Innovative Sustainable Pavement Solutions

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Portland Cement Association
Our Thanks to the following organizations for significant contributions to the content

- American Concrete Pavement Association
- California Nevada Cement Association
- Cement Council of Texas
Purpose of Paper/Presentation

- Raise awareness of the available cement based paving products that should be considered to:
  - Build durable and cost effective pavements
  - Conserve natural resources and energy
  - Reduce emissions

- Detailed LCAs or eco footprint calculations are beyond the scope of the paper and this presentation
Overview

- Concrete Pavements’ Contributions to Sustainability
- Integrated Pavement Solutions Concept and Sustainability
- Example Pavements Highlighting Innovative Sustainable Pavement Solutions with:
  - Full-Depth Reclamation
  - Cement-Treated Bases
  - Roller-Compacted Concrete
  - Composite Sections
Integrated Pavement Solutions: A Concept for Sustainable Pavements

- Conventional Concrete
- Pervious Concrete
- Roller-Compacted Concrete
- Full-Depth Reclamation
- Cement-Treated Base
- Cement-Modified Soil
Roller-Compacted Concrete
Full-Depth Reclamation
Cement-Treated Base
Integrated Paving Solutions Offer Additional Sustainable Options

- Reduce cost
- Increase recycling
- Increase use of in-situ materials
- Reduce use of virgin aggregates
- Reduce fuel use/emissions

There is a sustainable cement-based solution for every pavement project!
Sustainable IPS Examples
**TxDOT State Highway**

- 30 Year pavement
- Concrete and asphalt at *initial* cost parity
- Concrete section estimated to take *more than 3 times* the traffic loads (ESALS) than asphalt

### Design Section

<table>
<thead>
<tr>
<th>Pavement</th>
<th>Initial</th>
<th>Maint.*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt</td>
<td>$14.1M</td>
<td>$7.1M</td>
<td>$21.2M</td>
</tr>
<tr>
<td>Concrete</td>
<td>$14.1M</td>
<td>$0.6M</td>
<td>$14.7M</td>
</tr>
</tbody>
</table>

* 30 year pavement, costs discounted to present value

Source: TxDOT and Cement Council of Texas
TxDOT State Highway Example (Con’t)

- Top 2” of asphalt will need to be milled/overlayed every seven years
  - 7” initial + 8” maintenance = 15” total asphalt
- Concrete surface will need to be ground at year 25, no additional new materials
- At year 30:
  - Asphalt will need reconstruction
  - Concrete will continue to perform for many more “pavement lives” at estimated traffic counts with minor maintenance

Source: TxDOT and Cement Council of Texas
Friedman Memorial Airport Runway, Hailey, Idaho

- Single asphalt runway serving the airport
- 7,500 ft long runway. 6,900 ft needed rehab
- Priority No. 1: Minimize runway shutdown time
  - Construction time set at 30 days
- Three FAA approved methods considered but none could be done within 30 days (fastest construction was estimated at 48 days)
- FAA approved owner’s petition to use FDR
### Friedman Memorial Airport Runway, Hailey, Idaho

<table>
<thead>
<tr>
<th>Layer</th>
<th>Standard FAA</th>
<th>Alternate #1</th>
<th>Alternate #2</th>
<th>Alternate #3 (FDR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subbase (in.)</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Base (in.)</td>
<td>6 crushed stone</td>
<td>14 crushed stone</td>
<td>0 crushed stone</td>
<td>12 FDR with cement</td>
</tr>
<tr>
<td>Intermediate /Surface (in.)</td>
<td>4 Asphalt</td>
<td>4 Asphalt</td>
<td>14.5 Asphalt</td>
<td>6 Asphalt</td>
</tr>
<tr>
<td>Total Section (in.)</td>
<td>25</td>
<td>18</td>
<td>14.5</td>
<td>18</td>
</tr>
</tbody>
</table>
Friedman Memorial Airport Runway, Hailey, Idaho

- Constructed within contract time in 2007
- $1 million in construction savings
- Reduced use of virgin materials from quarries
- Eliminated about 4,000 truck trips
- Reduced fuel use, air emissions, traffic congestion and damage to nearby roads
Full-Depth Reclamation Vs. New Base

Energy and Materials Use*

- **Number of Truck Loads**: New Base - 180, Full-Depth Reclamation - 12
- **New Roadway Materials (tons)**: New Base - 4500, Full-Depth Reclamation - 300
- **Material Landfilled (yd³)**: New Base - 0, Full-Depth Reclamation - 2700
- **Diesel Fuel Consumed (gallon)**: New Base - 3000, Full-Depth Reclamation - 500

*Based on 1 mile 24-ft wide 2-lane road, 6-inch base, data from PCA Publication SR995.02
Full-Depth Reclamation
Life Cycle Inventory/Assessment

Typical Austin, TX Street

- Environmental life cycle inventory/assessment (LCI/A)
  - Traditional rehabilitation vs. FDR
  - LCI/A, “cradle to grave” analysis (ISO 14044)
    - Materials
    - Construction processes
    - Maintenance
    - Embodied energy and emissions

Source: CTL Group & Cement Council of Texas
Full-Depth Reclamation LCI/A

Remove/Replace

- New Asphalt (4.5 in)
- New Crushed Limestone Base (8 in)
- New Stabilized Subgrade

- Remove surface and base
- Re-stabilize subgrade
- Replace base and surface
- Crack seal at 10 years

Full-Depth Reclamation

- New Asphalt (2 in)
- FDR w/ Cement (8”)
- Existing Crushed Limestone Base Course (4.5 in)
- Existing Stabilized Subgrade

- Pulverize 4.5” surface + 3.5” base
- Add 4% cement and mix
- Add 2” asphalt surface,
- Crack seal at 10 years

Source: CTL Group & Cement Council of Texas
Full-Depth Reclamation LCI/A

50% reductions in life cycle energy and greenhouse gas emissions with FDR

Source: CTL Group & Cement Council of Texas
Choctaw Point Terminal, Mobile, AL

- Heavy duty section: 15.5” RCC on 6” stabilized sand
- Medium duty section: 8” RCC on 6” stabilized sand
- 95 acres for Phase I
- 350,000 TEU
Why Intermodal and Port Facilities Should Use RCC?

- Very cost effective rigid pavement
- Speed of Construction so areas may be utilized quickly
- Load carrying abilities
- Low maintenance cost
Choctaw Point Terminal, Mobile, AL

Option 1

- HMA Wear
- HMA Base
- Granular Base

12.5"
13"

Option 2

- HMA Wear
- HMA Base
- Cement Stabilized Sand

11.5"
13"

Option 3

- RCC
- Cement Stabilized Sand

15"
6"

Sustainable Contributions

- Cost savings
  - Construction cost
  - Less time to build
- Longevity
  - No rutting
  - Low maintenance
- In-situ materials
- Reduced excavation
- Cooler pavement
- Less damage to area roads
BMW Plant, Spartanburg, SC

**Design/Bid Section**
- 4” Asphalt
- 12” Crushed Stone Base
- Subgrade

**As Constructed**
- 6”-8” RCC
- 6” Soil-Cement Base
- Subgrade

**Sustainable Contributions**
- Reduced export/import/fuel use
- Less mined and processed materials
- Reduced excavation
- Faster construction
- Cooler pavement
- Used in-situ materials
- Less damage to area roads
Summary

- Reduce
- Reuse
- Recycle
- Renew

All possible using cement based paving products to build safe and long lasting pavements at a lower cost of ownership
Questions?

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