FOAMED ASPHALT STABILIZATION ON FM99
COST EFFECTIVE FIX FOR ENERGY SECTOR TRAFFIC?
AS YOU CAN CLEARLY SEE IN SLIDE 397...

GAAAAH!

"POWERPOINT POISONING."
PROJECT BACKGROUND
Completed and Permitted Wells – Eagle Ford (8/4/14)

Wells Permitted and Completed in the Eagle Ford Shale Play
August 4, 2014

Well Legend
- 5,965 Permits
- 6,508 On Schedule - Oil
- 3,265 On Schedule - Gas

Note: There are 5,965 permitted locations representing pending oil or gas wells, where either the operator has not yet filed completion paperwork with the Commission, or the completed well has not yet been set up with a Commission identification number.
Eagle Ford Well Activity 2008-Present

Wells Permitted and Completed in the Eagle Ford Shale Play
May 2008

Well Legend:
- 172 Permitted Locations
- 18 Completed Wells

Note: There are 172 permitted locations representing pending oil or gas wells, where either the operator has not yet filed completion paperwork with the Commission, or the completed well has not yet been set up with a Commission identification number.
Wells accessed through FM99
Aerial View – FM99 and Well Sites
State of Affairs
DISTRICT APPROACH
- Widen Subgrade (DC)
- Install 8” FL BS
- Cement treat new base crown width (8”) (Subbase)
- Install 6” FL BS over Subbase
- Prime Coat (MC-30)
- 2-Crse Surface Treatment
FOAMED ASPHALT OPPORTUNITY
Material Sampling
Mix Design

- TTI Assisted w/ Testing & Design
  - 2.4% Asph, 1.5% Cmnt vs.
  - 2.7% Asph, 1.5% Cmnt
  - 6 samples @ each content
  - 3 soaked, 3 dry
  - Subject to Indirect Tension Test
  - Sample w/ higher tensile strength ratio is chosen
## Mix Designs

### Table: Indirect Tensile Strength Test

<table>
<thead>
<tr>
<th>Condition</th>
<th>Dry (±25°C)</th>
<th>Soaked (±25°C)</th>
<th>Mean ten. strength (psi)</th>
<th>Tensile strength ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum load (lb)</td>
<td>1083</td>
<td>985</td>
<td>77</td>
<td>50</td>
</tr>
<tr>
<td>Tensile strength (psi)</td>
<td>84</td>
<td>78</td>
<td>35</td>
<td>45</td>
</tr>
<tr>
<td>Mean ten. strength (psi)</td>
<td>75</td>
<td>70</td>
<td>38</td>
<td>41</td>
</tr>
</tbody>
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<th>Tensile strength ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum load (lb)</td>
<td>1024.0</td>
<td>966.8</td>
<td>75</td>
<td>55</td>
</tr>
<tr>
<td>Tensile strength (psi)</td>
<td>80</td>
<td>75</td>
<td>38</td>
<td>41</td>
</tr>
<tr>
<td>Mean ten. strength (psi)</td>
<td>75</td>
<td>70</td>
<td>38</td>
<td>41</td>
</tr>
</tbody>
</table>

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*Sheet 2*
- Widen Subgrade (DC)
- Install 8” FL BS (edges)
- Install 6” FL BS (full width)
- Apply cement (width of mixer per pass)
- Foam treat
- Apply Prime Coat/Sand
- 2-Crse Surface Treatment
FOAMED ASPHALT
BACKGROUND
Hot Asphalt + Water + Air = Asphalt Cappuccino
Physical/Mechanical process (micro)

- Increased volume (foam) assists in dispersion
- Foam adheres to the fines forming the mortar that binds the larger particles together
- Moisture in the aggregate also assists in the dispersion of the binder
- Foam dissipates in a few minutes
- Immediate mixing is required
Foamed Asphalt Field Sample
CONSTRUCTION
SPECIAL SPECIFICATION
3279
In-Place Recycling Using Foamed Asphalt (Road Mixed)

1. **Description.** This Item shall consist of a full depth recycling process, where the existing bituminous cover and the underlying base material and if required, additional coarse aggregate and granular material are reclaimed and transformed into a homogenous mixture by an in-place mixing process using foamed asphalt.
D. Mix Design. The Engineer will provide an approved mix design before the start of the project. The approved mix design will meet criteria listed in Table 1 and 2.

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Procedure</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Indirect Tensile strength¹</td>
<td>Tex 226-F</td>
<td>45 psi</td>
</tr>
<tr>
<td>Strain at Break in IDT</td>
<td>Tex 226-F</td>
<td>Report</td>
</tr>
<tr>
<td>Min (wet) IDT²</td>
<td>Tex 226-F</td>
<td>30 psi</td>
</tr>
<tr>
<td>Tensile Strength Ratio</td>
<td></td>
<td>70%</td>
</tr>
<tr>
<td>Min Unconfined Compressive Strength³</td>
<td>Tex 117-E, Part II</td>
<td>Report</td>
</tr>
</tbody>
</table>

1) Average of three specimens air dried overnight then oven dried at 104F for 3 days
2) Average of three specimens 24 hours under water
3) Average of three specimens subjected to 10 days capillary moisture absorption before conducting UCS

<table>
<thead>
<tr>
<th>Test</th>
<th>Method</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Binder Expansion ratio</td>
<td>*</td>
<td>8 times</td>
</tr>
<tr>
<td>Asphalt Binder half life</td>
<td>*</td>
<td>6 seconds</td>
</tr>
</tbody>
</table>

* The recycler shall have a test nozzle attached to one side of the spray bar from which a quantity of foamed bitumen is injected into a straight sided container while recycling. The half-life is the measure of the time taken for the foamed bitumen to reach half the height of the maximum expansion noted in the container. The container is then set aside for at least 1 hour or until the foamed bitumen has subsided completely and the unexpanded volume of the quantity of bitumen injected into the container is noted. The expansion ratio is the ratio of the maximum expansion to the unexpanded volume where the unexpanded volume is taken as one unit.
C. **Reclaimer.** The reclaimer shall have the following features and capabilities:

1. Minimum power capability of 600 horsepower.

2. The capability to pulverize to the size specified, mix, and recycle material to the depth shown in the plans.

3. Ability to increase the effective volume of the mixing chamber in relation to depth of cut.

4. Two microprocessor controlled systems, complete with two independent pumping systems and spray bars, to regulate the application of foamed asphalt cement, separate from water that is used to increase the moisture content of the mixed material. Both systems shall perform in relation to the forward speed of the reclaimer and the mass of the material being processed.
Reclaimer requirements, cont.

Separate from water that is used to increase the moisture content of the mixed material. Both systems shall perform in relation to the forward speed of the reclaimer and the mass of the material being processed.

5. Two spray bars, one for foamed asphalt cement and one for compaction moisture, shall each be fitted with self-cleaning nozzles at a maximum spacing of one nozzle for each 6 inch width of the mixing chamber. Provide a way to monitor the flow rate at each nozzle to verify that all nozzles are producing foamed asphalt at the same rate.

6. The foamed asphalt cement shall be produced at the spray bar in individual expansion chambers into which hot asphalt cement, water, and air are injected under pressure through individual and small orifices that promote atomization. The rate of addition of water into the hot asphalt cement shall be kept at a constant percentage by mass of asphalt cement by the same microprocessor.

7. A system within the operator cabin to verify the foamed asphalt is being evenly distributed across the full width of the spray bar at the rate specified. The system shall be demonstrated to the Engineer to verify even spraying.

8. An inspection or test nozzle shall be fitted at one end of the spray bar that produces a representative sample of foamed asphalt cement.
New Generation Cold Recycler/Stabilizer
Operation Train
Complete the entire operation of mixing the existing road and incorporating additional flexible base, water, and foamed asphalt in one pass. Ensure that each adjacent pass of the mixer overlaps the previous pass by a minimum of 4 in.
Immediately after mixing

Perform initial compaction using a heavy tamping roller applying high amplitude and low frequency. Maintain the heavy tamping roller within 150 ft. of the mixer at all times. Continue rolling until the heavy pad-foot roller “walks out” of the material. Walking out for the heavy tamping roller is defined as light being evident between all of the pads at the material-heavy tamping roller drum interface.
Finish Blading

Perform final surface shaping on the same day as the foamed asphalt is incorporated. Clip, skin, or tight-blade the surface to remove and waste accumulated fines. Do not use fines to fill surface irregularities. The finished surface shall not vary by more than 3/8 inch when tested with a 10 ft straight edge applied in the longitudinal or transverse direction. Variations shall be corrected by the contractor at no cost to the Department.
Use a vibratory roller and pneumatic roller to compact the bladed material. Do not finish-roll in vibratory mode. If necessary, use a light spray of water to aid in final compaction density and appearance.
Finish Rolling
Finished section ready for Prime Coat
E. Curing. Keep traffic off the section for 2 hours after compaction. Apply a fog or a fog/sand seal before opening to traffic. The Engineer may allow traffic on the finished course during curing if proof rolling indicates adequate stability. Proof roll in accordance with Item 216, “Proof Rolling.”
After
## Early Results - Base Design Strength Values

<table>
<thead>
<tr>
<th>Base Material Types</th>
<th>Recommended range of Design Moduli from TxDOT’s Pavement Design Manual (ksi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible Base</td>
<td>40 – 70 ksi</td>
</tr>
<tr>
<td>Asphalt Treated base</td>
<td>250 – 400 ksi</td>
</tr>
<tr>
<td>Cement Treated Base</td>
<td>80 – 150 ksi</td>
</tr>
<tr>
<td>Lime Stabilized base</td>
<td>60 – 75 ksi</td>
</tr>
<tr>
<td>Cement/Foam Asphalt Base*</td>
<td>493 - 545ksi</td>
</tr>
</tbody>
</table>

* Project and Material specific values from FM 99
* FPS value 100 – 400 ksi depending on materials and mix design strength benchmarks (Joe Leidy)
COST EFFECTIVE?
A. **Asphalt.** Asphalt will be paid for at the unit price bid for “asphalt.” This price is full compensation for materials, delivery, equipment, labor, tools, and incidentals.

B. **Lime.** Lime will be paid for at the unit price bid for “Lime” of the specified type [Hydrated (Dry), Hydrated (Slurry), or Commercial Lime Slurry]. This price is full compensation for furnishing lime.

C. **Cement.** Cement will be paid for at the unit price bid for “Cement.” This price is full compensation for furnishing cement.

D. **Foamed Asphalt Treatment.** Foamed Asphalt treatment will be paid for at the unit price bid for “Foamed Asphalt Treatment (Existing Base),” or “Foamed Asphalt Treatment (Mixing Existing Material and New Base),” for the depth specified. No payment will be made for thickness or width exceeding that shown on the plans.

This price is full compensation for shaping existing material, loosening, mixing, pulverizing, spreading, applying additives and Foamed Asphalt, compacting, finishing, curing, curing materials, blading, shaping and maintaining shape, replacing mixture, disposing of loosened materials, processing, hauling, preparing secondary subgrade, water, equipment, labor, tools, and incidentals.
## Tale of the Tape

<table>
<thead>
<tr>
<th></th>
<th>CTB</th>
<th>Foam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>2.89 Ton/STA</td>
<td>2.78 Ton/STA</td>
</tr>
<tr>
<td>Cement</td>
<td>2% @ 8”</td>
<td>1.5% @ 11”</td>
</tr>
<tr>
<td>Manipulation</td>
<td>$1.78/SY</td>
<td>$3.25/SY *</td>
</tr>
<tr>
<td>Asphalt</td>
<td>-</td>
<td>$5.15/Gal</td>
</tr>
<tr>
<td>Unit Cost</td>
<td>$3.54/SY</td>
<td>$4.95/SY*</td>
</tr>
<tr>
<td>Modulus</td>
<td>150 ksi</td>
<td>493 ksi</td>
</tr>
</tbody>
</table>

*Manipulation cost includes operation of reclaimer, but not cost of ownership*
Cement vs. Asphalt - Advantages

Cement

- Acceptance
- Compressive Strength Improvement
- Cost

Foamed Asphalt

- Flexibility
- Durability
- Rate of Strength Gain
- Ease of Application
Cement vs. Asphalt - Disadvantages

Cement
- Shrinkage Cracking
- Increased Rigidity
- Proper curing & Protection from early traffic

Foamed Asphalt
- Cost
- Hot Asphalt
- Strict Adherence to Grading Requirements
So now what?

- Foamed asphalt appears viable solution – holds up under early trafficking
- Treatment appears moisture resistant – section while under traffic received 4 in. of rain without damage before placing final surface
- Foam asphalt requires full engineering evaluation with upfront testing, sampling, and lab design
- More testing of section proposed to confirm design modulus – initial tests found a value of over 400 ksi
- Further evaluation of benefit:cost vs. traditional methods is needed
Questions?

That concludes my two-hour presentation. Any questions?

DID YOU INTEND THE PRESENTATION TO BE INCOMPREHENSIBLE, OR DO YOU HAVE SOME SORT OF RARE "POWER-POINT" DISABILITY?

ARE THERE ANY QUESTIONS ABOUT THE CONTENT?

THERE WAS CONTENT?

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