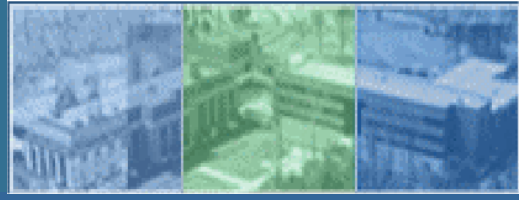
FHWA National Pavement Testing Program

Audrey Copeland

May 11, 2011



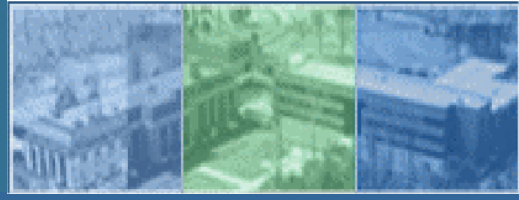
Previous NPT Programs

1. Initial Exploratory ALF Trials
2. WASHTO and Other Field Trials “Road Trip”
3. Evaluation of Tire Load, Type and Pressure Effects on Pavement Performance
4. Post SHRP Validation of Superpave Asphalt Binder Fatigue and Cracking PG Tests
5. Design and Performance of Ultrathin Whitetopping
6. TPF-5(019) & SPR-2(174) Full Scale Accelerated Performance Testing for Superpave and Structural Validation

Overview

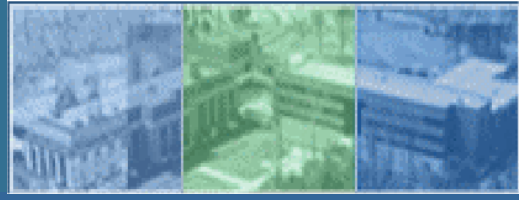
- Critical evaluation of rutting and fatigue cracking
  - All of the mixes were the same
  - Only binder was different; polymer modified & unmodified
  - Binder specification test methods were correlated with laboratory and full scale performance

- Experiment also appraised the strengths of:
  - Crumb Rubber Modified Asphalt and Fibers
  - Asphalt Mixture Performance Tester (AMPT) currently being implemented by FHWA in TPF-5(178)
  - NCHRP Mechanistic-Empirical Pavement Design and Analysis Methodology



Overarching Findings: TPF-5(019) & SPR-2(174)

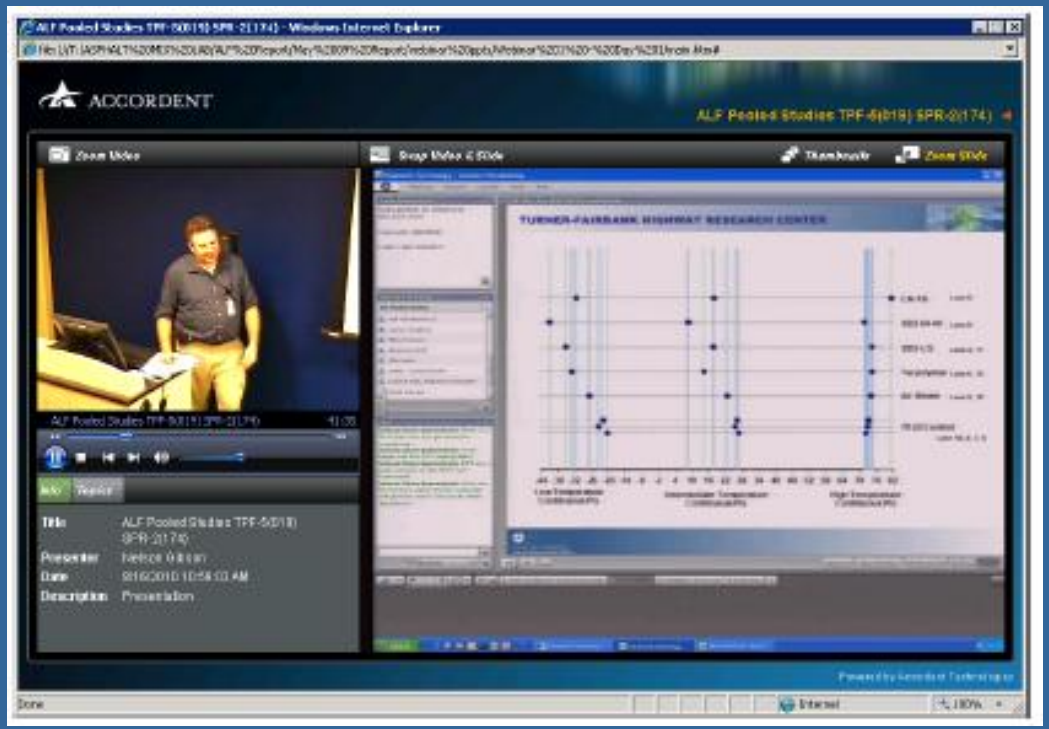
- **Binder Specs for Implementation**
  - **MSCR**
  - **Calculated Critical Tip Opening Displacement (CTOD) for fatigue cracking**
- **Crumb rubber modified asphalts exhibited excellent resistance to bottom-up fatigue cracks**
- **Fiber reinforced hot mix asphalt exhibited resistance to fatigue cracking**



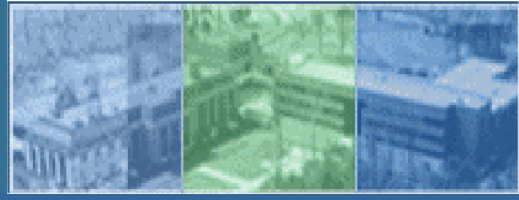
Overarching Findings: TPF-5(019) & SPR-2(174)

- The AMPT axial test method may be used as an alternative to flexural beam fatigue
- Flow Number (rutting) test is strong predictor of rutting
- The current MEPDG (DARWin-ME) has weaknesses with polymer modified mixtures

- Comprehensive 290 page final report + database
- First of two close-out webinars completed, recorded and available on DVD



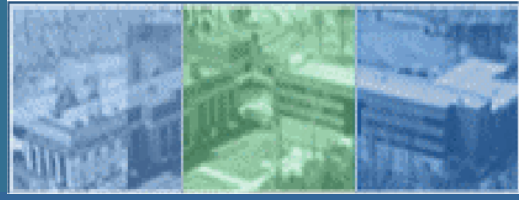
For more information, contact
Nelson Gibson at nelson.gibson@dot.gov



Status of Current NPT Program Studies

- **Enhanced Analysis of TPF-5(019) Binder & Full Scale Fatigue**
  - Testing complete
  - Analysis confirms CTOD method (double data points)

- **Pavement Preservation with 4.75 mm mix with RAP**
  - Ongoing Study

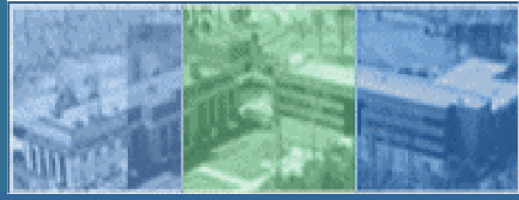


Future NPT Program Study

- ***Full-scale Evaluation of High RAP & WMA Mixtures for Performance***

  - **Every Day Counts**
    - **Biggest potential impact is WMA combined with high RAP**

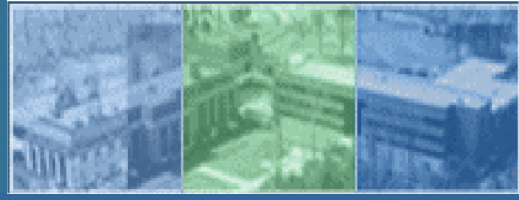
  - **NCHRP Projects Results**
    - **New guidance for WMA and High RAP use**



NCHRP WMA & RAP Projects

- 9-43 Mix Design Practices for WMA
- 9-46 Improved Mix Design, Evaluation, and Materials Management Practices for HMA with High RAP Content
- 9-47 Engineering Properties, Emissions, and Field Performance of WMA Technologies
- 9-47A Properties and Performance of WMA Technologies
- 9-49 Performance of WMA Technologies: Moisture Susceptibility
- 9-49A Performance of WMA Technologies: Long-Term Field Performance

Two more WMA projects in the pipeline…



Future NPT Program Study

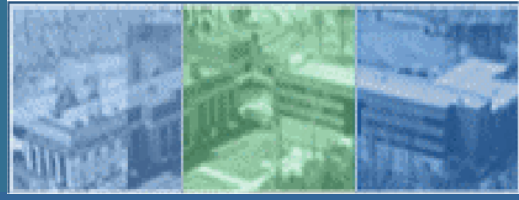
- ***Full-scale Evaluation of High RAP & WMA Mixtures for Performance***
- **Objectives:**
  - Quantify performance of combined use of WMA and High RAP for three different WMA processes
  - Verify guidance as a result of recent and on-going NCHRP research projects
  - Develop recommendations for RAP use by percent binder replacement and binder grade changes when using high RAP

What can the ALF do?

- Rapid simulation of traffic loading with controlled temperature (19°C to 70°C ± 1 to 2°)
- Rutting & Fatigue
- Distress survey methods including NDE
- Full forensic analysis
  - Trenching/severe coring
- MDD, Pressure Cells

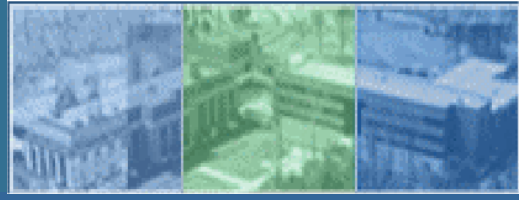
- Major upgrade in 2011

What can FHWA's Laboratories do?



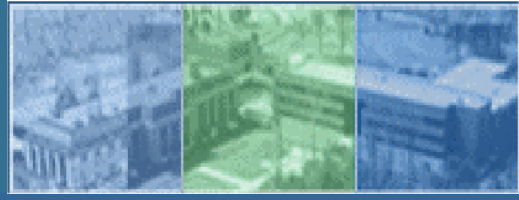
Proposed Activities (2011-2016)

- Stakeholder Engagement
- Development of Research Proposal & Review
- Design, Materials, & Lab Experiments to Support Field Study
- ALF Test Lane Construction & Instrumentation
- Full-scale ALF Testing and Analysis
- Research Dissemination
- Implementation of Research Results



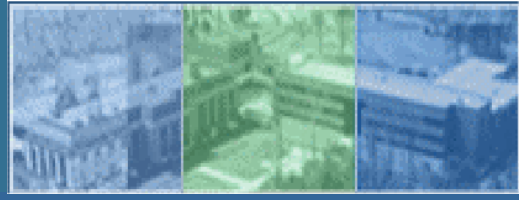
Experimental Design

Laboratory	ALF	Field?
Binder Characterization	Up to 12 Lanes with Supportive Lab Testing	?
Aggregate Char.		
RAP Sources(s)		
Mixture Char.		
WMA Technologies		
Chemical Char.		
Performance Testing		



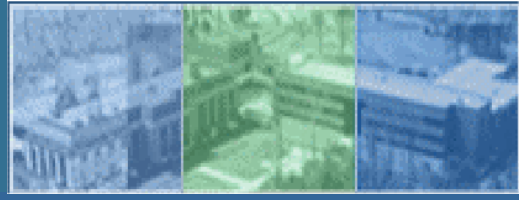
Possible ALF Matrix – Up to 12 Lanes

% RAP	HMA	WMA ?	WMA ?	WMA ?
Zero	Control	-	-	-
25%	-	X	X	X
Higher	-	X	X	X
Other	?	?	?	?



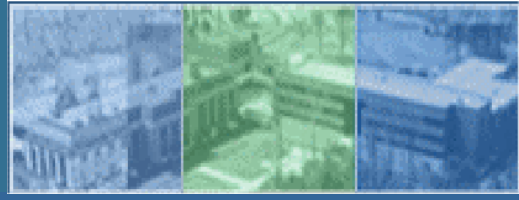
What Key Questions Will Be Answered?

- What is the benefit of the combined use of WMA and High RAP?
- Is recent guidance valid?
- What should AASHTO specifications be to best capture the combined benefits of WMA and High RAP?
- What else?



Implementation and Payoff - “Benefits”

- Takes risk off of State Highway Agencies
- Understanding field performance of WMA & high RAP mixture under actual conditions
- Controlled materials, processing, construction, and test sections including extensive laboratory characterization and performance monitoring
- Addresses climatic region not addressed by other test tracks
- The widespread use of WMA with high RAP may provide the largest impact for improved performance and direct cost savings.



Discussion / Questions

Overview

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  - All of the mixes were the same
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- Experiment also appraised the strengths of:
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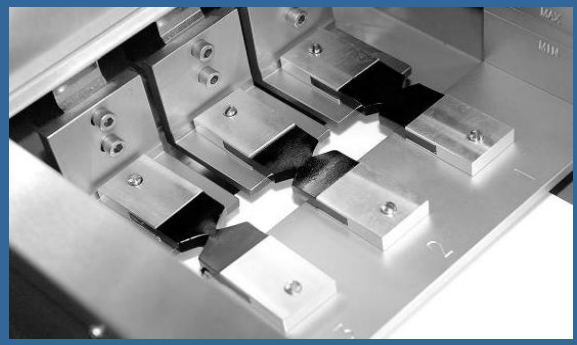
Key Findings – Asphalt Binder Specs

- **Strongest Implementable Specification Parameters are:**
  - **Multiple Stress Creep and Recovery (MSCR) and similar Oscillatory-based non-recoverable stiffness for rutting**
  - **Calculated Critical Tip Opening Displacement (CTOD) for fatigue cracking**
- **These are more performance related than what is currently being used**
  - **$|G^*|\sin\delta$ & $|G^*|/\sin\delta$ from SHRP**



Polymer modified asphalts clearly improve rutting and fatigue cracking performance.

Key Findings – Crumb Rubber Asphalt

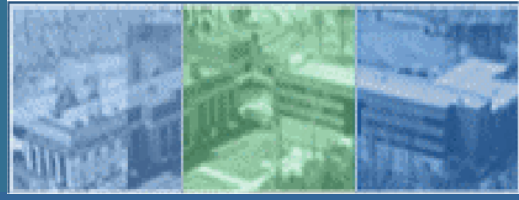
- Gap-graded crumb rubber modified asphalt mix (Arizona 'wet process') placed in a composite pavement structure exhibited excellent resistance to bottom-up fatigue cracks.
  - Fatigue cracks initiated and propagated up through the bottom layer but did not progress through any of crumb rubber mix on top.

- A newer "hybrid" terminally blended crumb Rubber modified asphalt binder performed well in fatigue and rutting and had easier handling and construction characteristics than Arizona 'wet process'

Key Findings – Fiber Modified Asphalt

- Fatigue cracking was measurably better than those of the polymer modified sections even though a less fatigue resistant unmodified asphalt binder was used in the mix.
- No substantial improvement in rutting performance
- Some of the better laboratory mixture tests still have trouble capturing the observed performance

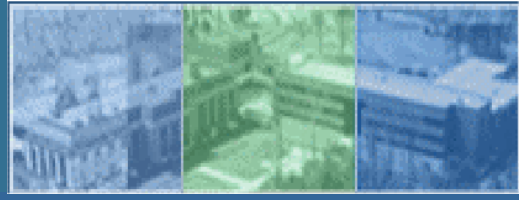
~25 mm polypropylene



Key Findings – AMPT Equipment

- Fatigue Cracking - An alternative test for flexural beam fatigue was shown to account for fatigue performance and have the ability to generate fatigue properties with a smaller experimental program with more user friendly, implementable equipment

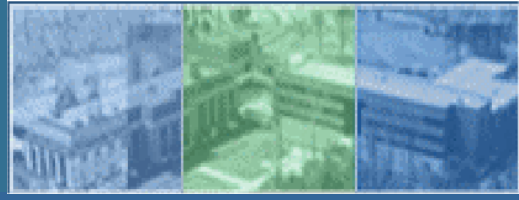
- Rutting - Flow Number and SST Repeated Shear at Constant Height (SHRP) were the two strongest indicators of ALF rutting. The AMPT Flow Number test is a stronger predictor and more implementable.



Key Findings – M·E Performance Prediction

- By design the ALF experiment utilized polymer modified asphalt binders which naturally challenged the MEPDG calibration having very few test sections with polymer modified asphalt
  - A single, global calibration for rutting and fatigue cracking could not capture the ALF performance ranking

- Additional mixture-specific characterization inputs are needed above and beyond the |E*| dynamic modulus to be able to better discriminate and rank performance of modified and unmodified asphalt.
  - To illustrate this, an analysis was completed using AMPT inputs for rutting which confirmed the NCHRP 9-30A approach (near completion) for mixture-specific tests that improve rutting prediction



Overarching Findings

- Polymer modified asphalts are good
- Crumb rubber modified asphalts are good
- Fiber reinforced hot mix asphalt is good
- MSCR binder test (rutting) is good
- CTOD binder test is (cracking) good
- The AMPT Flow Number (rutting) test is good
- Axial fatigue alternative to beam fatigue is good (AMPT)
- The current MEPDG has weaknesses with polymer modified mixtures