Hampton Roads Bridge Tunnel Expansion: Overview of Tunnel Construction Methods

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Ten Hampton Roads Tunnels

Monitor-Merrimac Memorial Bridge-Tunnel (1992)

Chesapeake Channel Tunnel (1964)

Hampton Roads Bridge-Tunnel (1957 & 1976)

Thimble Shoal Tunnel (1964)

Midtown Tunnel (1962 & 2016)

Downtown Tunnel (1952 & 1987)
65 Years of Tunneling in Hampton Roads

- 9 tunnels are steel-shell immersed tubes
- 1 tunnel is concrete-box immersed tube
- Future tunnel #11 at Thimble Shoal will be bored tunnel
Proposed Tunnel Alignment
(Hampton Side)
Proposed Tunnel Alignment (Norfolk Side)
Proposed Lane Configuration for Tunnel and Approach Bridges

- **2+1+1** concept in each direction:
  - 2 free General Purpose lanes
  - 1 full-time HOT lane
  - 1 peak-hour HOT lane on left shoulder
Tunnel Considerations

- Landside work has risks but is largely conventional
- Tunnel work is less conventional and will generate greater risks from a contracting standpoint
  - E.g. Midtown Tunnel contract’s limit of liability was tested against a potential scenario involving construction impacts to existing tunnel
- This is a rare location where both immersed-tube and bored-tunnel construction methods are feasible
  - All ten Hampton Roads tunnels to date have been immersed tubes
  - Until recently, bored tunnels were not feasible in soft soils
  - But recent advances in technology now make bored tunnels possible in soft soils
- These methods were directly compared in the nearby Thimble Shoal Tunnel procurement in 2015
Immersed-Tube Tunneling (ITT)
New Midtown Tunnel Section

Utility Corridor

Egress Corridor

Jet Fans

Images property of respective owners.
Parallel Thimble Shoal Tunnel

(initial concept)

- Proposed Thimble Shoal Channel Tunnel (SB Traffic)
- Existing Thimble Shoal Channel Tunnel (NB Traffic)
- Approximate Edge of Existing Island
- #1 Island
- #2 Island
Bored Tunneling

Tunnel boring machine “Bertha,” recently at work in Seattle

Images property of respective owners.
Interior of SR99 Tunnel in Seattle
(57.5’ external diameter, 52’ internal diameter)
Key Differences between Bored and Immersed-Tube Tunneling

- **Alignment**
  - ITT alignment must be further away from existing tunnel (Hampton Roads typical practice → about 200 feet)
  - Bored tunnel can be much closer to existing facilities (estimate on other projects → about one diameter ≈ 50 feet)

- **Geotechnical**
  - ITT method has limited concern for soil properties, since soil along tunnel path is dredged out and removed
  - Bored method is specifically tailored to local soil properties

- **Environmental and Permitting**
  - Section 408 coordination with marine stakeholders / federal channel
  - Section 103 concurrence for offshore disposal of ITT spoils
  - Joint permit covering upland disposal of bored-tunnel spoils
Immersed Tunnel Considerations

- **Concept design**
  - Approx. 7,500 ft. long
  - Approx. 3.5 million cubic yards dredged material
  - Dredged trench approx. 90 ft. wide with 3:1 side slopes

- **Navigational considerations at channel**
  - Trench dredging
  - Placement & screeding of gravel bedding
  - Immersion of tunnel elements
  - Placement of cover fill

- **Other navigational considerations**
  - Barge transport of dredged material for ocean disposal
  - Island expansion (fill & armor stone)
  - Limited additional geotechnical investigation is anticipated
Bored Tunnel Considerations

- Concept design
  - Approx. 8,300 ft. long
  - Deeper than immersed-tube tunnel because more cover is needed e.g. for buoyancy control – therefore tunnel is longer
  - 4% roadway grades likely require island expansion lengthwise
  - Approx. 1 million cubic yards excavated tunnel material
  - Ground improvement at islands to support weight of tunnel boring machine

- Navigational considerations
  - Additional geotechnical investigations
  - Island expansion (fill & armor stone)
Procurement Milestones and Next Steps

- Initial outreach to industry in April 2017
- Follow-up with potential proposers in January/February 2018
- Firms expressed interest in both tunnel-construction methods

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Questions?