Alaskan Way Viaduct REPLACEMENT PROGRAM

T-20 Committee Meeting
June 24, 2014
Building the New SR 99 Corridor
Before

Remember the southern mile of the viaduct? Completed in 1960, it was demolished in 2011, about 18 months after this May 2010 photo. The southern mile was the last part of the viaduct to open and the first part of it to go into the concrete recycling bin.

2010

2014

Fast forward to March 2014. The southern mile of the viaduct has been replaced by a new SR 99 through SODO. Traffic is using a temporary four-lane bypass to get around tunnel construction. To the south, the new South Atlantic Street overpass helps move traffic in and out of the Port of Seattle.

After
South Atlantic Street Overpass – Precast Girders

Photo from April, 2013.
Before

It’s April 24, 2014, and crews are building a permanent section of northbound SR 99 just south of the entrance to the future SR 99 tunnel. The new strip of pavement on the right will connect to a new northbound exit near the stadiums.

April 2014

May 2014

By May 21, 2014, much of the new roadway is done. Starting in June 2014, it will assume a couple of interim roles. The right half will be part of a new temporary routing of northbound SR 99. The left half will be used as a tunnel construction access road.

After
Aerial of SR 99 Tunnel Work Site

Photo from winter 2014.
**Before**

It’s March 12, 2014. You’re looking north toward the future south portal of the SR 99 tunnel and downtown Seattle. Below those giant metal braces, crews are building the future northbound lanes and on-ramp heading into the tunnel. The sunny section is the site of the on-ramp. The northbound lanes will be located in the shade on the left.

**March 2014**

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**April 2014**

Just six weeks later (April 25) the northbound lanes are covered by a concrete lid that will help support the southbound lanes. South of the bored tunnel, the highway is double-decked for about 900 feet before it splits to meet the existing side-by-side roadway a block west of Safeco Field.

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**After**
South Portal Construction

Photo from May 1, 2014.
North Portal Construction

Photo from May 1, 2014.
SR 99 Tunnel

- Approximately two miles long.
- Two lanes with eight-foot safety shoulder in each direction.
- State-of-the-art safety systems.
Meet Bertha, the SR 99 Tunneling Machine

Photo from spring 2013.
TBM machine (spring 2013) was assembled in Osaka, Japan.

Trip from Japan
- The tunneling machine arrived in Seattle on April 2 after a 5,000 mile voyage from Japan.
- The machine is nearly 7,000 tons.
- It was delivered in 41 different pieces.
- Largest piece weighs 900 tons.

Hitachi Zosen
- The tunneling machine was fabricated in Japan by Hitachi Zosen.
- Hitachi Zosen has successfully built a number of large-diameter tunnels:
  - Tokyo Metropolitan Expressway (45 feet in diameter)
  - Tokyo Bay Highway Tunnel (47 feet in diameter).
  - Supplied boring machines for Sound Transit’s Link Light Rail Capitol Hill Station to Pine Street segment.
SR 99 TBM

- The world’s largest diameter tunneling machine to date, at more than 57 feet in diameter.
- More than 300 feet long, about the same size as some of the Ferries’ largest vessels.
- 260 cutting tools (teeth) on cutterhead.
- Cutterhead weighs 838 tons.
- 2,300 number of miles the cutterhead will rotate by the end of tunneling.
Manufacturing the Tunnel Liner Segments

• Preparing the segment molds.

Photo from Sept. 12, 2013.
Manufacturing the Tunnel Liner Segments

- Assembly of a reinforced cage for the segment liners.

Photo from Sept. 12, 2013.
Manufacturing the Tunnel Liner Segments

Photo from Sept. 12, 2013.
• Cages being placed in a segment mold.
• Each ring is 6.5 feet wide (2 feet thick) and 19 feet long. There will be 1450 universally tapered rings.
• Each segment is 37,500 pounds. The tunnel will have approximately 14,500 segments.
• These segments are being fabricated in Puyallup, Wash.
• Liner segments made with over 500 million pounds of concrete and steel.
Casting Concrete in Mold
Manufacturing the Tunnel Liner Segments

- Concrete finishing in a segment mold.
Manufacturing the Tunnel Liner Segments

- A vacuum lifter preparing to move a completed liner segment.

Photo from Sept. 12, 2013.
Manufacturing the Tunnel Liner Segments

Photo from Sept. 12, 2013.
Manufacturing the Tunnel Liner Segments

Photo from Sept. 12, 2013.
Tunnel Liner Segments at the SR 99 Tunnel Site

• Tunnel liner segments being lowered into the SR 99 tunnel launch pit.

Photo from October 2013.
• Tunnel liner segments are loaded on specialized trucks in the launch pit and driven to the front of the machine for placement.
Inside the Tunnel

- Image from Dec. 6, looking north at completed tunnel rings. Tunneling machine trailing gear in the distance.
- The conveyor belt is hung from the ceiling.
- The large yellow tube is for temporary ventilation system.
Northbound Lower Roadway Slab

- Panel Length 29’-9 1/2”
- Panel Width 8’- 0 ½”
- Panel Depth 1’-2 ½”
- Total number of Panels 1127 ea.
- f’c = 7.0 ksi
Access Pit Site Today, Below Ground
General location of Bertha

- 60’ down to top; 120’ to bottom
- The tunnel drive started in a controlled environment at the south end of downtown.
- Fill soils dumped here by the city’s early settlers have been removed or strengthened ahead of tunneling.
- Additionally, crews have built three protected areas — we call them safe havens — where crews can do inspections or testing.
- Almost 1,700 drilled shafts make up launch pit and protected area to north of launch pit.
- Pit is anticipated to be approximately 120 feet deep and more than 80 feet wide.
Relocate Utilities (After)

• This image shows where sewer, electrical, and water lines are being relocated to make room for construction of the access pit.
STP crews injected a wall of grout near the back of the machine’s shield to seal water out of the access pit. This work was completed on schedule in May 2014.
Build the Access Pit’s Walls

CONCEPTUAL

Seattle Tunnel Partners’ repair plan – June 2014
• STP crews are installing concrete columns that will form the underground walls of the circular access pit.
• Made up of 73 columns, the pit will be about 120 feet deep and more than 80 feet wide.
• Secant piles diameter ranges from 1.5 – 3 meters.
• Underground wall construction started on schedule in May 2014.
Build the Access Pit’s Walls
STP crews will install wells to lower groundwater near the access pit.
Excavate, then Tunnel into the Access Pit
• STP will excavate the pit and then drive the machine forward the remaining distance into the pit.

• The contractor will create a controlled environment in order to move the machine into the pit. They will likely pre-cut the wall of the pit in order to break through.

• A concrete cradle will hold Bertha in place while she is being repaired.

• At this point, the contractor knows they will replace the main bearing with the spare that was required in the contract. The bearing that is being removed will be refurbished so it can serve as the spare.

• STP’s schedule: Excavation of pit expected to begin in July and continue through September.
Install a Crane Above the Access Pit
• A large crane will be used to hoist pieces of the machine to the surface

• For expediency purposes, the contractor hopes to lift the main drive unit as one large piece.

• The main drive unit weighs more than 2,000 tons.
  • Front Body + Middle body front top section: 248 t
  • Front Body + Middle body front left section: 82 t
  • Front Body + Middle body front right section: 74 t
  • Cutter drive unit: 2,000 t

• This is a very heavy lift and a specialized gantry crane must be used. It is similar in nature to the type of crane that was used to lower the pieces of the machine into the launch pit.
Remove Pieces, Make Repairs

Seattle Tunnel Partners’ repair plan – June 2014
# Seattle Tunnel Partners’ Repair Schedule

<table>
<thead>
<tr>
<th>April 21:</th>
<th>Late May:</th>
<th>October:</th>
<th>March 2015:</th>
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<tbody>
<tr>
<td>STP announces new schedule</td>
<td>Underground wall construction begins</td>
<td>STP begins repairs to seal system and replacement of main bearing</td>
<td>Tunneling resumes</td>
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<td>Late July:</td>
<td>Access pit excavation begins</td>
<td>November:</td>
<td>Testing of machine begins</td>
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<td>June 16:</td>
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<td>STP provides WSDOT with a full list of repairs</td>
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<td>STP/Hitachi announce repair plan</td>
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Seattle Tunnel Partners’ repair plan – May 2014