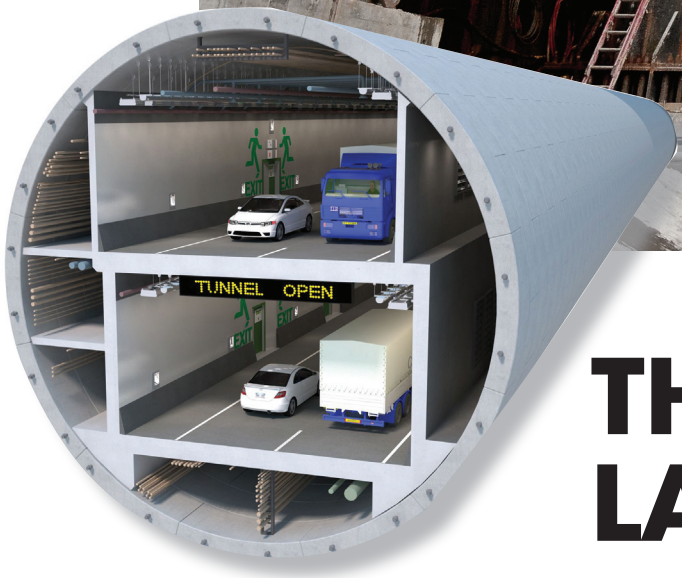


THE WORLD'S LARGEST TUNNEL

New boring technology paves the way for Seattle's double-deck highway replacement

BY BARBARA BILLITZER

In the summer of 2013, the world's largest diameter tunneling machine began a historic journey beneath downtown Seattle. Its purpose: dig a tunnel to replace the State Road 99 Alaskan Way Viaduct, a double-deck highway that was built in the 1950s and suffered earthquake damage in 2001.

The $3.1 billion Alaskan Way Viaduct Replacement Program showcases a two-mile long tunnel that will change the way traffic uses SR99. With a diameter of 57.5 feet, the tunnel will allow drivers approaching from either direction to drive through the tunnel to bypass the downtown area or exit at tunnel portals to city streets and head into downtown. The project is being led by the Washington State Department of Transportation (WSDOT), along with its agency partners, including the Federal Highway Administration (FHWA), Port of Seattle, King County and the City of Seattle.

WSDOT owns SR 99 as well as the viaduct, and is responsible for highway inspections, major maintenance and for ensuring that state regulations are followed. The FHWA is responsible for ensuring that the viaduct replacement project meets federal regulations. The Port of Seattle relies heavily on the SR 99 corridor and has committed $300 million in funding to the program. King County is responsible for implementing transit changes and improvements associated with the program. And the City of Seattle is responsible for viaduct traffic operations and minor maintenance. In addition, the city owns and maintains the area underneath the viaduct and many of the utilities located in the project area.

The world's largest diameter bored tunnel beneath downtown Seattle, WA will replace a double-deck highway built in the 1950s, opening to traffic in 2015.

SIX DECADES OF SERVICE

The Alaskan Way Viaduct has seen its fair share of critics. Before the double-deck highway took its place on Seattle's downtown waterfront, transportation planners and city leaders spent nearly two decades debating the best way to fix the city's growing traffic problems. The viaduct, a bridge composed of several small spans, quickly became a fixture of Seattle's skyline and a vital north-south route through the downtown area. It gave drivers an alternative to the congested city streets, and even offered impressive views of Elliott Bay and the Olympic Mountains. By the end of the 20th century, it was among the state's busiest and most important sections of highway, carrying 110,000 cars each day.

But in February 2001, a 6.8 magnitude earthquake struck Seattle. When the shaking stopped, sections of the viaduct had sunk several inches. Engineers agreed that had the quake lasted a few moments longer, the viaduct would have collapsed entirely. Although crews were able to stabilize the structure, Mother Nature had sent a clear message: the viaduct needed to be replaced. Thus began one of the most scrutinized public processes in state history.

TURNING SOIL INTO QUICKSAND

The 50 year old viaduct was already showing signs of age and deterioration before the earthquake further weakened it, and this event only heightened the need for its replacement. The major risk facing the viaduct was its seismic vulnerability. It stands on fill soil bounded by the seawall. Marine organisms have slowly eaten away parts of the seawall and weakened it. In an earthquake, the fill soil is subject to liquefaction, where a shaking motion causes the soil to transform into a quicksand-like condition. Another major earthquake could collapse the seawall and liquefy the soil, damaging the viaduct beyond repair.

Routine safety inspections and maintenance kept the viaduct safe for public use. In 2008, crews strengthened four column footings where the viaduct had settled roughly five inches into the ground since the earthquake. The columns limit settlement in this area of the viaduct and prevent further damage to the structure. As an extra precaution, a system was installed that is designed to close the viaduct automatically in the event of a moderate to severe earthquake. The automated closure system consists of traffic gates that are controlled by an earthquake detection system at all viaduct access points. If the system detects significant ground movement, it will simultaneously lower all nine traffic gates and safely close the viaduct in two minutes.

EVALUATING THE ALTERNATIVES

In the decade following the 2001 earthquake, state and local agencies studied more than 90 viaduct replacement alternatives. Between 2003 and 2004, WSDOT evaluated five proposals and decided that the six-lane cut-and-cover tunnel was the preferred alternative. Rebuilding the viaduct was retained as a backup plan. However, due to the costs and scope of the project, other options were still being discussed in the local media.

In 2007, with much of the public's attention focused on how to repair the waterfront section of the viaduct, leaders decided to take a fresh approach. Crews would begin a separate project to replace the viaduct's south end. Doing so would allow them to remove almost half of the viaduct while discussion about the waterfront section continued. Time passed, environmental studies were published and the debate intensified. Cars, trucks and buses continued to rumble over the viaduct each day.

In 2001, then-Washington Governor Gary Locke inspects a roadway after the region survived the strongest earthquake in a half-century. Infrastructure damage was estimated at $2 billion.

Washington Governor Chris Gregoire (seated) celebrated with state and local officials in 2009 after signing the bill authorizing $2.8 billion in state funds for the deep-bore tunnel.

In 2008, the governor announced that the State of Washington would take down the viaduct in 2012. The total cost of removal of the viaduct, repairing the seawall, and improvements to I-5 and existing streets was unofficially estimated at $1.6 billion. In response to concerns about the cost of the originally proposed tunnel construction, the city council created a scaled-down, four-lane hybrid tunnel option. This would have combined the smaller tunnel with surface transit improvements to address traffic needs. The tunnel's 14-foot shoulders would be used as an extra travel lane each way during periods of high demand. Transit service would be increased during peak commuter periods.

But the passage of time, while frustrating to politicians and the public alike, brought with it an unforeseen development. Tunneling technology was advancing at a remarkable rate. So fast, in fact, that by the end of a yearlong stakeholder effort, an alternative that had previously been considered too expensive reemerged: a bored tunnel. In January 2009, leaders from the state, county, city and port recommended a bored tunnel – along with a host of other improvements – to replace the waterfront section of the viaduct. It was the only alternative that would allow SR 99 to remain open during construction, maintaining a vital stretch of state highway.

A detailed environmental study of the tunnel was followed by approval from the FHWA making it official: crews would dig the world's largest diameter bored tunnel beneath downtown Seattle. Afterward, the viaduct would be demolished, ushering in a new era for the downtown waterfront.

FUNDING THE PROJECT

The state senate passed a bill in 2009 endorsing the tunnel option, and the governor signed Senate Bill 5758, authorizing $2.8 billion in state funds for deep-bore tunnel. The approved design is a double-deck four-lane, two-mile long underground tunnel with a north and south portal that travels beneath Pioneer Square, the central business district of Downtown, and Belltown.

The Alaskan Way Viaduct Replacement Program, which is made up of more than 20 projects, is estimated to cost $3.1 billion, with $2.8 billion coming from the state and the federal government covering financing for the tunnel boring and a new interchange in SoDo, the southern downtown area. The city of Seattle will make surface street improvements, utility relocation, and replace the Elliott Bay Seawall, which is also vulnerable in an earthquake. Since the proposed tunnel will contain two lanes in each direction as opposed to the viaduct's three, with no exit to serve the neighboring areas, King County will make transit improvements to offset the loss. The Port of Seattle is funding part of the project, and $200 million will be collected from tolls at rates set by the Washington State Transportation Commission with input from the Advisory Committee on Tolling and Traffic Management.

BUILDING STABILIZATION

To accommodate building stabilization requirements during the boring of the tunnel, WSDOT needed to acquire a temporary construction easement. One of the buildings impacted by this project was located in the Pioneer Historic Square District located along Seattle's Art Walk Route. Since 1981, the 619 Western Building had been home to artists who shared open studios with the neighborhood. A community event held each month had

More than 5,000 people attended the July 2013 public dedication ceremony for Bertha, the SR 99 tunneling machine, many of whom signed a concrete segment that will form one of the tunnel walls.

In May 2013, Washington State Secretary of Transportation Lynn Peterson gathered with elected officials as the tunneling machine's five-story-tall cutterhead is lowered into the launch pit.

become a mainstay for artists to showcase their works for sale and make contacts with curators for gallery showings.

The proposed building fixes required all occupants to vacate the building prior to the commencement of any construction activities. Although the proposed property rights were temporary in nature, the easement term was expected to be longer than 12 months, so the occupants were provided with relocation assistance.

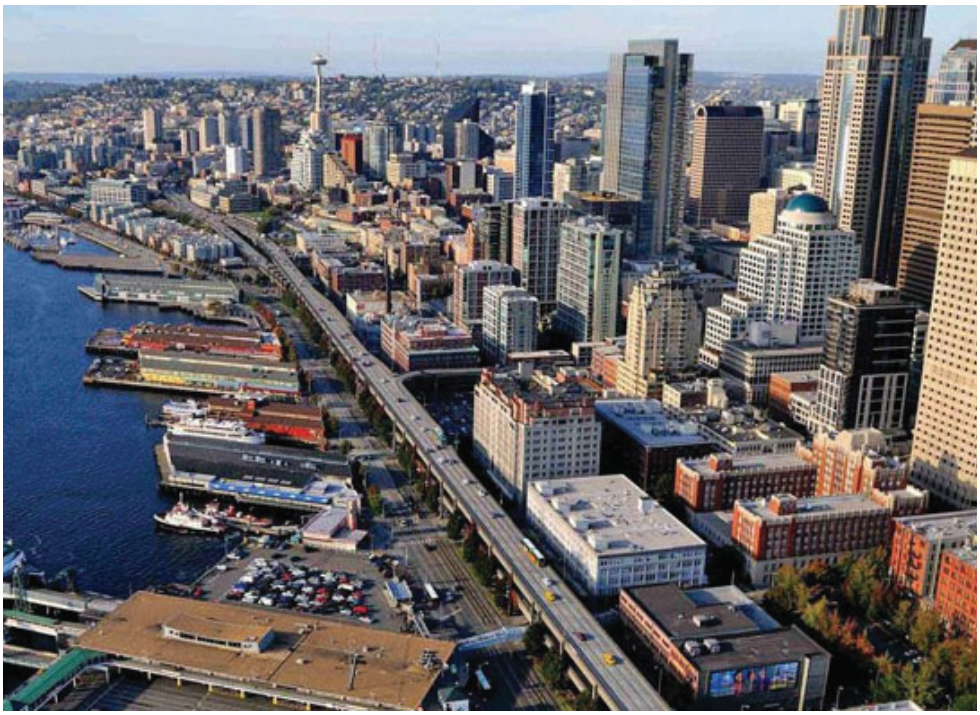
As WSDOT staff designed the building stabilization improvements, they found out that the City of Seattle had issued a hazard notice to the building owner back in 2001. The city was unaware that the repairs had not been made. Following this discovery, the City of Seattle Code Compliance Division provided the owner of the building a notice in June 2011 that required the building to be repaired or the occupants to vacate on or before October 2011. The letter stated that continued occupancy of the damaged structure constituted a substantial danger to the residents.

Construction of building stabilization improvements needed to commence in the early 2012 to meet SR99 tunneling schedule requirements. With FHWA concurrence, WSDOT, in coordination with the City of Seattle, moved forward with providing relocation assistance entitlements on an accelerated schedule in order to vacate the 619 Western building by the October deadline.

A COORDINATED MOVE

Since the project involved both acquisition and relocation services, the project team was assembled pooling statewide WSDOT resources for individuals with business and relocation experience and utilizing in-house staff for acquisition services. The acquisition services were completed by HDR Engineering, Inc., a consulting firm already working in the WSDOT project office. The rest of the project team was comprised of support staff from the WSDOT Headquarters Relocation Review and Oversight Program.

The objective was to get all 118 occupants of the 619 Western building relocated to suitable replacement sites within a 45-day window. Another objective was to preserve the artist community in Pioneer Square, if at all possible. There were 118 individuals and businesses that netted a total of 130 displacements, 22 personal property and 108 non-residential. The project scope



As part of the viaduct replacement project, a new surface street will run along the waterfront and connect SR 99 to downtown.

included the relocation of 118 occupants into suitable replacement locations or the move of personal items into storage if suitable sites could not be located within the given timeframe to vacate before the city of Seattle locked the building on October 2011.

The team met personally with each building occupant at 619 Western and completed an occupancy survey that detailed specific needs. This was accomplished by scheduling mass appointments over the course of several days, nights and weekends. Finding available replacement sites was challenging because the sites needed to provide adequate space and be affordable at the same time. Some of the buildings in the Pioneer Square area had space available, but it was either not suitable for the artists or the landlords were unable to rent the studios because of prohibitive costs for upgrades necessary to meet the occupancy requirements. Costs would have exceeded the $50,000 per relocation reestablishment limit.

The project team was able to create a plan that streamlined many of the relocation activities. Combining the General Notice and Notice of Relocation Eligibility letters saved a significant amount of time. Also, WSDOT was not required to issue a 90-Day Notice or Assurance to Vacate, the result of the safety issues associated with occupying the building and the urgent need to have the occupants vacate. The team categorized displacements as property owner, master leaseholder or subtenant and developed a centralized plan with moving companies to coordinate the bids to move displaced persons.

Today, WSDOT has completed its work to correct major structural flaws in the building so that it meets modern safety standards. They focused on satisfying the requirements established for renovating historical properties. The contractor was able to take advantage of financing through historical tax credits, and working alongside the Pioneer Square Preservation Board, the renovation has been viewed as a stellar example of cooperation and compromise. As it now stands, prospective tenants will have an opportunity to work in a restored building with original elements, modern amenities and tremendous skyline views.

KEEPING THE ECONOMY MOVING

Boring of the tunnel started in July 2013 and is expected to take 14 months to complete. A temporary bypass structure now connects the south end replacement to the viaduct along the waterfront, allowing SR 99 to remain open during tunnel construction. Completed on budget and one year ahead of schedule, this new section of SR 99 connects to the remaining viaduct along the waterfront to keep SR 99 traffic moving until the tunnel opens in late 2015.

The Port of Seattle has a long history of contributing to local transportation projects related to moving freight and goods throughout the region. In August 2013, the Port Commission approved $267.7 million for the viaduct replacement project. The funding agreement between the State and the Port fulfills the memorandum of agreement between the two agencies that was adopted in early 2010.

Voicing support for the Port's contribution to the $3.1 billion program, Washington State Transportation Secretary Lynn Peterson said, "We're grateful to have such a strong partnership with the Port of Seattle. The Port's contribution is essential to our shared effort to build a new SR 99 corridor that keeps freight – and Washington's economy – moving."

Once completed, the Alaskan Way Viaduct Replacement Program will include a mile of new highway that connects to the south entrance of the tunnel near Seattle's stadiums, a new overpass that allows traffic to bypass train blockages near Seattle's busiest port terminal, demolition of the viaduct's downtown waterfront section and a new Alaskan Way surface street along the waterfront that connects SR 99 to downtown.

To showcase the neighborhood's changing landscape, an award-winning information center now sits at the western edge of Pioneer Square. The center gives visitors an inside look at the SR 99 Tunnel Project and the exhibits show the neighborhood's changing landscape, from earth-moving efforts of the past to the massive tunnel project that will soon move the highway underground and reconnect Pioneer Square to the waterfront. ✪