THE EVOLVING ROLE OF VOLUMETRICS IN ASPHALT MIXES

Nathan Moore, P.E.

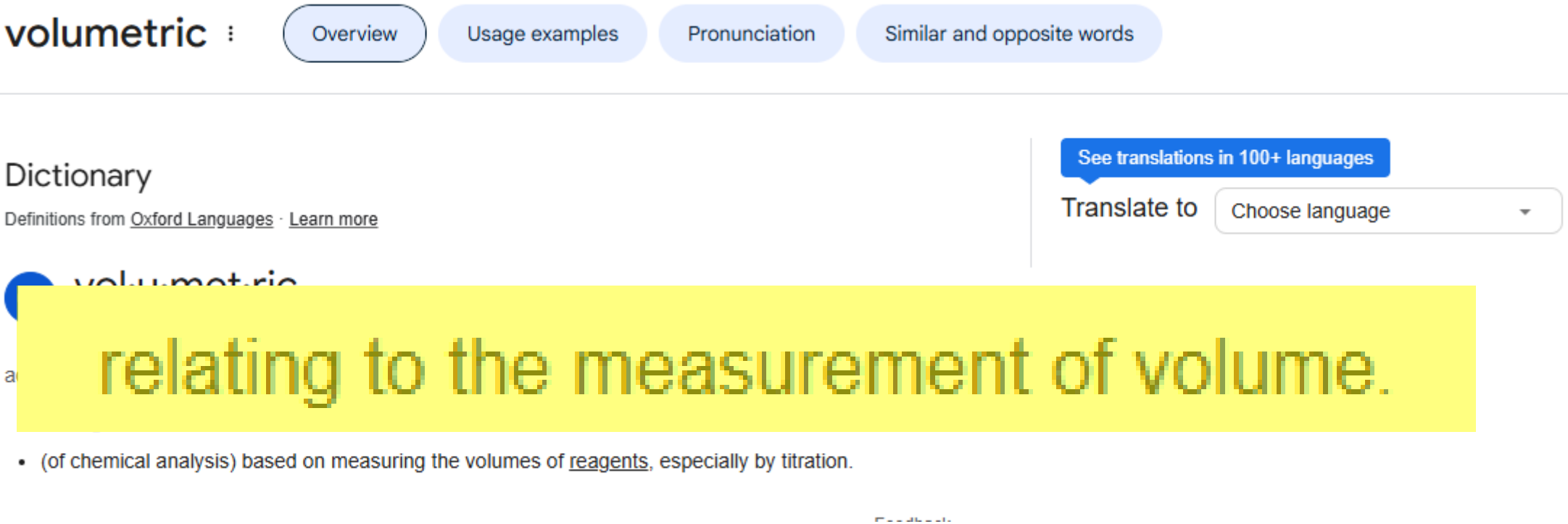
December 17, 2025

2025 ACAF Expo and Conference

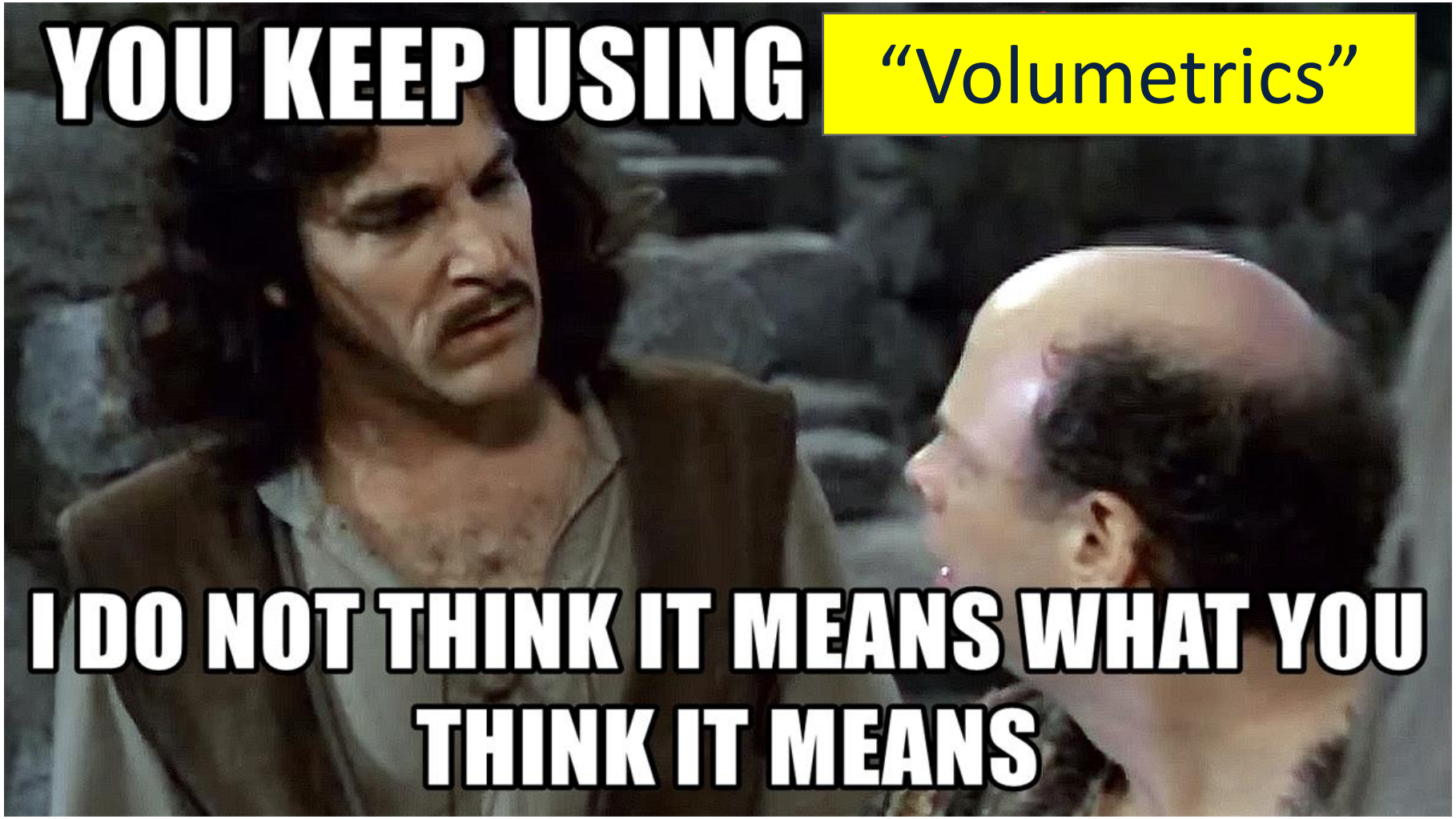
ACAF Asphalt Contractors Association Of Florida, Inc.

National Center for Asphalt Technology NCAT AT AUBURN UNIVERSITY

WHAT IS A VOLUMETRIC?



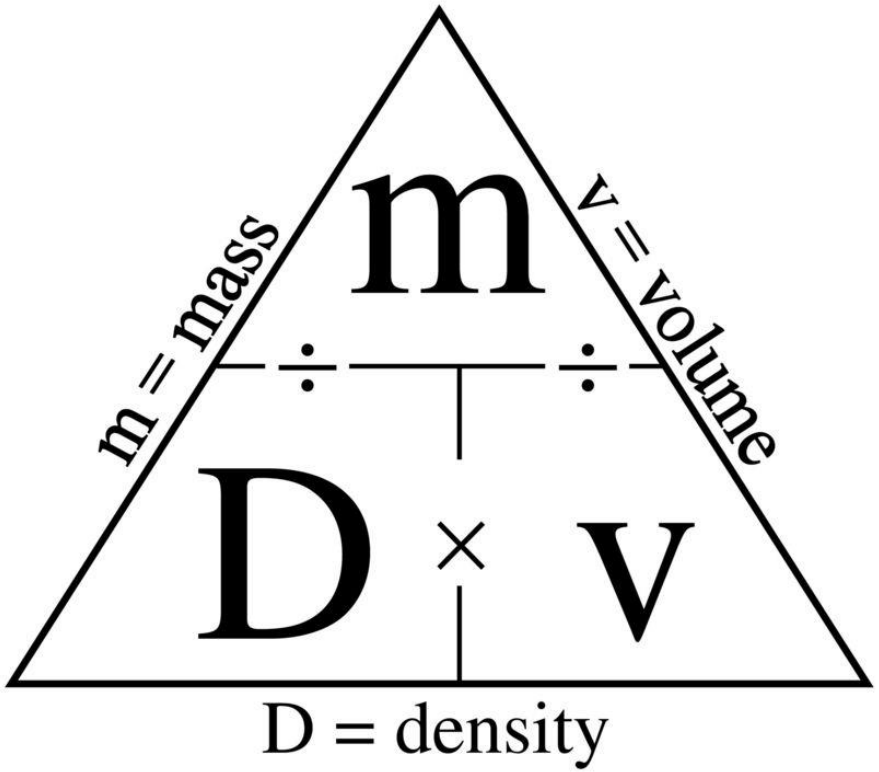
HOW MANY OF YOU HAVE FELT LIKE THIS?



WHAT *ACTUALLY* ARE VOLUMETRICS?

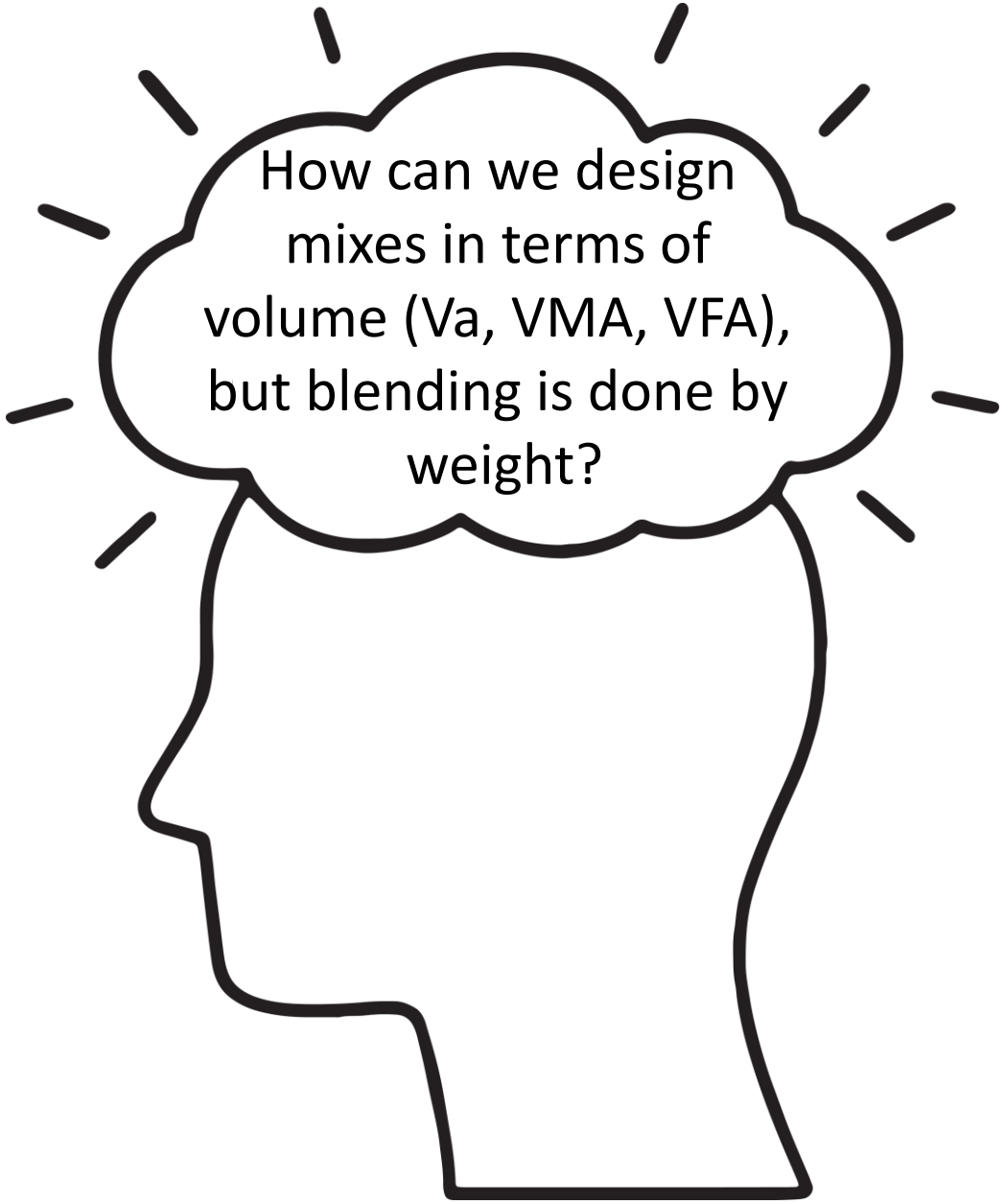
- All matter has mass and occupies space

- Volumetrics are the relationships between mass and volume



POP QUIZ!

$$? = \frac{\text{mass}}{\text{volume}}$$



VOLUMETRICS 101 – G_{MB} VS. G_{MM}

Gmb

- Bulk Specific Gravity of Mix
- $G_{mb} = \frac{Mass_{Agg+Asphalt}}{Volume_{Agg+Asphalt+Air}}$
- What about the volume of air?

Gmm

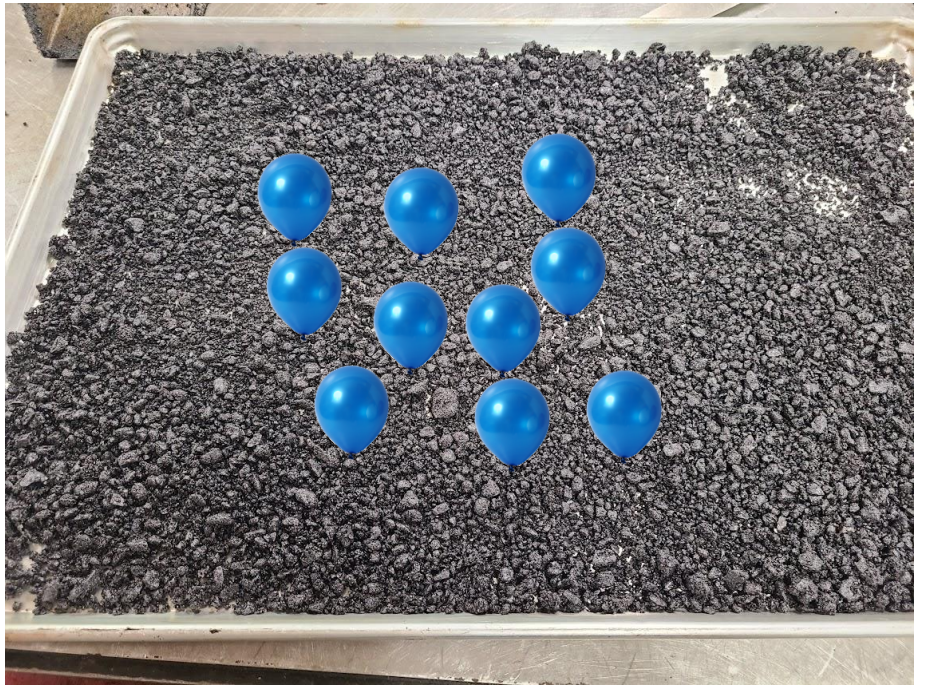
- Maximum Specific Gravity of Mix
- $G_{mm} = \frac{Mass_{Agg+Asphalt}}{Volume_{Agg+Asphalt}}$
- What about the volume of air?

https://www.youtube.com/watch?v=B5IzrlH6wJM

VOLUMETRICS 101 – G_{MB} VS. G_{MM}

Gmb

Gmm



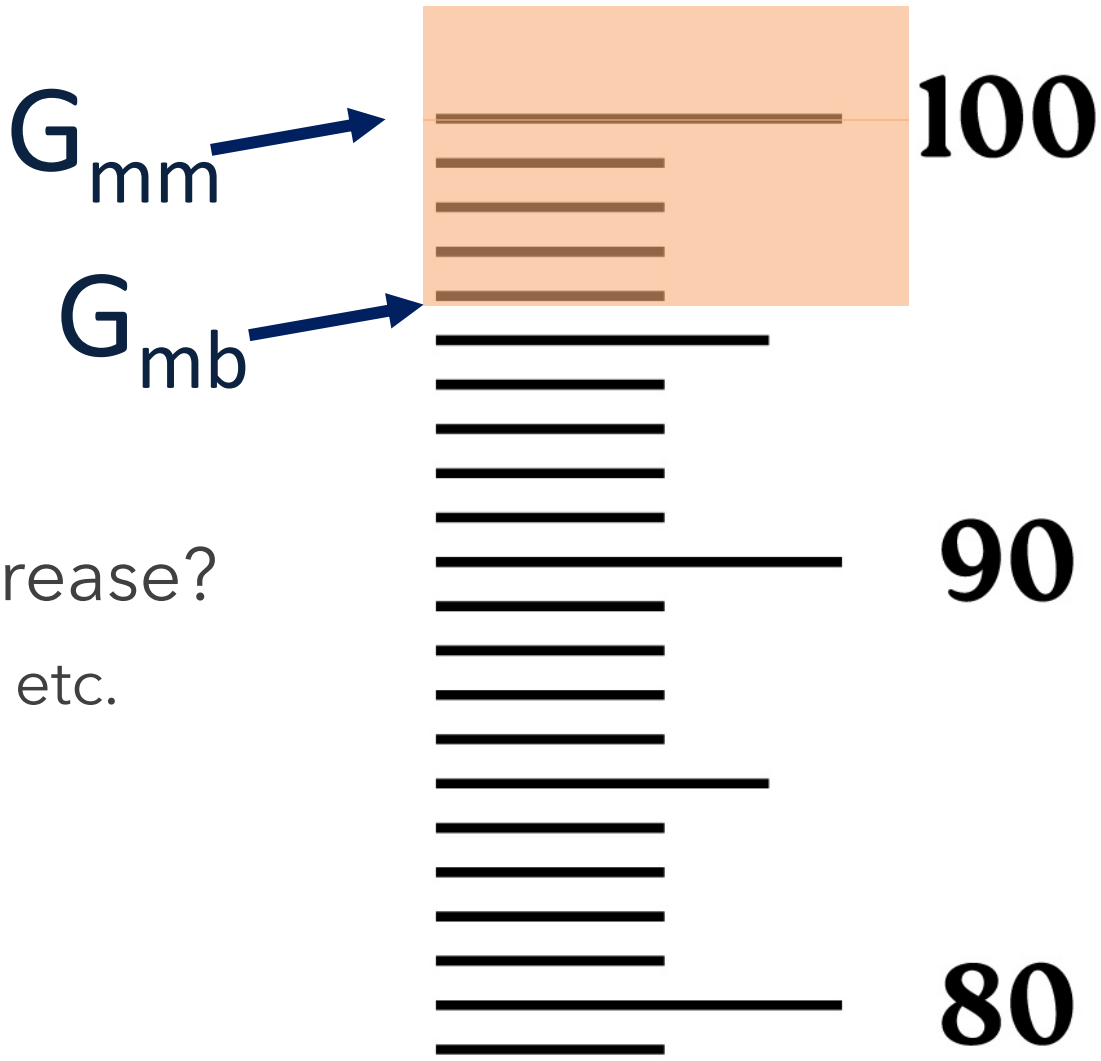
WHY DO G_{MB} AND G_{MM} MATTER?

- Gmb tells you the density of the compacted mix at Ndes
  - Somewhat meaningless by itself
  - Influences air voids & VMA
  - Affected by AC%, aggregate type, compactive effort

- Gmm tells you the maximum possible density of a mix
  - Slightly less meaningless, but still mostly meaningless by itself
  - Influences air voids and in-place density targets
  - Affected by AC%, Gse, & binder absorption

AIR VOID EXAMPLE

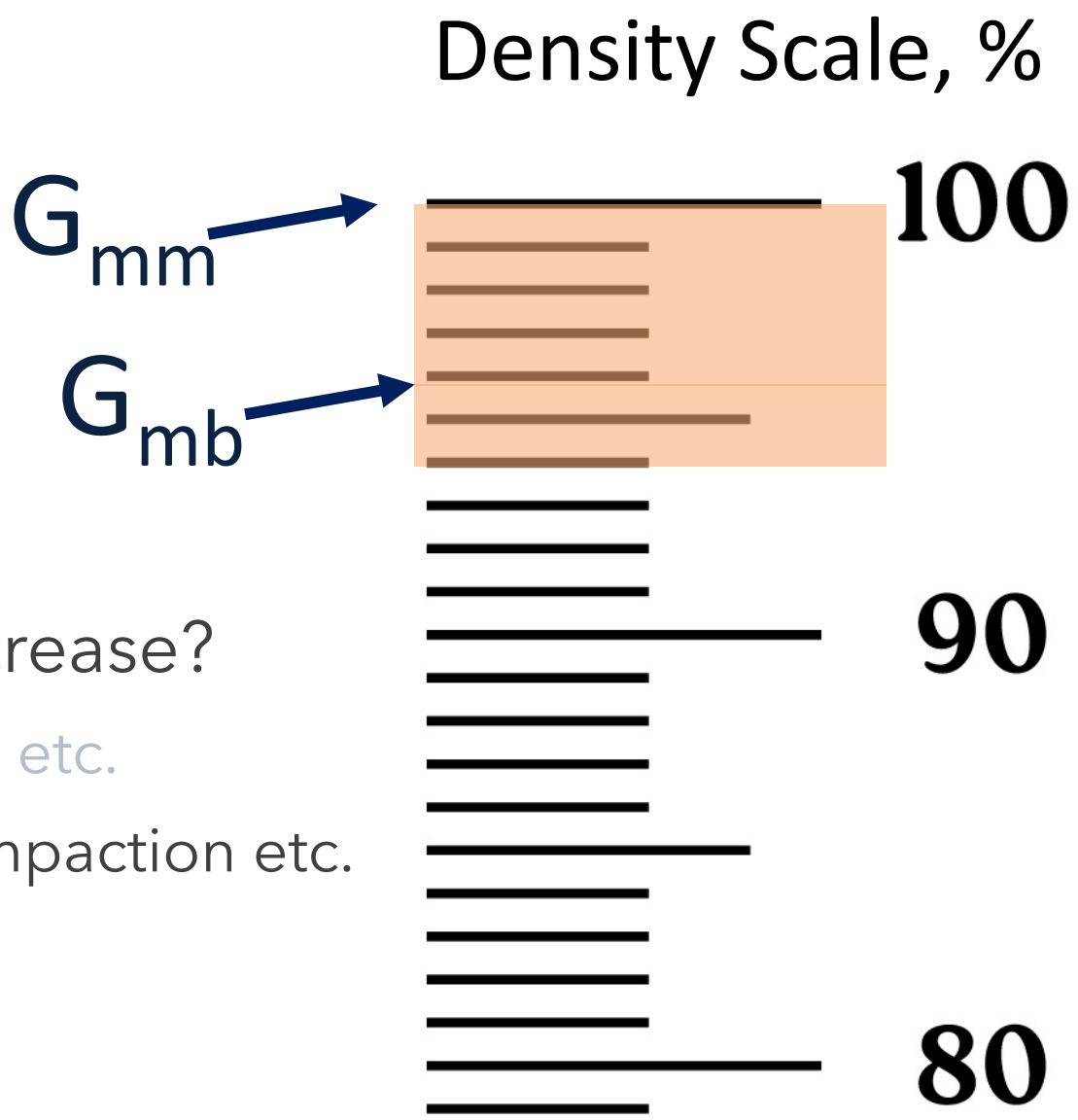
$$Air\ Voids = \frac{G_{mm} - G_{mb}}{G_{mm}} \times 100$$



- What could cause air voids to increase?
  - Gmm goes up – Binder absorption, etc.

AIR VOID EXAMPLE

$$Air\ Voids = \frac{G_{mm} - G_{mb}}{G_{mm}}$$

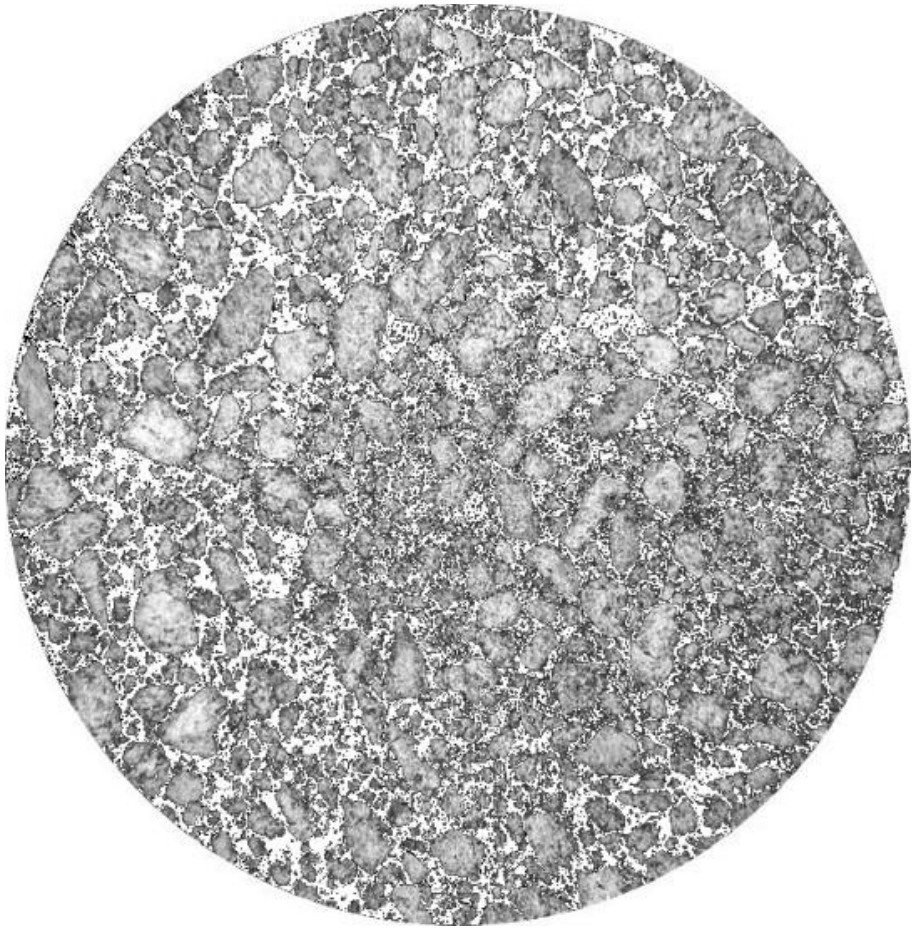


- What could cause air voids to increase?
  - Gmm goes up – Binder absorption, etc.
  - Gmb goes down – Not enough compaction etc.

WHAT ABOUT VMA?

Total Mix

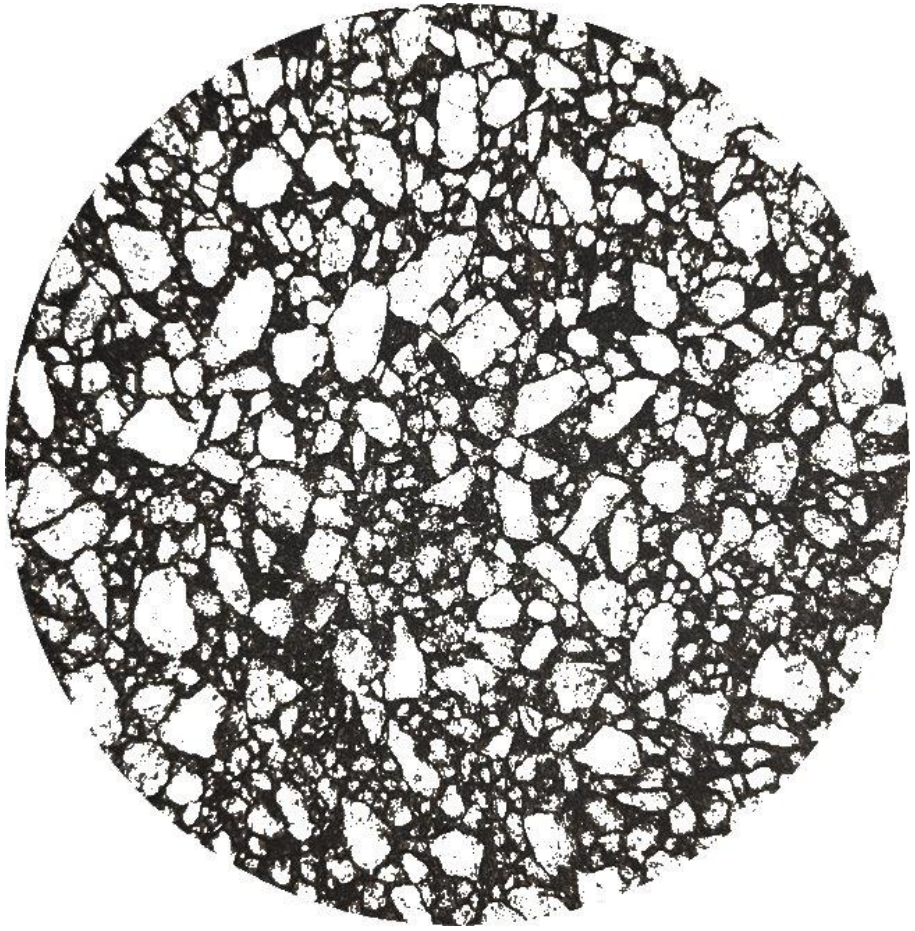
Aggregate Portion



WHAT ABOUT VMA?

Total Mix

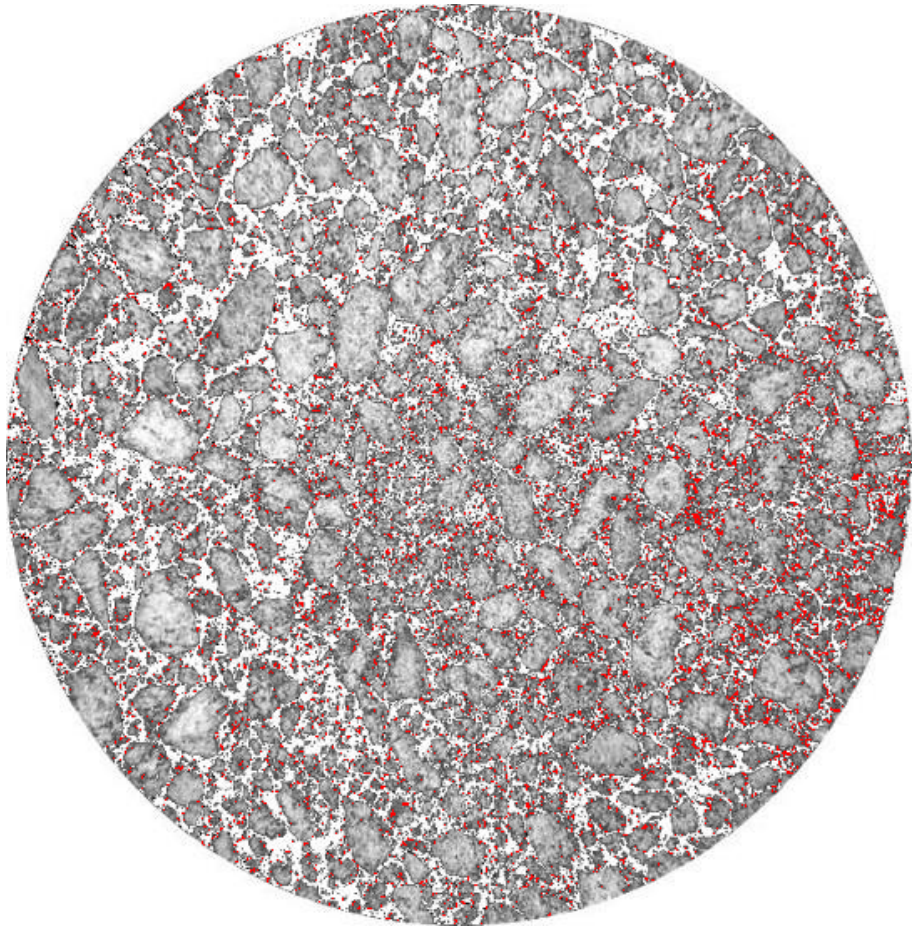
Binder Portion



WHAT ABOUT VMA?

Total Mix

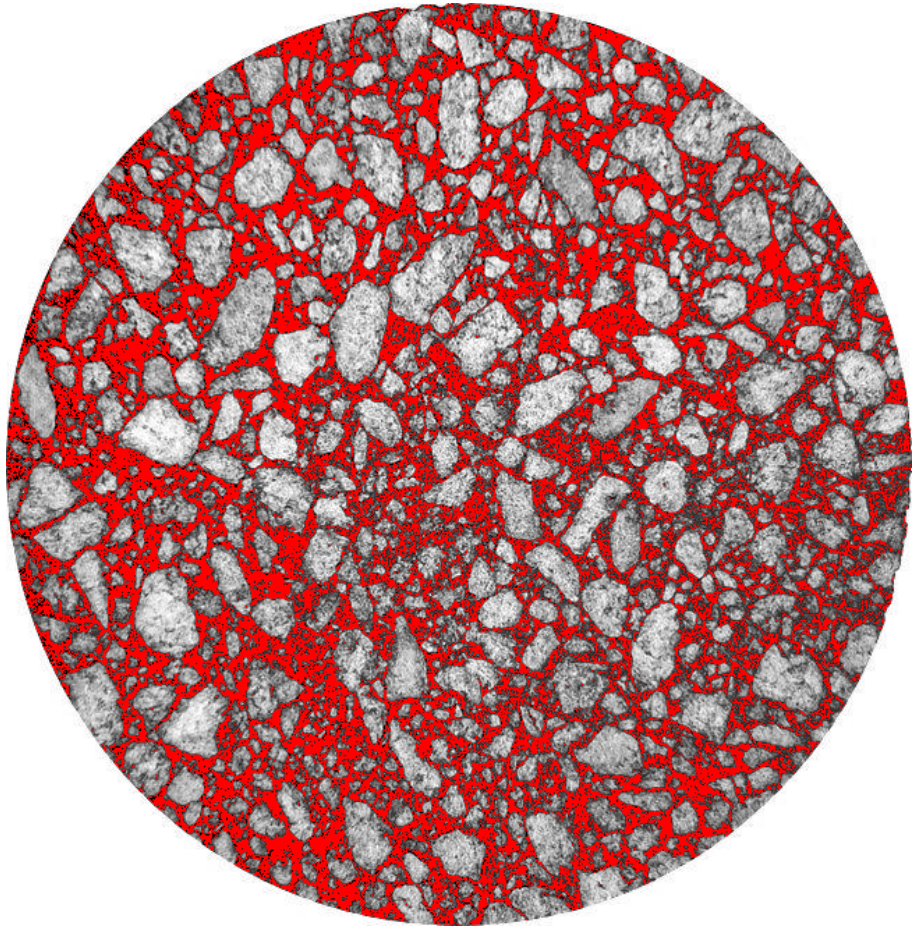
Air Voids



WHAT ABOUT VMA?

Total Mix

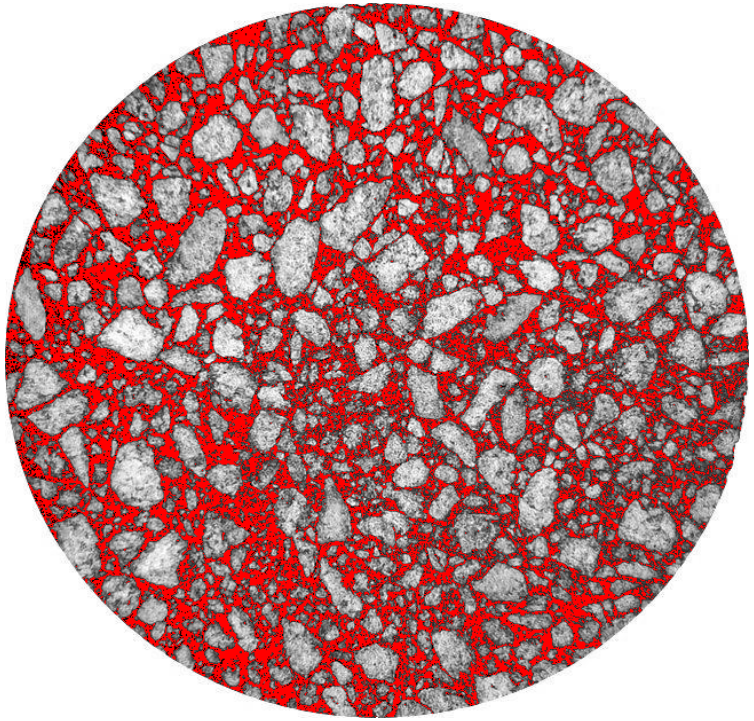
VMA
(air voids + volume of binder)



WHY DOES VMA MATTER?

- VMA = Air voids + Volume of Effective Binder
  - If you have a minimum VMA target and require fixed air voids, VMA controls the binder content

- VMA has become more difficult & less meaningful over the years
  - Less meaningful if air voids are not fixed
  - What about RAP?
  - Requires accurate aggregate gravities

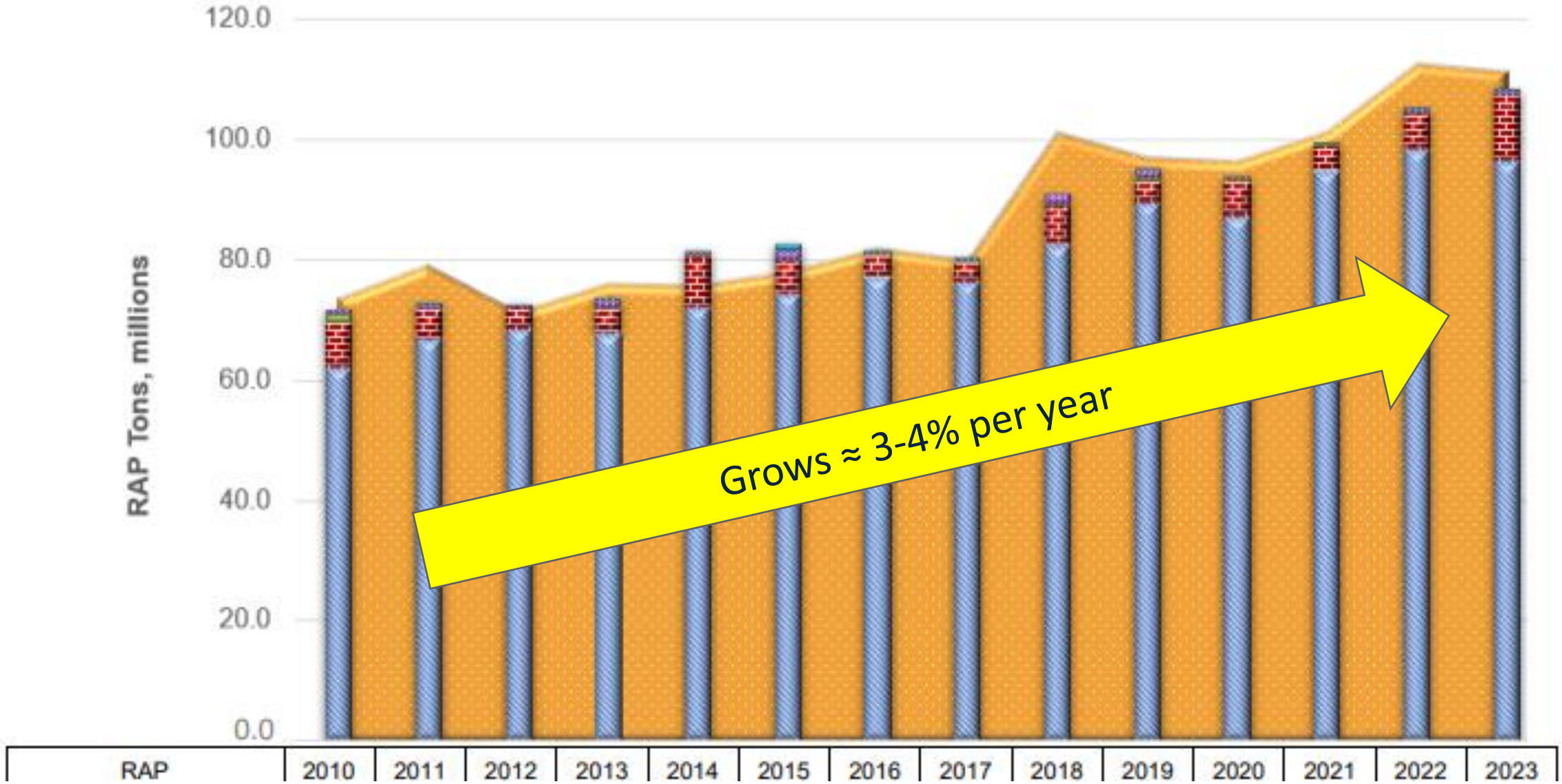


VOLUMETRICS AND MIX DESIGN

- Historical mixes have been designed by volume (i.e. recipe)
- Volumetrics provided an easy method to ensure we were getting enough asphalt
  - Materials were more consistent
- But materials have changed
  - RAP, polymer, additives, WMA, rubber, fibers, etc.

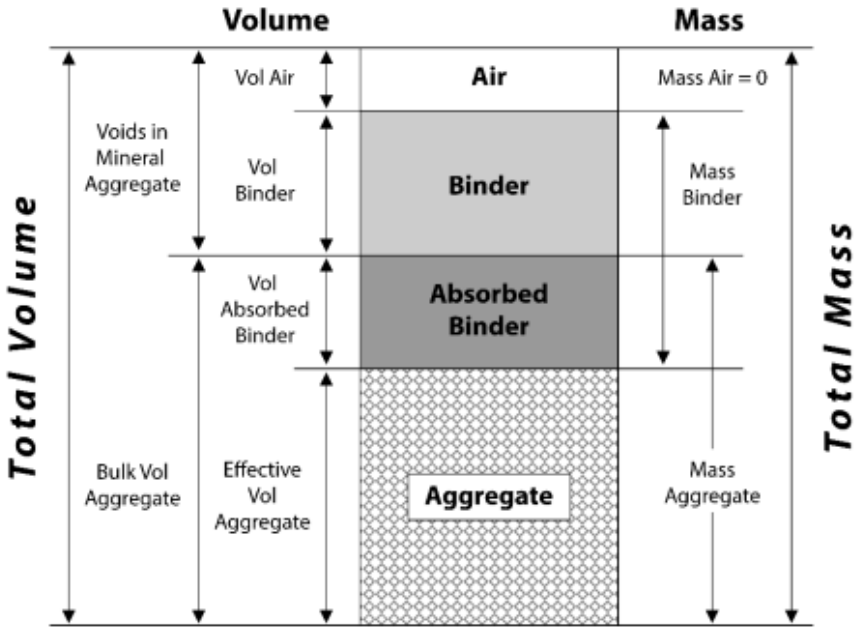
With the current volumetric mix design system…

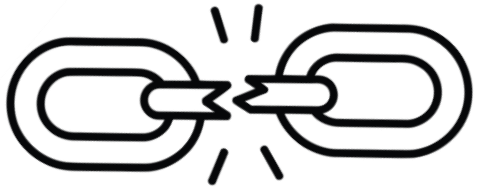
EXAMPLE: RAP USAGE (NAPA IS-138)



LINK BETWEEN VOLUMETRICS & PERFORMANCE

Volumetrics





Mix Quality

LINK BETWEEN VOLUMETRICS & PERFORMANCE

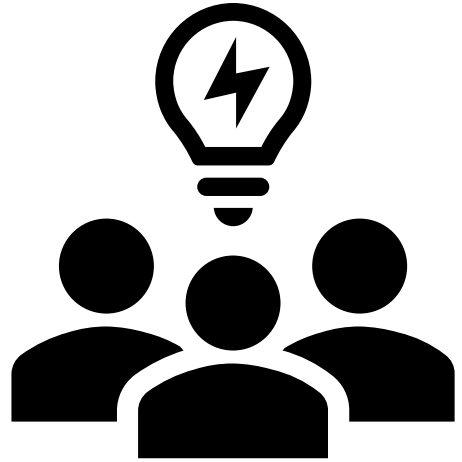
- Volumet

- When m
  betweer
  binder v

- But now
  clearly a

HOW HAS THE INDUSTRY RESPONDED?

- Decrease gyration levels to get more binder in the mix
  - Benefit is short-lived
- Regressed air voids
  - Design for 4% air voids, produce at 3% air voids
  - This forces ≈ 0.3% more binder into the mix
- Corrected Optimum Asphalt Content (COAC)
  - Assumes that not all RAP binder is "active"
  - Higher RAP = Higher need to "correct" for this
- Balanced Mix Design
  - Implement tests that focus on rutting/cracking results



WHAT IS THE GOAL?

WHAT ARE OUR TOOLS?

TARGETS VS. TOOLS

TARGET VS. TOOLS

- Using volumetrics as targets & tools *can* be done, but we **need to be careful**…

- Volumetrics are **easy to measure**, **already understood**, and **rooted in asphalt fundamentals**

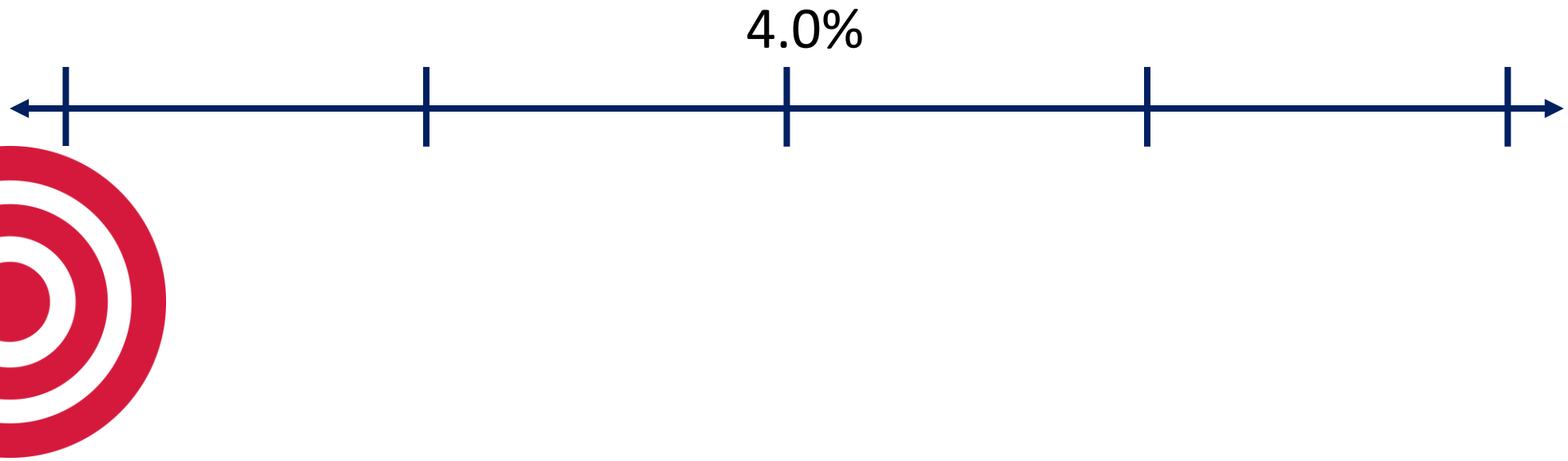
  but…

- Keep performance as the **ultimate target!**

Volumetrics may be easy, but that **doesn't mean they indicate performance!**

The target should be performance. Contractors will use volumetrics as the **tools to hit the target.**

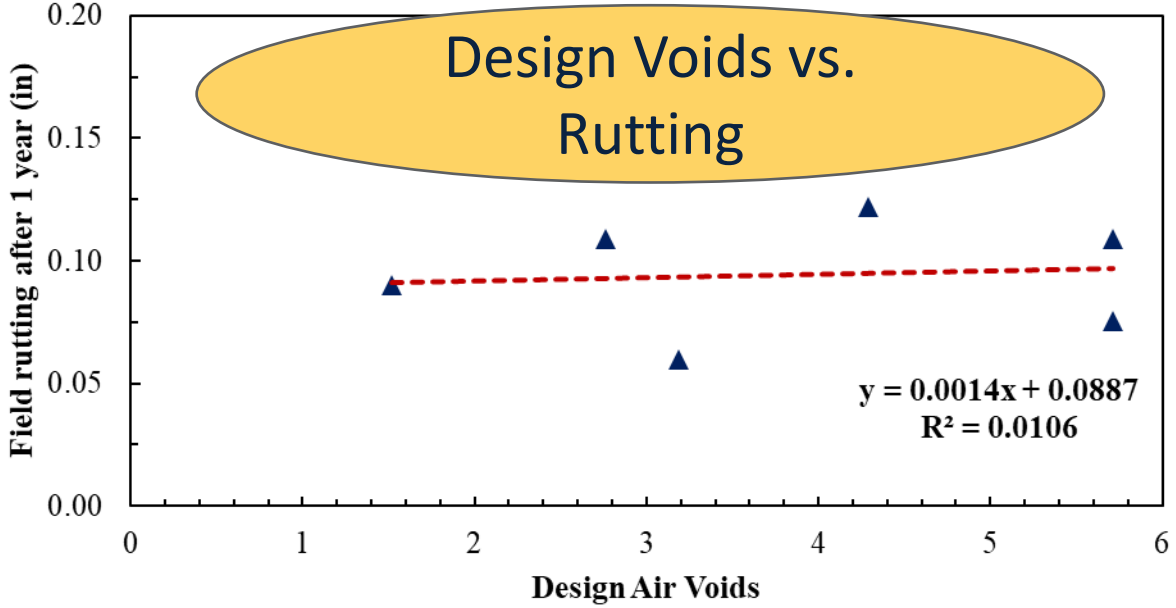
If agencies want to keep volumetrics, **consider what volumetrics are actually telling you**…

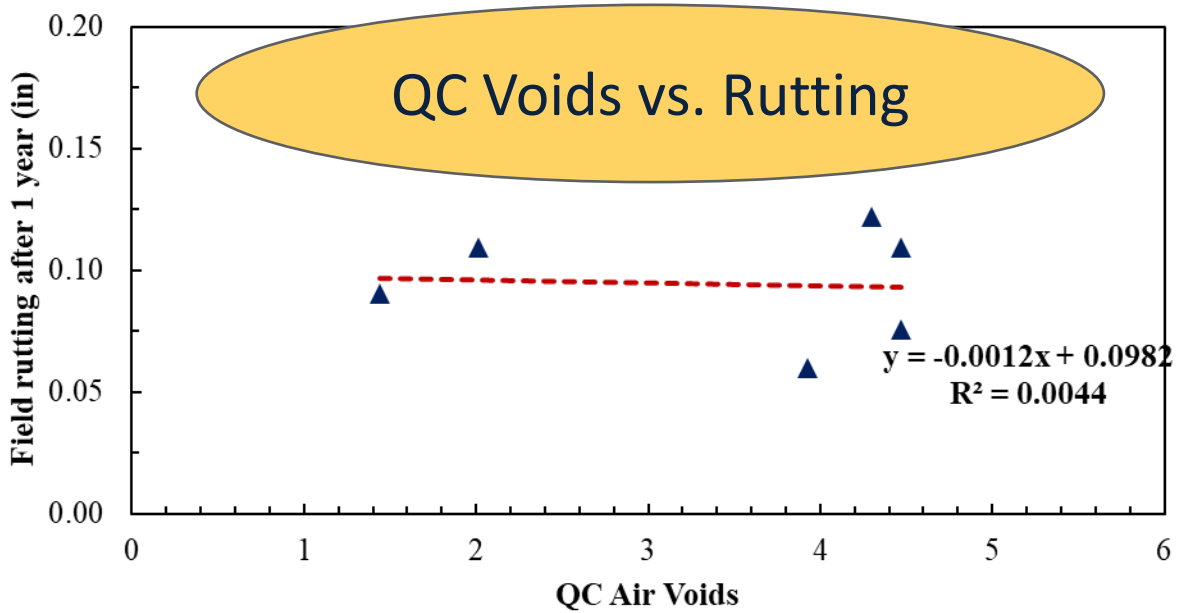


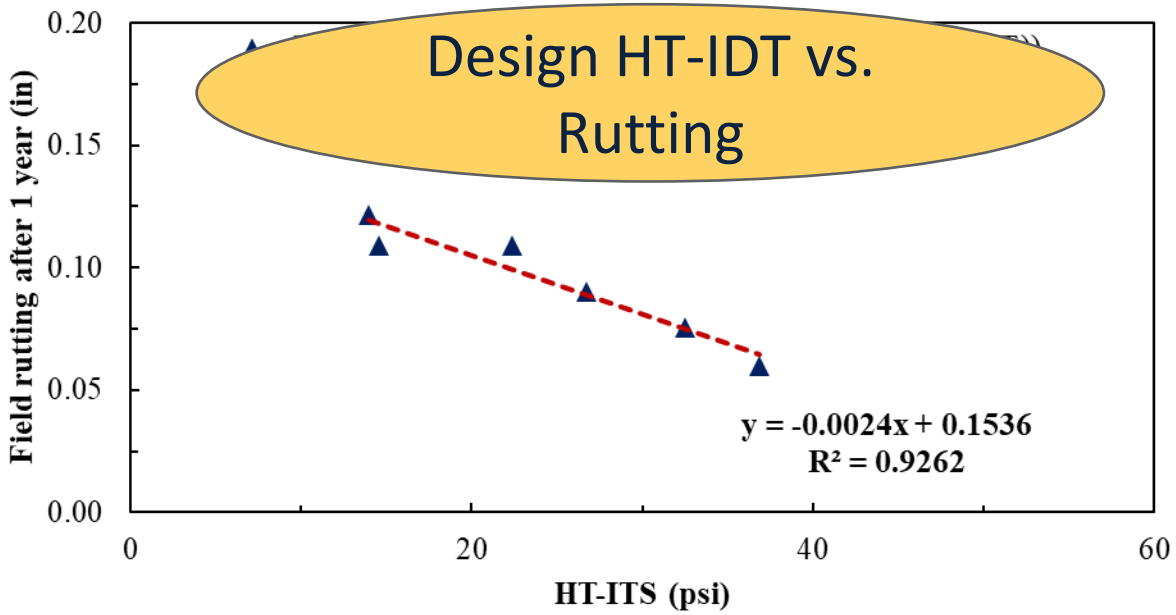
If agencies want to keep volumetrics, **consider what volumetrics are actually telling you**…

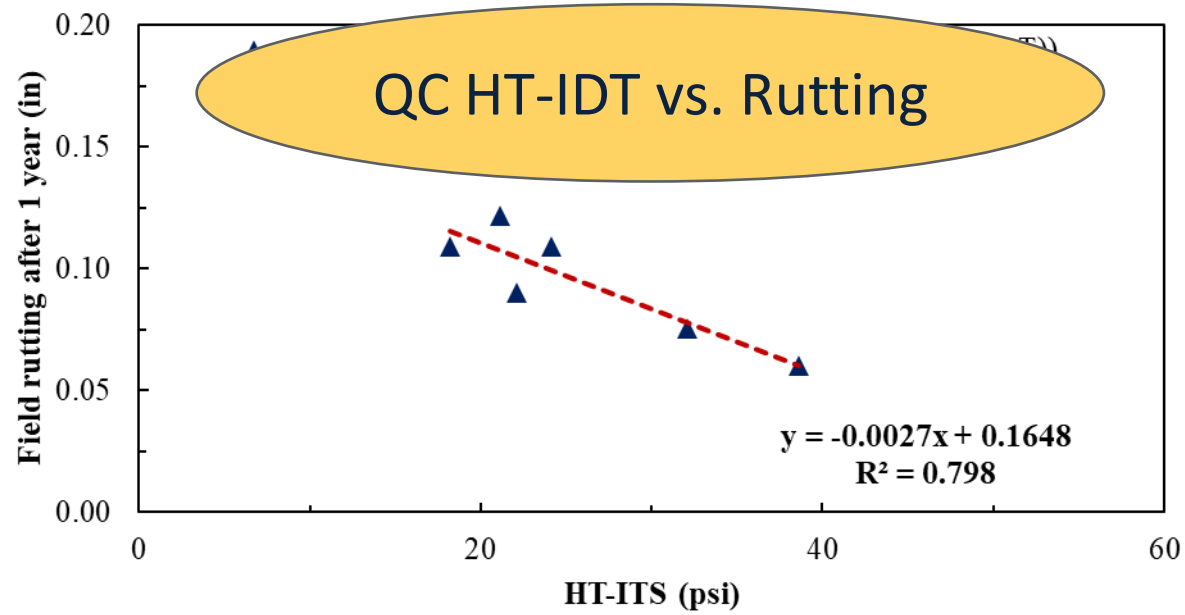
'olumetric targets should be **dynamic** and dapt to the **needs of the specific mix**

FINAL QUICK EXAMPLE









SUMMARY & TAKEAWAYS

- **A good understanding of volumetrics** will help design mixes, write good specifications, perform quality control, make mix adjustments, etc.
- **Materials have changed**; mix design recipes must change too.
- **Performance** is the ultimate target.
- Volumetric targets should be dynamic and **adapt to the needs of the specific mix.**

ASPHALT CONTRACTORS ASSOCIATION TOURS AND TRAINING AT THE NATIONAL CENTER FOR ASPHALT TECHNOLOGY

FEB 24-26 2026

Join the Asphalt Contractors Association of Florida (ACAF) for a visit to the National Center for Asphalt Technology (NCAT) in Auburn, Alabama. This exclusive event features state-of-the-art laboratory tours, FDOT research highlights, hands-on demonstrations, and dedicated binder and QC training led by NCAT engineers and staff.

- **Tuesday, February 24 – Thursday, February 26**
- **National Center for Asphalt Technology (NCAT) Auburn, AL**
  277 Technology Parkway, Auburn, AL 36830
- **Three-day event with tours of the NCAT Main Laboratory and Test Track on day 1. Binder and QC Lab Technician Training on Days 2 and 3**
- **ONLY ACAF members may register for this event**
- **Instruction for the training provided by NCAT staff**
- **Ticket options**
  - 3-day ticket for those wanting to attend tours and the trainings – Total cost is $1,250 and covers training fees, lunches, and one private dinner event.
  - 1-day ticket is for those wanting to ONLY attend the first day – Tours, one lunch, and private dinner. Total cost is $750. For those purchasing the 1 day ticket, your logo will be displayed as a sponsors would at various places online, in email, and on-*site*.
- **Hosted by David Allain, Technical Director, and Amy Miller, President**

ACAF Asphalt Contractors Association Of Florida, Inc.

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

CLICK HERE FOR MORE INFORMATION

Register at acaf.org/events/ncat-tours-and-training---acaf-members-only/register

THANK YOU!

NATHAN MOORE, P.E.

NATHANMOORE@AUBURN.EDU

ACAF
Asphalt Contractors Association Of Florida, Inc.

National Center for Asphalt Technology
NCAT
AT AUBURN UNIVERSITY