



## **Maximizing the Service Life of Dense Graded Asphalt Mixes**

David Lee, P.E. - ARAC Chair  
Salem District Materials

# OUTLINE

**Evolution/History**

**Perceived Underperformance of Superpave Mixes**

**Task Force Developed to Initiate Potential Research**

**ARAC Supports Phased Process**

**Results from Phase I**

**Modified Phase II**

**Phase III**

## EVOLUTION/HISTORY

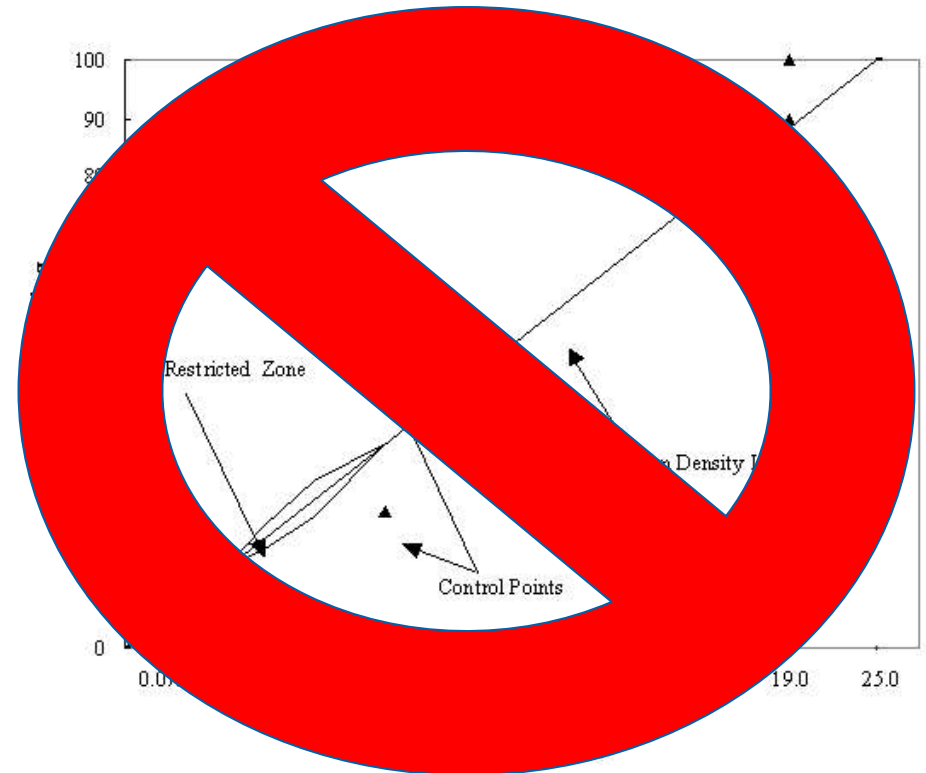
- **Over 30 years, VDOT evolved from Marshall to SUPERPAVE Design Procedures**
- **Progressed from the S-Series, to SM-2 Series to the present SM-9.5/12.5 mixes**
- **Moved from AC-10/20/30/40 to PG 64-22, 70-22 and 76-22 in 1996/1997**
- **Full implementation of SUPERPAVE in 2000**

# INITIAL CHANGES TO NATIONAL SUPERPAVE APPROACH

Removal of gradation restricted zone

Adoption of 1 gyration level

Elimination of BM-37.5



## OTHER MODIFICATIONS SINCE 2000

**Permeability requirement for surface mixes**

**Minimum AC content for BM-25.0A and D**

**Increase in RAP percentage without binder change**

**Addition of SM-9.0 and SM-4.75**



# PERCIEVED UNDERPERFORMANCE OF SUPERPAVE MIXES

- **There is a clear perception by both VDOT and Industry leaders that our present Superpave mixes do not have enough liquid asphalt content and, as such, are not lasting as long as they could.**
- **This perception is supported by some recent data suggesting that our mixes are lasting 1-3 years less than previously determined.  
(McGhee/Clark)**
- **Majority of failures occurring due to age related cracking/fatigue.**
- **2010 Research Report by G. W. Maupin “Investigation of Optimized Mixture Design for Superpave Surface Mixtures” recommended additional research on the subject.**

## TASK FORCE MEMBERS

**Kevin McGhee - VCTIR**

**Todd Rorrer – VDOT**

**David Lee – VDOT**

**Rob Crandol - VDOT**

**Trenton Clark – VAA**

**Richard Schreck - VAA**

**Ken Arthur – Templeton Paving**

**Dickie Mattox – Superior Paving**

**Brent Moore – Branscome Paving**

## RESEARCH QUESTION

- Are dense graded mixes designed with SUPERPAVE system providing consistently longer service life compared to previous mixes?
- **Criteria for Life**
  - Durable or Fatigue resistant
  - Rutting resistant
  - No flushing
  - Skid resistant (surface mixes)
- **Research Objective – Maximize the service life of dense graded asphalt mixes**





# PHASED PROCESS SUPPORTED BY ARAC

## Phase I – Superpave Designed Mix Analysis

- **Comparisons**
  - Volumetrics for 50 and 65 Gyration
  - Volumetric results for 50 and 75 blow Marshall
- **Mix gradations**
- **Bag samples for future phases**



# Phase 1 – Sampled Mixes

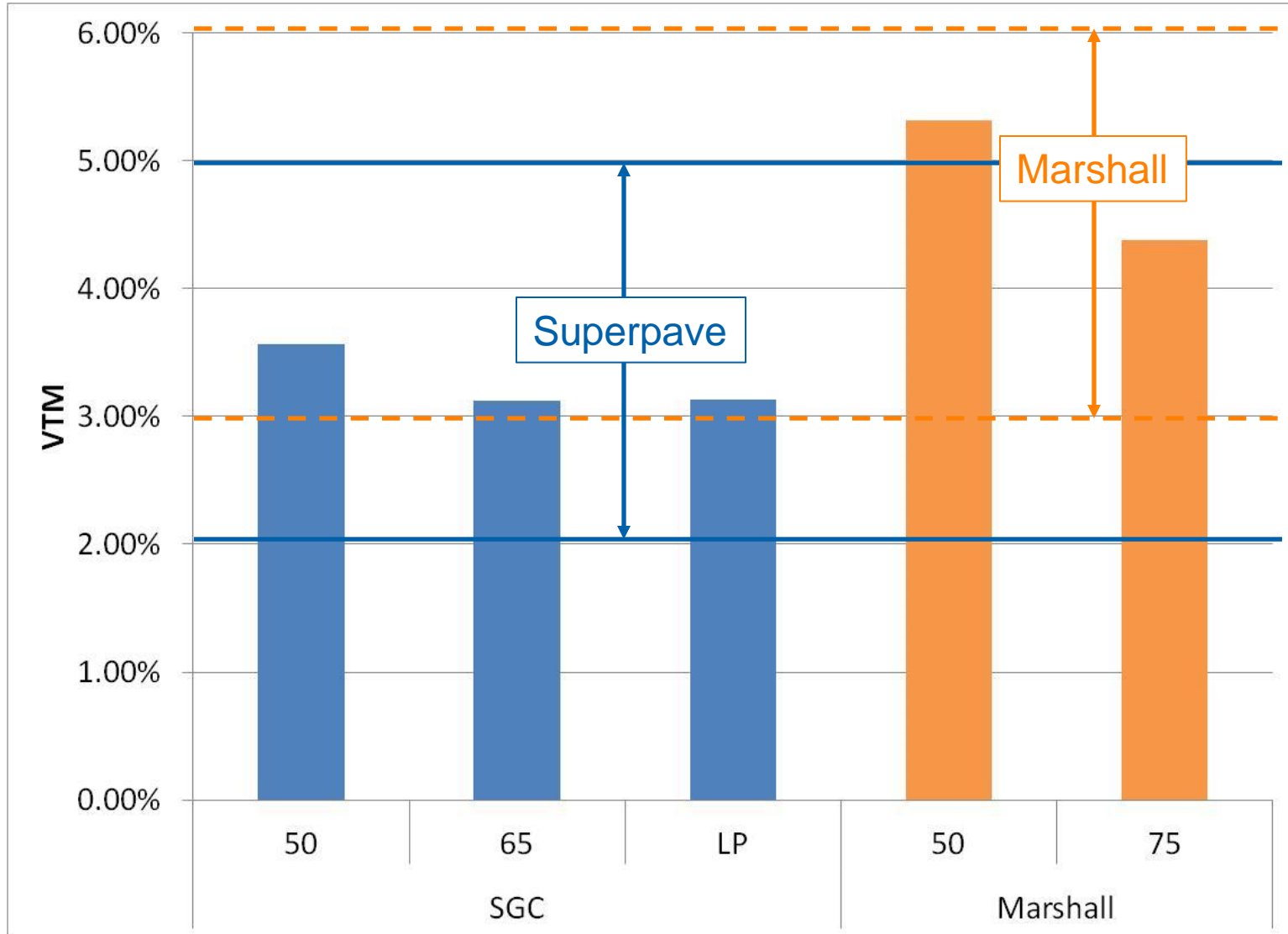
## SM – 9.5 Mixes:

- Branscome Deepwater
- Branscome Hampton
- Templeton Mt. Athos
- Superior Stevensburg

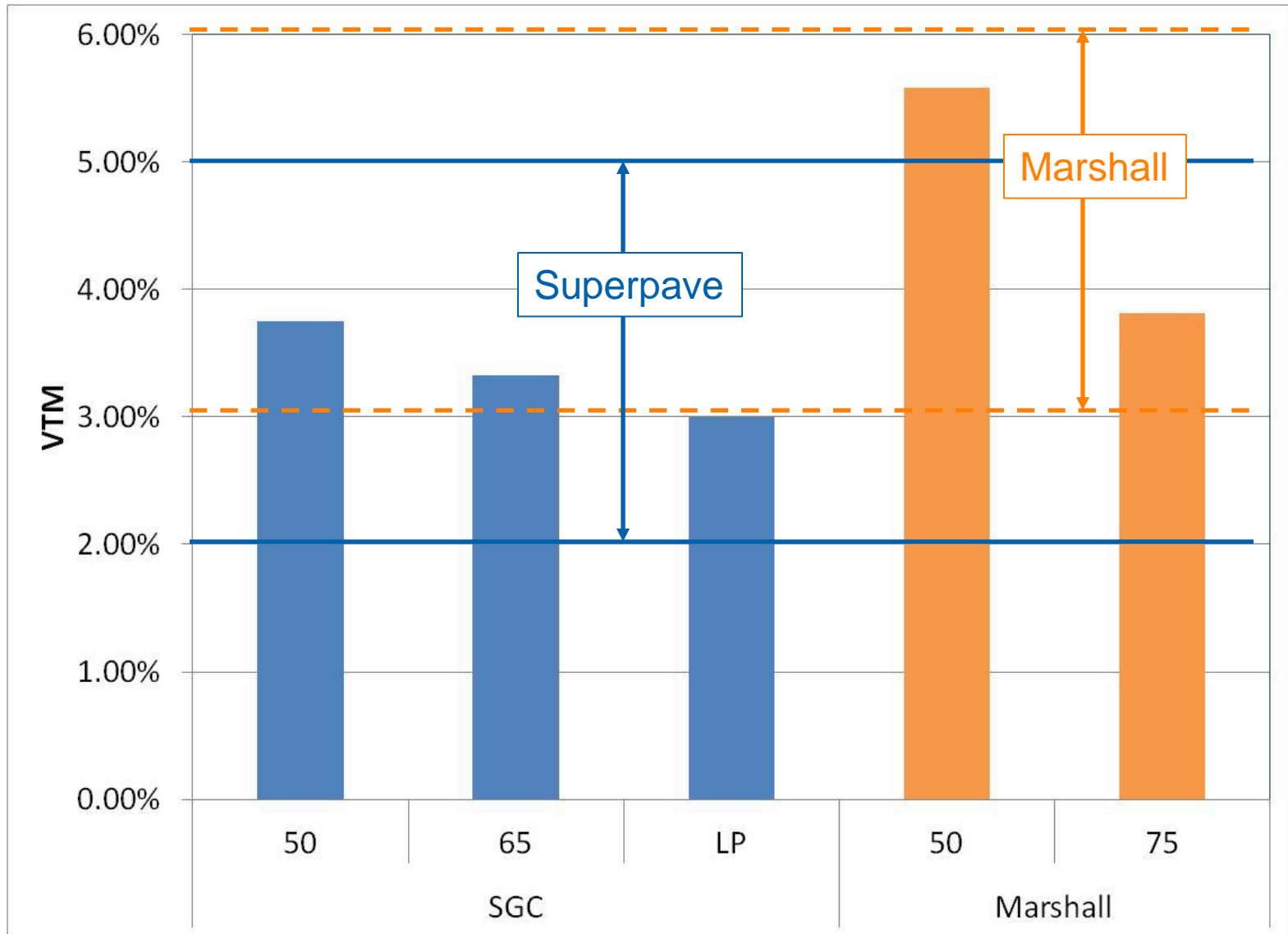
## SM 12.5 Mixes:

- LeeHy New Kent
- Branscome Hampton
- Superior Stafford

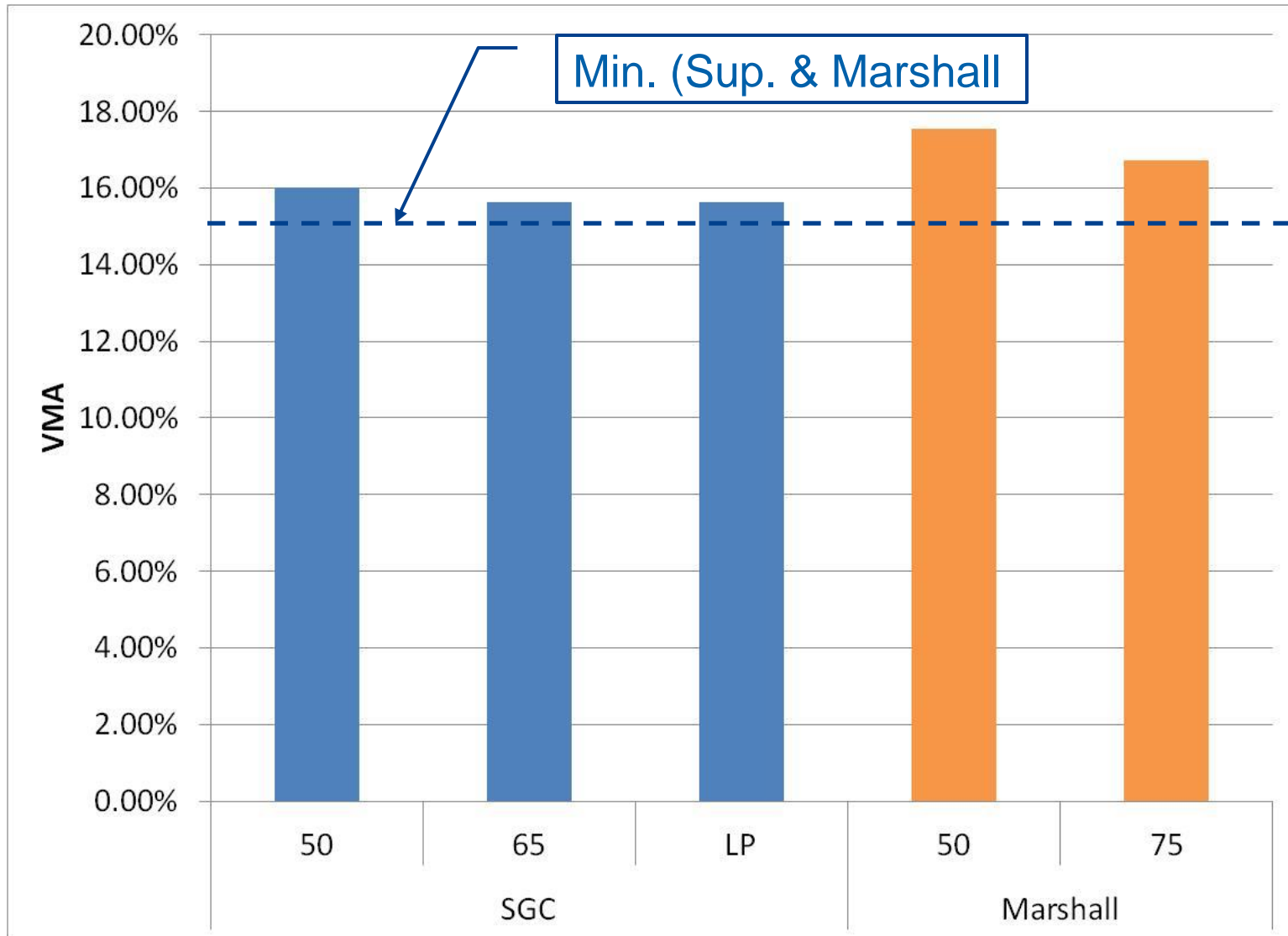
# VTM – SM 9.5 Mixes



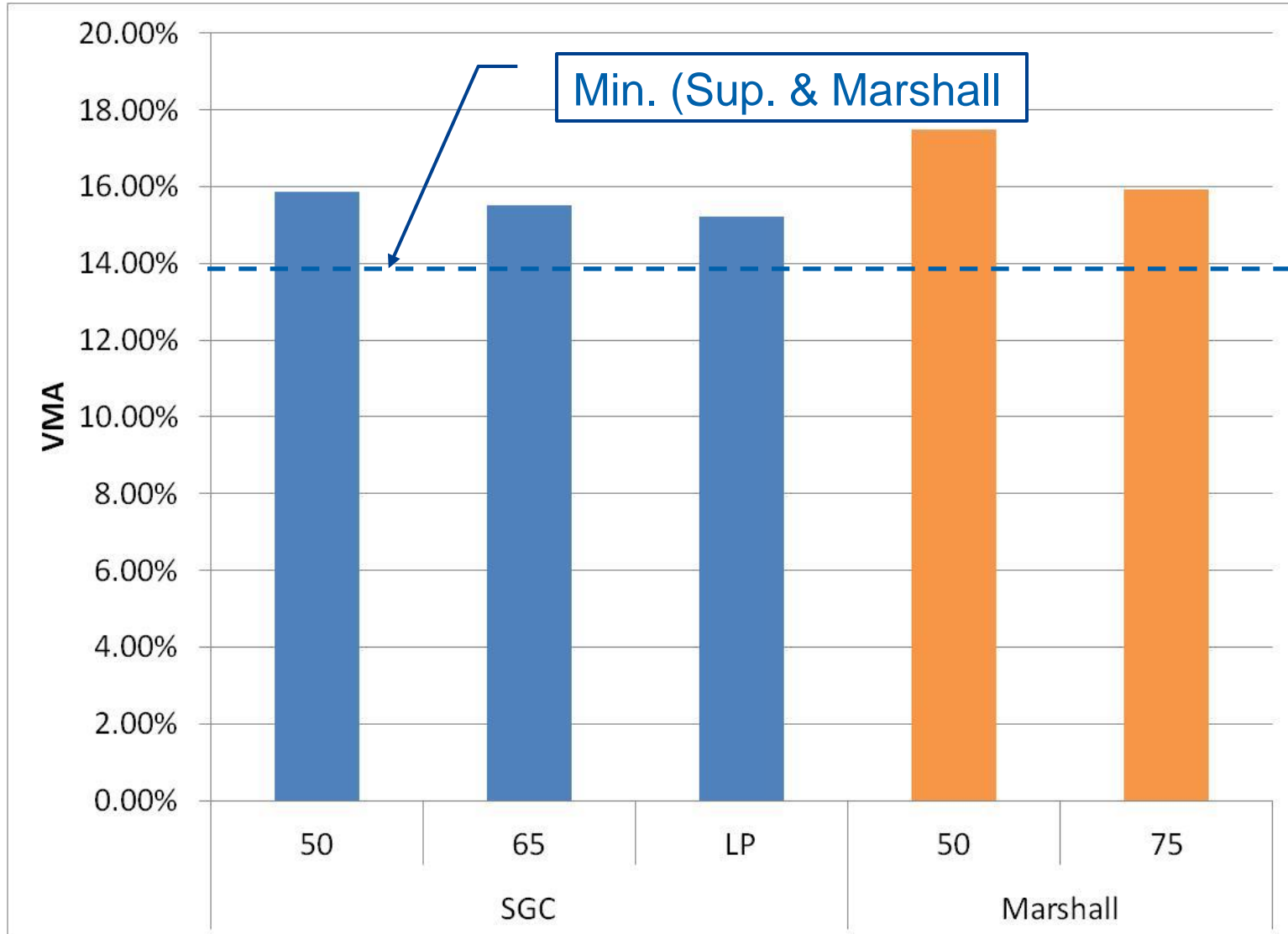
# VTM – SM 12.5 Mixes



# VMA – SM 9.5 Mixes



# VMA – SM 12.5 Mixes



## RESULTS FROM PHASE I

- **VTM – Superpave Gyrotory (SGC) produces approximately 2% lower VTM than the Marshall hammer.**
- **VMA – SGC produces approximately 1-2% lower VMA than the Marshall hammer.**
- **Review of the data did not produce a definitive “simple solution” (i.e., just reduce the number of gyrations).**
- **Seeking Results of Marshall Gradation in SGC.**

## Phase II (Modified) – Marshall Designed Mix Analysis

- **Comparisons**
  - Volumetric results for 50 and 75 blow Marshall
  - Volumetrics for 50 and 65 Gyrations
- **Mix gradations**
- **Bag samples for future phases**





## Phase III – Research Laboratory Testing



## Phase III

**Evaluate performance of dense graded mixes based on different mix designs (Produced mixes in the field and laboratory mixes):**

**Current Superpave (VDOT 65 gyrations) vs Marshall (50 blows)**

**Effect of mix gradation: coarse vs. fine**

**Performance Tests (Laboratory):**

**Dynamic modulus (Stiffness indicator)**

**Flow number (Rutting indicator)**

**Indirect tension strength (Cracking indicator)**

# MIXES BEING EVALUATED

Mix Designation	S-5	SM-2	SM9.5	SM9.5	SM9.5	SM9.5	North Carolina
Production	Laboratory	Laboratory	Laboratory	Laboratory	Plant	Plant	Plant
Design	Marshall 50 blows 4.5% VTM		Superpave 65 gyrations 4% VTM				As Obtained
binder	PG 64-22						
Aggregate	Superior and Branscome (2 sources)				Branscome	Superior	
RAP (%)	30				As produced		
3/8 Sieve	<b>96%</b>	<b>88-90%</b>	According to VDOT specifications		As produced		
#4 Sieve	Will be determined						
#30 Sieve	<b>23%</b>	<b>21%</b>	<b>22%</b>	<b>28%</b>	21%	28%	
#200	6%	6%	5.2%	5.2%	As produced		

## Phase III Project Status

**Testing of field produced mixes will start in the second half of February**

**Characterization of raw materials and field mixes is under way:**

**Gradation and asphalt content of field mixes**

**Gradation and asphalt content of RAP**

**Gradation of virgin aggregates**

**Final Report due late Summer**

## The Bottom Line

- **We know we need mixes that have a longer fatigue life to prolong the development of cracking.**
- **We know we need to ensure that any added AC does not lead to rutting or bleeding.**
- **We believe the aggregate gradations need to be tighter on certain sieves as well as the addition of one or more control sieves (#30) to combat mix tenderness and rutting.**
- **We know higher RAP is not a bad thing, but the overall mix must be considered to get the right AC and gradations.**

## RESOURCES

- **VAA Contractor members for Phase I & II**
- **VCTIR for Phase III**
- **VDOT/VCTIR/VAA for data analysis during each phase**