Utilization of Roller Compacted Concrete for Roadways

Chris Carwie, Business Development Manager
A.G. Peltz Group LLC | Birmingham, AL
RCC Paving for Roadways

• Todays Agenda
  – What, Where, Why?
  – Why DOT/Agencies are interested?
  – Crossgate Road
  – Prior GDOT Projects
  – What have we learned?
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VIDEO:
Roller Compacted Concrete Pavement offers the Best of Both Worlds
What: 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
RCC PAVEMENT USAGE IS INCREASING
And it has been used throughout the US

RCC Pavement Usage in the U.S.A.
(1983-2011)

[Graph showing RCC pavement usage from 1983 to 2011]
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Utilization of RCC for Roadways
RCC Pavement

Why are DOT/Agencies 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
• Composite Pavement System – Volume 1 – HMA/PCC Composite Pavement
  – Part of SHRP 2 – Renewal Research, complete in 2013
  – Study looked at composite pavement systems using a variety of HMA and concrete pavement types, thicknesses, etc.
    • New and existing composite pavements evaluated
    • Composite systems utilizing JPC, CRC, RCC, and CTB as base layer
    • Several RCC jobs were included in the study – 8”, 15” RCC with 1-3” HMA cap
• Summary findings
  – Excellent surface characteristics can be obtained from thin (1”-3”) asphalt top layers.
    • Allows rapid renewal of the surface while maintaining high structural carrying capacity in the rigid base.
  – There is an avoidance of certain distress types that occur in conventional pavements.
    • Fatigue cracking in HMA was minimal because pavement is almost always in compression
    • Fatigue cracking in PCC was reduced due to the insulating effects of the HMA
    • Rutting is minimized due to high quality materials and thin layer of HMA
    • Transverse cracking controlled through sawing and sealing techniques
RCC Paving for Roadways

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**Crossgate Road**
Port Wentworth (Savannah), GA

<table>
<thead>
<tr>
<th>Pavement Design Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Owner: Georgia DOT</td>
</tr>
<tr>
<td>• Use Type: Travel lane</td>
</tr>
<tr>
<td>• Year Built: 2016</td>
</tr>
<tr>
<td>• Thickness: 10”</td>
</tr>
<tr>
<td>• Quantity: 16,000 SY</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>• First use of RCC as a final riding surface on a state travel lane</td>
</tr>
<tr>
<td>• RCC Placed in single pass, 24 feet wide in most cases</td>
</tr>
<tr>
<td>• 325 acres of undeveloped property on existing roadway</td>
</tr>
<tr>
<td>• Project Diamond Ground for smoothness</td>
</tr>
<tr>
<td>• 3000 PSI achieved within 2 days allowing quick return to traffic</td>
</tr>
</tbody>
</table>
Crossgate Road, Port Wentworth, GA

HMA Roadway prior to replacement with RCC: GDOT wanted to improve structural capacity of the roadway.
Majority of the roadway was pulled full 24 foot width. Operations were started at midpoint to allow traffic to be maintained at all times. 3000 PSI reached in 48 hours.
Joints were sawcut using early entry saws at 15 foot intervals. Joints were sealed with DOW 888 Silicone Sealant as per GDOT Specification.
Project was Diamond Ground for smoothness. GDOT did not require a ride spec, but they did take PRI readings.
PRI (Profile Ride Index)
- West Bound 8.4 inch/per mile
- East Bound 12.5 inch/per mile
Crossgate Road Test Results
Compressive Strength Cylinders

\[ y = 1024\ln(x) + 2378.3 \]
\[ R^2 = 0.9983 \]

Graph showing the relationship between time (days) and strength (psi).
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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
Atlanta, GA
I-285 Shoulder Replacement: Completed Shoulder
<table>
<thead>
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<th>Pavement Design Information</th>
<th>Additional Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Owner: Georgia DOT</td>
<td>• First use of RCC in travel way in United States</td>
</tr>
<tr>
<td>• Use Type: State Route shoulder and Median</td>
<td>• Project won 2007 SCAN Quality Award for concrete pavement construction</td>
</tr>
<tr>
<td>• Year Built: 2006</td>
<td>• ADT - 17,000, 5% trucks – 22 M ESALS</td>
</tr>
<tr>
<td>• Thickness: 7” RCC (Shoulder &amp; Median)</td>
<td>• RCC used for travel lane during construction</td>
</tr>
<tr>
<td>• Quantity: 16,500 CY</td>
<td></td>
</tr>
</tbody>
</table>
SR 6 – Powder Springs, GA
2016 Pictures
RCC Paving for Roadways

- Today's Agenda
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Roadway Applications for 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.
Roadway Applications for RCC
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- 10”+ RCC can cause problems when placed with specialized RCC equipment
- Even with best practices, surface texture is varied and material dependent
- RCC can be placed in an urban environment without excessive traffic disruption.
- Cost vary significantly by market and job size.
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 / IN</th>
<th>BID PRICE / SY / CY</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>
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<tr>
<td>Crossgate Road</td>
<td>10</td>
<td>4,000</td>
<td>$66.00</td>
<td>$6.60</td>
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<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>$4.11</td>
</tr>
<tr>
<td>I-285 Atlanta</td>
<td>6”</td>
<td>20,000</td>
<td>$17.75</td>
<td>$2.95</td>
</tr>
<tr>
<td></td>
<td>8”</td>
<td>18,500</td>
<td>$23.67</td>
<td>$2.95</td>
</tr>
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Questions and Contact Information

Chris Carwie
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205.335.0579
RCC Roadways History

- **City of Portland**
  - Composite Roadways back to 1995
  - 8” RCC with 2” HMA Cap
  - Minimal Maintenance to date

- **City of Edmonton, Alberta, Canada**
  - Contact: Hugh Donovan, Construction Services Engineer (780-496-6773)
  - Various Industrial and Street Projects, including city streets and arterials in early 90’s
  - Use between 7-11” RCC layer with 2” asphalt surface layer on top
    - No joint sawing – allow material to crack naturally
    - Typically cracks every 40 feet
    - No experience with crack relief layer
RCC Roadways History

- **City of Fort St. John British, Columbia, Canada**
  - Contact: Victor Shopland, Materials Engineer
  - RCC Placed in 1992 on city streets
  - 9” RCC with 2” HMA wearing surface
  - No sawed joints at all
  - Traverse cracks roughly every 20 feet – crack sealing used as appropriate

- **Columbus, Ohio**
  - Contact: Vic Cummins – City Engineer (614) 645-0412
  - Largest RCC City Streets program in the country
  - Started in 2001 and have bid over 60 projects since
  - Use 6-8” RCC with varying HMA thickness on top
  - Varying joint treatments including sawcutting through HMA at RCC transverse joints
Early RCC Roadways: Project Pictures

Portland, Oregon
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
US 78 Ladson, SC 2009

- 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