Asphalt Research Update
Asphalt Conference

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December 1, 2021

Outline

- **Top three projects in the following categories**
  - Completed
  - In progress
  - Upcoming projects

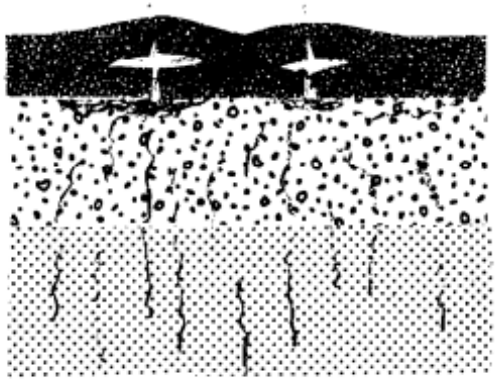
Completed #1
Road Worms (a.k.a. Blisters or Ripples)

Road Worms (Blisters, Ripples)

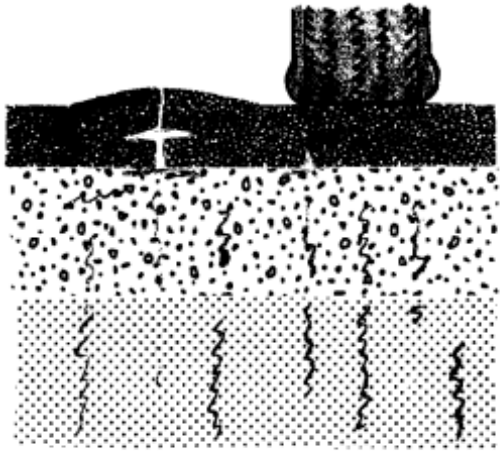
Road Worms (Blisters, Ripples)

- Previously researched in 1972, 1990, 2011 for individual projects.
- Consensus is that moisture in the asphalt pavement (or sometimes granular base/subgrade) is vaporizing due to heat.

Road Worms (Blisters, Ripples)



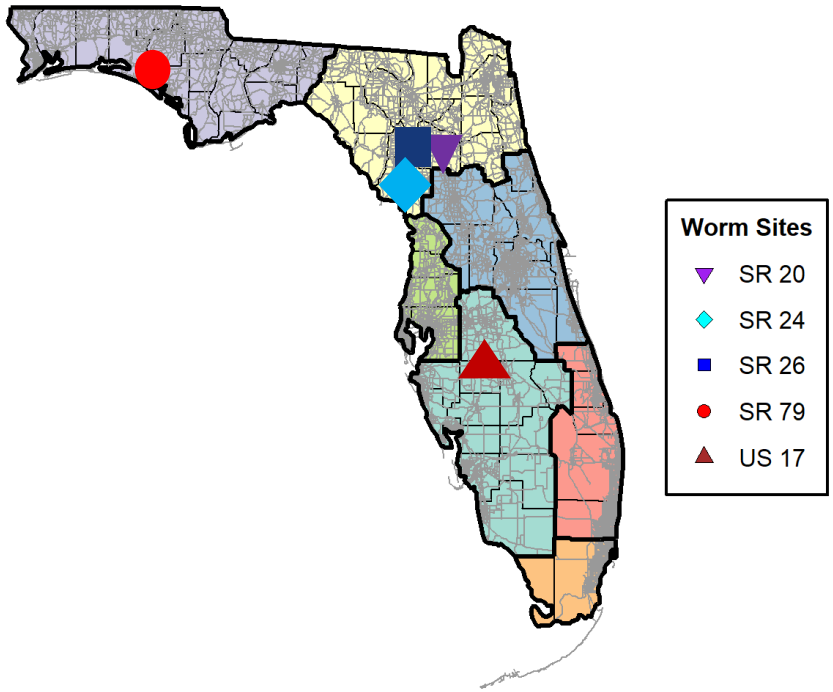
③ Heat causes vapor to expand which pushes up small ripples on the pavement surface



④ The blisters rupture or crack to allow vapor to escape. The ripples are "ironed out" in the wheel-paths by traffic.

Road Worms (Blisters, Ripples)

- Applied Research Associates (ARA) performed the research.
- 5 projects
- 3 Dense FC
- 2 OGFC



Road Worms (Blisters, Ripples)

- **Performed extensive field and lab testing on granular and asphalt layers.**
- **Control and worms sections for each project.**
- **Conclusions:**
  - Lower bond strength between upper two asphalt layers.
  - High air voids, especially at bottom of top layer and top of 2nd layer.
  - Segregation, especially at bottom of top layer.
  - Granular layers not suspected.

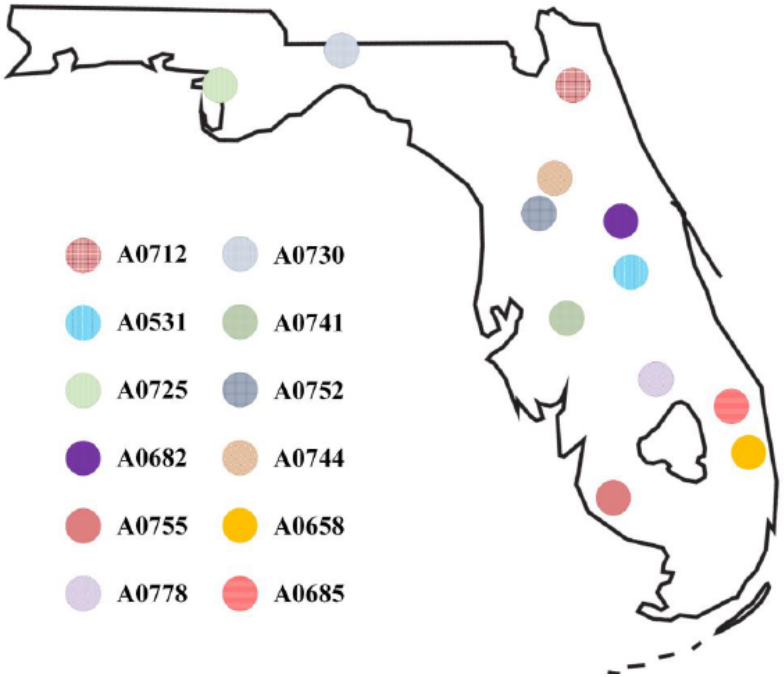
Completed #2
Increased RAP in PG 76-22 Structural Layers

Increased RAP in PG 76-22 Structural Layers

- Max limit was 20% RAP for structural layers containing PG 76-22 binder.
- Could this amount be increased to 25 or 30% without affecting cracking?
- The University of Florida performed the research.

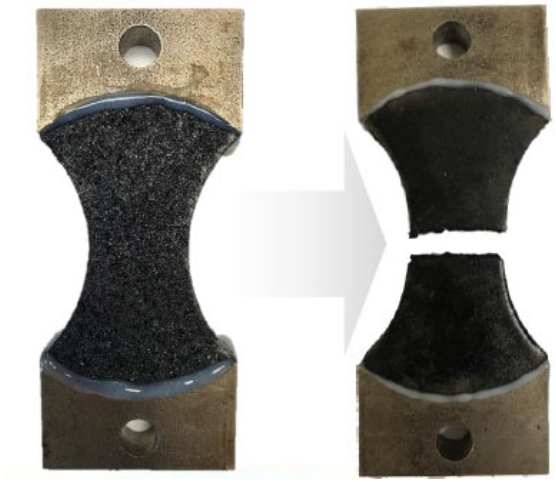
Increased RAP in PG 76-22 Structural Layers

- **Eight RAP sources selected out of twelve sampled.**
  - Covered a broad range of RAP binder stiffness and gradation.



Increased RAP in PG 76-22 Structural Layers

- Used complex tests focused on cracking.

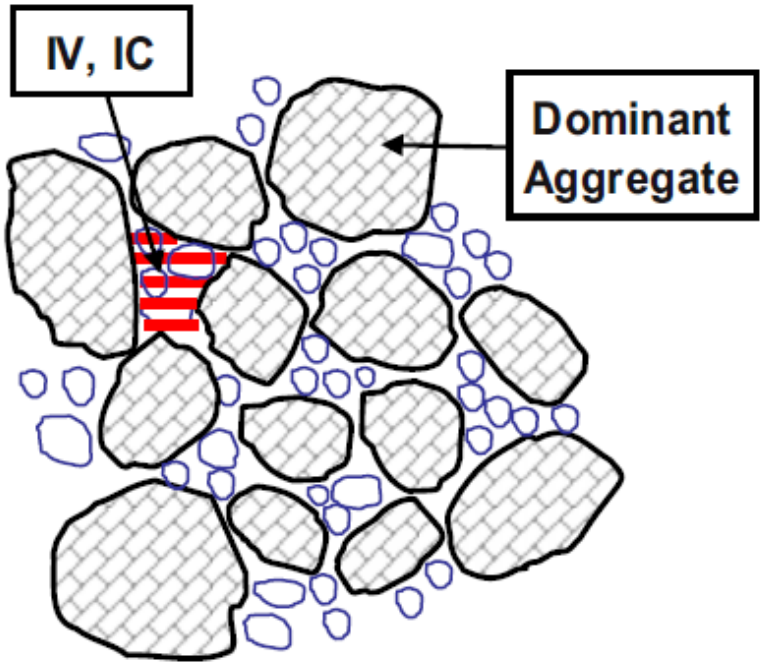


Mortar testing
(Passing #16 sieve)

Mixture testing

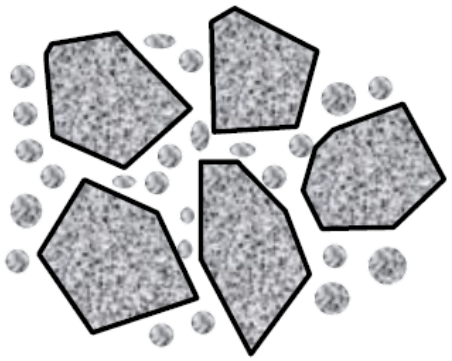
Increased RAP in PG 76-22 Structural Layers

- The interstitial components in the interstitial volume affect cracking the most.

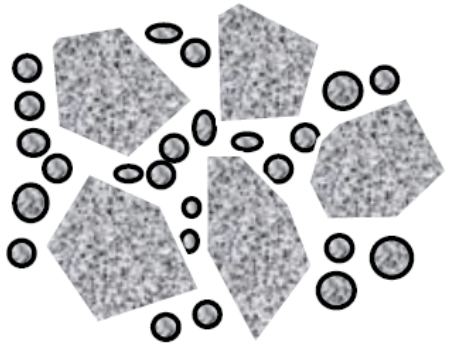


Increased RAP in PG 76-22 Structural Layers

- **Results:**
  - Coarse RAP performs better than fine RAP.
  - Less stiff RAP performs better than stiffer RAP.
  - Gradation more important than RAP binder stiffness. Why? Because of IC/IV.



Mixture with **coarse RAP**



Mixture with **fine RAP**

Increased RAP in PG 76-22 Structural Layers

- Implemented in January 2021 Specifications.

Table 334-3
Allowable RAP Percentages[1] in Type SP Structural Mixtures with PG 76-22 Asphalt Binder

		Coarse RAP	Intermediate RAP	Fine RAP
Gradation % Passing #16 Sieve[2]		≤ 40%	> 40% to ≤ 50%	> 50%
PG_{HT}[3] > 100.0° C	Allowable RAP Percentage	≤ 25%	≤ 20%	≤ 20%
PG_{HT}[3] ≤ 100.0° C		≤ 30%	≤ 25%	

Notes:
1. RAP aggregate by weight of total aggregate or RAP binder by weight of total binder.
2. RAP gradations based on ignition oven extraction of RAP material in accordance with FM 5-563.
3. PG_{HT}: asphalt binder high temperature continuous performance grade of RAP in accordance with Section 916.

Completed #3
Increased Anti-strip Additives in Granite FC-5 Mixtures

Liquid Anti-strip

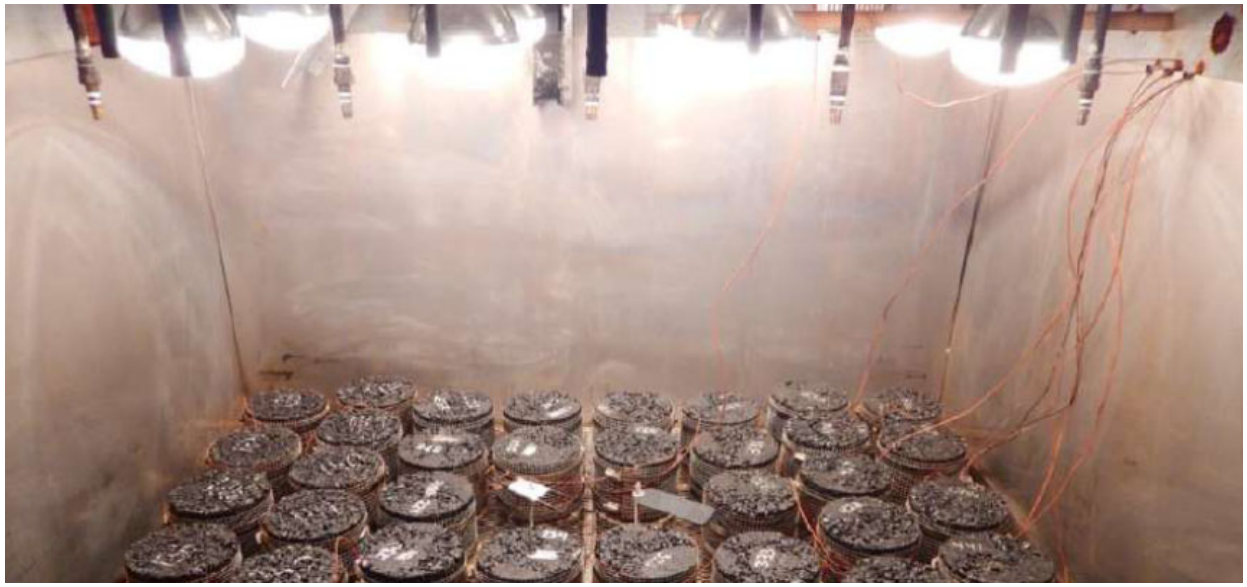
Hydrated Lime

Increased Anti-strip Additives in Granite FC-5 Mixtures

- **Examined the influence of anti-strip additives on the durability and moisture susceptibility of granite-based OGFC (FC-5) mixtures.**
- **Research performed by the National Center for Asphalt Technology (NCAT) in Auburn, AL.**
- **Examined Georgia and Nova Scotia Granite.**
- **Examined the following four conditions:**
  - 1% lime (current spec).
  - 1% lime and 0.5% liquid anti-strip.
  - 1.5% lime.
  - 1.5% lime and 0.5% liquid anti-strip.

Increased Anti-strip Additives in Granite FC-5 Mixtures

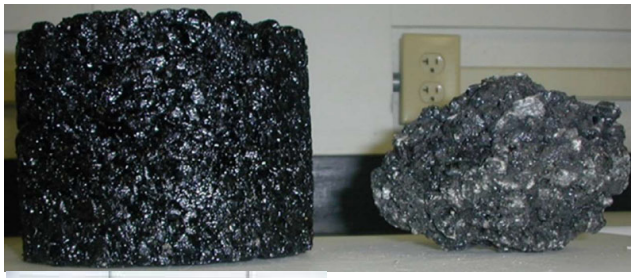
- Specimens were conditioned to simulate the long-term exposure to water infiltration, vapor diffusion, and thermal and ultraviolet oxidation.



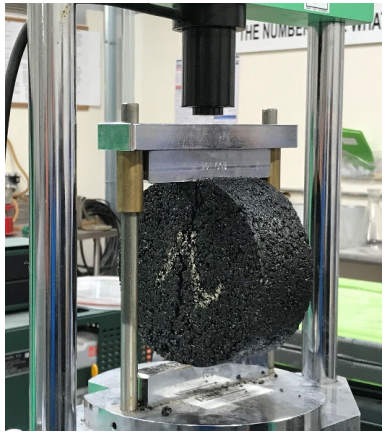
Increased Anti-strip Additives in Granite FC-5 Mixtures

Hamburg Rut Tester

Binder Bond Strength



Cantabro

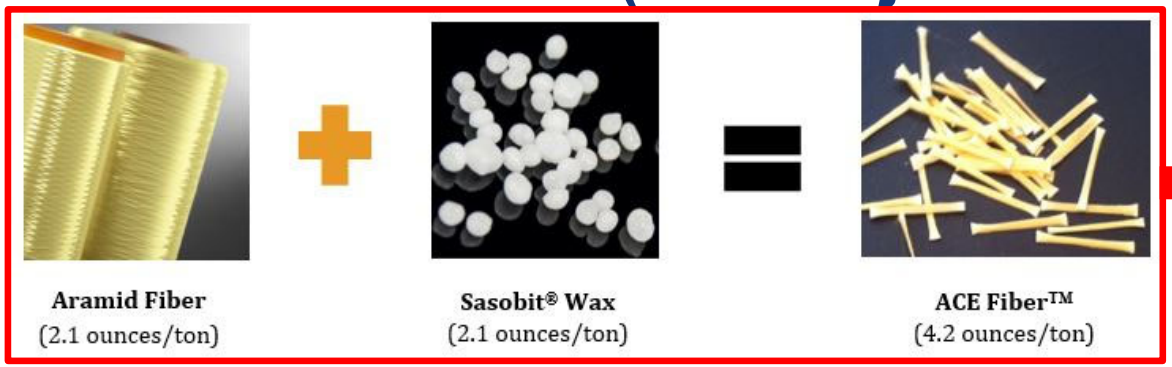


Indirect Tensile Strength

Increased Anti-strip Additives in Granite FC-5 Mixtures

- **Results:**
  - Georgia granite - 1% hydrated lime and 0.5% liquid anti-strip additive performed the best and had the best cost-benefit ratio.
  - Nova Scotia granite - 1.5% hydrated lime and 0.5% liquid anti-strip additive performed the best and had the best cost-benefit ratio.
  - Implemented in the July 2021 specifications.

In Progress #1
Aramid Fibers (two major brands)



Blend of Aramid and Polyolefin Fibers

Aramid Fibers

- **Being studied at the State Materials Office Test Track, a field test section (SR-200 in Dist. 2), and in SMO lab.**
- **Will it help rutting and/or cracking resistance?**
- **Is it worth the cost increase?**
- **<u>Potential</u> outcomes:**
  - Fibers allowed as an alternate to PG 76-22.
  - PG 76-22 PMA + fibers used as an alternate to HP binder.
  - HP binder + fibers used in extreme situations.

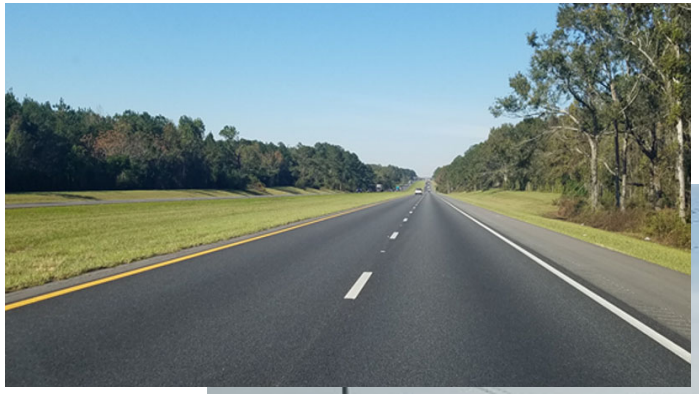
In Progress #2
Performance Comparison between SP-9.5 and SP-12.5 (TTI)

SP-9.5 SP-12.5

Performance Comparison between SP-9.5 and SP-12.5 (TTI)

- **Current specification restrictions for SP-9.5 mixtures:**
  - Do not use on Traffic Level D and E applications.
  - Limited to the top two structural layers, two layers maximum.
- **Project objectives:**
  - Compare the performance (rutting, cracking, and durability) between SP-9.5 and SP-12.5 mixtures.
  - Determine if SP-9.5 mixtures are at least equivalent to SP-12.5 mixtures.
- **Potential outcome:**
  - The restrictions above are removed to provide more flexibility.

In Progress #3
OGFC for Suburban Environments (NCAT)



OGFC for Suburban Environments (NCAT)

OGFC for Suburban Environments (NCAT)

- **Project objectives:**
  - Reduce instances of premature raveling while maintaining the safety benefits of FC-5 (reduced hydroplaning and water spray).
- **Researching modified OGFC and SMA mix types.**

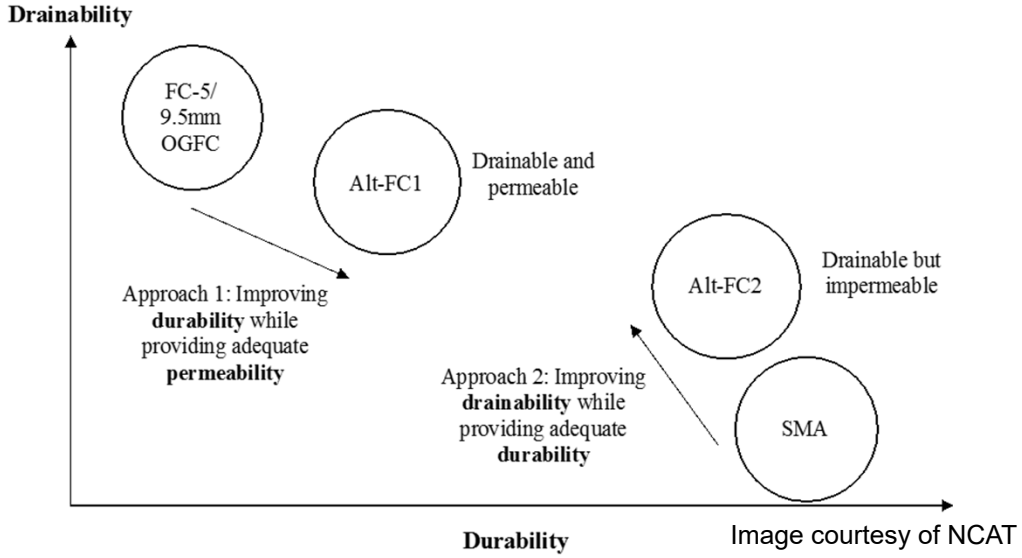


Image courtesy of NCAT

OGFC for Suburban Environments (NCAT)

- **Potential outcome:**
  - A new mix type, which is more durable but also safe, to be used in suburban areas that qualify for FC-5.

Upcoming #1
RAP Binder Contribution to the Mixture

- **FDOT assumes all of the binder in the RAP is activated, whereas most research says it is not.**
  - Therefore, the current FDOT RAP binder contribution factor is 100%.
- **GDOT used a 75% factor from 2012 to 2019.**
- **GDOT switched to a 60% factor in 2019.**
- **GDOT adds extra binder (equal to the 40% of inactive RAP binder) back into the mixture.**
- **Provides increased crack resistance and durability.**

RAP Binder Contribution to the Mixture

- FDOT's #1 pavement distress is cracking.
- Adding more binder will decrease cracking, but how much will it increase rutting?

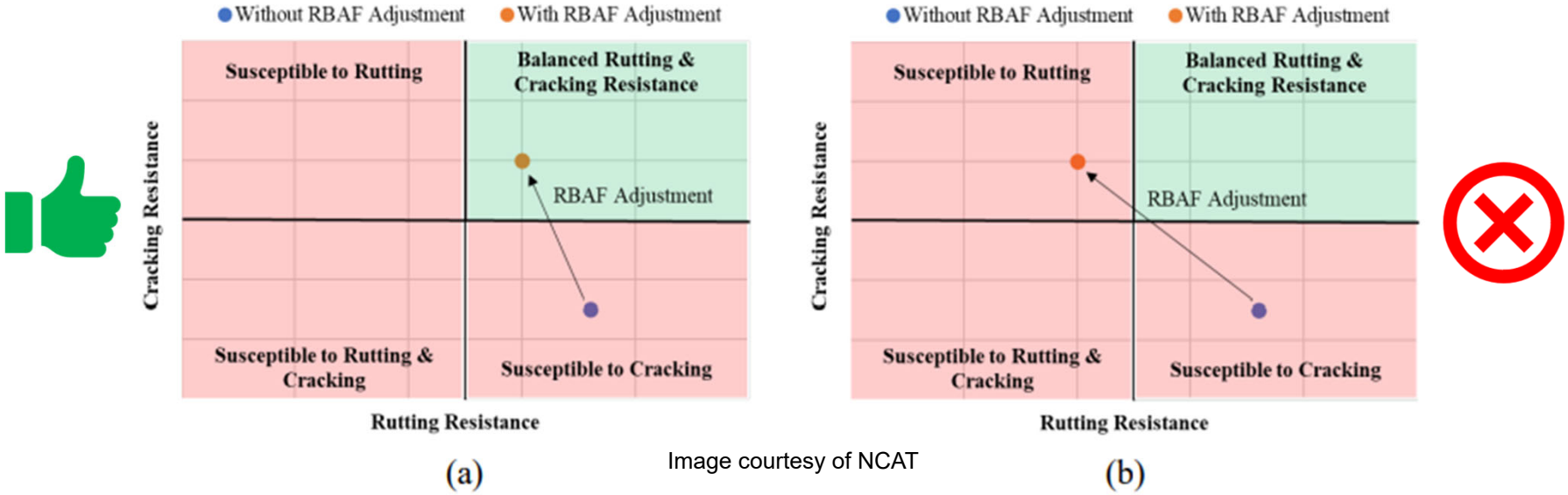


Image courtesy of NCAT

RAP Binder Contribution to the Mixture

- **Objectives:**
  - Determine what value FDOT should use for the RAP contribution factor.
  - Evaluate mixtures for rutting and cracking resistance.
  - Suggest how to implement this during mix design and production.

Upcoming #2
Review of Protocols for Evaluating Defective Material

- **Will evaluate the Department's practices for evaluating defective material.**
- **Will place emphasis on:**
  - Rutting for low air void dense graded mix.
  - Durability for low binder content FC-5.
- **The APA rutting test and Cantabro durability tests will be utilized, among others.**
- **Will evaluate in-place sections where defective material was left in place.**

Upcoming #3 - Alternative Friction Overlays

- Will explore asphalt-based alternatives to High Friction Surface Treatment (epoxy based).
- Will research FC-4.75, FC-9.5, FC-5, and at least one asphalt-based surface treatment to include bauxite or equivalent.

Thank you.

Questions?