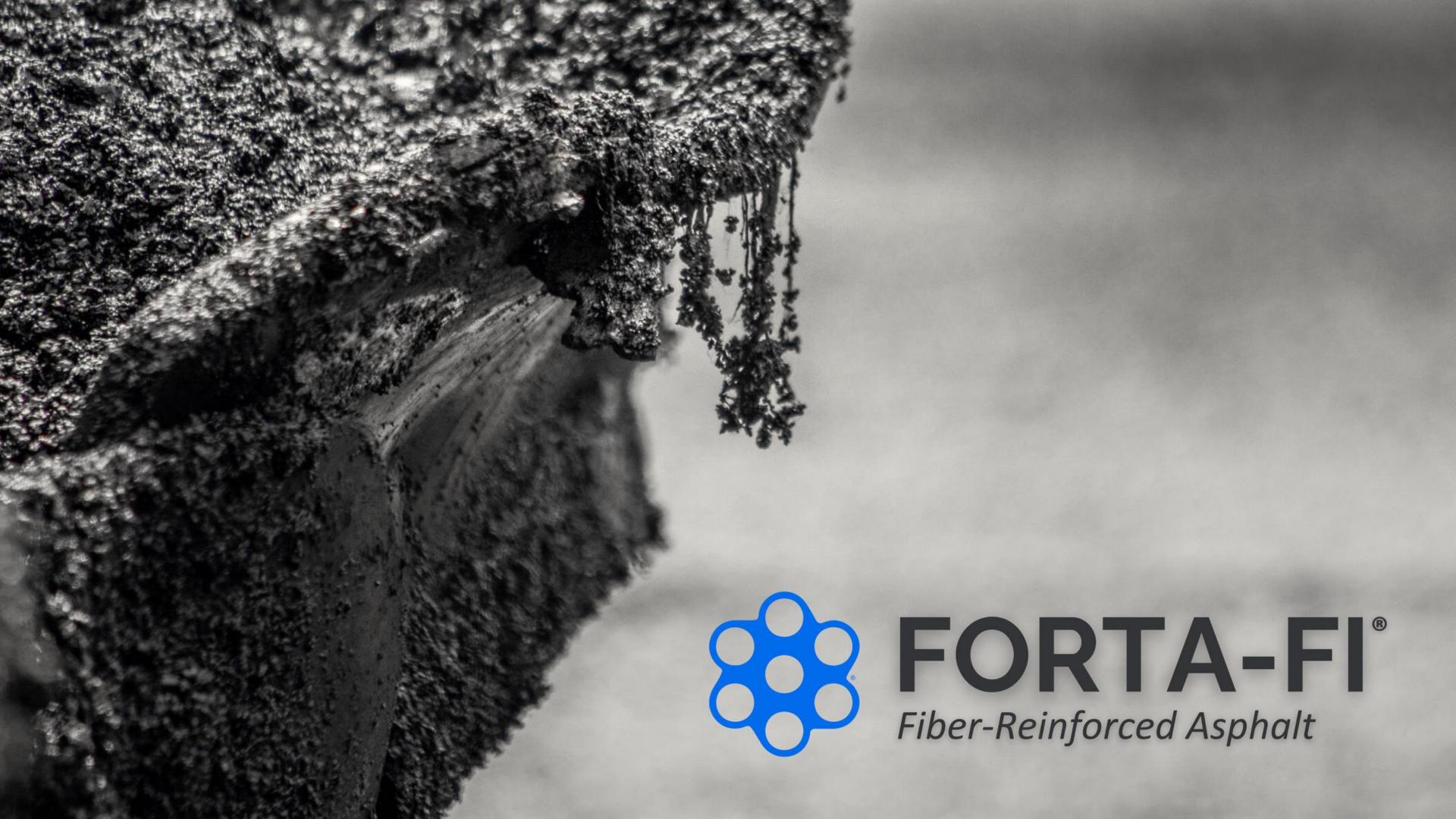


8 FORTA

REINFORCEMENT THAT LASTS

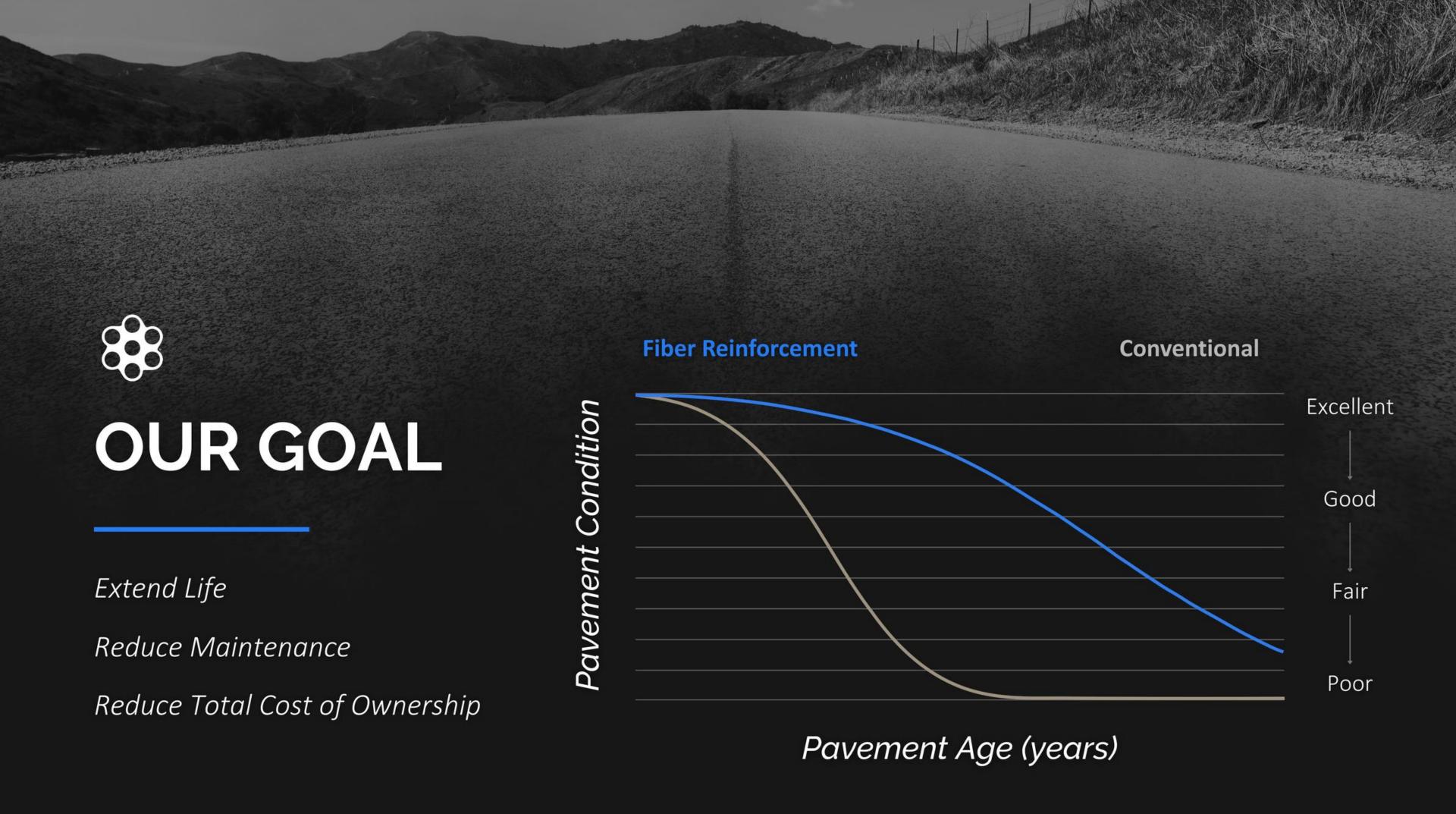






>20 Million Tons of Asphalt Reinforced









ALL FIBER IS NOT THE SAME



HOW DOES

FORTA-FI®

REINFORCED ASPHALT WORK?

STRENGTH

5x the Strength of Steel

19 MILLION

Individual Fibers Per Ton of Asphalt

LESS CRACKING, LESS RUTTING, LESS PROBLEMS



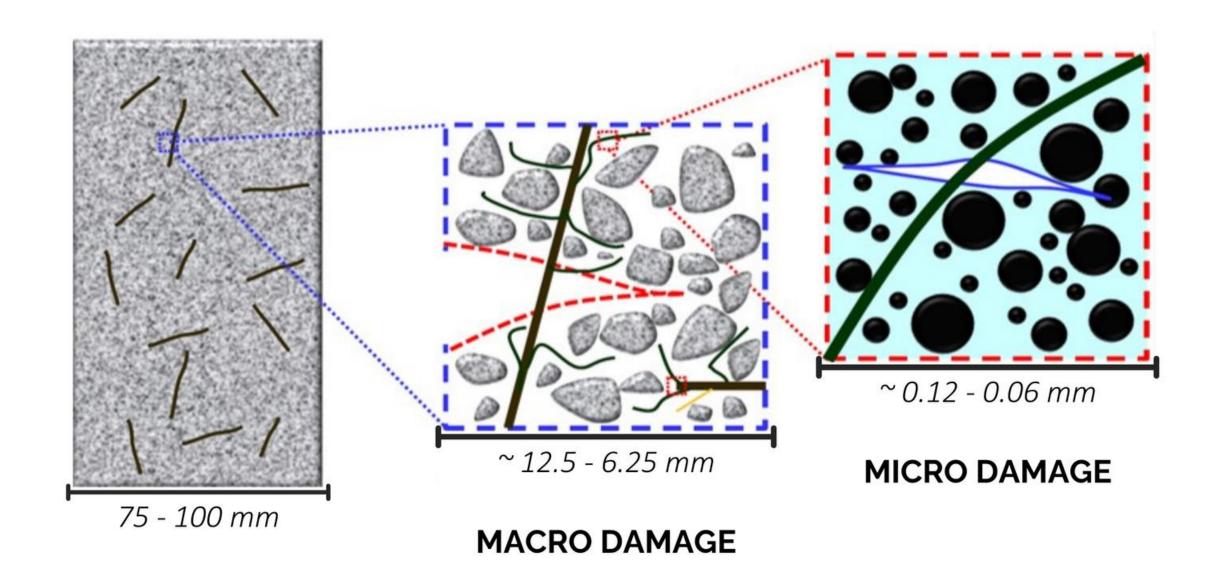
MECHANICAL BENEFITS

TOUGHNESS

Ability to Absorb Energy and Plastically Deform without Fracture

RESISTANCE

Of Material to Fracture when Stressed



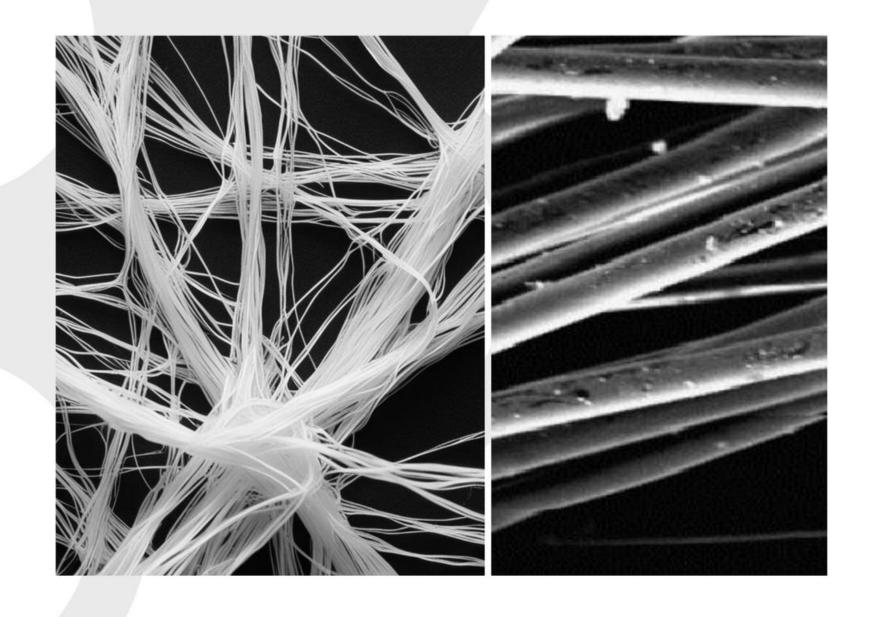














NON-FIBRILLATED FIBERS

MICRO FIBRILLATION



A SIMPLE SOLUTION

- 1. Standard Dosage 1.0 lb/ton (0.5 kg/ton)
- 2. Batch or Drum Plants
- 3. No Changes to Mix Design or Construction Laydown
- 4. Easier to Compact
- 5. Manual or Automated Fiber Feeding



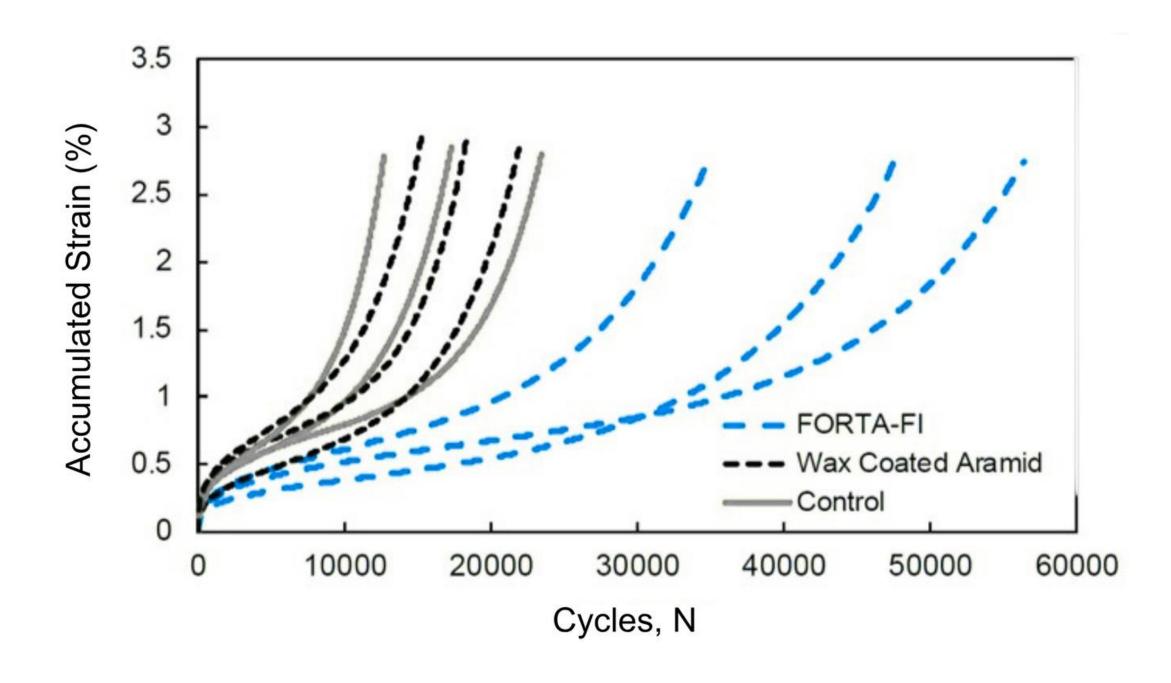








Image: Noorvand, Hossein, et al. "Effect of Synthetic Fiber State on Mechanical Performance of Fiber Reinforced Asphalt Concrete." *Transportation Research Record* (2018).













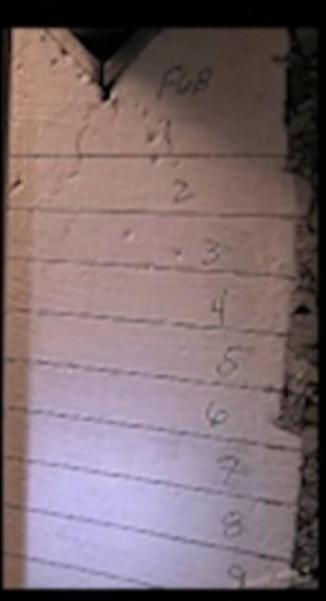
FRA

FORTA-FI

CONTROL

Control

Crack Length Time



CONT. 1

Crack Length Time

CRACKING

Loading Rate: 0.9mm/min. Test Temp 21C

C* LINE INTEGRAL



CONTROL

CONTROL VS FIBER NEW YORK DOT

CONTROL

6-in Joint Repair Dig Outs, Polymer Modified Binder (PG 64V-22), 2-in Mill & Overlay

FIBER REINFORCED ASPHALT

2-in Mill & Overlay, Neat Binder (PG 64S-22)

RESULTS

FRAC Section Significantly Outperformed; Further Adoption from NYDOT



I-5 SOUTH OREGON DOT

ROSEBURG, OR

STANDARD TREATMENT

Prioir to 2013, "Replacement needed every 2-3 years" ODOT Maintenance Supervisor

FIBER REINFORCED IN 2013

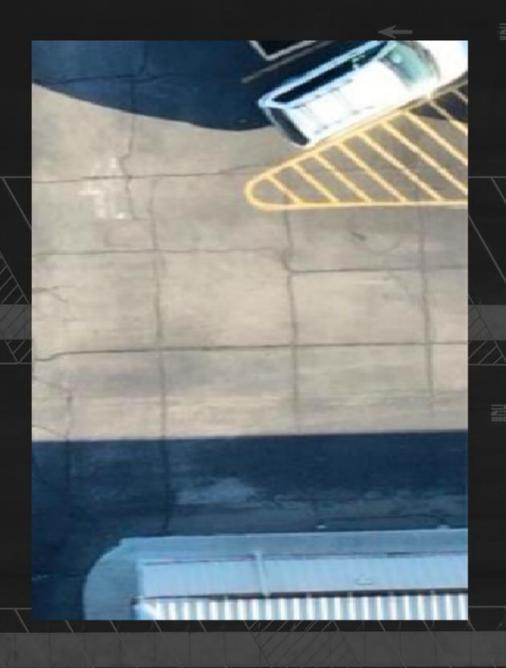
10+ Years, Still in Great Condition

RESULTS

Pavement Lifespan Significantly Extended

B FORTA*fied*™

3 Year Unreinforced





FORTA*fied* ™ 3 Year Fiber Reinforcement

88

DISTRIBUTION CENTERS WALLMART

ASPHALT OVER CONCRETE

3 Year Comparison – Same Location > 100 °F

≈ 250 Retail Stores in 2024

RESULTS

Cracking Significantly Improved, Extended Lifespan

LANCASTER, CA AVENUE D

STANDARD TREATMENT

Asphalt Destroyed, Reconstruction Needed, > 100 °F

2 INCH OVERLAY

Despite Being Warned

RESULTS

Side-by-side Showed Significant Benefit from Fiber, but will Still Fail



AFTER BEFORE



CONTROL

FORTA*fied™*



CASE STUDY

HILLSBORO

NE Grant Street, Hillsboro, OR

RESULTS

63% Less Cracking

10 YEAR EVALUATION

Since 2013, the control lane has received a crack seal treatment and continues to show cracking, while the reinforced side holds strong with no crack seal treatment needed.

2022







CONTROL

FORTAfied™ 2 INCH OVERLAY



8

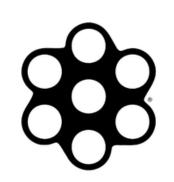
OREGON CITY, OR PEARL ST.

CONSTRUCTED IN 2011

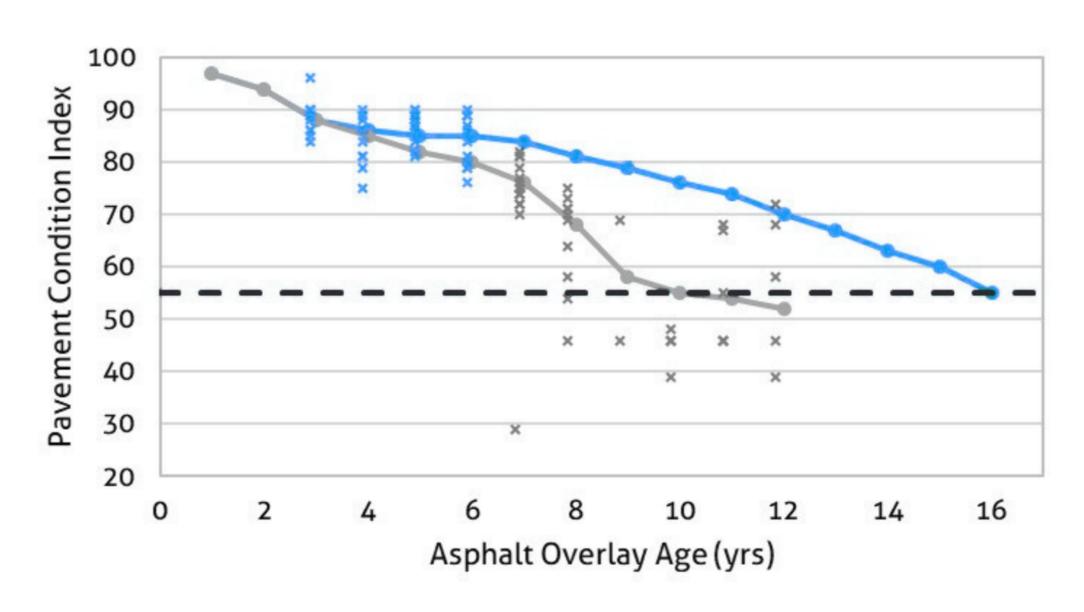
Pavement Condition Index < 40

RESULTS

In 2023, the FORTA fied™ Section in Great Condition After +12 Years



PINE TOWNSHIP, PA



93 SEGMENTS EVALUATED

Evaluation Done by Kindler & Associates

43 Conventional 50 Fiber Reinforced Asphalt

Conventional Average Lifespan: 10 Years Fiber Reinforced Average Lifespan: 16 Years

Conventional HMA Deteriorates Almost 2X Faster Over First 10 Years

LA COUNTY DAVENPORTRO

FIBER VS. CONTROL; CONSTRUCTED 2017

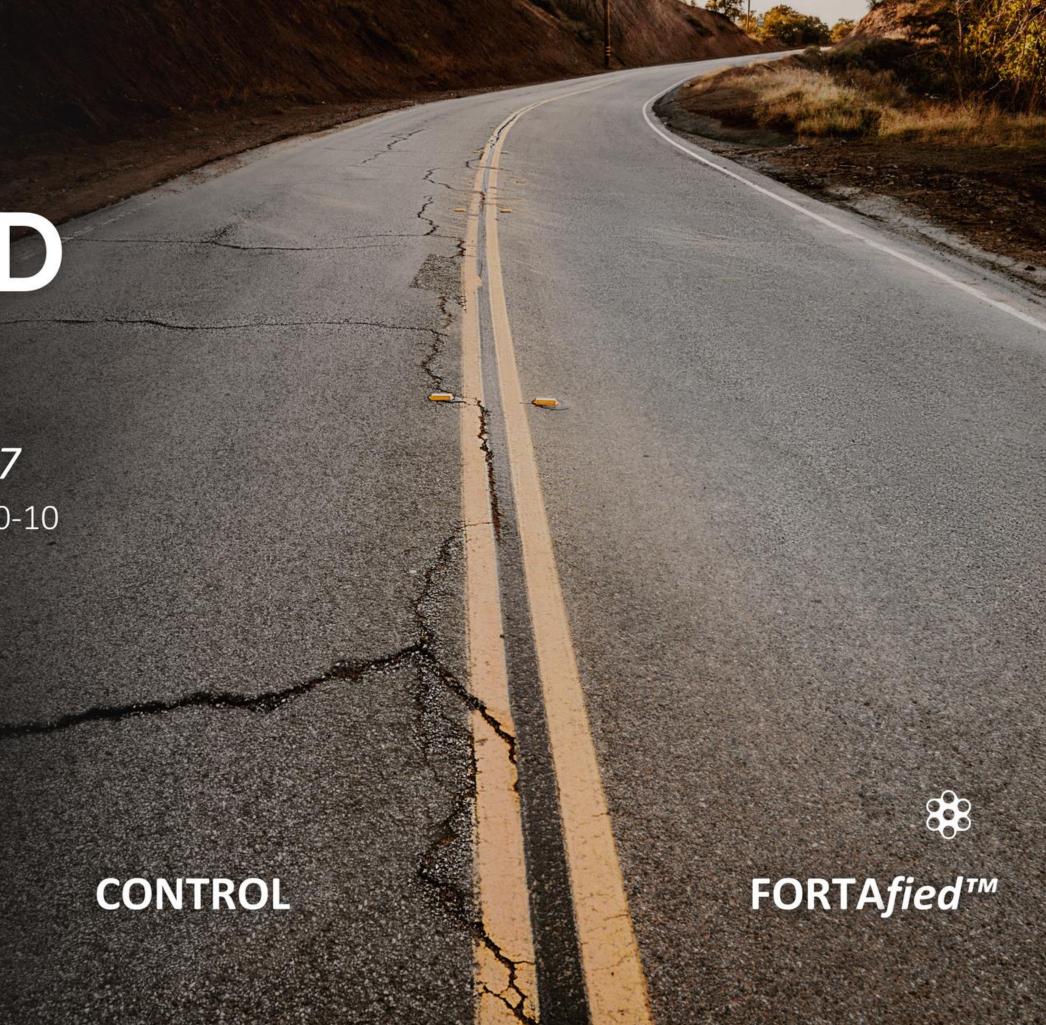
5 Year Evaluation, > 100 °F 2-in Mill and Overlay, PG 70-10

PAVEMENT ENGINEERING INC.

Independent Condition Survey

RESULTS

Less Fatigue, Reflective, & Thermal Cracking





CONTROL

FORTAfied™ 2 INCH OVERLAY



88

NEW BRAUNFELS

TEXAS

CONSTRUCTED IN 2017

> 100 °F

RESULTS

65% Less Cracking After 5 Years

NORTHERN ARIZONA UNIVERSITY

HAVASUPAI RD

2" Mill & Overlay - PG 76-22 TR+

200 Freeze-Thaw Cycles Per Year (7000 ft)

High Temps > 100 °F



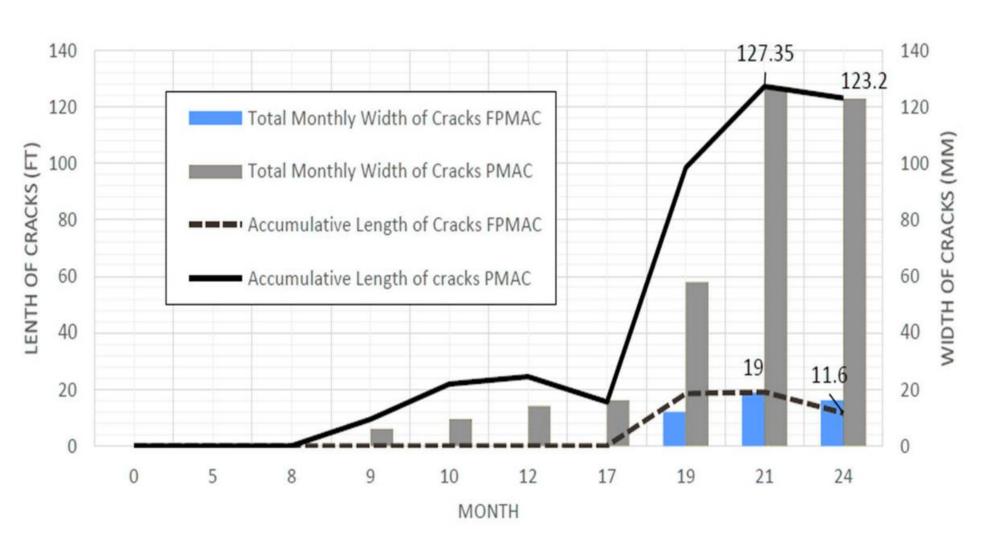
2 YEAR EVALUATION

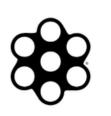
Total Crack Length (90% Less)

Control: 127'

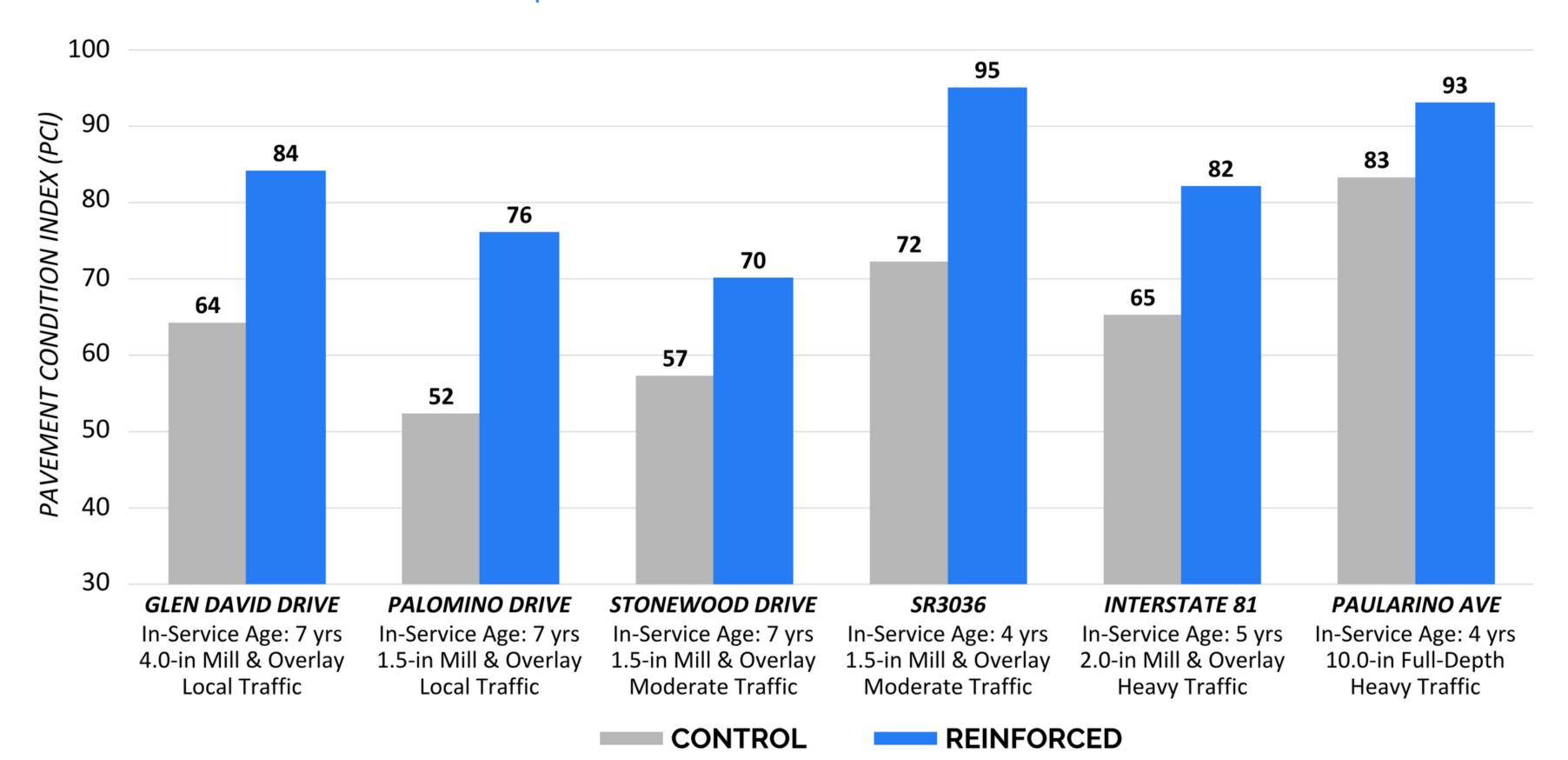
FORTA-FI®: 19'







SIDE BY SIDE FIELD RESULTS



JACKSON HOLE, WY

AIRORT RUNWAY

STANDARD TREATMENT PRIOR TO 2009

6-7 Year Lifespan, Maintenance Every 2-3 Years; Failures Attributed to High Dynamic Loading, Locked-Wheel Turning, and Extreme Environmental Conditions

CONDITION SURVEY

Completed by NCE, 10 Years



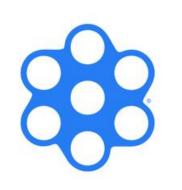
RESULTS

Fiber Reinforced in 2009 12+ Years Lifespan Maintenance - 1 Application









MALAYSIA

50 mm = 2 inches

_	onventional				
	7111			33	

FRAC Alternative

MP200

MP110+SFM

50mm WC

50mm FRAC-WC

90mm DBM

60mm BC <u>60mm BC</u>

Existing Pavement Structure

Existing Pavement Structure

RM185.64

RM121.39

Costs have been reduced by 34.61%

Conventional

FRAC Alternative

MP110

MP50+SFM

50mm WC

60mm BC

50mm FRAC-WC

Existing Pavement Structure

Existing Pavement Structure

RM105.89

RM64.61

Costs have been reduced by 38.98%

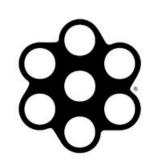
Pavement Section		2018 PreOverlay Max Crack Percentage	2024 Average Crack Percentage	2018 Average Rut Depths (mm)	2024 Average Rut Depths (mm)
Control	50mm* Surface 60mm Binder 90mm Base Existing Pavement	26.67%	5.72%	1.74mm	5.84mm
MP 110	50mm* Surface w/ FORTA-FI 60mm Binder Existing Pavement	47.14%	1.57%	3.04mm	5.32mm
MP 50	50mm* Surface w/ FORTA-FI Existing Pavement	32.67%	2.10%	4.59mm	5.66mm

^{*50}mm = 2 inches





AFTER 6 YEARS



TEST SECTION: E98

NCAT TEST TRACK

3 Cycles, 30 Million ESALs (≈30 Years of Traffic)

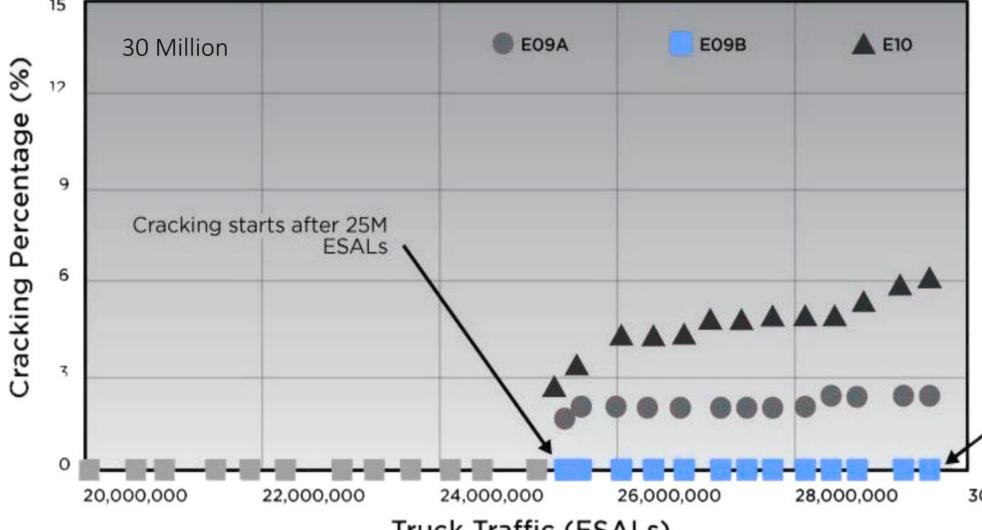
E9A – Improved PFC

E9B - PFC w/ FORTA-FI®

E10 - PFC Asphalt Rubber

RESULTS

The FORTA-FI section was the only section with no cracking after 30 million ESALs.







FORTA-FI section still has no cracking distress 30,000,000

Truck Traffic (ESALs)

NCAT: The National Center for Asphalt Technology (NCAT) just outside of Auburn, Alabama, is a world leader in asphalt research. NCAT is renowned for their asphalt test track that utilizes accelerated pavement testing. During each testing cycle, 10 million ESALs (about 10 years of traffic) can be applied to the track in only several years. There are 46 different test sections on the track and each one is accurately monitored using temperature probes, a wireless mesh network, strain gauges, and pressure plates where applicable.

MOBILE LOAD SIMULATOR

PENN STATE UNIVERSITY RESEARCH



Following 300,000 cycles, neither the control or FORTA-FI samples exhibited cracking or rutting. The loading speed was then reduced for an additional 25,000 cycles. The reduced loading speed caused significant rutting in the conventional mix while the FORTA-FI reinforced section exhibited 50 percent less rutting.

NORTHEAST CENTER OF EXCELLENCE FOR PAVEMENT TECHNOLOGY

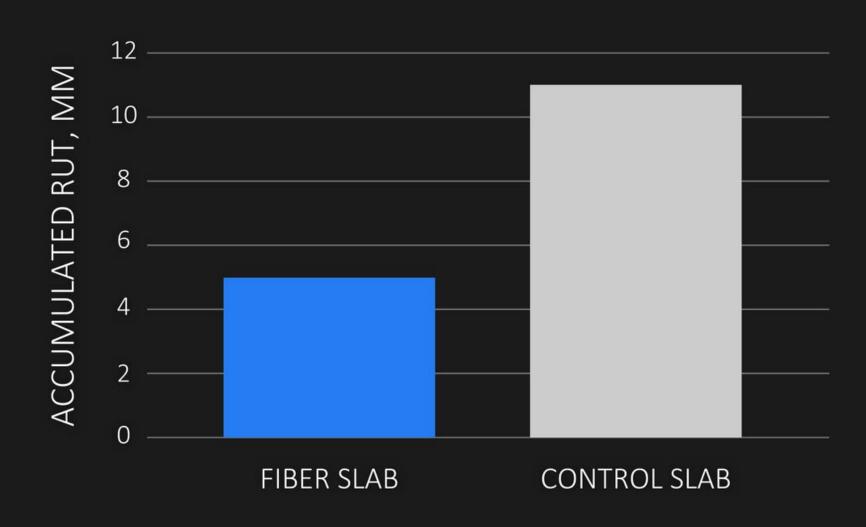
Dense Graded 9.5mm

PG 64-22, 15% RAP



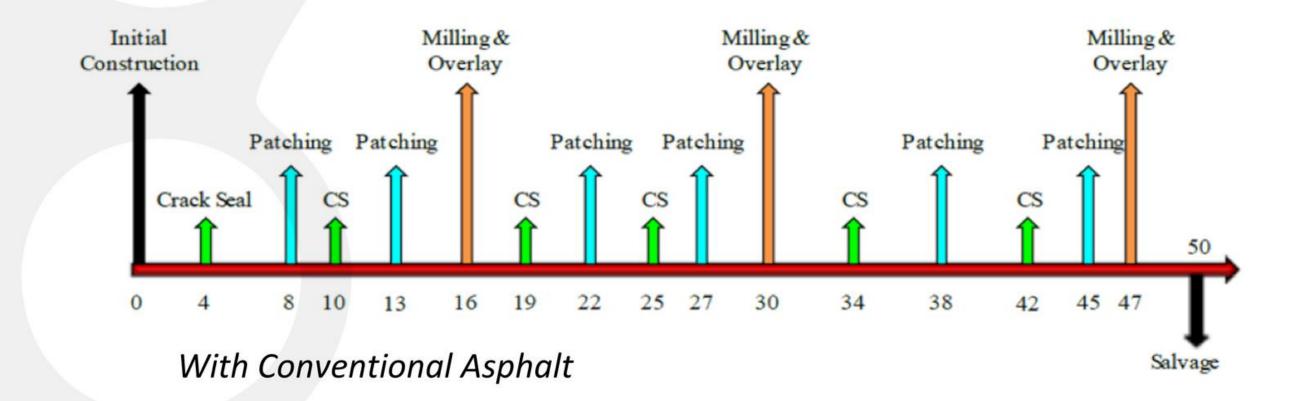
RESULTS

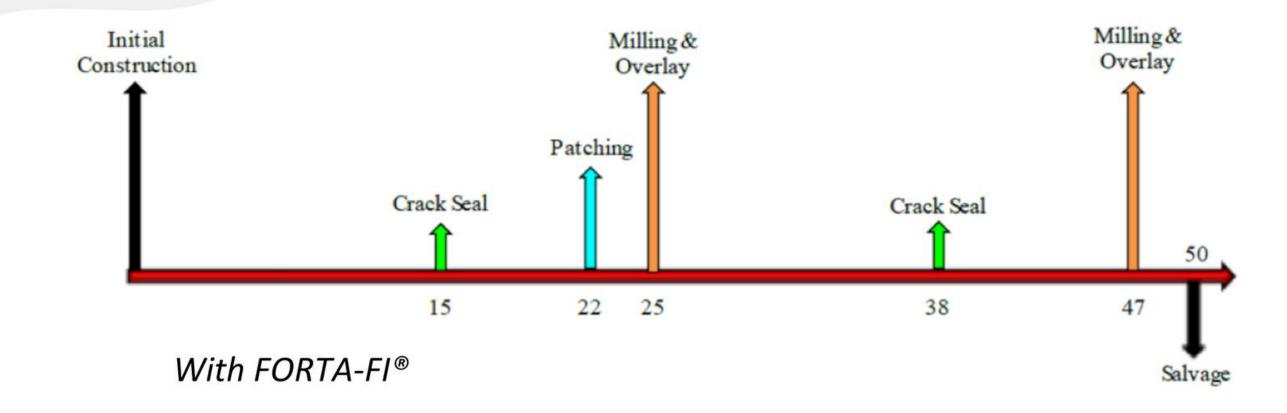
50% Less Rutting with FORTA-FI®



LIFE CYCLE ANALYSIS

ANALYSIS DONE BY ARIZONA STATE UNIVERSITY

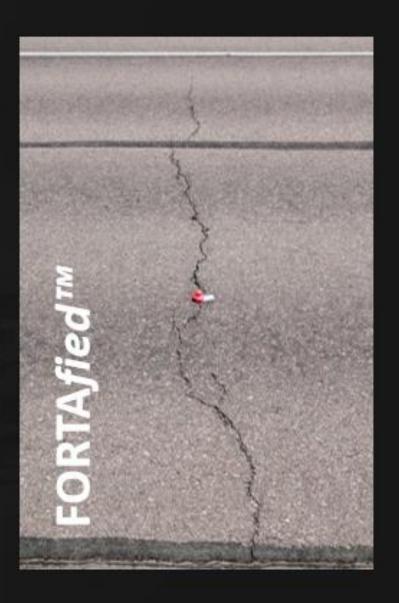








2025



THERMAL CRACKING WIDTHS

Avg Crack Width

Max Crack Width



COLORADO SPRINGS, CO TUTT BLVD

Constructed in 2018 Elevation of 6,035 ft

120-150

FREEZE THAW CYCLES IN 1 YEAR
January 2025: 61 °F Temperature
Swing in 1 Day

RESULTS

Twice as Many Thermal Cracks than the FORTA-FI Section

FI-GREEN**

FORTA-FI® WITH RECYCLED PLASTIC POLYMER

Predictable Sourcing

Safe, Clean, & Free From Microplastics

WHERE SUSTAINABILITY
MEETS PERFORMANCE



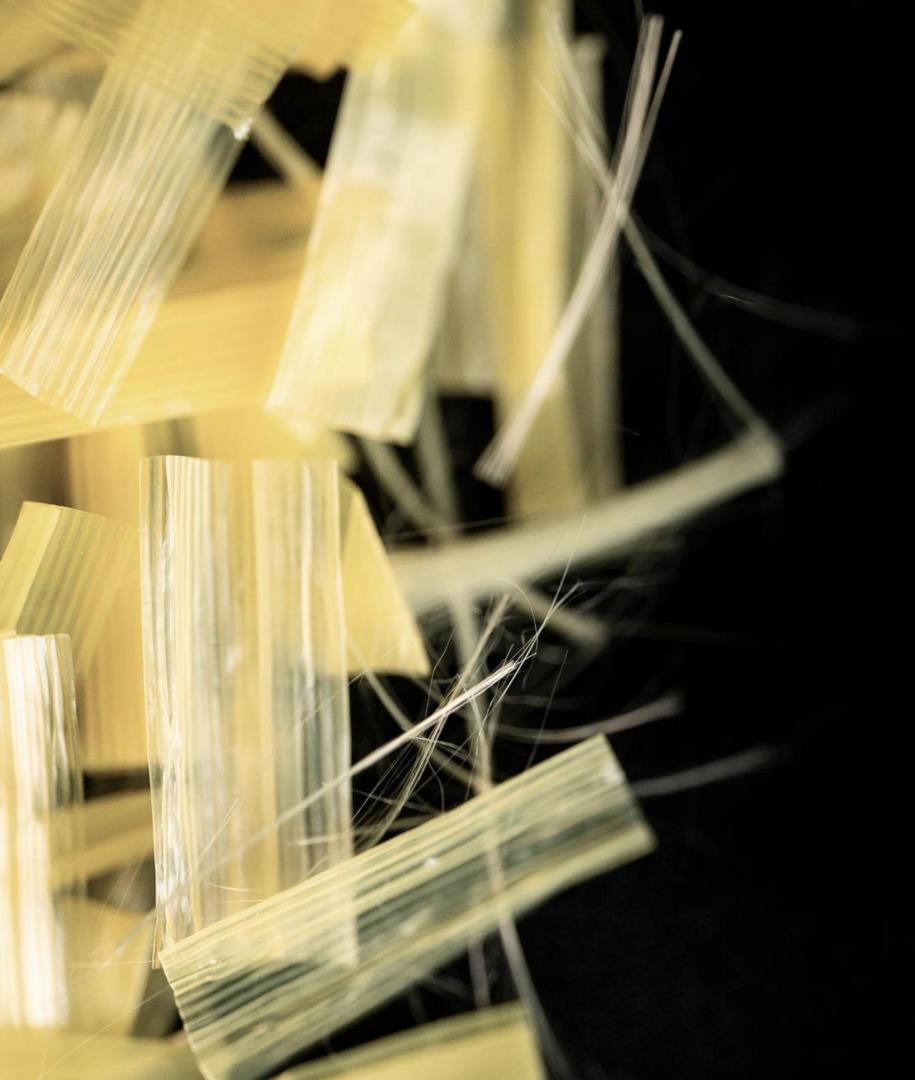


NEXT STEPS

- 1. Project Identification
- 2. Specification
- 3. Paving & Support
- 4. Standard Specification







REINFORCEMENT THAT LASTS™