

Virginia's Experience with Balanced Mix Design

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Asphalt Mix Design – Once Upon a Time



Asphalt Mix Design – not that long ago

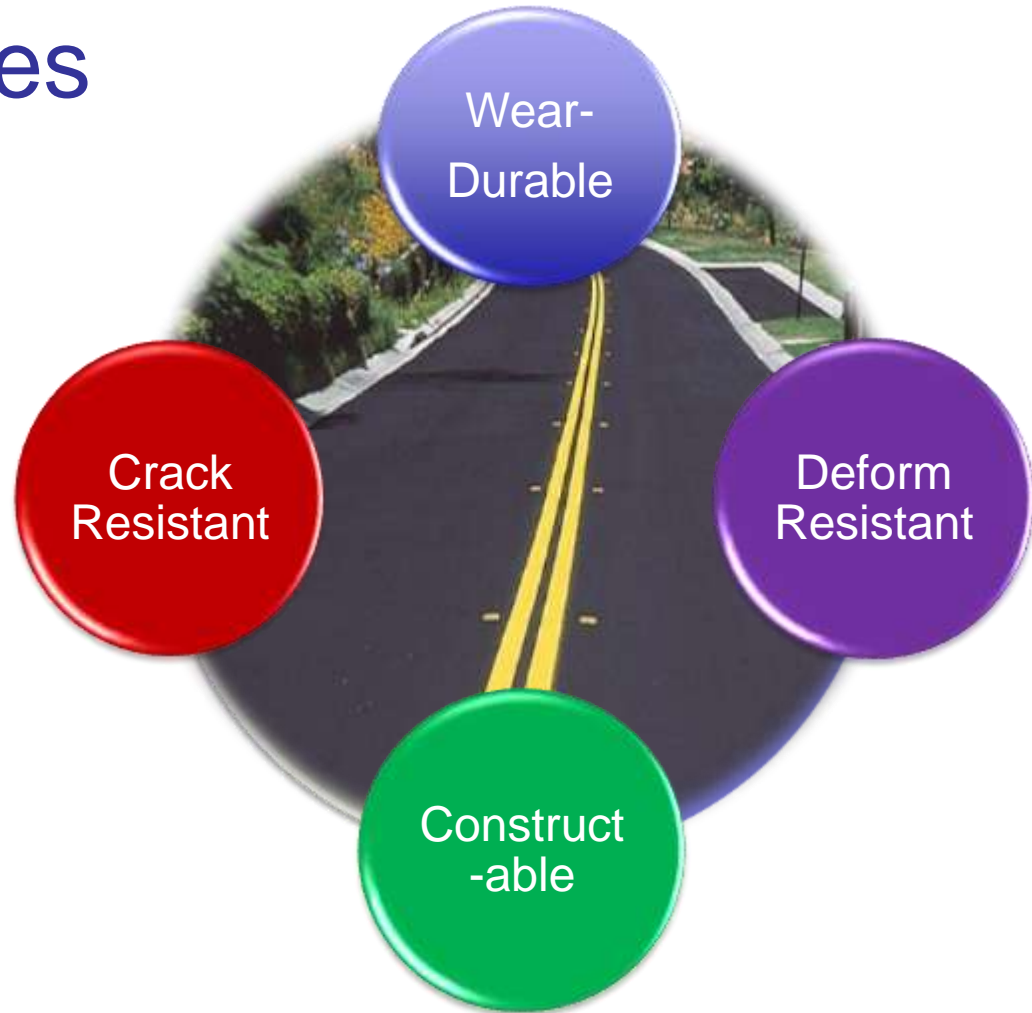


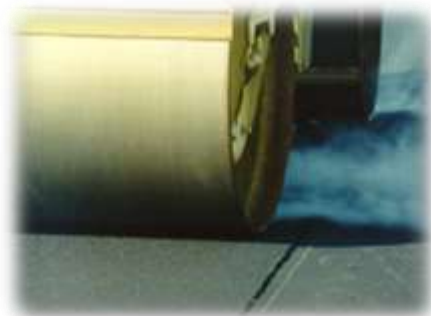


Asphalt Mix Design – Today Moving Forward



Our Objectives Remain...

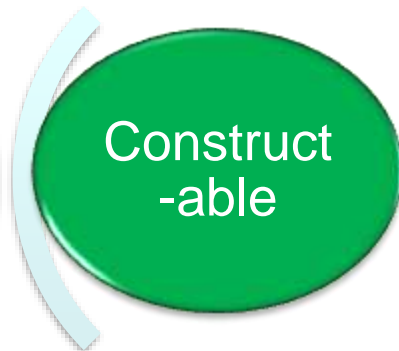




Produce



Deliver

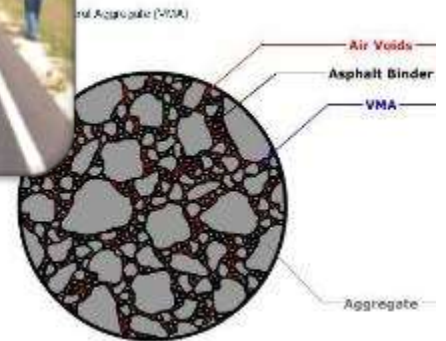


Finish

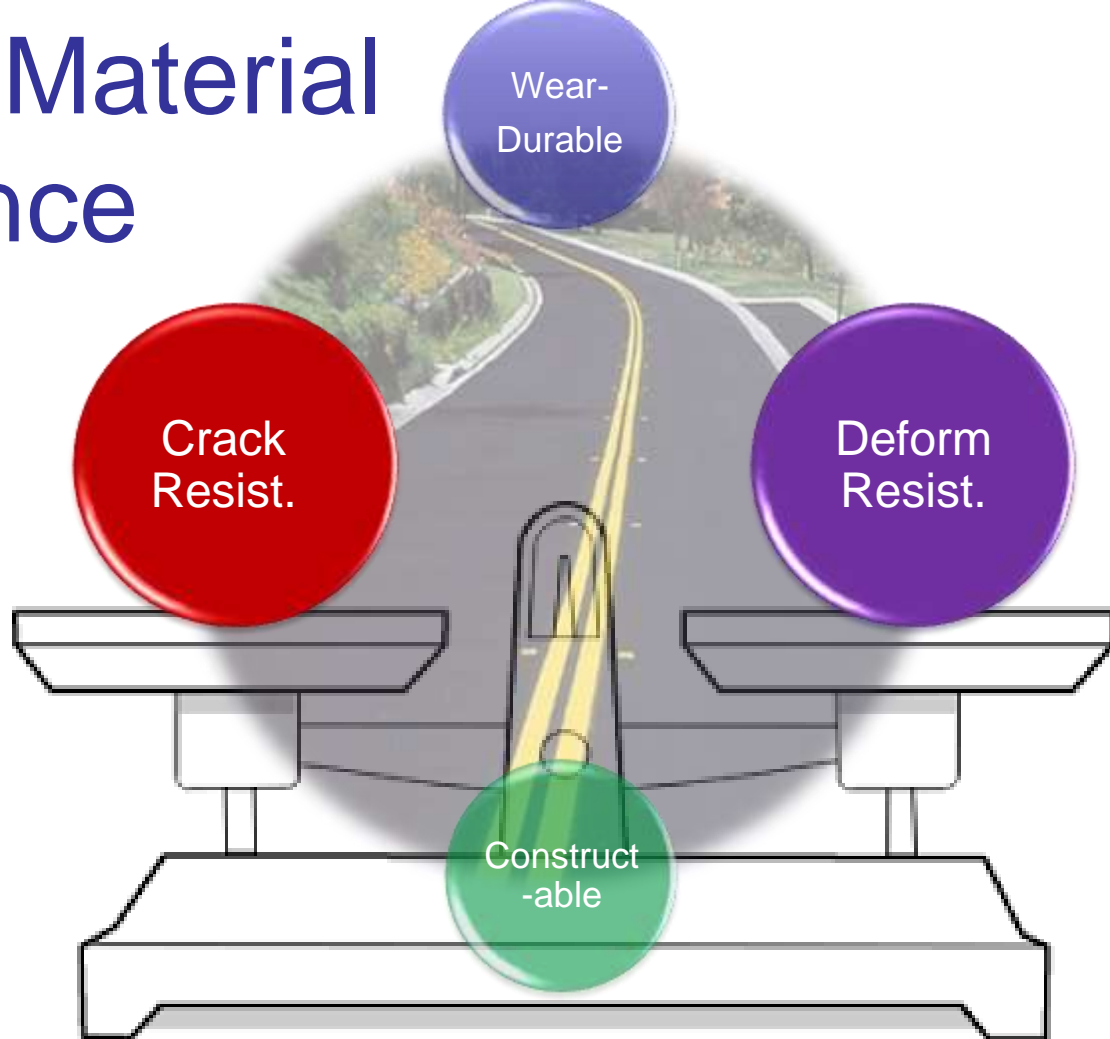




Wear
Durable



Balanced Material Performance



What is Balanced Mix Design?

Designing mixes using performance tests on appropriately conditioned specimens to address multiple modes of distress taking into consideration mix aging, traffic, climate and location within the pavement structure.

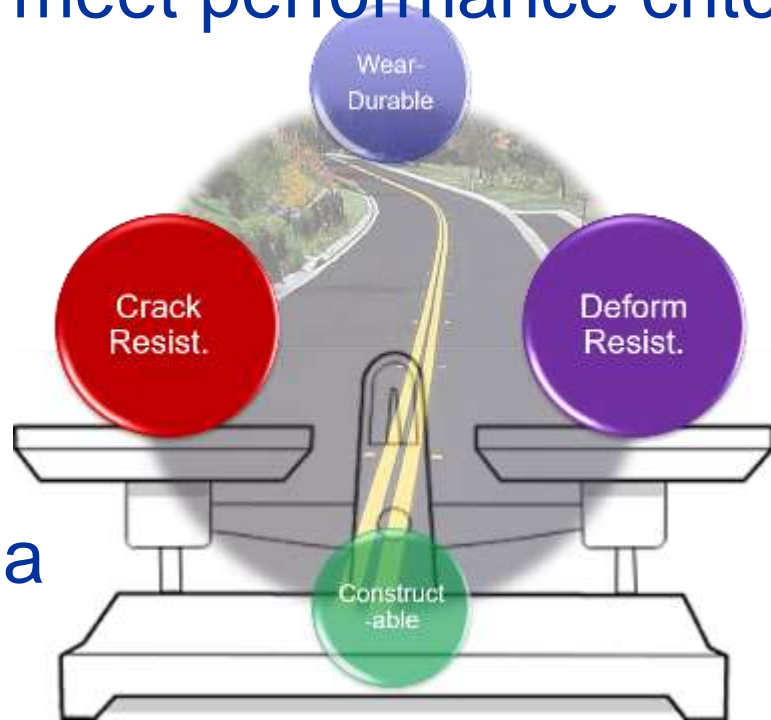
– from FHWA Balanced Mix Design Task Force



What does BMD Mean – Practically?

- Designing mixtures to meet performance criteria:
 - Rutting
 - Cracking
 - Durability

Ultimately can use
volumetrics
as a ***tool***, rather than a
requirement



Why Use BMD?

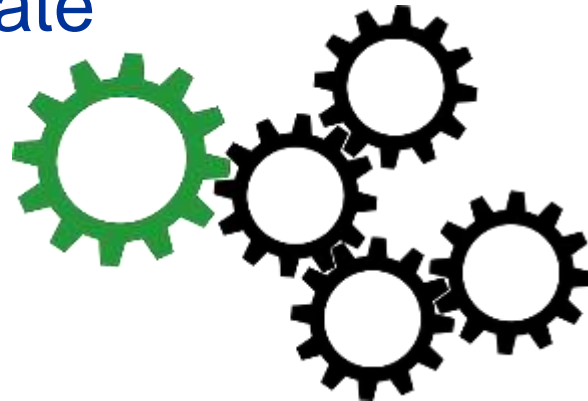
- Achieve improved pavement performance
 - Optimization of cracking and rutting resistance
 - Foster innovation
 - Mix performance approach vs. totally prescriptive specifications
 - Incentivize quality attributes
- 
- A collage of circular images illustrating various aspects of pavement engineering and construction. The images include: a close-up of different aggregate materials; a worker in safety gear; a yellow construction vehicle; a pile of dark material; a cross-section diagram of a road showing layers like 'Subgrade' and 'Base'; a large pile of gravel; a construction site with heavy machinery; a close-up of a road surface; and a diagram of a road cross-section with labels like 'Total wet', 'Dry', and 'Key'.



Building a BMD Specification

- Know existing mix/pavement performance*
- Determine baseline/expectation for performance
- Select appropriate test procedure
- Develop testing and specification structure
- Re-evaluate and validate

* Yeah, easily said, but done??



Virginia's Approach to BMD

Assume BMD Framework

Select Performance Tests

Develop Initial Specification Limits

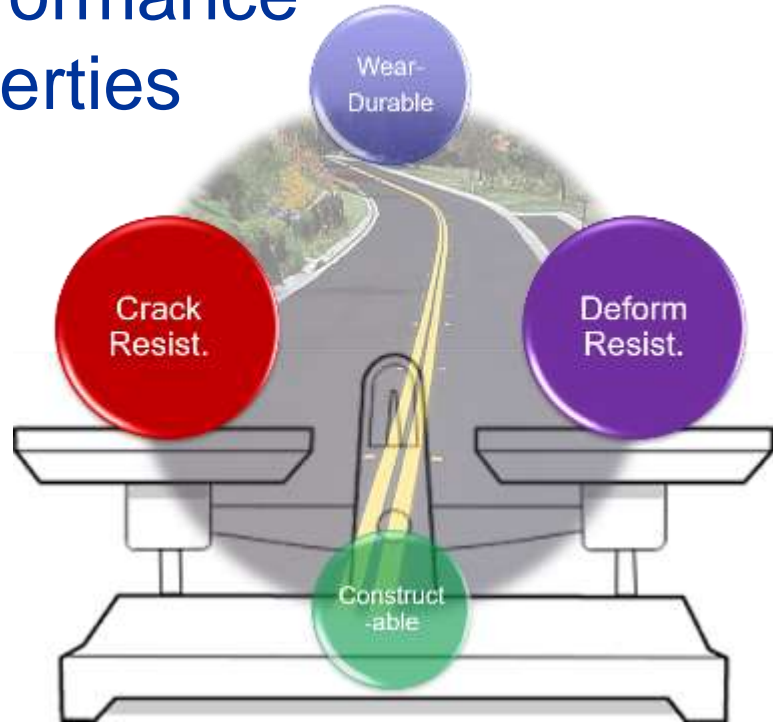
Validate Using Actual Performance

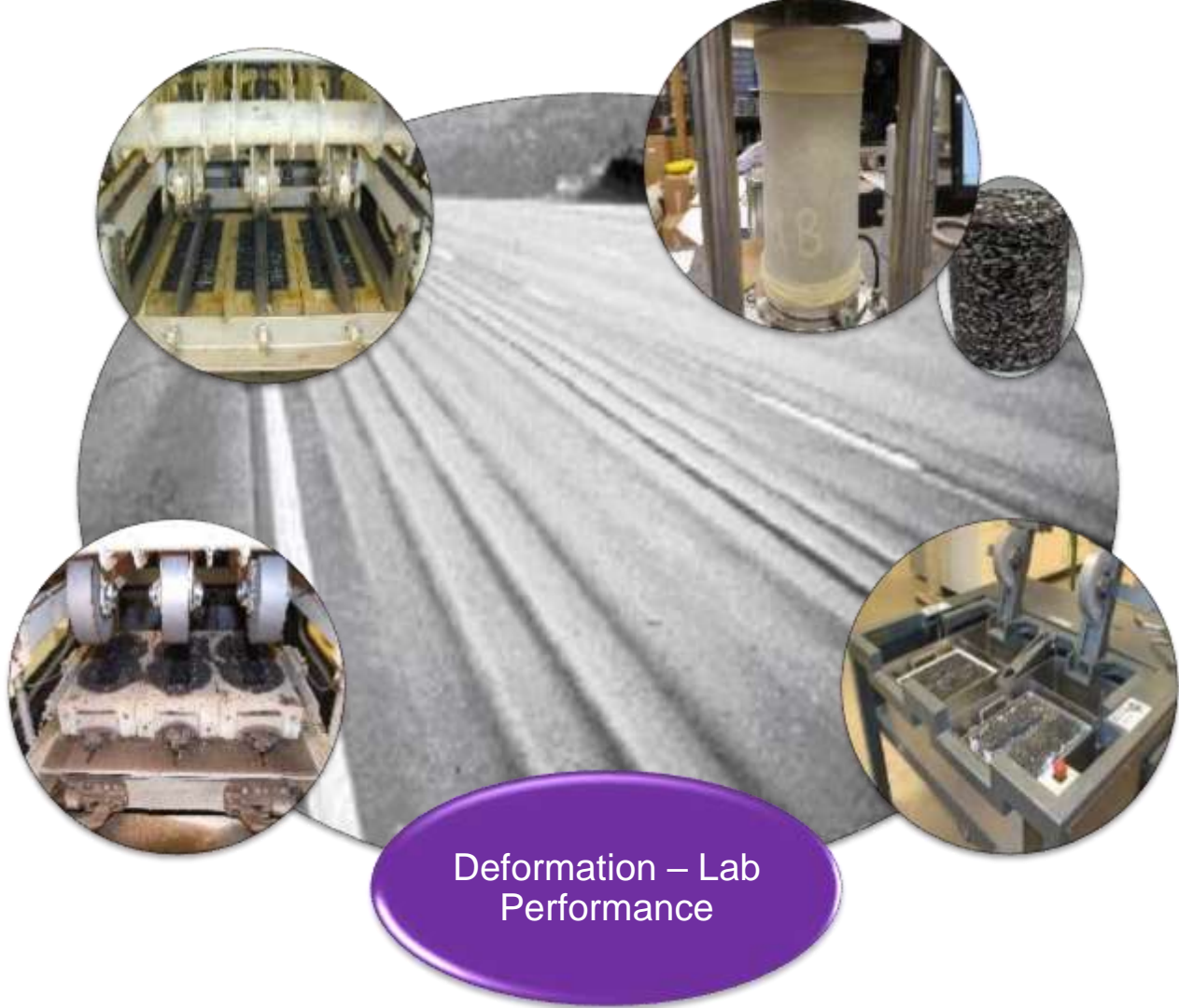
Select Final QC/QA Acceptance Criteria



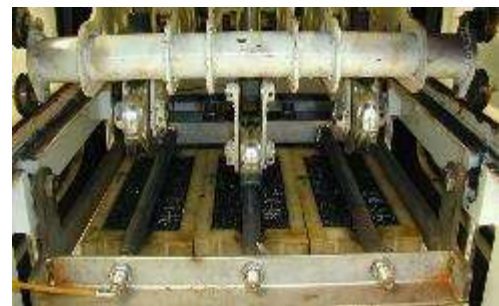
Selecting Test Procedures

- Correlates to field performance
- Sensitivity to mix properties
- Repeatability
- Ease of use
- Availability/cost



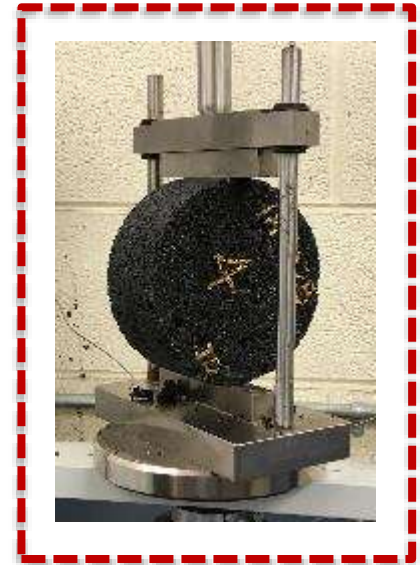
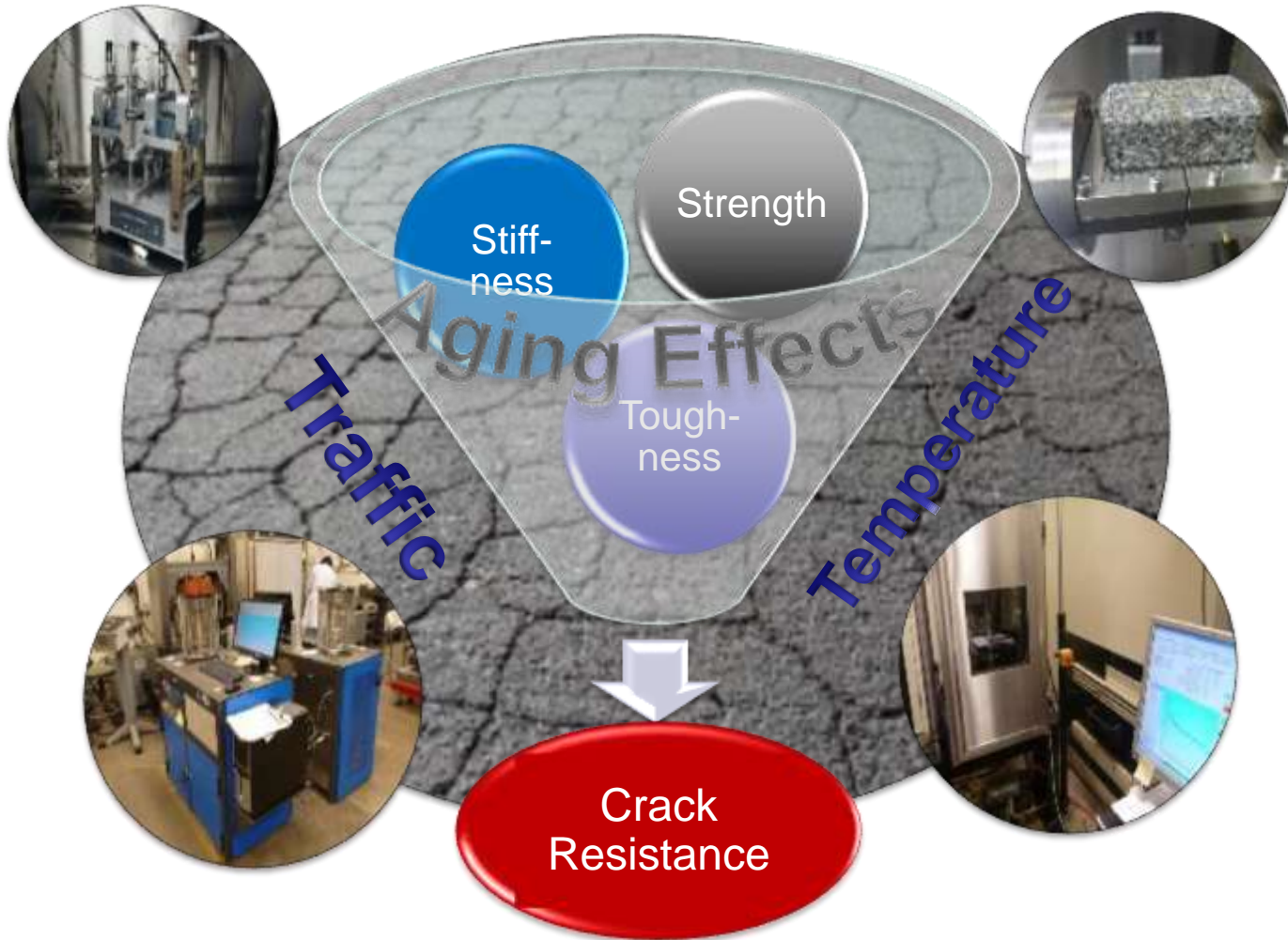


Deformation – Lab
Performance



APA Rutting
AASHTO T340





IDEAL CT
ASTM D8225



Developing Initial Spec Targets

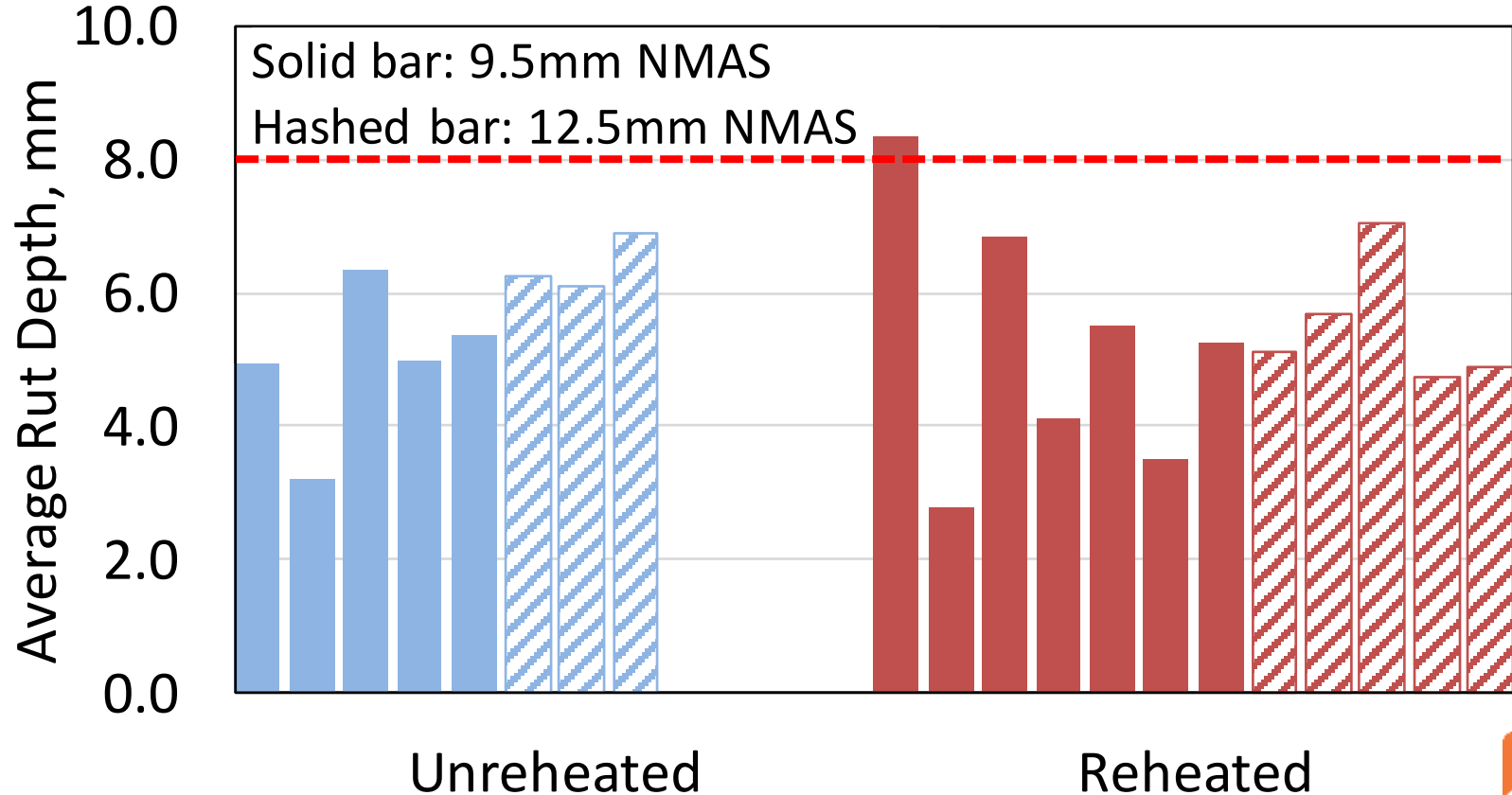
Benchmarking/Shadow Testing

- Surface mixtures with 9.5mm & 12.5mm NMAS
- 2015 - 11 field projects
- 2018 - 13 mixtures
 - 6 field projects
 - 7 plant sampling only

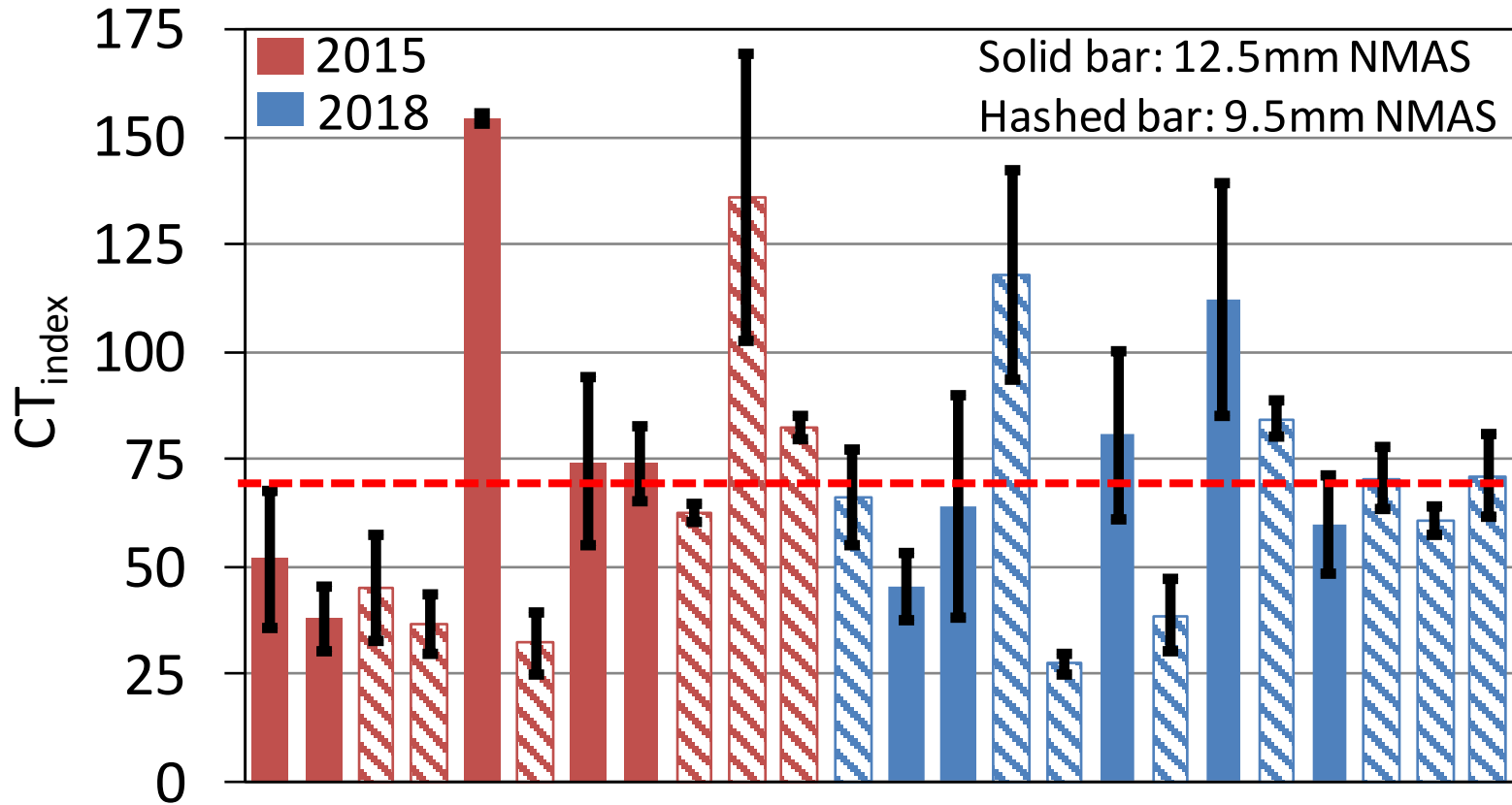
See - “Initial Approach to Performance (Balanced) Mix Design: The Virginia Experience”, TRR Vol. 2673, Jan, 2019



APA Rutting – 2018 Mixes

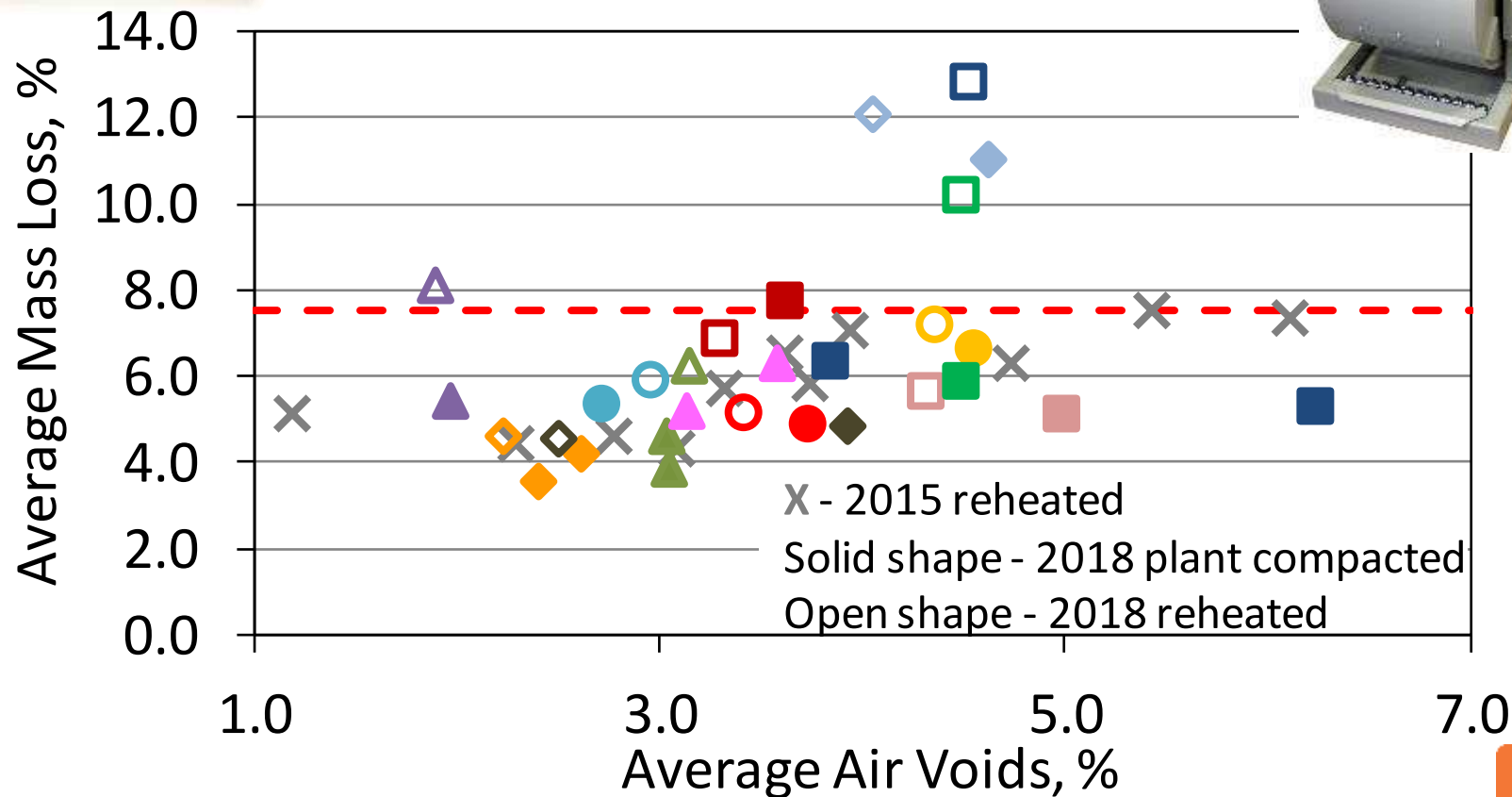


CT_{index} – Reheated Mix





Cantabro Mass Loss



VDOT BMD *Experiments* (2019)

1. Control (traditional design)
 - Meets current volumetric specs
2. Volumetric + Performance
 - Meets current volumetric specs AND performance requirement
3. Performance Only
 - Current volumetric requirements waived
 - *Design* must meet performance requirements
 - Producer maintains *design* volumetrics during production



Performance Criteria

Test	Test Temp.	Specimens	Criteria
AASHTO T340 (APA rutting)	64°C	2 replicates of 2 pills (APA Jr) [Note: Plant-mix shall not be reheated when producing APA rut specimens.]	Rutting $\leq 8.0\text{mm}$
AASHTO TP108 (Cantabro mass loss)	25°C	3 replicates Report air voids	Mass loss $\leq 7.5\%$
ASTM D8225 2019 (CT _{index})	25°C	3 replicates	CT _{index} ≥ 70

Lab-produced mix – loose mix shall be aged at the design compaction temperature prior to compacting



Production Testing Frequency

Table 2. Production Testing Frequency¹

Entity	Gradation/ AC	Volumetrics	APA rutting	Cantabro	CT _{index}
Producer	500T	500T	-	500T	500T
VDOT	500T	1,000T	-	1000T ²	1000T ²
Research	500T	500T	500T ²	500T (reheat)	500T (reheat)

¹ With a minimum of 1 sample per day, per entity, per test.

² Minimize any cooling of the plant-produced mix and bring the specimens to the compaction temperature and compact immediately, to the specimen size requirements in Table 1. Specimens shall be fabricated and provided to the Department by the Contractor.



BMD Special Provision Use

- BMD (optimized dense-graded) Projects
 - Apply BMD concepts to typical dense-graded mixtures
 - Assess impact of binder grade changes and additives
- High-RAP BMD Projects
 - Apply BMD concept to mixes with 40%+ RAP content
 - Assess impact of binder grade changes and additives

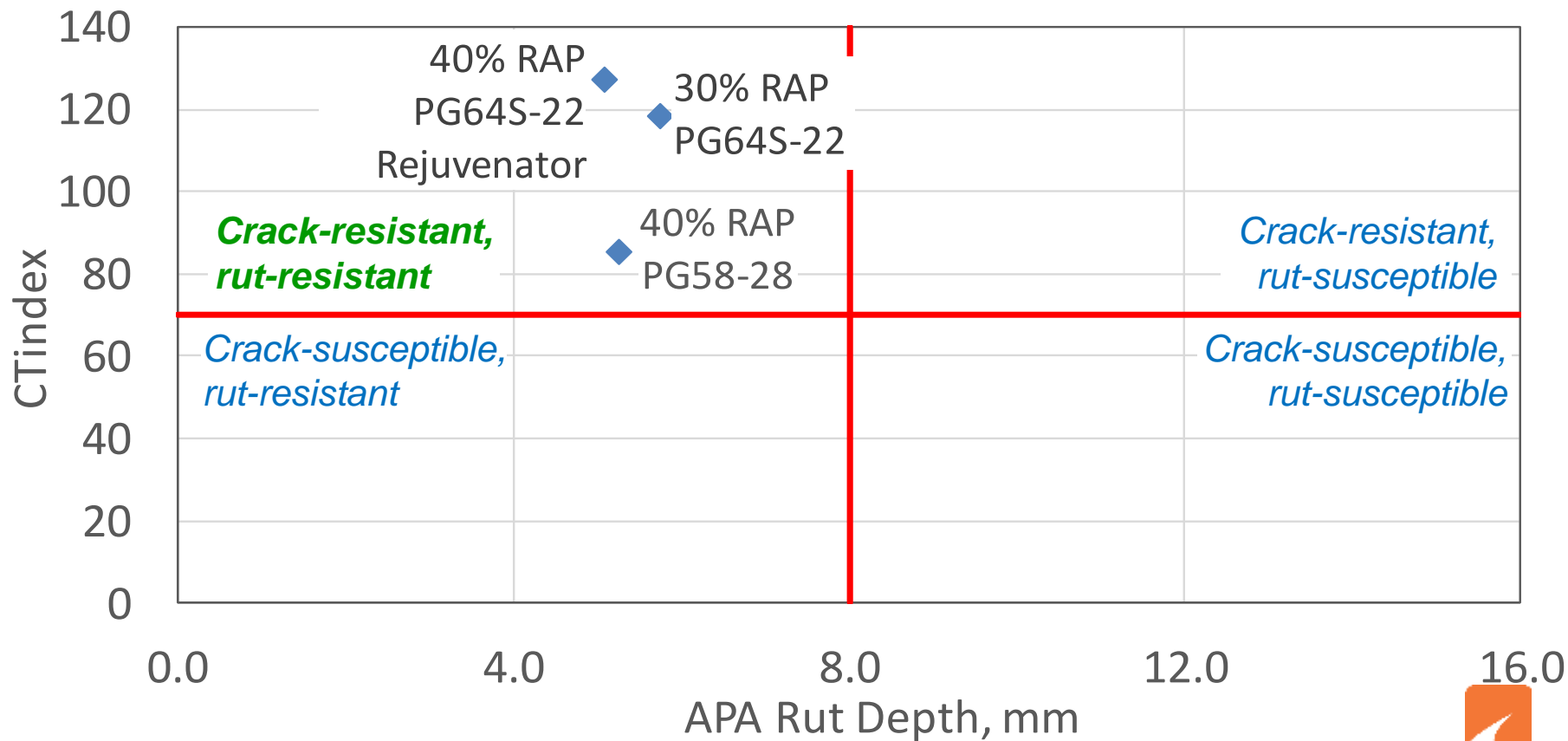


2019 BMD Projects

Date	Mixes
June 27-28	SM-9.5 30% RAP PG 64S-22
July 15-18, 24-25	SM-9.5 30% RAP PG 58-28
August 22, 26-27	SM-9.5 40% RAP PG 64S-22
	SM-9.5 40% RAP PG 58-28
	SM-9.5 40% RAP PG 64S-22, rejuv.
July 12, 17, 24	SM-9.5 26% RAP PG 64S-22
	SM-9.5 26% RAP PG 64S-22, rejuv. 1
	SM-9.5 26% RAP PG 64S-22, rejuv. 2



Example Performance Space



Challenges/Opportunities

- Meeting BMD performance test criteria
 - What changes need to be made to mixes for performance?
 - What additives are effective?
 - What impact do plant/production characteristics (production temp., plant type, production rate) have?
 - What role(s) do traditional QA measures play?
 - Acceptance/payment?



Moving Forward

- Relating *design* to *production* (to *as-placed*)
 - Aging procedure(s) for cracking tests
- Relating *laboratory* to *in-service* performance
- Precision and bias statements for tests
- Understanding of how normal production variability impacts performance measures
- Production QA – tests, frequency, etc.
- Accepting/understanding rejuvenators

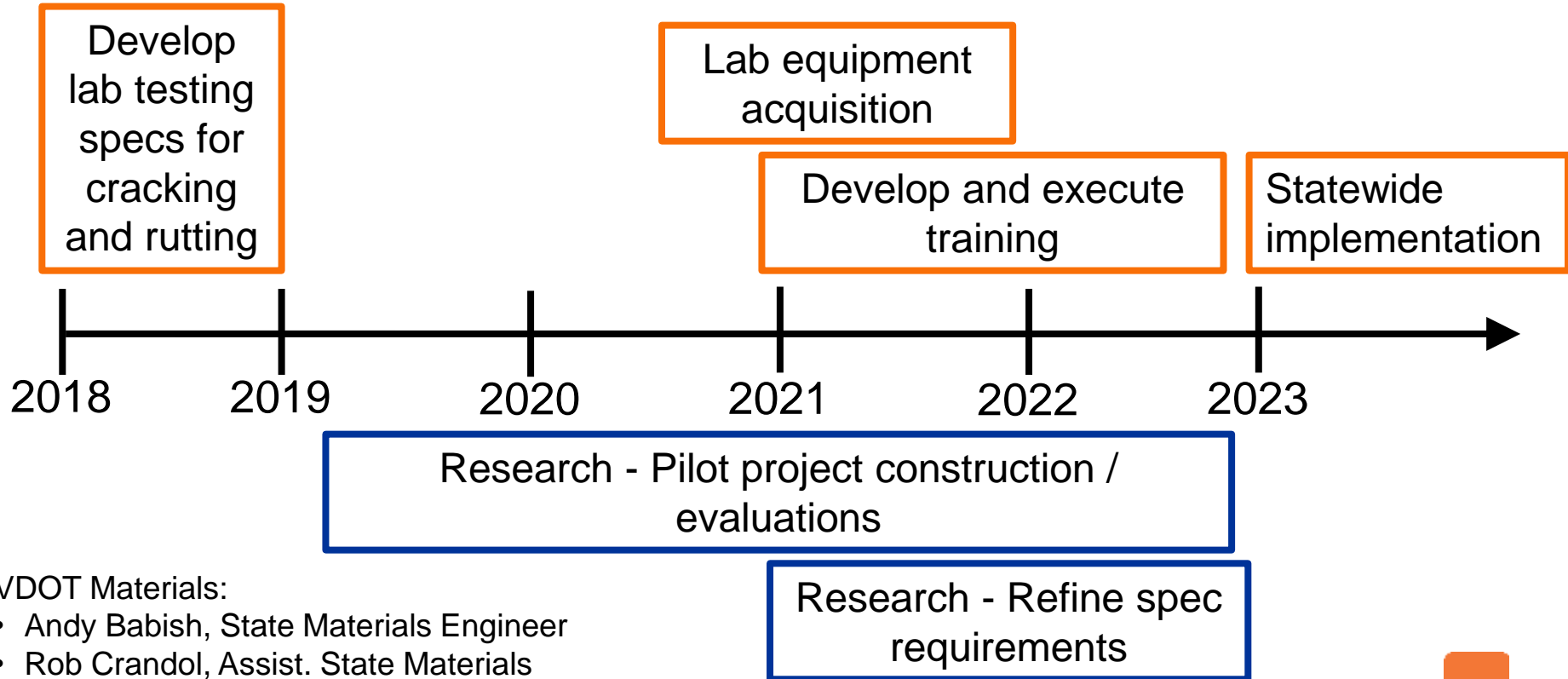


Status of Virginia “Experiments”

- Ongoing:
 - Trial projects – year 2 / “Shadow” testing – year 3
 - Statewide (at least) round-robin for CT_{index}
 - Evaluating production variability (NCAT contract)
- Upcoming:
 - IDT rutting test evaluation(e.g., IDEAL RT)
 - Rejuvenator evaluation process for acceptance
- Enduring:
 - Relating design/production to actual performance



Agency Timeline



VDOT Materials:

- Andy Babish, State Materials Engineer
- Rob Crandol, Assist. State Materials Engr. & BMD Project Manager



Thank You!

Also see - “Initial Approach to Performance (Balanced) Mix Design: The Virginia Experience”, TRR Vol. 2673, Jan, 2019

For further info:
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