VTrans BMD: Motivations

- 2008: Up to 50% RAP by aggregate weight required in asphalt mixtures per VT state statute.
  - 2018: Up to 3% RAS by aggregate weight added to specifications
  - 2022: State statute amended to consider other “sustainable building components” (19 VSA § 10m)
- Observed Distresses in VT Pavements
  - Rutting
  - Raveling
  - All 3 Modes of Cracking (Fatigue, Thermal, Reflective)
- Original Superpave Performance tests too complex (example: Superpave Shear Tester)
VTrans BMD: Chosen BMD Tests

• Hamburg Wheel Tracker Test (HWTT)
  – Purchased in 2015
  – Raveling distresses suspected to be moisture susceptibility related
  – Not confident in AASHTO T 283 TSR method in VT’s climate conditions
• Illinois Flexibility Index Test (I-FIT)
  – Purchased in 2017
  – NCHRP 09-57: test for looking at thermal and fatigue cracking
  – Increase in Recycled Asphalt Materials (RAM) anticipated
• Indirect Tensile Cracking Test (IDEAL-CT)
  – Purchased in 2019
  – Initially looked at as “surrogate” test to I-FIT
    • Now our “chosen” test method to evaluate cracking
Why an ILS?

- Can identify issues with current standard operating procedures (SOPs) and equipment in each lab.
- Demonstrates reproducibility of each test being considered
  - Cutting of specimens for I-FIT has been challenging.
- Increases user confidence in each test.
- Recommended as Task 4.5 per Tech Brief FHWA-HIF-22-048
- Overarching question: is Contractor data submitted with mix designs enough?

Research Approach

- Inter-Laboratory Testing with isolated machine and operator variability
- A single plant-produced sample was used for all material
- A single laboratory was the source of all gyratory compaction and initial specimen fabrication
Collecting Mix: Pike Industries | Waterford, VT
## Participants

<table>
<thead>
<tr>
<th>Laboratories</th>
<th>[Different Types of] Devices</th>
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</thead>
<tbody>
<tr>
<td>• 4 State DOTs</td>
<td>• 4 Hamburg Machines</td>
</tr>
<tr>
<td>• 5 Contractors</td>
<td>• 3 IFIT Load Frames</td>
</tr>
<tr>
<td>• 2 Universities</td>
<td>• 3 IDEAL CT Machines</td>
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</tbody>
</table>
Perform 20+ $G_{mm}$ [T209] tests
Perform 200+ $G_{mb}$ [T166] tests
All Saw Cuts Necessary for iFIT

No prep for T324/Hamburg
Or
IDEAL-CT
Hamburg [AASHTO T 324]

- 45° C Water Temperature
- 20,000 Cycles
- 158 lb wheel load
Interval Plot of Average Rut Depth (mm)
95% CI for the Mean

Individual standard deviations are used to calculate the intervals.
Fracture Testing - Background

- Post-Peak Slope
- Fracture Energy (Area Under the Curve)
- Peak Strength
IFIT [AASHTO T 393]

- 25° C Specimen Temp
- 50 mm/min displacement
iFIT [AASHTO T 393]

Individual standard deviations are used to calculate the intervals.
iFIT [AASHTO T 393]

Individual standard deviations are used to calculate the intervals.
Outlier Plot of Flexibility Index (FI) vs Lab

<table>
<thead>
<tr>
<th>Lab</th>
<th>Min</th>
<th>Max</th>
<th>G</th>
<th>P</th>
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<td>1.14</td>
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IDEAL-CT [ASTM 8225]

- 25° C Specimen Temp
- 50 mm/min displacement
IDEAL-CT [ASTM 8225]

*Individual standard deviations are used to calculate the intervals.*
IDEAL-CT [ASTM 8225]

Individual standard deviations are used to calculate the intervals.
Conclusions: Hamburg

- In all cases, the round 1 and round 2 test data were statistically equal.

- For Hamburg Wheel Tracking, all specimens met the 20,000 pass test length without a Stripping Inflection Point.

- Variability of results across all HWT tests was minimal (<3 mm) between the minimum and maximum results from all testing.
Conclusions: I-FIT + IDEAL-CT

- iFIT variability was smaller than that of IDEAL-CT testing, however both had several samples that would have been considered ‘low’ for acceptance.

- For both IDEAL-CT and iFIT testing, the fracture energy \((G_f)\) and post-peak slope \(|m|\) values were quite uniform across the dataset. In both tests, the post-peak slope was more uniform across the test devices in the 2\(^{nd}\) round of testing.
Special thanks to the Vtrans TAC Members:
Emily Parkany
Ian Anderson
Ashlie Mercado
Brandon Kipp

James Mahoney (UConn CAP Lab), Principal Investigator

and Pike Industries for allowing us to sample at Waterford
VTrans Next Steps

• For the Hamburg, no major changes are anticipated at this time…
• For the IDEAL-CT, min # of specimens & max coefficient of variance (COV) values will likely be included in final specification criteria & Policy
• Another ILS?
  – No current plans for another one facilitated/funded by VTrans, but the need exists
  – Ideas to explore…
    • Dwell/lag time
    • Water bath conditioning: bags vs. no bags
• In the meantime…
  – Investigate IDEAL-RT as “surrogate” to HWTT
  – Transition to MSCR PG binder grading system
Thank you!