Heartland Corridor Clearance Improvement Project

Investigative Probing Program (IPP)

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Heartland Corridor Clearance Improvement Project

Heartland Corridor Overview

- **Purpose of the Project:**
  - To achieve “double-stack” - 21’-0 vertical clearance along the Heartland Corridor

- **Benefits:**
  - NS – increased corridor capacity and allowed for more efficient use of assets
  - Rail Customers – cut transit time between Norfolk to Chicago from 4 days to 3 days and improved reliably of service.
  - Ocean Carriers – more efficient access to nation’s heartland
  - Port of Virginia – makes port more attractive to ocean carriers
  - Public – reduces number of trucks on congested highways and reduces fuel consumption and greenhouse emissions
Heartland Corridor Clearance Improvement Project

Heartland Corridor Overview

• Largest railroad improvement project of this caliber with the last 100 years
• Project reached from Walton, VA to Columbus, OH
• Consisted of 67 Project Sites over 379 miles of track
• Reduced rail travel distance for “double-stack” freight by about 230 miles and increased freight capacity
• Cost for tunnel and overhead obstruction modifications - $191 million
Heartland Corridor Route

To Chicago via Harrisburg (1,264 miles)

To Chicago via Heartland (1,031 miles)

To Chicago via Knoxville (1,342 miles)
Heartland Corridor Construction Team

- **Design Firm**
  - Hatch Mott McDonald

- **Construction Management Team**
  - STV (Prime Contractor)
  - AMEC
  - Jacobs Associates

- **Contractors**
  - Johnson Western Gunite, Inc.
  - R.J. Corman Railroad Construction
  - LRL Construction
Heartland Corridor Modifications

- 28 Tunnels located over 3 states (5.7 miles)
- 8 Through Truss Bridge Modifications
- 3 Overhead Bridges requiring track lowering
- 8 Slide Fence Modifications

- Construction performed during a modified work schedule
  - Saturday thru Wednesday – 2:00AM to 12:00pm (noon)
- Construction period – October 2007 to September 2010
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Heartland Corridor Tunnel Locations

Heartland Project
Norfolk Southern Tunnels
Requiring Modification for 20’ 3” Doublestack Operation

- New Double-stack Route
- NS Rail System
- Interstate Highways
- State Highways

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Investigative Probing Program (IPP)

- 3 Probe Holes within the crown
  - Radial probes 20 feet deep (2 and 10 o’clock position)
  - Crown probes 45º and 40 feet deep (12 o’clock position)
- 8 notch probes per probe bay, spaced 5 foot c/c
- Rock cores 50 feet in from portals and evenly spaced throughout (apprx. 250’)

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- Crown probes spaced 25 feet apart
- Drilling logs were recorded for each probe hole
- Each probe was camera logged (written log and video recorded)
- A total of 2,642 crown probes, 105 vertical rock cores, and 5,150 notch probes
- Overall total of 20 miles of exploratory drilling
**IPP Design Parameters**

- **3 Ground Classification Types (GCT)**
  - Type A – good sound rock quality, minor discontinuities, bolt zone clean.
  - Type B – rock quality moderate, moderate discontinuities, bolt zone minor.
  - Type C – rock quality poor, major discontinuities, bolt zone weak.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Recovered Core</th>
<th>Probe Drilling</th>
<th>Camera Inspection</th>
<th>Water Pressure Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock Type</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated Strength of Intact Rock</td>
<td>X</td>
<td>X*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RQD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spacing of Discontinuities</td>
<td>X</td>
<td>X**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition of Discontinuities</td>
<td>X</td>
<td>X**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater Conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedding Orientation</td>
<td></td>
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<tr>
<td>Bedding Dip</td>
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<td></td>
</tr>
<tr>
<td>Joint Orientation</td>
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<td></td>
</tr>
<tr>
<td>Joint Dip</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Changes in rock condition from adjacent holes</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liner Quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Provides indications only of possible strength increase/decrease not estimated value
** For Significant features only to such extent such features are readily apparent.
IPP Design Parameters

Ground Condition, Classification and Support Flow Chart

**DATA GATHERED FROM FIELD**

- FROM ROCK CORES
  1. LITHOLOGIES
  2. RQD
  3. BEDDING/JOINT
  4. ROCK FIELD STRENGTH
  5. WEATHERING
  6. RMR OR Q INDEX

- FROM PROBE HOLE DRILLING
  1. PENETRATION RATE
  2. SOFT ZONES/VOIDS
  3. WATER COLOR

- FROM CAMERA INSPECTION
  1. POSITION OF ROCKBOLT ZONE
  2. BEDDING/TIGHT OPEN
  3. JOINT SPACING, TRENDS, TIGHT, WEATHERED, OPEN
  4. SOFT BEDS/WEATHERED ZONES
  5. GROUNDWATER

**TABLE 1 (GCT)**

Assess Rockbolt Zone in terms of Rockbolt bond and capability to form a reinforced arch.

**TABLE 2 (VOID)**

- VOID SIZE*

**TABLE 3 (GST)**

- GST * A
- GST * B
- GST * C

* = Void height, 1, 2

Unexpected conditions

Further Investigation
### IPP Design Parameters

- **3 Ground Support Types (GST)**

#### Table 3: Double Track Tunnel Summary of Ground Support Types (GST)

<table>
<thead>
<tr>
<th>Ground Classification Type</th>
<th>Ground Support Type</th>
<th>Tunnel Notching</th>
<th>Tunnel Lining Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCT A</td>
<td>GST 1A** or 2A**</td>
<td>N/A</td>
<td>8 DCP rockbolts*, 16.5’ long at 6.5’ longitudinal spacing with 11,000 lbs pretension. 4” lining shotcrete.</td>
</tr>
<tr>
<td></td>
<td>GST 1D</td>
<td>8 DCP rockbolts*, 20’ long at 6.5’ longitudinal spacing with 11,000 lbs pretension.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>GST 2D**</td>
<td>9 DCP cable bolts, 22'-30’ long at 5’ longitudinal spacing with 11,000 lbs pretension.</td>
<td>N/A</td>
</tr>
<tr>
<td>GCT B</td>
<td>GST 1B or 2B</td>
<td>N/A</td>
<td>8 DCP rockbolts*, 16.5’ long at 4’ longitudinal spacing with 11,000 lbs pretension. 4” lining shotcrete.</td>
</tr>
<tr>
<td></td>
<td>GST 1E</td>
<td>8 DCP rockbolts*, 20’ long at 4’ longitudinal spacing with 11,000 lbs pretension.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>GST 2E</td>
<td>9 DCP cable bolts, 22'-30’ long at 4’ longitudinal spacing with 11,000 lbs pretension.</td>
<td>N/A</td>
</tr>
<tr>
<td>GCT C</td>
<td>GST CV*** or CH***</td>
<td>N/A</td>
<td>Initial array – 30 groutable bar spiles, 2” dia., 26.25’ long at 1’-2” radial spacing. Subsequent arrays – 18 groutable bar spiles, 2” dia., 16’ long at 2’ radial spacing, 10’ longitudinal spacing.</td>
</tr>
</tbody>
</table>
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Construction Photos

ANTLER TUNNEL

HEMPHILL TUNNEL

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