Stone Interlayer Pavements
(*inverted pavements*)

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Reflection cracking in flexible pavements from underlying cement stabilized bases is a common problem in Louisiana.
Repeated traffic loads → Cracks extend to HMAC surface

Cracks within soil-cement are extended to HMAC

Shrinkage crack

Hot-Mix Asphalt Concrete

Soil-cement base
Field Evaluation Project (LA 97)

A research project was established in an effort to reduce reflection cracking in flexible pavement.
Proposed solution

Stone interlayer pavement systems
Methodology

• The test section contained 4 inches (102 mm) of crushed lime stone layer over 6 inches of (152 mm) stabilized soil cement.

• The control section consisted of 8.5 inches (216 mm) of in-place stabilized soil cement base, ( conventional pavements).

*both sections had a 3.5 inch (89 mm) HMAC surface.*
Performance Measurements

• Pavement Distress Survey
• Structural Capacity (Dynaflect)
• Ride
• Rutting
LA 97 Project
Study Area

Station 30+96

LA-97 Northbound

Test Section #2

Limestone interlayer

Station 41+52

LA-97 Southbound

Station 73+36

Test Section #1

Soil-cement base

Station 83+92

322 m
1056 ft

322 m
1056 ft

3.66 m
12 ft

3.66 m
12 ft
Typical test section- LA 97
Control section- LA 97

3½" Type 3 Hot Mix Asphaltic Concrete

8½" In-Place Stabilized Soil Cement
Evaluation Results
LA97

- Distress Survey
- Nondestructive Testing
Date since pavement construction

Time after pavement construction, t(month)

Total cracking length, ft

Mar-91, Mar-92, Mar-93, Mar-94, Mar-95, Mar-96, Mar-97, Mar-98, Mar-99, Mar-00, Mar-01, Mar-02, Mar-03

0 12 24 36 48 60 72 84 96 108 120 132 144

0 120 240 360 480 600 720 840 960 1080 1200 1320 1440

0 61 122 183 244 305 366

Conventional pavement
Stone interlayer pavement
Accelerated Pavement Testing

- September 1994: Louisiana Becomes First State to Establish an APT Facility.
- ALF Machine, a proven and reliable technology.
- Full Size Construction & Traffic Loads.
ALF TAC

- Abadie, Chris
- Arena, Phil
- Boudreaux, Mike
- Cambas, Luanna
- Duos, Craig
- Holm, Rick
- Hood, Doug
- Metcalf, John
- Mohammad, Louay
- Morvant, Mark
- Nelson, Gordon
- Paul, Harold
- Rasoulian, Masood
- Roberts, Freddy
- Temple, Bill
- Weathers, Don
La. PRF Staff

George Crosby

Bill King

Keith Gillespie
<table>
<thead>
<tr>
<th>Lane 002:</th>
<th>8 ½’ Stone over Fabric over 3 ½’ Select Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane 003:</td>
<td>5 ½’ Stone over Grid &amp; Fabric over 6 ½’ Select Soil</td>
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<tr>
<td>Lane 004:</td>
<td>4’ Stone over 6” Stone Stabilized Soil over 2” Select Soil</td>
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<tr>
<td>Lane 005:</td>
<td>8 ½’ (10%) Plant Mix Soil Cement over 3 ½’ Select Soil</td>
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<tr>
<td>Lane 006:</td>
<td>8 ½’ (4%) Plant Mix Soil Cement over 3 ½’ Select Soil</td>
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<tr>
<td>Lane 007:</td>
<td>8 ½’ (4%) Plant Mix Soil Cement w/ fibers over 3 ½’ Select Soil</td>
</tr>
<tr>
<td>Lane 008:</td>
<td>8 ½’ (10%) In-Place Soil Cement over 3 ½’ Select Soil</td>
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<tr>
<td>Lane 009:</td>
<td>4” Stone over 6” (10%) In-Place Soil Cement over 2” Select Soil</td>
</tr>
<tr>
<td>Lane 010:</td>
<td>12” (4%) Plant Mix Soil Cement</td>
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Parking Strip

TEST BED PLAN – EXPERIMENT ONE
Comparison of Louisiana’s Conventional and Alternative Base Courses
All Lanes received 3 ½” Thick HMAC overlay
First Experiment

Accelerated Pavement Testing Results

Lanes Tested to Failure

<table>
<thead>
<tr>
<th>ESALs</th>
<th>Lanes Tested to Failure</th>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>400000</td>
<td>393000</td>
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<tr>
<td>800000</td>
<td>583000</td>
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<tr>
<td>1200000</td>
<td>1475000</td>
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<tr>
<td>1600000</td>
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Interlayer:
- Stone
- Soil
- Cement
<table>
<thead>
<tr>
<th>Thickness</th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>38 mm (1.5 inch)</td>
<td>AR-HMA</td>
<td>Type 8F</td>
<td>Type 8F</td>
</tr>
<tr>
<td>51 mm (2.0 inch)</td>
<td>Type 8</td>
<td>Type 8</td>
<td>Type 8</td>
</tr>
<tr>
<td>89 mm (3.5 inch)</td>
<td>Type 5A</td>
<td>AR-HMA</td>
<td>Type 5A</td>
</tr>
<tr>
<td>216 mm (8.5”)</td>
<td>Crushed Stone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>254 mm (10”)</td>
<td>Cement Stabilized Embankment</td>
<td></td>
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</tr>
</tbody>
</table>

**Experiment 2**  
Comparative Performance of Conventional and Rubberized Hot Mix Asphalt
Observed rut depth versus cumulative 18-kip ESALs

Cumulated 18-kip ESALs (million)

Rut Depth (in.)

Lane2-1
Lane2-2
Lane2-3

2\textsuperscript{nd} Experiment
Experiment # 3

ALF Stone/RAP - INTERLAYER PROJECT
Alf Experiment No. 3 Rutting Data

ESAL (x1000)

Stone over 6” CSB
RAP over 6” CSB
RAP over 10” CTB
Deflection Measurements

• Falling Weight Deflectometer (FWD)
FWD Test System

(Dynatest FWD Test System)

(Note: The right trailer tire has been removed to clarify illustration.)

Drop Height Sensors:
- 16,000 lbf
- 12,000 lbf
- 9,000 lbf
- 6,000 lbf
- Baseline

Electronic Control Box

Battery

Raise/Lower Bar

Tow Vehicle

Deflection Basin

SHRP Sensor Spacing for Flexible Pavement

0" 8" 12" 18" 24" 36" 60"

FWD Schematic
Economical Impacts of Stone Interlayer Systems Based on ALF Results
Life Cycle Cost Analysis
High Volume Road

Initial Construction
\( \frac{211,057}{\text{ln mi}} \)
Mill (2”) & Overlay (3.5”)
\( \frac{66,965}{\text{ln mi}} \)
Annualized cost = \( \frac{16,078}{\text{ln mi/yr}} \)

Initial Construction
\( \frac{257,521}{\text{ln mi}} \)
Rehab Base & Replace 9” AC
\( \frac{208,241}{\text{ln mi}} \)
Annualized cost = \( \frac{26,935}{\text{ln mi/yr}} \)

2:1 EASL advantage

Stone Interlayer Base
4” stone/8.5” cement stabilized base
(30 yr design life)

12” Stone Base
(15 yr design life)

40 % savings
The bar chart represents the LCC (Life Cycle Cost) of Stone Interlayer Systems for different pavement types.

- **HV Con Stone Base** has the highest annualized lane-mile cost, approximately $27,000.
- **HV Stone Int**, **HV RAP Int**, **LV Con SC**, and **LV Stone Int** have costs in the range of $10,000 to $15,000.
- The cost for **LV Stone Int** is around $10,000.

The chart shows a clear distinction in cost efficiencies for different interlayer systems.
Conclusions

- Stone Interlayer (inverted pavement) experienced about 1/2 of the conventional pavement cracking after 10 years of service.
- Stone Interlayer had almost 4 times the performance life of conventional soil cement.
- Stone interlayer systems are more economical.
- Structural capacity, ride, and rutting are similar.
- RAP is an effective alternative for stone.
Implementation

• Louisiana DOTD adopted stone interlayer base course design as a standard option for pavements in Louisiana.
Stone Interlayer Projects

LA28
SP 373-01-15
Vernon Parish

LA10-LA77
constructed 1999

US 190-AC Overlay RAP,
SP 008-02-0029
Pointe Coupee Parish

I-10
La27-Coone Gully
Calcasieu Parish

LA 37
Magnolia Bridge Rd-Indian Mound
SP 254-02-0040
EBR Parish

Lake Fausse Point Rd. St. Martin Parish

LA347-LA103
RAP Project
St. Landry Parish
For further information…