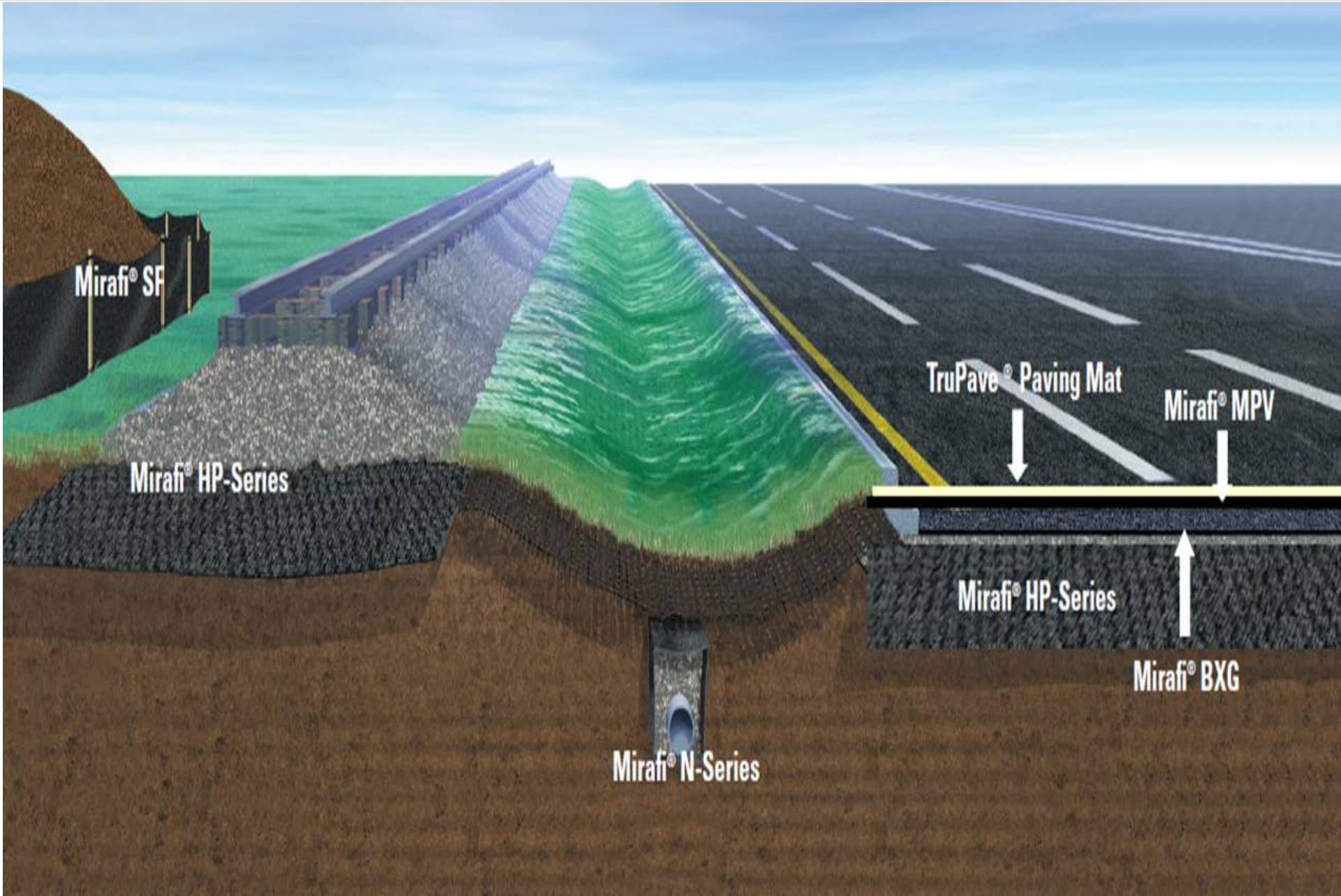
WELCOME

Dennis Rogers

Mirafi - Pavement Solutions

Business Manager, West

Geosynthetic In Construction



Geosynthetic Pavement Interlayers

- **Deterioration Causes & Delay**
- **Interlayer Types & Functionality**
- **Cost/Benefit**

Pavement Deterioration

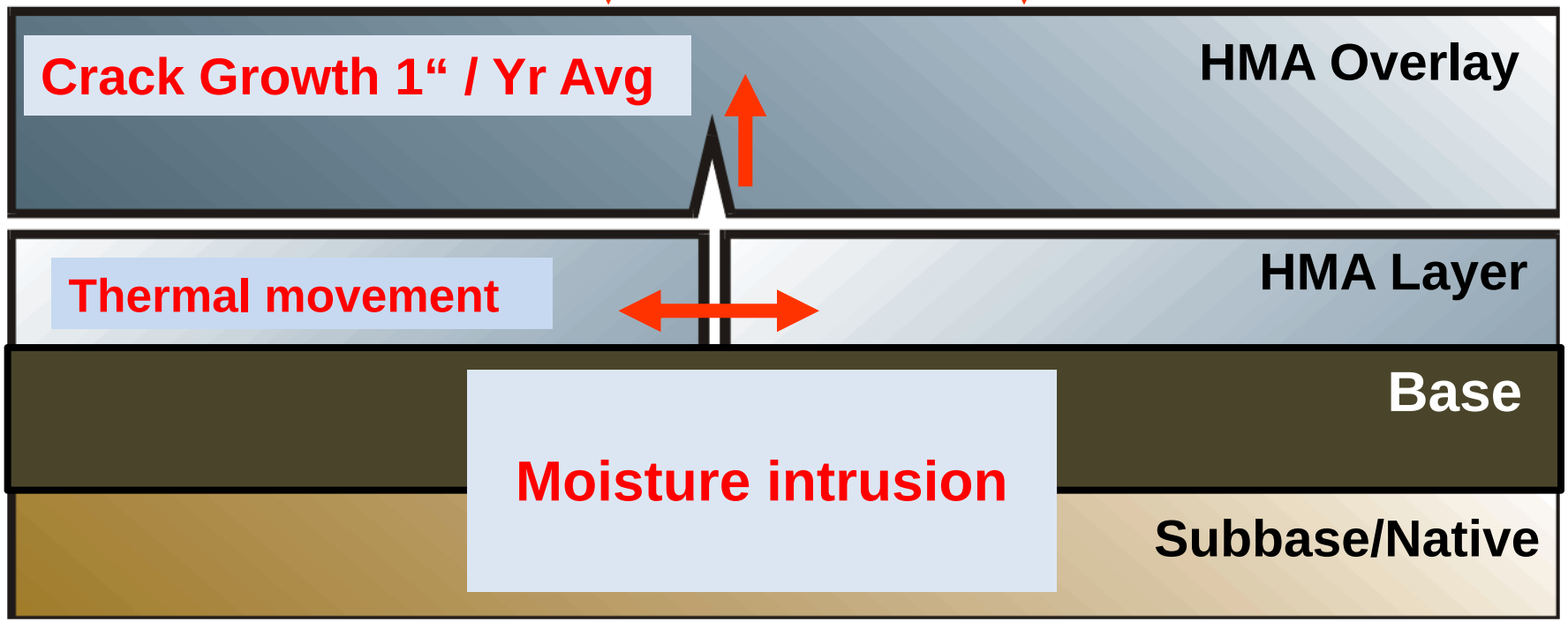
From day ONE these forces are at work

Deficiencies in design, construction and maintenance

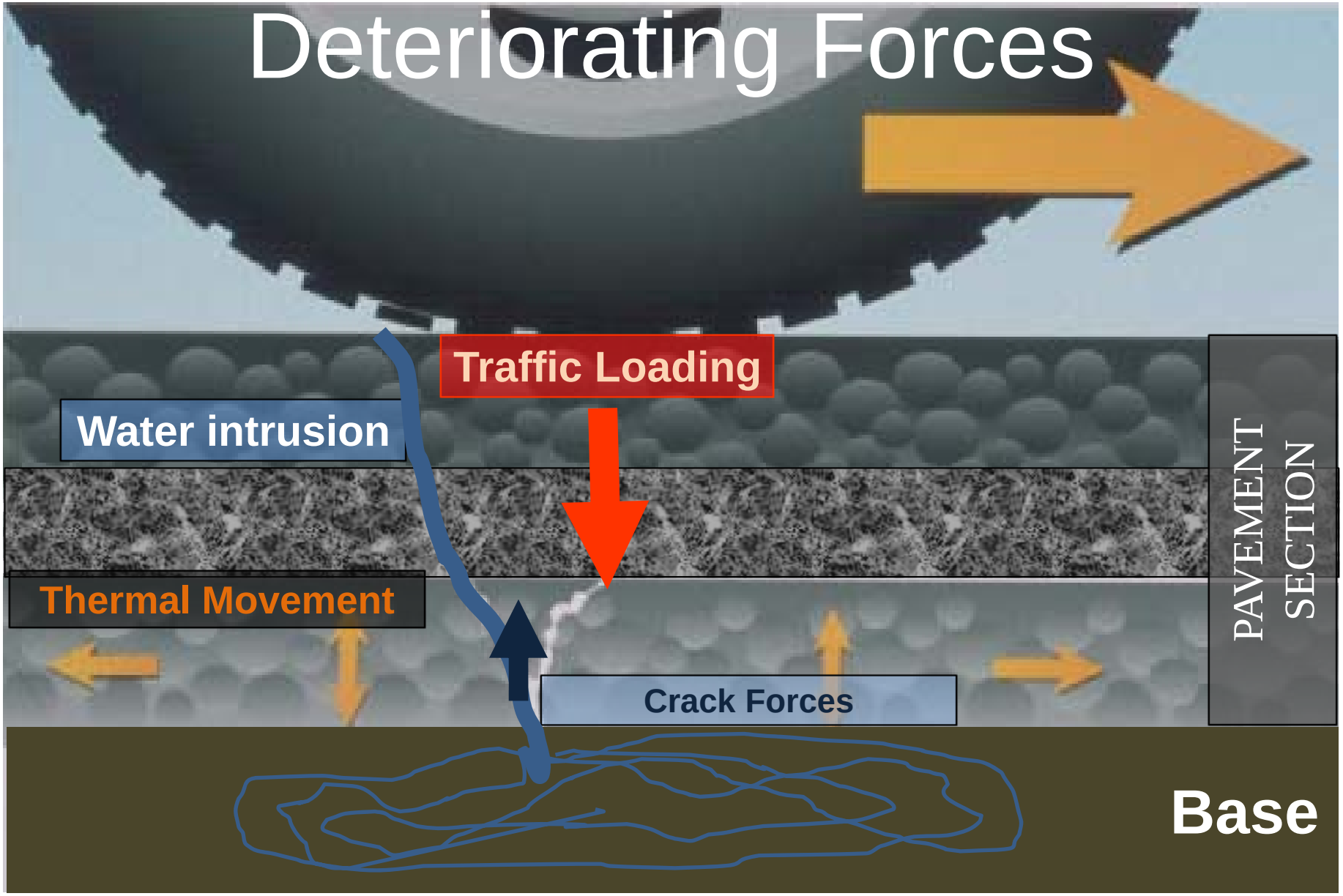
Weather / Environmental Action

Aging

Traffic Loading



Pavement Deterioration



Pavement Deterioration

Distressed Pavements

Deteriorating Impact of Moisture Intrusion

FHWA - Moisture intrudes through pavement:

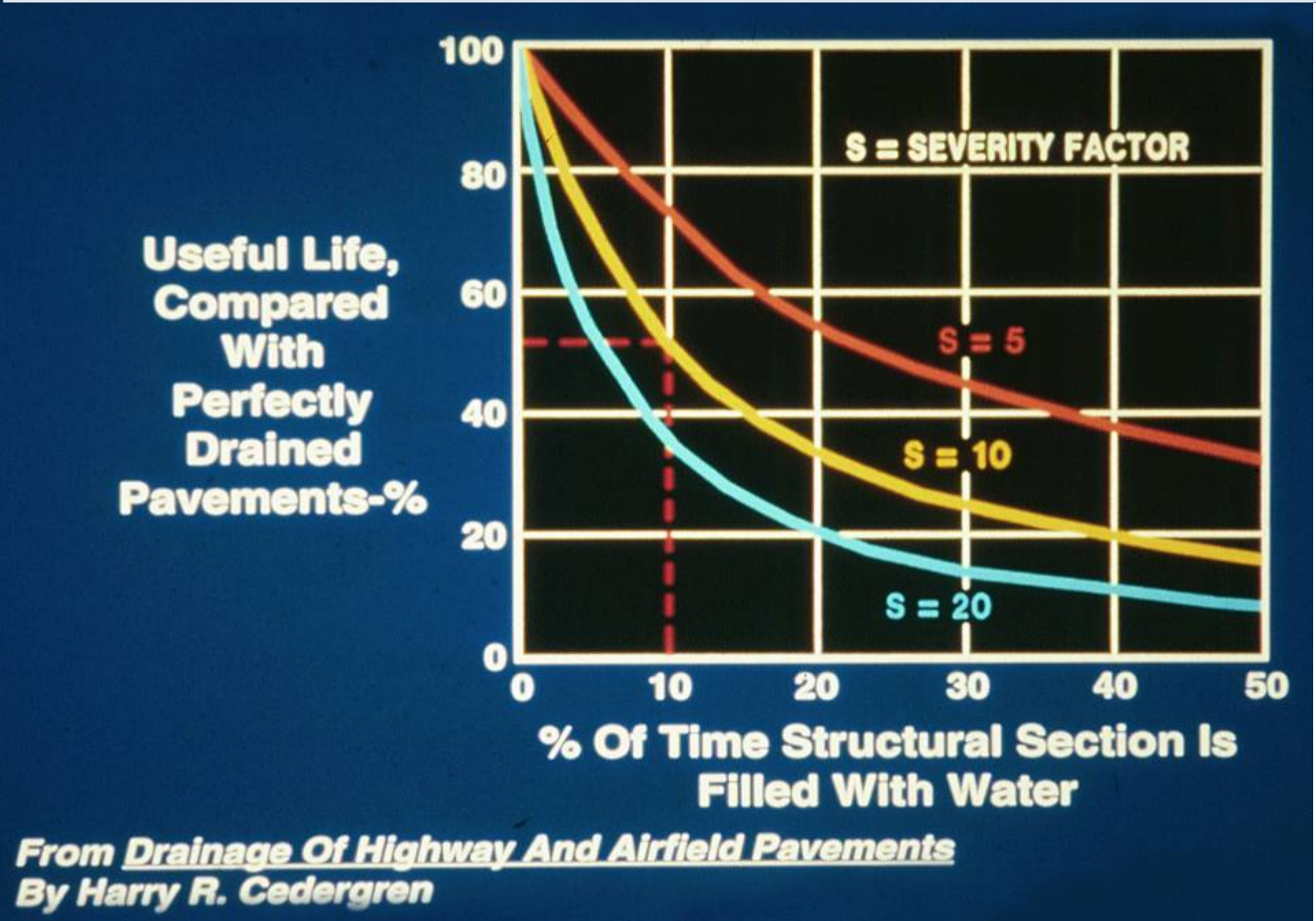
Asphalt up to 50%

Concrete up to 67%

"One major factor that degrades a roadbed's ability to function is the infiltration of water into the base material."

Caltrans Pavement Evaluation Manual
Pavement Condition Survey
John Poppe

Deteriorating Impact of Moisture Intrusion



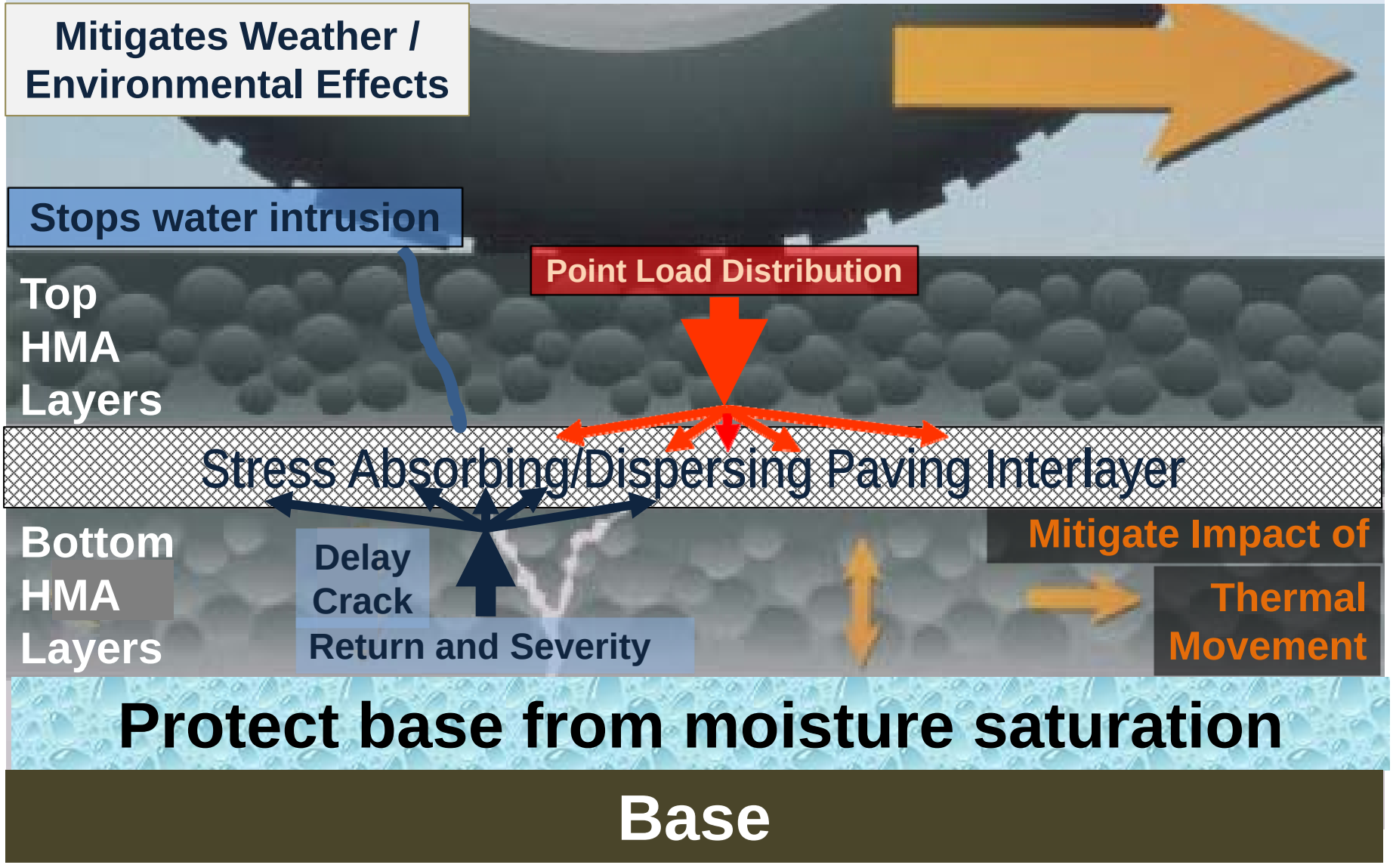
Deteriorating Impact of Moisture in Base

AASHTO DESIGN: IMPACT OF WATER ON AGGREGATE BASE

Drainage Quality	Time	Drainage Coefficient
Excellent	2 hours	1.2
Good	1 day	1.0
Fair	1 week	0.8
Poor	1 month	0.6
Very Poor	Doesn't drain	0.4

Pavement Deterioration Delay

Interlayer Functions that Delay Deterioration



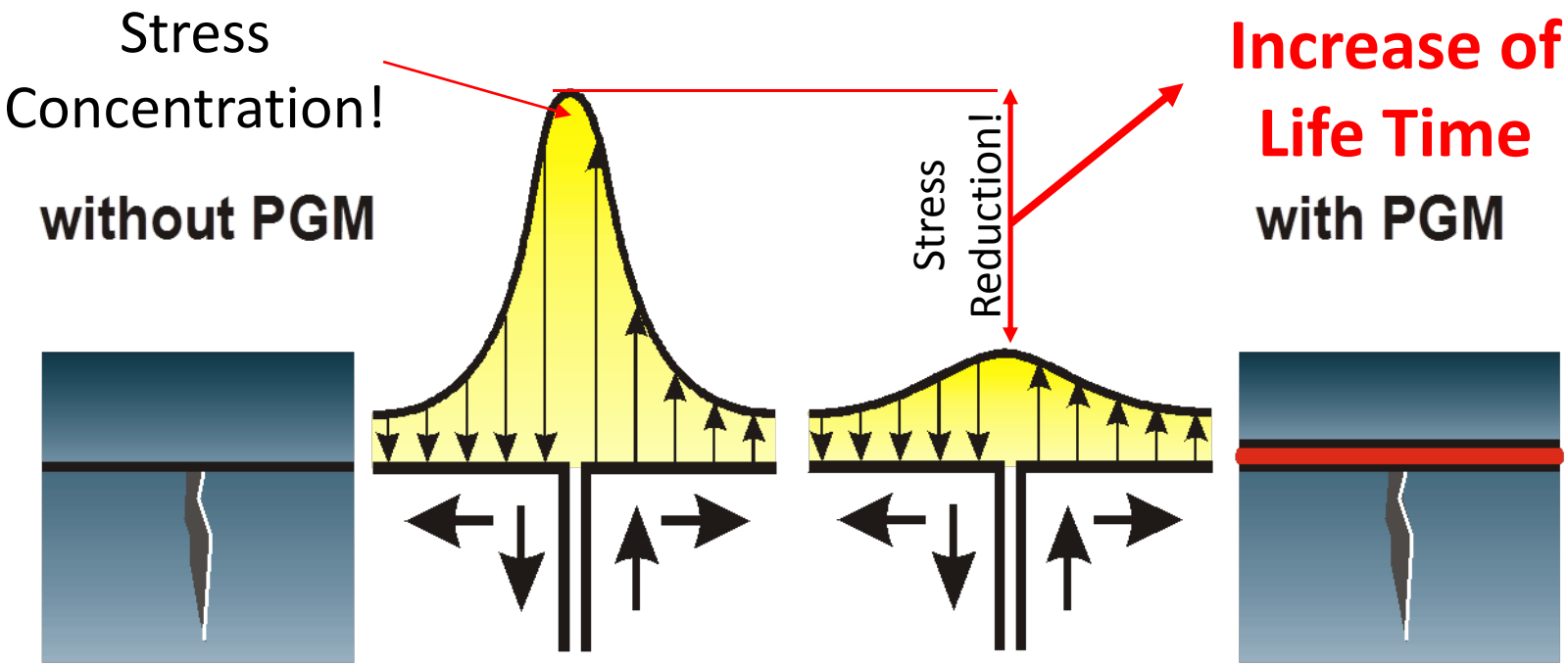
Pavement Interlayer Functionality

Keeping Water out of the Base

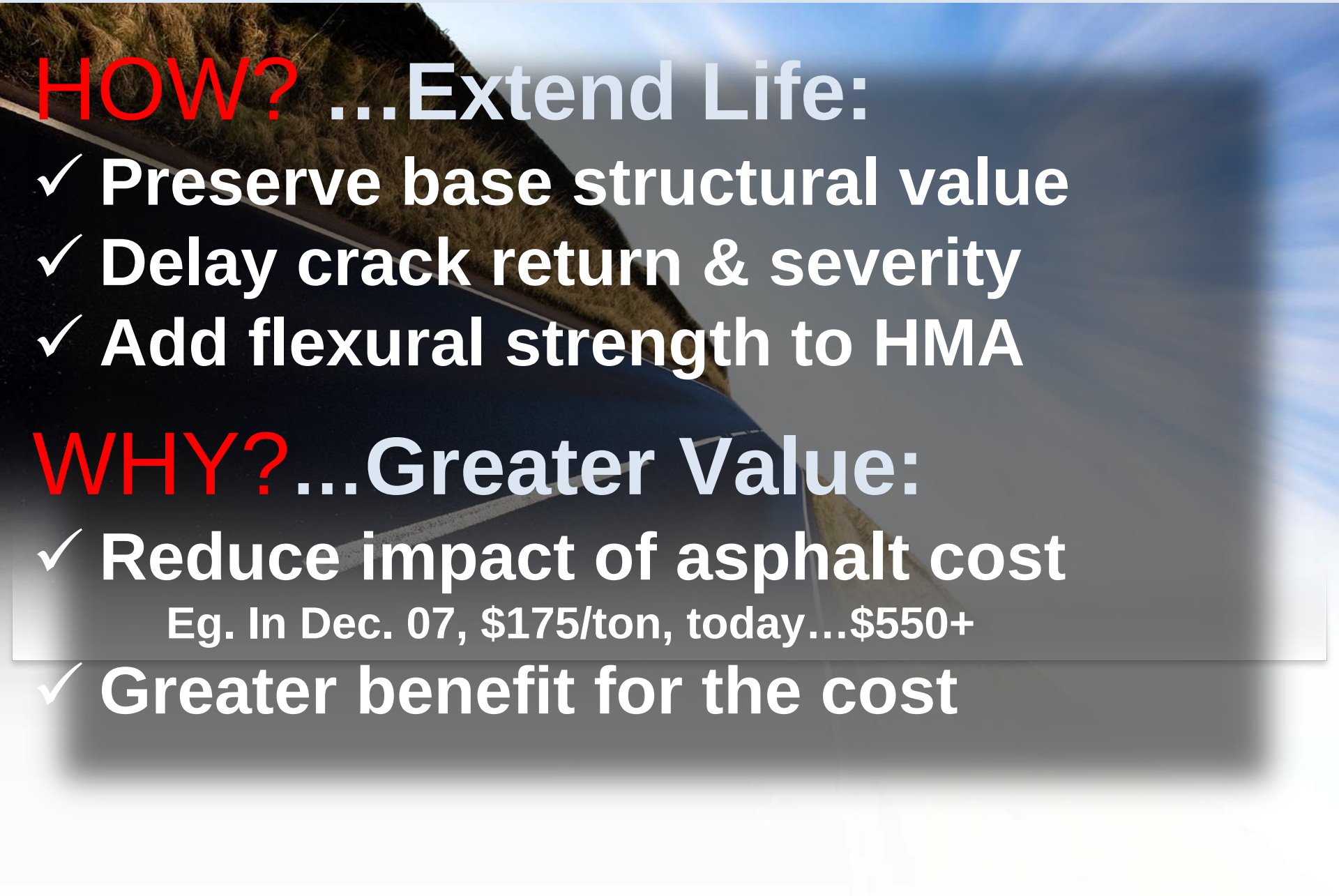
No Moisture Barrier

With Moisture Barrier

Stress Dissipating Interlayer



Pavement Interlayer Value



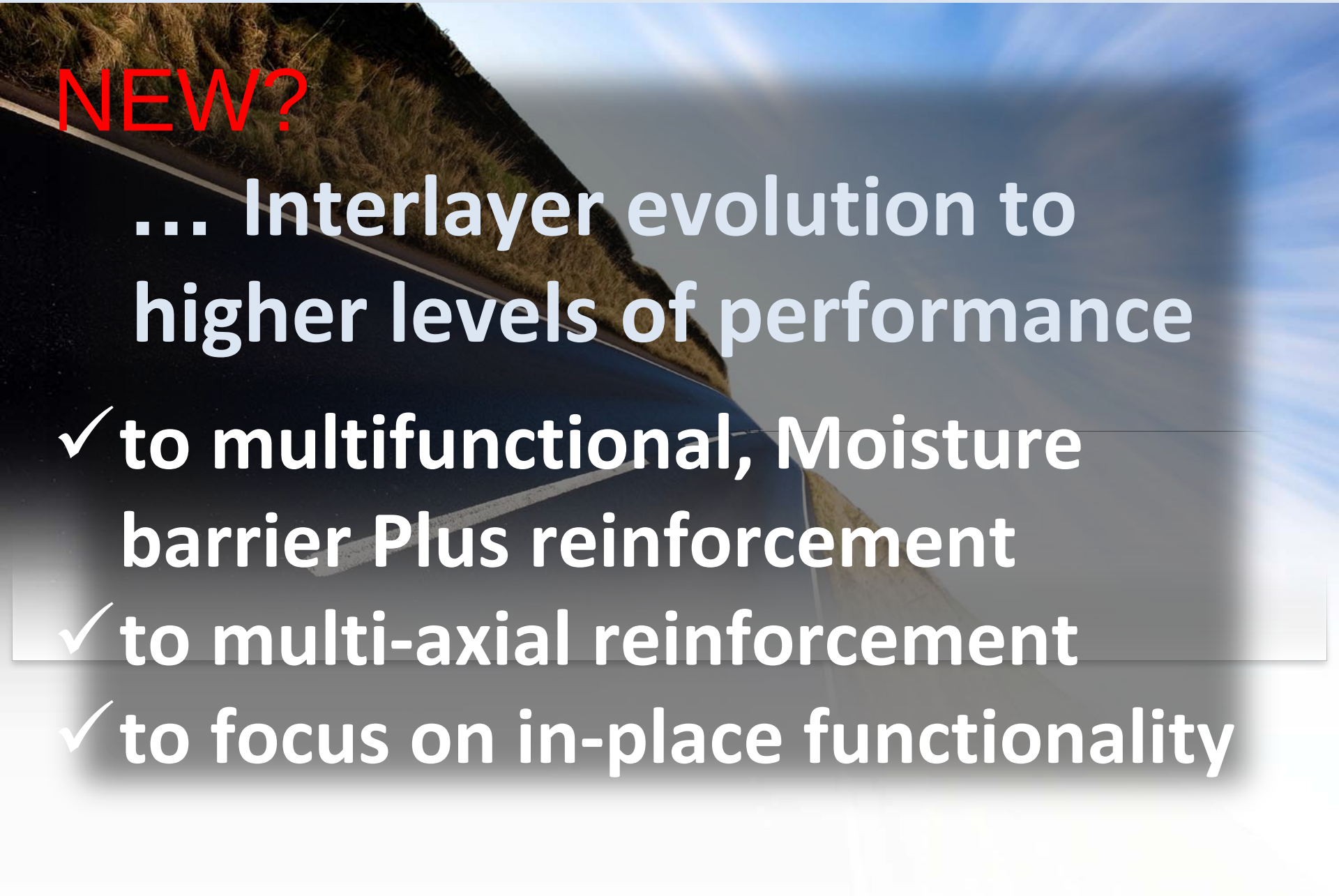
HOW? …Extend Life:

- ✓ **Preserve base structural value**
- ✓ **Delay crack return & severity**
- ✓ **Add flexural strength to HMA**

WHY?…Greater Value:

- ✓ **Reduce impact of asphalt cost**
  - **Eg. In Dec. 07, $175/ton, today…$550+**
- ✓ **Greater benefit for the cost**

Pavement Interlayer Evolution



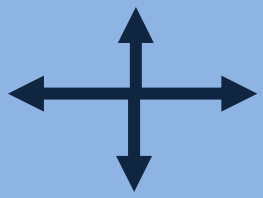
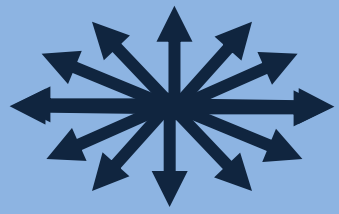
NEW?

… Interlayer evolution to higher levels of performance

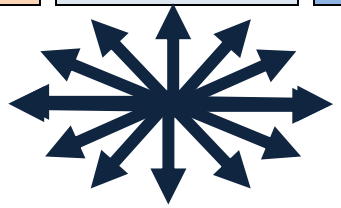
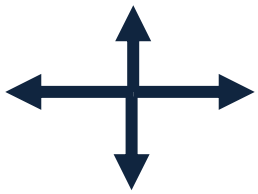
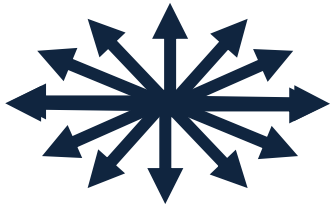
- ✓ to multifunctional, Moisture barrier Plus reinforcement
- ✓ to multi-axial reinforcement
- ✓ to focus on in-place functionality

Pavement Interlayer Functionality

How interlayers work to delay reflective cracks

STRAIN ABSORBING	STRESS DISSIPATING REINFORCEMENT
	 OR 
Mass to soak up (Sponge)	Tensile strength and efficiency to disperse low strain crack energy within the fiberglass reinforcement (Rebar)
Tighter bond, thicker/more mass = greater ability to absorb = better reflective crack retardation	Tighter bond, higher, more efficient tensile strength, more homogeneous the structure = greater ability to dissipate crack energy = better reflective crack retardation

Interlayers Types

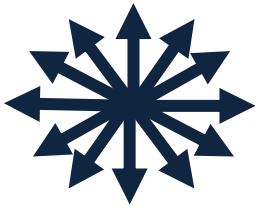
FABRICS	MAT Multi-Axial	GRIDS
		Continuous Strand Fiberglass
		Bi-Axial I Multi-Axial
		 

Pavement Interlayer Functionality

Interlayers Types

FABRICS Absorb

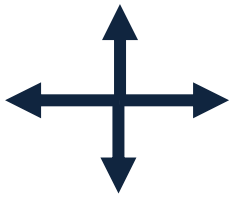
MAT Reinforces



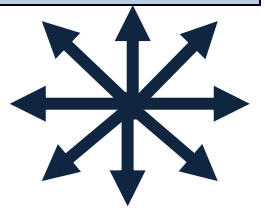
Multi-Axial

GRIDS Reinforces

Continuous Strand Fiberglass



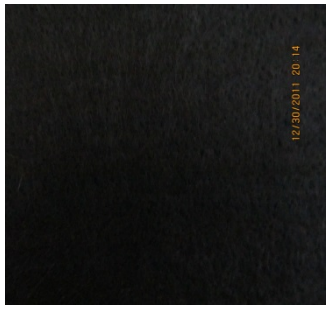
Bi-Axial

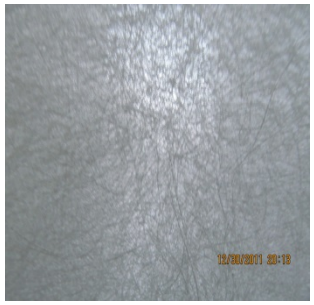


Multi-Axial

Composite Grid absorbs and reinforces

With Asphalt forms Moisture Barrier

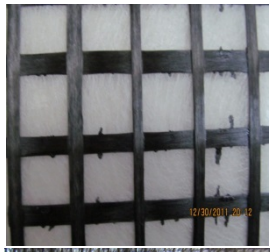


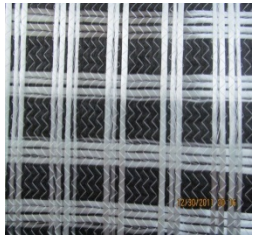


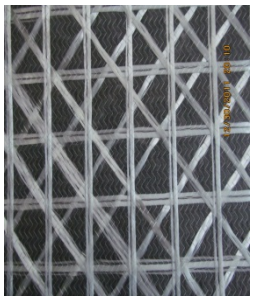
NO Moisture Barrier

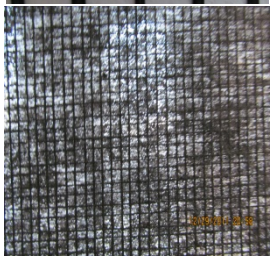
Self Adhesive

With Asphalt forms Moisture Barrier

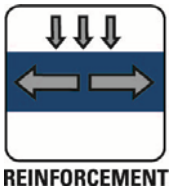




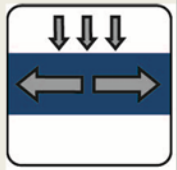




Critical Interlayer Functionality

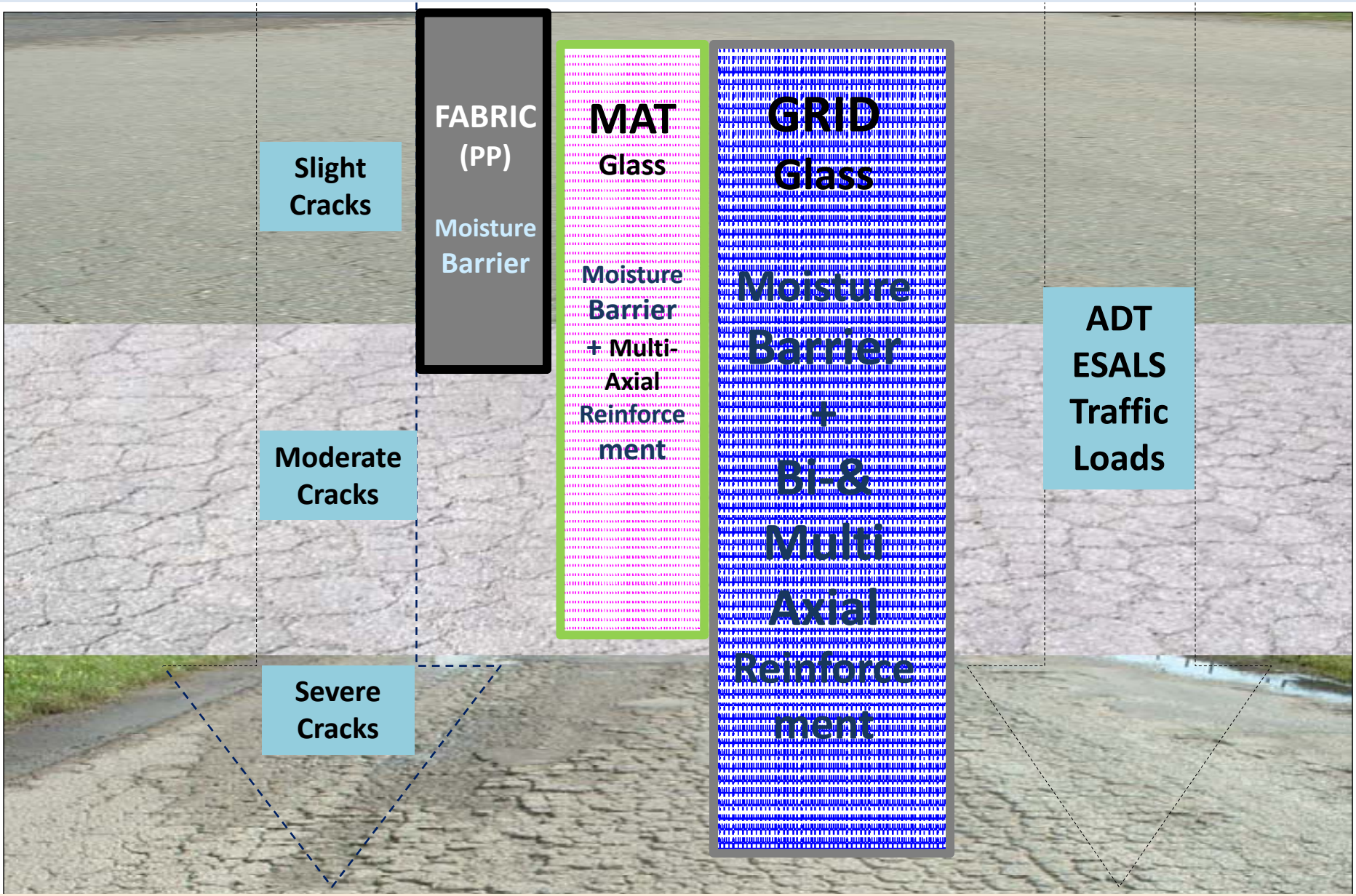
Function	Description
	With Asphalt forms Moisture Barrier
	With Asphalt absorbs and/or disperses crack forces
	Multi-Axial, multi-directional reinforcing
	Bi-Axial, 2 way reinforcing, weak at bias angle
	With Asphalt tack forms a strong bond between layers
	Mills completely and can be added back into new mix

Interlayer Functionality Summary

TenCate Products			FUNCTIONALITY	 SEALING	 STRESS RELIEF	 REINFORCEMENT	 REINFORCEMENT	 ADHESIVE BONDING		Constructibility Ease of Installation	
			Description	Moisture Barrier Membrane	Crack Stress Relief and Delay: Stress Absorbing	Crack Stress Relief and Delay: Tensile to Reinforce: Bi-Axial	Crack Stress Relief and Delay: Tensile to Reinforce: Multi-Axial	Monolithic bond	Mills + Recycles into new mix	Wide Vs Narrow Rolls	Uncoated, Flexible Rolls
Stress Absorbing Geosynthetic Interlayer											
MPV	Fabric	Polypropylene Fabric		YES	YES	NO	NO	YES	Can Be	YES	YES
Fiberglass Tensile Reinforcing Geosynthetic Interlayers											
Tru Pave	Mat	Multi-Axial	Multi-Axial Mat	YES	YES	YES	Up to 80N	YES	YES	YES	YES
PGM G4	Grids	Multi-Axial	Multi-Axial Composite	YES	YES	YES	Up to 100kN	YES	YES	YES	YES
PGM G2	Grids	Bi-Axial	Composite	YES	YES	Up to 100kN	NO	YES	Can Be	YES	YES
FG[1]	Grids	Bi-Axial	PreCoated Self Stick/Scrim	NO	NO	Up to 100kN	NO	NO	YES	NO	NO
FGC[2]	Grids	Bi-Axial	PreCoated Composite	YES	YES	Up to 100kN	NO	YES	Can Be	NO	NO

[1] Replaced by G4, [2] Replaced by G2

Interlayer Selection by Functionality



Over Stable Base

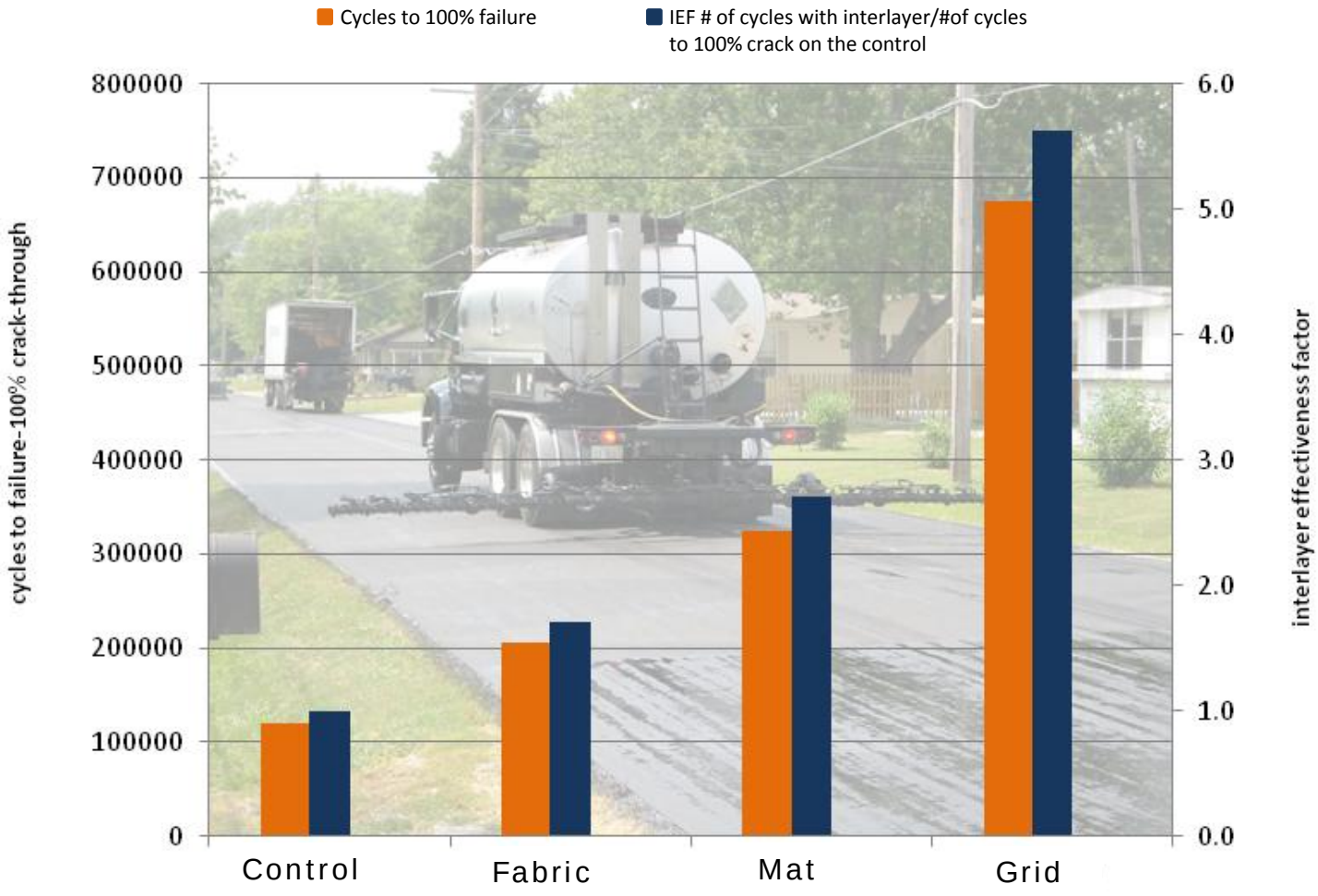
Interlayer Functionality Study

The Asphalt Pavement Analyzer - Wheel Track

Figure 5: Asphalt Pavement Analyzer – Wheel Track

Interlayer Functionality Capability

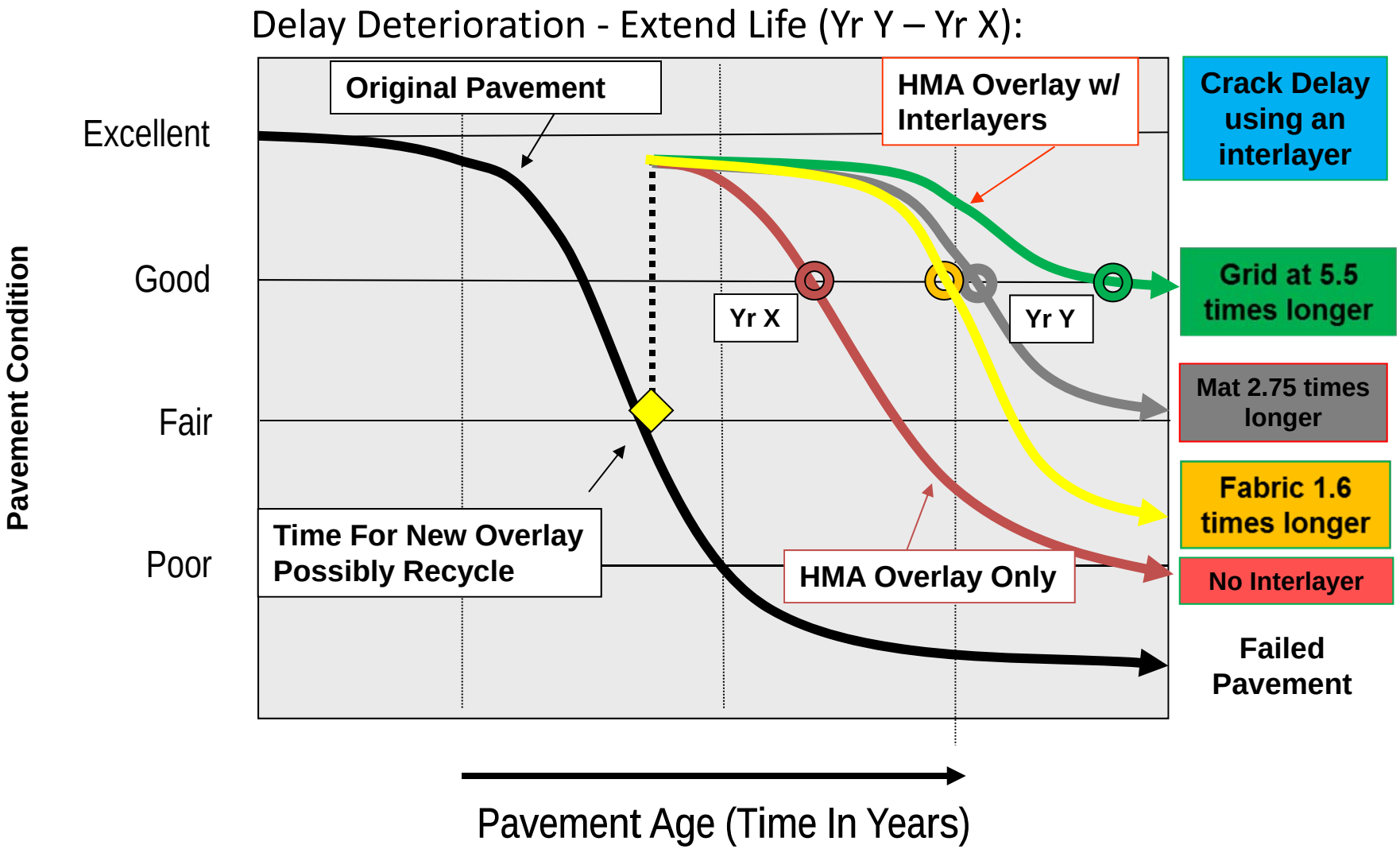
Interlayer Effectiveness and Total Life Averages



Selection by Type/Functional Impact

Interlayer Impact on Pavement Deterioration Curve

REHAB – OVERLAY PAVEMENT



Interlayer Cost/Benefit Calculation

Crack Mitigation

Cost of Hot Mix Asphalt

HMA Cost:	$75.00	Ton	HMA Density	140	Lbs/Inch	Tons	0.07	Inch/ SY	$5.25	Cost
					$ SY	% Added Cost	IEF^*	Yrs to Crack Return^	% Added Perf.	SY Cost Per Year
Hot Mix Asphalt			Inch Thickness:	2.0	$10.50	0	1	2		$5.25

Added Value of Crack Mitigation

Interlayer Type	AVG	Total	Added value based on performance Vs cost				
MPV500 4.1 Oz PP Fabric	$2.10	$12.60	20%	1.6	3.2	60%	$3.94
TruPave Multi-Axial Fiberglass Mat	$2.50	$13.00	24%	2.75	5.5	175%	$2.36
PGM G4 Multi-Axial Fiberglass Grid	$6.00	$16.50	57%	5.5	11	450%	$1.50

Interlayer Performance Compromised

Expectation Not Met

1. Incomplete Interlayer System:

Includes Interlayer WITH asphalt

2. Installation quality

a. Asphalt tack
b. Overlay too thin
c. Lack of base prep
d. Uncut wrinkles

3. Site selected exceeds functionality

a. Unstable base
b. Unstable underlying surface
c. Wide cracks with excessive thermal movement

Performance Compromised: Site Selection

Extreme Pavement and Base Failures

Mix Rutting

Slab Fracture/Uneven

Base Failures

Extreme fatigue cracking/unstable base

Caution! Not all conditions interlayer appropriate!

Pavement Interlayer Installation

Interlayer Installation

Interlayer Installation

Interlayer Install Comparison

City of Santa Cruz Profile

City of Santa Cruz test sections,

In 2004 installed 2” HMA over concrete using three different options:

- Section #1 - No interlayer
- Section #2 - Paving Fabric
- Section #3 - Paving Mat

No Interlayer Install

2006

2008

2012

Section #1
NO INTERLAYER

Installed 2004

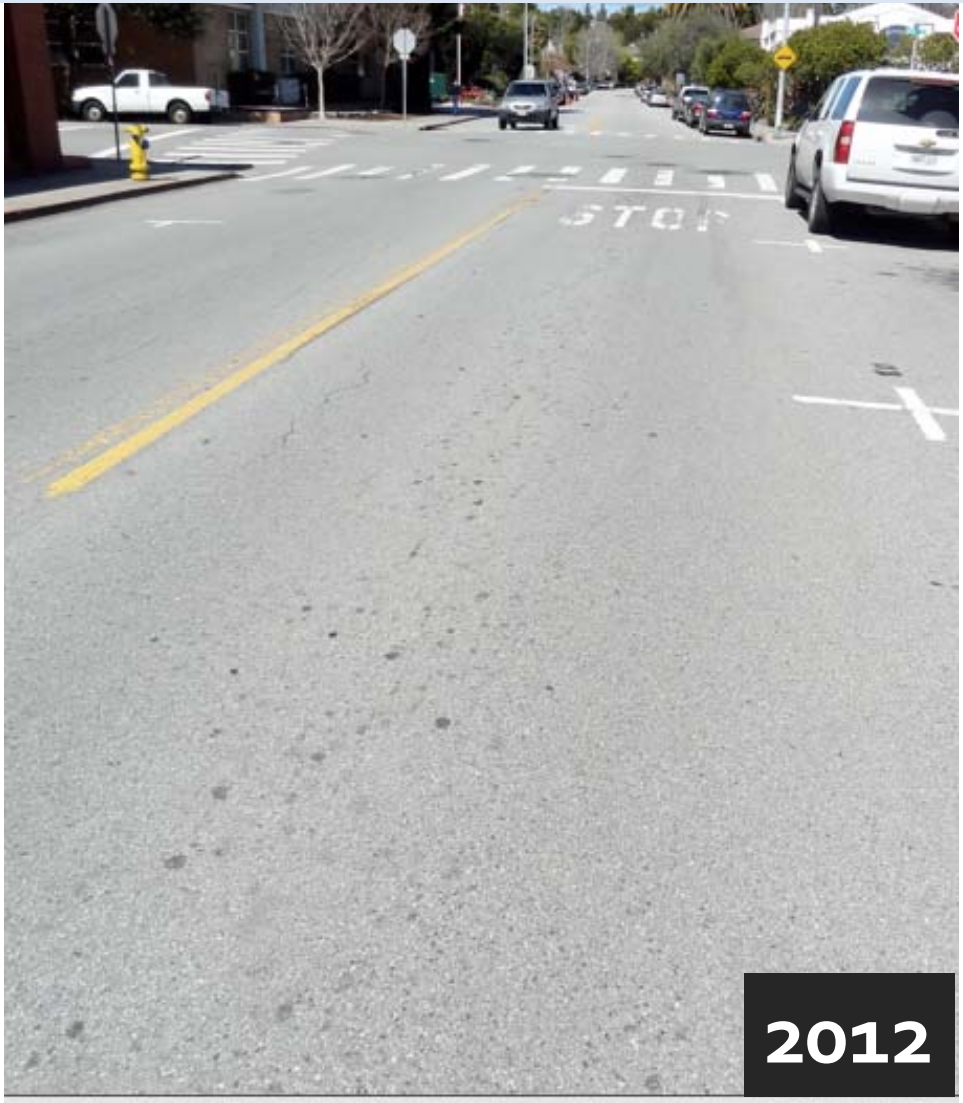
Fabric Interlayer Install

Section #2

Paving Fabric

Installed 2004

Mat Interlayer Install



Section #3

Installed 2004

TruPave Multi Axial Paving Mat

Interlayer Installs

City of Hollister 2007 Overlay

Overlay done 4/07: Heavy cracking, but good base.

Updated 7/22/10: No reflective cracking found. Street is still in great condition.

NOTE: Other streets in the same project with Paving Fabric and SAMI as their interlayer are both already showing cracking and fatigue.

Interlayer Installs

Lake Oswego-Boones Ferry - BEFORE

Before TruPave Multi-Axial Paving

Interlayer Installs

Lake Oswego-Boones Ferry

TruPave Multi-Axial Paving Mat

2” HMA Overlay After 7 Years

Lake Oswego-

No Interlayer installed

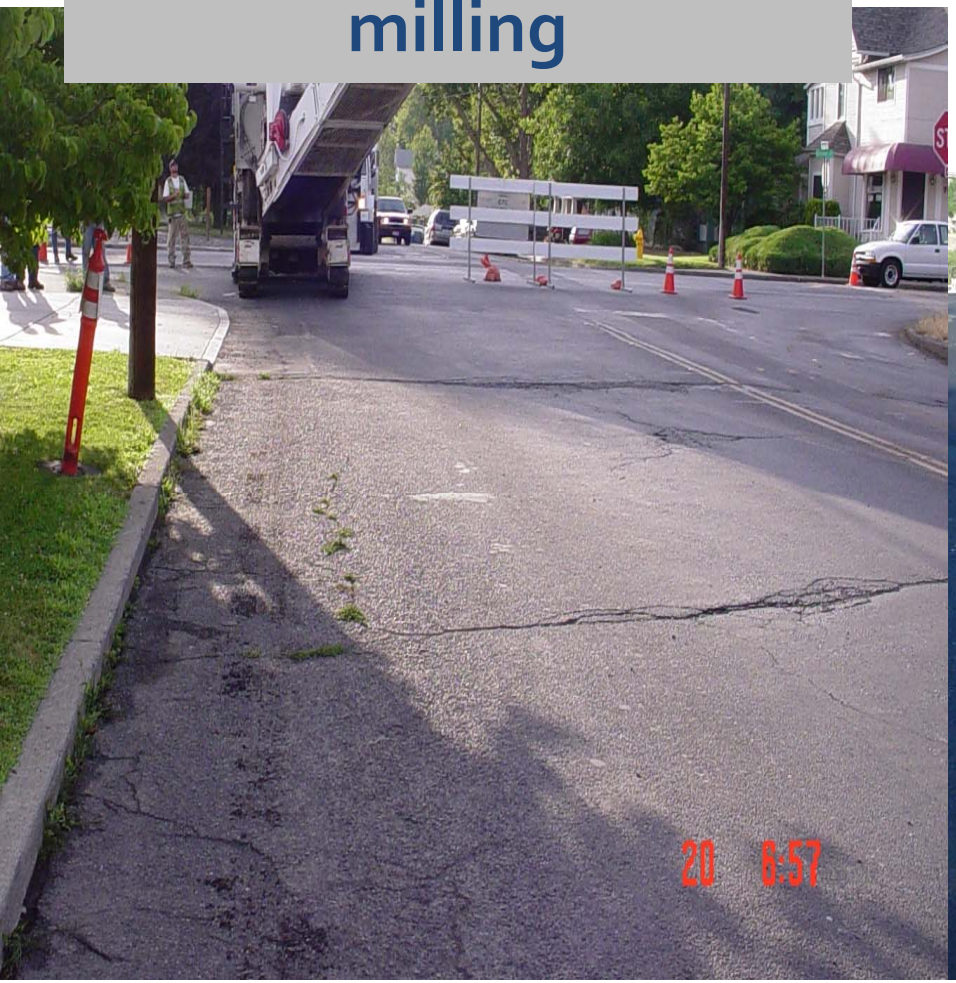
2” HMA Overlay After 7 Years

Lake Oswego-

No Interlayer installed

BEFORE 7th Ave Lewiston ID 2007

Before: 2" over old macadam street. Edge milling



Installing TruPave over leveling course. Overlay with 2" HMA

Prospect St Lewiston ID 2007

Before: 2" over old macadam street. Edge milled with level course

Installing TruPave

Completed 2" HMA overlay

Interlayer Installs

BEFORE

True Case
San Carlos St., San Diego

Background: Severe pavement failure & alligator cracking.

Strategy: Edge ground the street then thin leveling course over to force material down into failed areas and provide a uniform surface for the TruPave

Install Date: 2009

Interlayer Installs

AFTER

True Case
San Carlos St., San Diego

Result: The Engineer from the County said that if they did not use TruPave on this street that they would have expected to see most of the cracking reflect back through in six months.

3 years later, not one crack in the failed areas.

Interlayer Use Summary

CHEAPEST INSURANCE TO:

- **Extend pavement life**
- **Maximize base performance**
- **Delay crack return & severity**
- **Reduce impact of asphalt cost**
- **Reduce maintenance & road closure**

Thank You

QUESTIONS?

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Pavement Solutions
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Email: d.rogers@tencate.com
www.tencate.com

TENCATE
materials that make a difference

Geosynthetic Reinforced Chip Seal (GRCS)

Unmatched Value - Chip Sealing over Fabrics

Pavement Maintenance System

SKIP BROWN

@

AsphaltConsultingServices.com

916-761-1817

State of the Art for Paving Today

Interstate 6 in Southern California

Mobilize Patching Crew

You Can Always Just Keep Patching It

AC Overlay on Fabric – Installed 1982

New Technology for Crack Repair in Asphalt Pavement

Geosynthetic Reinforced Chip Seal (GRCS) Installed 1983

Distressed Pavements - Clear Lake, California

Distressed Pavements - Clear Lake, California

Distressed Pavements - Clear Lake, California

Mark Out Irregular Surface Areas for Skin Patch

Skin Patch to Fill Holes and Smooth Surface

Soft Subgrade!!!!!!

One Too Many Heavy Axle Trips

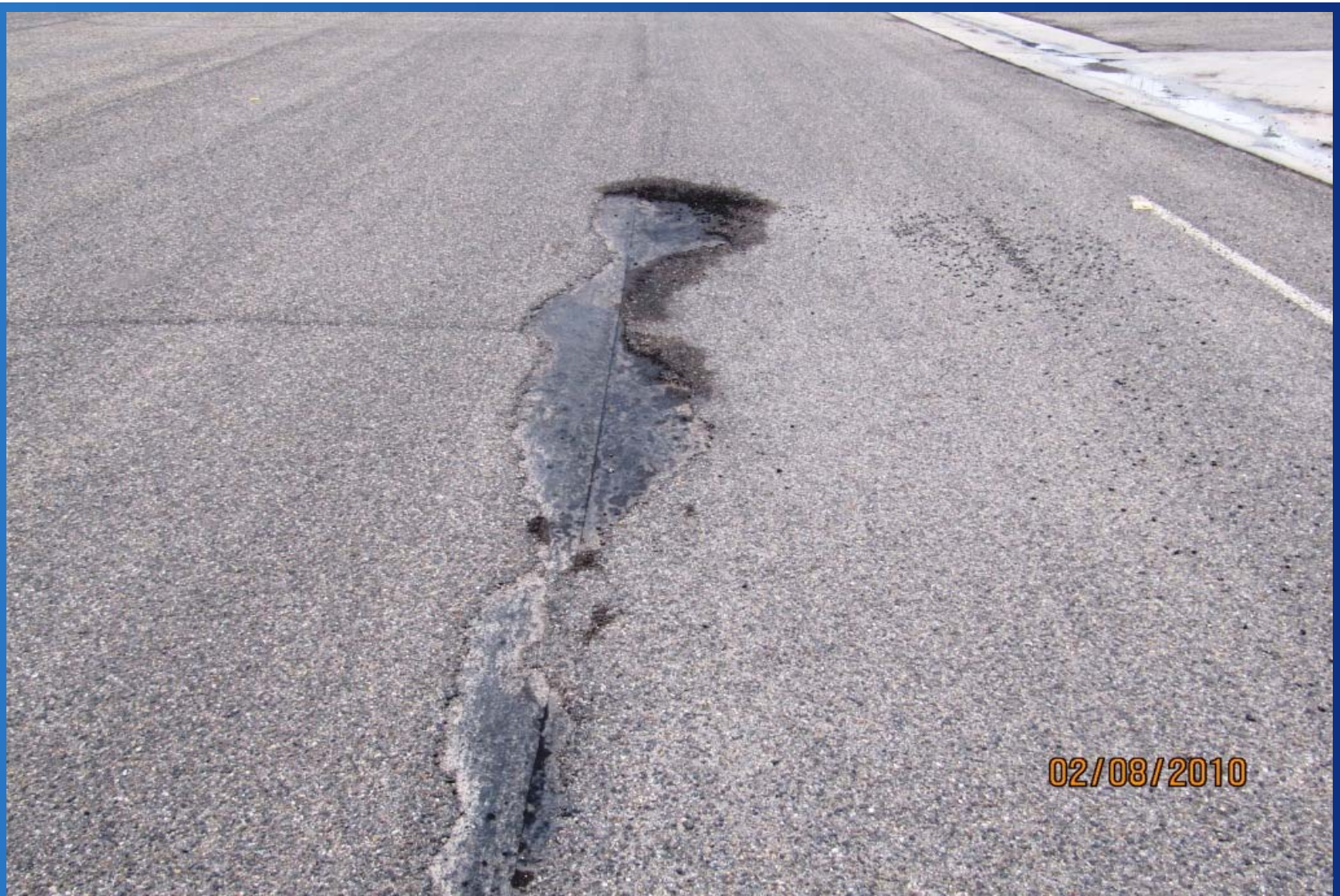
Place and Immediately Roll Fabric

Roll Fabric – Camino, California

Placing Fabric on Swansboro Airport

What is the Proper Application Rate to Saturate Fabric

Separation due to lack of good fabric saturation

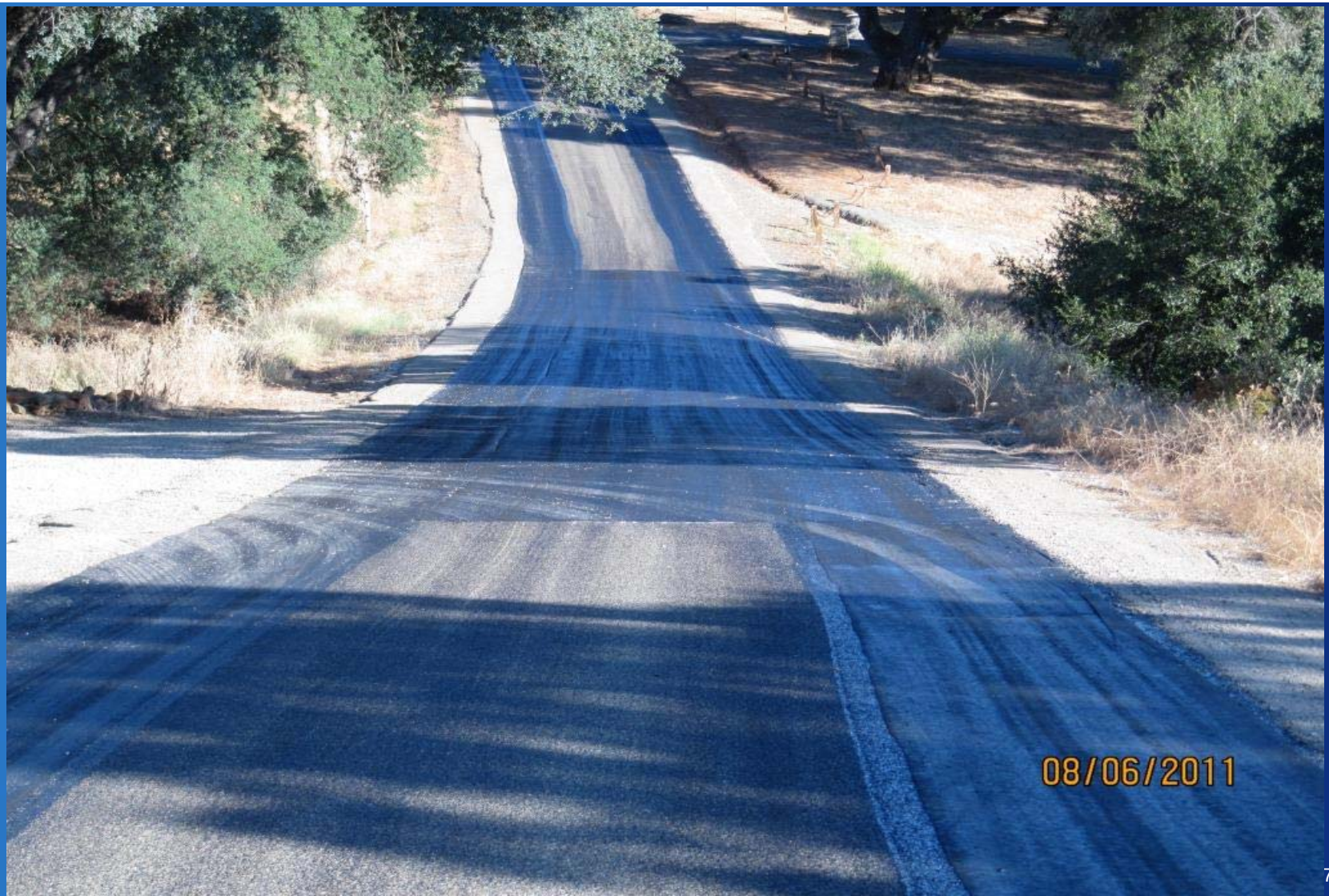


Sanding the Fabric for Traffic

First Course Chips – Clear Lake, California

Second Course Chips – Clear Lake, California

GRCS Presents Options on Where to Use Fabric



Fabric on only the Cracked Pavement

Double Chip on Fabric, Single over Balance

AC Overlay on Cracked Pavement After Six Years

Asphalt Overlay on Paving Fabric After 4 Years

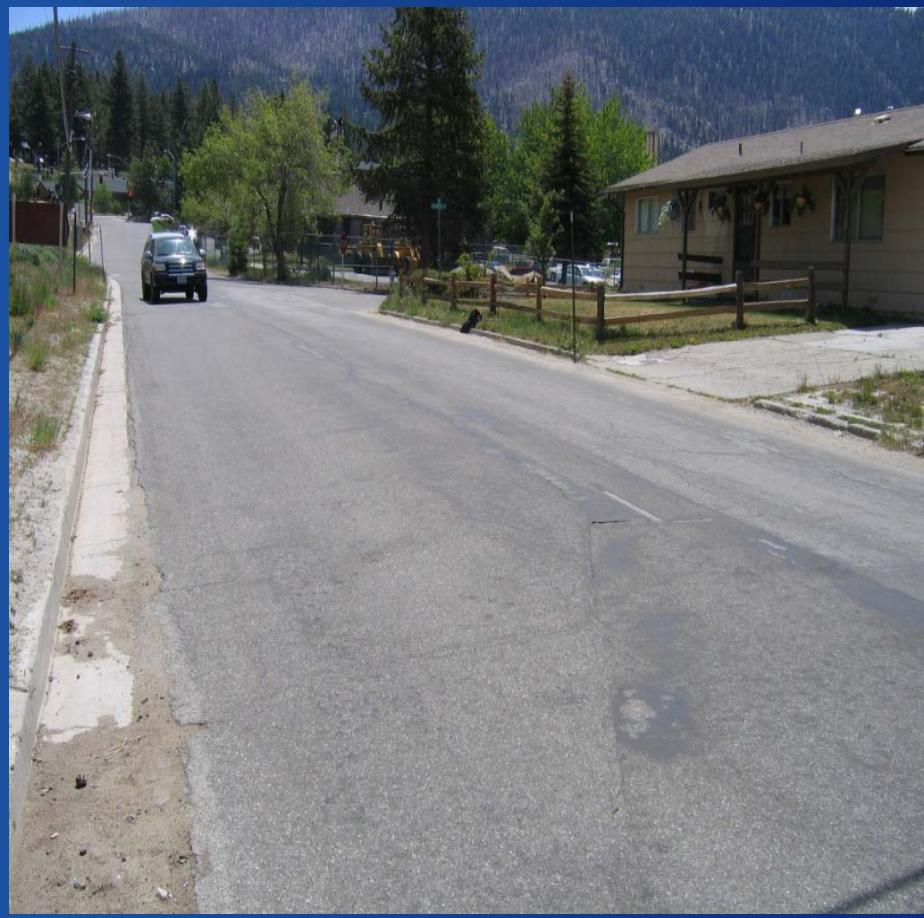
Asphalt Overlay Without Fabric After 5 Months

Overlay on Fabric after 8 years

Before Gardnerville, Nevada After 7 Years

Before Gardnerville, NV After 7 Years

Before South Lake Tahoe After 7 years



Before Clear Lake, CA After 14 Years

Underground Spring after 10 Years

Before Clear Lake, CA After 2 Years

AC Overlay on GRCS 10 years

Before Clear Lake, CA After 10 Years

Before City of Williams After 5 Years

GRCS-Chip Seal/Fabric – Woodbridge Rd/5 Fwy

Chip with and without Fabric 2005 – 2013 – 8 Yrs.

With Fabric

Without Fabric

After 25 Years– Sacramento, Calif.

Cost to Install - $1.40 to $1.80 per Square Foot

AC Overlay

Cost to Install- $0.75 to $0.85 per square foot

Chip over Fabric

Aerojet Intersection, GRCS Process Meets AC over Fabric after 20 years

Where GRCS Stops, 25 years later

Fog Seal at Swansboro Airport

When GRCS is Not Advisable

1) Where loose chips can not be tolerated for a short period of time

2) When water is present from beneath the surface

3) Traffic conditions over 10,000 ADT and ambient temperatures above 90 degrees F.

4) On pavements with many tight curves

Benefits of Geosynthetic Reinforced Chip Seal

1) *Extends the life of pavements approaching or beyond their useful life*

2) *Retards crack reflection better than any other process seen to date*

3) *Stops oxidative hardening and further deterioration of existing pavements*

4) *Can be installed on pavements where subbase is inadequate for asphalt concrete*

5) ***The price is right!!!***

Unlimited Offer

If anyone here has a better process for pavement maintenance, I will send them on a seven day, six night cruise on the fabulous new Carnival Cruise Line Ship, the Dixie Bell.

All airfares, transfers, food and drinks included

THE DIXIE BELL !!!!!


Earth First
We'll Pave the Other Planets Later

QUESTIONS?

Follow-up discussion 1-2 PM today in Adler Room

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