WSDOT consults worldwide tunnel experts

The Alaskan Way Viaduct and Seawall Replacement Program team held a three-day construction strategies workshop in March, bringing together several national and international experts on tunneling to get their feedback on our plan for a new SR 99 bored tunnel.

Tunnel experts from Italy, Germany and the United States were invited to Seattle for the workshop. They weighed-in on recommended bored tunnel delivery strategies, contracting methods and technological considerations. By having these experts all in the same room, the goal was to:

- Identify potential innovative project delivery and contracting methods;
- Advise on the scope, size and complexity of potential contract packages;
- Consider risks and risk management strategies; and
- Advise regarding necessary strategies and actions to meet program goals.

The program team is challenged to meet an aggressive delivery schedule for the bored tunnel, which is targeted to be complete in 2015. The team is gathering and refining information to move the project through the environmental process while conducting technical investigations and right of way research along the bored tunnel alignment.

The workshop concluded with the panel summarizing its work and setting a timeline for presenting bored tunnel contracting and delivery strategy recommendations.

Workshop members review materials from the WSDOT project team.

Comments or questions?

Visit: www.alaskanwayviaduct.org
E-mail: viaduct@wsdot.wa.gov
Call: 1-888-AWV-LINE

Write: Alaskan Way Viaduct and Seawall Replacement Program
c/o Washington State Department of Transportation
999 Third Ave, Suite 2424, Seattle, WA 98104

Americans with Disabilities Act & Title VI information

Americans with Disabilities Act (ADA) Information: Materials can be provided in alternative formats: large print, Braille, cassette tape, or on computer disk for people with disabilities by contacting Heather Santic at 206-267-3789 / SanticH@wsdot.wa.gov. Persons who are deaf or hard of hearing may make a request for alternative formats through the Washington Relay Service at 7-1-1.

Title VI: WSDOT ensures full compliance with Title VI of the Civil Rights Act of 1964 by prohibiting discrimination against any person on the basis of race, color, national origin or sex in the provision of benefits and services resulting from its federally assisted programs and activities. For questions regarding WSDOT's Title VI Program, you may contact the Department's Title VI Coordinator at 360-705-7098.

U.S. Department of Transportation Federal Highway Administration · WSDOT · King County · City of Seattle

U.S. Department of Transportation Federal Highway Administration · WSDOT · King County · City of Seattle

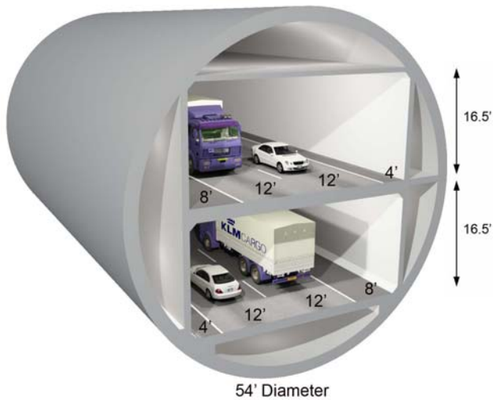
A world of experience
Learning from local and international tunnel projects

WSDOT, King County and the City of Seattle plan to replace the central waterfront portion of the Alaskan Way Viaduct and Seawall with an approximately two-mile-long deep bored tunnel beneath downtown, a new waterfront surface street, transit investments, and downtown city streets and waterfront improvements.

As we design the bored tunnel, we will benefit from lessons learned by other tunnel projects that have been completed or are underway. Several international tunnels have been completed in similar environments and with sizes comparable to the proposed SR 99 bored tunnel. From projects in the United States, including Seattle's Sound Transit Beacon Hill Tunnel and the downtown transit tunnel, to projects in Germany, China and Russia, advances in tunnel technology and experience are being made around the world.

In addition to technology and construction, we will benefit from lessons learned about how to manage large transportation projects on time and on budget. We know that many infrastructure projects, including those with tunnels, have been completed under budget, but also that many have gone over budget. WSDOT understands this issue and, as a result, developed the Cost Estimate Validation Process (CEVP®) in 2002. Additionally, WSDOT has proactively met with teams from large infrastructure projects around the country and made significant changes to how the agency manages such projects, including formation of the Urban Corridors Office to address the special needs of large, complex urban infrastructure projects.

This tunnel boring machine is 50.6 feet in diameter and is similar in size and type to the machine we will use to create the SR 99 bored tunnel.



Cross section of SR 99 bored tunnel.

Learning from local and international tunnel projects

Learning about construction

Tunnels with similar sizes

There are a number of successful tunnel projects with sizes similar to the proposed SR 99 bored tunnel. The bored tunnel itself will be designed with an outside diameter of approximately 54 feet and a length of two miles. The tunnel's depth will range from 100 to 130 feet through downtown and possibly up to 200 feet under Belltown.

Tunnel projects of similar sizes include:

- *Shanghai Yangtze River (China):* Includes two bores, each about 5 miles long with a 50.6-foot diameter.
- *Fourth Elbe River Tunnel (Germany):* Includes a single bore with a length of about 2 miles and a 46.6-foot diameter.
- *Lefortovo Tunnel (Russia):* Includes two bores, each about 1 mile long with a 46.6-foot diameter.
- *Madrid M30 (Spain):* Includes bores with a length of about 5 miles and a 49.9-foot diameter.

Tunnels constructed in similar environments

Numerous tunnel projects, including several in Seattle, have successfully excavated ground conditions similar to those anticipated for the viaduct replacement. The ground conditions along the proposed tunnel route include soft soils at the tunnel's southern entrance, then hard and dense glacier-deposited soils toward the tunnel's north entrance. During tunnel construction, we also expect to find materials normally present in glacial soils, such as small rocks and boulders.

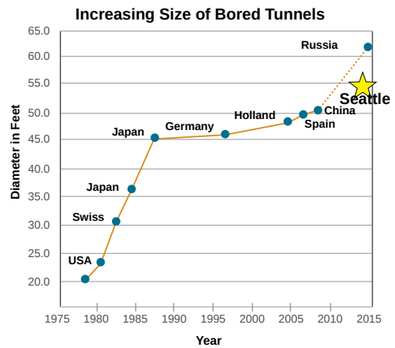
More than 150 tunnels have been completed in Seattle since 1890, mostly in glacial soils. International and local tunnels constructed in similar soil as the bored tunnel replacement include:

- *Sound Transit Beacon Hill Tunnel, Metro Transit Tunnel and Mercer Street wastewater tunnel (Seattle)*: Ground conditions of glacial sand, silt, clay and other soils similar to the hard and dense soils along most of the proposed SR 99 bored tunnel alignment.
- *Grauholz Tunnel (Switzerland):* Ground conditions of glacial sand, clay and silts.
- *Shanghai Yangtze River Tunnel (China):* Ground conditions of clay, sand and rubble that are similar to soils at the south entrance of the SR 99 bored tunnel.
- *Fourth Elbe River Tunnel (Germany):* Ground conditions of sand and clay with boulders and obstructions.

Advances in technology

As more projects are completed, tunnel boring technology will continue to experience advances and improvements. Tunnel boring machines have been developing at a rapid rate with a major increase in diameter, better ground control, and improved reliability. These machines can now safely excavate almost any type of soil, rock or groundwater conditions.

Technological advances can be expected to continue into the future. For example, a 62.3-foot diameter boring machine to construct a Russian tunnel is in design. Advances in technology, as well as lessons learned from other tunneling projects, will help us build the bored tunnel safely, efficiently and successfully.



Learning from cost and schedule problems

Prior to the state legislature's approval of the Nickel Program, which funded more than $3.9 billion in transportation investments across the state, WSDOT set up a number of programs and processes to better ensure that projects were delivered on time and on budget. These programs were established after agency managers visited large infrastructure projects around the United States to understand how projects were successfully managed and what went wrong when budgets and schedules were not met.

Key elements of WSDOT's management program include:

- Cost estimating – WSDOT developed the internationally recognized Cost Estimate Validation Process (CEVP®), which uses outside experts to help establish a "base cost" for a project and to identify and quantify risks and opportunities that may add to or subtract from the base cost. CEVP® can establish a more realistic budget at the early stages of a project and identify risks, opportunities and issues that need to be actively managed.
- Risk management – When risks are identified in CEVP®, plans are developed to mitigate, avoid, transfer, or accept these risks. The result can be a better managed project that is less vulnerable to surprises.
- Project delivery – WSDOT's procedures and tools for delivering projects include a project delivery system, which uses proven industry tools and standards.
- Direct management – Large projects take dedicated project teams, so WSDOT set up the Urban Corridors Office and established dedicated project teams to better manage these large projects using practices different from those normally required for a smaller capital project.

Examples of tunnel projects that have been completed under or close to their early estimate/budget as a result of better management include:

- *Mt. Baker Ridge Tunnel (Seattle):* 54 percent under estimate.
- *Mercer Street Sewer Tunnel (Seattle*): 23 percent under estimate.
- *Red Line North (Boston):* 30 percent under estimate.
- *Dorchester Sewer Tunnel (Boston*): 19 percent under estimate (not yet complete).
- *Metrowest Tunnel (Boston):* 9 percent under estimate.
- *Boston Harbor Project (Boston):* 4 percent over estimate.
- *Southwest Corridor (Boston):* 1 percent under estimate.
- *Metro Gold Line East (Los Angeles):* On budget.

However, we are well aware of projects that exceeded their early estimate/budget.

- *Red Line 3 Subway (Los Angeles):* 11 percent over baseline.
- *Hiawatha Airport tunnels (Minnesota):* 23 percent over baseline.
- *63rd Street Transit Connector (New York City):* 29 percent over baseline.
- *Silverline Subway (Boston):* 90 percent over baseline.
- *Tren Urbano Subway (Puerto Rico):* 133 percent over baseline.

Problems on these and other international projects have led to the processes, noted previously, that WSDOT uses to establish cost and schedule control with accountability.