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# BMD Overview and Update

## Outline

- BMD Approaches
- BMD Survey May 2020
- Education Efforts
- Implementation Challenges

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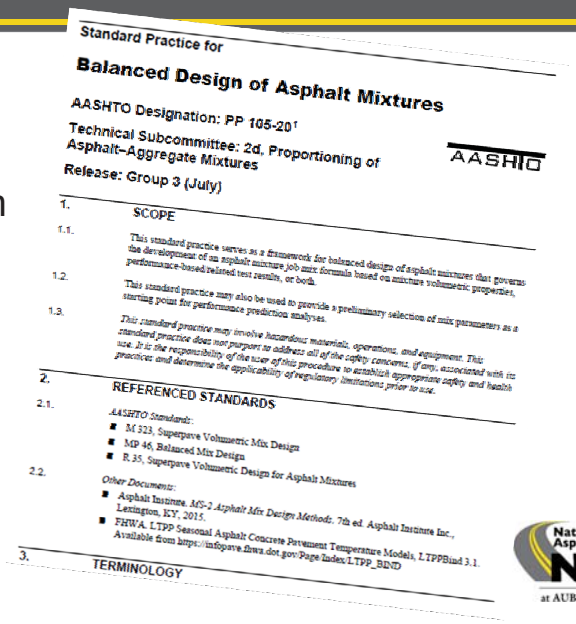
# Four BMD Approaches - AASHTO PP 105

A. Volumetric Design with Performance Verification
B. Volumetric Design with Performance Optimization
C. Performance-Modified Volumetric Design
D. Performance Design



Standard Practice for

**Balanced Design of Asphalt Mixtures**

AASHTO Designation: PP 105-20[1]

Technical Subcommittee: 2d, Proportioning of Asphalt–Aggregate Mixtures

Release: Group 3 (July)

AASHTO

1. SCOPE

1.1. This standard practice serves as a framework for balanced design of asphalt mixtures that governs the development of an asphalt mixture job mix formula based on mixture volumetric properties, performance-based related test results, or both.

1.2. This standard practice may also be used to provide a preliminary selection of mix parameters as a starting point for performance prediction analyses.

1.3. *This standard practice may involve hazardous materials, operations, and equipment. This standard practice does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. REFERENCED STANDARDS

2.1. *AASHTO Standards:*
- M 323, Superpave Volumetric Mix Design
- MP 46, Balanced Mix Design
- R 35, Superpave Volumetric Design for Asphalt Mixtures

2.2. *Other Documents:*
- Asphalt Institute, *MS-2 Asphalt Mix Design Methods*, 7th ed. Asphalt Institute Inc., Lexington, KY, 2015.
- FHWA, LTPP Seasonal Asphalt Concrete Pavement Temperature Models, LTPPBind 3.1. Available from https://infopave.fhwa.dot.gov/Page/Index/LTPP_BIND

3. TERMINOLOGY

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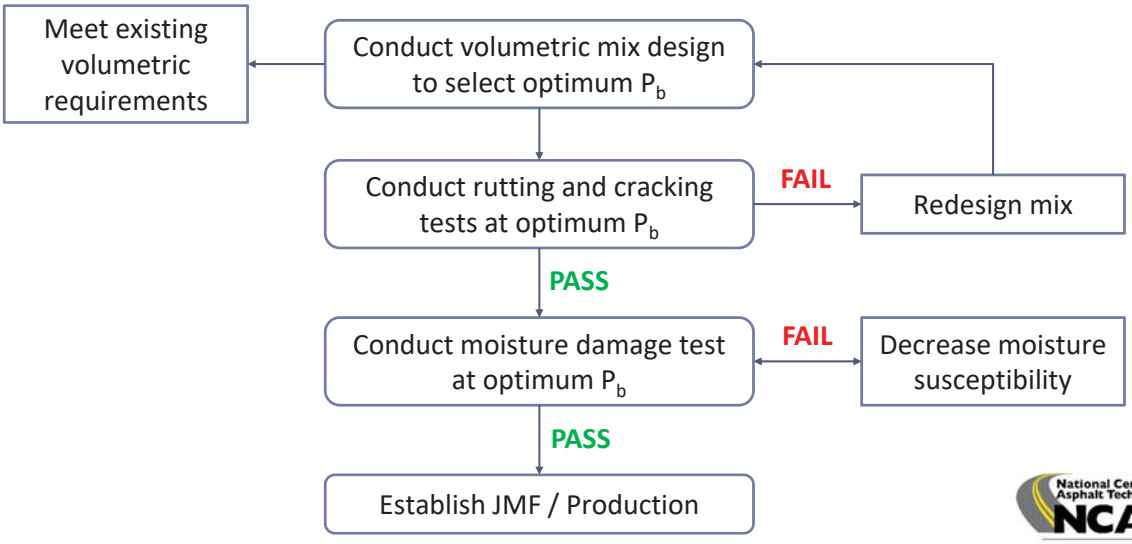
# Volumetric Design with Performance Verification

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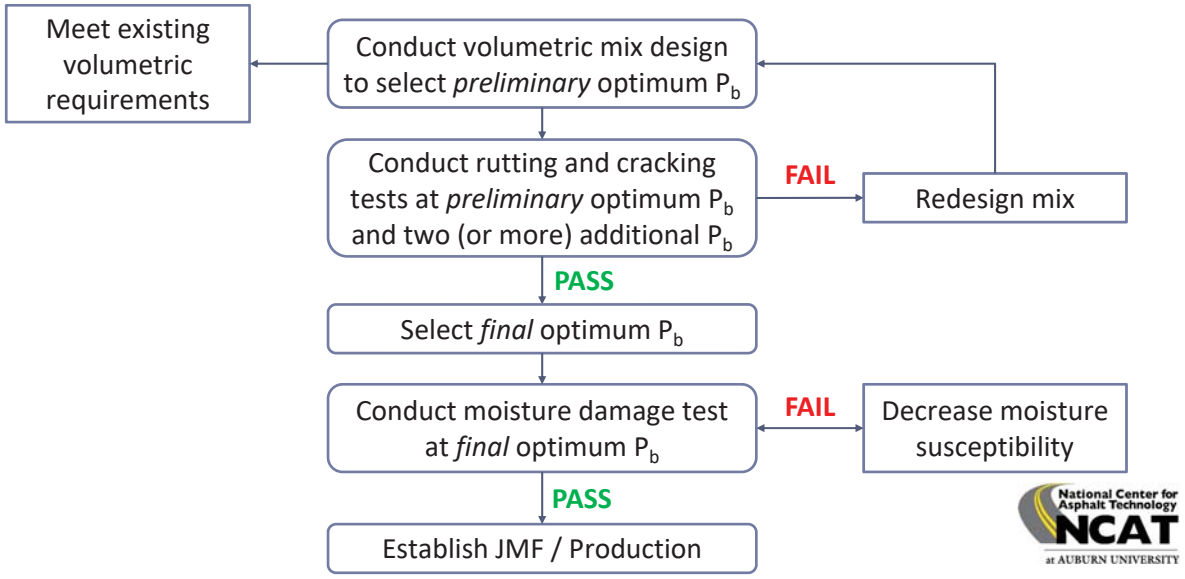
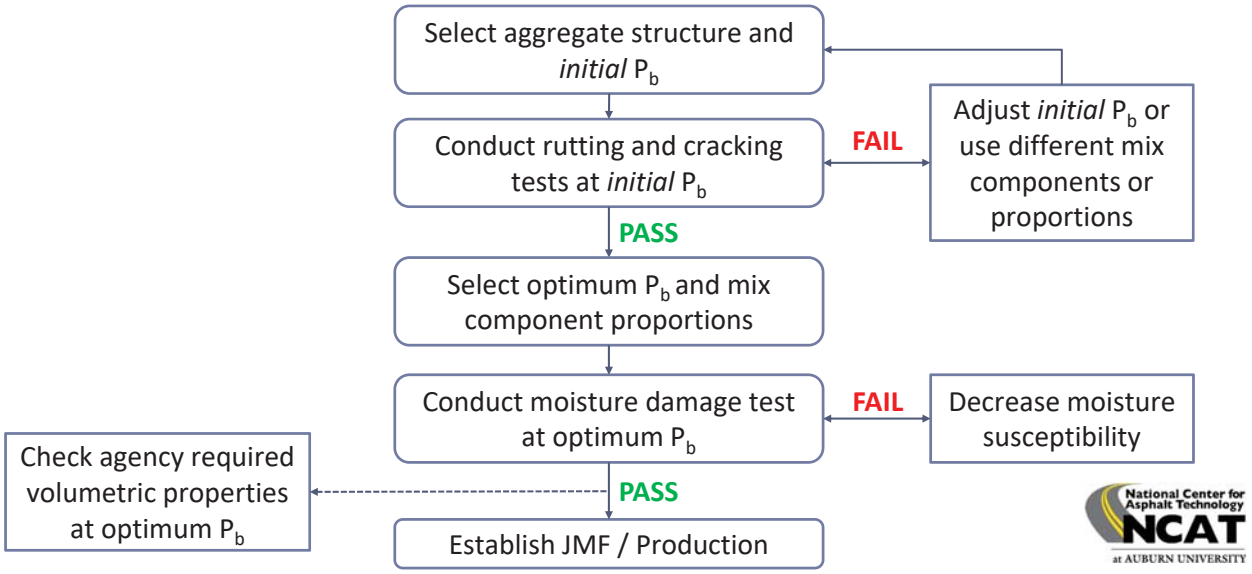
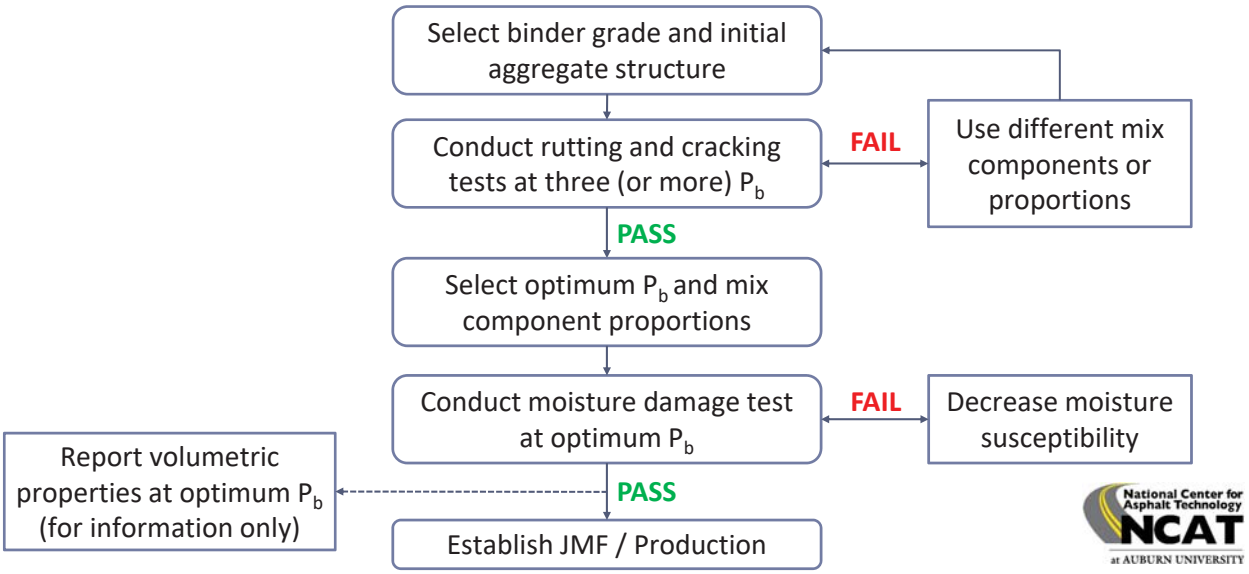
# Volumetric Design with Performance Optimization




# Performance-Modified Volumetric Design



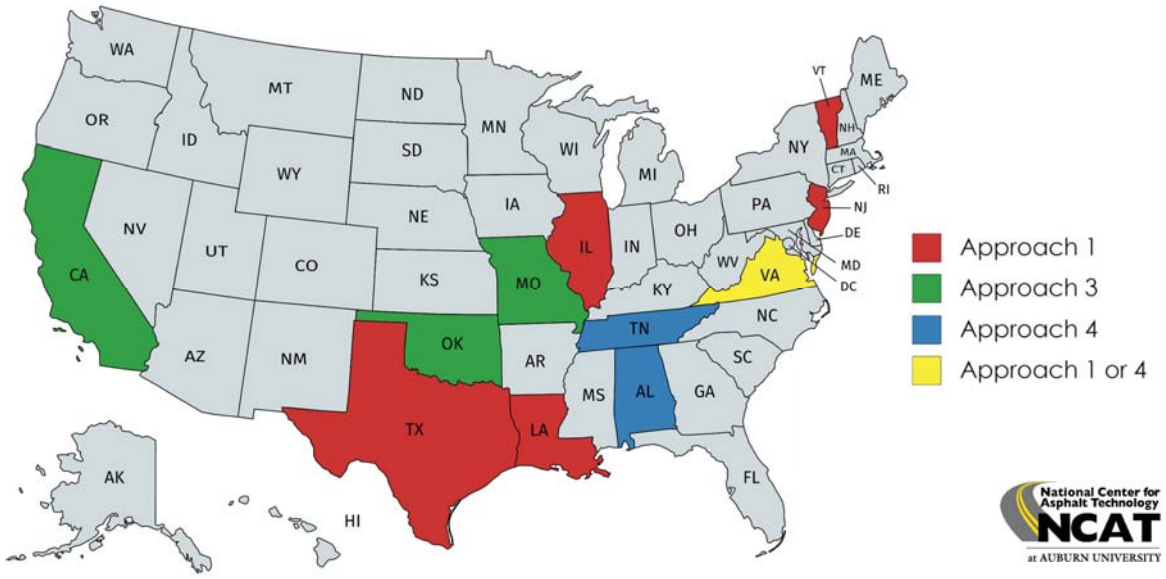
# Performance Design




# Comparison of Four BMD Approaches

| | BMD Approach | Volumetric Requirements | Innovation Potential |
|---|---|---|---|
| A. | 1. Volumetric Design with Performance Verification | All existing criteria retained | Low |
| B. | 2. Volumetric Design with Performance Optimization | All existing criteria retained before $P_b$ optimization | Low-Medium |
| C. | 3. Performance-modified Volumetric Design | Some existing criteria relaxed or eliminated | Medium |
| D. | 4. Performance Design | All existing criteria eliminated | High |

# State of the Practice for BMD




# BMD Survey 2020

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# BMD Survey 2020

- Focused questions to gather BMD status of agencies around the US
- Approximately 5-10 minutes
- Dynamic questions
- Sent to SAPAs and passed along
  - Contractor/Producer
  - SAPA
  - Supplier
  - Agency
  - Academia
  - Consultant


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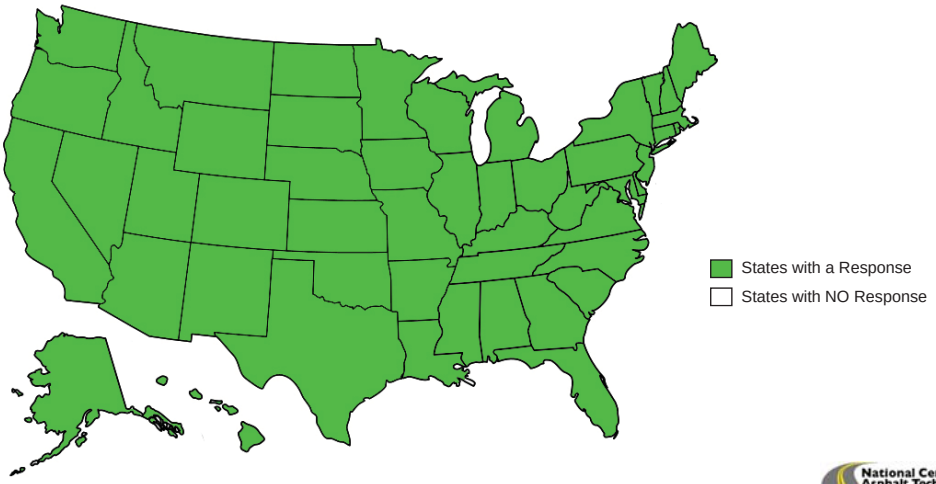
# Response

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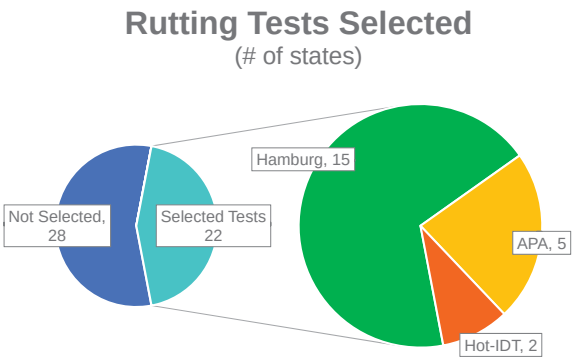
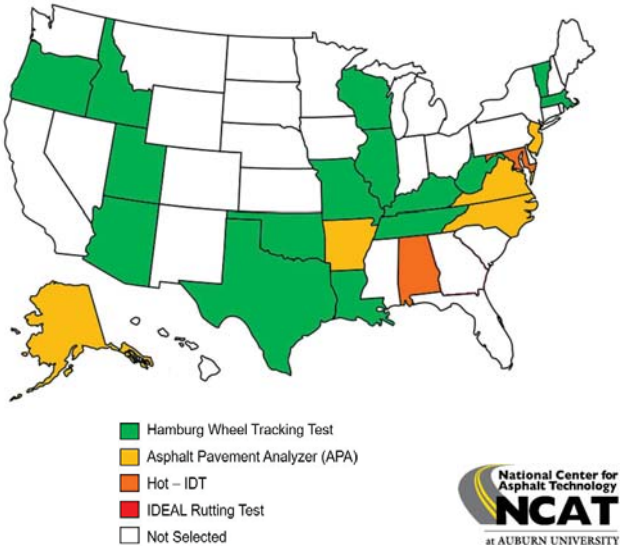
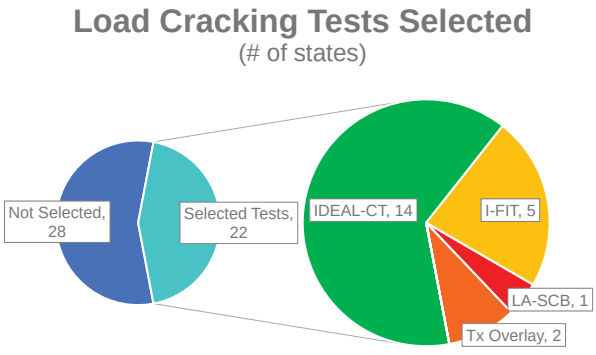
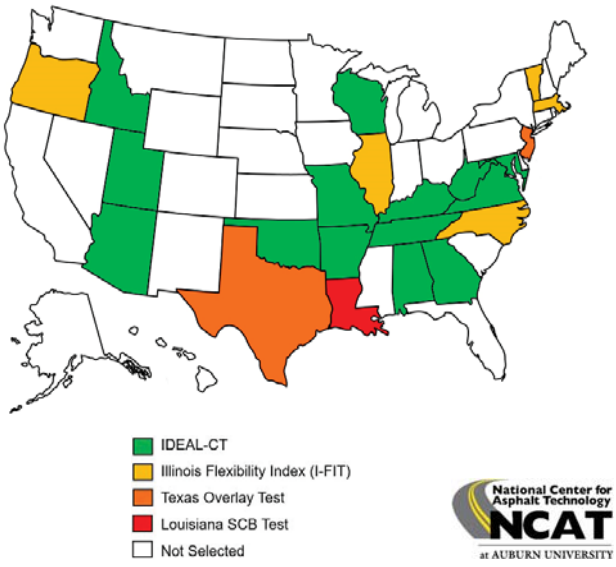
# Rutting Tests



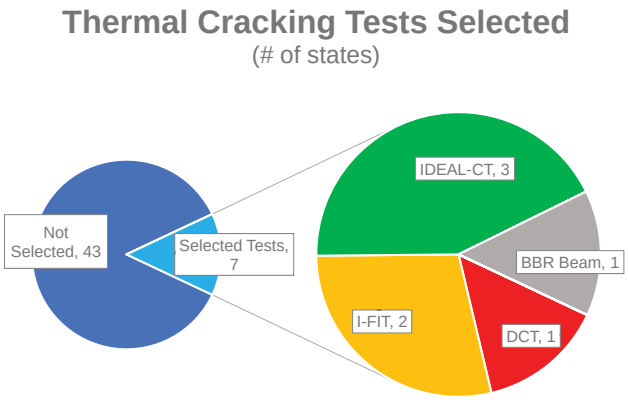



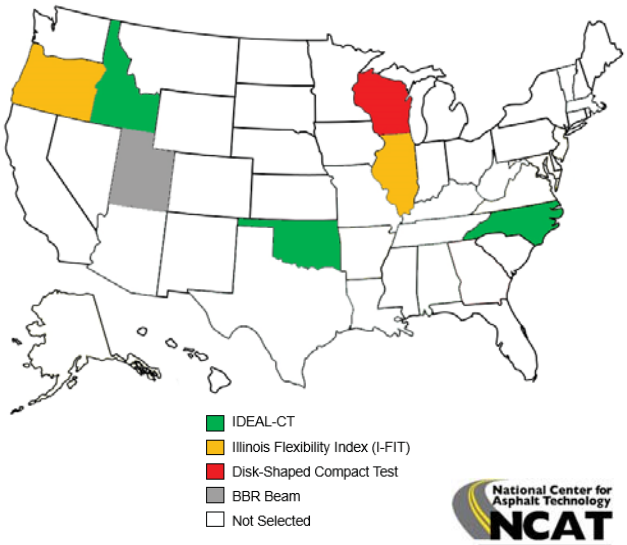

# Load Related Cracking Tests



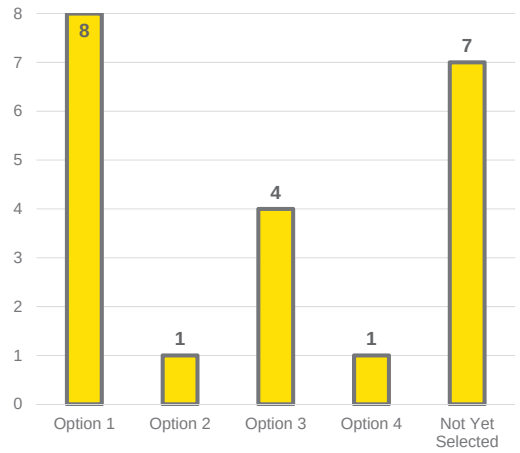



# Thermal Cracking Tests



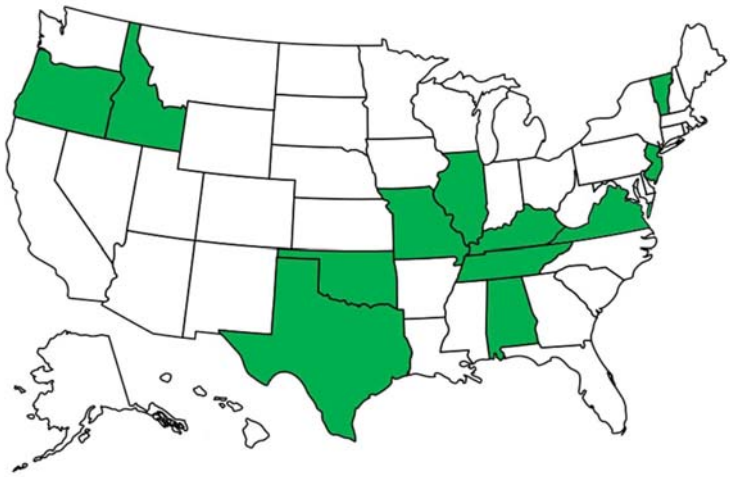




# Design Approach




- **Option 1:** Volumetric Design with Performance Verification
- **Option 2:** Volumetric Design with Performance Optimization
- **Option 3:** Performance-Modified Volumetric Mix Design
- **Option 4:** Performance Design

# 2020 BMD Projects

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# Major Takeaways

88%
- States that have at least organized a committee to discuss BMD

42%
- Have selected BMD tests to use in their state

18%
- Selected the combination of Hamburg Wheel Tracking Test and IDEAL-CT

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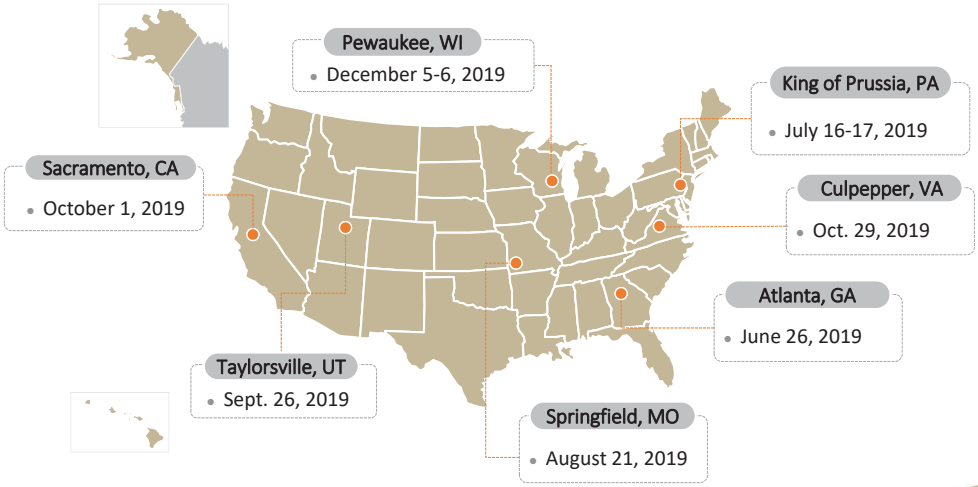
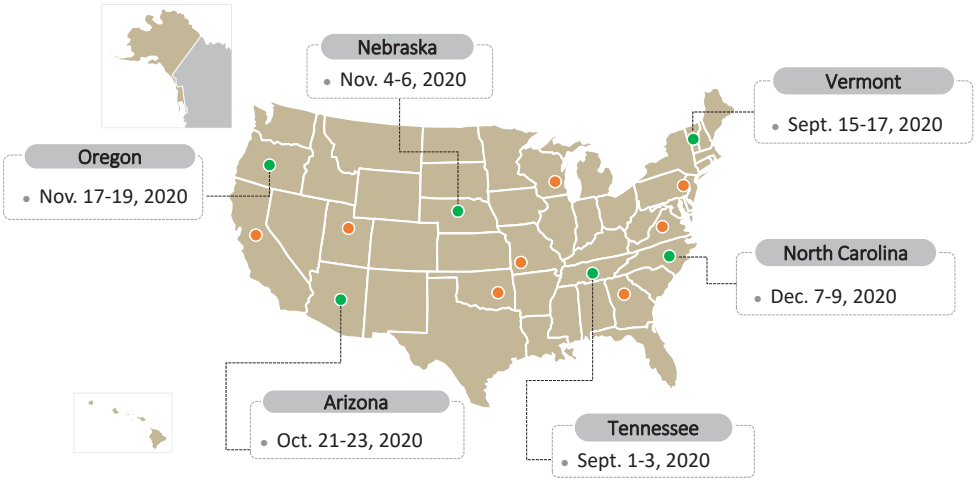
# Education Efforts

## Pre-Pandemic BMD Workshops



# Pandemic BMD Workshops

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# Implementation Challenges

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# 16 Steps to Implementation


1. Identify Champions
2. Joint Industry/Agency Task Force
3. Select Performance Tests
4. Equipment Purchasing & Preliminary Training
5. Benchmarking Studies
6. Shadow Projects
7. Precision/Variability Studies
8. Production Data Analysis
9. Sampling & Testing Plans
10. Preliminary Acceptance Criteria
11. Pay Adjustment Factors
12. Pilot Specifications
13. Training & Pilot Projects
14. Final Analysis & Specification Revisions
15. Update Training Program & Lab Accreditation
16. Full Implementation

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# Rutting Tests

## Fundamental Tests

E* and Fn
AASHTO T 378

iRLPD
AASHTO TP 116

Stress Sweep Rutting (SSR)
AASHTO TP 134

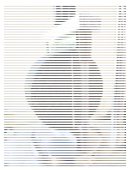
Shear Stiffness
AASHTO T 320

## Empirical/Simulative Tests

Hamburg Wheel
AASHTO T 324

Asphalt Pavement Analyzer
AASHTO T 340

## Empirical/Monotonic Tests



High Temp. IDT
No national std.

Rapid Shear Rutting Test
No national std.

# Cracking Tests (Load-Related Cracking)

## Fundamental Tests

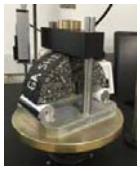
Bending Beam Fatigue
AASHTO T 321

Cyclic Fatigue
AASHTO TP 107

## Index Tests

Semi-Circular Bend
Louisiana method
ASTM D8044

Ideal Cracking Test
ASTM D8225



Illinois Flexibility Index Test (I-FIT)
AASHTO TP 124

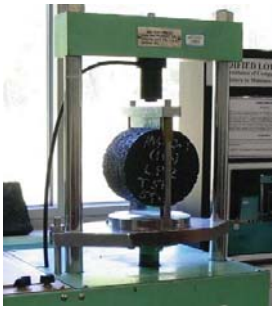
Nflex Factor
AASHTO TP 141

## Simulative Tests

Texas Overlay Test
TEX 248-F

NCAT Overlay Test
No national std.

# Moisture Susceptibility Tests



Tensile Strength Ratio
AASHTO T 283

Hamburg Wheel Tracker
AASHTO T 324

Boil Test
ASTM D 3625

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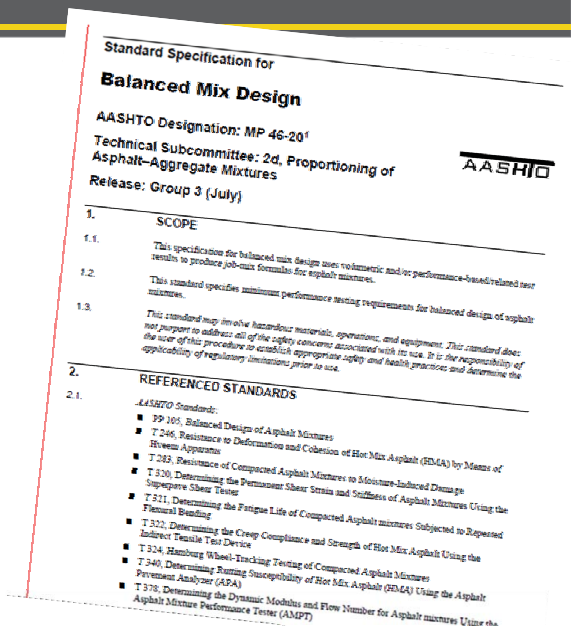
# Accepted Standard

- AASHTO MP 46
  - Identifies performance tests
  - Recommends test criteria

TBD



Standard Specification for

**Balanced Mix Design**

AASHTO Designation: MP 46-20[1]

Technical Subcommittee: 2d, Proportioning of Asphalt–Aggregate Mixtures

Release: Group 3 (July)

AASHTO

1. SCOPE

1.1. This specification for balanced mix design uses volumetric and/or performance-based/related test results to produce job-mix formulas for asphalt mixtures.

1.2. This standard specifies minimum performance testing requirements for balanced design of asphalt mixtures.

1.3. *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. REFERENCED STANDARDS

2.1. *AASHTO Standards:*

- PP 105, Balanced Design of Asphalt Mixtures
- T 246, Resistance to Deformation and Cohesion of Hot Mix Asphalt (HMA) by Means of Hveem Apparatus
- T 283, Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage
- T 320, Determining the Permanent Shear Strain and Stiffness of Asphalt Mixtures Using the Superpave Shear Tester
- T 321, Determining the Fatigue Life of Compacted Asphalt mixtures Subjected to Repeated Flexural Bending
- T 322, Determining the Creep Compliance and Strength of Hot Mix Asphalt Using the Indirect Tensile Test Device
- T 324, Hamburg Wheel-Tracking Testing of Compacted Asphalt Mixtures
- T 340, Determining Rutting Susceptibility of Hot Mix Asphalt (HMA) Using the Asphalt Pavement Analyzer (APA)
- T 378, Determining the Dynamic Modulus and Flow Number for Asphalt mixtures Using the Asphalt Mixture Performance Tester (AMPT)

# Is Mix Aging Important?

Yes, for surface mixes.

June 2013 Sept. 2016 July 2019

# Mix Aging

- Aging occurs much more severely at the surface of the pavement.
- All asphalt binders do not age at the same rate
- Surface mixes should be evaluated for cracking resistance AFTER the mix has been aged to represent the amount of time when surface cracking typically starts to occur in the field.
- Aging is inconvenient for QA testing.

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# Summary

- Four approaches are outlined in AASHTO PP 105
  - Several states have selected their approach
  - Approach 1 or A seems to me most comfortable, but allows less room for innovation
- Survey in 2020 is a snapshot in time of how states are approaching BMD, changes happen
  - 44 States have 'started'
- Education efforts have been regional and state specific, more to come
- Implementation Challenges
  - A lot of test to choose from
  - No national test limits
  - Additional guidance is coming


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