

Innovations in Asphalt Materials, Mixtures, & Testing

Phillip Blankenship, PE

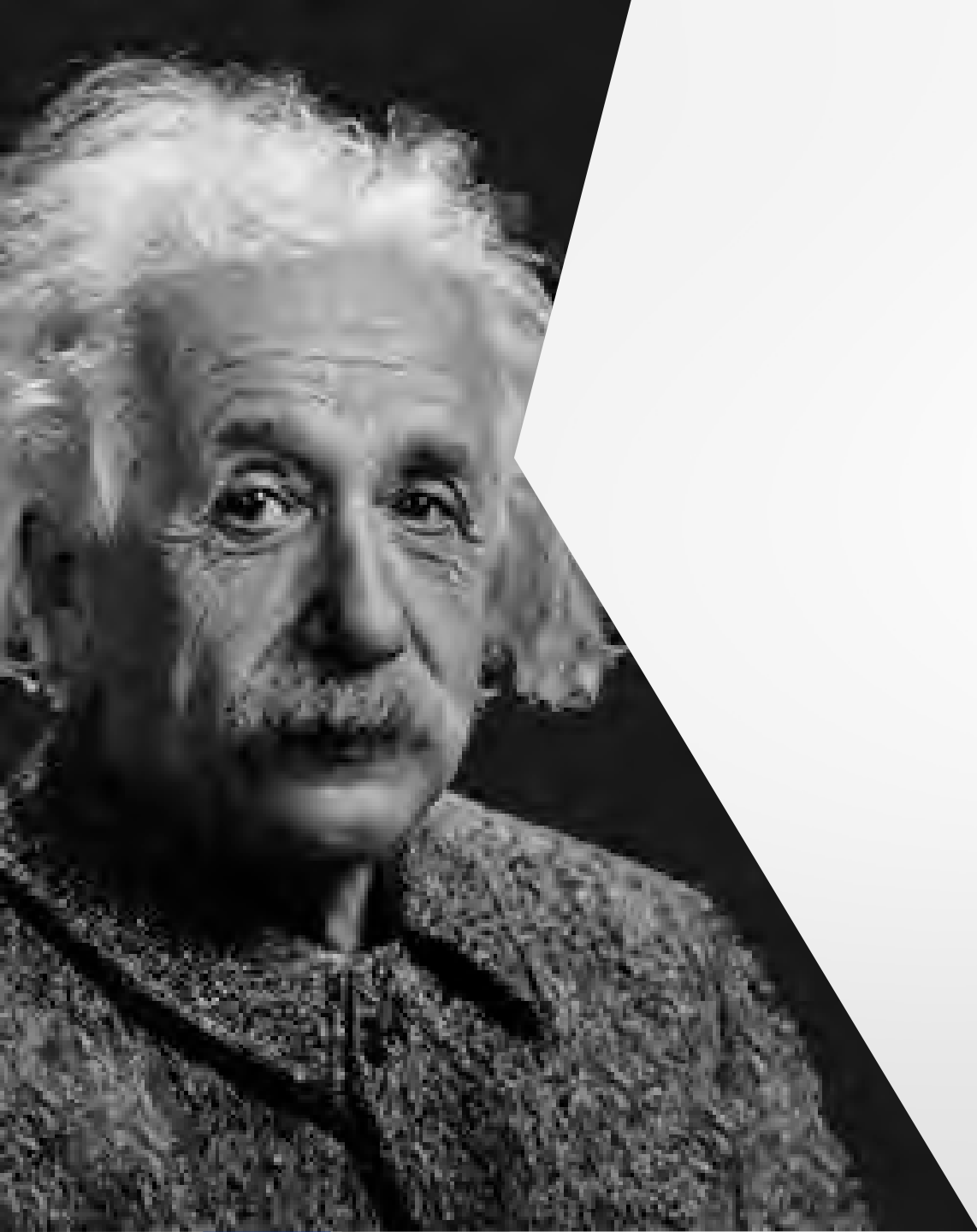


January 2024



Topics

- Challenges and the Need for Innovation
- Modern Testing
- New(er) Mixtures and Materials
- Products
- Demo Projects Using Aramid Fiber, Bio Oils, and Reacted Isocyanate
- What's Next?



*"Creativity is
intelligence having
fun."*



What Is Asphalt Mix Innovation?

It depends on who you ask

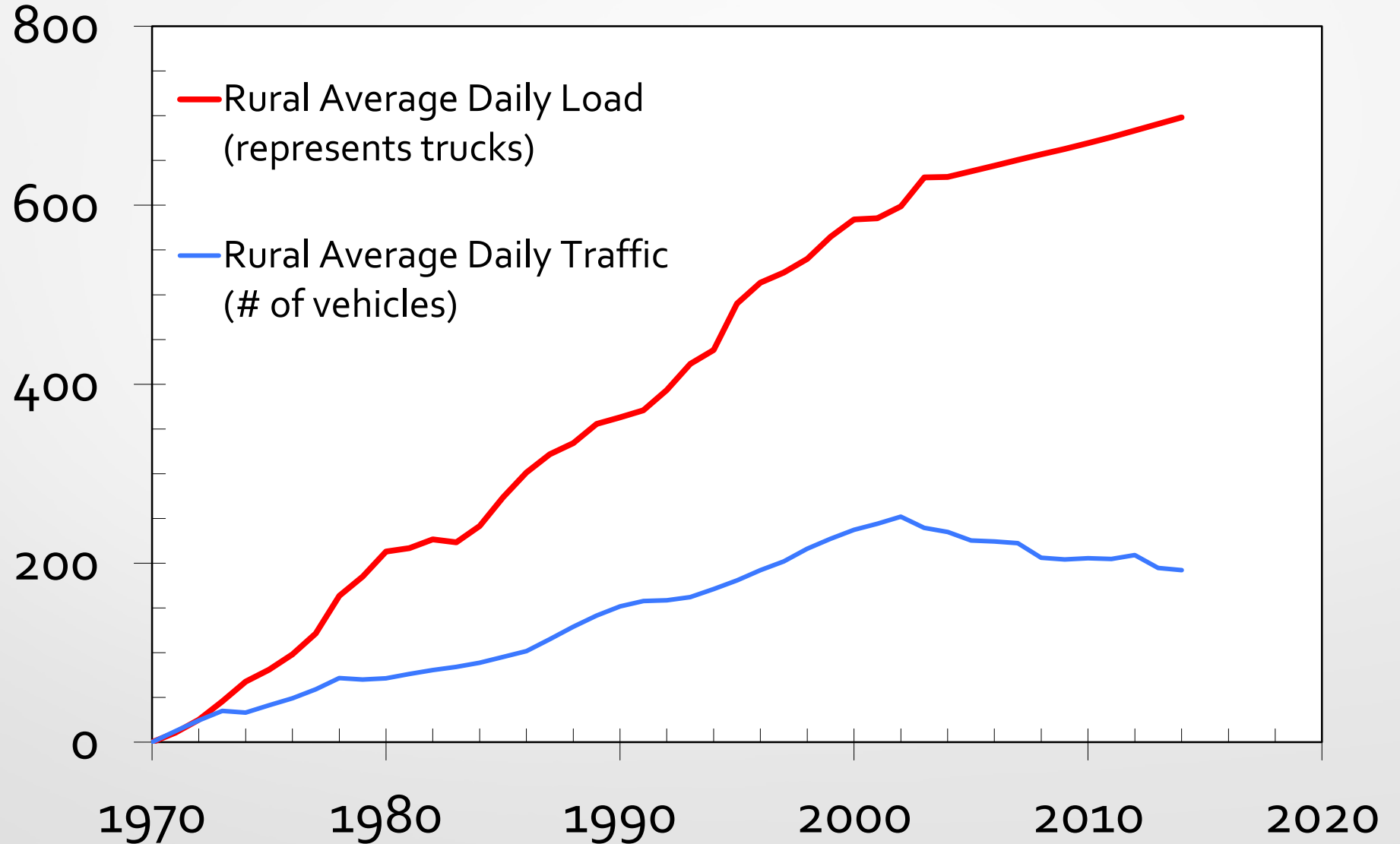
- **DOT** – much longer life at less cost. Best if not proprietary.
- **HMA Contractor** – better control of mix at the HMA plant that is easy to use (mix, haul, compact). Use of more RAP.
- **Private Property Owner** - more sustainable options. Longer life. Cost not real issue if performance is delivered.



Challenges

Traffic & Load Growth on Rural Interstate System

Percent
Change Since
1970



2021 ASCE Infrastructure Report Card

2021
REPORT CARD
FOR AMERICA'S INFRASTRUCTURE

COVID-19 RESOURCES



MAKING THE GRADE

INFRASTRUCTURE CATEGORIES

INFRASTRUCTURE BY STATE

SOLUTIONS

RESOURCES

TAKE ACTION

NEWS & INSIGHT



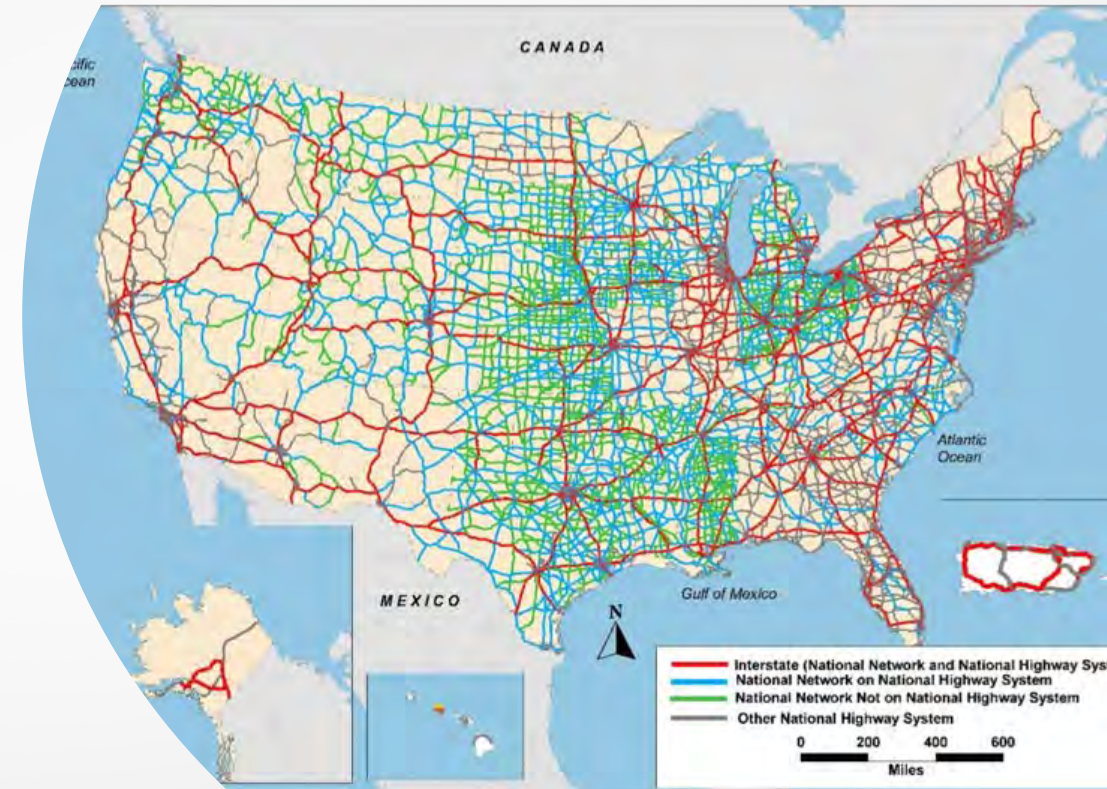
Roads



Source: <https://www.infrastructurereportcard.org/>

Facts

- 4 million miles of public roadways in the United States
- Our nation's highways and roads move 72%, or nearly \$17 trillion, of the nation's goods
- Vehicle miles traveled reaching more than 3.2 trillion in 2019, an 18% increase from 2000
- Every lane-mile of road costs approximately \$24,000 annually in operation and maintenance





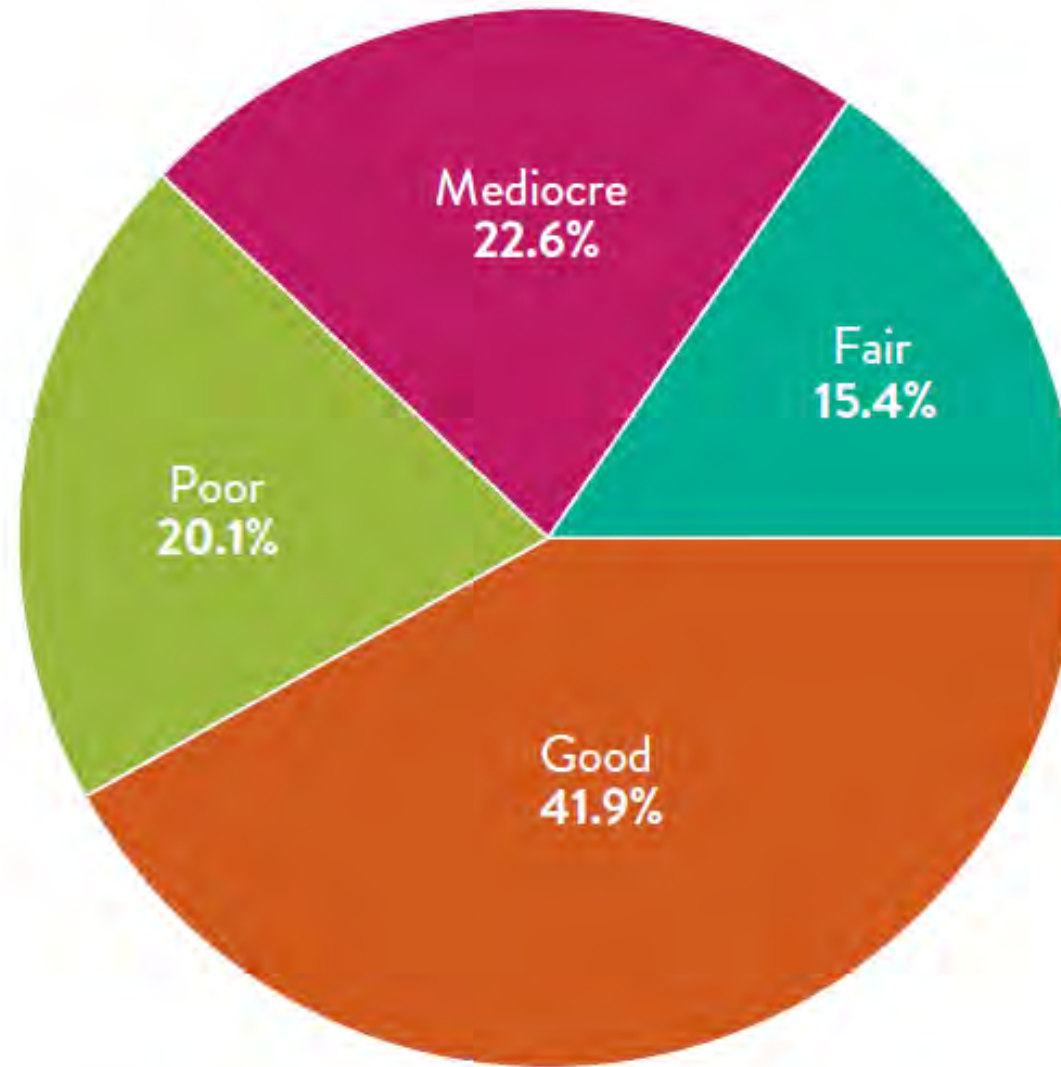
Congestion: 47% of the nation's urban interstates are experiencing congestion during peak hours, and 30% of trips taken on the nation's roads are impacted by severe or extreme congestion.

Condition

- “D” rating of our highway system
- 43% of the system is now in poor or mediocre condition costing drivers an estimated \$1000 annually
- While traffic fatalities have been on the decline, over **36,000 people are still dying** on the nation’s roads every year
 - Number of pedestrian fatalities is on the rise
- At least **27 states have de-paved** roads.



Roadway Condition



Source: Data from TRIP, a National Transportation Research Nonprofit



Recommendations to Raise the Grade

- **Focus** resources on preserving a state of **good repair**
- **Increase funding** from **all** levels of government
- **Develop** state and local level comprehensive transportation asset management **plans**



Innovation

- Timely, preventive maintenance of our roads with better materials extends the life of pavement and costs less than reconstructing pavements after they reach failure
- Create smart pavements with sensors to provide real-time feedback with low user impact
- Additionally, the use of next generation materials and decentralized traffic lights to promote traffic flow
- See FHWA: <https://www.fhwa.dot.gov/innovation/everydaycounts/edc-4.cfm>

Targeted Overlay Pavement Solutions (TOPS) – Everyday Counts by FHWA

- ***“Design methods (SMA), interlayer technology...”*** – FHWA
- For asphalt overlays
 - Several DOTs have adopted SMA due to increased service life and performance
 - Other DOTs found highly modified asphalt in thin overlays is more resistant to reflective cracking increasing pavement life by 2 to 4x
- Learn more:
www.fhwa.dot.gov/innovation/everydaycounts/edc_6/targeted_overlay_pavement.cfm



U.S. Department of Transportation
Federal Highway Administration

Asphalt Materials

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Sustainability

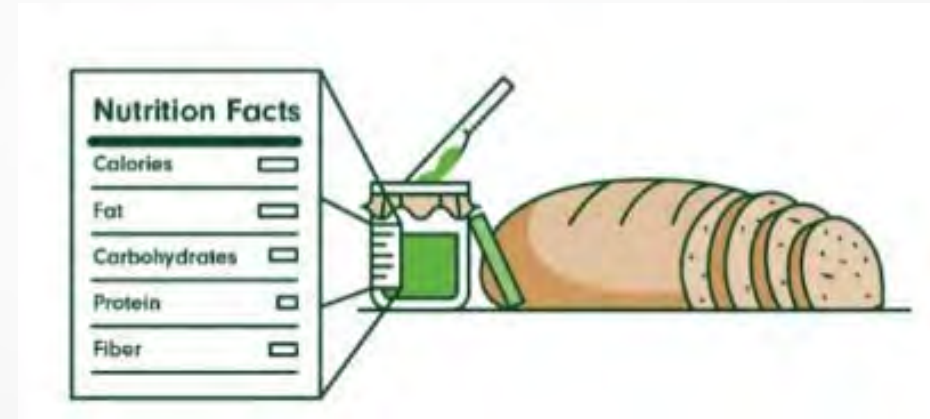
- Push to evaluate sustainable options
- Happening at a time we are trying to fix our mixes



Environmental Product Declaration (EPD)

<https://www.fhwa.dot.gov/pavement/sustainability/hif21025.pdf>

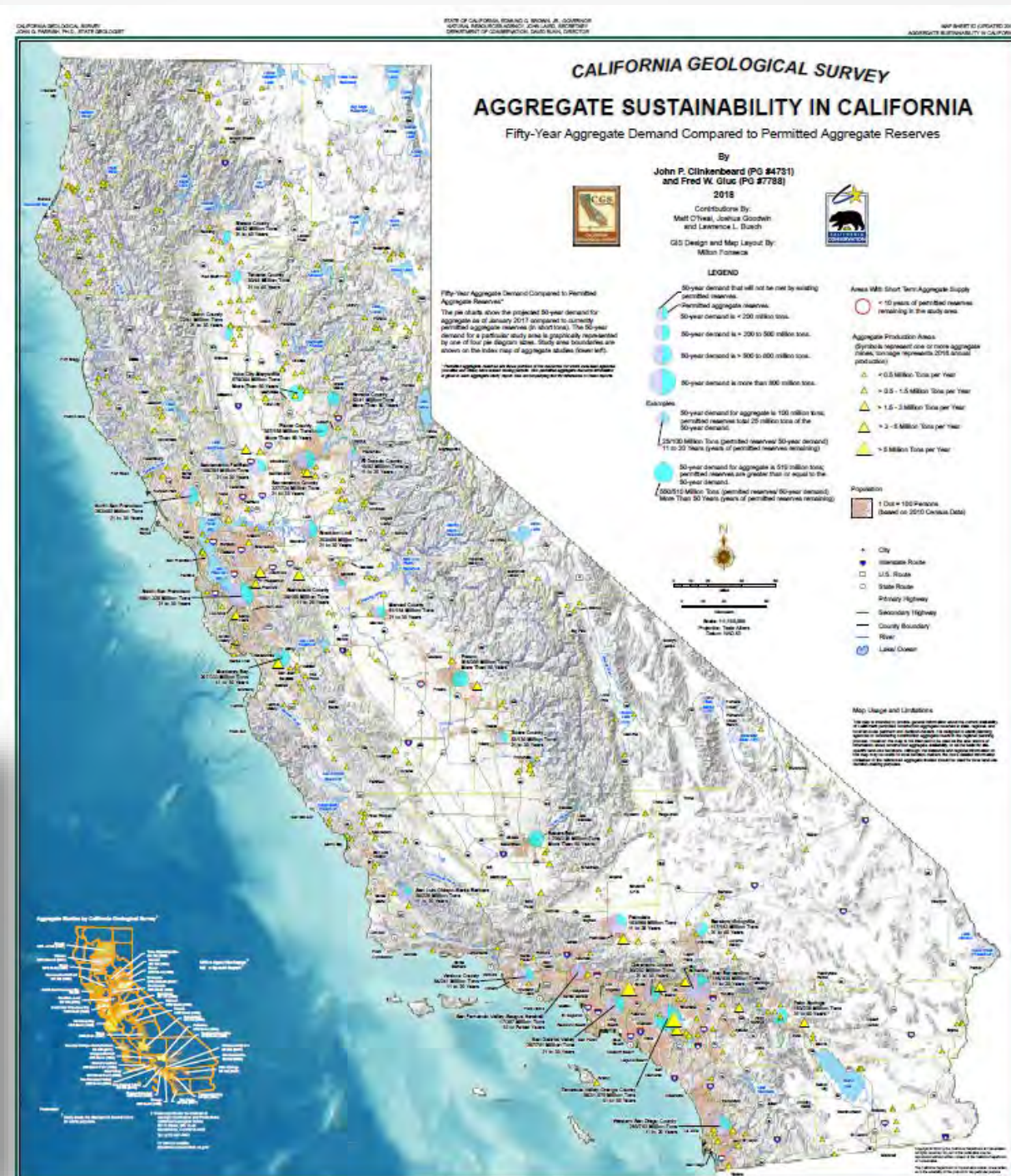
- What is EPD?
 - “Nutritional label for our mixes”



- Environmental Product Declarations (EPDs) are developed by the producers of construction materials as tools that communicate the environmental impacts of material production



Scarcity of New Aggregate Sources





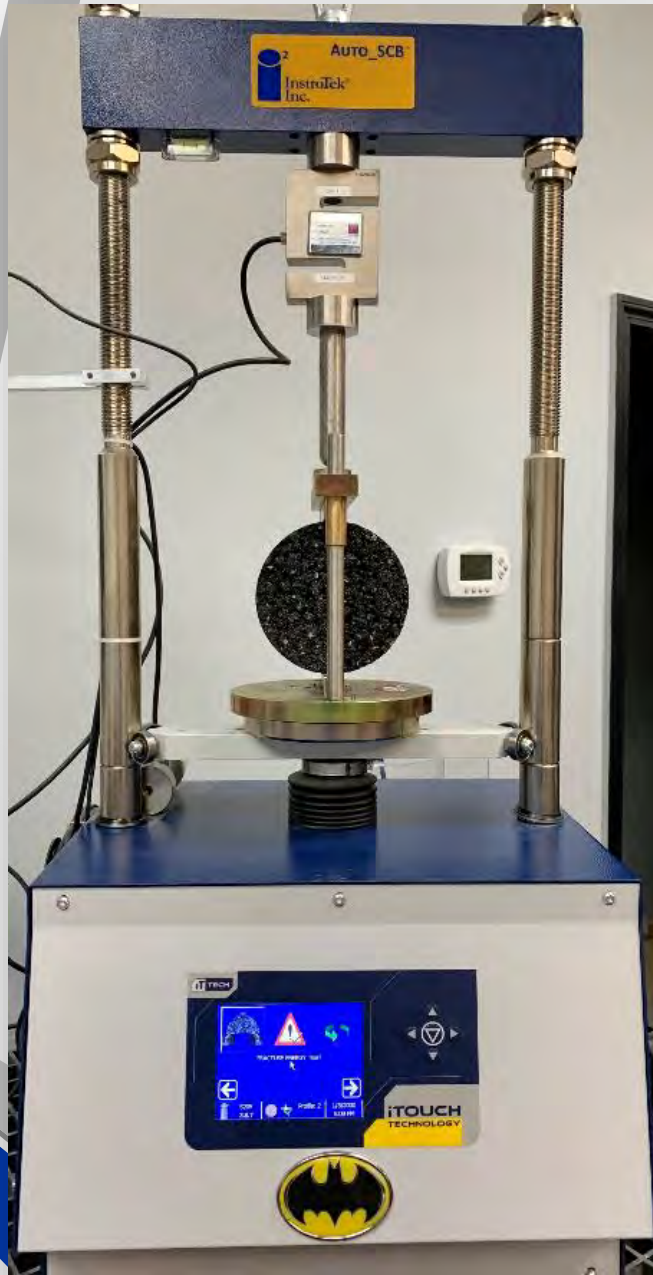
Modern Testing



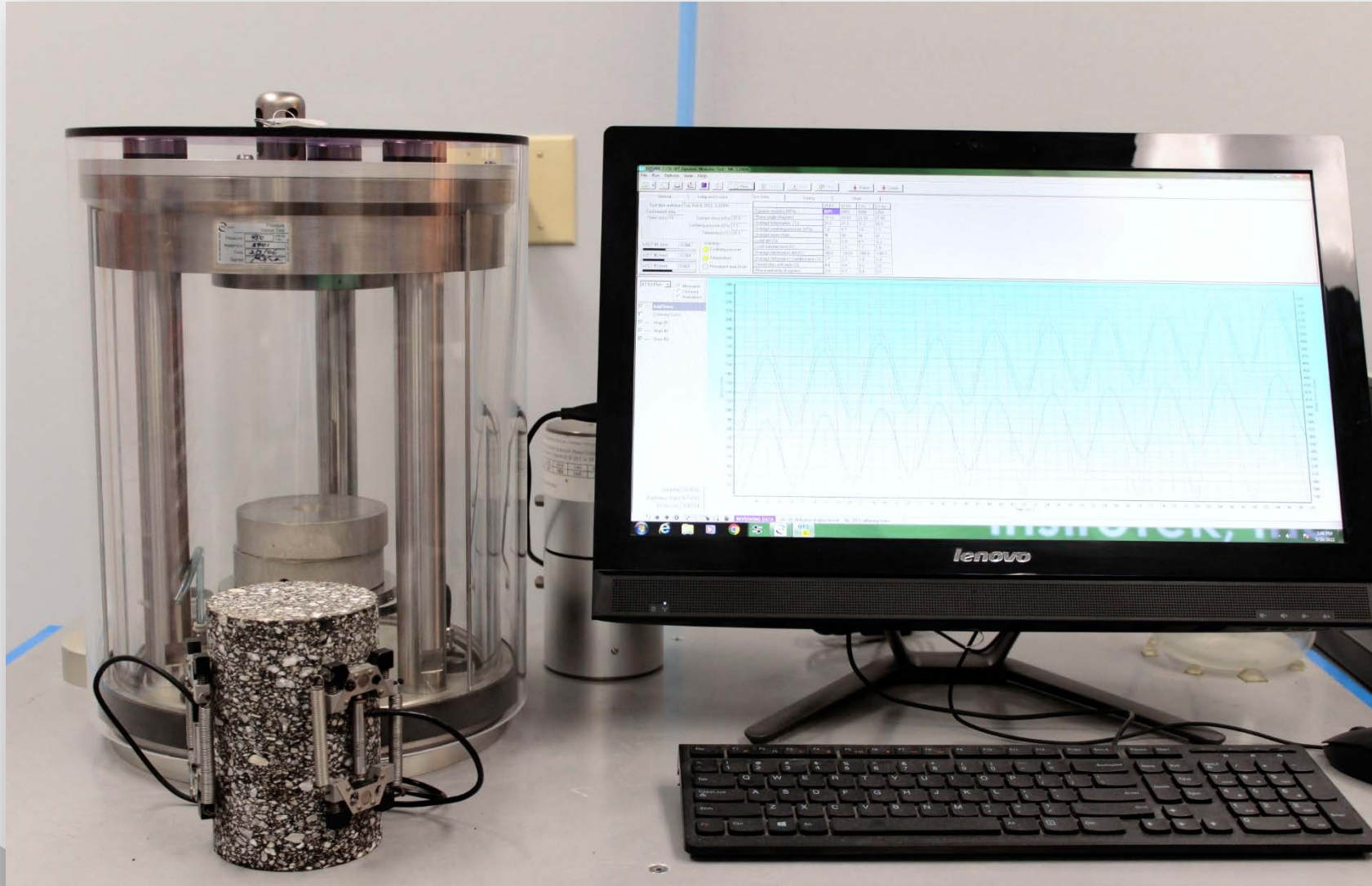
BATT – 6,000 sf facility



IDEAL-CT and HWT



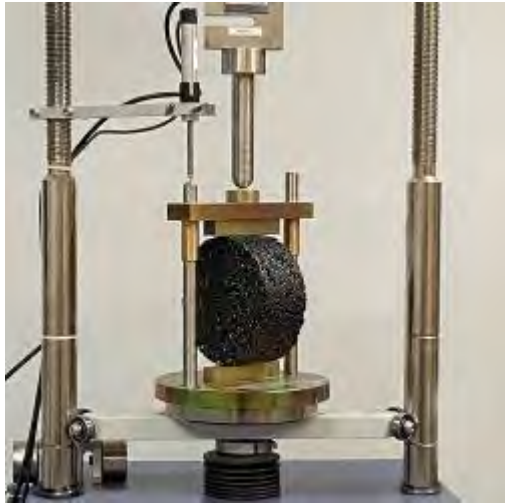
Quick Pavement Modulus for Structural Design



Friction Testing



BATT Services



Asphalt Material Testing

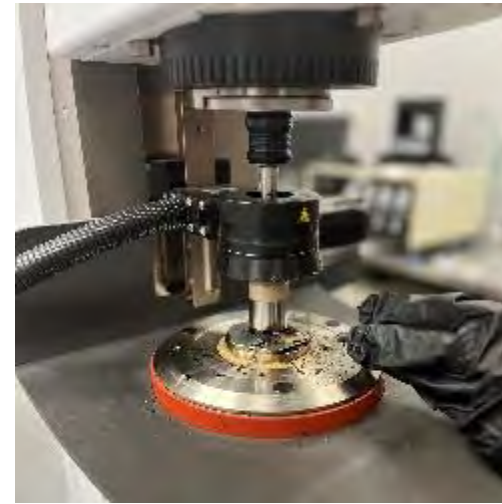
Accredited Lab

- Binder
- Hot Mix Asphalt
- Aggregate



Consulting Services & Forensic Analysis

- Engineering
- Pavement Design
- Expert Witness
- Pavement Distresses



Product Development

- Lab to Pavement
- Commercialization
- Trial Applications
- Formulation



Training

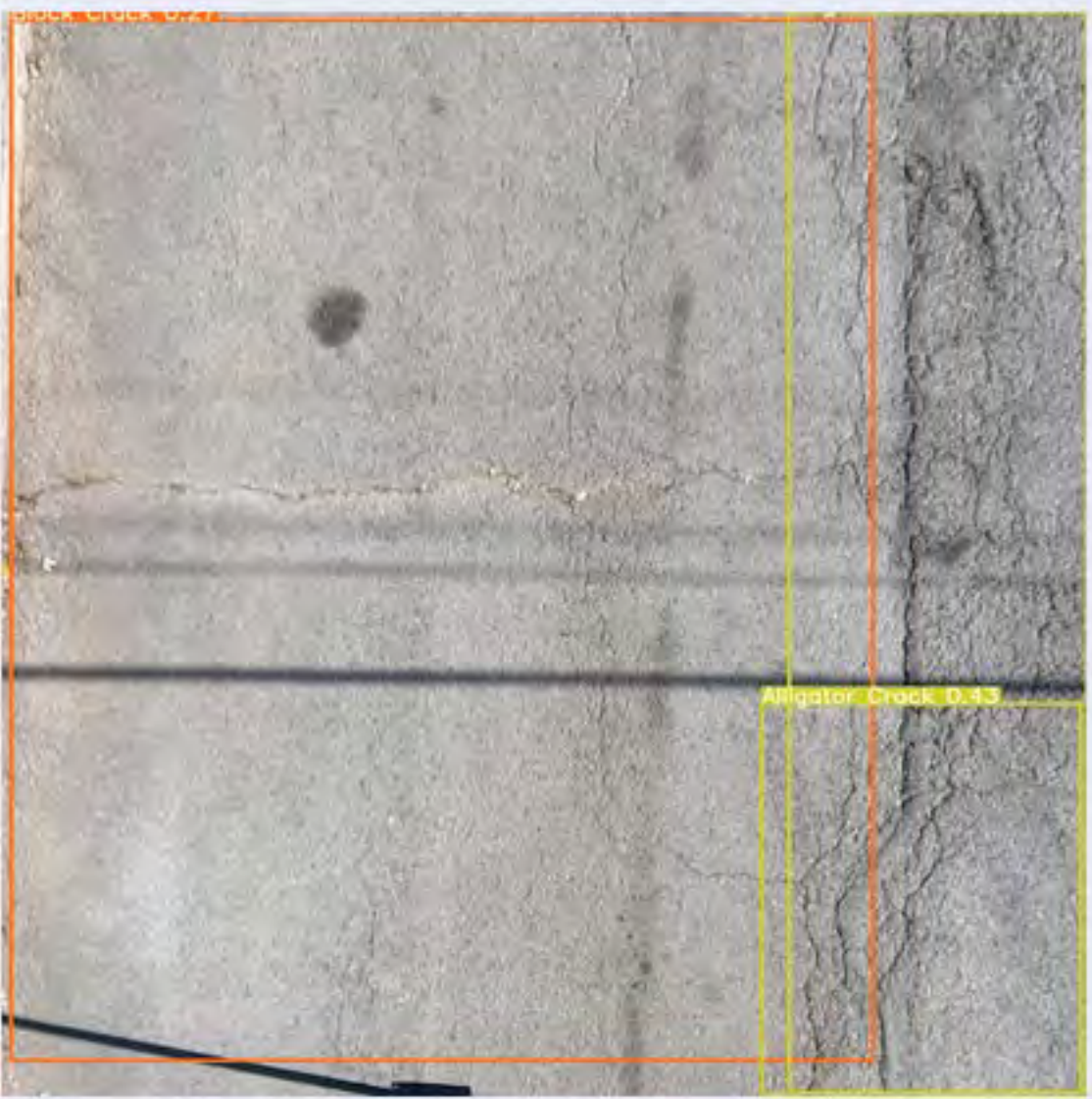
- Mix Design
- Asphalt 101
- Materials Testing
- Custom-Design Training

Extract/Recover Safely



BATT Services

Pavement Condition (PCI) Monitoring





New(er) Mixtures and Materials

New Mixtures

BMD – enough said

- Contractor (and agency) can see the potential outcome of materials combinations

High RAP

- Not just high RAP...engineered with BMD

Asphalt interlayer - RCRI

- US has had in place since 2000
- Included in FHWA Every Day Count & TOP's program

Thin lift surfaces

- Similar to interlayer (#4 mix), but lower AC and more open

Products

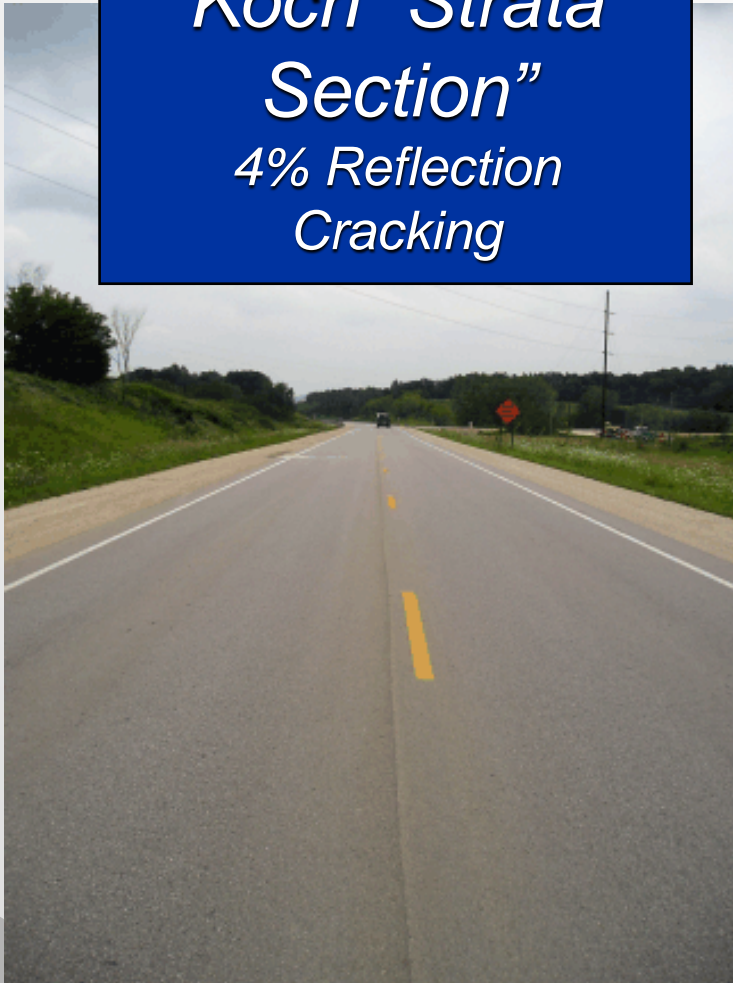
- Pre 2020
 - Asphalt Reflective Crack Relief Interlayer (RCRI)
 - 1 in (25 mm) thick
 - PG 64-28 lightly modified binder
 - Can also make with just high polymer asphalt if available
 - 4.20 oz/ton aramid fiber (2x dose)
 - AC Content - ~8.5%



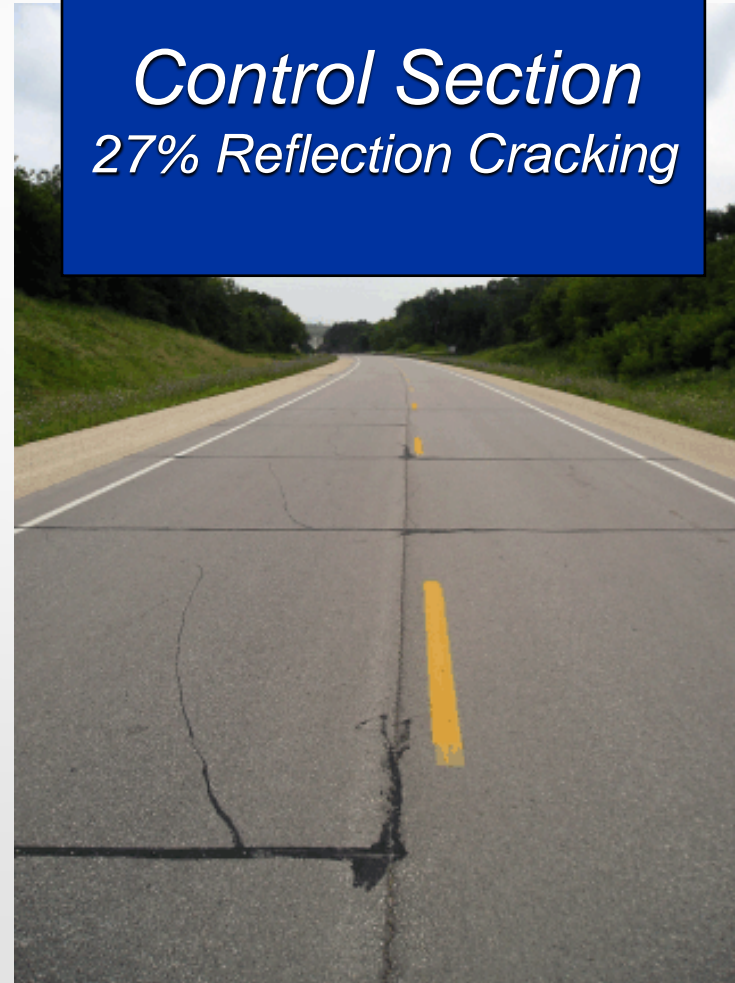
~2004 Example

IA-9, Decorah Iowa (from older Koch data)

*Koch "Strata
Section"
4% Reflection
Cracking*



*Control Section
27% Reflection
Cracking*



Performance after
3 winters

Modifiers To Watch

- Pre 2020
 - Aramid (polymer) fiber
 - Surface Tech (one brand)
 - Improves rutting, cracking, and reduced thickness
 - Add at HMA plant. Proven.
 - Hi-polymer (HiMA)
 - Kraton **KRATON**
 - Improves rutting, cracking, and reduced thickness
 - Terminal dependent. Proven.

SURFACE TECH™



Products To Watch

- Pre 2020
 - Bio-oils (ex. soybean and corn-based oils) – they work well and react with asphalt binder
 - Some recycling agents



What Are All of These Oils/Recycling Agents?

Table 7. Recycling-agent categories and types (Willis and Tran 2015).

Category	Types	Description
Paraffinic oils	Waste engine oil Waste engine oil bottoms Valero VP 165 [®] Storbit [®]	Refined used lubricating oils.
Aromatic extracts	Hydrolene [®] Reclamite [®] Cyclogen L [®] ValAro 130A [®]	Refined crude oil products with polar aromatic oil components.
Napthenic oils	SonneWarmix RJ [™] Ergon HyPrene [®]	Engineered hydrocarbons for asphalt modification.
Triglycerides and fatty acids	Waste vegetable oil Waste vegetable grease Brown grease Oleic acid	Derived from vegetable oils.
Tall oils	Sylvaroad [™] RP1000 Hydrogreen [®]	Paper industry by-products. Same chemical family as liquid antistrip agents and emulsifiers.

Note that other **Bio Oils** (soybean and corn) are not listed in 2015

Products To Watch

- 2020 +
 - BASF B2Last
 - New modifiers – reactive isocyanate chemistry
 - Binder replacement with new products
 - UberBinder, maybe plastics, etc.
 - Plastics
 - Old product with new look at processing
 - High (bottles) and low (Walmart bags) density polyethylene
 - Shredded and liquid form
- Many more...just a few here



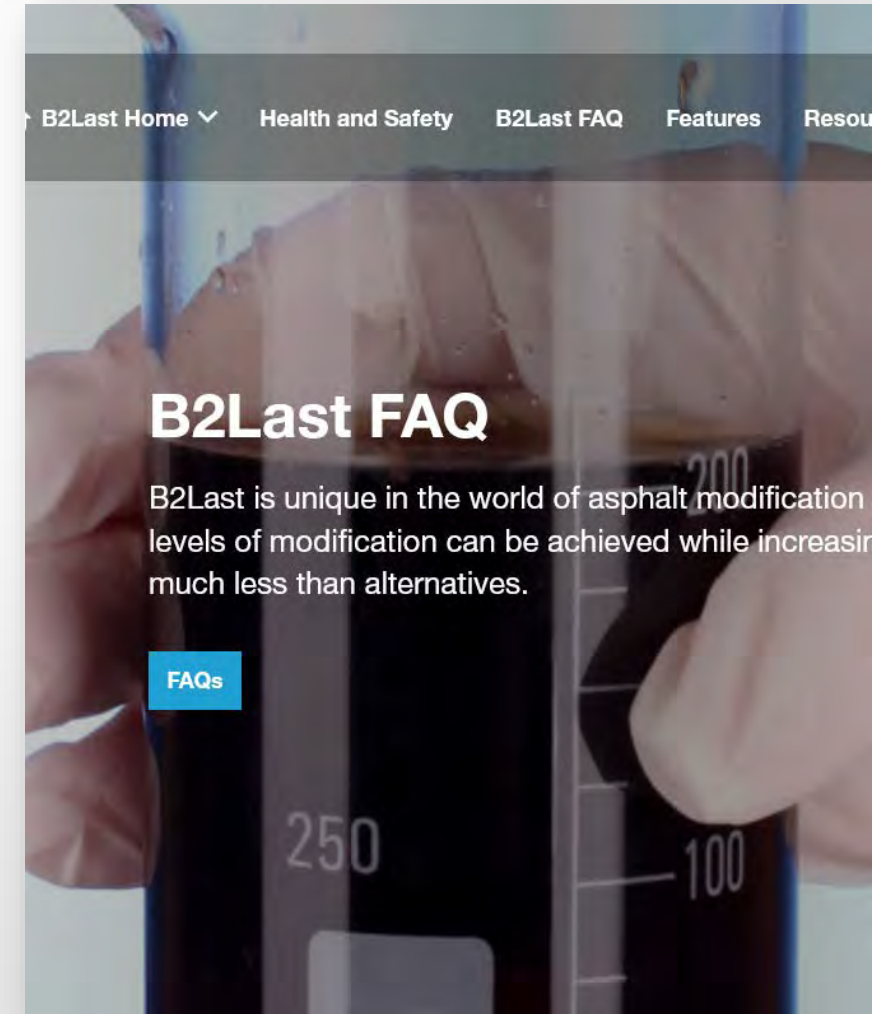
UBERBINDER™

Low carbon concrete and asphalt
Repair the world



BASF Reactive Isocyanate Modifier

- Gorilla glue-type technology
- Liquid additive that can be added at the HMA plant and reacted overnight
- Works with or without polymer
- Lower vis than polymer (easy to compact and loot)
- Sets up very strong and very adhesive when cool
- Lower H₂S fumes
- 4 trials in KY
- <https://b2lastna.basf.com/>



- NCAT is working new projects related to plastics in asphalt
 - NCHRP 9-66 (Mechanical Properties of Laboratory Produced Recycled Plastic Modified (RPM) Asphalt Binders and Mixtures) – started May 2021
 - FHWA funding project: Compatibilization of Waste Plastic to Enhance Mechanical Properties of Asphalt Cement
 - Performed Louisiana Tech
 - NCAT will build a pair of test sections on the Test Track in the next few months: wet process and dry process for adding plastics to the mixture
- NAPT reports:
 - [Recycled Plastics in Asphalt, Part A State of Knowledge](#)
 - [Recycled Plastics in Asphalt, part B Literature Review](#)

The logo features the word "KEY" in a stylized, colorful font above the word "TAKEAWAYS" in a similar style. The letters are multi-colored and have a 3D effect. The background is a dark blue textured surface.

KEY TAKEAWAYS

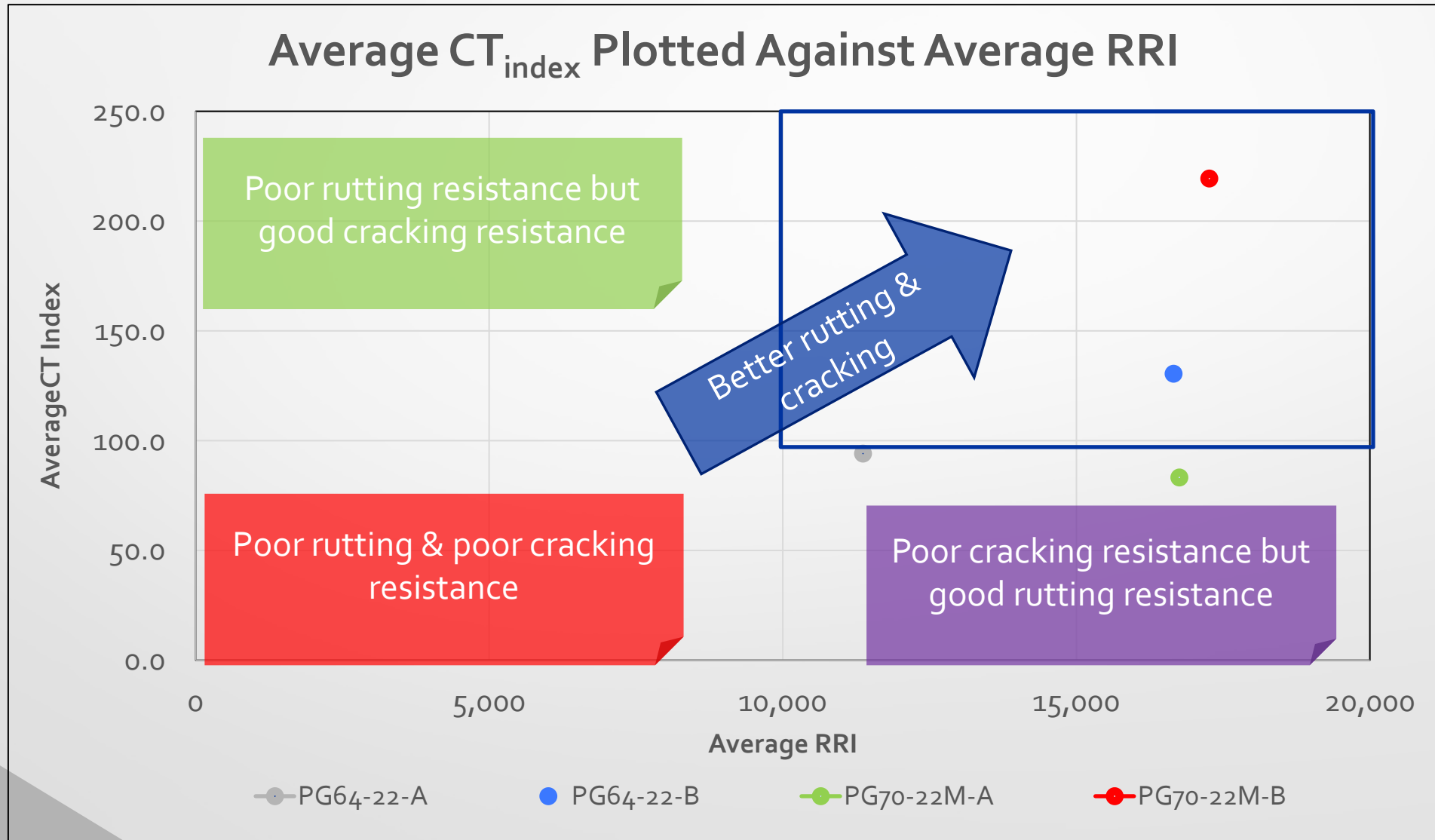
- Some states have already begun to improve mixtures...but this is more than raising the %AC
- HWT and IDEAL-CT requirements are here
 - Per latest KY update, **significant cracking** is appearing in **3 years or less** in asphalt pavement.
 - KYTC is aiming to improve this to 7 years by
 - Implementing IDEAL-CT (much higher than Tx recommendations)
 - Provide rutting check with HWT

Factors on IDEAL-CT, HWT, & Density

Factor	IDEAL-CT	HWT	Density
Increase %AC (assuming typical PG)	+++	---	+++
Lower PG	++	--	+
Higher PG	--	++	-
Time Under Heat (oven or silo)	---	+++	-
Increase RAP (generally stiffens)	--	++	-
Increase DP (dust-asphalt ratio)	--	++	?
High absorption agg	--	++	--
Recycling Agents – bio oil type (soybean or corn oil)	++	--	+
Aramid fibers (polymer fiber)	++	++	?
Thicker paving mat	NA	NA	+++

The "Balancing" Act

Test limits vary state to state and on traffic load





Demonstrations in KY

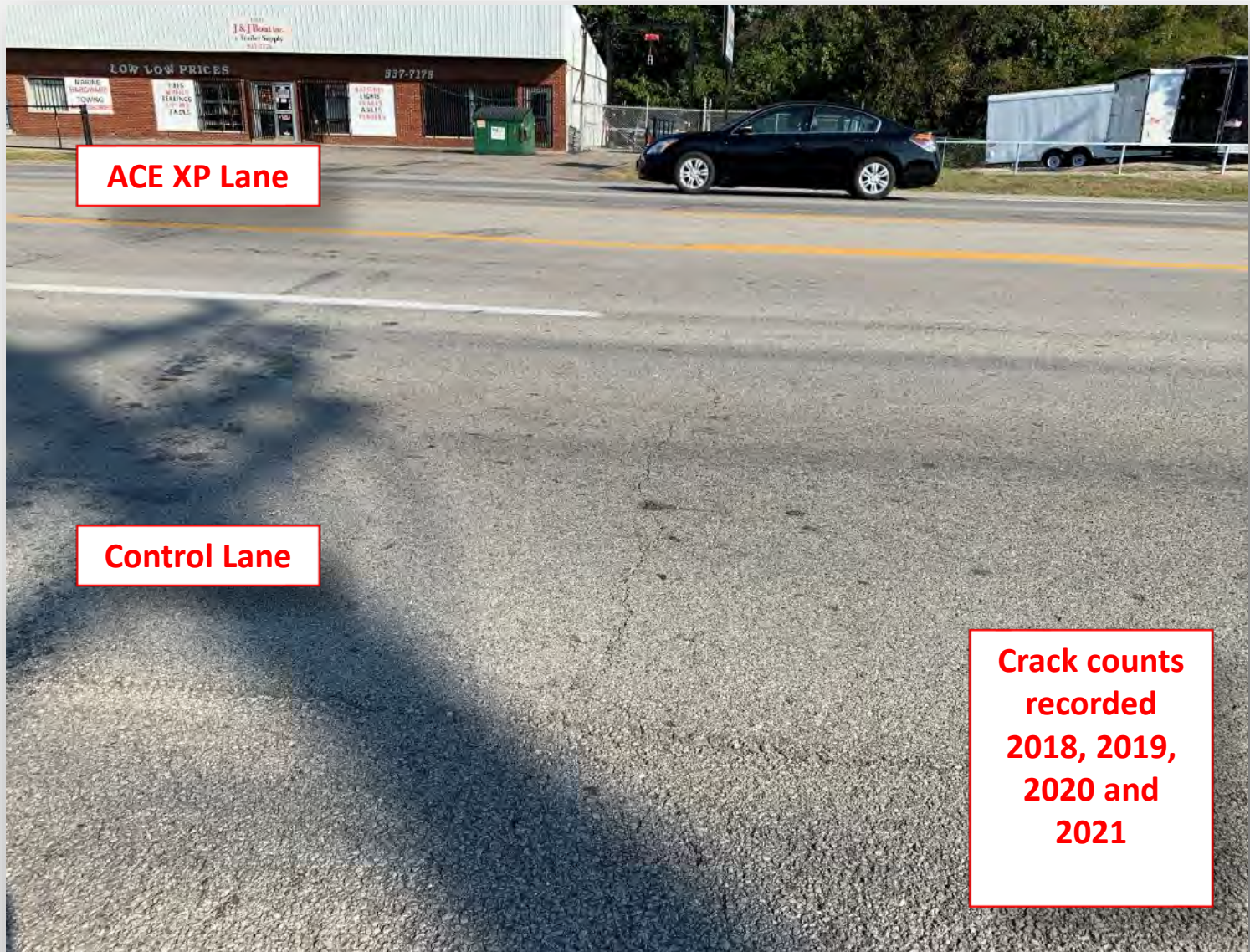


SURFACE TECH™

Aramid Fiber



2016 KYTC Project Dixie Hwy US-31W



ACE XP Lane

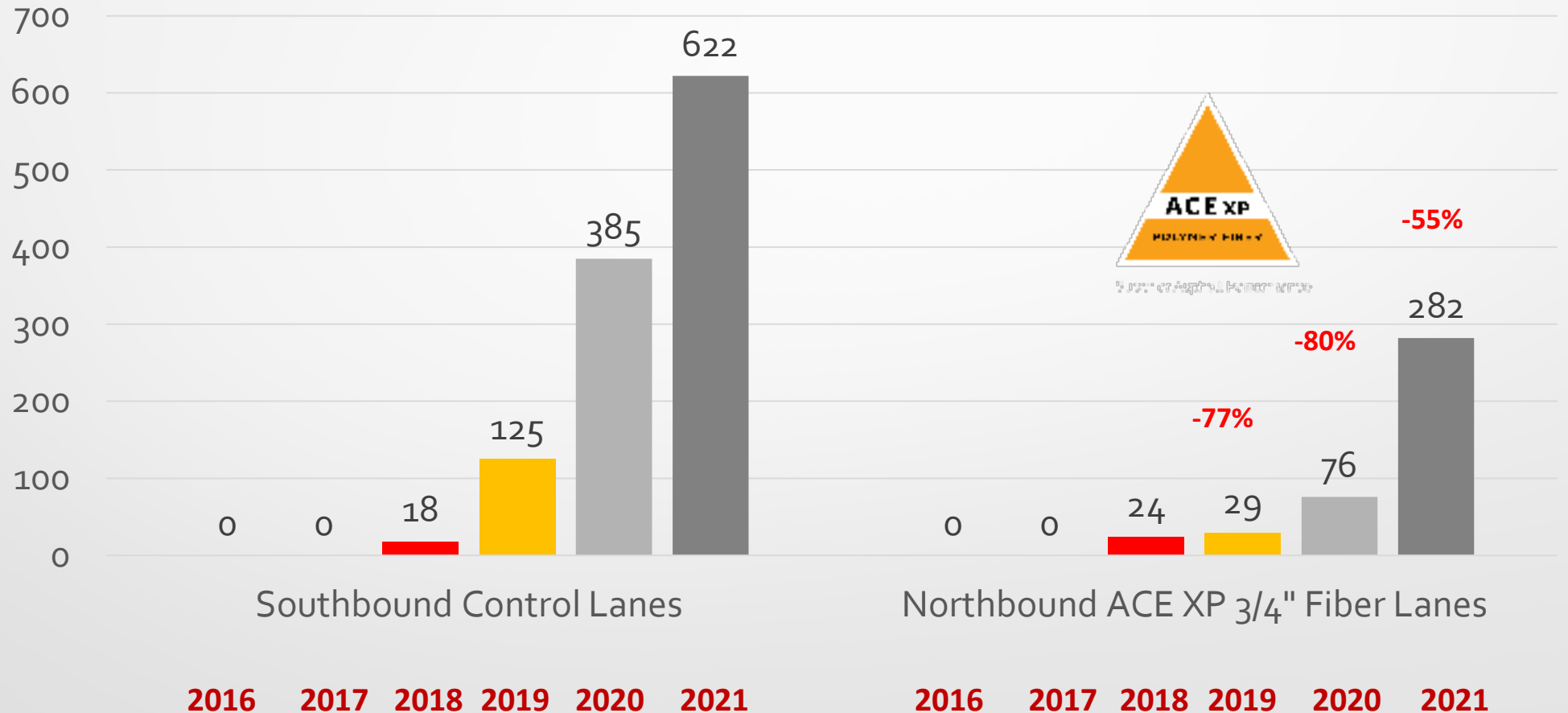
Control Lane

**Crack counts
recorded
2018, 2019,
2020 and
2021**

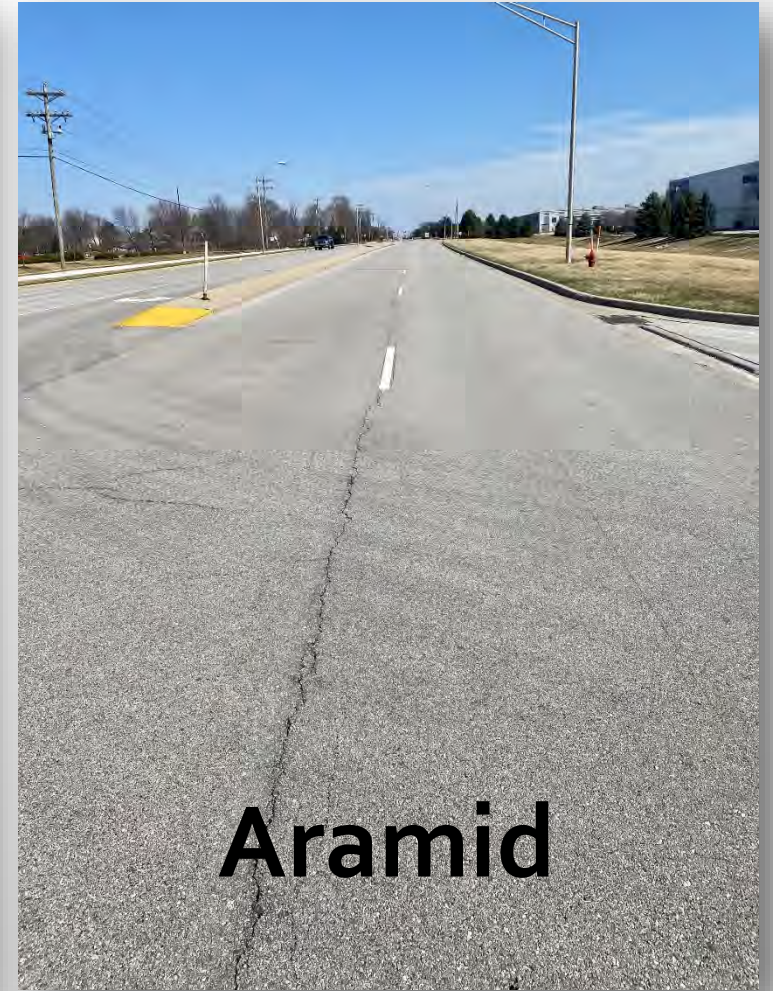
KYTC Project Dixie Hwy US-31W

3 Years After
1.5" Overlay

6 Year Comparison - Lineal Feet of Crack
Installed August 2015

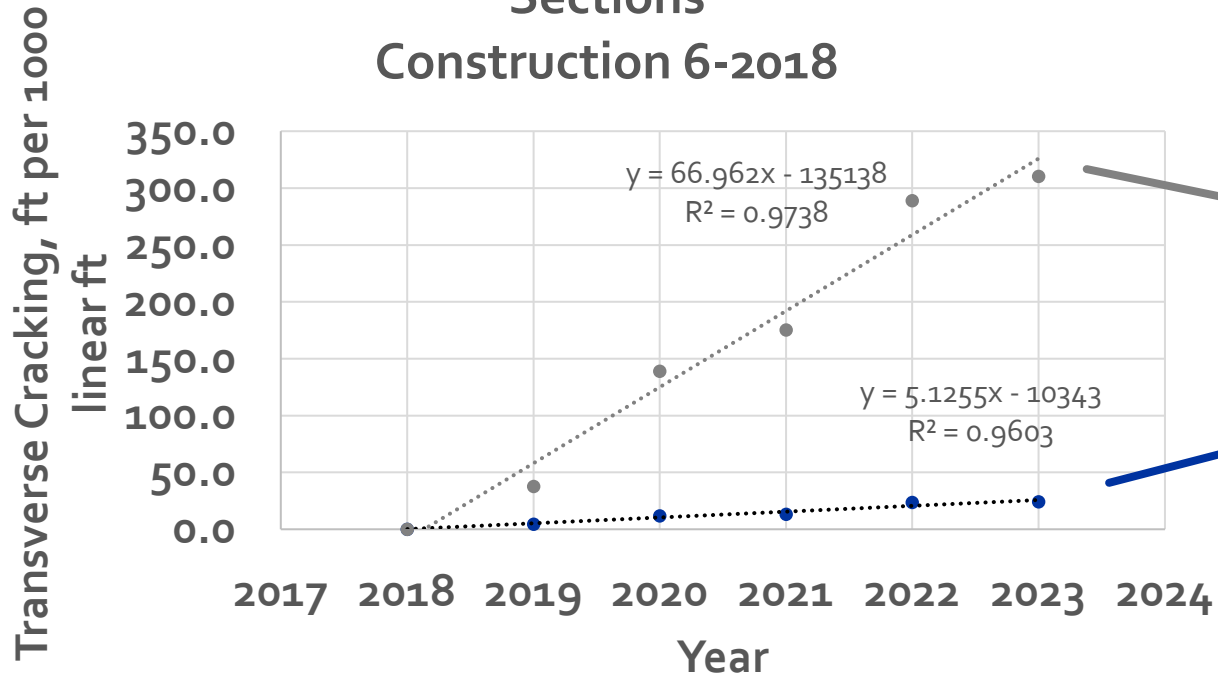


Stafford Road, City of Plainfield, IN 3/17/22



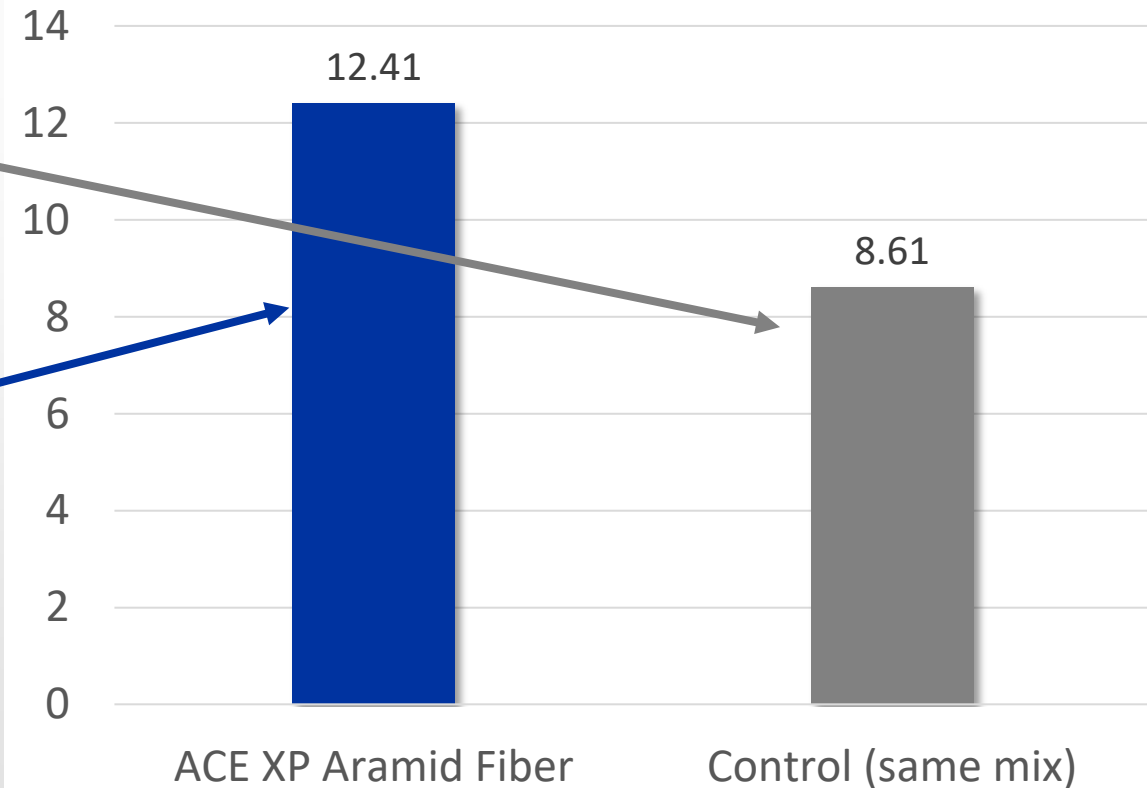
5-Year Comparison of SCB_{iFit} to Field Cracking

Manual Crack Count on Equal Length Sections Construction 6-2018



- ACE XP: Cracking (ft/1000 linear ft)
- CONTROL: Cracking (ft/1000 linear ft)

SCB_{iFit} Flexibility Index (FI) on Cores from 6-2018 Construction





Interlayer



Taylor County, KY GA Airport (KAAS)

April 2019



*Aramid polymer
fiber reinforcement*



Taylor County, KY GA Airport (KAAS)

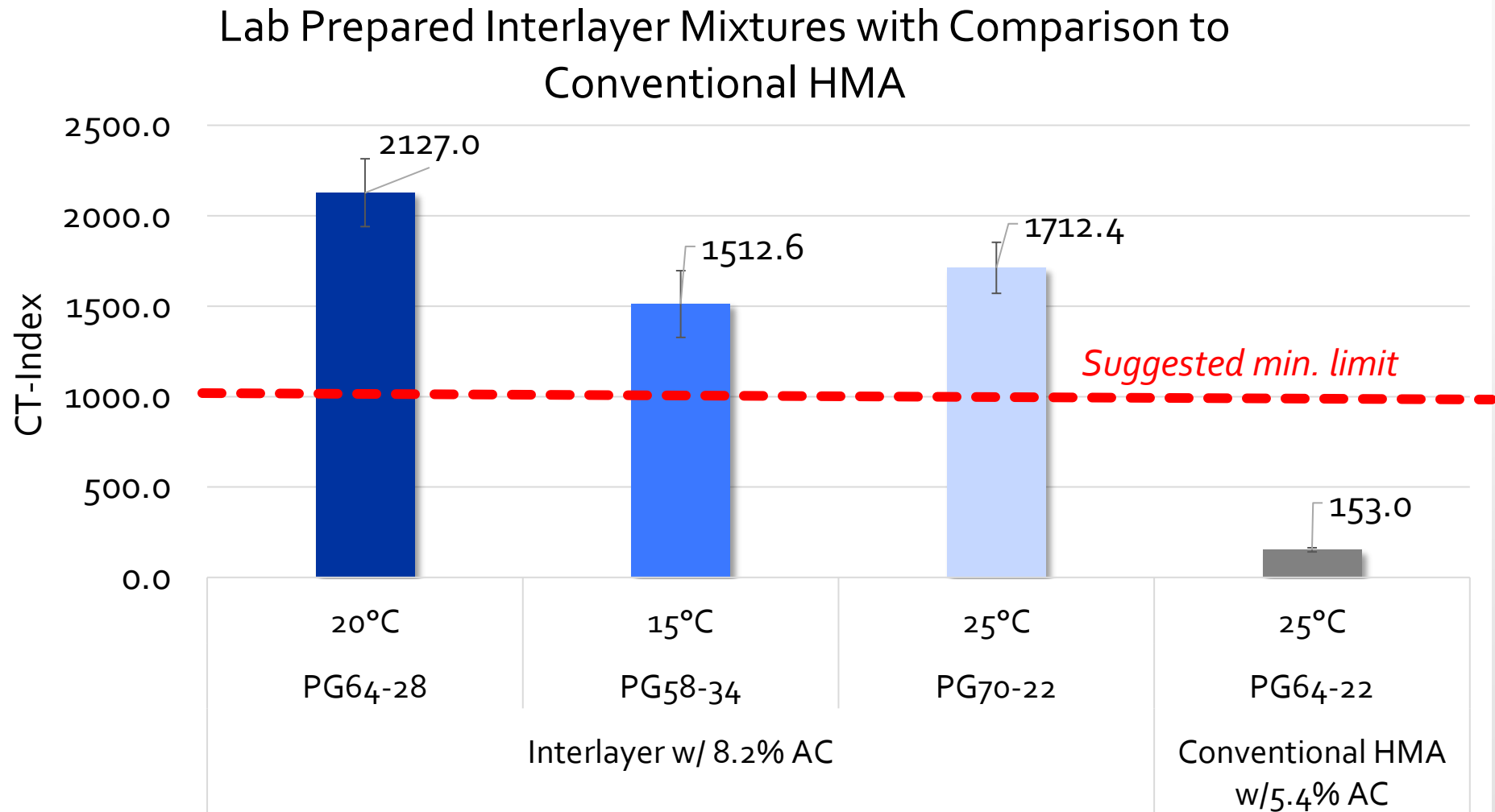
April 2019

- Compacts approximately 1/8" per inch
- Extremely flexible but does not shove under load



Modern Design Example

Work Performed at BATT with IDEAL-CT Test



High RAP with Bio and Aramid Fiber



2020 Louisville Project with 36% RAP

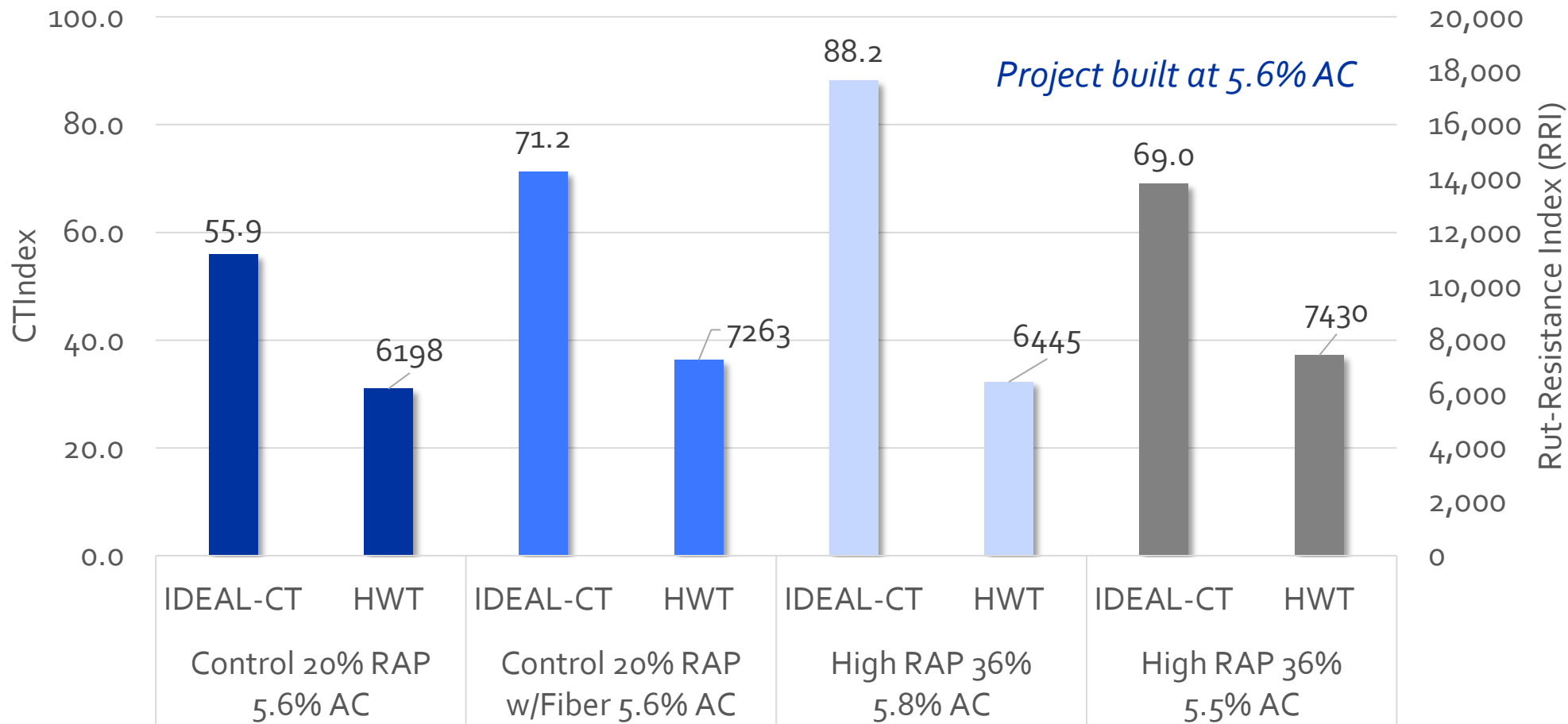


Used contractor-
controlled mix
modification. Combo
of bio oil & aramid
fiber (Surface Tech)



Project Design for Louisville, KY

Lab Prepared High RAP Mixture Comparison of IDEAL-CT & HWT Test Results



High RAP mix contained bio oil and aramid fiber by Surface Tech to make high-performance RAP

Lexington Project with 45% RAP Mercer Road (High-load access road to airport) Contractor: ATS Construction, Sept 2020

Typical (Control)

- 20% RAP
- PG 76-22

Trial

- 45% RAP
- PG 64-22
- TuffTrek bio oil (recycling agent)
- 2x dose Surface Tech ACE XP aramid fiber

About 30% potential reduction in CO₂

Used contractor-
controlled mix
modification. Combo
of bio oil & aramid
fiber (Surface Tech)

2020 Lexington Project with 45% RAP Mercer Road



Mercer Road - After 3 Winters



Control

45% RAP

BASF Reactive Isocyanate Modifier

[B2Last Home](#) ▾

[Health and Safety](#)

[B2Last FAQ](#)

[Features](#)

[Resou](#)

B2Last FAQ

B2Last is unique in the world of asphalt modification levels of modification can be achieved while increasing much less than alternatives.

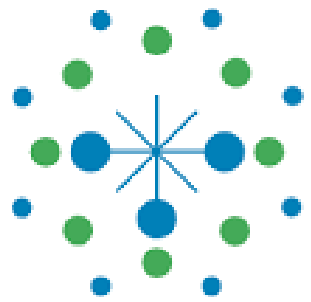
[FAQs](#)

2019

Reactive Isocyanate Projects

2021





GREENMANTRA
TECHNOLOGIES

Plastic



Greenmantra Technologies Projects

250,000 bag equivalents used in 2 miles

2023





What's Next



Thank you

Q&A

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www.linkedin.com/company/batt-lab/



www.twitter.com/BATT_Lab

