Update: AMPT Specification and Test Standards

FHWA Mixture and Construction Expert Task Group
September 21, 2017
Bozeman, Montana
Agenda

- Equipment specification (draft)
- Small specimen standards (draft)
- Stress sweep rutting (draft)
- Cyclic fatigue (AASHTO TP 107)
• Temperature range from about 4° to 70°C
• Computer-controlled device
  • Software built-in for various test procedures
• Fundamental tests
  – Stress and strain modeling
  – “Bulk testing”
  – Pavement ME or FlexPAVE™
• Kits available for other tests
AMPT Implementation

- Transportation Pooled Fund Study (TPF(5)-178)
  - Purchase, installation of 29 AMPTs
  - NHI Course (over 80 trainees) – need to update
  - Interlaboratory study on effect of air voids
  - National workshop
- Test standard development, improvement, and revision
- Instructional videos, TechBriefs
- PRS shadow implementation (TFHRC-led)
- Mobile Asphalt Testing Trailer (MATT) projects/training
- User Groups at TRB and regional meetings
Current AMPT Equipment Specification

- Current specification – Appendix E of NCHRP Report 629
• Update for additional test procedures
  – AASHTO T 378 (dynamic modulus (|E*|), flow number)
  – AASHTO TP 107 (cyclic fatigue)
  – AASHTO TP 116 (incremental repeated load permanent deformation)
  – These tests require additional data analysis for fundamental properties

• Collaborative group effort (55 reviewers)
• Specify tension-compression loading machine
• Reference to specific tests
• Range for temperature sensor increased
• Calibration of machine in tension recommended for TP 107 users
• Calibration and compliance checks included as Annexes
• Electrical requirements changed to 208 VAC
Specify tension-compression loading machine

- Reference to specific tests requiring additional data analysis
- Range for temperature sensor increased
- Calibration of machine in tension recommended for TP 107 users
- Reference manual extended to include tests

ETG REVIEW UPCOMING!
Small Specimen Standard Update
Use of fundamental tests to capture variance between as-designed and as-built AQC\'s

Asphalt Mixture Performance Tester (AMPT) used in performance-engineered mixture design (PEMD)

Structural response model (stresses and strains)

Performance volumetric relationships used in construction
Use of fundamental tests to capture variance between as-designed and as-built AQCs

• Asphalt Mixture Performance Tester (AMPT) used in performance-engineered mixture design
• Structural response model (stresses and strains)
• Performance volumetric relationships used in construction

FHWA PRS Initiative
Standardization of Test Methods

FULL SIZE SPECIMEN

- Specimen Prep
  AASHTO R 83
- Dynamic Modulus
  AASHTO T 378
- Cyclic Fatigue
  AASHTO TP 107
- Stress Sweep Rutting
  AASHTO TP XXX

SMALL SIZE SPECIMEN

- Specimen Prep
  AASHTO PP XXX
- Dynamic Modulus
  AASHTO TP XXX
- Cyclic Fatigue
  AASHTO TP XXX

Performance-Related Specification
PASSFlex™
Small Specimen – Crash Course

Large Specimen (100 mm diameter)

|E*| Tests

Fatigue Tests

Small Specimen (38 mm diameter)

|E*| Tests

Fatigue Tests
Asphalt concrete layers are generally thinner than 100 mm

- Allow for performance testing individual layers of as-built pavement
• Core 4 test specimens from one gyratory
  – Taken from 100 mm diameter area to minimize unfavorable air void distribution
• Based off AASHTO R 83 (formerly PP 60)
• Includes method to core 2 test specimens from one field core
• Use full size specimen to target mass for desired air voids
• Target 50-75 microstrain
• Data quality indicators the same
• Appendix for 50 mm and prismatic test specimens
• Generally recommended at temperatures of 45°C and below
• Decreased seating load
  – 0.01 kN compared to 0.09 kN
• 5-minute epoxy recommended
  – compared to 16 h for full-size
• Used for mixtures up to 25 mm NMAS
• Ruggedness testing to begin
  – ILS afterwards
• 2 temperatures
  – Low temp – 0.4 s load, 1.6 s rest
  – High temp – 0.4 s load, 3.6 s rest
• 10 psi confinement
• 3 loading blocks of 200 cycles each at varying deviatoric stress levels
• Data used in shift model for permanent deformation
Draft Standard – Stress Sweep Rutting

- 2 temperatures
  - Low temp – 0.4 s load, 1.6 s rest
  - High temp – 0.4 s load, 3.6 s rest
- 10 psi confinement
- 3 loading blocks of 200 cycles each at varying deviatoric stress ratios
- Data used in shift model for permanent deformation
Testing Efficiency and Simplicity
AASHTO TP 107 Revisions

- Submitted to AASHTO COMP TS 2d
- Add failure criterion
- Simplification of language
- AMPT-specific
- Removal of spreadsheet derivation
- New strain selection guidance
- Instructional videos
- Output template provided for FlexMAT™
- Ruggedness and ILS
Submitted to AASHTO COMP TS 2d
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OUT FOR FULL BALLOT THIS FALL!
• National/International
  – Biannual meetings
    • Summer meeting: FHWA update, FlexPAVE™ demo, maintenance and tuning issues
  – Discussion of issues, best practices, future efforts
  – 164 members, 28 DOTs
Asphalt Technology Guidance Program (ATGP)

Long-Life Asphalt Pavement for the 21st Century
Solutions to Agency Needs

• Project-Specific Workplans
  – Material Characterization
    • High RAP/RAS, GTR, SMA, PRS...
  – Mix Design Replication and Testing
  – Mix Production Testing
  – Performance Prediction
  – Training and Demonstration
Questions?

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### Testing Efficiency and Simplicity (2)

#### Small-Specimen Geometry

<table>
<thead>
<tr>
<th></th>
<th>Large Specimen</th>
<th>Small Specimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel Putty</td>
<td>Devcon 10110</td>
<td>Devcon 10240</td>
</tr>
<tr>
<td>Working Time</td>
<td>10 – 20 min.</td>
<td>5 min.</td>
</tr>
<tr>
<td>Functional Cure</td>
<td>16 hours</td>
<td>1 hour</td>
</tr>
<tr>
<td>Amount of Putty (per specimen)</td>
<td>100 g</td>
<td>3 g</td>
</tr>
</tbody>
</table>

[Image of equipment setup with small and large specimens]
- **Witczak et al. (2000) AAPT**
  - Minimum height-to-diameter ratio of 1.5
  - 70, 100, and 150 mm diameter tested
  - $|E^*|$, permanent deformation considered
- **Kutay et al. (2009) TRR**
  - 38 mm diameter, 100 mm height specimens
  - Field core testing by horizontally coring
  - Cyclic fatigue results statistically equal (C vs. S curve)
- **Li and Gibson (2013) AAPT**
  - 38 mm diameter, 110 mm height
  - Cyclic fatigue results statistically equal (modulus reduction)
  - Small specimen slightly softer $|E^*|$ at high temperatures
  - 5 test specimens per gyratory specimen
Small Specimen History

• Bowers et al. (2015) AAPT
  – 50 mm diameter, cored horizontally
  – Modulus differs most at 54.4°C and with 19.0 and 25.0 mixtures

• Castorena et al. (2017) NCHRP IDEA N-181
  – Test procedures developed
  – Recommend 4 test specimens per gyratory specimen
  – Cyclic fatigue results statistically equal