WELCOME

NWPMA - Workshop

Building HIGHER PERFORMING HMA Pavements with High Tensile REINFORCEMENT

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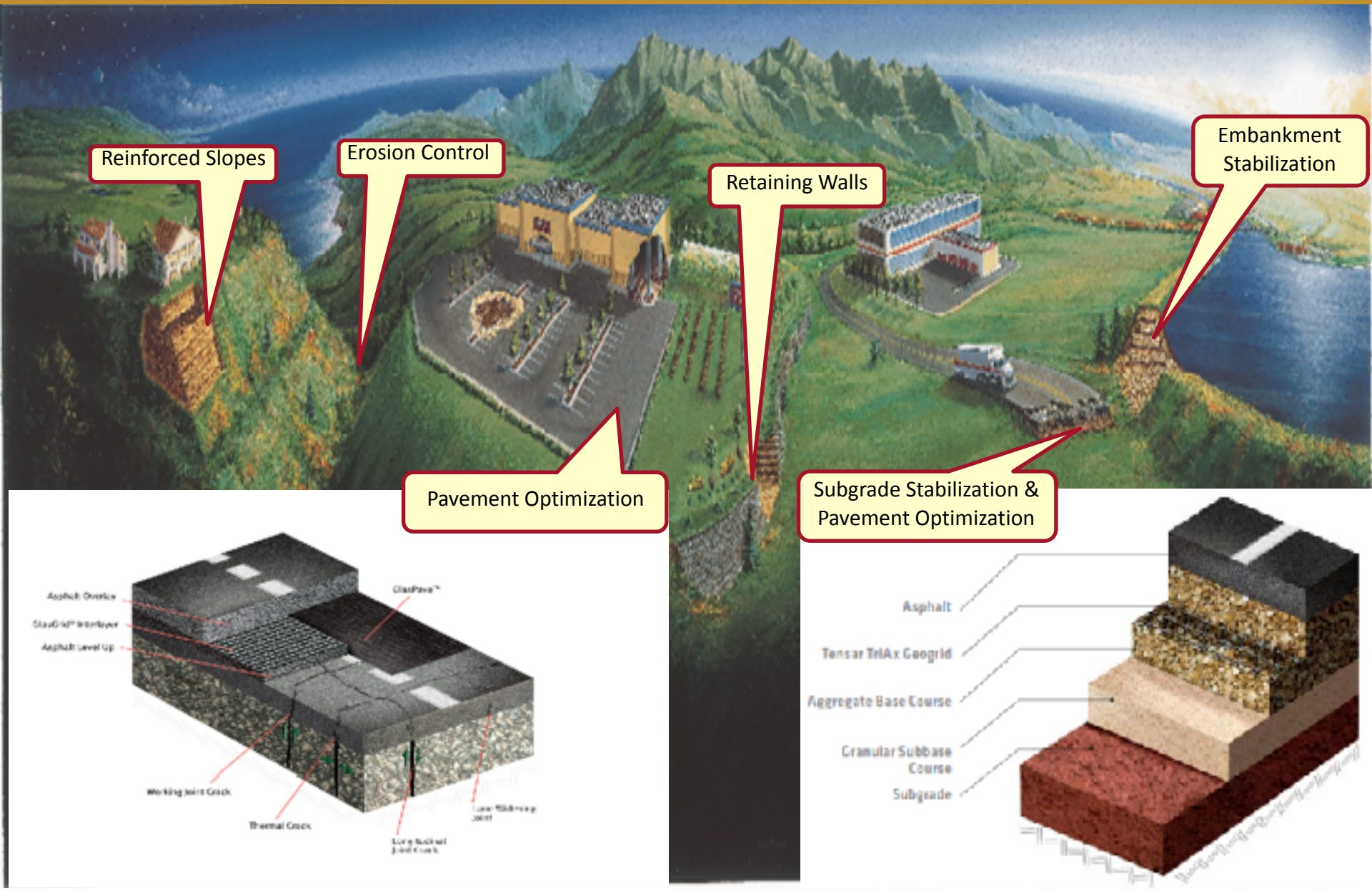
Tensar. THE COMPANY YOU CAN BUILD ON

HMA Pavement Reinforcement
Maximize Pavement Load Disribution



Building Longer Life, More Maintenance Free HMA Pavements, that Cost Less

Building Longer Life, More Maintenance Free HMA Pavements, that Cost Less

WE DID MAINTAIN IT!

HMA Pavements Rehabilitation for Higher Performance

Key Points

- Evaluate to understand deterioration root cause
- Assess methods to slow down deterioration
- Evaluate/Select best options to achieve

Functional vs Structural

HDOT Chapter 4 : Pavement Rehabilitation Procedures

Non-Structural Failure

Loss of functional quality from distresses other than traffic loading is considered non-structural failure. For asphalt concrete (AC) pavements, block cracking, transverse cracking, longitudinal cracking, raveling, and rutting and depressions due to instability of the AC mixture are distresses for which the primary cause is not structural failure of the pavement section. For Portland cement concrete (PCC) pavements spalling, scaling, popouts, map cracking, and failure of joint sealant are non-structural failures. Other conditions that affect both AC and PCC pavements are items such as utility trenches and settlement of embankments.

Pavement Functional Deterioration

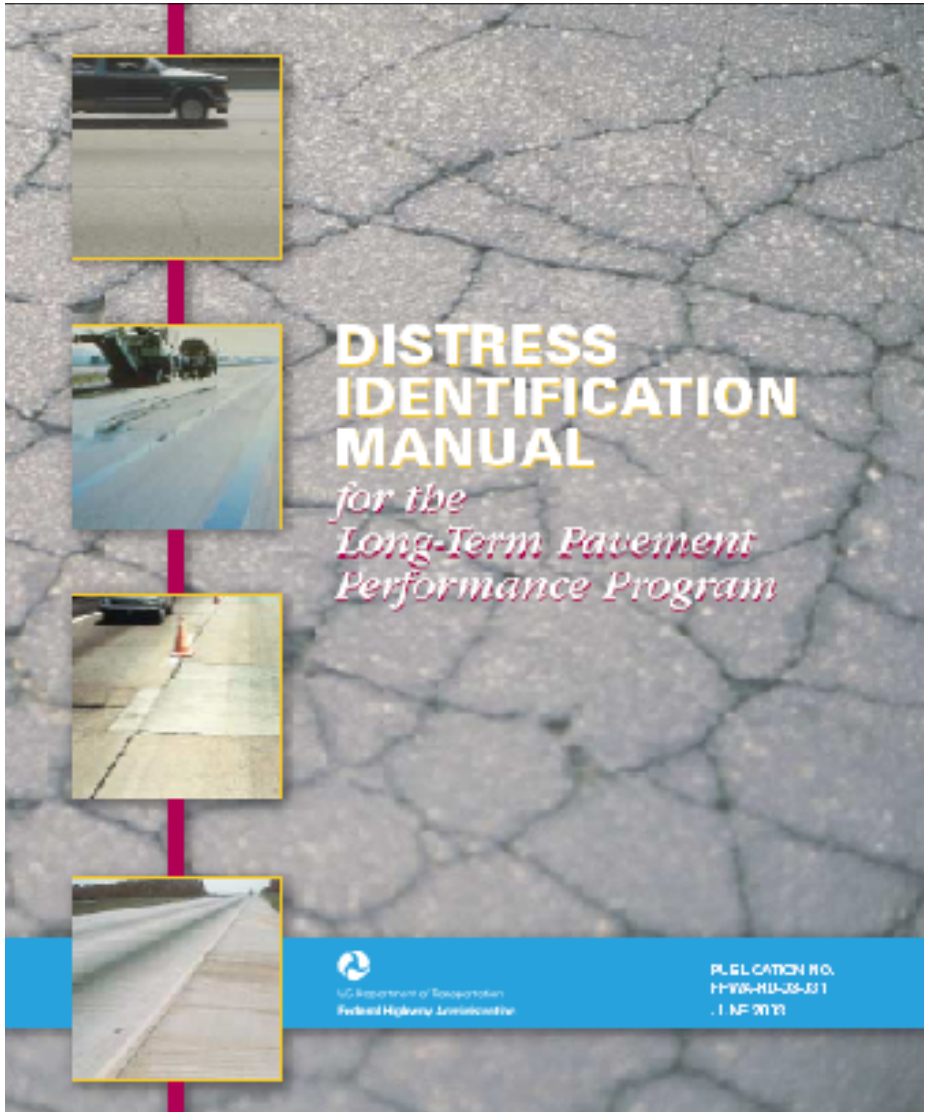
How Flexible Pavements Fail

Source: MODOT youtube site

Pavement Evaluation

https://www.fhwa.dot.gov/publications/research/infrastructure/pavements/ltpp/reports/03031/03031.pdf

Great Resource: FHWA Distress ID Manual



STRUCTURAL Evaluation – Base Issues

Reading A Road – Base Issues

Check for Rutting

Greater than ¾ “ depth is a concern

STRUCTURAL Evaluation – Base Issues

Reading A Road - Base Issues

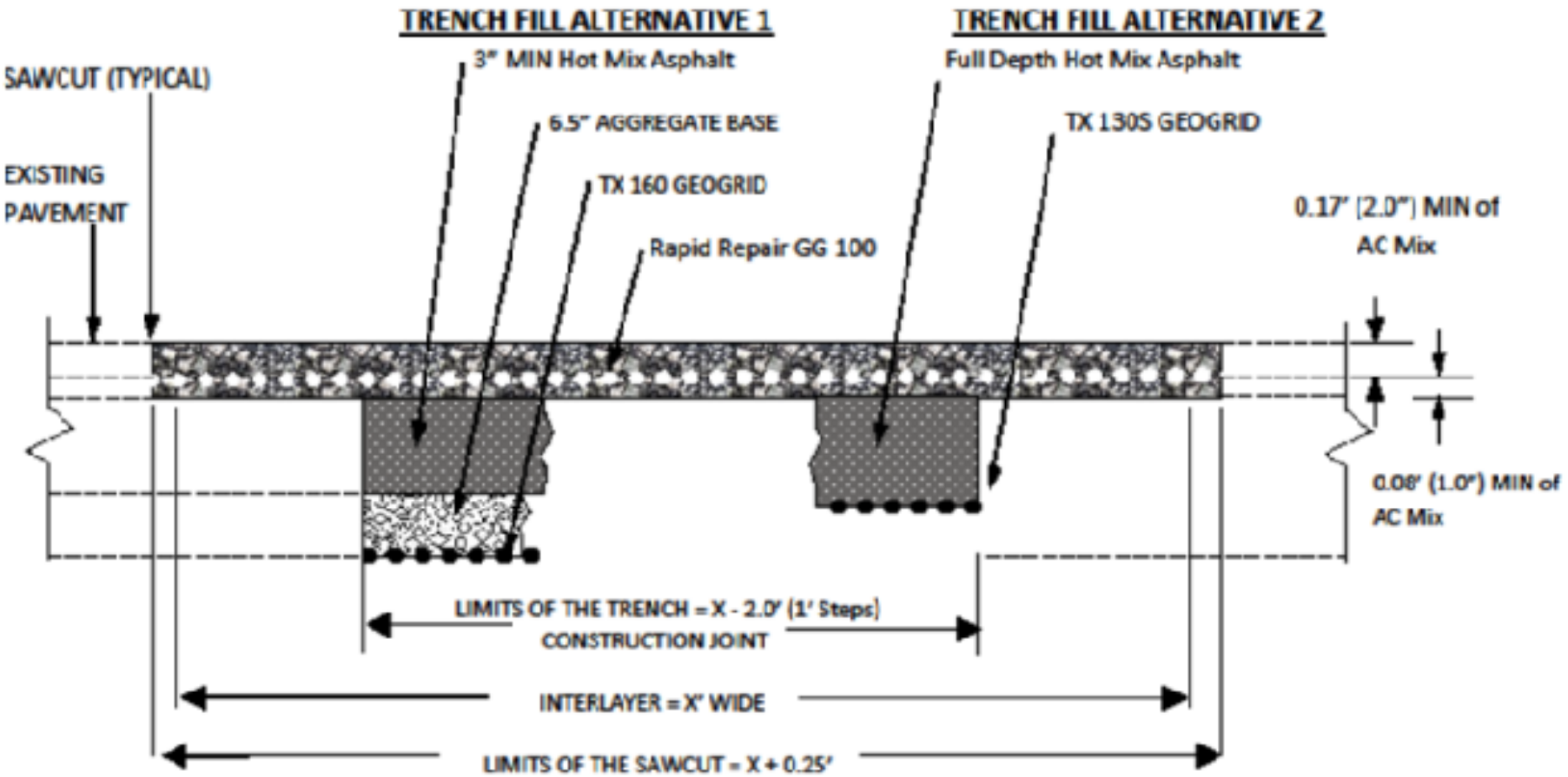
Check for Pumping

Alligator/Chicken Wire with fines pumping

STRUCTURAL – Base Issue CORRECTION

Trench Cut- Dig Out Repairs

TriAx Geogrid & Rapid Repair GlasGrid 100
Trench Detail Alternatives



FUNCTIONAL Evaluation – HMA Issues

Reading A Road - HMA Issues

Delamination, Pop-outs, Trench Cut, Block Cracks

Alligator/Chicken Wire

Delamination Pop-outs

Block Cracking

FUNCTIONAL Evaluation – Crack Issues

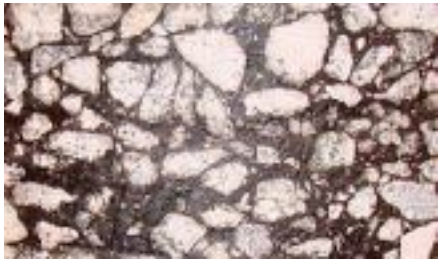
Reading A Pavement – Severe Crack Type

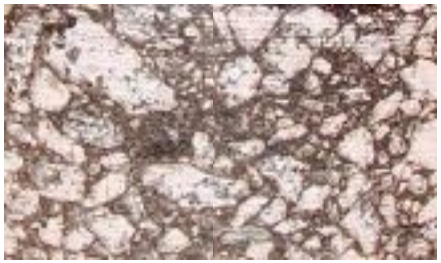
Understanding Cracks

1. Indication of expansive clay sub grades
2. Old aged “shrinkage” asphalt
3. Thermal
4. PCC Joints

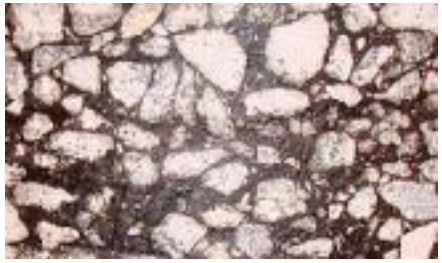
Crack Evaluation

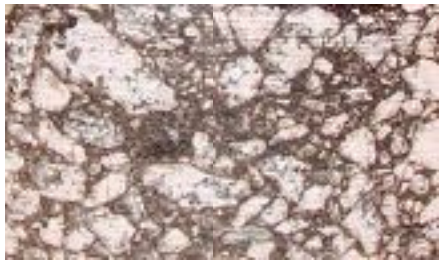
PCC Joint Cracking



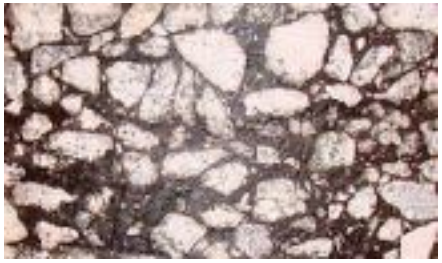


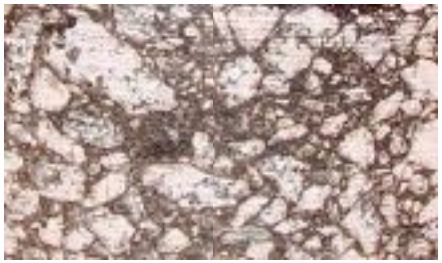
Thermal Cracking





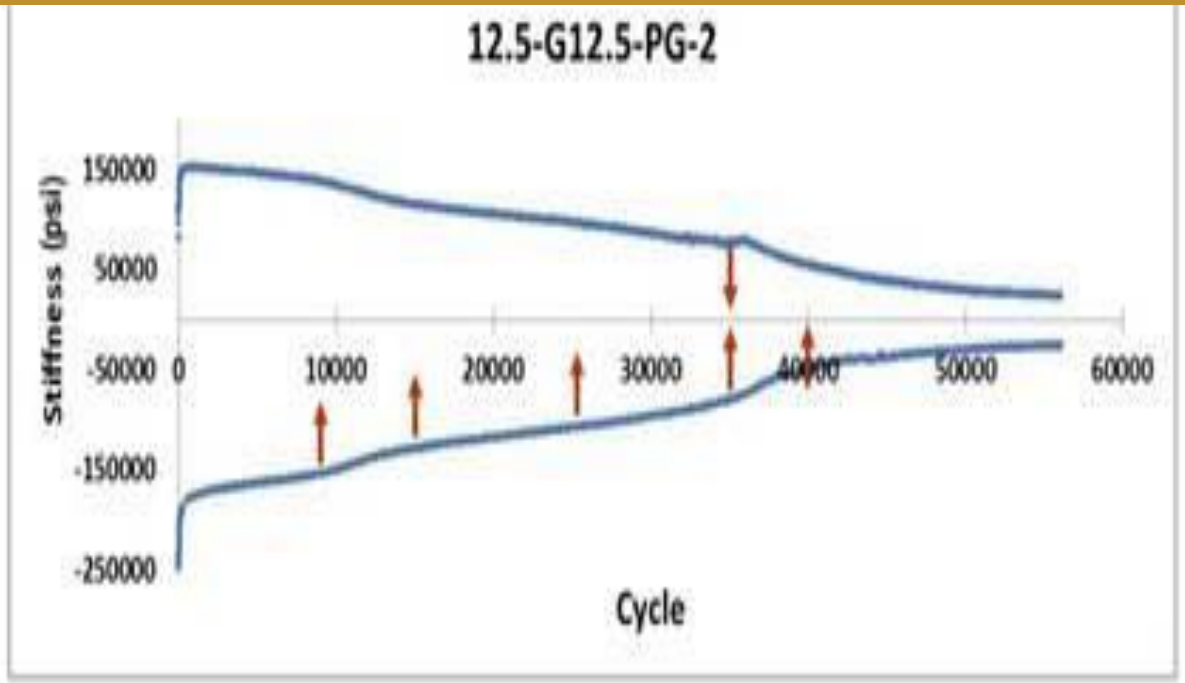
Lane Widening





It is important to understand the type of movements associated with a particular crack type

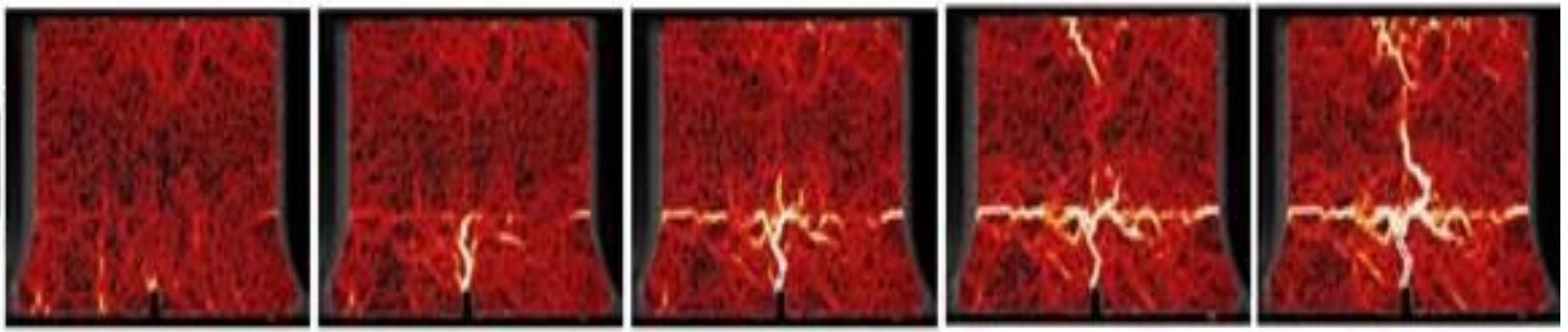
Crack Evaluation



Number of Cycle

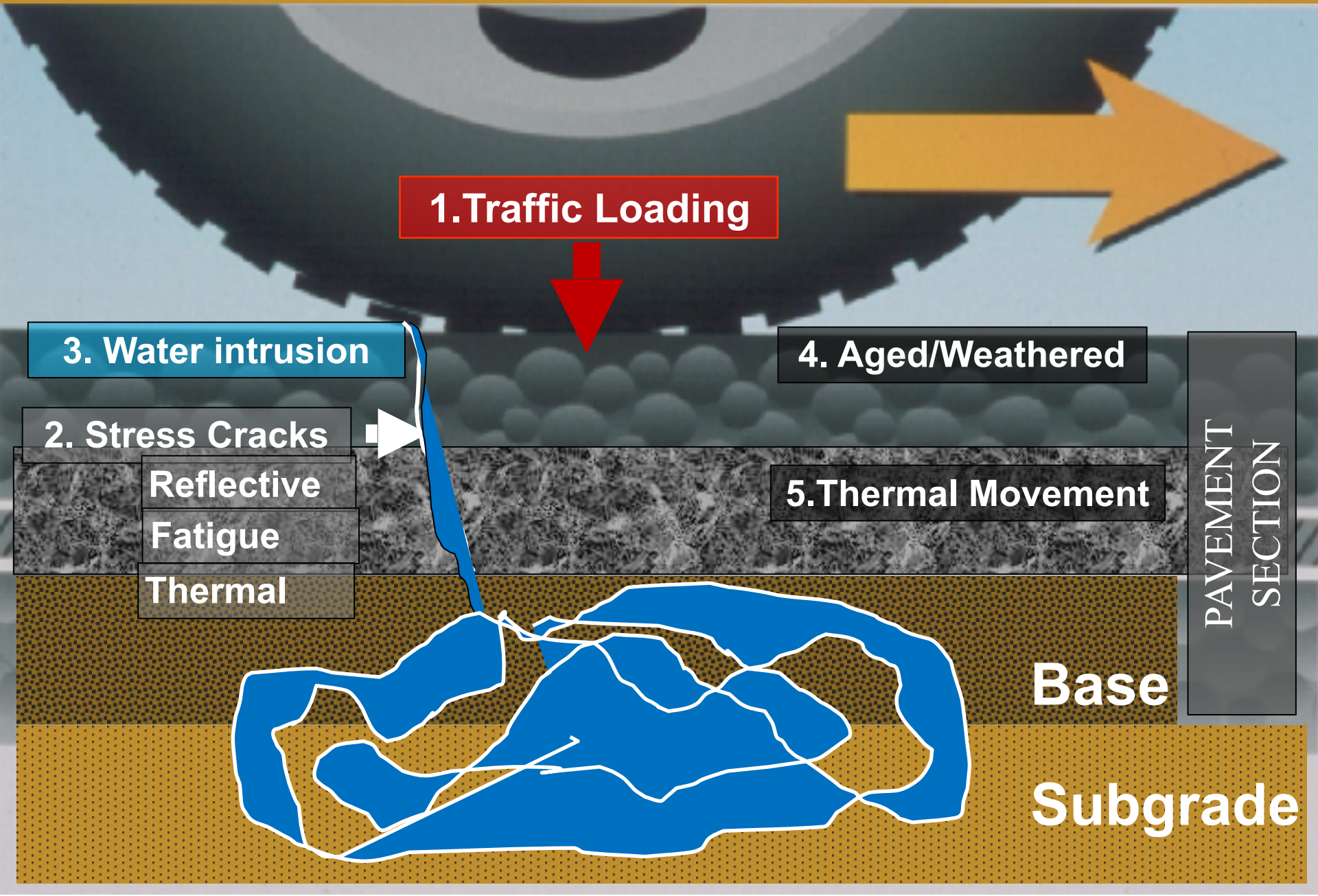
9,000 | 15,000 | 25,000 | 35,000-Zero | 40,000

vM



Digital Imaging – Not visible to naked eye

Deteriorating Effect



Higher Performing New/Rehab HMA Pavements

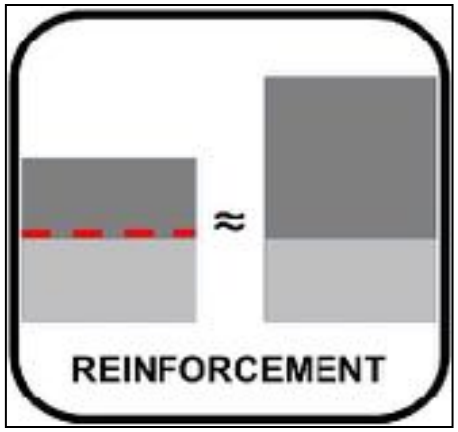
We can achieve longer life, more maintenance free performance, that cost less, when we counteract the root causes of deterioration

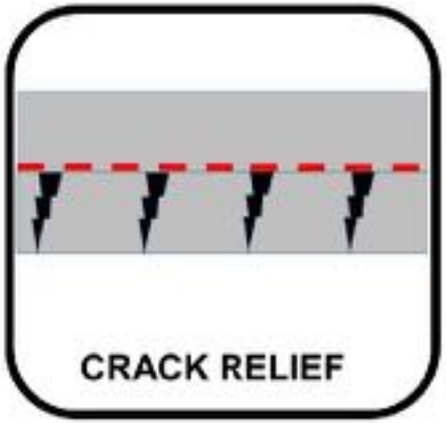
HOW?

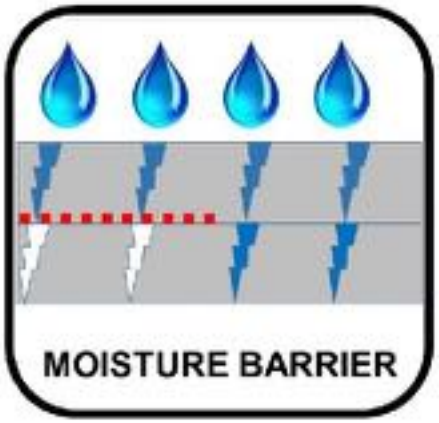
Designs for Higher Performing New/Rehab HMA Pavements

PRIORITIES

- Reinforce to maximize ESAL capacity
- Tensile to mitigate cracking
- Waterproof to keep base dry
- Sustainable practices







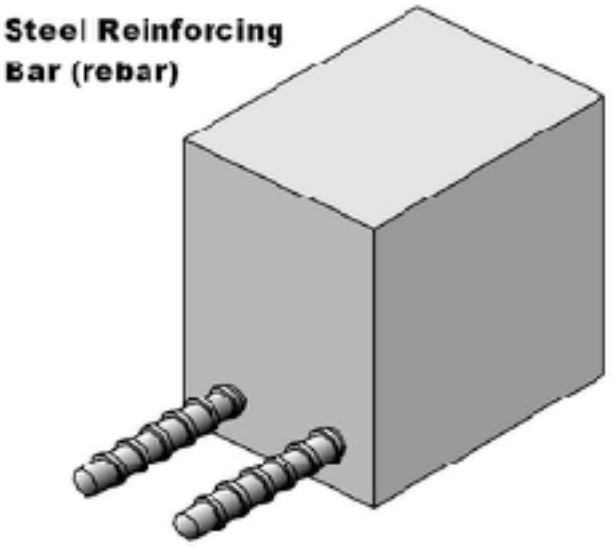
Counteracting Deterioration

Priority 1

- Maximize traffic capacity

Structural Reinforcement

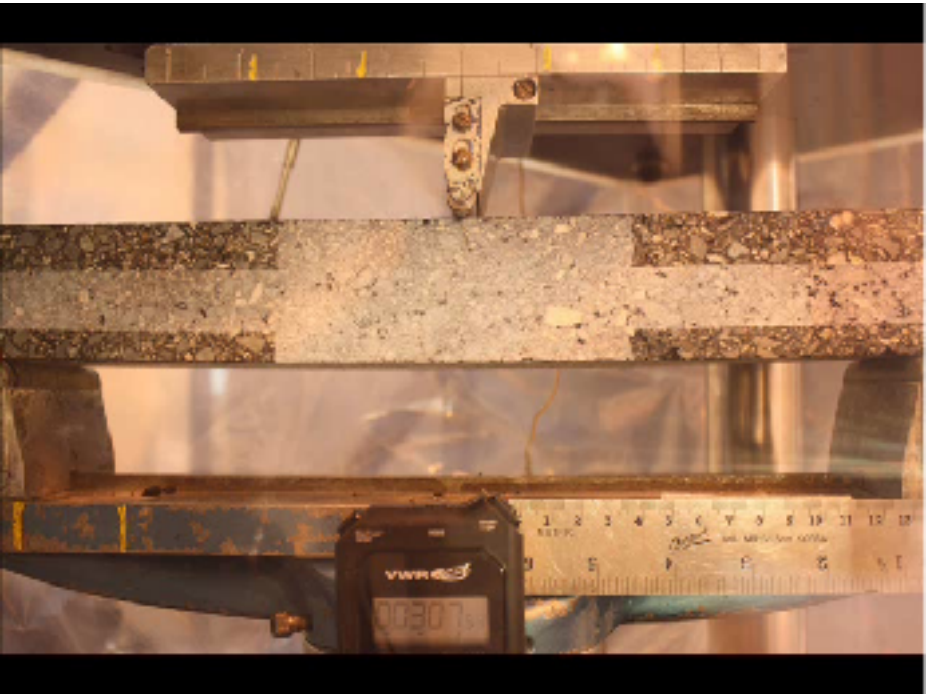
Continuous high tensile fiberglass is to asphalt as steel rebar is to concrete



Increase the structural life of the asphalt pavements using a high tensile rebar type fiberglass with a modulus advantage over the asphalt and is not water/temperature sensitive

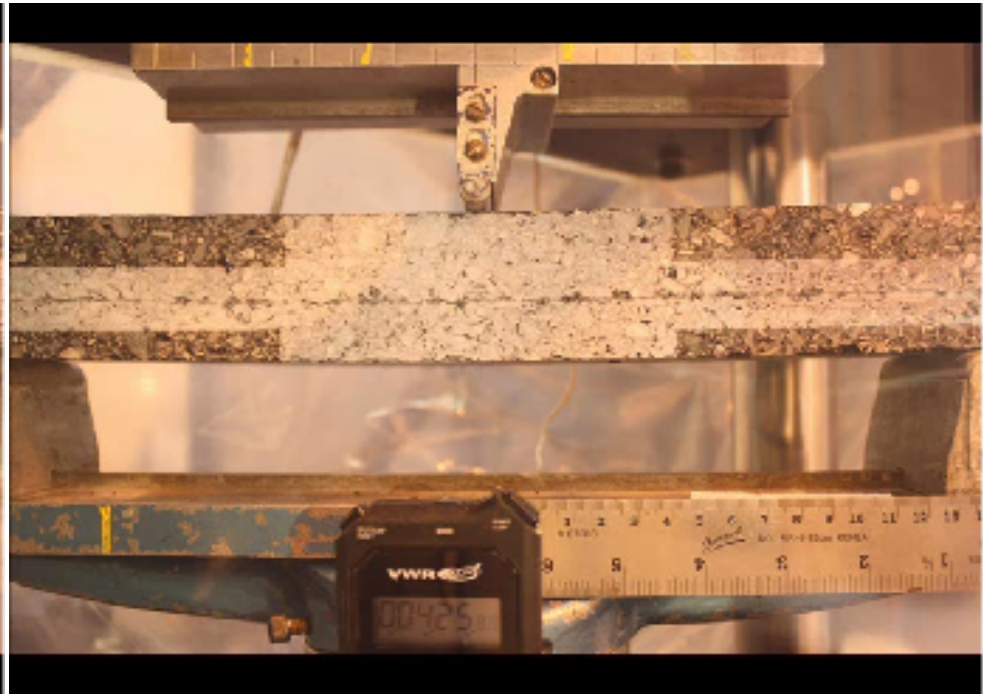
REINFORCEMENT MATTERS!

No Reinforcement



Run Time
0h 51m

Reinforced with GlasGrid TF



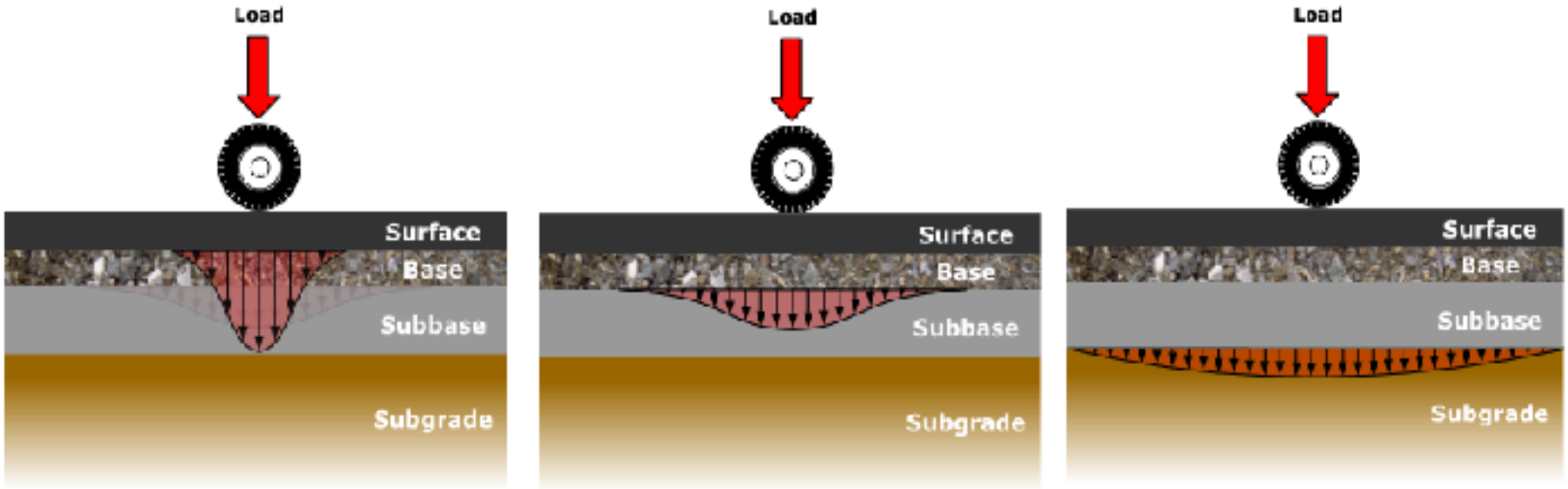
Run Time
5h 30m

Over 5 Times Longer

Maximum Load Distribution

Load distribution is one of the primary functions of a pavement

Conventional Pavement Load Distribution Curves



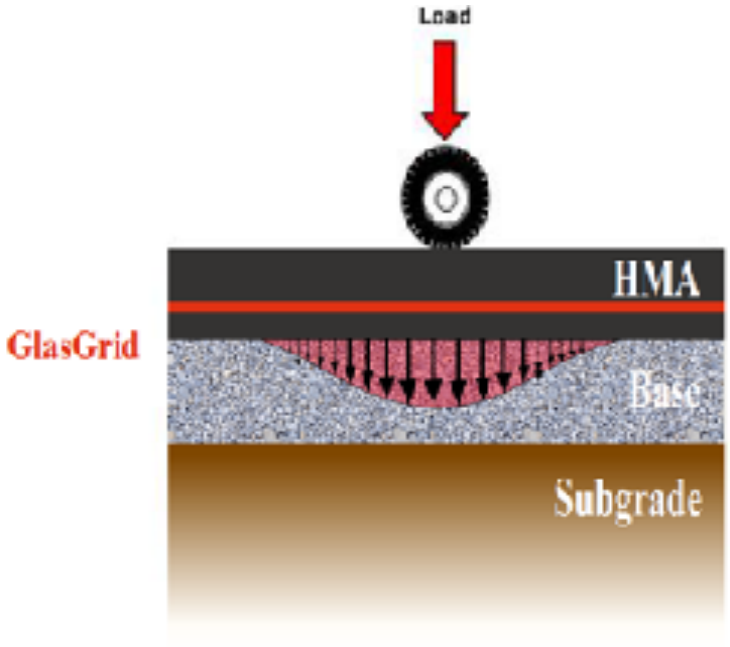
Maximum Load Distribution

Load distribution is one of the primary functions of a pavement

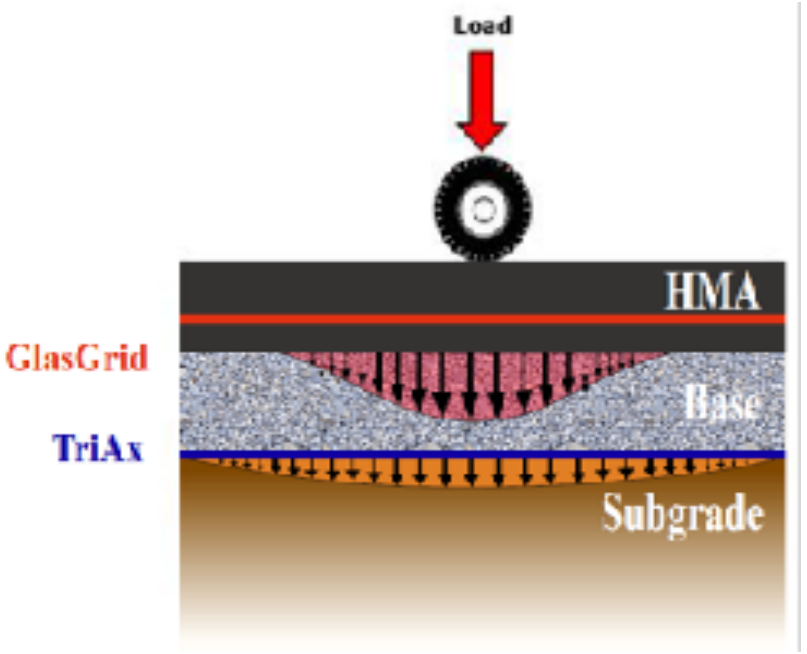
More Cost Effective and Higher Performing HMA Pavements

Most Efficient Pavement Load Distribution Curves

Rehabilitation

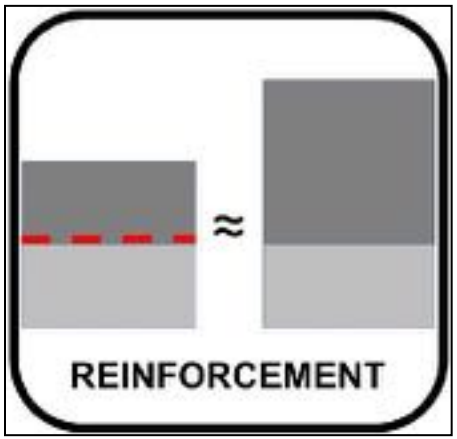


New or Reconstruct



Design for Maximum Traffic Load

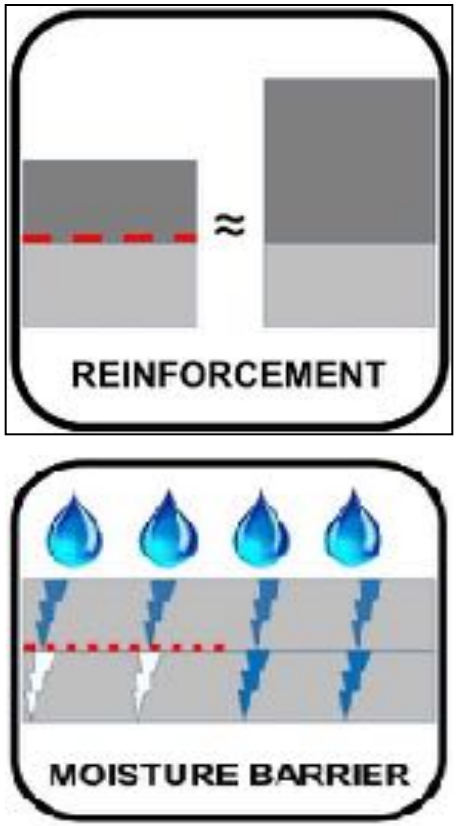
Structural Reinforcement



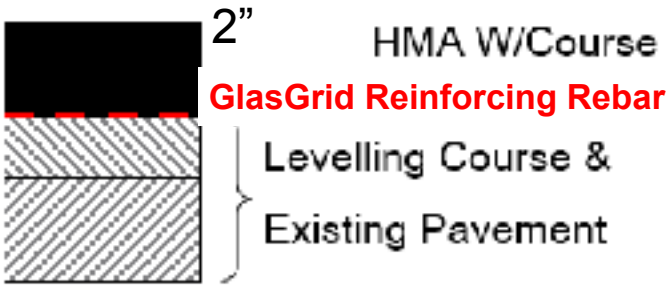
Design to increase ESAL capacity with continuous rebar type high tensile fiberglass :

1. HMA section must be critical layer
2. Must be placed in the tension zone of the pavement

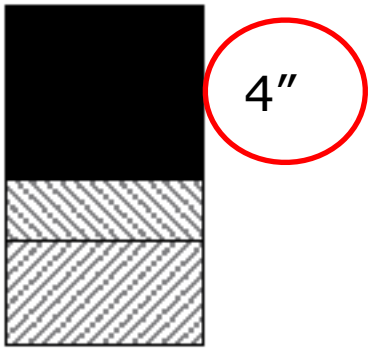
Equivalent ESAL Design with Reinforcement



Reinforced Option



Thicker Equivalent Option



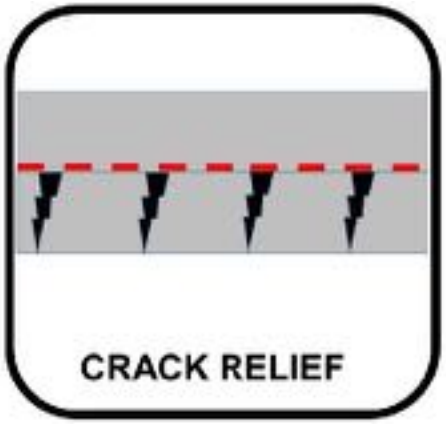
Counteracting Deterioration

Priority 2

- Maximize traffic capacity
- **Delay crack return**

Slowing Crack Deterioration

Crack Relief



High tensile rebar type reinforcing
+
Low tensile HMA =
Crack Resistant Pavements

Crack Mitigation

High tensile = Crack delay

HMA Lacks Tensile

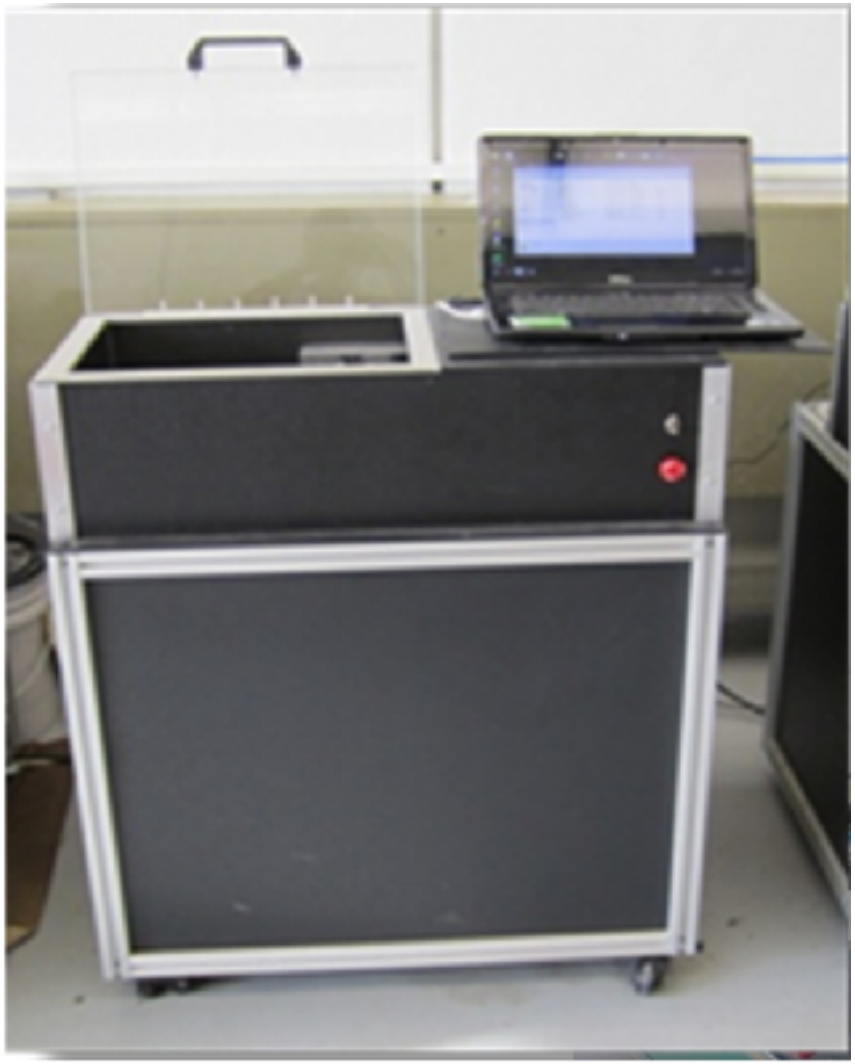
When new can be flexible, perform well

When cold or old gets brittle and cracks

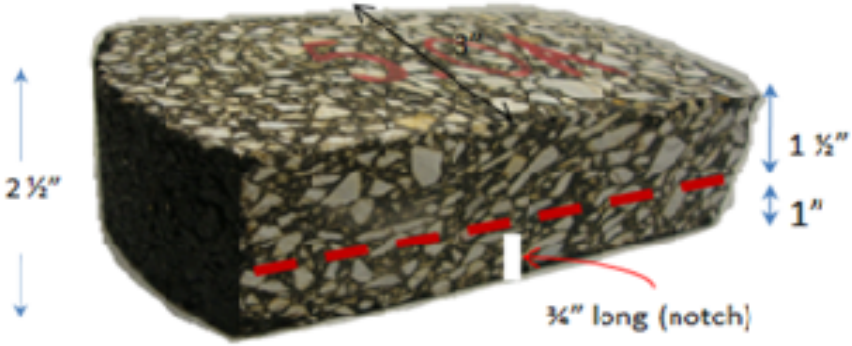
Add tensile to absorb crack stress in new and rehab pavement construction

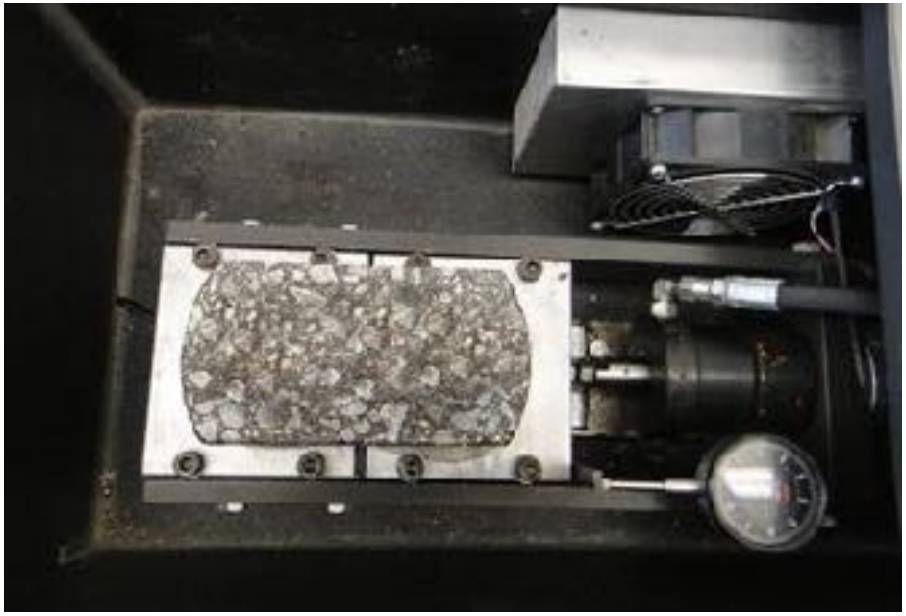
Crack Mitigation

Texas Transportation Institute Overlay Tester



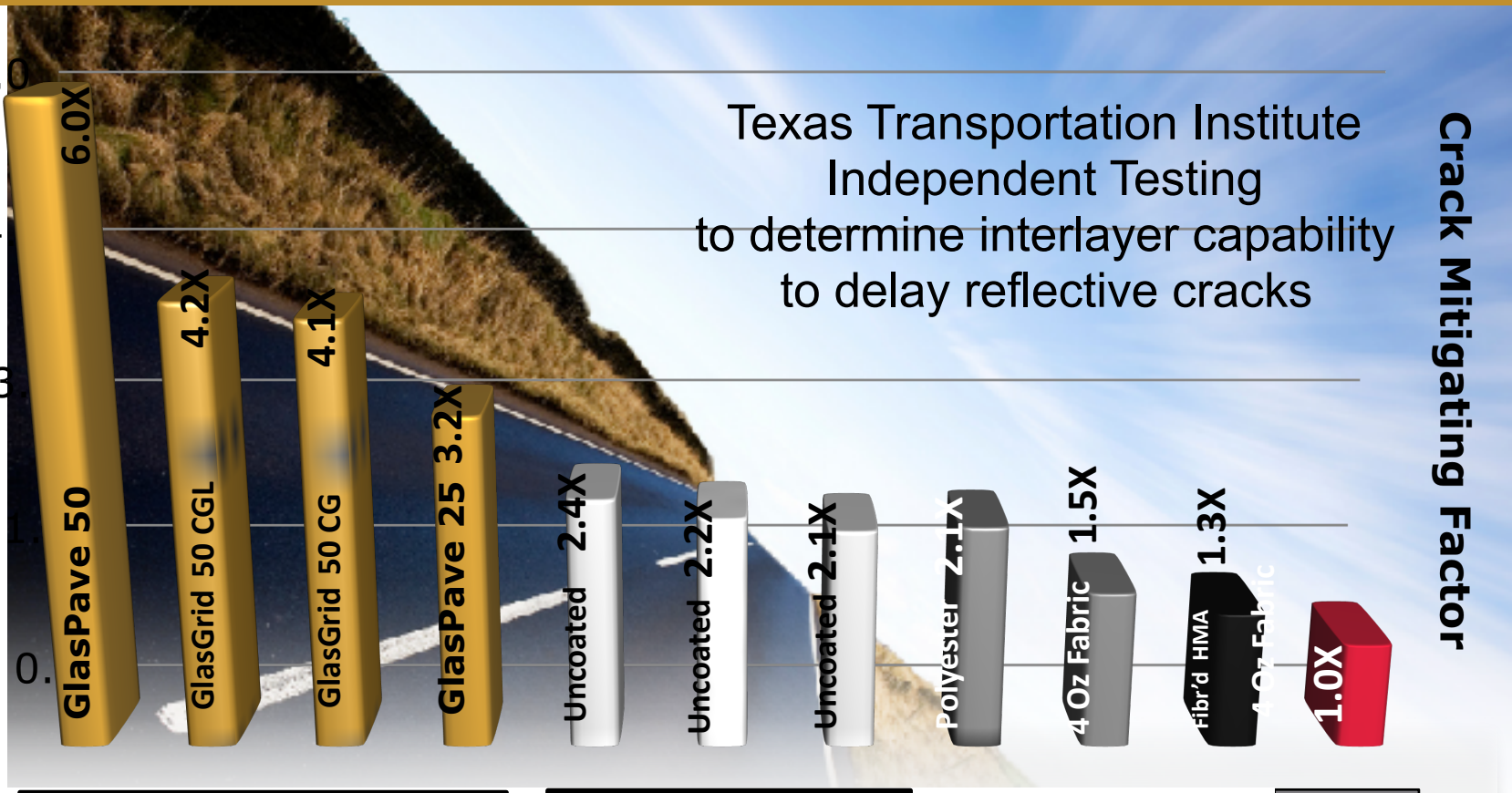
Typical Sample





Pavements Ability to Resist Cracks

ALL Pavements (New, Overlay or Patch Repairs) Should Include reinforcement



	Coated Glass				Uncoated Glass						
Tensile (kN/m)	50	50	50	25	50	6.25	30	50	1	Min	No Inter-layer
%Elongation	<5	<5	<5	<5	<5	<5	<5	>12	>50	∞	
Type	PM	CG	CG	PM	CG	PM	CG	CG	Fabric	Fibers	
Elastomeric Polymer Coating								Polyest	PolyProp	Mix Add	

PM=Paving Mat, CG=Composite Grid

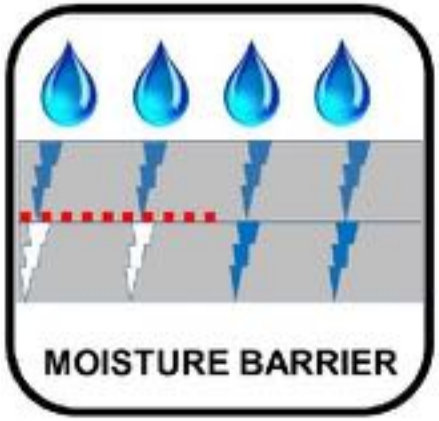
Pavement Foundation Preservation

Priority 3

- Maximize traffic capacity
- Delay crack return
- **Mitigate the effects of water**

Slowing Impact of Moisture

Moisture Barrier



Preserve the traffic bearing capacity of a dry Foundation:

Moisture barrier protects base from top down moisture intrusion into the base

Moisture Intrusion Impact

Saturated base = rapid deterioration

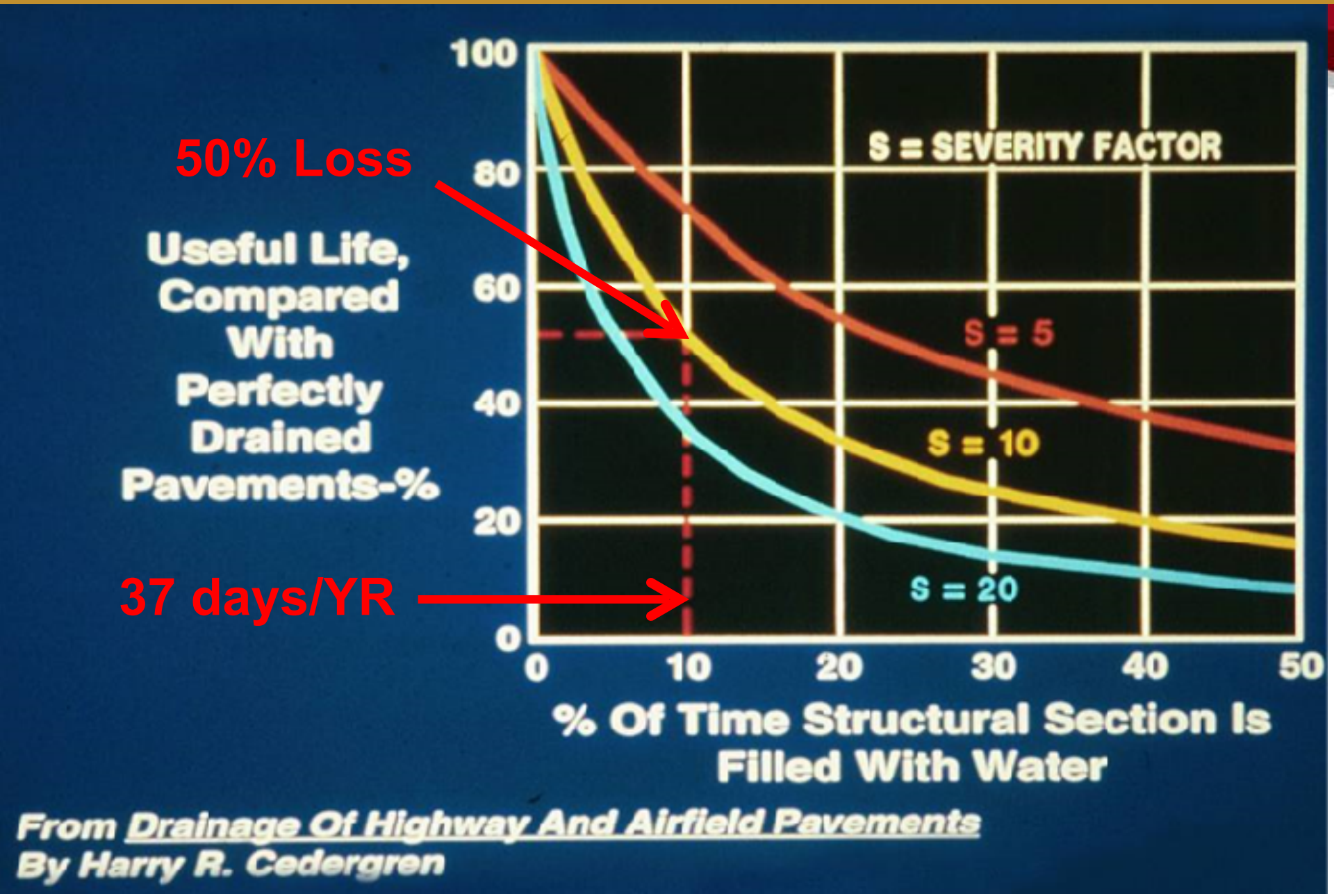
Water

Single largest impact on rate of deterioration

Keeping water out is the most fixable

Include a long lasting moisture barrier in New and Rehab pavement construction

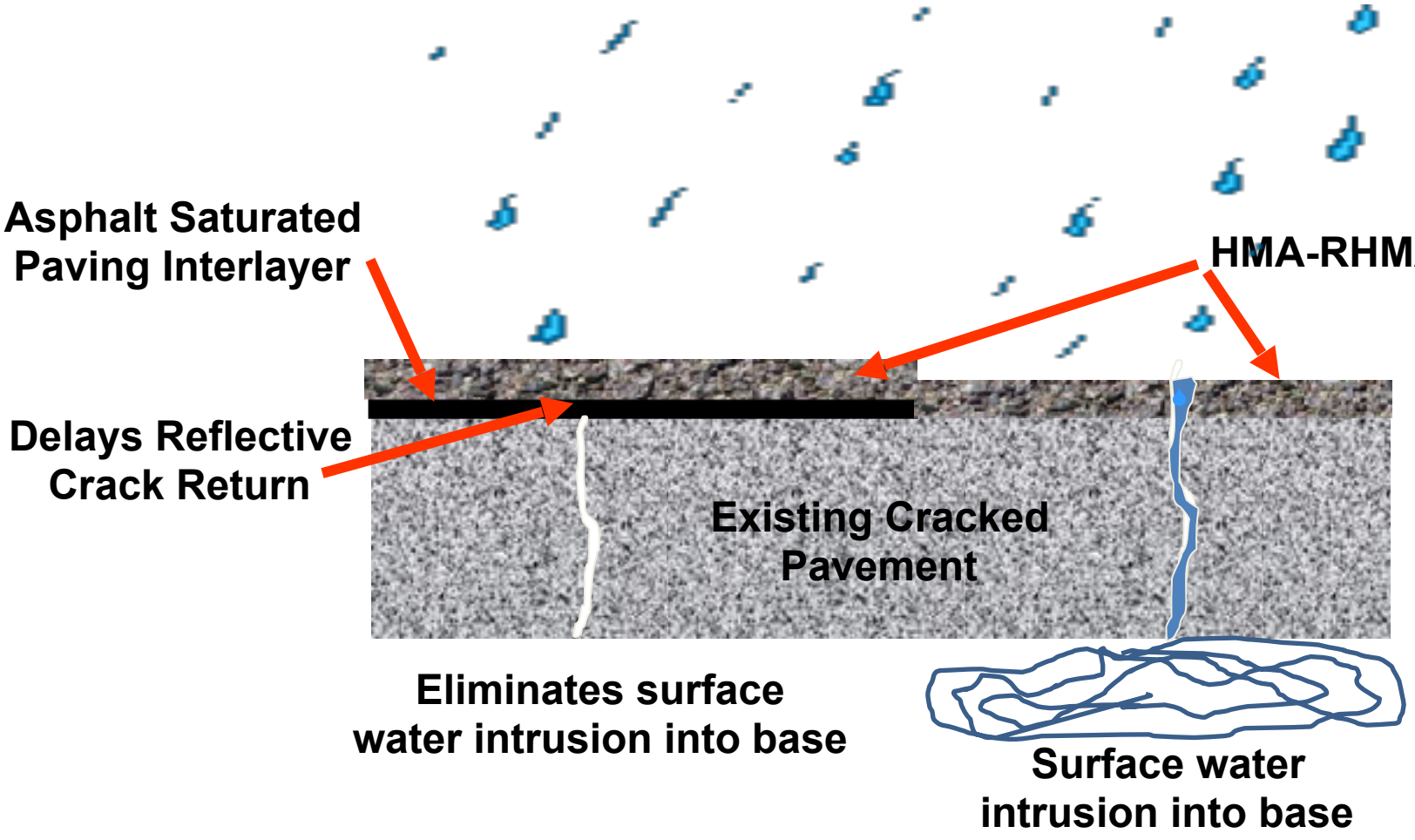
Water in Foundation Deterioration



Mitigate Moisture Intrusion

Seals cracks to keep water out of base

Preserves load bearing capacity



Counteracting Deterioration

Priority Step 4

- Maximize traffic capacity
- Delay crack return
- Mitigate the effects of water
- **Sustainability**

Ability to Mill, Recycle + Add to New HMA

New HMA with up to 30% RAP containing it will pass AASHTO testing T281 for rutting and moisture susceptibility + T322 low temp cracking

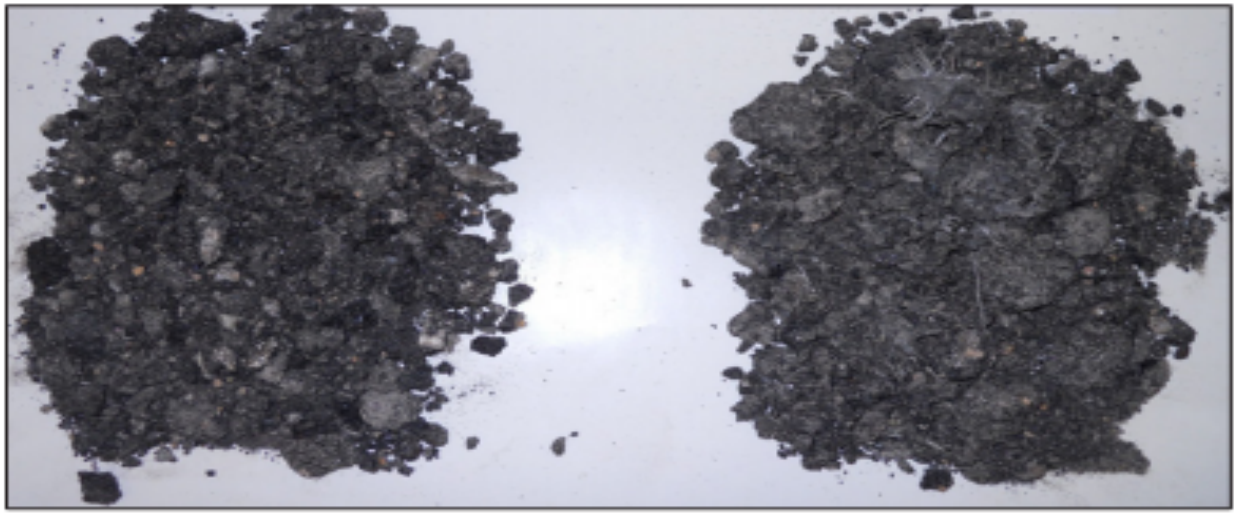


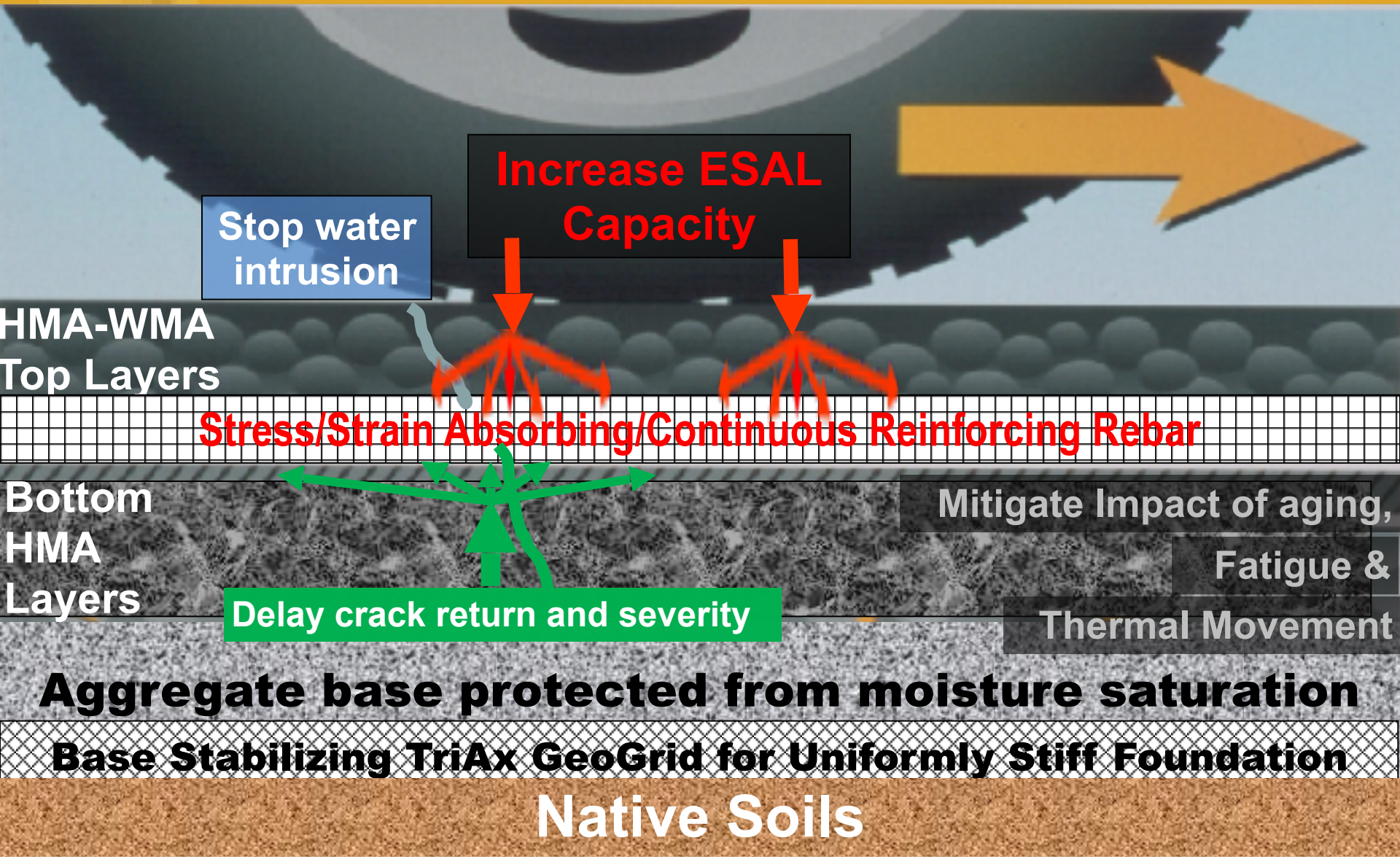
Figure 2 Control RAP mixture (left) and RAP mixture containing GlasPave (right).

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

The Effect of GlasPave™ in RAP on Asphalt Mixture Performance

RESEARCH SYNOPSIS–NCAT REPORT

Design for Longer Life, More Maintenance Free, HMA Pavements that Cost Less



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INSTALLATION

GlasGrid TF Installation

GlasGrid GlasPave Installation

Tensar

IN-PLACE PERFORMANCE

Job Profiles

GlasGrid Performance

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Loretta Heights, CO Installed 2006

2" HMA overlay on heavily alligator cracked HMA

←BEFORE 2006 Vs AFTER 2017→

2017 Yr. 11 - Minor Crack

GlasGrid Performance

Tensar.

Loretta Heights, CO Installed 2006

2" HMA overlay on heavily alligator cracked HMA

←BEFORE 2006 Vs AFTER 2017→

2017 Yr. 11 - Minor Crack

GlasGrid Performance

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Santa Cruz, CA Installed 2004 2" HMA over PCC

←No mat Vs Paving Mat →

2015 Yr. 11 - Minor Crack

GlasGrid Performance

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LAKE Oswego, 2" HMA over Milled HMA

←BEFORE 2007 Vs AFTER 2015→

GlasGrid Performance

Lake Oswego, OR 2" HMA over Milled HMA

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Same contractor, same mix, but No reinforcing

Fosburg Rd, Collector, After 7 Yrs.

GlasGrid Performance

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Pyramid, Sparks NV 4 lane, Heavy truck traffic, 3” HMA

GlasGrid 8501 Installed 2003 S/B curb lane only

2016 Yr. 13 Still NO CRACKS in S/B Curb Lane

GlasGrid Performance

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I-70 GlasGrid Trial Genesee CO 2" HMA over HMA

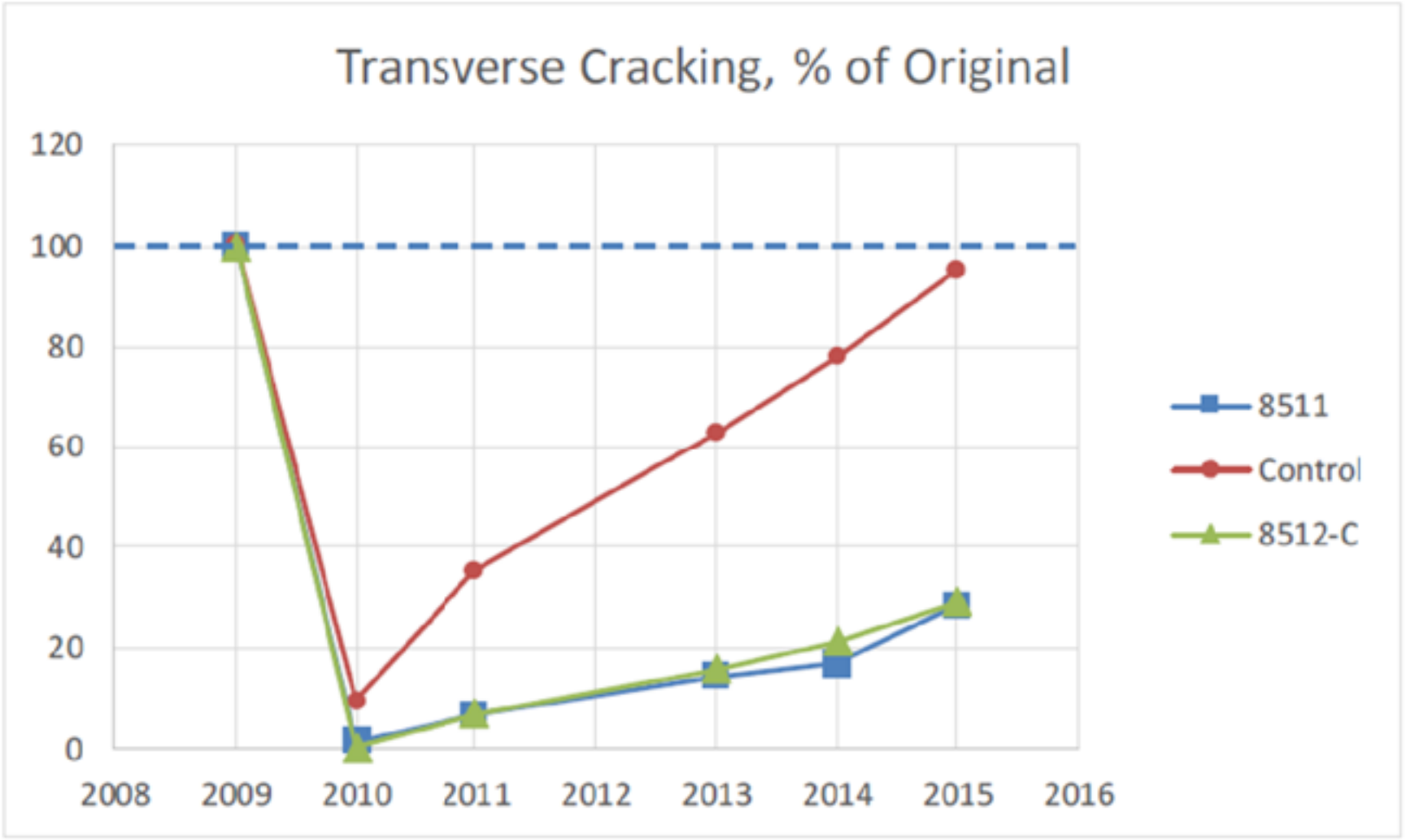

Figure 16. Transverse Cracking in Eastbound Median Lane

GlasGrid Performance

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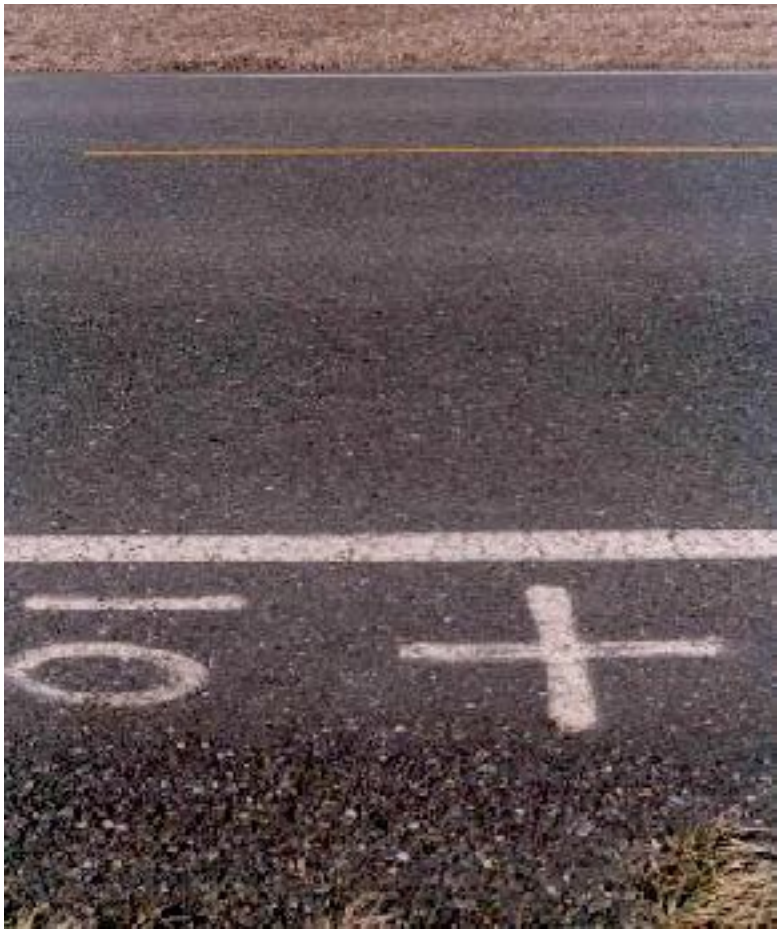
Highway 513, Lethbridge, Alberta, CAN
Crack Repair after 2.5 Years

Crack #11
No GlasGrid

Crack #10
GlasGrid 8502



GlasGrid Performance

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Influence of GlasGrid® on Asphalt Pavement Performance.

- NCAT Ongoing full scale research
- 2018 Update: 18 years and 60 million ESAL's of accelerated traffic loading

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Performance Update 2018

GlasGrid Performance

2018 Unreinforced Section: Cracking first observed in 2006. Additional cracking extending from the centerline cracking.

GlasGrid Performance

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GlasGrid Reinforced Section
after 60 Mil ESALs and 18 Yrs.

Cracking first observed in 2018 along the at construction joint

Summary Points

Tensar.

Proper High Temperature Coated, High Tensile, Low Elongating, Continuous rebar type Reinforcement will:

- **Reinforce to add ESAL Capacity**
- **Delay cracks and their severity**
- **Waterproof to preserve base**

Take Away:

With Increased ESAL capacity, Delayed Cracks and a Dry Foundation we can:

1. More rapidly improve network PCI
2. Reduce maintenance cost and intervals
3. Less downtime, work zones, liability
4. Better Ride, Better looks, longer

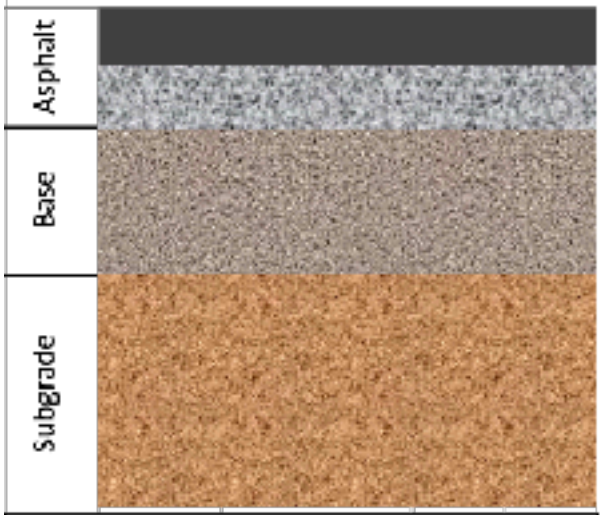
Let us Help You Design & Build More Maintenance free Pavement Structures that Last Longer and Cost Less

Design Services:

HMA Pavement ESAL Increase Worksheet

Project Title: Date:

Project Location:



HMA Overlay Thickness (Inches)	
HMA Overlay Modulus (ksi)	
Existing HMA Thickness (Inches)	
Existing HMA Modulus (ksi)	
PCC-Other Concrete or Treated Base (Inches)	
Base Thickness (Inches)	
Base Modulus (ksi)	
Base Type	
Subgrade Thickness (Inches)	
Subgrade Modulus (ksi)	
Subgrade CBR (%)	
Subgrade Type	

ADDITIONAL EXISTING INFORMATION

STRUCTURAL

CURRENT TRAFFIC INDEX	
CURRENT PCI	
STANDARD SINGLE AXLE LOAD (kips)	18
DUAL/SINGLE WHEEL	
TIRE PRESSURE PSI (PSI)	80
Joint or Crack Wheel Transfer % Efficiency (70% Min)	
RELIABILITY (% per AASHTO 98, typical 80-95%)	
STANDARD DEVIATION (per AASHTO 98)	0.40

NOTES:

The more complete the information, the more accurate the design.

DESIRED OUTCOMES

STRUCTURAL

TRAFFIC INDEX	
PCI GOAL	
PERCENT TRUCKS	%
ESALs PER YEAR 1	
ESALs GROWTH RATE (%)	%
TERMINAL PCI	
DESIGN LIFE (Years)	

FUNCTIONAL

YEARS TO CRACK RETURN	
YEARS TO FIRST PREVENTATIVE MAINTENANCE	
ANTICIPATED MAINTENANCE CYCLE	

Send to: Tensar Dennis Rogers Phone: 760.568.34306 Email: drogers@tensarcorp.com

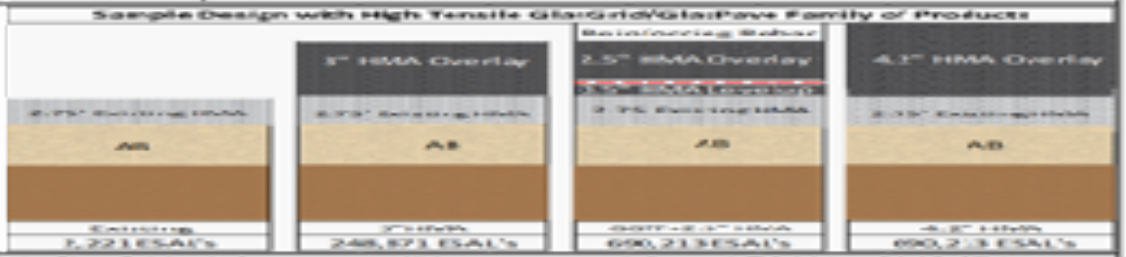
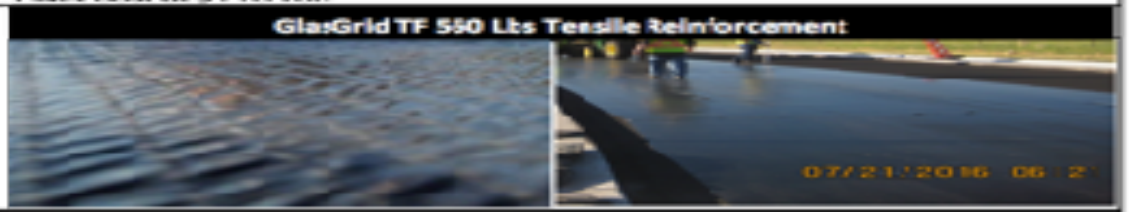
Sample Design:

Tensar.

Tensar. THE COMPANY YOU CAN BUILD ON®	Prajwol Tamrakar, Ph.D., P.E. | Application Technology Manager – Pavement Optimization Garrett Fontain, P.E.G.E | West Area Engineer
Tensar Team	Dennis Rogers, Pavement Maintenance Mgr. West

Project:	**Buckland Crossing - Spruce Ave Rehabilitation**			
Location:	Silver Springs, Lyon Co. NV			
Client/Contact:	Marco Lucich, Mustang Ventures	916 416-7901	Date	10/8/2018
Design Assistance:	Reinforcement	Reference No.:		SSNV 10318
Product	GlasGrid TF - High tensile reinforcing type rebar for HMA Pavements			

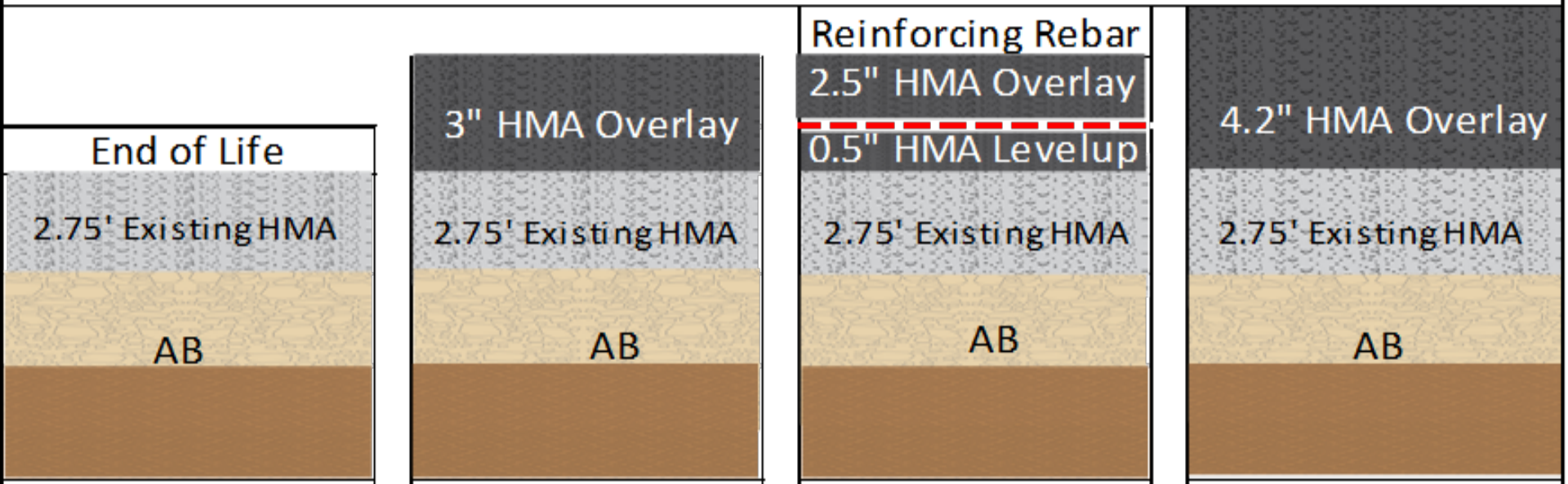
Executive Summary

Objective:	Add reinforcement to increase ESAL capacity, maximize HMA pavement design life and performance, with the least construction delay, for the least cost.
Proposal:	Dig out and repair weak base areas. Fill all cracks over 1/4" and repair any pop-outs. Install 1/2" thick HMA levelup, GlasGrid TF reinforcement . Overlay with 2.5" compacted HMA.
Design to Maxmize ESAL Capacity	
Results:	1. GlasGrid reinforcement will increase unreinforced ESAL's of 248,671 (TI=7.63) SN 2.94 to 690,213K ESAL's (TI=8.51) and SN to 3.43 2. Structurally equivalent to adding 1.2" of HMA and is cost neutral 3. Maximum Crack delay up to 18 longer than using no reinforcement (Sparks Pyramid project report and NCAT Study) 4. The RAP containing the milled GlasGrid TF can be recyced back into a new hot mix up to 30% 5.Long -term waterproof to preserve base structure
Assumptions:	These suggestions are based on and subservient to the Black Eagle Consulting Evaluation and Pavement Design Report dated 10/2018 and provided to quantify the suggestion to use GlasGrid to maximize the performance of the HMA layer to its highest level of performance using GlasGrid reinforcement. Areas of weak base, to be dug out and repaired. HMA cost at $110/Ton
Product Installed	

Sample Design:

Tensar.

Sample Design with High Tensile GlasGrid/GlasPave Family of Products



Existing	3"HMA	GGTF+2.5" HMA	4.2" HMA
1,514 ESAL's	248,871 ESAL's	690,213 ESAL's	690,213 ESAL's
TI : 4.16	TI : 7.63	TI : 8.61	TI : 8.61
SN: 1.35	SN: 2.94	SN: 3.42	SN: 3.42

Sample Design:

1. Structurally equivalent to adding 1.2" of HMA at 14% less cost
2. Crack delay up to 9X longer than using no reinforcement (NCAT Study)
3. Long -term waterproof to preserve base structure
4. RAP with milled GlasGrid can be recycled back into a new hot mix and pass AASHTO T281 + 322 for rutting/water susceptibility and cracking

Performance Vs Cost:

Sample Design with High Tensile GlasGrid/GlasPave Family of Products			
EXISTING End of Life	3" HMA Overlay	Reinforcing Rebar 2.5" HMA Overlay 0.5" HMA Levelup	4.2" HMA Overlay
2.75' Existing HMA	2.75' Existing HMA	2.75' Existing HMA	2.75' Existing HMA
AB	AB	AB	AB
ESAL's	248,871	690,213	690,213
Added Load %	1X	177%	177%
Crack Delay	1X	9X	1.4X
Waterproof	NO	YES	NO
Design Life (Yrs)	15	26.6	26.6
SY Cost Per/Yr	$2.22	$1.70	$1.77

QUESTIONS?

Thank you for your time!
If I did right, it was time well spent!

Dennis Rogers
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INTERMISSION

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Longer Life Pavements

Importance of building longer lasting, more maintenance free pavements that cost less

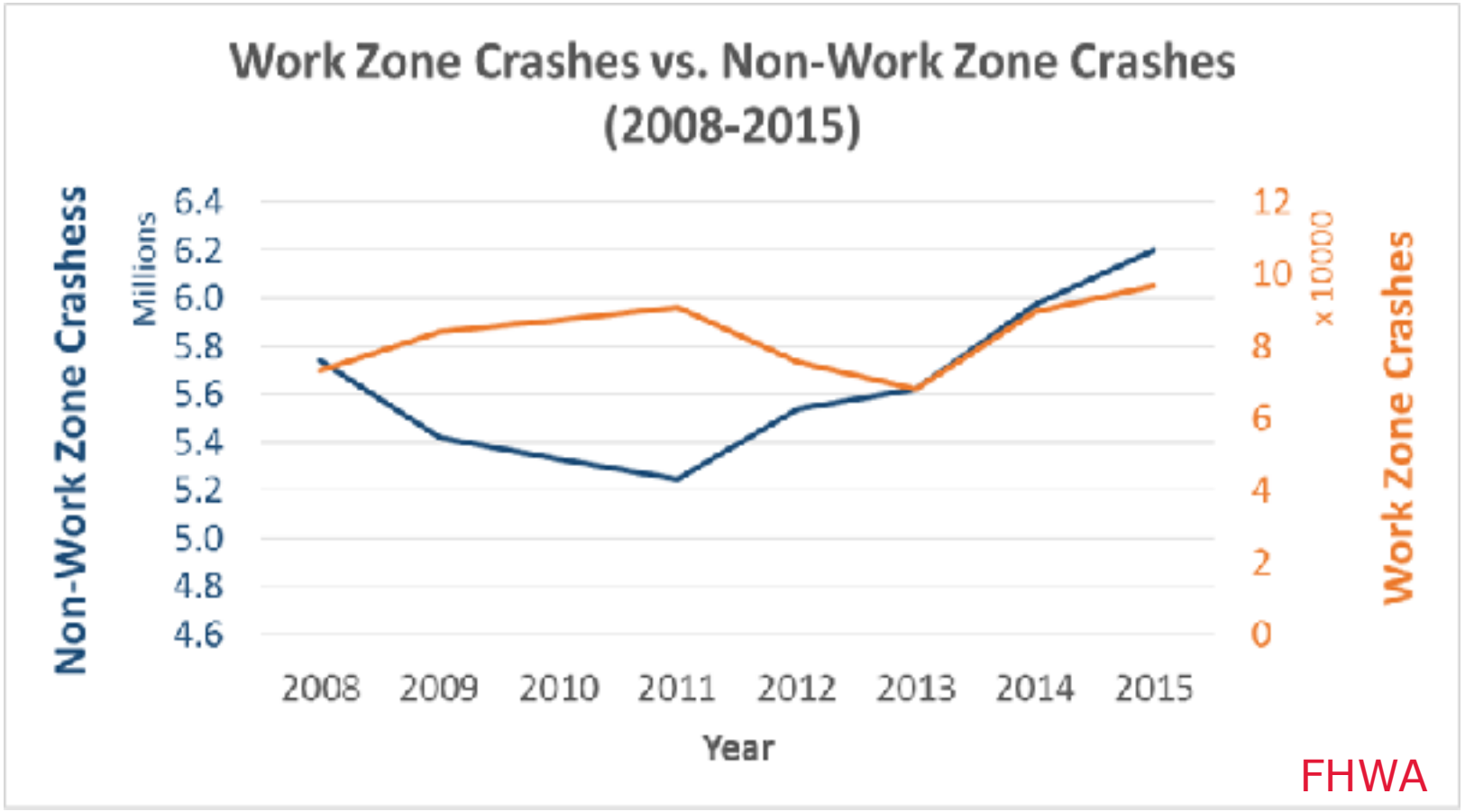
WHY?

- **Longer Life-Improving PCI**
- **Reduce maintenance cost**
- **Looks better - longer lasting ride quality**
- **Fewer road closures, less public disruption**

Means: Fewer work zone accidents and lawsuits

Safer Pavements

Work Zone Crashes: 2015 96,626, a 42% Increase last two years!

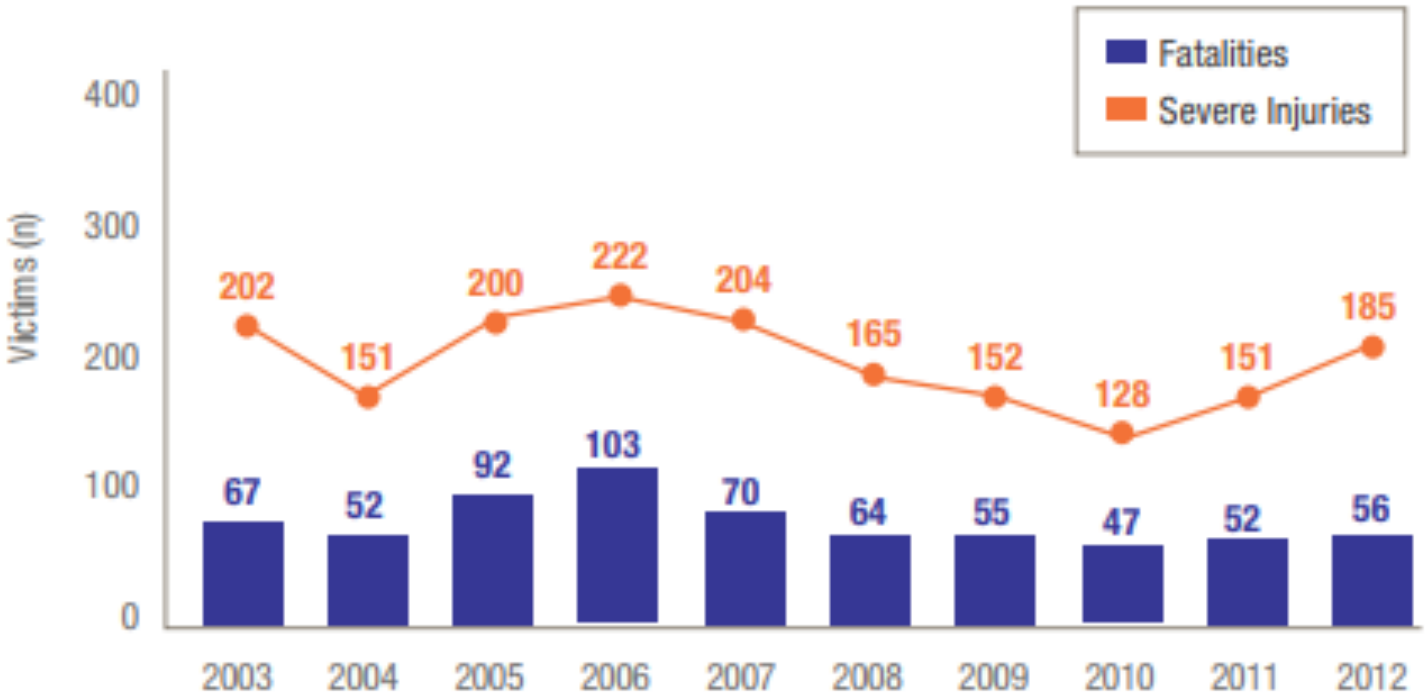


In 2015 Work Zone Crashes occurred once every 5.4 minutes.
Every day, 70 people are seriously injured. Over 25,500 Yr.!
Every week, 12 people die Over 600 Yr.!

Safer Pavements

CA Strategic Highway Safety Plan

Figure 7 Work Zone Fatal and Severe Injury Trends, 2003 to 2012



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According to the National Highway Traffic Safety Administration (NHTSA), traffic crashes cost CA more than $22 billion per year