Recent Progress: Virginia Tunnel Inspections

June 27, 2016
Agenda

• Overview of Virginia Tunnels

• Tunnel Inspection Planning Process

• Recent Inspection Progress
  – Big Walker Mountain Tunnel
  – East River Mountain Tunnel (special inspection)
  – New Midtown Tunnel
  – Monitor Merrimac Memorial Bridge Tunnel

• Lessons Learned
Big Walker Mountain Tunnel
East River Mountain Tunnel
Hampton Roads Bridge Tunnel (2 tunnels)
Monitor Merrimac Memorial Bridge Tunnel
Downtown Tunnel (2 tunnels)
Midtown Tunnel (2 tunnels)
Rosslyn Tunnel
Thimble Shoal Tunnel
Chesapeake Channel Tunnel
Roanoke Airport Tunnel
I-564 Runway Tunnel
<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Length</th>
<th>Year Built</th>
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</thead>
<tbody>
<tr>
<td>Big Walker Mountain Tunnel</td>
<td>Twin Rock Bore (NATM)</td>
<td>4228’</td>
<td>1972</td>
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<tr>
<td>East River Mountain Tunnel</td>
<td>Twin Rock Bore (NATM)</td>
<td>5661’</td>
<td>1974</td>
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<td>Hampton Roads Bridge Tunnel</td>
<td>Westbound</td>
<td>Immersed Tube</td>
<td>7479’</td>
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<td></td>
<td>Eastbound</td>
<td>Immersed Tube</td>
<td>7315’</td>
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<td>Monitor Merrimac Memorial Bridge Tunnel</td>
<td>Immersed Tube</td>
<td>4860’</td>
<td>1992</td>
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<td>Elizabeth River Downtown Tunnel</td>
<td>Westbound</td>
<td>Immersed Tube</td>
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<td></td>
<td>Eastbound</td>
<td>Immersed Tube</td>
<td>3814’</td>
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<td>Elizabeth River Midtown Tunnel</td>
<td>Eastbound</td>
<td>Immersed Tube</td>
<td>4192’</td>
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<td>Westbound</td>
<td>Immersed Tube</td>
<td>4198’</td>
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<td>I-564 Runway Tunnel</td>
<td>Cut and Cover</td>
<td>662’</td>
<td>1972</td>
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<td>Thimble Shoal Tunnel</td>
<td>Immersed Tube</td>
<td>5738’</td>
<td>1964</td>
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<td>Chesapeake Channel Tunnel</td>
<td>Immersed Tube</td>
<td>5424’</td>
<td>1964</td>
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<td>Rosslyn Tunnel</td>
<td>Cut and Cover</td>
<td>900’</td>
<td>1983</td>
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<td>Roanoke Airport Tunnel</td>
<td>Cut and Cover</td>
<td>951’</td>
<td>1985</td>
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**Average Tunnel Age: 41 Years**
**Tunnel Criticality**

- Multi-Billion Dollar Investment
- Used by over 400,000 Vehicles per Day
- Limited Detour Routes
- Over 20,000 events logged each year that require operator response
Statewide Tunnels Oversight Committee (STOC)

Formed in 2010 to provide direction and guidance for all of the tunnels across the state

- Executive Leadership
- Regional Operations Managers
- Operations Division
- Tunnel Managers
Recent Progress: Inspections

- Preliminary Tunnel Inventory complete
- Began development of element inventory and inspection manuals
- Completed initial inspections of 3 tunnels:
  - Big Walker Mountain Tunnel
  - Monitor Merrimac Memorial Bridge Tunnel
  - New Westbound Midtown Tunnel
- Special inspection - tunnel fire at ERMT
Tunnel Inspection Manuals

- Description of element configuration and components
- Pre-inspection preparation and review
- Tools and Equipment
- Personal Protective Equipment
- Field Inspection Procedures
- Reporting and Rating Procedures
Tunnel Inspection Manuals

5. Field Inspection Procedures

Perform a visual inspection of each component in an orderly and sequential manner, starting with the utility service and proceeding by area to the utilization equipment so that all components of the system are inspected.

Service Switching Stations

There are two service switching stations outside each ventilation building. The switching station contains the utility service, utility metering equipment, and manually operated rotating insulator switch that serves as the feed point to power circuit breaker which can be operated and monitored from the control room. The medium voltage feeders originate at the breaker in each switching stations.

Physical Condition

- Note condition of security features such as fencing, locks, area lighting, and CCTV cameras.
- Note any vegetation around the service equipment that could impact systems operation during storm events.
- Verify integrity of all visible grounding for all equipment including security fencing.
- Note all physical defects to the equipment including paint loss, settlement, corrosion, blocked ventilation openings, improperly secured closure plates and doors.
- Verify arc flash hazard labeling is in place.
- Verify operation of all panel meters and record measurements.
- Note missing equipment identification labels.

Operational Condition

- As determined feasible by the facility supervisor, observe remote operation of service equipment from the control room. This may require closure of the tunnel.
Tunnel Inspection Manuals

Sketches explaining tunnel configuration

4228’
Big Walker Mountain Tunnel (BWMT)
Big Walker Mountain Tunnel (BWMT)
Big Walker Mountain Tunnel (BWMT)
Initial inspection performed over a three week period

- **Week 1**: Tunnel elements along the roadway with nightly lane closures
- **Week 2**: Ventilation ducts and mechanical/electrical equipment in buildings
- **Week 3**: Testing switchgear and electrical panels with planned night time outages
BWMT – Civil/Structural

• Inspection of all civil/structural elements along the roadway with single lane closures

• Inspection of supply and exhaust ventilation ducts above roadway (confined space entry procedures)
BWMT – Electrical Systems

• Visual inspection of equipment
• Infrared scanning to detect ‘hot spots’
• Electrical testing per NETA Maintenance Testing Specifications (MTS)
• Observation of generator load testing
BWMT – Mechanical Systems

- Visual inspection and operation of all fans
- Vibration analysis of all fan bearings
- Review of maintenance records
BWMT – Fire Life Safety

- Operation of all emergency ventilation modes
- Mobile Ventilation Units (MVU’s)
- Fire detection pull stations and emergency telephones
- Fire extinguishers, water storage tanks and hose connections
- Emergency communications systems
East River Mountain Tunnel (ERMT)

- Tractor trailer fire in July 2014
- Damage to tunnel lighting and conduits, wall tiles, ceiling slab, and pavement
- **Special Inspection** performed immediately to assess damage
- Both lanes were opened to traffic within 24 hours
East River Mountain Tunnel (ERMT)

- Fire Damage to Wall Tiles
- Taking Cores from Ceiling Slab
East River Mountain Tunnel (ERMT)

- Damaged concrete inspected for cracking and spalling
- Concrete cores taken at fire location and unaffected area
- Petrographic analysis and compressive strength testing
  - Fire damage limited to bottom $\frac{3}{4}$" of the slab
  - Concrete strength slightly reduced but still exceeded design strength
- Repairs consisted of replacing mortar/tile on walls, and coating ceiling slab with epoxy
New Westbound Midtown Tunnel

- Public private partnership between VDOT and Elizabeth River Crossings (ERC)
- New immersed tunnel constructed parallel to existing
- Opened to one lane of traffic on June 17, several months ahead of schedule
- Initial safety inspection completed by VDOT prior to opening
New Westbound Midtown Tunnel

- To minimize delays, inspection began while construction of tunnel interior finishes was still underway

- Detailed plan for commissioning and testing
  - Ensure proper function of systems
  - Avoid duplication of effort by inspectors

- Working closely with project team
  - VDOT
  - Elizabeth River Crossings (ERC)
  - SKW Constructors (Skanska, Kiewit, Weeks)

- Close out of all major inspection findings prior to opening to one lane of traffic
New Westbound Midtown Tunnel
New Westbound Midtown Tunnel
Monitor Merrimac Bridge Tunnel
Monitor Merrimac Bridge Tunnel
Monitor Merrimac Bridge Tunnel
Monitor Merrimac Bridge Tunnel
Lessons Learned

- Review of maintenance and testing records for tunnel systems
- Clear identification of inspection procedures for tunnel systems, including any planned operation or testing
- Coordination meetings at the beginning and end of each day to discuss planned activities, provide updates, and monitor inspection progress
- Communication with tunnel maintenance staff, maximizing use of outages or lane closures to make repairs immediately if possible
THANK YOU