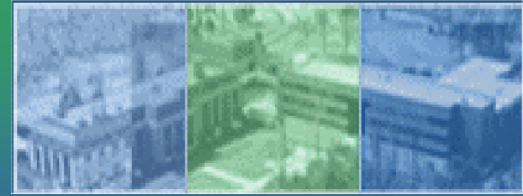




Strategies for Implementing TSDDs in Network Level Evaluation

- Appropriate TSDD Indices (AUPP, SCI or any from 3D-MOVE)
- Optimal operational parameters for TSDDs
- Most appropriate algorithm for structural condition assessment
- Recommended protocols

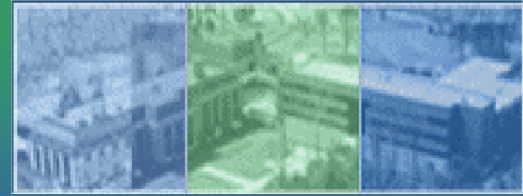




Expected Benefits

- Field validation of TSDD measurements with pavement response
- Use to TSDD indices is expected to allow continuous monitoring of structural deterioration including the effect of preservation and rehabilitation.
- Possible application of TSDD for more than just delineating the weak pavement sections.
- Use of TSDD measurements for performance monitoring and budget planning at network level.





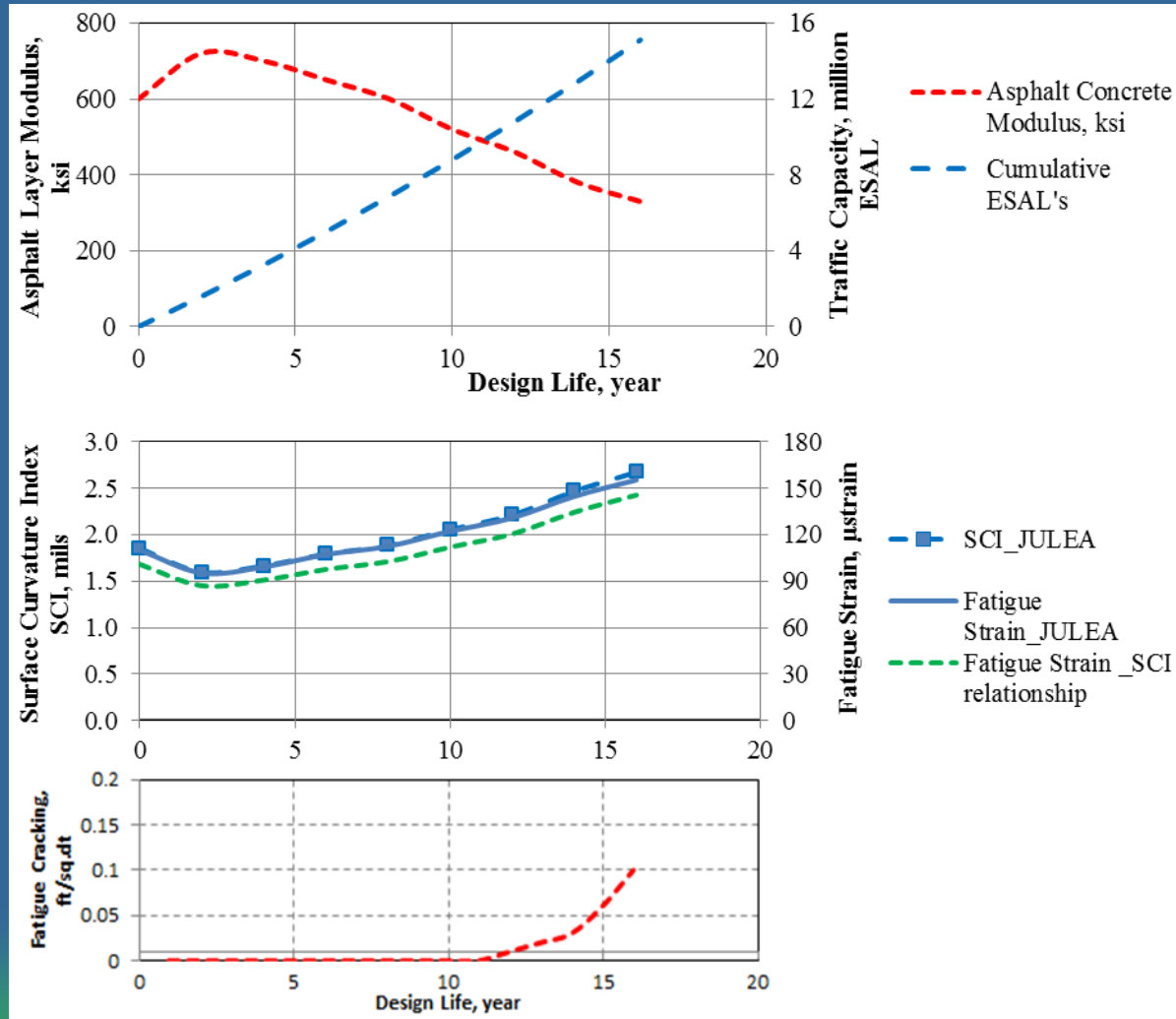
Rest of the Story

- **Structural Session 4:** *“Evaluation of Accuracy and Precision of Several Highway Speed Deflection Devices”* by Soheil Nazarian
- **Structural Session 4:** *“Investigation of Applicability and Use of a Pavement Response Model with High Speed Deflection Devices”* by Raj Siddharthan



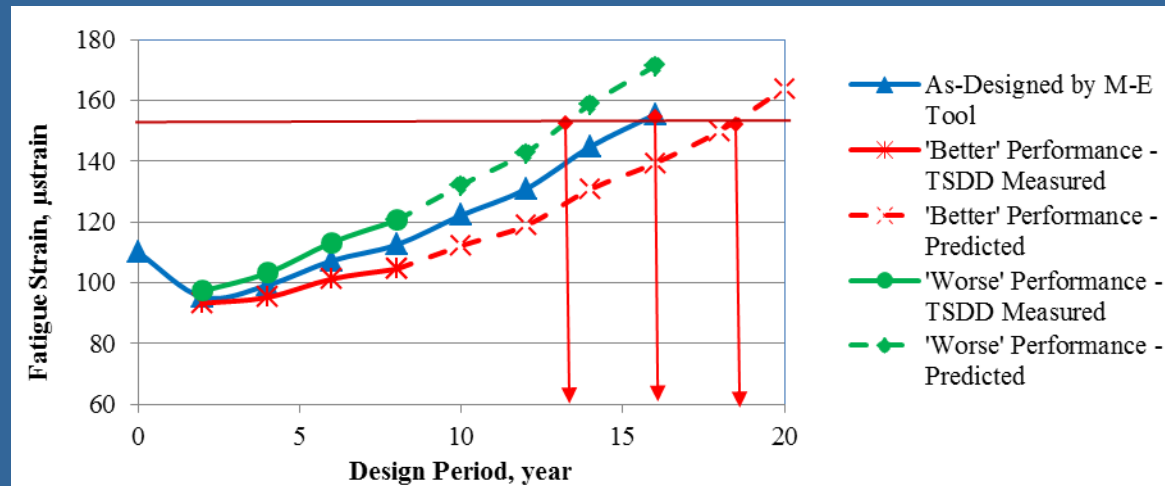


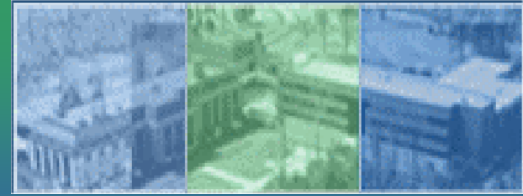
Performance Tracking of Pavement Sections





Estimate Future Budget Requirements

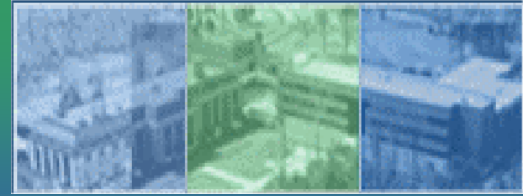




Next Steps

- Evaluation and analysis of data – completed and in review
- Development of analysis methodologies and process – Fall 2014
- Final report - early 2015





Transportation Pooled Fund Study - TPF-5(282)

- Objective: Assess the feasibility of and demonstrate the use of TSD for network level pavement structural evaluation for use in participating SHA's pavement management application
- Scope: Coordination and collection of TSD data on agency designated pavement sections and post-processing of all collected data

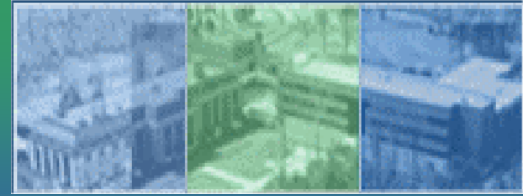




TPF-5(282)

- Includes transportation, calibration, data collection on 30 – 50 miles of pavement and post processing of data. Additional centerline miles can be arranged.
- Apply methodology to be developed under the FHWA study to demonstrate and enable the use of TSD data in SHA PM application (FHWA contribution)
- Current participation – CA, GA, IL, NV, NY, PA and SC

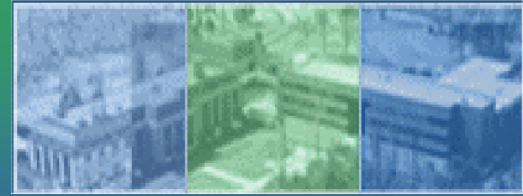




Coordination, Data Collection and Analysis

- ESC Inc. – Dr. Raghu Satyanarayana (PM)
- VTTI - Dr. Gerardo Flintsch (PI)
- Greenwood Engineering
- TRL – Brian Ferne (SME)





TPF-5(282)

- Testing Schedule

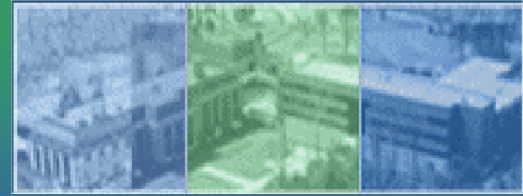
- First Round Completed

- NY (November 5 -6, 2013), GA (May 8 – 9, 2014), SC (May 12 – 13, 2014), CA (June 3-4, 2014), NV (June 9 – 10, 2014), IL (June 26 -27, 2014), PA (July 17 – 18, 2014)

- Second Round

- NY (July 21-22, 2014)
 - 2014 July - 2015: Time history data





Questions?

Thank you!

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