Asphalt Mixture Performance Tester

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Topics

- Development
- Implementation Status
- Uses
- AMPT Resources
What is the AMPT?

- Machine specifically for asphalt concrete testing
- Measures engineering properties of asphalt concrete:
  - Dynamic Modulus
  - Flow Number
  - Flow Time
Why Do We Need It?

- Volumetric design alone is not always sufficient
  - High traffic
  - Critical projects
  - Evaluate new materials
- Engineering properties needed for structural analysis
  - DARWin ME
Asphalt Concrete Mixture Design
Performance Testing Evolution
Asphalt Concrete Mixture Design Performance Testing Evolution

Pre-SHRP

Marshall and Hveem design procedures included unreliable performance tests
Asphalt Concrete Mixture Design Performance Testing Evolution

Pre-SHRP

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Superpave

Level I

Level II

Level III

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Pre-SHRP

Superpave

Level I

Marshall and Hveem design procedures included unreliable performance tests

Level II

Level III

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Pre-SHRP
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Superpave
Level I

Level II

Level III

Post SHRP NCHRP & FHWA Research
Wheel Tracking, Gyratory Compactor, Modulus, Creep, Repeated Load
Dynamic Modulus Test
Dynamic Modulus Test

- Mixture Stiffness
- Rutting
- Fatigue Cracking

\[ |E^*| = \frac{\sigma_0}{\varepsilon_0} \]

Stress
Strain

Time
Flow Number Test

- Rutting

\[ \text{Strain} \quad \text{Stress} \]

\[ \text{Time} \]

\[ \text{Time} \]

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Flow Number Test

- Rutting

![Flow Number Test Diagram](image)

- Stress vs. Time
- Strain vs. Time
- Haversine Axial Compression
- Strain Curve
- Flow Number
Flow Time Test

- Rutting
Flow Time Test

- Rutting

![Diagram](image)

Constant Axial Compression

Strain Curve

Flow Time
AMPT is Not Prototype Equipment!

- Need
- Ruggedness
- Round Robin Testing
- Precision and Bias
- Critical Aspects
- Draft Test Method
- Prototype Equipment Verification
- Improve Test Method Equipment
- Training
- Commercial Equipment Specification
- First Article Equipment
- Production Equipment Provisional AASHTO Test Methods
- Engineering Practice

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AASHTO Standards

- PP60, Preparation of Cylindrical Performance Test Specimens Using the Superpave Gyratory Compactor
- TP79, Determining the Dynamic Modulus and Flow Number for Hot Mix Asphalt (HMA) Using the Asphalt Mixture Performance Tester (AMPT)
- PP61, Developing Dynamic Modulus Master Curves for Hot-Mix Asphalt Concrete Using the Asphalt Mixture Performance Tester (AMPT)
Pooled Fund Study TPF-5(178)

- Implementation of the Asphalt Mixture Performance Tester (AMPT) for Superpave Validation
- Purchase AMPT’s for Participating Agencies
- Develop and Deliver Training Course on AMPT
  NHI Training Course 131118 Asphalt Mixture Performance Tester
- Coordinate Testing
How Has AMPT Data Been Used?

- **Mixture Design**
  - Flow Number
  - Dynamic Modulus

- **Pavement Structural Design**
  - Dynamic Modulus

- **Materials Evaluation**
  - High RAP Mixtures
  - RAS Mixtures
  - WMA
  - Additives and Modifiers
Flow Number in Mixture Design

- NCHRP Project 9-33, Mix Design Manual for HMA
  - Criteria for Minimum Flow Number

<table>
<thead>
<tr>
<th>Traffic Level Million ESAL’s</th>
<th>Minimum Flow Number Cycles</th>
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<tbody>
<tr>
<td>&lt;3</td>
<td>---</td>
</tr>
<tr>
<td>3 to &lt;10</td>
<td>50</td>
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<tr>
<td>10 to &lt;30</td>
<td>190</td>
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<tr>
<td>&gt;30</td>
<td>740</td>
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E* in Mixture Design

- Quality Related Specifications (QRS) Software
  - Arizona State University
  - NCHRP-19 and 9-22
  - Interpolates Database of DARWin ME Solutions

- Uses Dynamic Modulus Master Curve

- Predicted Rut Depth
Pavement Structural Design

DARWin ME

- HMA Characterized by a Dynamic Modulus Master Curve
  - Plant Aged Conditions

- Modulus Needed
  - Stress-Strain Analysis
  - Rutting Model
  - Fatigue Cracking Model
RAP/RAS Mixing Analysis

- Recycled Mixture Homogeneity is Important
- Dynamic Modulus is Very Sensitive to Binder Stiffness
- Good Plant Mixing
  - Mixture Stiffness Consistent With Blended Binder Stiffness
RAP/RAS Mixing Analysis

- Dynamic Modulus Master Curve for Plant Produced Mixture
  - As-Produced Stiffness
- Recovered Binder Master Curve Estimate Mixture Master Curve
  - Hirsch Model
    - Mixture Modulus = f(Binder modulus, VMA, and VFA)
  - Fully-Blended Stiffness
- Compare
Good Mixing
Good Mixing
Poor Mixing
Transportation Pooled Fund Study TPF-5(178)

www.pooledfund.org
Search forKeyword “AMPT”
or
ContactJeff Withee
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SEAUPG AMPT User Group

The purpose of this User Group is to provide a forum to educate current and future Asphalt Mixture Performance Tester (AMPT) users on the proper use and implementation of the AMPT as a pavement design tool. Knowledge of proper use of this machine will become more critical as agencies shift their design framework from empirical to more mechanistic-empirical methods. The members of this group are encouraged to ask questions and provide feedback on their experiences with the AMPT.

The members of this user group consist of representatives of highway agencies, industry, and academia.

http://www.eng.auburn.edu/center/ncat/SEAUPG/index.shtml
Questions/Discussion

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