DOT Utilization of Roller Compacted Concrete

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DOT Utilization of RCC

- What?
- Where?
- Why?
What is RCC?

Definition

- “Roller-Compacted Concrete (RCC) is a no-slump concrete that is compacted by high density pavers and vibratory rollers.”
  - Negative Slump
  - No reinforcing steel
  - No finishing
  - Consolidated with vibratory rollers

- Concrete pavement placed in a different way!
Where? Project Feasibility

- Project Size
- Site Geometry
- Loading Characteristics
- Project End User
Why RCC Paving?

- Speed of construction
- Early strength gain
- Durability
- Cost
<table>
<thead>
<tr>
<th>Nominal Expenditures by Pavement Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asphalt</strong> – Rehab: Crack / cape sealing in years 6, 13, 16, 24, 34, 38</td>
</tr>
<tr>
<td>Microsurfacing in years 10, 28</td>
</tr>
<tr>
<td>Major rehab in year 18 (2” OLAY + PDR)</td>
</tr>
<tr>
<td>Major Rehab in year 45 (5” OLAY + 20% AGG Base repair)</td>
</tr>
<tr>
<td><strong>RCC</strong> – Rehab: Patch &amp; diamond grind at years 25, 35, 2” AC Overlay at yr 45</td>
</tr>
</tbody>
</table>

### Why RCC? Offers Lower Life Cycle Cost

Asphalt is 22% more expensive than RCC throughout the life cycle of the road.

Rehabilitation – Activities based on Proper Maintenance Cycles for asphalt pavements. Current year costs are inflated at 4%. Rehab costs also include other Incidental Costs (striping, mob, etc) - 40% of material costs, Traffic Control - 5% of material cost, and Engineering & Inspection - 5% of material cost.
DOT Utilization of RCC

Materials & Mix Design
Typical Mixture Design

- 400 – 550 lbs/CY Cementitious Material.
- 3400 – 3700 lbs/CY Well Graded Aggregate.
- 20 – 30 gallons/CY Water.
- W/C Ratio usually between 0.3 – 0.45.
- Water amount dictated by Moisture/ Density Relationship.
Highly dependent on aggregate gradation and binder content.
DOT Utilization of RCC

Construction
Continuous Mix Pug Mill

- High-volume applications
- Excellent mixing efficiency for dry materials
- 250 to 900+ tons/hr
- Mobile, erected on site
- Mobilization costs
Transporting & Placement
Placing Equipment

- High density pavers
  - Vibrating screed
  - Dual tamping bars and or pressure bars
  - High initial density, 90-95%
  - Reduces subsequent compaction
  - High-volume placement (1,000 to 2,000 cubic yards per shift)
  - Designed for harsh mixes
  - Smoothest RCC surface
High Density Screed

VDT-V 78
VDT-V 88

VDT 120
VDT 121
Compacted Edges through the use of Edging Shoes
• Final density is critical for strength and durability
• Compacted to 98%
• Modified Proctor
• Dual Steel Drum Roller
• Combination Roller
• Rubber coated steel drum roller
Concrete Curing Compound

- White-pigmented concrete curing compounds
- Apply 1 to 1.5 times the normal application rate
RCC Pavement
Why are DOT’s interested?

- Improve Structural Capacity of Existing Roadways
- Urban/fast-track construction
  - Lift thickness limitations
  - Drop-off limitations
  - Maintenance of cross-traffic
  - Construction speed
- Use RCC as base under asphalt
  - Success with Cement Stabilized Aggregate Bases
- Stimulation of competition
  - Lowers cost to the taxpayer
- Expand the portfolio of pavement types available
  - Price run-up of asphalt binder
  - Uncertain petroleum supply in future
- Concrete pavement at a initial price competitive with HMA
DOT Utilization of RCC

- Composite Pavements
- Interstate Shoulders
- Turn Lanes
- Lower Volume Roadways

Solms Road – New Braunfels, TX
Grape Creek Road – San Angelo, TX
I-85 Interchange – Lagrange, GA
SR 6 – Powder Springs, GA
I-285 Shoulder – Atlanta, GA
Woody Hayes Drive – Columbus, OH
50th
San Angelo, TX
Wishful Vista Lane – Fairview, OR
US 78 – Aiken, SC
DOT utilization of RCC – Project Types Used to Date

- Composite Pavements
- Interstate Shoulders
- Turn Lanes
- Lower Volume Roadways
Typical RCC Composite Pavement Cross-Section

1” – 3” Asphalt

6” – 10” RCC Base

Existing Subgrade / Base
Composite Pavement History

- Select cities started using RCC as a base layer over 25 years ago
  - Portland (1985)
  - Fort St. John (British Columbia)
  - City of Edmonton (92-93)
- Columbus, Ohio adopted an aggressive city streets program in 2001
  - Over 50 projects to date
- Various methods of treating cracks from saw and sealing to allowing to crack naturally
RCC - City Streets Examples

Joint sealed – not saw cut

City of Edmonton
1992
SCDOT Projects

- Powell Pond Rd, Aiken County (Demo. Project)
- SC 5, York County
- US 78, Charleston County
- New State Road, Lexington County
- Greystone Boulevard, Richland County
- S. Beltline Boulevard, Richland County
- Richland Street (US78), Aiken County
- SC 9, Horry County
- S-11-171, Cherokee County
US 78 Ladson, SC
Pavement Cross-Section

2” Asphalt

10” RCC Base

Existing Subgrade / Base
- State route with heavy truck traffic
- Poor & wet subgrade/soils resulted in consistent rutting
Must be able to get compaction/density, subgrade improvement may be necessary
US 78 Ladson Co. Completed Project
DOT utilization of RCC – Project Types Used to Date

- Composite Pavements
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I-285 Shoulder Replacement
Atlanta, GA

Pavement Design Information

- Owner: Georgia DOT
- Use Type: State Route shoulder
- Year Built: 2006
- Thickness: 6 & 8” RCC
- Quantity: 35 lane miles 38.500 CY

Additional Details

- 2006 SCAN Innovation Award
- Material placed on weekends only
- Removal of shoulders on Friday night starting 9:00 PM
- Had to be off the road by 5:00 AM Monday morning ($5,000 per hour fine)
- Typically 1.5-2 miles per night
I-285 Shoulder Replacement: Completed Shoulder
DOT utilization of RCC – Project Types Used to Date

- Composite Pavements
- Interstate Shoulders
- Turn Lanes
- Lower Volume Roadways
Pavement Design Information

- Owner: Georgia DOT
- Use Type: State Route shoulder and Median
- Year Built: 2006
- Thickness: 7” RCC (Shoulder & Median)
- Quantity: 16,500 CY

Additional Details

- First use of RCC in travel way in United States
- Project won 2007 SCAN Quality Award for concrete pavement construction
- ADT - 17,000, 5% trucks – 22 M ESALS
- RCC used for travel lane during construction
DOT utilization of RCC – Project Types Used to Date

- Composite Pavements
- Interstate Shoulders
- Turn Lanes
- Lower Volume Roadways
Richland Ave (US 78)  
Aiken, SC - 2009

Pavement Design Information

- Owner: South Carolina DOT
- Use Type: US Highway
- Year Built: 2009
- Thickness: Milled 10” asphalt  
  Placed 10” RCC
- Traffic: 6000 ADT, 4 lanes
- Speed: 45 mph

Additional Details

- Replaced 27,500 SY in 15 days
- Placed 10” RCC in 1 lift
- All milled areas were paved within same day
- Maintained 1 lane open in each direction
  - Transverse Joints: 20 ft, early entry saw cut within 3 hours
- Traffic re-opened within 24 hours
- 100% Diamond Ground
RICHLAND AV. (US 78) AIKEN, SC
Completed Surface Texture
### Actual RCC Bids are Very Competitive When the Market is Developed

Projects Bid to SC & GA DOT in 2006-2009

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>RCC Thickness (in)</th>
<th>BID QUANTITY (CY)</th>
<th>BID PRICE / SY</th>
<th>BID PRICE / SY / IN</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 78 Aiken Co.</td>
<td>10</td>
<td>27,050</td>
<td>$ 29.93</td>
<td>$ 2.99</td>
</tr>
<tr>
<td>Lexington/ Richland Co.</td>
<td>10</td>
<td>51,500</td>
<td>$ 33.60</td>
<td>$ 3.36</td>
</tr>
<tr>
<td>Rock Hill</td>
<td>10</td>
<td>25,650</td>
<td>$ 33.00</td>
<td>$ 3.30</td>
</tr>
<tr>
<td>I-385 Lauren Co.</td>
<td>10</td>
<td>135,387</td>
<td>$ 22.00</td>
<td>$ 2.20</td>
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<tr>
<td>I-385 Greenville County</td>
<td>8</td>
<td>54,957</td>
<td>$ 21.85</td>
<td>$ 2.73</td>
</tr>
<tr>
<td>SR 6 – Powder Springs</td>
<td>7”</td>
<td>16,500</td>
<td>$28.78</td>
<td></td>
</tr>
<tr>
<td>I-285 Atlanta</td>
<td>6” 8”</td>
<td>20,000 18,500</td>
<td>$17.75 $23.67</td>
<td></td>
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</table>
DOT Utilization of RCC
What have we learned?

- Proper Joint construction is Critical
- RCC can be diamond ground to achieve a smooth ride.
  - Helps improve surface texture.
  - IRI numbers in the 60s are achievable.
- RCC can be milled if it is going to be covered.
  - Milling can cause joint damage.
- 10”+ RCC can cause problems when placed with typical equipment.
- Even with best practices, surface texture is varied and material dependent
- RCC can be placed in an urban environment without excessive traffic disruption.
- You only get one shot at doing it right.
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Questions and Contact Information

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