Construction Academy
Asphalt Research

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Road Worms (a.k.a. Blisters or Ripples)

Road Worms (Blisters, Ripples)

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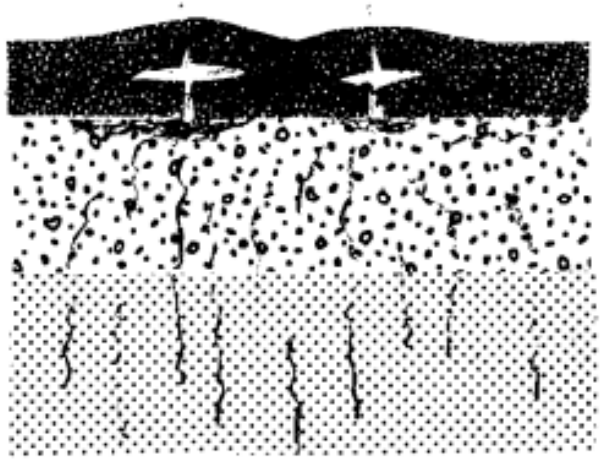
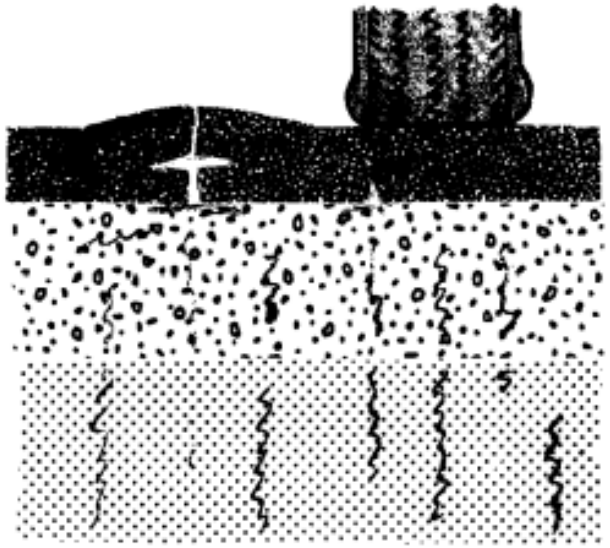
- Previously researched in 1972, 1990, 2011 for individual projects.
- Consensus is that moisture in the asphalt pavement (or sometimes granular base/subgrade) is vaporizing due to heat.

Road Worms (Blisters, Ripples)



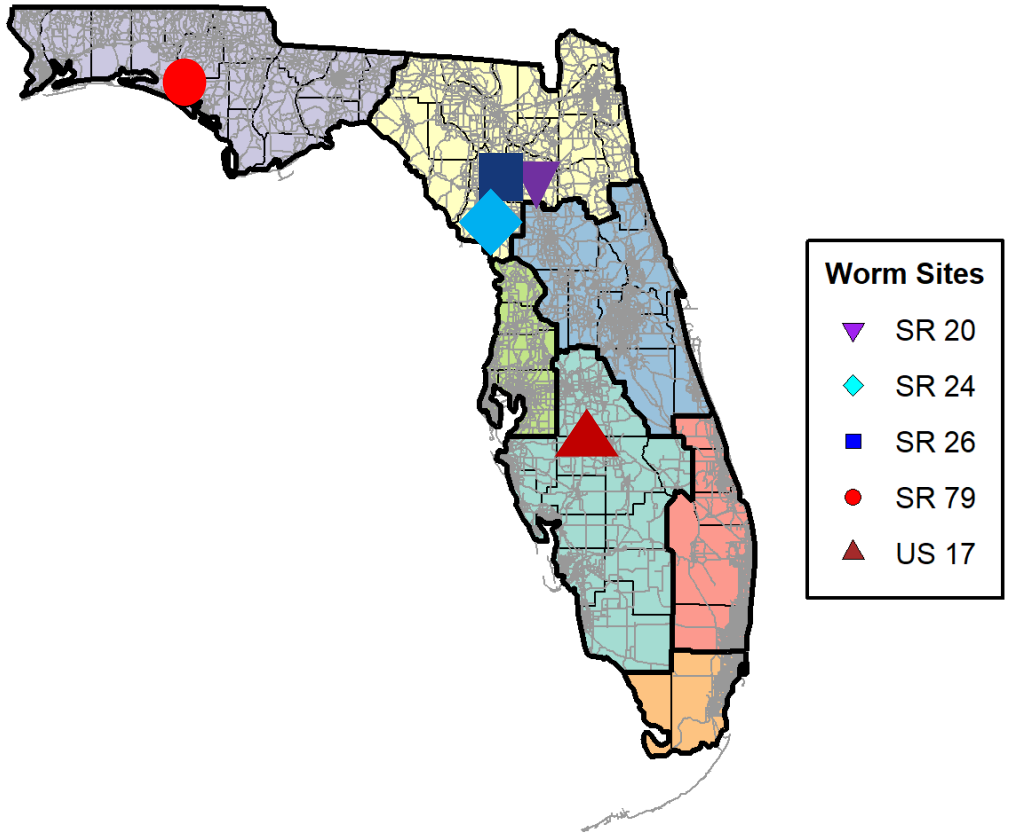
③ Heat causes vapor to expand which pushes up small ripples on the pavement surface



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)

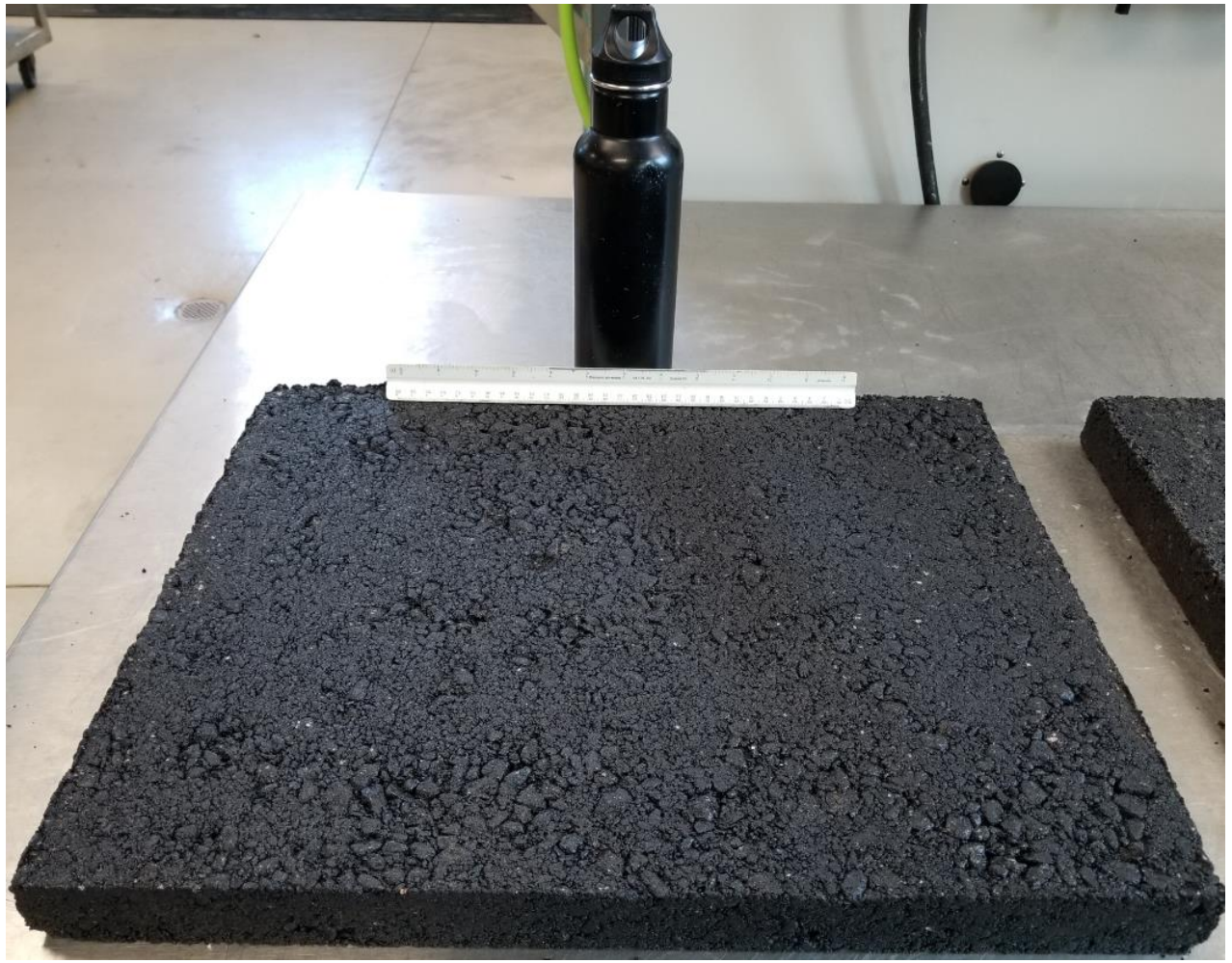
- Applied Research Associates (ARA) performed the research.
- 5 projects
- 3 Dense FC
- 2 OGFC



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.

Expedited Pavement Wearing and Friction Determination



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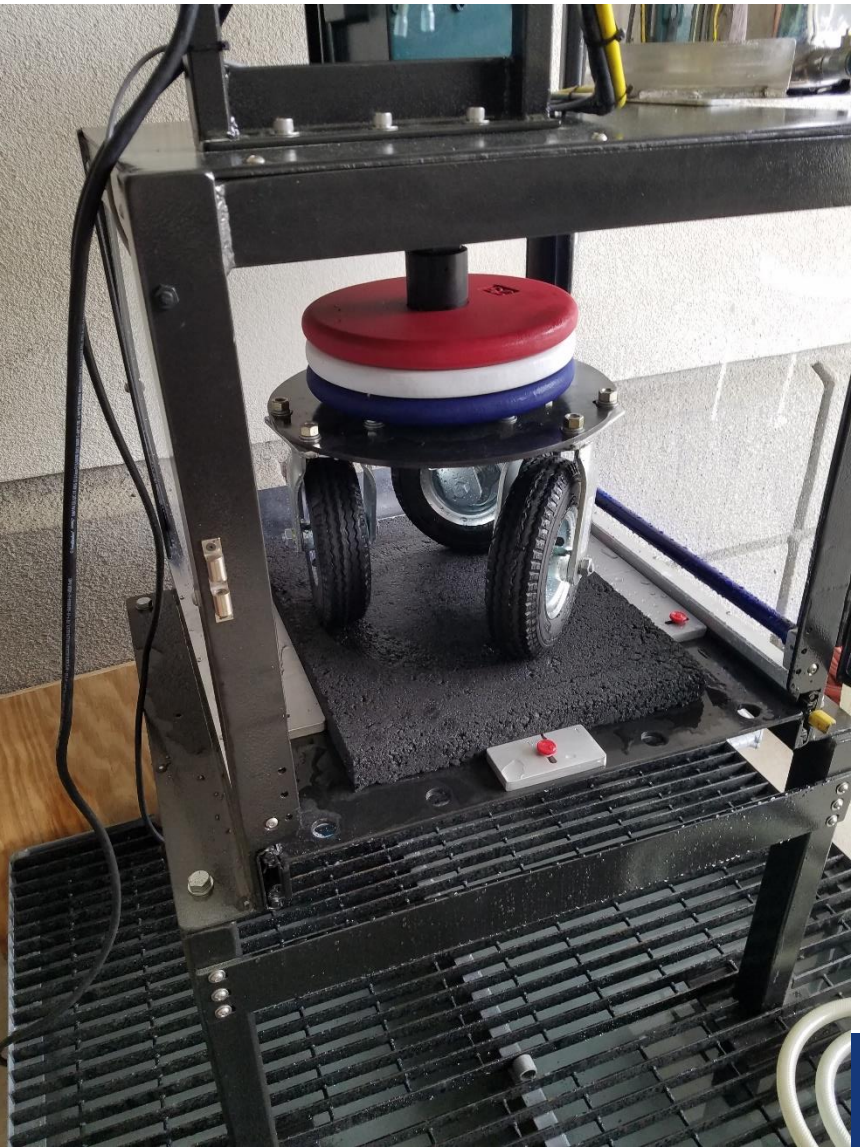

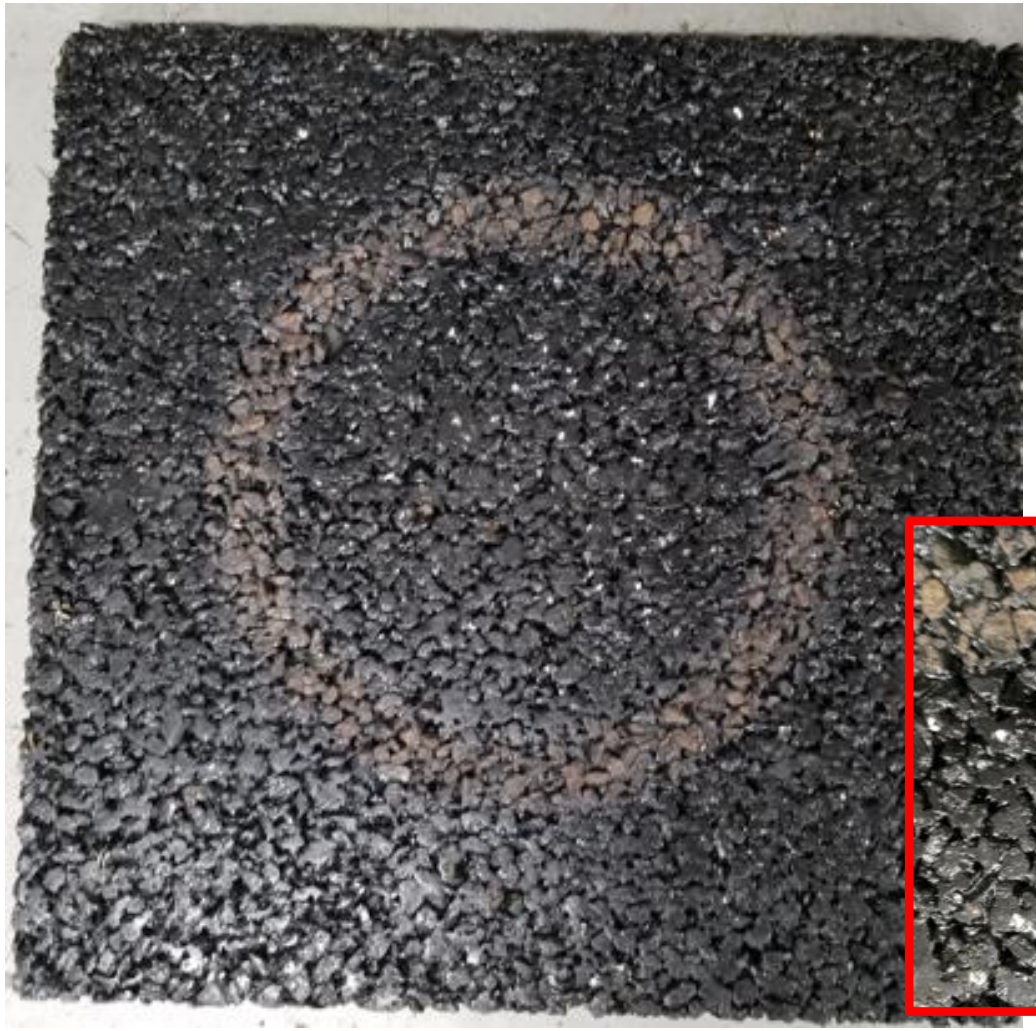

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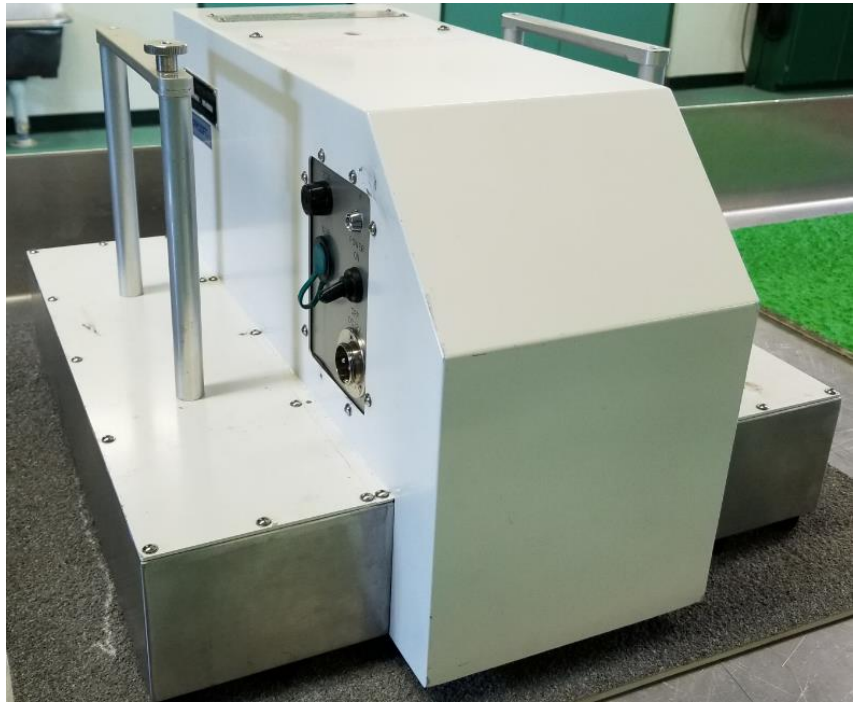
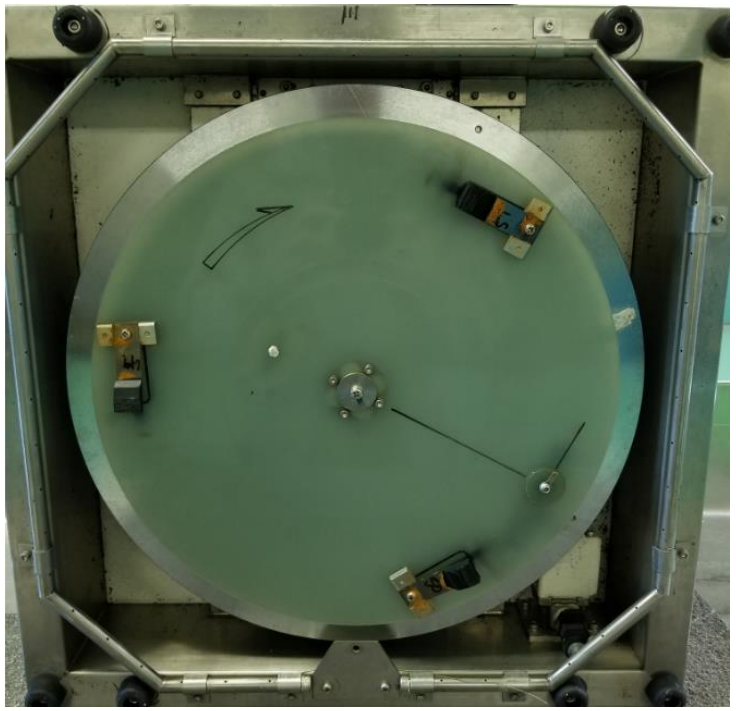


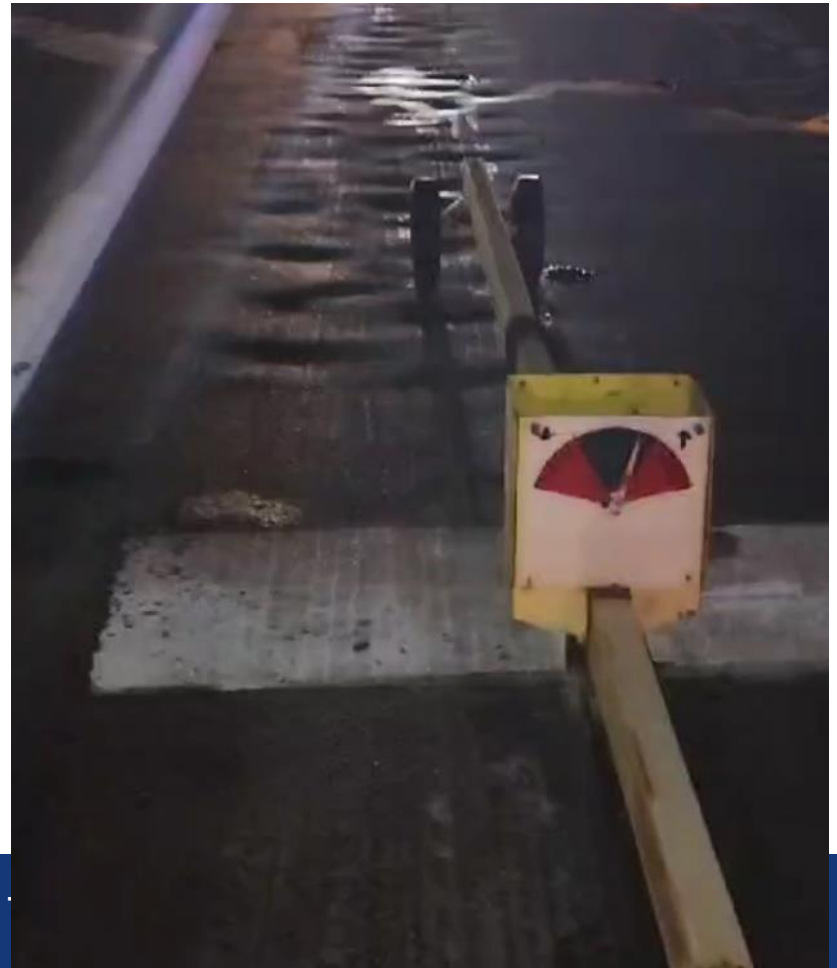


Expedited Pavement Wearing and Friction Determination

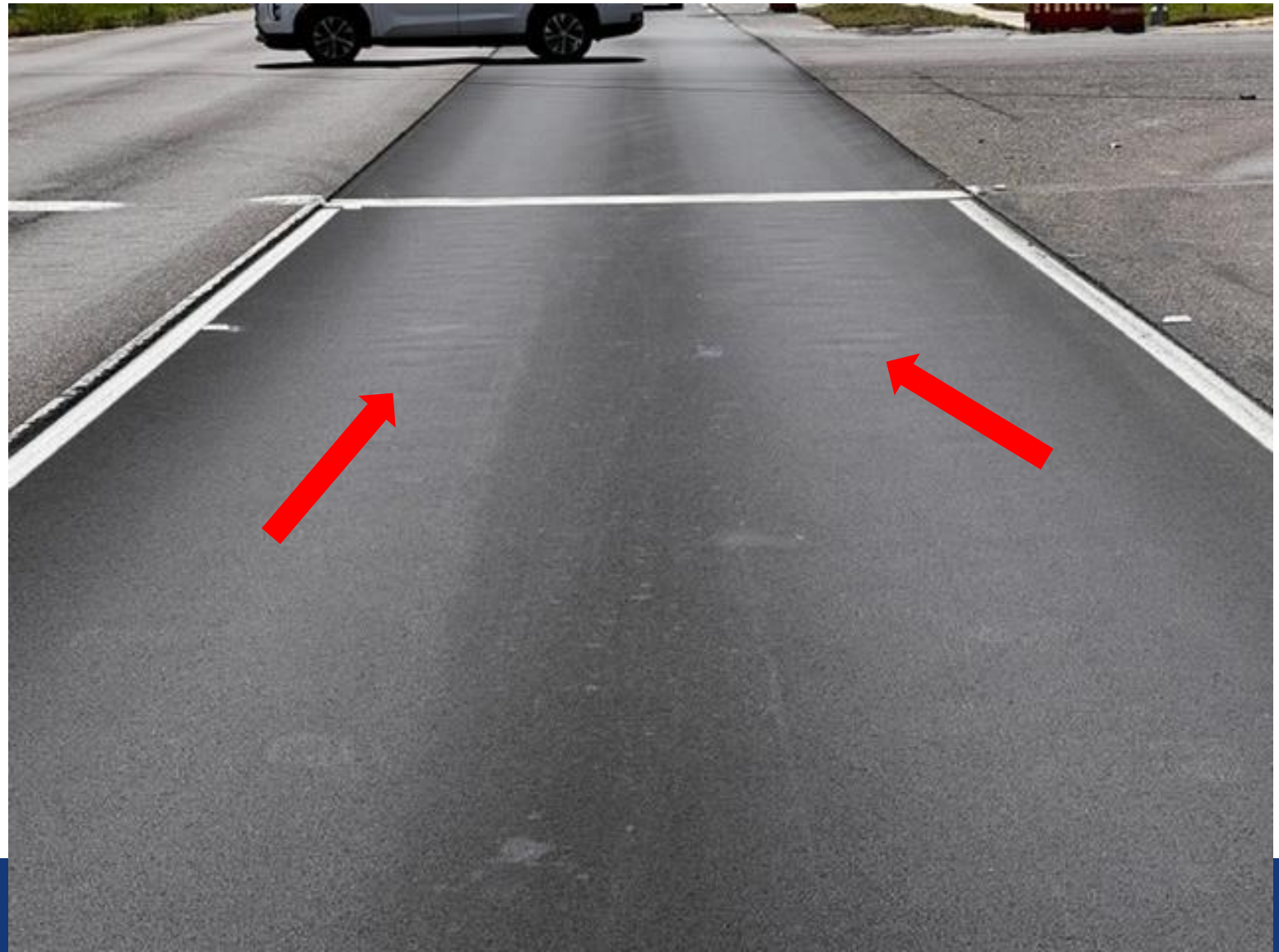
- **Will allow expedited evaluation and approval/disapproval of:**
  - New aggregate sources.
  - Evaluation of mixtures containing RAP with FL limestone.
  - Any mixture type with questionable friction properties.
- **Current process requires a roadway test section and the application of six million AADT.**
  - This process takes about two years.
  - The new process takes about two months.

Case Study of Rutting Investigation

- District 3 project; mill and fill to remove rutted pavement.
- Milling machine left indentations in underlying layer. Ripples in new structural mix.



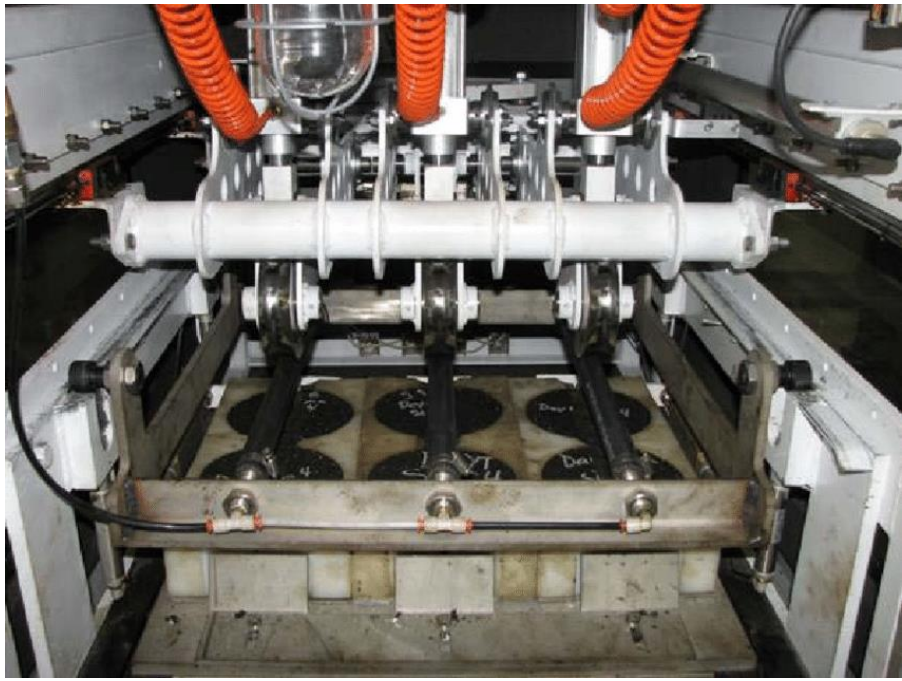
Case Study of Rutting Investigation



Case Study of Rutting Investigation

- Overlaid milled surface with SP-9.5 mix, 1.25” thick.
- Were the ripples a mix problem or caused by the underlying layer?
- Used Asphalt Pavement Analyzer to measure rut depths of both layers.

Location	Layer	Rut Depth (mm)
US-29 & W-Street	Top	1.4
	Lower	8.0



Increased Anti-strip Additives in Granite FC-5 Mixtures

Liquid Anti-strip

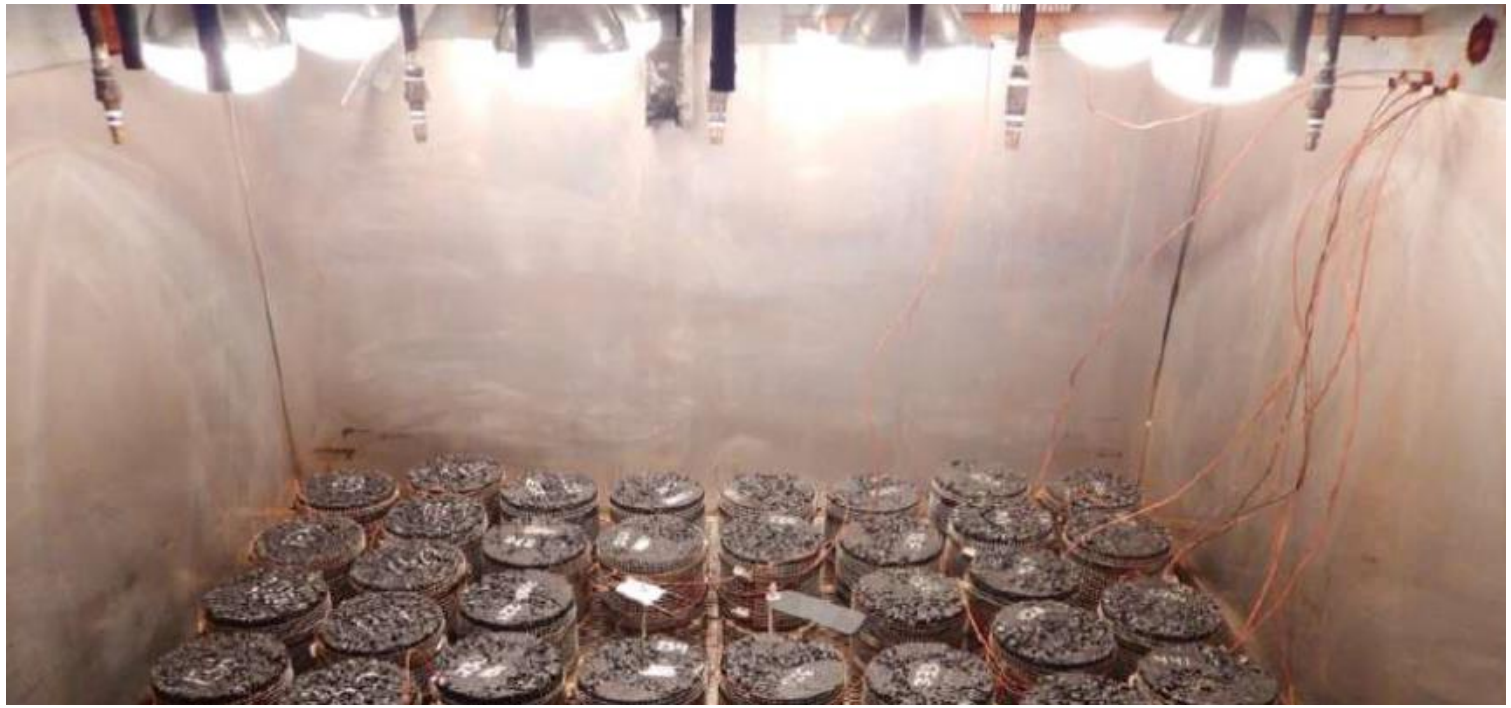
Hydrated Lime

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

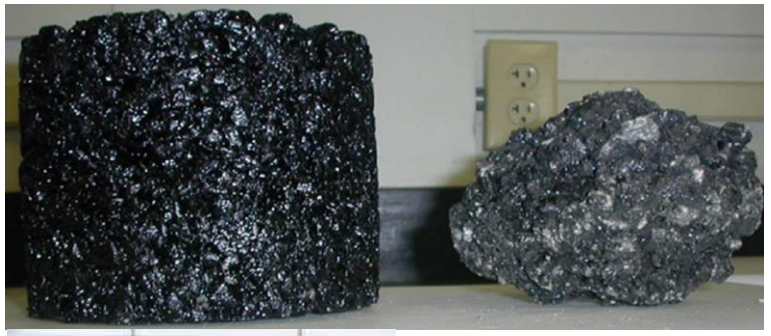
- Specimens were conditioned to simulate the long-term exposure to water infiltration, vapor diffusion, and thermal and ultraviolet oxidation.



Increased Anti-strip Additives in Granite FC-5 Mixtures

Hamburg Rut Tester

Binder Bond Strength



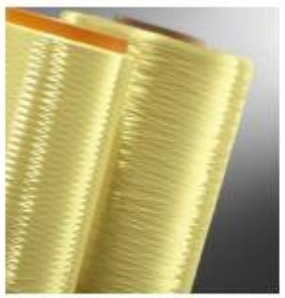
Cantabro

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
Aramid Fibers (two major brands)



Aramid Fiber
(2.1 ounces/ton)

+

Sasobit® Wax
(2.1 ounces/ton)

=

ACE Fiber™
(4.2 ounces/ton)

ACE Fibers

Forta Fibers

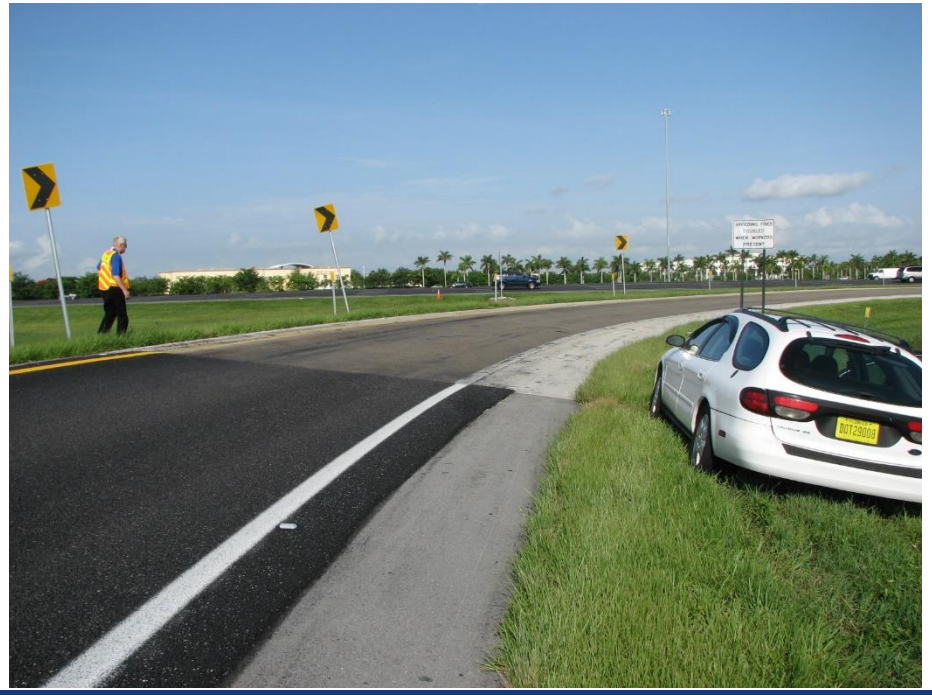
Blend of Aramid and Polyolefin Fibers

Aramid Fibers

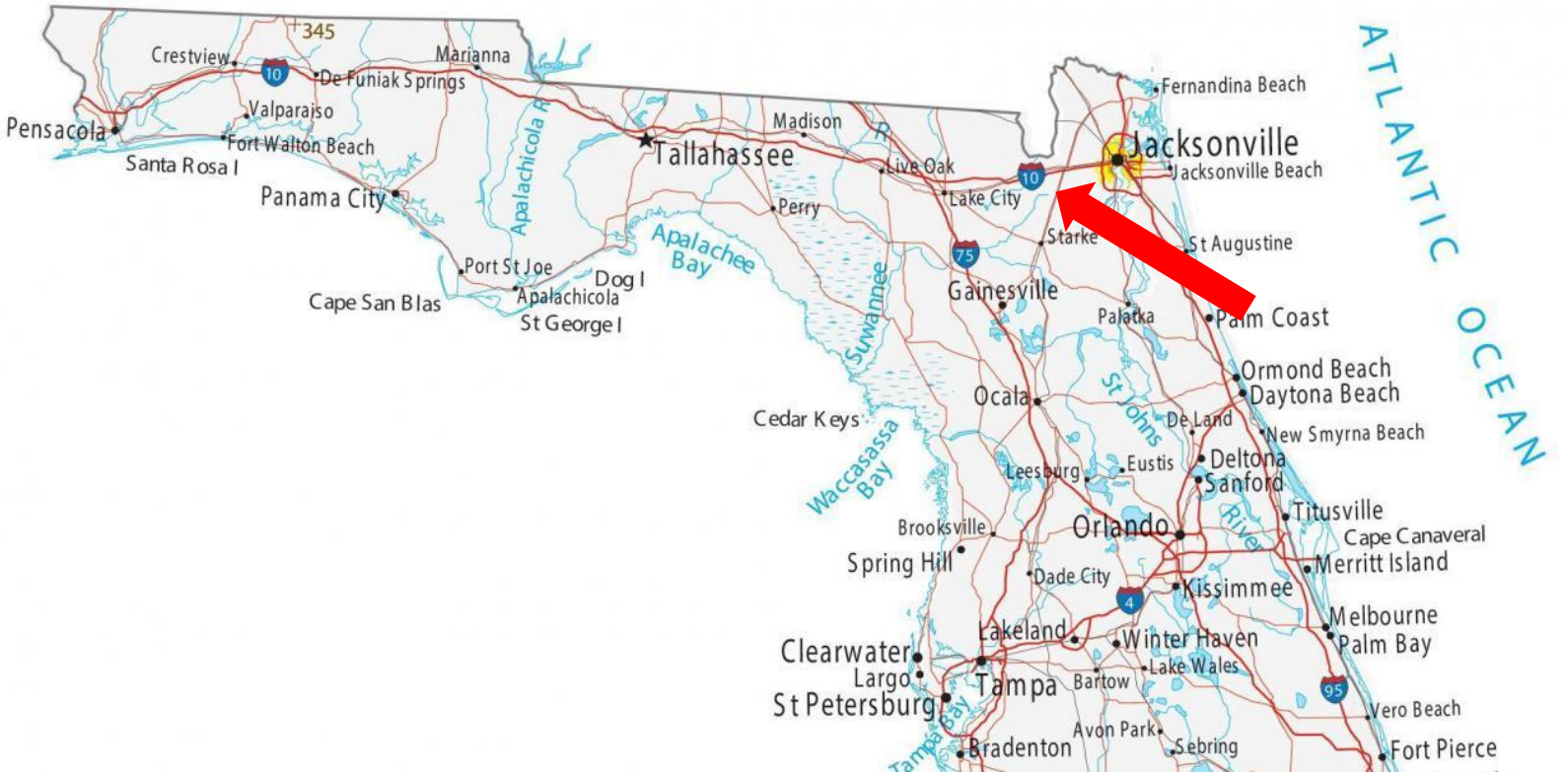
- **Being studied at the State Materials Office Test Track, a field test section (SR-200 in Dist. 2), and in SMO lab.**
- **Will it help rutting and/or cracking resistance?**
- **Is it worth the cost increase?**
- **<u>Potential</u> outcomes:**
  - Fibers allowed as an alternate to PG 76-22.
  - PG 76-22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

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.



Asphalt Test Road



Asphalt Test Road

Asphalt Test Road

- Southbound direction
- Both travel lanes
- 1000’ test sections
- Remove existing material down to the stabilized subgrade as applicable.

Section #1 - Control

- 12” limerock base
- 4” Type SP (TL-E)
- 2” Type SP (PG 76-22) (TL-E)
- 3/4” FC-5 (PG 76-22)

Section #2 – Un-stabilized RAP Base

- 12” Un-stabilized RAP base
- 4” Type SP (TL-E)
- 2” Type SP (PG 76-22) (TL-E)
- 3/4” FC-5 (PG 76-22)

Section #3 – Cold RAP Mix Base (CCPR)

- 12” Cold Central Plant Recycled (CCPR) RAP base (emulsion stabilized)
- 4” Type SP (TL-E)
- 2” Type SP (PG 76-22) (TL-E)
- 3/4” FC-5 (PG 76-22)

Section #4 – Cold RAP Mix Base (Recharge)

- 12” RAP base stabilized only with Recharge (by Blacklidge Emulsions)
- 4” Type SP (TL-E)
- 2” Type SP (PG 76-22) (TL-E)
- 3/4” FC-5 (PG 76-22)

Section #5 – Limerock/RAP Mix Base

- 12” Limerock/RAP base (mixing ratio 50% limerock & 50% RAP) (minimum LBR 100)
- 4” Type SP (TL-E)
- 2” Type SP (PG 76-22) (TL-E)
- 3/4” FC-5 (PG 76-22)

Section #6 – Limerock/RAP Mix Base

- 12” Limerock/RAP base (mixing ratio 75% limerock & 25% RAP) (minimum LBR 100)
- 4” Type SP (TL-E)
- 2” Type SP (PG 76-22) (TL-E)
- 3/4” FC-5 (PG 76-22)

Section #7 – Full Depth Reclamation (FDR)

- Mill 6-3/4”
- Remix the existing materials per FDOT **FDR** spec (12” mixing depth)
- 4” Type SP (TL-E)
- 2” Type SP (PG 76-22) (TL-E)
- 3/4” FC-5 (PG 76-22)

Section #8 – Reflective Cracking Study

- **Test Section (500’)**
  - Mill 3-3/4”
  - Sawcut longitudinal and transverse cracks to the base
  - 1-1/4” Crack Relief Mix (HP binder)
  - 1-3/4” Type SP (PG 76-22) (TL-E)
  - 3/4” FC-5 (PG 76-22)
- **Control (500’)**
  - 3” Type SP (PG 76-22) (TL-E)
  - 3/4” FC-5 (PG 76-22)

Section #9 – Superpave 5

- Mill 3-3/4”
- 3” Type SP5 (PG 76-22) (TL-E)
- 3/4” FC-5 (PG 76-22)

Section #10 – Deep Lift Study

- **Mill 8.25”**
- **Test Section A (500’)**
  - 6” Type SP (HP binder) (TL-E)
  - 1-1/2” Type SP (HP binder) (TL-E)
  - 3/4” FC-5 (PG 76-22)
- **Test Section B (500’)**
  - 6” Type SP (PG 76-22) (TL-E)
  - 1-1/2” Type SP (PG 76-22) (TL-E)
  - 3/4” FC-5 (PG 76-22)

Section #11 – FC-5 Only

- Mill 1”
- 1” FC-5 (PG 76-22)
- Control mix to compare to Section #12

Section #12 – FC-Q Only

- **Mill 1”**
- **1” FC-Q (PG 76-22)**
  - Similar in gradation to old FC-2 but modernized to FC-5 standards.
  - Gradation is finer than FC-5.
  - More durable open graded mixture (ideal for suburban environments).

Thank you.
Comments/Questions?

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