Two-Lift Concrete Paving & Use of Geotextiles as a Bond Breaker

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Long Life Concrete Pavement
International SCAN (2005) - Recommendations for Implementation

- Two-Lift Construction
- Design Features Catalog
- Construction of High-Quality Foundations
- Greater Attention to Mix Design Components
- Geotextile Interlayer
- Exposed Aggregate Surfaces
What is Two-Lift Paving?

• Two-Lift paving consists of two layers of PCC placed wet on wet, with each layer consisting of a special mix.

• The top layer should be engineered to obtain surface characteristics of reduced noise, improved friction, and greater durability.

• The bottom layer may be engineered to reduce materials cost and recycle.
Goals of Two-Lift Paving

• Improved Surface Durability
• Improved Safety (friction)
• Reduced Tire/Pavement Noise
• Improved Environment by Recycling
• Improved Pavement Performance
European Experience

• Countries employing two lift paving
  – France, Germany, and Austria

• Lessons learned
  – 2 to 5.5-inch high quality surface courses
  – 8.5 to 9.5-inch low cost base courses
  – Use of local aggregates in the base and imported aggregates in the surface
  – Two-lift paving equipment built
USA Experience

  – Iowa, North Dakota, Florida, Kansas, Michigan
  – Wet on wet construction
  – Use of recycled materials in base layer
  – Capping of base layer
  – Use of econocrete in base layer
  – Use of durable aggregates in surface or employment of exposed aggregate surfaces for improved noise/durability

• All in service today
USA Projects Characteristics

- Facility – Street, Road, Interstate
- Lower Lift – gravel or lower quality limestone
- Width – 24 to 36-feet
- Load Transfer – some
- Joint Spacing – 15 or 20-feet
- ADT > 4,800
- Paving Method – slipform and/or forms
- Time Between Lifts – 30-60 minutes minimum
Two-Lift Paving Design and Construction Details

• Lower Layer
  – Materials
  – **Recycling**
  – Construction

• Surface Layer
  – Materials
  – Texture
  – Construction
Two-Lift Paving Lower Layer

- Recycling
  - Sort out wood and sealants when crushing the old pavement.
  - Use impact type crusher and operate at less than maximum output.
  - Dowels and reinforcement are no problem for magnetic separator.
  - An old 2-lane pavement should provide all the coarse aggregate for a new 3-lane pavement.
  - Keep RCA wet and monitor its density.
Recent Implementation of Two-Lift Paving

Kansas DOT
Two-Lift Paving Project
Completed Summer 2008
I-70
Saline County
Scope of Kansas Two-Lift Paving Project

- Construct 24-foot pavement with 6-foot inside and 10-foot outside shoulders
- Use non-”D” cracking aggregates in surface
- Construct several surface textures for noise reduction, improve friction, and reduce splash and spray
- Form centerline plastic joint
<table>
<thead>
<tr>
<th></th>
<th>Bottom Lift</th>
<th>Top Lift (Textured Sections)</th>
<th>Top Lift (Exposed Aggregate Section)</th>
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</thead>
<tbody>
<tr>
<td>PCC Type I/II (lb/yd³)</td>
<td>548</td>
<td>438</td>
<td>526</td>
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<tr>
<td>Fly Ash Class F (lb/yd³)</td>
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<td>110</td>
<td>132</td>
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<td>Water (lb/yd³)</td>
<td>236</td>
<td>236</td>
<td>270</td>
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<tr>
<td>Coarse Aggregate: Fine Aggregate Ratio</td>
<td>60 : 40</td>
<td>50 : 50</td>
<td>70 : 30</td>
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<tr>
<td>W/CM</td>
<td>0.43</td>
<td>0.43</td>
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<td>Design Air Content</td>
<td>6.5%</td>
<td>6.5%</td>
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<tr>
<td>Air Entraining Admixture (oz/yd³)</td>
<td>14</td>
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<tr>
<td>Mid-Range Water Reducer (oz/yd³)</td>
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<tr>
<td>Anti-Bleed/Ant-Segregate Admixture (oz/yd³)</td>
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<tr>
<td>Type A Water Reducer (oz/cwt)</td>
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Typical Two-Lift Paving Train

Lower Layer
Unterbeton

Upper Layer
Oberbeton
Aggregate Management

• Plant
  – Dual Drum
  – Two Silos
    • Split
  – Aggregate Bins
    • Four

Courtesy Koss Construction Company
Paving

Courtesy Koss Construction Company
Kansas Test Section

Courtesy Koss Construction Company
Paving

Courtesy Koss Construction Company
Finished Surface

Courtesy Koss Construction Company
Cores

Courtesy Kansas DOT
Kansas Two-Lift Texturing

- 7 Surfaces
  - Longitudinal Tining + Burlap Drag (Surf A, 500m)
  - Burlap Drag + Longitudinal Grooving (Surf B, 800m)
    • Measured pre- and post-grooving
  - Turf Drag + Longitudinal Grooving (Surf C, 800m)
    • Measured pre- and post-grooving
  - Turf Drag (Surf D, 600m)
  - Conventional Diamond Grinding (Surf E, 800m)
    • Measured pre- and post-grinding
  - “Next Generation” Diamond Grinding (Surf F, 800m)
    • Measured pre- and post-grinding
  - Exposed Aggregate Concrete (Surf G, 1000m)
Exposed Aggregate Concrete

Courtesy CP Tech Center
Construction Considerations

- Extra Equipment – plants, placers, pavers
- Definition of Low Quality Layer and a durable economical mixture – strength, durability, cost, etc.?
- Construction - site management, trucks, etc.
- Thermal coefficient differences between lifts
Kansas DOT Conclusions

• Two-lift paving is possible and practical
• Economic paving sections can be achieved
• Exposed aggregate surface is possible and practical
• There are many choices for surface texture; their use may be condition dependant
Contractor Conclusions (Koss Construction Company)

- Two-lift paving is a practical application
- There is limited production impact
- Economical
  - Economical bottom lift
  - Extended pavement life
- Team effort needed
More Resources on Two-Lift Paving

- ISU- National Concrete Pavement Technology Center
    - Presentations from the open house held in Kansas
    - FHWA video conference
    - Kansas DOT workshop
    - 2006 International SCAN final report
    - Research reports
Geotextile Interlayer

- A key detail recently introduced in Germany for cement-treated bases

- Thick geotextile interlayer prevents the concrete slab from bonding to the cement treated base

- Geotextile material is thicker than the materials commonly used for layer separation in the USA
Geotextile Interlayer
Geotextile Interlayer

• Geotextile is sufficiently porous and mortar from fresh concrete can permeate the geotextile

• Mortar provides a good mechanical bond to the concrete layer while achieving separation from the base layer
Advantages

• Geotextile may provide a suitable alternate to the asphalt interlayer used in many States

• Ease of construction

• Cost savings?
More Resources on the Geotextile Interlayer

• Draft Final Report


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Questions?

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