How Best to Protect Asphalt Overlays with Interlayers -
Delay Deterioration and Extend Pavement Life

Dennis Rogers, Tensar
Pavement Maintenance Manager, West
Geosynthetics Used in Construction

- Reinforced Slopes
- Erosion Control
- Retaining Walls
- Embankment Stabilization
- Pavement Optimization
- Subgrade Stabilization & Pavement Optimization

Used in Construction
Pavement Deterioration

Distressed Pavements
Pavement Deterioration

Deteriorating Forces

1. Water intrusion
2. Crack Forces
3. Traffic Loading
4. Thermal Movement

Base
Deteriorating Impact of Moisture Intrusion

Near 50% Loss

37 days/YR

From *Drainage Of Highway And Airfield Pavements* by Harry R. Cedergren
Deteriorating Impact of Moisture Intrusion

Moisture intrudes through pavement: 33-67%

Asphalt up to 50%
Concrete up to 67%

FHWA REPORT: FHWA/RD-73/14

“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
Types of Deteriorating Cracks

Reflective Cracking

PCC Joint Cracking  Thermal Cracking  Lane Widening

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

Interlayer Functions that Delay Deterioration

Mitigates Weather / Environmental Effects

Stops water intrusion

Top HMA-WMA Layers

Point Load Distribution

Stress Absorbing/Dispersing Paving Interlayer

Bottom HMA Layers

Delay Crack Return and Severity

Mitigate Impact of Thermal Movement

Aggregate Base Protected from moisture saturation
# Paving Interlayer Types

## FABRICS

<table>
<thead>
<tr>
<th>Polypropylene</th>
<th>12.5 kN</th>
<th>30 kN</th>
<th>50 kN</th>
<th>25 kN</th>
<th>50 kN</th>
<th>80 kN</th>
<th>50, 100kN</th>
<th>50, 100 kN</th>
<th>50, 100, 200 kN</th>
<th>50, 100, 200 kN TF</th>
</tr>
</thead>
</table>

## MATS

<table>
<thead>
<tr>
<th>Chopped Fiber</th>
<th>Uncoated Glass</th>
<th>Protective Coated Glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5 kN</td>
<td>30 kN</td>
<td>50 kN</td>
</tr>
</tbody>
</table>

## COMPOSITE GRIDS

<table>
<thead>
<tr>
<th>Fabric plus Grid</th>
<th>Uncoated Glass</th>
<th>Protective Coated Glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 kN</td>
<td>50, 100kN</td>
<td>50, 100 kN</td>
</tr>
</tbody>
</table>

## GRIDS

<table>
<thead>
<tr>
<th>Self Adhesive</th>
<th>50, 100, 200 kN TF</th>
</tr>
</thead>
</table>

- **MATS**
- **FABRICS**
- **COMPOSITE GRIDS**
- **GRIDS**
# Interlayer Selection by Function

<table>
<thead>
<tr>
<th>Function</th>
<th>Moisture Barrier Membrane</th>
<th>Crack Stress Relief and Delay</th>
<th>Mills + Recycles into new mix</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Stress Absorbing</td>
<td>Tensile Reinforcement</td>
</tr>
<tr>
<td>Fabric</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polypropylene</td>
<td>YES</td>
<td>Low</td>
<td>NO</td>
</tr>
<tr>
<td>Mat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiberglass/Polyester</td>
<td>YES</td>
<td>Med</td>
<td>Up to 50kN</td>
</tr>
<tr>
<td>Grids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composite Grid</td>
<td>YES</td>
<td>Med-High</td>
<td>Up to 100kN</td>
</tr>
<tr>
<td>PreCoated Self Adhesive</td>
<td>NO</td>
<td>High</td>
<td>Up to 200kN</td>
</tr>
<tr>
<td>PreCoated Self Adhesive TF</td>
<td>YES</td>
<td>Max High</td>
<td>Up to 200kN</td>
</tr>
</tbody>
</table>

*Claim is that when fully saturated with asphalt will mill and recycle completely, Need independent confirmation.
88-1.07B  Paving Mat

Geosynthetics used for paving mat must be a nonwoven fiberglass and polyester hybrid material. Paving mat must comply with:

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breaking force, lb/2 inches minimum</td>
<td>D 5035</td>
<td>45</td>
</tr>
<tr>
<td>Ultimate elongation, percent maximum</td>
<td>D 5035</td>
<td>5</td>
</tr>
<tr>
<td>Mass per unit area, oz/ sq yd minimum</td>
<td>D 5261</td>
<td>3.7</td>
</tr>
<tr>
<td>Melting point, °F minimum</td>
<td>D 276</td>
<td>400</td>
</tr>
<tr>
<td>Asphalt retention, gal/yd² minimum</td>
<td>D 6140</td>
<td>0.10</td>
</tr>
</tbody>
</table>
Interlayer Performance Measures

In-Place Validation Testing

4 Point Strain Controlled Beam Test

Plate Load Testing
Interlayer Performance Measures

4 Point Notched Beam Testing
Interlayer Performance Measures

4 Point Notched Beam Testing
Interlayer Performance Measures

4 Point Notched Beam Testing

Number of Cycle

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

vM
Interlayer Performance Measures

4 Point Notched Beam Test Repeatability

![Graph showing load vs. displacement for different samples labeled GP50#3, GP50#1, and GP50#2. The x-axis represents displacement (Inches) ranging from 0 to 0.16, and the y-axis represents load (lbs) ranging from 0 to 1600. The graph compares the load-displacement behavior of the three samples.]
Interlayer Performance Measures

4 Point Notched Beam Testing

![Graph showing load vs. displacement for different test conditions.]

- Control_AVG
- Test1 (GP25-45°)
- Test1 (TruPave)
Interlayer Performance Measures

4 Point Overlay Test

[Bar graph showing interlayer crack mitigation factor for different products tested, with values ranging from 0.5 to 6.0 kN.]
Comparison of reflective cracks
Texas DOT TRB, January 1989

1 ¼” AC w Fabric—Cost 31% more/45% less cracks + moisture barrier
2 ½” AC--Cost 100% more/55% less cracks/NO moisture barrier
Interlayer Effectiveness

Interlayer Impact on Pavement Deterioration Curve

NEW or REHAB OVERLAY PAVEMENT

Delay Deterioration - Extend Life (Yr Y – Yr X):

- Original Pavement
- HMA Overlay w/ Interlayers
- HMA Overlay Only
- No Interlayer
- Grid at 5.5 times longer
- Fabric 1.6 times longer
- Mat 2.75 times longer
- Crack Delay using an interlayer

Pavement Condition:
- Excellent
- Good
- Fair
- Poor

Time For New Overlay Possibly Recycle

Pavement Age (Time In Years)
Interlayer Creates Moisture Barrier

Seals cracks to keep water out of base
Preserves load bearing capacity

Asphalt Saturated Paving Interlayer

HMA-WMA Overlay

Existing Cracked Pavement

Delays reflective cracking
Eliminates surface water infiltration

Surface water infiltration into base
• **Definition:**
  - Increase the structural life of the asphalt overlay by using an interlayer with a modulus advantage over the asphalt
  • Similar to steel in concrete
Figure 2  Control RAP mixture (left) and RAP mixture containing GlasPave (right).
BUDGETARY - Paving Mat Interlayer Cost/Benefit Calculation

Value of crack mitigation, base structure preservation and maintenance savings

Change the RED cost numbers in this tool to the local cost to change this sample, to a job specific calculation.

### Cost of Hot Mix Asphalt Installed

| Local HMA Cost: | $97.00 | Tons | Density | 110 | Lbs/Inch | 0.055 | Cost/In | SF | $0.59 | SY | $5.34 | $0.30 | Per SY/Per Yr | Maintenance Cost $0.30 |

### Cost of HMA/WMA Pavement ONLY with NO Paving Interlayer

<table>
<thead>
<tr>
<th>Inch Thickness</th>
<th>Total Cost Installed</th>
<th>IPF*</th>
<th>Yrs to Crack</th>
<th>Interlayer Added Value</th>
<th>SY Cost Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>$1.19</td>
<td>$10.67</td>
<td>1</td>
<td>2</td>
<td>$5.34</td>
</tr>
</tbody>
</table>

### Interlayer Added Cost Installed**

<table>
<thead>
<tr>
<th>50kN Paving Mat</th>
<th>$/SY</th>
<th>% + Cost</th>
<th>$/SF</th>
<th>$/SY</th>
<th>Added Perf.*</th>
<th>Maint. Savings</th>
<th>Added Life²</th>
<th>$/SY</th>
</tr>
</thead>
<tbody>
<tr>
<td>$4.40</td>
<td>41%</td>
<td>$1.67</td>
<td>$15.07</td>
<td>6</td>
<td>12</td>
<td>$3.00</td>
<td>18.0</td>
<td>$0.67</td>
</tr>
</tbody>
</table>

### HMA/WMA thickness needed to achieve same reflective crack reduction***

<table>
<thead>
<tr>
<th></th>
<th>$/SY</th>
<th>% + Cost</th>
<th>$/SF</th>
<th>$/SY</th>
<th>Added Perf.*</th>
<th>Maint. Savings</th>
<th>Added Life²</th>
<th>$/SY</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.0</td>
<td>500%</td>
<td>$7.11</td>
<td>$64.02</td>
<td>1</td>
<td>12</td>
<td>$3.00</td>
<td>12.0</td>
<td>$5.09</td>
</tr>
</tbody>
</table>

* IPF=Interlayer Performance Factor from Texas Transportation Institute (TTI) Study comparing crack delay of different interlayer types.
**The average budgetary installed cost at maximum daily production. Every job can have significant variables that will impact the actual project cost.
***The industry standard is that cracks reflect through HMA at the rate of 1 inch per year on average.

1 Crack delay and reduced severity = less road closure and maintenance. Crack fill cost is from Maryland study

2 Added Life is from Cedergren Study showing that base saturation as little as 10% of time can result in near 50% loss of pavement life.
Interlayers probably would not have helped!
Site Selection for Success

Extreme Pavement and Base Failures

- Mix Rutting
- Slab Fracture/Uneven
- Wide Thermal Cracks
- Depressed pavement/unstable base

Caution! Not all conditions interlayer appropriate!
Installation Quality

a. Asphalt binder application
b. Overlay thickness
c. Surface prep & cleaning
d. Large wrinkles cut, laid flat

Control with Specs and QA/QC
Typical Street
Spread Hot Asphalt Binder
Paving Mat Install
Crack Repair Install
Paving Overlay Install
Finished
Section 1
Installed 2004

2" HMA Overlay on PCC - No Interlayer
2” HMA Overlay on PCC with Paving Mat

Section 2 Installed 2004
City of Hollister 2007 Overlay

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

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

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

Lake Oswego-Boones Ferry

BEFORE

Sep 2007
Immediate cracking  No Interlayer installed
Interlayer Advantage Summary

BEST VALUE for Long Life Pavements

Interlayers delay deterioration

1. Delay & reduce crack severity
2. Preserve the base structure
3. Add flexural strength
4. Reduce maintenance cost and road closure

Longer lasting roads = Cost savings + Improving PCI of road inventory
INTERMISSION
WELCOME

GRCS CAPA Webinar
Geosynthetic Reinforced Chip Seal

Pavement Maintenance
Dennis Rogers
Regional Manager, West

12-2-15
Cost Effective Pavement Preservation

GRCS - Chip Sealing over Paving Interlayer

- Super charged chip seal pavement preservation treatment
- Most flexible, durable preservation, longest pavement life
- No other preservation provides this level of base protection
- NO treatment can perform as well for the cost
Double Chip Seal over Interlayer Application
Double Chip Seal over Fabric Application

4 Oz Paving Fabric Installation into Hot PG Asphalt Tack
Double Chip Seal over Mat Application

Paving Mat Installation into Hot PG Asphalt Tack
Rubber Tire Rolling to “Seat” the Interlayer

Interlayer immediately rolled to ensure removal of all voids, and to get full embedment of fabric into hot asphalt and adhesion to old pavement.

Double Chip Seal over Interlayer Application
Double Chip Seal over Interlayer Application

Chip Oil Application

Emulsion or Hot Asphalt Chip Oil Applied on top of Interlayer
Double Chip Seal over Interlayer Application

Chip application into Emulsion or Hot Asphalt

1st Course Chips

Hot Tack Interlayer

Emulsion or Hot Asphalt
Double Chip Seal over Interlayer Application

Rolling Chips to “Seat”, then sweep
Double Chip Seal over Interlayer Application

2nd Chip Oil Applied on top of First Chip
Double Chip Seal over Interlayer Application

2nd Chip applied on top of second chip oil application
Double Chip Seal over Interlayer Application

2nd rolling to seat chip, then sweep
Double Chip Seal over Interlayer Application

Durable, flexible system that accommodates thermal movement, keeps cracks sealed and water out of base, preserving load bearing capacity.

Asphalt Saturated Paving Fabric

Double Chip Seal

Existing Cracked Asphalt Pavement

Delays reflective cracking

Eliminates surface water infiltration
## Double Chip Seal over Interlayer Application

### GRCS System Functional Capability compared to 2" HMA/WMA Overlay

<table>
<thead>
<tr>
<th>Function Factors*</th>
<th>GRCS-Flexible Chip Seal over Fabric System</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 % Asphalt</td>
<td>13.5</td>
</tr>
<tr>
<td>9 % Air Voids</td>
<td>0</td>
</tr>
<tr>
<td>0 % Fabric</td>
<td>0.5</td>
</tr>
<tr>
<td>95 % Rock</td>
<td>86</td>
</tr>
<tr>
<td>NO Moisture Barrier</td>
<td>YES</td>
</tr>
<tr>
<td>100% SF Cost Differential</td>
<td>50%</td>
</tr>
<tr>
<td>2 Yrs Flexibility</td>
<td>20+ Yrs</td>
</tr>
<tr>
<td>2 Yrs Crack Free</td>
<td>20+ Yrs</td>
</tr>
<tr>
<td>2 Yrs Base Protection</td>
<td>20+Yrs</td>
</tr>
</tbody>
</table>

**Cross Section**

- **HMA/WMA Layer, Min. 2''**
- **Old Existing HMA Layer**
- **Existing base layer**

The longer life difference: Flexibility, Cracks Sealed, Base Protected AT HALF THE COST
Double Chip Seal over Interlayer Application

After 30 Years – Sacramento, Calif.
The power to stay flexible to seal and delay cracks

HMA Overlay

GRCS

Cost for this Install
$1.40 to $1.80 per SF

GRCS at half the cost of HMA yet double the performance!

Cost for this Install
$0.75 to $0.85 per SF
Double Chip Seal over Interlayer Application

Where GRCS Stops, 25 years later
Double Chip Seal over Interlayer Application

After 15 Years

The interlayer continues to bridge the surface of the underlying crack and eliminate the need for further crack sealing.
Double Chip Seal over Interlayer Application

Before Clear Lake, CA After 14 Years

9/96
HVL28
Double Chip Seal over Interlayer Application

Before | Clear Lake, CA | After 10 Years
GRCS - Chip Seal over Interlayer Application

Installed 2005 Woodbridge Rd, Stockton, CA

With Fabric
Chip with and without Fabric after 10 Yrs.

Without Fabric
Double Chip Seal over Interlayer Application

Before Gardnerville, Nevada After 7 Years
Double Chip Seal over Interlayer Application

Before

Gardnerville, NV

After 7 Years
Double Chip Seal over Interlayer Application

Whitlow St, Boulder, CO

BEFORE 7/2007

Without Fabric

AFTER 8/2014

With Fabric
Chip Seal over Interlayer Application
Pavement Life Extension

Added life due to moisture barrier preserving the base.

- Single Chip Seal
- Double Chip Seal
- Single Chip Seal over Fabric
- Double Chip over Fabric
San Diego County Chip Seal
Life Cycle Cost Analysis 30 Yr

Chip Seal
- Yr 21 Chip & Crack Fill: $5,206,290
- Yr 11 Chip & Crack Fill
- Yr 16 Chip & Crack Fill
- Yr 15 Crack Fill

Rubberized Chip Seal
- Yr 5 Crack Fill: $3,993,867
- Chip & Crack Fill

Fabric & Chip Seal
- Yr 16 Chip Seal: $2,615,032
- Fabric Chip Seal & Crack Fill

Total Costs:
- Chip Seal: $5,206,290
- Rubberized Chip Seal: $3,993,867
- Fabric & Chip Seal: $2,615,032

Davis Transportation Research News 228
GRCS Use Summary

No Higher Value Preservation System

- More than double life of Chip Seal treatment
  - Seals and protects base
  - Polymerized asphalt and high content makes it flexible, durable
- NO treatment for the cost can perform as well
Thank You

QUESTIONS?

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