

# BMD Do's and Don'ts



December 6, 2023

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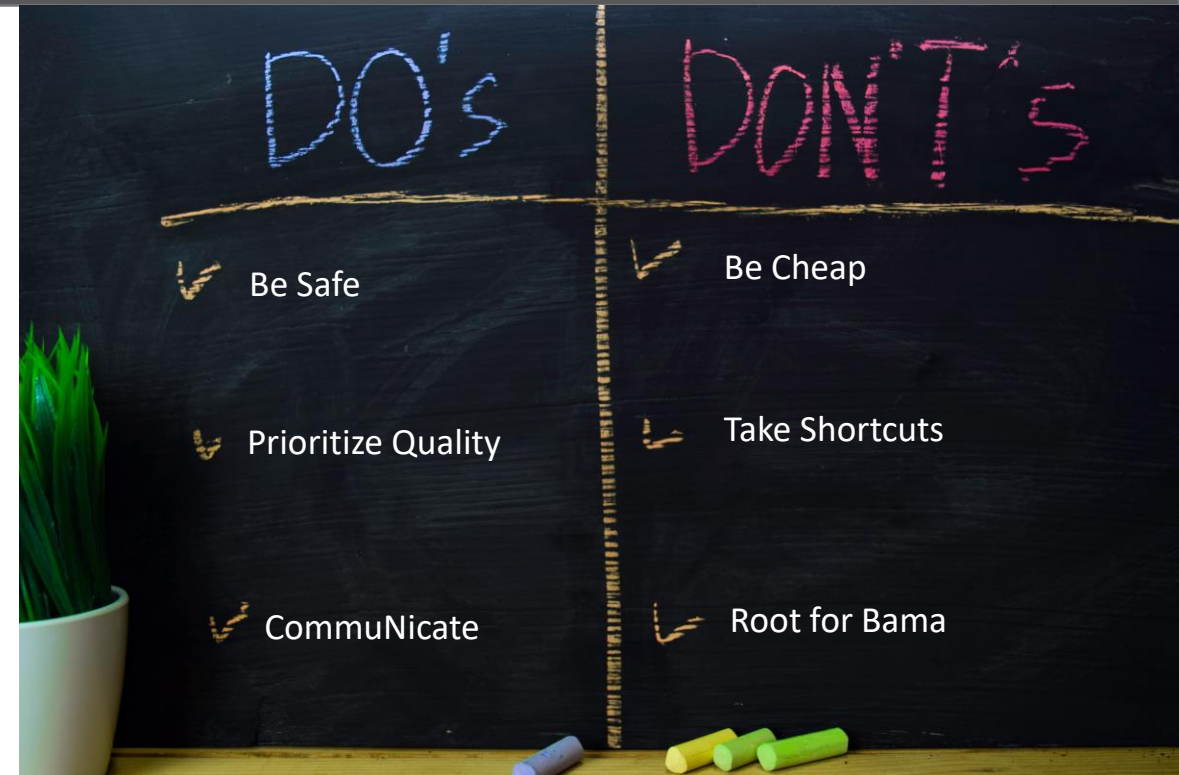
# My Background

- Started at NCAT in 2012
  - “Responsible” for QC for 2012 Test Track
- Graduated from Auburn in 2014 & 2016
- Started at NCAT in 2017
  - BMD, Mix Design, Friction, Training



# BMD – Do's and Don'ts (Lab Perspective)

- Been working on BMD since 2017
- Many, many, many lessons learned
  - Some the easy way, most the hard way...
- Many lessons learned are surprisingly simple and reinforce the importance of the basics



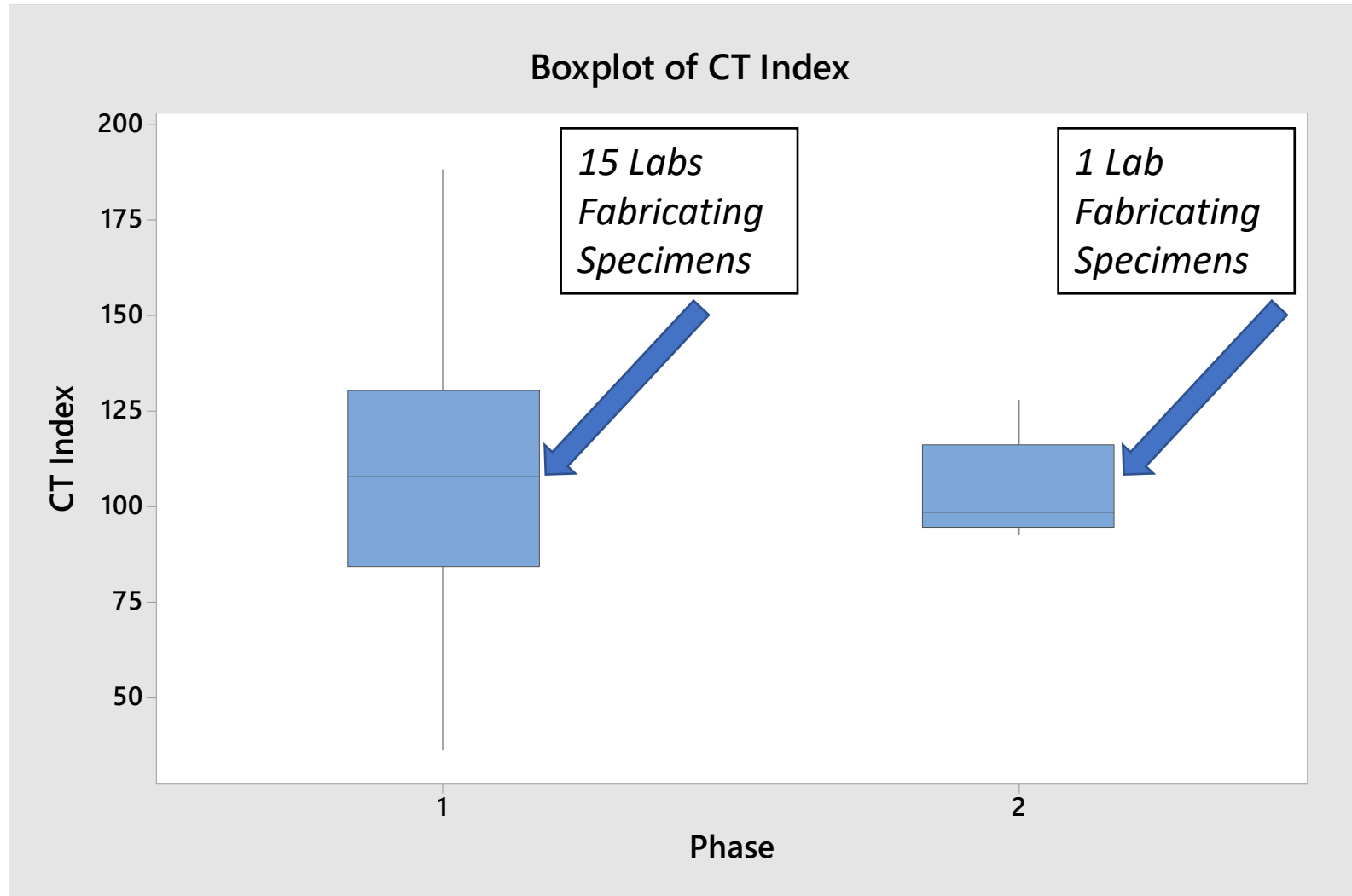
# Do's & Don'ts Lesson #1

## Specimen Preparation

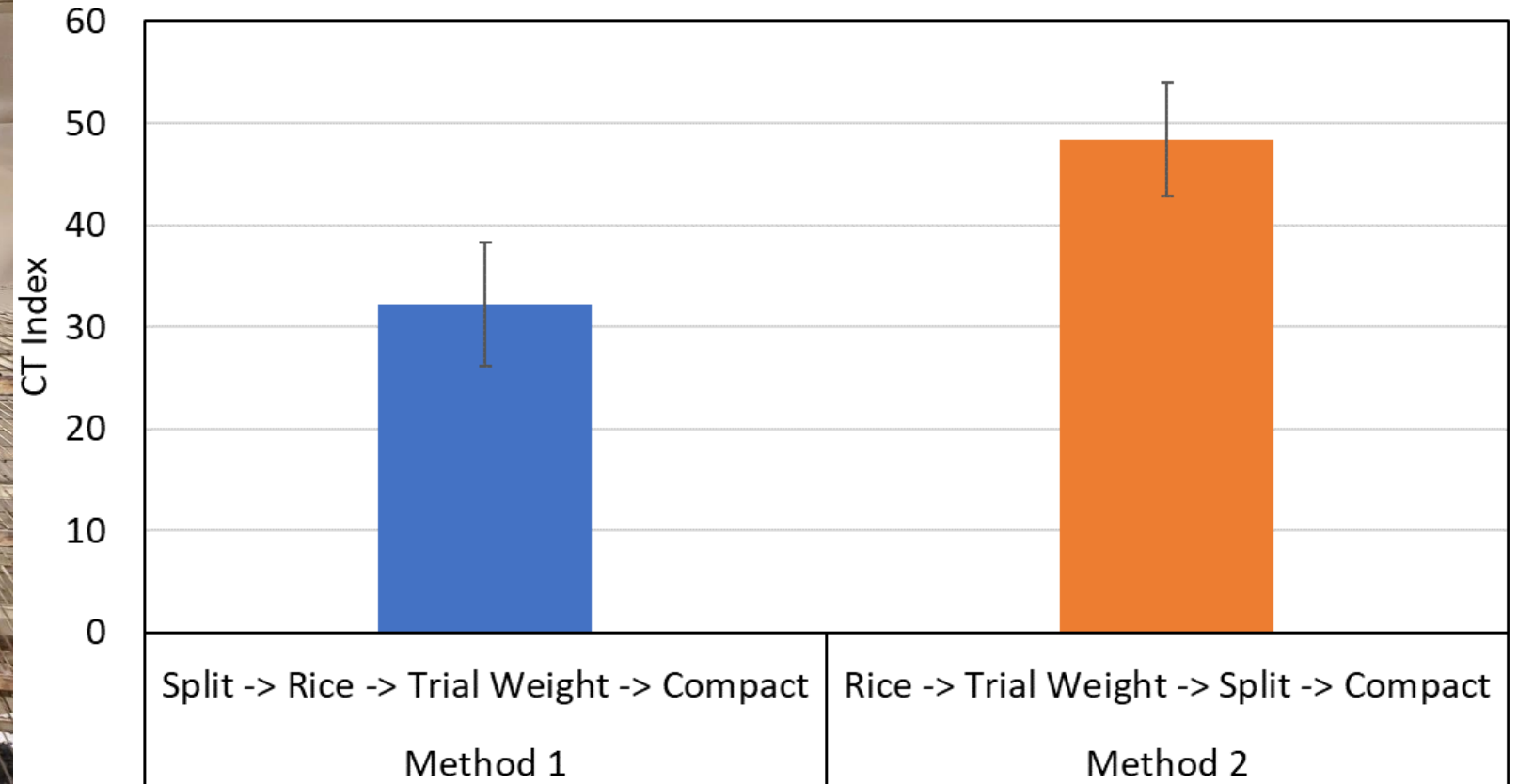
- Specimen preparation is the #1 most important factor in achieving consistent and quality BMD results!



# Importance of Specimen Fabrication



# Spec' Prep – Time in Oven



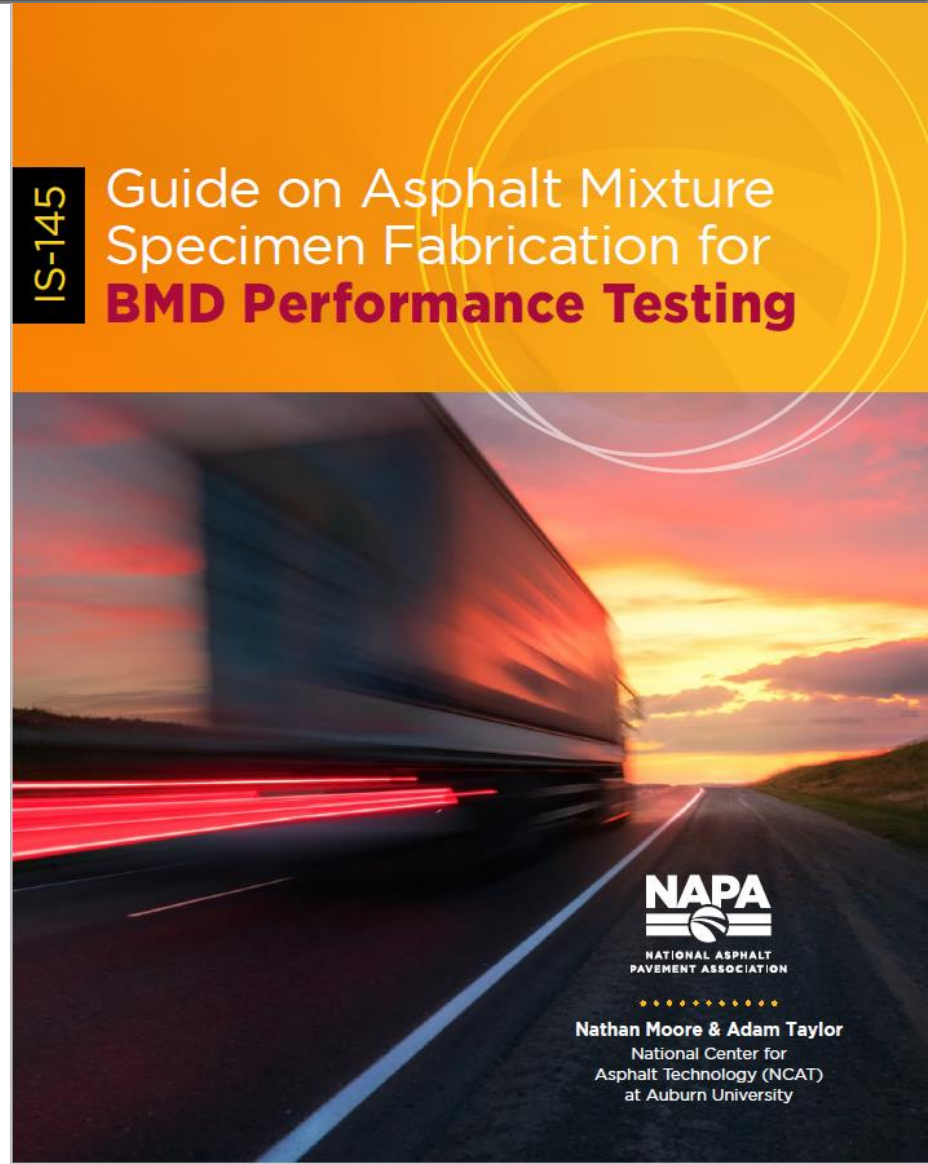
# Specimen Prep - Segregation



# BMD Specimen Preparation Guide

- NAPA IS-145: Guide on Asphalt Mixture Specimen Fabrication for BMD Performance Testing
  - NAPA BMD Resource Guide
  - Training and Resources

*Link* →

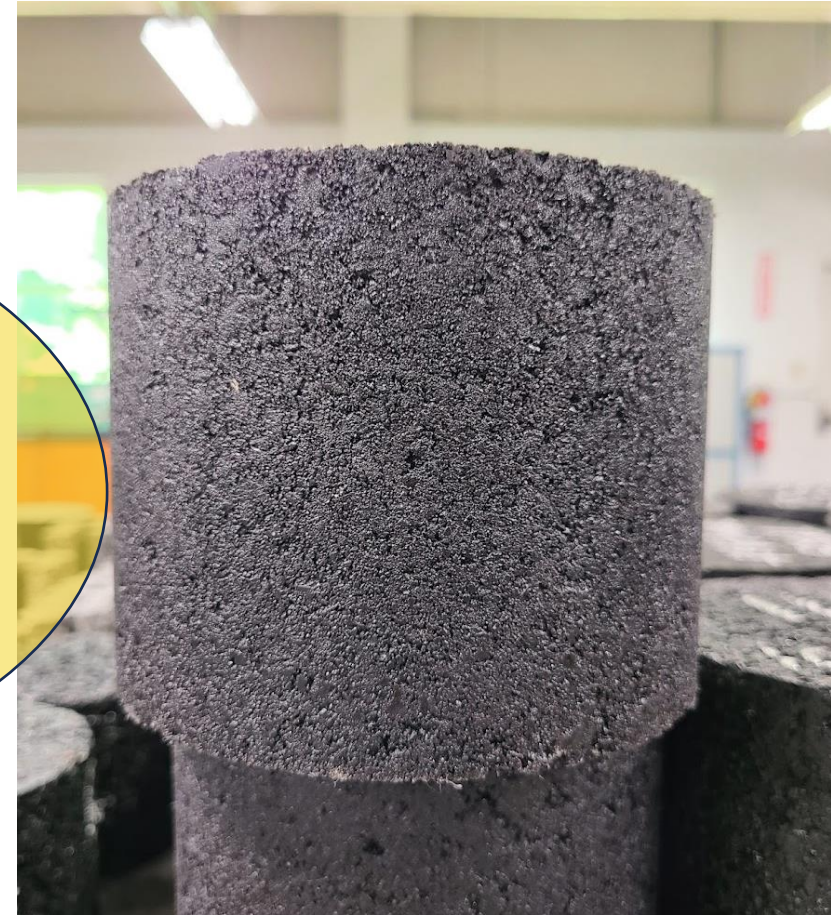




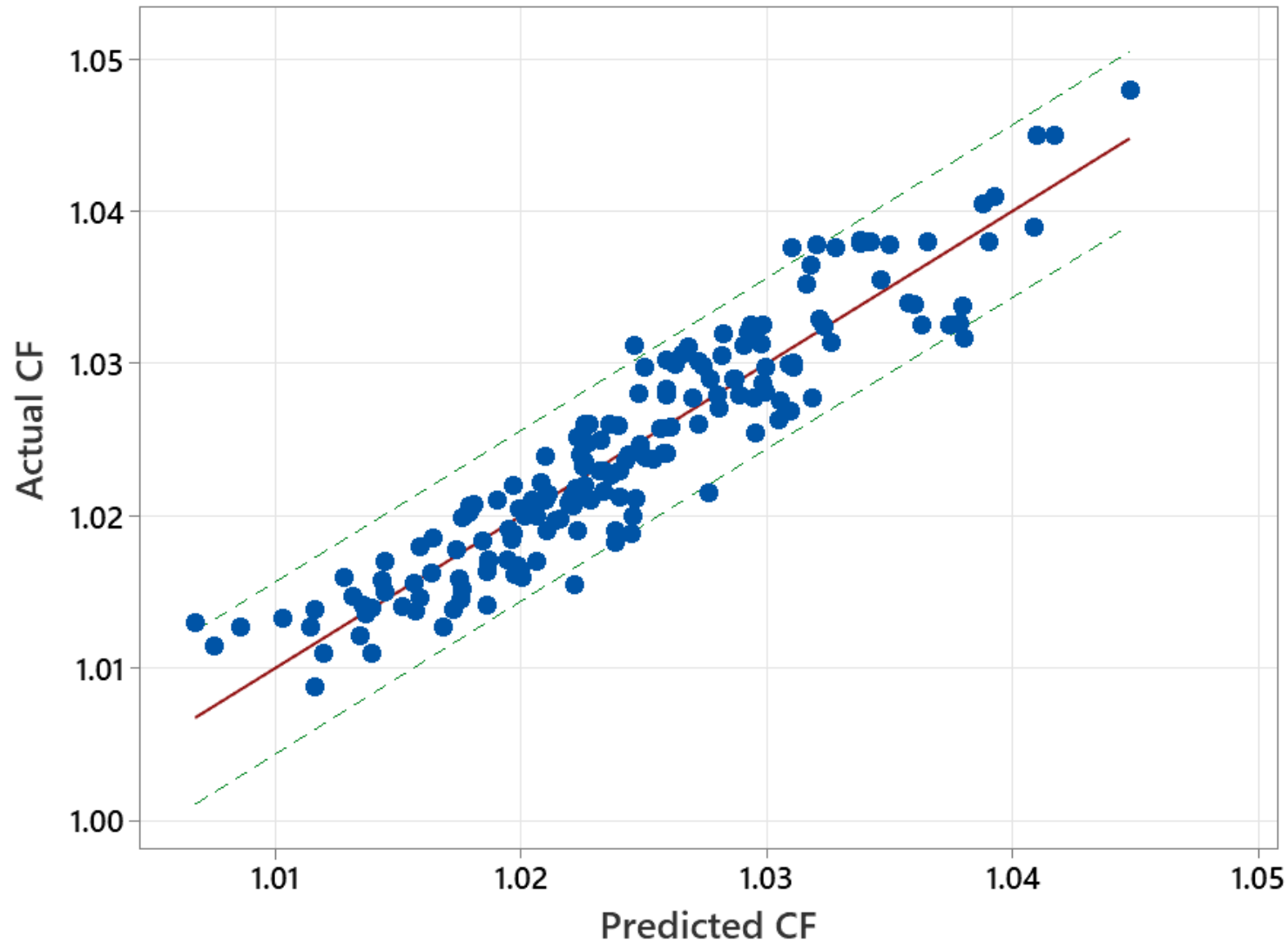
# BMD Mixture Trial Weight Predictor



**How much mass is needed to achieve equal air voids between these different mixtures?**



# BMD Mixture Trial Weight Predictor



# Specimen Preparation Summary

## Do's

Limit heating times

Pay attention to material changes

Fractionate as needed

Use good tools and equipment

Seek to improve lab practices

Utilize databases

## Don'ts

Heat RAP or binder too long

Be inconsistent

Be cheap or lazy

Ignore segregation

Batch from buckets

Skip steps

## Do's & Don'ts Lesson #2

### Don't skip the basics

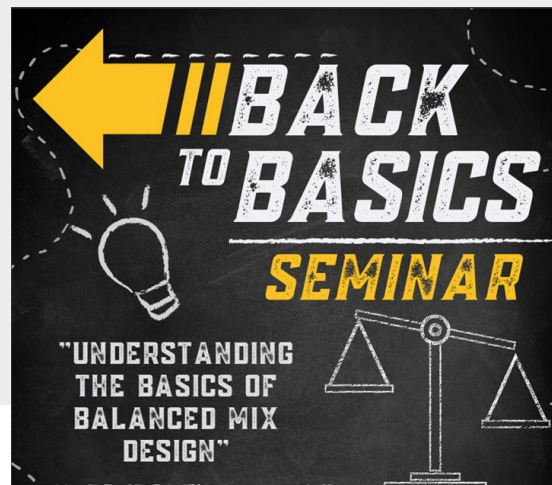
- Although the tests are different the basics of Asphalt 101 still apply



# Why do Basics Matter?

Back to Basics Workshop

Nathan Moore, P.E - NCAT  
November 17-18, 2022



Jointly sponsored By VAA, VTRC and VDOT



# Asphalt Mix Fundamentals

- BMD brings new challenges, test methods, equipment, criteria, etc...
- But these problems will still require tried-and-true fundamentals
- “Champions are brilliant at the basics.” – John Wooden

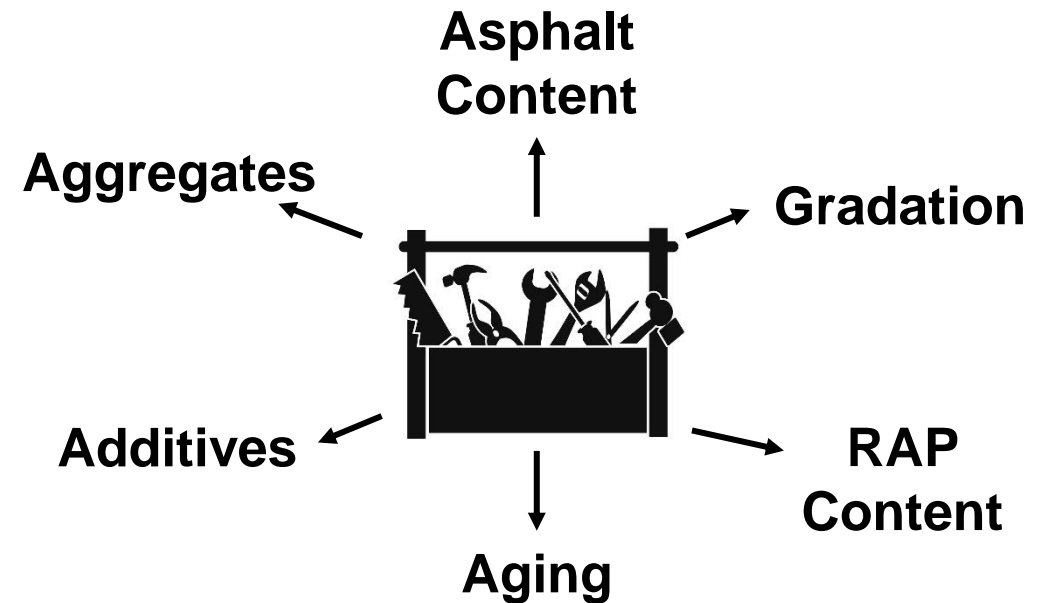


# Mix Design Tools – Volumetric vs. BMD

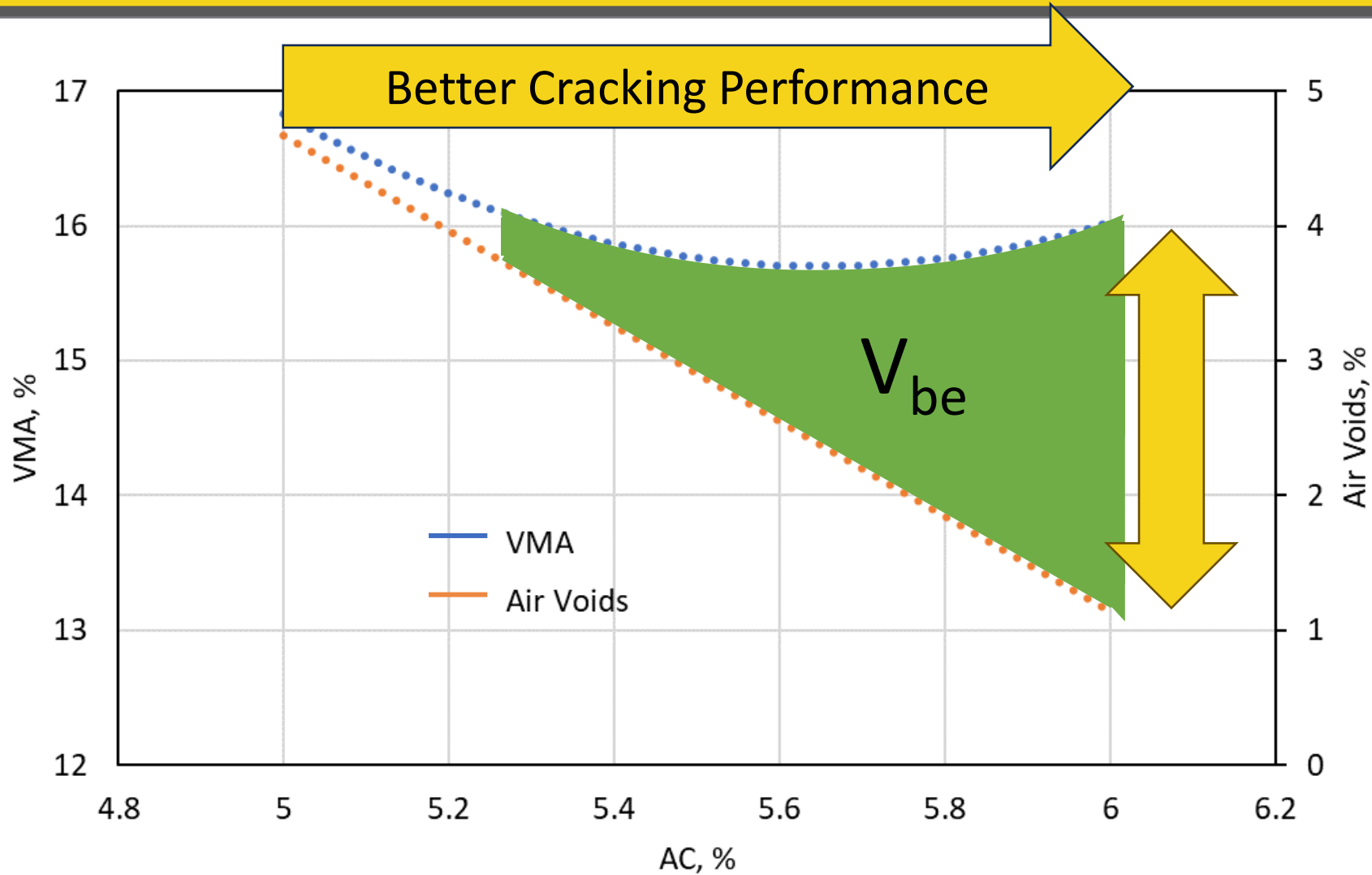
- Even if we move past volumetrics, the basics of asphalt mixtures will still control mixture performance

## Examples

- Gradation
- $V_{be}$
- $P_{ba}$
- Binder grade

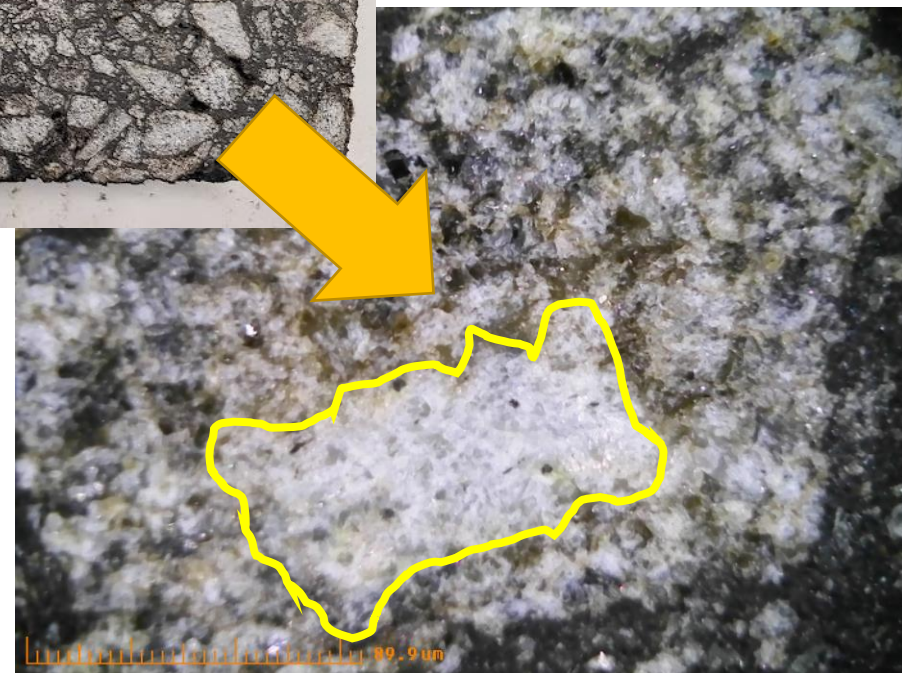
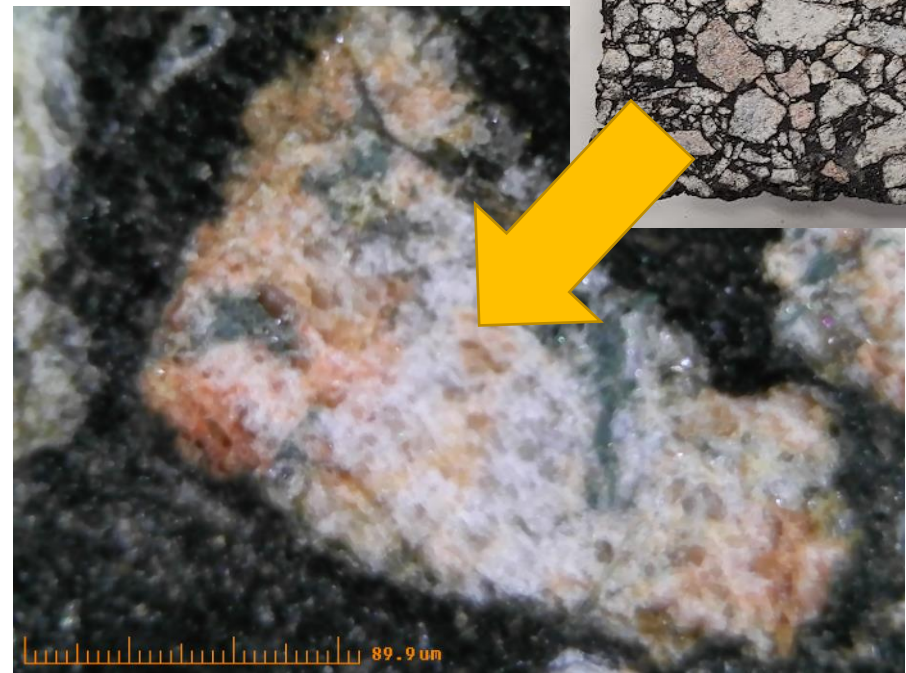


# Example – $V_{be}$ (i.e. gradation)

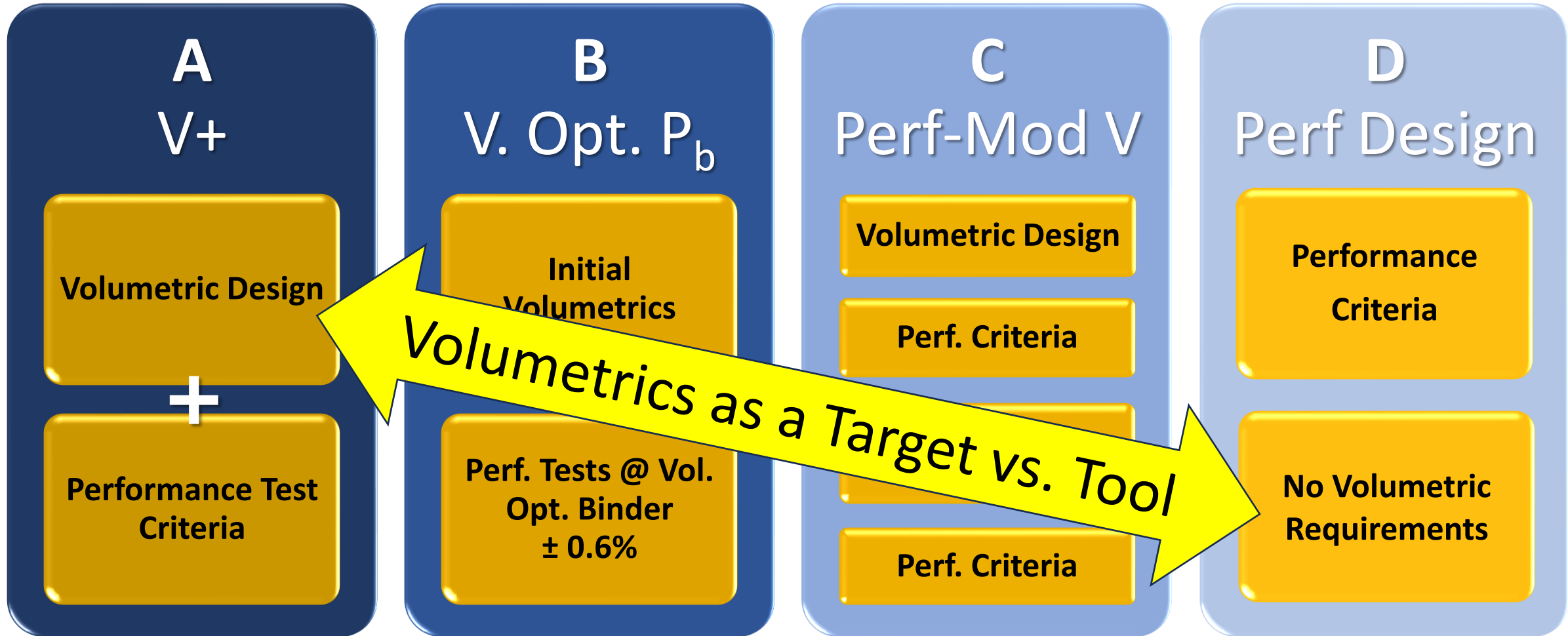




# Example – Binder Absorption



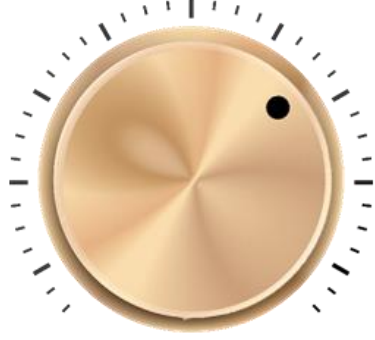
# Current BMD Approaches



# Mix Adjustments



Gradation



Asphalt Content



Modifiers



Additives



RAP Content



RAS Content



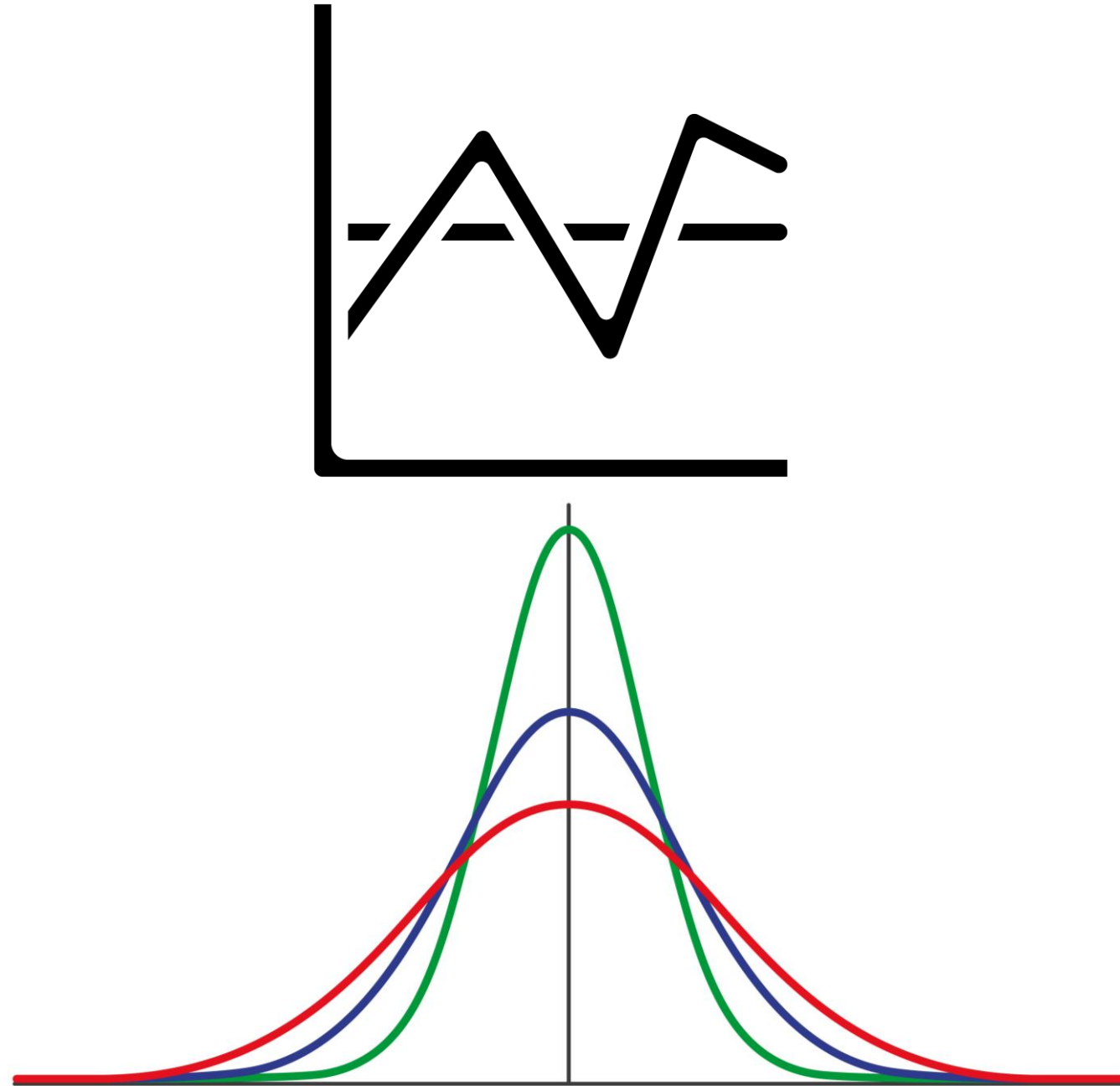
Rejuvenator



## Do's & Don'ts Lesson #3

### Understand variability

- BMD tests *can* have more variability than traditional test methods
- Know how this affects results!



# Statistics & Variability 101

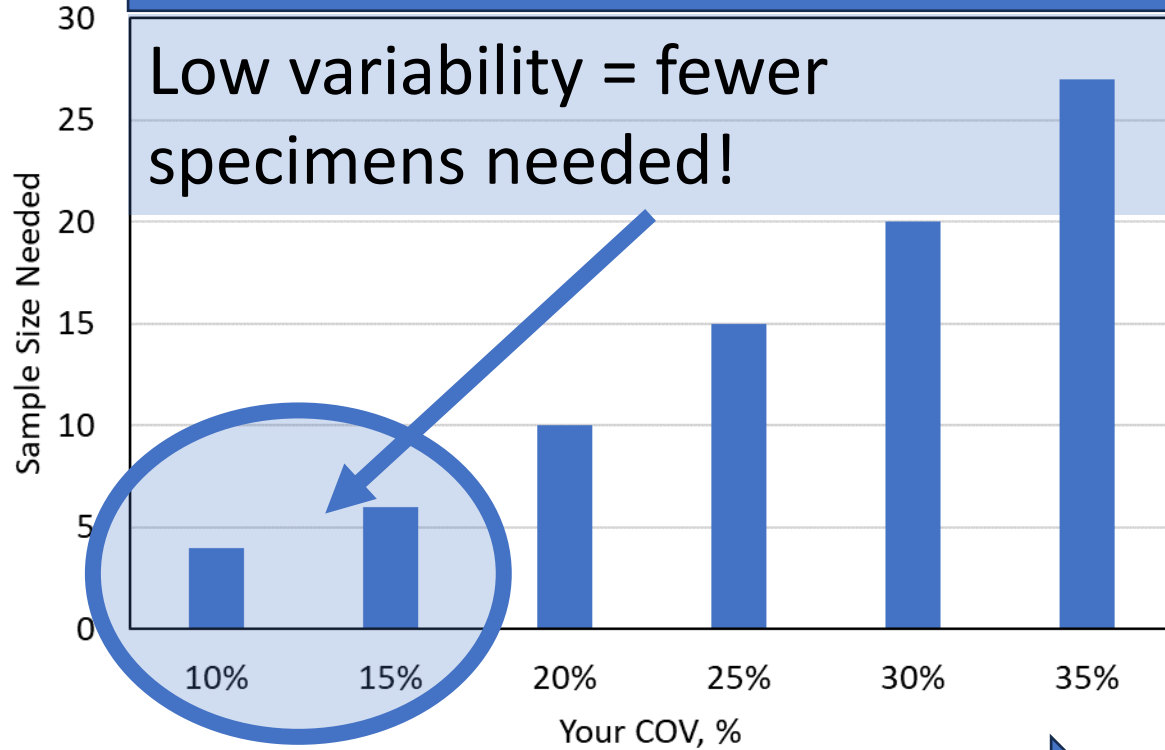
- **Coefficient of Variation (COV%)**
  - Definition: *Standard deviation divided by average*
  - Measures the spread of the data in relation to the average
- **Statistical Power**
  - Definition: *Power is the ability to correctly identify true differences between two groups*
- **Example:  $CT_{\text{Index}}$  of 70 vs. 85**
  - Assume typical IDEAL-CT variability
  - Replicates needed to achieve 50% power

## Introduction to Asphalt Statistics



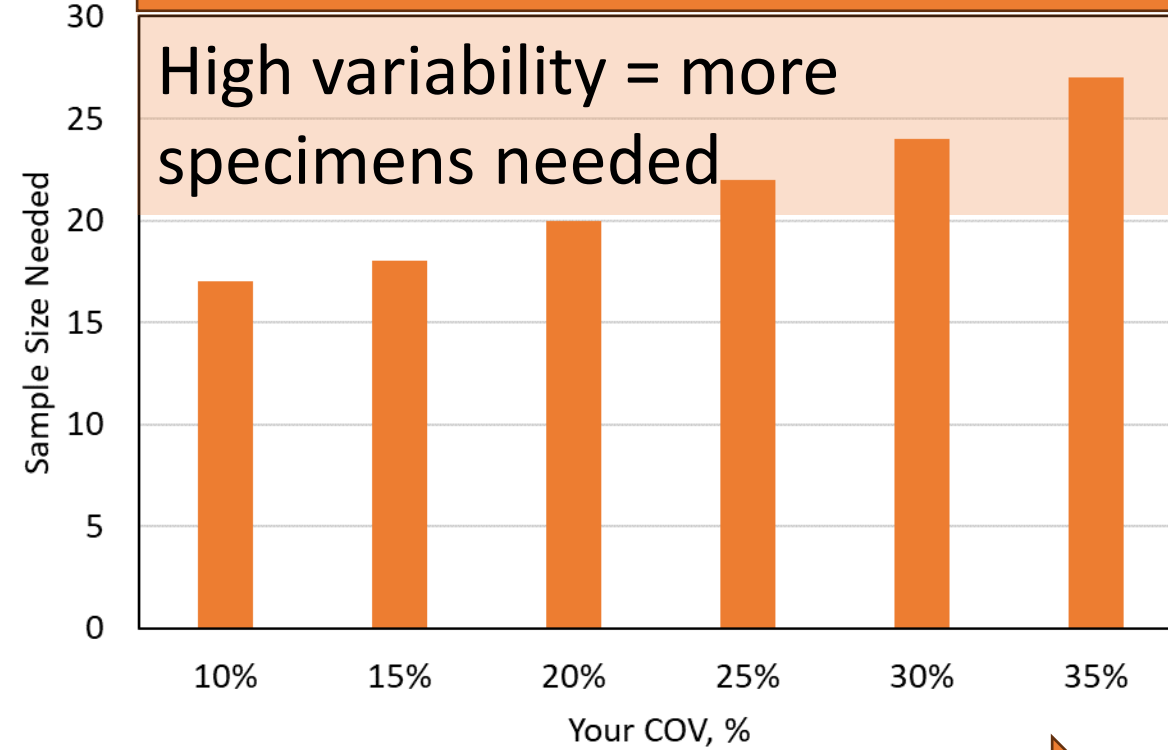
# Variability Example

Scenario #1:  
Both labs have equal variability



Increasing variability

Scenario #2:  
Comparing Lab has high variability



Increasing variability

# Handling variability: Specimen Prep and Replication

- It's too expensive to be cheap!
- Do it right the first time!
  - Combining production runs can create problems
- Benefits will outweigh the costs
  - Recommend the following **minimums**:
    - IDEAL-CT = 5 specimens (easy to get 6)
    - HT-IDT = 3 specimens



# Closing Remarks

**Do** Keep an open mind regarding new methods, materials, devices, etc.

**Do** Communicate with each other and the DOT!

**Do** Record and store everything!

You never know when you'll reference it again

**Do** Hire curious minds and hard workers

Teach technical stuff later

**Don't** Be cheap or take shortcuts



NCAT Test Track Conference – May 7-9, 2024

**SAVE  
THE  
DATE!**

**May 7-9, 2024  
NCAT TEST TRACK CONFERENCE  
AUBURN UNIVERSITY | AUBURN, AL**



Thank you!  
Questions?



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