Rehabilitation of the Rivermont Avenue Bridge
Lynchburg, Virginia

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AECOM
Roanoke, Virginia
Project Overview and Goals
• Gateway Structure
• Steel Trestle (1891)
• Encasement (1928)
• Present Structure (1973)
Bridge Overview

- Total Length = 885 feet, Total Width = 68’-0”
- Haunched steel plate girders with CIP deck
- 5-span continuous unit, simple end spans
- Tooth joints at Piers 1 and 6
- Accelerated deterioration
Deck Condition
- Uncoated reinforcing
- Deck deterioration
- Previous repairs
- > 10% deck area
Cross Section at Tooth Joint
Bridge Condition
Bridge Condition
Bridge Condition

Project Goal: Fix it for good
Evaluation Phase
Deck Evaluation

- Half Cell Potential
  - 5 ft grid
  - Readings taken at grid points
- Delamination Mapping
  - 5 ft grid resolution
- Chloride Tests
  - 2 per span per travel direction
  - Random locations
- Pachometer
  - 5 ft grid
- Petrographic analysis
Reinforcing Cover Survey

- **Pachometer Readings**
  - Uses electrical current to measure reinforcement cover

### Southbound Lanes

<table>
<thead>
<tr>
<th>Span</th>
<th>Cover Measurement</th>
<th>Design Cover = 2.25&quot;</th>
<th>Total Readings</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 2&quot;</td>
<td>&lt; 1.75&quot;</td>
<td>&lt; 1.5&quot;</td>
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<tr>
<td>1</td>
<td>79 %</td>
<td>62 %</td>
<td>29 %</td>
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<tr>
<td>2</td>
<td>42 %</td>
<td>18 %</td>
<td>7 %</td>
</tr>
<tr>
<td>3</td>
<td>44 %</td>
<td>14 %</td>
<td>5 %</td>
</tr>
<tr>
<td>4</td>
<td>33 %</td>
<td>17 %</td>
<td>5 %</td>
</tr>
<tr>
<td>5</td>
<td>43 %</td>
<td>18 %</td>
<td>1 %</td>
</tr>
<tr>
<td>6</td>
<td>58 %</td>
<td>38 %</td>
<td>14 %</td>
</tr>
<tr>
<td>7</td>
<td>74 %</td>
<td>32 %</td>
<td>6 %</td>
</tr>
</tbody>
</table>

**Average =** 53 % 28 % 10 %
Half-Cell Potential Tests

- 5 ft grid layout
- All four lanes
- Approximately 1800 readings
### Half-Cell Potential Tests

#### Half-Cell Readings – Typical Span

<table>
<thead>
<tr>
<th>Southbound Lanes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
</tr>
</thead>
</table>

| Northbound Lanes | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| E                | -251 | -228 | -206 | -287 | -287 | -402 | -212 | -249 | -244 | -264 | -250 | -335 | -374 | -244 | -221 | -224 | -245 | -222 | -230 | -229 | -452 |
# Chloride Ion Content Tests

## Chloride Ion Content Analysis Results

### Northbound Lanes

<table>
<thead>
<tr>
<th>Span</th>
<th>Sample No.</th>
<th>Chloride Ion Content</th>
<th>1/2&quot; Depth</th>
<th>2&quot; Depth</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>1A</td>
<td>4.84</td>
<td>1.81</td>
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<tr>
<td></td>
<td>1B</td>
<td>4.37</td>
<td>1.41</td>
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<tr>
<td>2</td>
<td>2A</td>
<td>3.04</td>
<td>1.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2B</td>
<td>4.37</td>
<td>2.12</td>
<td></td>
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<tr>
<td>3</td>
<td>3A</td>
<td>4.48</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3B</td>
<td>3.67</td>
<td>1.50</td>
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<td>4A</td>
<td>3.86</td>
<td>1.01</td>
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<tr>
<td></td>
<td>4B</td>
<td>4.71</td>
<td>2.02</td>
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<tr>
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<td>5A</td>
<td>2.72</td>
<td>0.83</td>
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<tr>
<td></td>
<td>5B</td>
<td>3.49</td>
<td>1.82</td>
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<tr>
<td>6</td>
<td>6A</td>
<td>3.16</td>
<td>1.29</td>
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<tr>
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<td>6B</td>
<td>3.67</td>
<td>2.31</td>
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<tr>
<td>7</td>
<td>7A</td>
<td>1.17</td>
<td>0.79</td>
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<tr>
<td></td>
<td>7B</td>
<td>3.32</td>
<td>1.50</td>
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<th>2&quot; Depth</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1D</td>
<td>3.73</td>
<td>1.91</td>
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<tr>
<td></td>
<td>2C</td>
<td>1.91</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2D</td>
<td>3.93</td>
<td>1.48</td>
<td></td>
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<tr>
<td>3</td>
<td>3C</td>
<td>3.49</td>
<td>1.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3D</td>
<td>3.49</td>
<td>1.50</td>
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<tr>
<td>4</td>
<td>4C</td>
<td>3.32</td>
<td>1.35</td>
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<td>4D</td>
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<td>1.74</td>
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<tr>
<td>5</td>
<td>5C</td>
<td>3.32</td>
<td>1.57</td>
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<tr>
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<td>4.96</td>
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<td>6</td>
<td>6C</td>
<td>4.48</td>
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<tr>
<td></td>
<td>6D</td>
<td>4.06</td>
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<tr>
<td>7</td>
<td>7C</td>
<td>2.46</td>
<td>1.29</td>
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</table>

**Key:**
- Below threshold
- Threshold at which corrosion begins (1-2 lb/yd³)
- Above threshold
Bridge Rehabilitation Alternatives

- Deck Replacement
  - Expensive and complex
- Traditional Overlay
  - Does not meet goals
- “Deep” Overlay
  - Remove concrete below top mat
  - New overlay to provide adequate cover
  - Utilize hydrodemolition
Staged Construction
Bridge Rehabilitation

- **Joints and Bearings**
  - Remove, rebuild, and replace tooth joints
  - Clean and paint bearings
- **Structural Steel**
  - Modify for new joint details
  - Clean and paint beam ends
- **Piers**
  - Concrete surface repair
  - Galvanic anodes
Construction Phase
Deck Rehabilitation

- 20,000 psi
- 53 gpm
- Calibration
  - Pressure
  - Nozzle
  - Speed
  - Passes
- 7 ft width
- 200 ft strip
- High to low
Deck Rehabilitation
Deck Rehabilitation
Deck Rehabilitation
Deck Rehabilitation
Deck Rehabilitation

- Class A4
- Small aggregate
- Low permeability
- Pump delivery
Pier Rehabilitation
Joint Rehabilitation

- Clean / paint
- Replace supports
- Trough
- Reset
Joint Rehabilitation
Enhancements
Bridge Overview

- 4 travel lanes & 2 sidewalks
- Barrier style median
- Single bar railing
- Cobra head lights
- Aesthetic enhancements
Aesthetic Enhancements
Aesthetic Enhancements
Aesthetic Enhancements
Aesthetic Enhancements
Conclusions

- Owner: City of Lynchburg
- Prime Contractor: DLB, Inc.
- Engineer: AECOM

- Total Construction Cost: $2,500,000
  - Deep overlay: $800,000 (1/2 hydrodemolition)
  - Tooth Joint Rehab: $200,000
  - Structural Steel: $200,000
  - Piers: $400,000
  - Enhancements: $300,000
  - Other: $500,000
Conclusions

• Bridge preservation during planning / design
  o Joint details

• Bridge preservation during initial construction
  o Deck reinforcing cover

• Bridge preservation during maintenance
  o Clearing drainage

• Importance of data driven decisions

• Deep overlay effectiveness

• Aesthetic value
Thank You