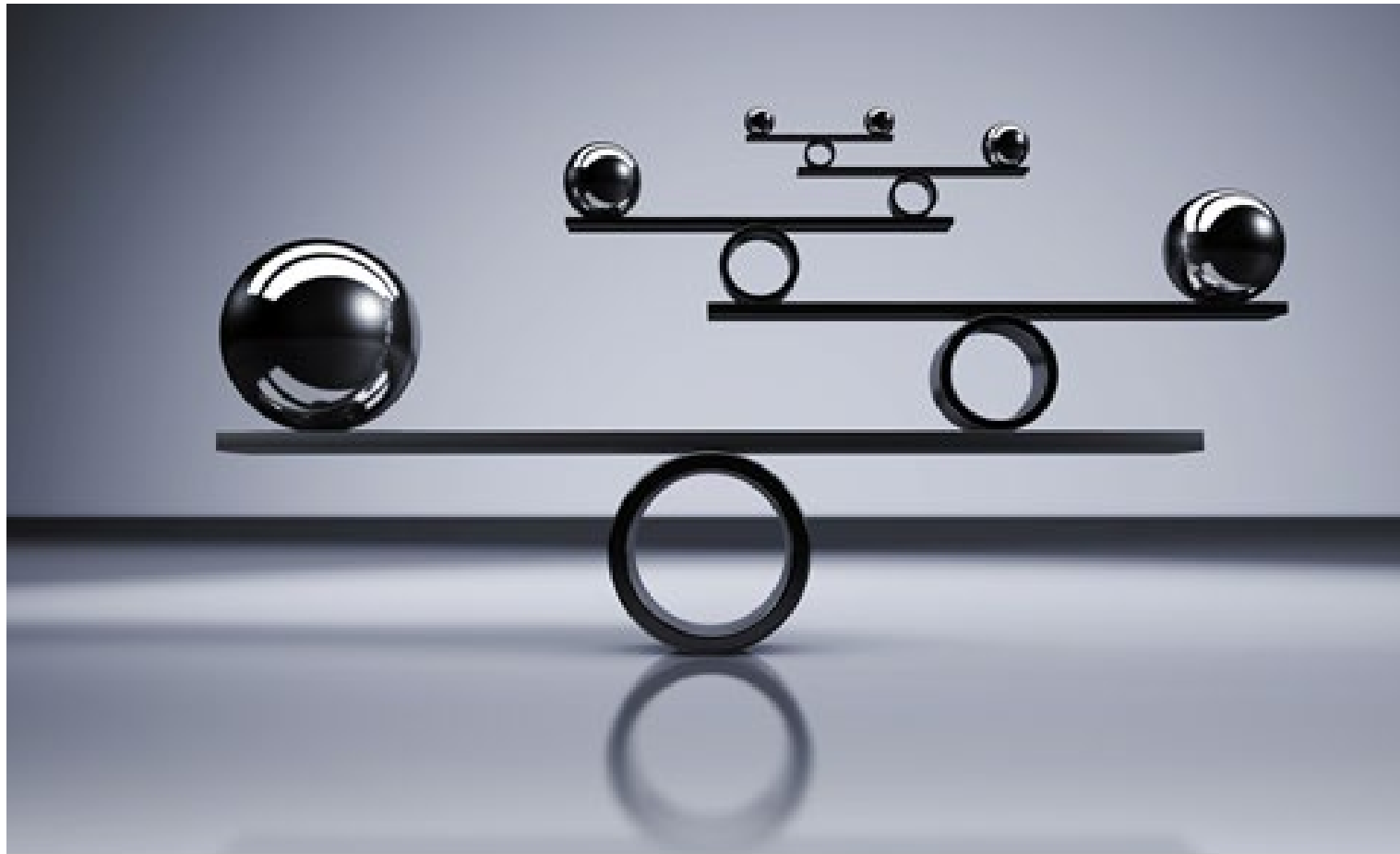


# Balanced Mix Design A National Perspective



Dave Johnson, P.E.  
Senior Regional Engineer  
Rocky Mountain Region  
Billings Montana



# Balance the Mix Design

Strength/  
Stability

Rut Resistance

Shoving

Flushing  
Resistant

Smooth Quiet Ride  
Skid Resistance

Durability

Crack  
Resistance

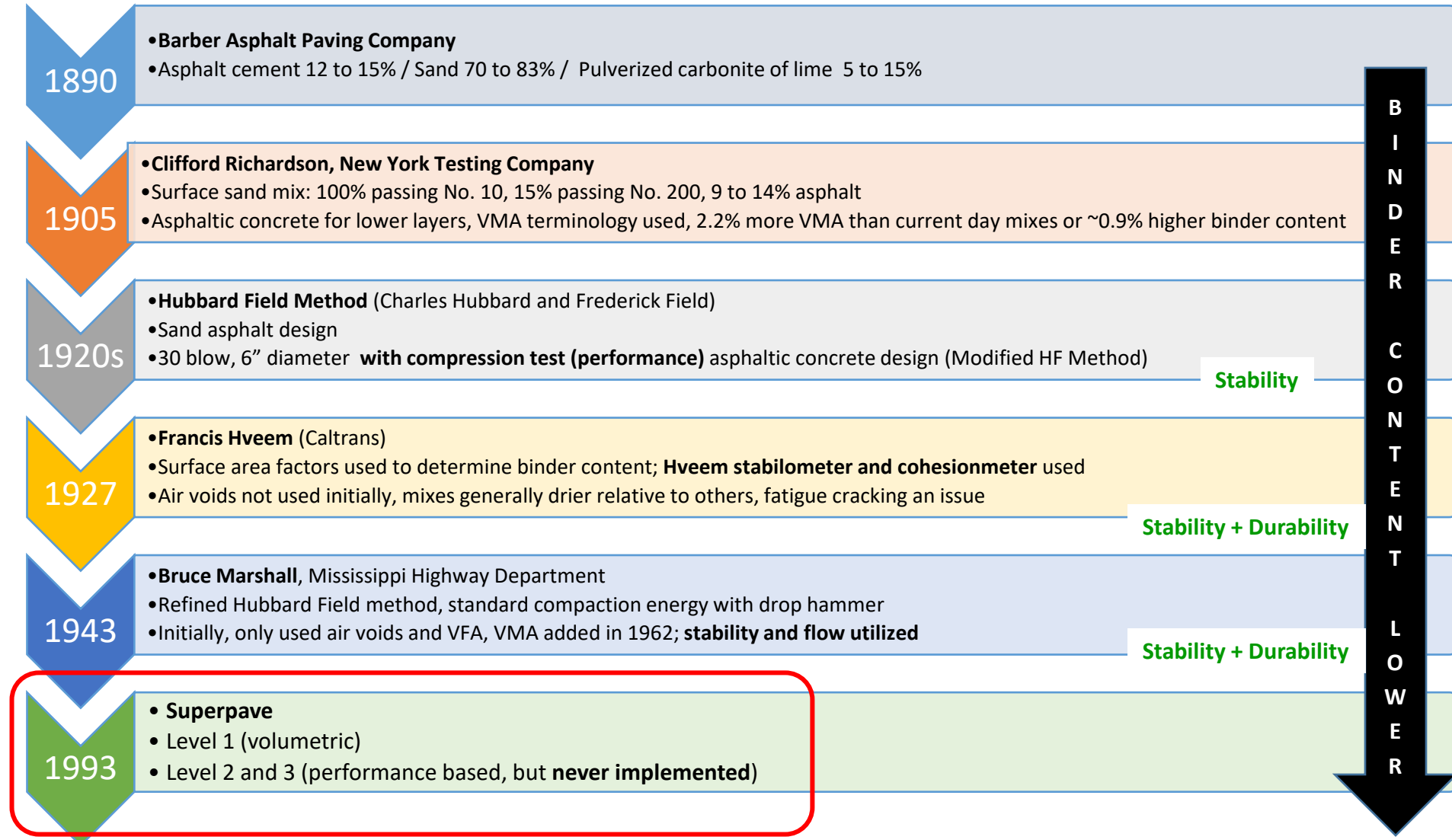
Raveling

Permeability



**DON'T ATTACK ONE HALF AT THE EXPENSE OF THE OTHER HALF!!**

# History of Mix Design

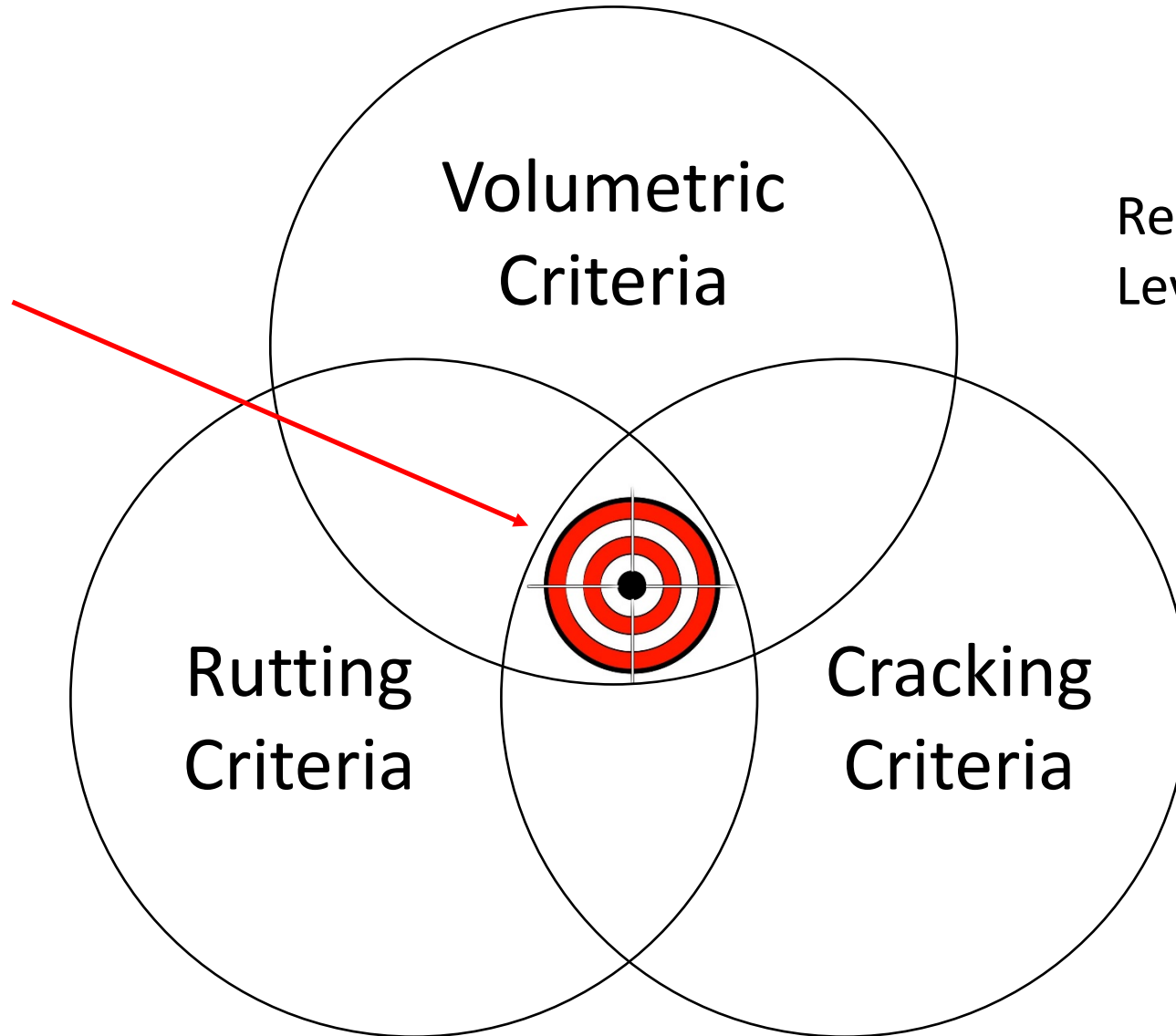


# What Should Have Happened with Superpave...

- Superpave called for **Level 1, 2, and 3** testing based on traffic load
- **Level 1 (Volumetrics + TSR)** was only for up to around 1 million ESALS
- Level 2 and 3 were to be used for higher traffic loads and included rutting and cracking performance test
- Since we saw such good performance (with materials in 1993-2000), **Levels 2 and 3** were soon forgotten

# Balanced Mix Design Basic Concept

Target area of balanced performance



Remember Superpave Levels 2 & 3?

- Rutting?
  - NO
  - Generally not a widespread distress since Superpave implementation
- Cracking?
  - YES
  - Various cracking distresses have increased nationally
- Durability?
  - YES
  - Related to cracking, durability concerns have been noted

# Balanced Mix Design Goals

---

- Ensure pavement performance
  - Rutting
  - Cracking
  - Durability
- Enable innovation
  - Materials
  - Specifications
- Optimize economics

- AASHTO PP 105
  - Four approaches
  - Condition specimens
  - Test for differing distress types
  - Consider
    - Aging
    - Traffic
    - Climate
    - Layer



# BMD Approach A

## Volumetric Design with Performance Verification

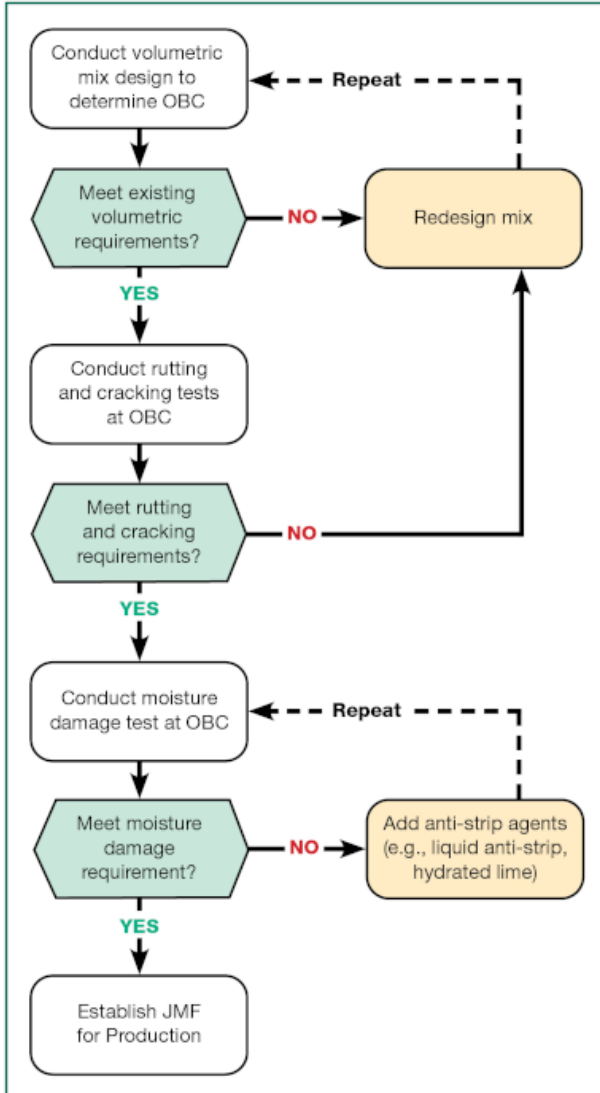


Figure 1. Graphical Illustration of the Volumetric Design with Performance Verification Approach (Approach A)

- Most traditional approach
- Starts with a volumetric design
- Adds performance testing
  - Rutting
  - Cracking
  - Moisture damage
- Adjust design (gradation, AC content, additives, etc.) though the process as needed
- Establish JMF
- Least innovative

# BMD Approach B

## Volumetric Design with Performance Optimization

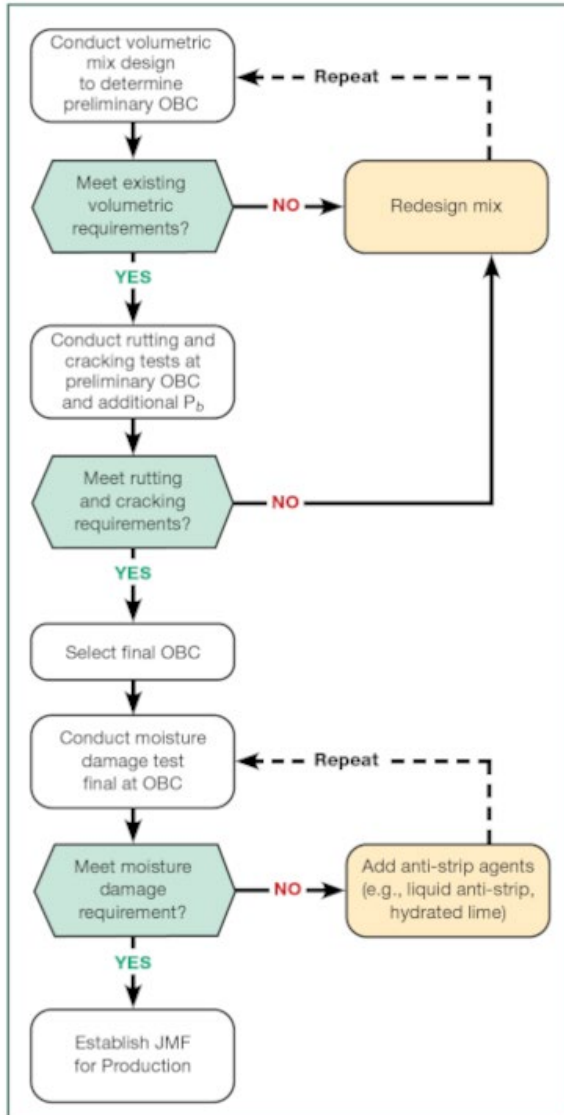
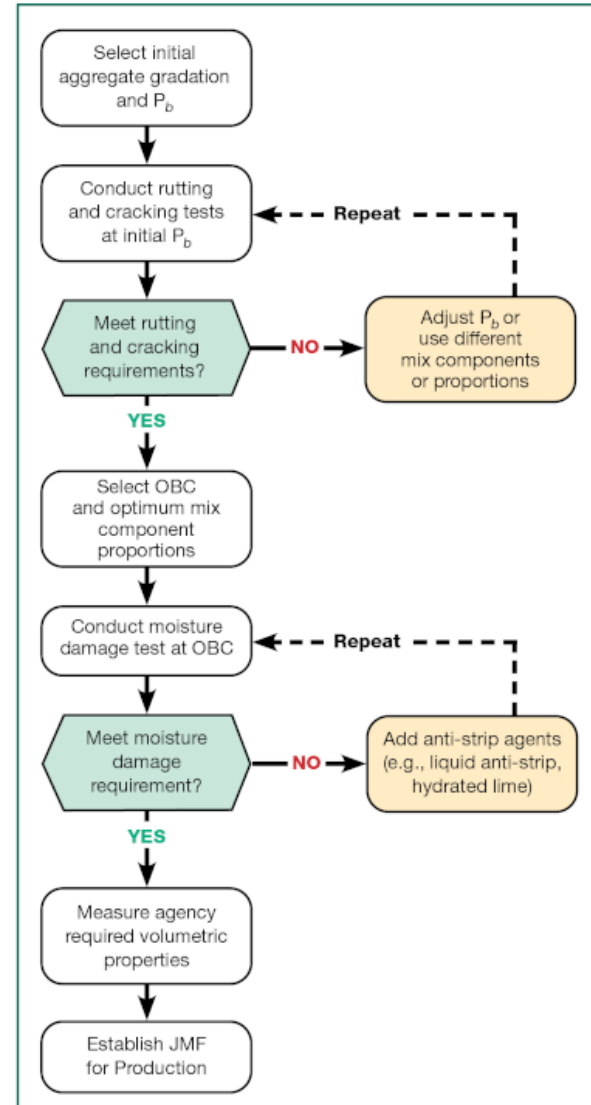


Figure 2. Graphical Illustration of the Volumetric Design with Performance Optimization Approach (Approach B)

- Starts with a volumetric design
- Add performance testing
  - Rutting
  - Cracking
- Adjust mix to meet volumetric and rutting and cracking requirements
- Conduct moisture damage testing
- Establish JMF
- More innovative than Approach A

# BMD Approach C

## Performance-Modified Volumetric Design

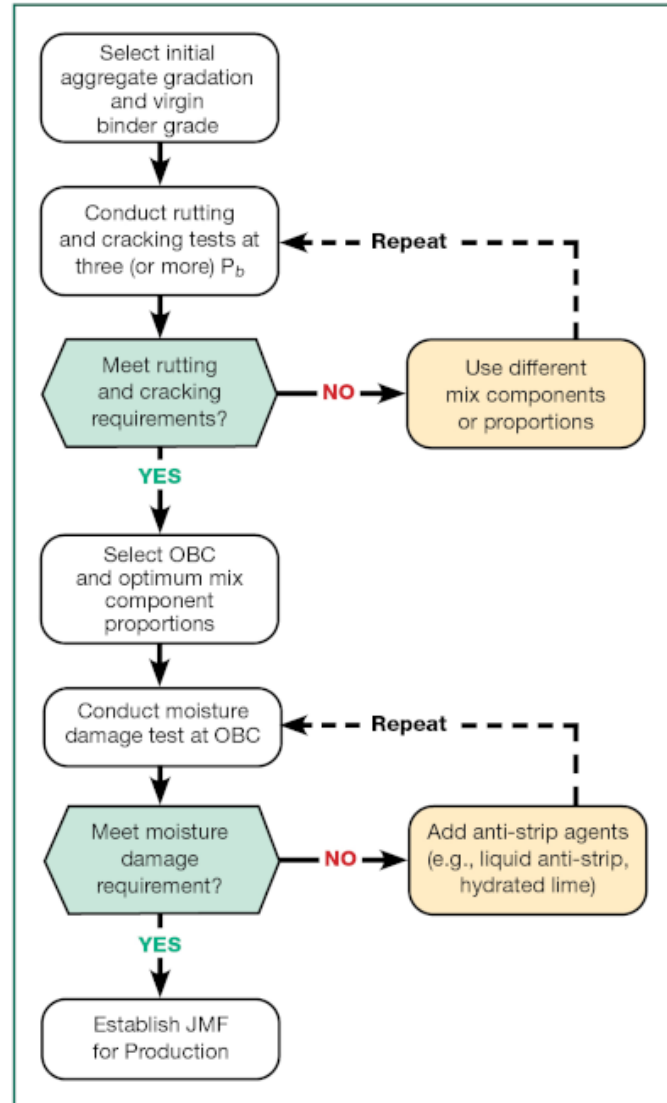


- Less reliant on traditional volumetrics
- Use performance testing to establish initial binder content
  - Rutting
  - Cracking
- Adjust components if needed
- Conduct moisture damage testing
- Add anti-strip if needed
- Verify agency volumetric compliance
- Establish JMF
- More innovative than Approach B

Figure 3. Graphical Illustration of the Performance-Modified Volumetric Design Approach (Approach C)

# BMD Approach D

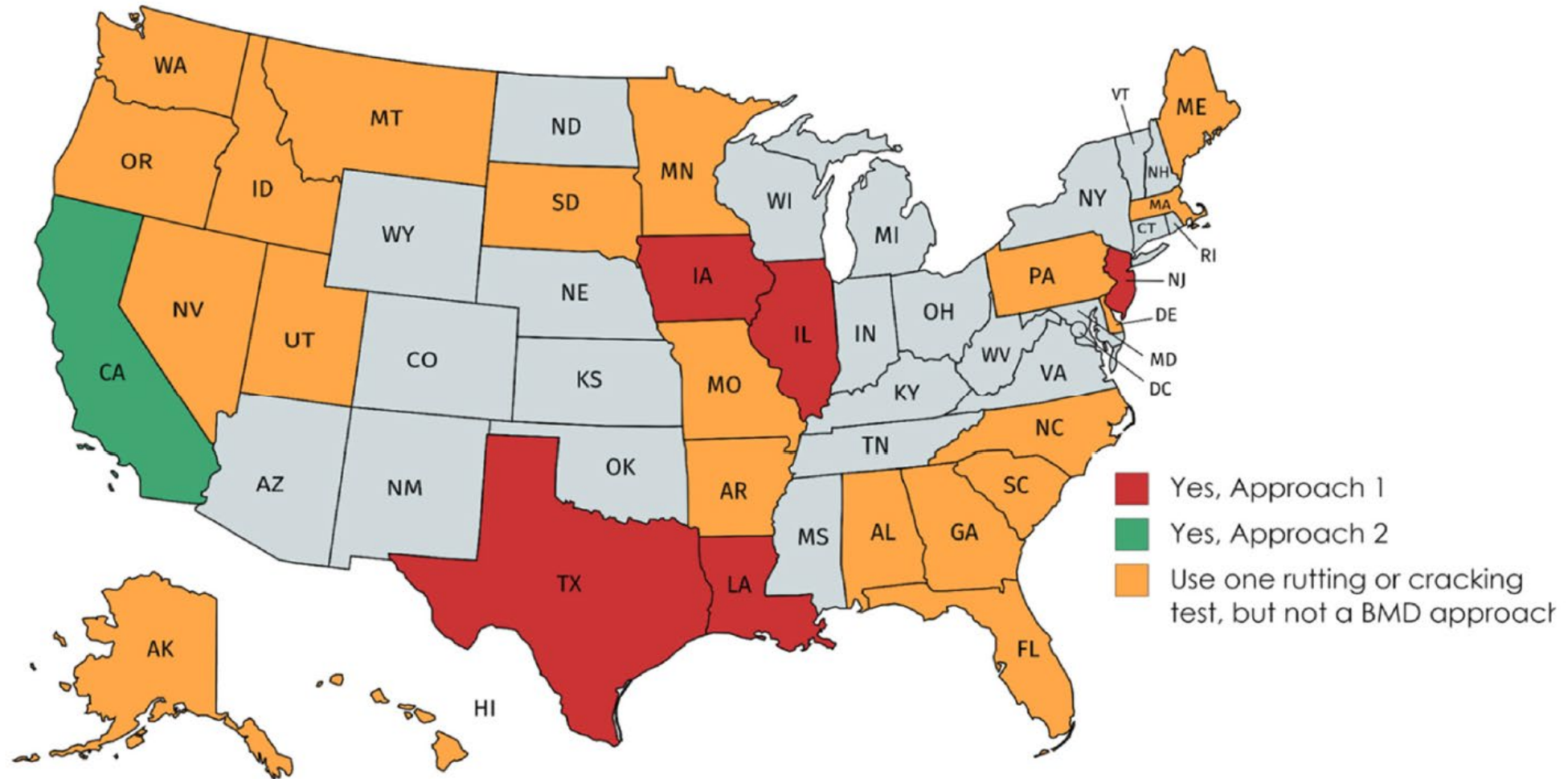
## Performance Design



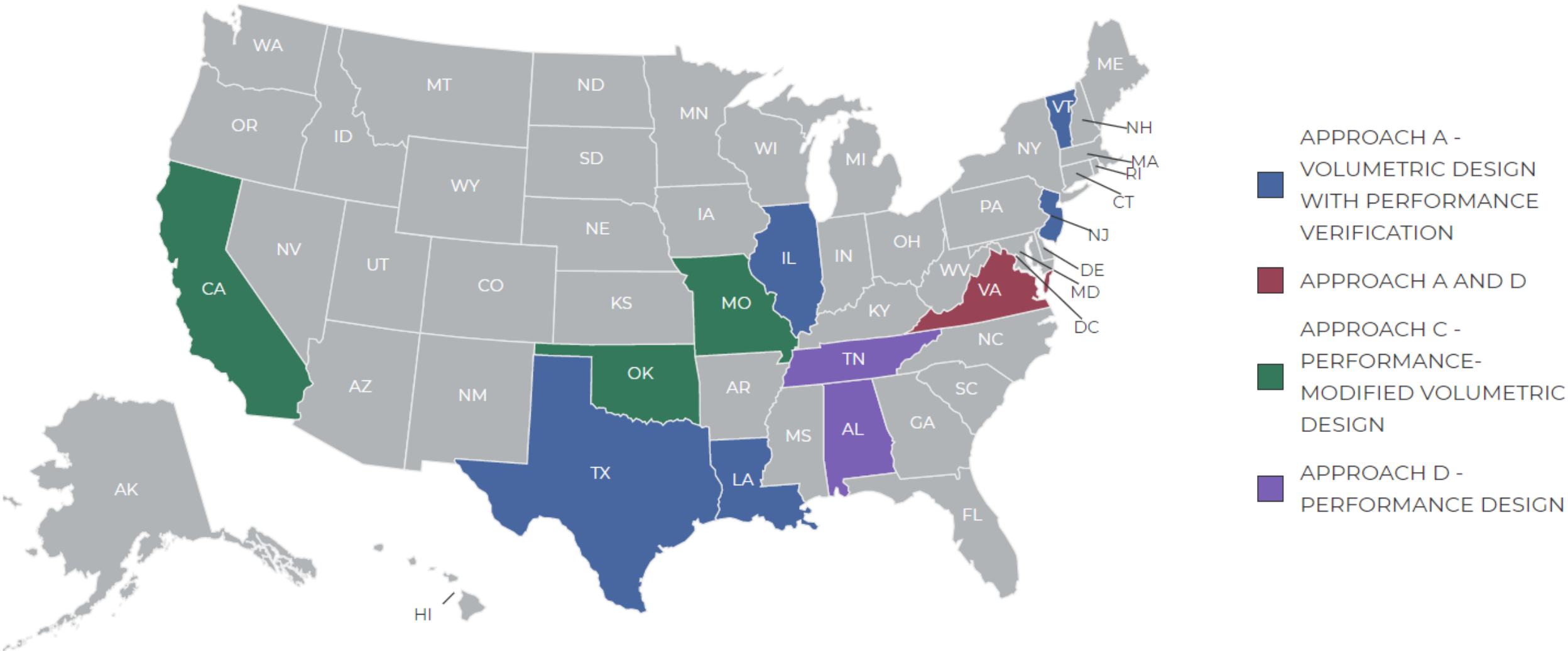
- Most innovative approach
- No volumetric requirements
- Performance testing for mix optimization
- Select initial combination of materials
- Conduct performance testing at multiple AC contents
- Select binder content
- Conduct moisture damage testing
- Establish JMF

Figure 4. Graphical Illustration of the Performance Design Approach (Approach D)

# Performance Asphalt Design Approach in USA (2017)



# Performance Asphalt Design Approach in USA (August 2021)

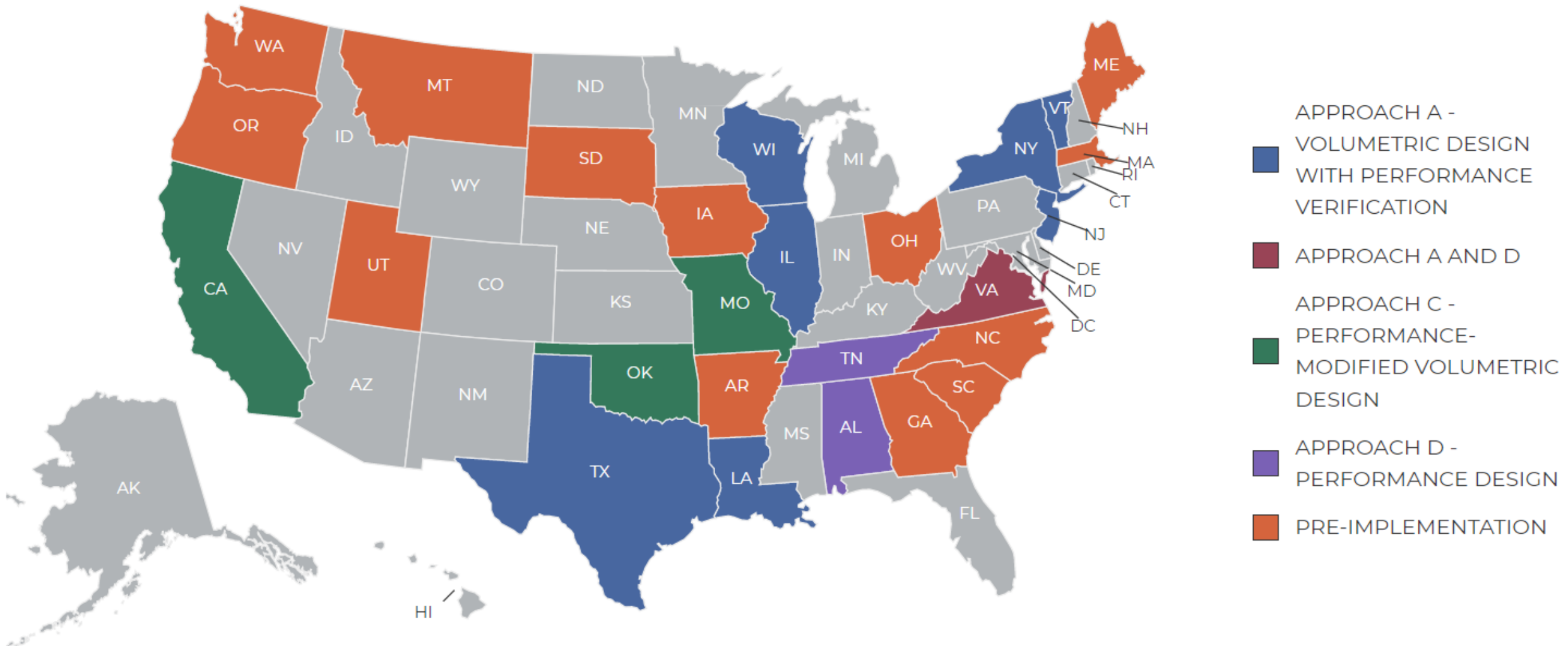




# Performance Asphalt Design Approach in USA (January 2022)



asphalt institute



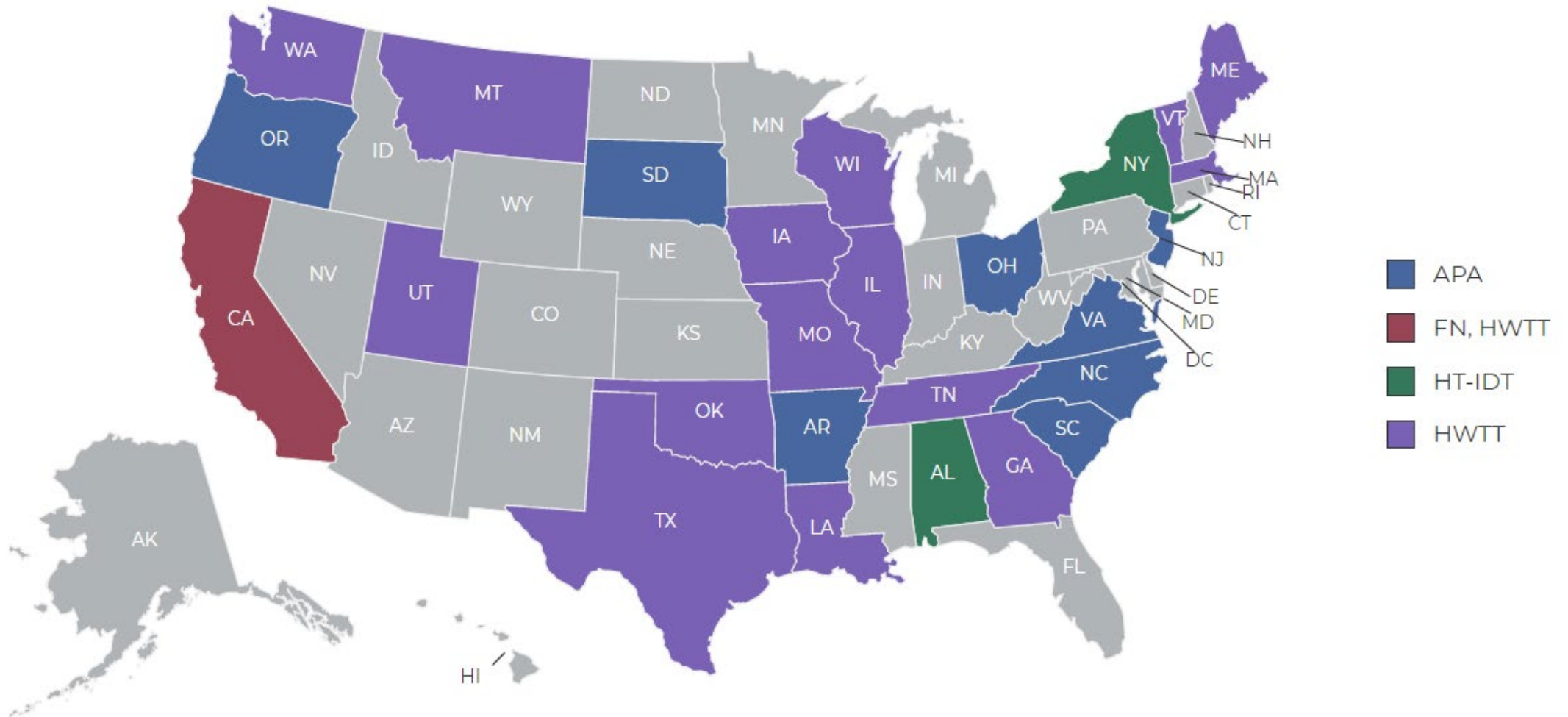
# Rutting Performance Testing Options

FILTER BY:

BMD APPROACH

RUTTING TEST

CRACKING TEST





# Rutting Performance Testing Options

---

- Hamburg Wheel Tracking Test
  - Most common choice
  - Used in seventeen states
  - Generally gaining popularity (BMD and non-BMD states)
- Asphalt Pavement Analyzer
  - Used by eight states
  - Used by FAA
  - Generally losing popularity (BMD and non-BMD states)
- Hot Indirect Tension Test
  - Used in Alabama only for BMD

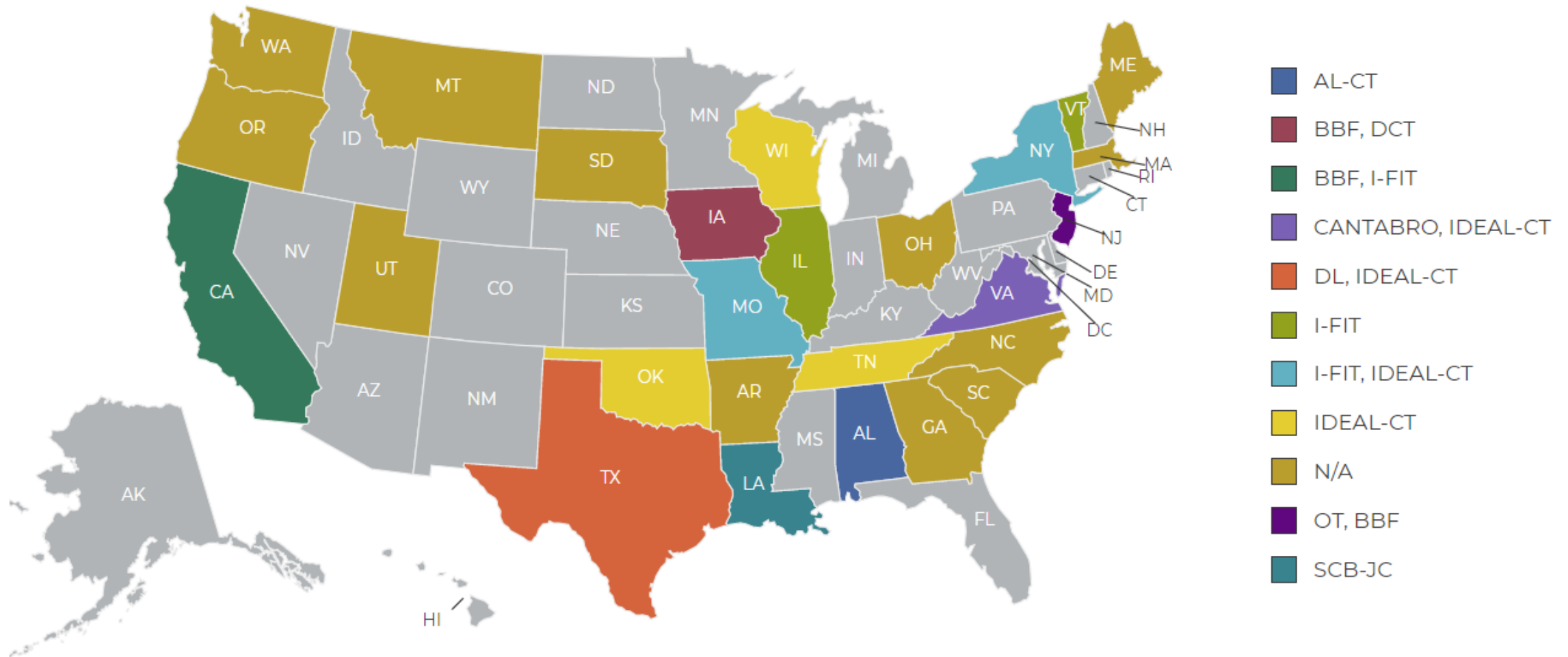
# Cracking Performance Testing Options

FILTER BY:

BMD APPROACH

RUTTING TEST

CRACKING TEST



# Cracking Performance Testing Options

---

- Eight test procedures currently reported
- Two tests most common
  - I-FIT test
  - IDEAL-CT
- Seven states report two cracking tests are required

- Interest in BMD approaches growing significantly
- Multiple combinations of design approaches and testing requirements being seen
- Likely trends that BMD will instigate (Dave's opinions)
  - Increases in binder contents
    - Mitigates cracking and durability concerns
  - Less reliance on volumetrics
  - Greater reliance on laboratory performance testing during design
  - Innovations
    - Rejuvenators
    - Alternative materials

# Thank You Asphalt Institute Membership



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# Questions?

