Using RAP In Florida

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Florida Department of Transportation
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Florida

- Population: Over 15.9 million
  - 4th Largest State in the US
  - Increases by 1,200 people per day
- Roadways: 114,000 miles
- State Highway System
  - 12,000 miles of roadway
    - 44,000 lane miles
  - Carries 66% of all traffic in state
Florida

- Florida Department of Transportation
  - $3 billion construction budget
    - Approximately 500 Construction contracts/year
  - Approximately 5.2 million tons hot mix asphalt (HMA) placed per year
    - Total amount of HMA statewide = 19 million tons
2006 NATIONAL CHAMPIONS

41-14
History

• 1977: Palm Beach County
  – Rubin Construction
  – 28,000 tons HMA base w/25% RAP
    • RAP from another project
  – Batch plant (bypassed drier)

• 1978: Bay County
  – Florida Asphalt Paving Company
    • US-98 Panama City
  – Milled 1”
  – Leveling course w/30% RAP
  – Factory modified batch plant
History

• 1979: Marion County
  – Okaloosa Asphalt
    • US-441
  – Recycled structural mix
  – 65% RAP + 35% Local Sand
  – Asphalt Emulsion Rejuvenator
  – 35,000 tons
  – Drum Mix Plant
Remember…there are two types of Research

• Academic Research:
  – Tons of data; limited conclusions

• State Agency Research:
  – Limited data; tons of conclusions
Performance of early projects is excellent after six months! Let’s implement!
History

• 1980: Recycled HMA specifications developed as a standard practice
  – Used on selected projects that were considered good candidates for milling
  – Contractor given ownership of RAP
  – Allowed up to 60% RAP in mix
  – FDOT monitored mix viscosity
  – All other construction specifications the same
  – FDOT Provided Pavement Composition Report
**Pavement Composition Report**

**COMPOSITION OF EXISTING PAVEMENT**

*Project No.: 1001-041-P (K.S. 18)*

<table>
<thead>
<tr>
<th>FAP No.</th>
<th>SR</th>
<th>County</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001-041-P</td>
<td>25</td>
<td>Hendry</td>
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</table>

<table>
<thead>
<tr>
<th>From Km.P.</th>
<th>to Km.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.336</td>
<td>21.337</td>
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</table>

<table>
<thead>
<tr>
<th>From M.P.</th>
<th>to M.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.537</td>
<td>13.258</td>
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</table>

<table>
<thead>
<tr>
<th>NB &amp; SB Traffic and Passing Lanes (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANGE</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>Viscosity @ 60°C (pa.s)</td>
</tr>
<tr>
<td>Viscosity @ 140°F (Poise)</td>
</tr>
<tr>
<td>Penetration @ 25°C (0.1 mm)</td>
</tr>
<tr>
<td>Asphalt Content (%)</td>
</tr>
</tbody>
</table>

**Viscosity**

**Asphalt Content**

**Gradation**

**Gradation - Percent Passing**

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 mm</td>
<td>100</td>
</tr>
<tr>
<td>19 mm</td>
<td>99 - 100</td>
</tr>
<tr>
<td>12.5 mm</td>
<td>98 - 100</td>
</tr>
<tr>
<td>9.5 mm</td>
<td>85 - 94</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>57 - 71</td>
</tr>
<tr>
<td>2.00 mm</td>
<td>44 - 57</td>
</tr>
<tr>
<td>1.00 mm</td>
<td>28 - 35</td>
</tr>
<tr>
<td>0.50 mm</td>
<td>13 - 22</td>
</tr>
<tr>
<td>0.25 mm</td>
<td>5.5 - 8.5</td>
</tr>
</tbody>
</table>

**Total Pavement Thickness (mm)** | 85 - 291 | 140
**Thickness Evaluated (mm)** | Top 60

**Total Pavement Thickness (in.)** | 3.35 - 11.46 | 5.51
**Thickness Evaluated (in.)** | Top 2.25
## Pavement Composition Report

**State of Florida Department of Transportation**

**Pavement Composition Data Sheet**

**Date:** May 9, 2005  
**Milling Depth:** 2.50 in.  
**Page:** 2 of 2

<table>
<thead>
<tr>
<th>F. P. N.</th>
<th>213003-2-52-01</th>
<th>S. R. No.</th>
<th>I-10</th>
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<tbody>
<tr>
<td>F. A. P. No.</td>
<td>0105 121 i</td>
<td>From:</td>
<td>Columbia C/L</td>
</tr>
<tr>
<td>County:</td>
<td>Baker</td>
<td>To:</td>
<td>US 90</td>
</tr>
<tr>
<td>No. of Lanes:</td>
<td>4</td>
<td>Beg M.P.:</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>End M.P.:</td>
<td>8.884</td>
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</tbody>
</table>

### Core Data

<table>
<thead>
<tr>
<th>Core No.</th>
<th>M.P.</th>
<th>Lane</th>
<th>Pavement Layers (in.)</th>
<th>Core Length (in.)</th>
<th>Percent Passing Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>FC-2</td>
<td>S-I</td>
<td>S-II</td>
</tr>
<tr>
<td>1</td>
<td>0.100</td>
<td>R-1</td>
<td>0.50</td>
<td>1.40</td>
<td>1.80</td>
</tr>
<tr>
<td>2</td>
<td>0.400</td>
<td>R-1</td>
<td>0.70</td>
<td>1.40</td>
<td>1.50</td>
</tr>
<tr>
<td>3</td>
<td>0.700</td>
<td>R-1</td>
<td>0.50</td>
<td>1.30</td>
<td>1.20</td>
</tr>
<tr>
<td>4</td>
<td>1.100</td>
<td>R-1</td>
<td>0.50</td>
<td>1.30</td>
<td>1.60</td>
</tr>
<tr>
<td>5</td>
<td>1.400</td>
<td>R-1</td>
<td>0.70</td>
<td>1.10</td>
<td>1.50</td>
</tr>
<tr>
<td>6</td>
<td>1.700</td>
<td>R-1</td>
<td>0.60</td>
<td>1.20</td>
<td>1.50</td>
</tr>
<tr>
<td>7</td>
<td>2.100</td>
<td>R-1</td>
<td>0.50</td>
<td>1.50</td>
<td>1.30</td>
</tr>
<tr>
<td>8</td>
<td>2.400</td>
<td>R-1</td>
<td>0.80</td>
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<tr>
<td>10</td>
<td>3.100</td>
<td>R-1</td>
<td>0.40</td>
<td>1.50</td>
<td>1.30</td>
</tr>
</tbody>
</table>
History

- Mid 1980’s: FDOT experienced rutting problems...
  - Low in-place air voids/high dust
- Reduced maximum P-200 at design
- Implemented better controls of P-200 during production
- Began monitoring air voids during production
- Resulted in a reduction of RAP usage
  - RAP has high P-200
History

• Late 1990’s: FDOT implemented Superpave…..
  – RAP usage declined further in order to meet VMA criteria

• Mid 2000’s: FDOT increased use of polymer modified asphalts
  – Max 15% RAP
Quantities
Percentage of HMA Mixes Containing RAP

![Graph showing the percentage of HMA mixes containing RAP from 1980 to 2004. The graph indicates an increasing trend from 1980 to 1990, followed by a peak in 1998, and a slight decline thereafter. The percentage ranges from 0% to 80%.](image-url)
Benefits of Recycling

- Saves money!
- Conserves resources
  - Aggregate & Binder
- Conserves energy
- Allows milling as a standard practice, without generating waste material
Milling

- Removes old/distressed pavement
- Eliminates costly shoulder work
- Maintains drainage features
Financial Savings

Current costs of aggregate, binder and hot mix asphalt are at an all time high!

- Binder: 1.72 $/gal (401 $/ton)
- Aggregate: 18 – 23 $/ton
- HMA: >90 $/ton
Cost of Asphalt Binder in Florida

![Graph showing the cost of asphalt binder in Florida from June 1999 to February 2006. The graph displays a steady increase in cost, with a notable spike in February 2006.]
Conservation of Resources

• 2005:
  – 5.2 million tons HMA
  – 60% of HMA mixes contained RAP
  – Average RAP content = 20%
  – Used 624,000 tons of RAP
Conservation of Resources

• Typical RAP Contains:
  – 5.5% binder
  – 94.5% aggregate

• Example:
  – Resources conserved in 2005:
    • 589,680 tons aggregate
    • 34,320 tons binder
    – 8 million gallons
RAP Usage

Year

Tons

Aggregate Savings

![Graph showing aggregate savings over years]

- X-axis: Year (1980 to 2004)
- Y-axis: Tons (0 to 1,400,000)

The graph illustrates the trend of aggregate savings from 1980 to 2004, with significant fluctuations in savings over the years.
Binder Savings

Year

Gallons


0 2,000,000 4,000,000 6,000,000 8,000,000 10,000,000 12,000,000 14,000,000 16,000,000 18,000,000
Savings in Materials Costs

![Savings in Materials Costs Graph]
Conservation of Energy

• It is estimated that the usage of 1 ton of HMA containing RAP conserves 200,000 BTU’s of energy
  – Less aggregate to mine, process & deliver
  – Less asphalt to refine & deliver
Performance
## Deficient Pavements:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride</td>
<td>2.6%</td>
<td>6.3%</td>
<td>3.8%</td>
</tr>
<tr>
<td></td>
<td>1063 Miles</td>
<td>2556 Miles</td>
<td>1575 Miles</td>
</tr>
<tr>
<td>Crack</td>
<td>15.8%</td>
<td>16.5%</td>
<td>15.8%</td>
</tr>
<tr>
<td></td>
<td>6410 Miles</td>
<td>6718 Miles</td>
<td>6559</td>
</tr>
<tr>
<td>Rut</td>
<td>1.5%</td>
<td>1.2%</td>
<td>0.9%</td>
</tr>
<tr>
<td></td>
<td>596 Miles</td>
<td>498 Miles</td>
<td>384 Miles</td>
</tr>
</tbody>
</table>
Current Practices
Various Source RAP Pile…aka GOK RAP
Various Source RAP
Fractionated RAP
Top Ten Reasons FDOT has had a successful HMA recycling program

10) Allows milling without generating waste
9) Pavement Composition Reports
8) Three good projects 25 years ago!
7) Wasn’t mandated by Congress
6) Viscosity monitoring during production
Top Ten Reasons FDOT has had a successful HMA recycling program

5) It’s good for the environment
4) Receptive/innovative Contractor & Agency personnel – 25 years ago!
3) Giving the RAP to the Contractor
2) It conserves energy
1) It saves money!
Thank you!