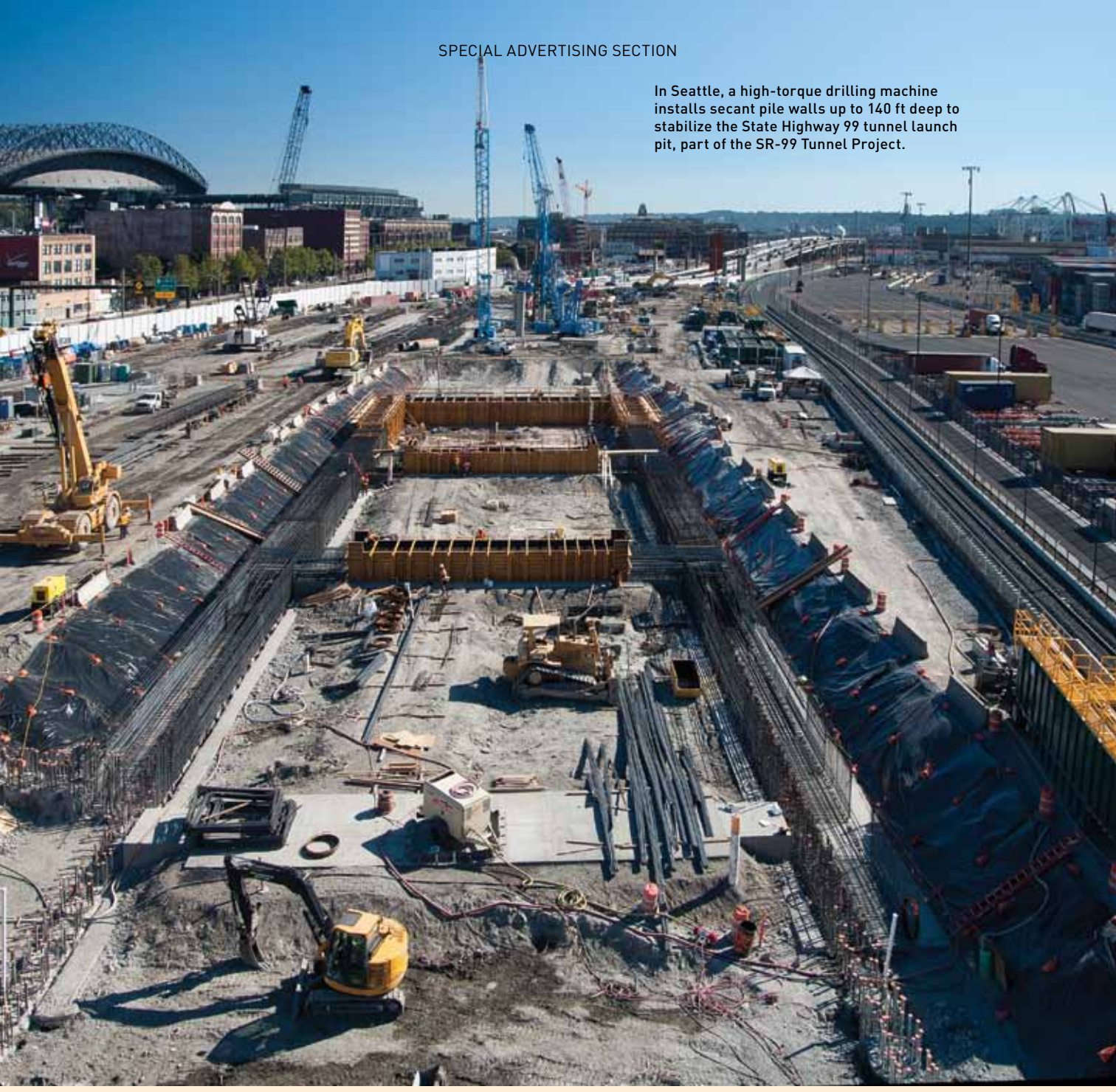


In Seattle, a high-torque drilling machine installs secant pile walls up to 140 ft deep to stabilize the State Highway 99 tunnel launch pit, part of the SR-99 Tunnel Project.

PHOTO COURTESY OF MALCOLM DRILLING

Underground I

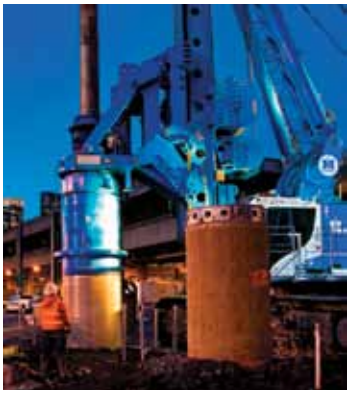
Digging Deep in 2013

From transportation improvements to infrastructure repairs, replacements and upgrades, this year will unearth some of the underground industry's most innovative, advanced and impressive solutions.

By Vicki Speed

Reinforcing the Alaska Way Tunnel in Advance of World's Largest TBM

The SR-99 Tunnel Project, part of the Alaska Way Viaduct Replacement Program for the Washington Dept. of Transportation, parallels the waterfront through the south Seattle area and will be constructed utilizing the world's largest-diameter tunnel boring machine (TBM). Boring operations for the 2-mile-long tunnel will commence with the 57.5-ft-dia TBM in the summer of 2013. Malcolm teamed with the Seattle Tunnel Partners Joint Venture to construct and dewater the TBM launching pit to depths exceeding 85 ft. Additional ancillary work included the support of excavation for several cut and cover roadways along with ground improvement by jet grouting.



Crews install the launch pit to prepare for the world's largest TBM.

The ground along Seattle's waterfront consists of very soft, highly saturated and unstable material along with abandoned wood and timber foundations. To meet these various geotechnical challenges and clearance issues, which precluded internal bracing, the retention system of choice was heavily reinforced secant pile walls supplemented with high-capacity strand anchors. Additional stability was achieved with jet grouting in poor soil in critical settlement mitigation areas.

Construction of the launch pit is well under way with the majority of the 1,700, 5-ft-dia secant and tangent pile walls already installed. Pile verticality is critical in order to handle the horizontal loads as well as to minimize water inflow; as such, a very restrictive 0.5% vertical tolerance was specified. With pile lengths up to 140 ft, the task of advancing sectional casing through several layers of wood and debris as well as soft, silty sand requires the most current state of practice equipment and techniques. Secant pile walls at the diameter and depths specified on SR-99 are extremely uncommon and require specialized high-torque rotary drills with oscillators. The technique transfers the necessary torque and thrust to advance and retract casings within critical tolerances and to great depths.

Tieback operations to depths of 125 ft are under way to provide the lateral support as the launching pit is excavated. When the pit is down to subgrade, 747 tiebacks will be incorporated into the support of excavation with the deepest part of the portal requiring six rows. The work is on schedule and the portal will be available to erect the TBM in late spring or early summer. ■

PHOTO CREDIT

California's $100-billion High-Speed Rail Project includes a proposed 30-50 miles of tunnels.

PHOTO COURTESY OF CALIFORNIA HIGH-SPEED RAIL AUTHORITY

Innovation Drives a New Era in Underground Solutions

From Rio de Janeiro's metro extension in advance of the 2014 Olympics to the large-diameter railway tunnels planned for London's massive Crossrail project, 2013 looks to be the year of the underground transportation project. In the U.S., tunneling projects are visible coast-to-coast, from Florida's Miami Port Tunnel, which will include the first 4,200-ft underwater drive, to the Northwest where the world's largest tunnel boring machine is scheduled to begin work on the SR-99 Alaska Way Viaduct Project in Seattle, Wash.

In fact, the advancements that have facilitated projects like the SR-99 have sparked interest in underground projects in many other parts of the country, particularly California. Projects proposed include three major Los Angeles metro projects—Westside Extension Section 1, the Crenshaw Corridor extending north-south just east of LAX Airport and the Regional Connector, which ties several transit lines together underneath downtown Los Angeles. As well, several major multibillion-dollar highway projects have tunnel components including the 710 North Gap Closure, which could include about 5 miles of twin road tunnels and a tolled tunnel project underneath Pasadena, Calif., and the first phase of the Sepulveda Pass (405), which may include roughly 10 miles of single or double-bore road tunnels and twin subway tunnels below the 405 freeway. As well, engineers for the $100-billion California High-Speed Rail Project propose some 30-50 miles running underground in twin tunnels.

Christopher Laughton, chair of the Underground Construction Association's Benefits of Going Underground Committee and tunnel engineer for Samsung C&T, Engineering & Construction Americas, says, "The underground movement is definitely picking up speed. Underground tunnels for mass transit and highway corridors have become a viable and cost-effective option for transportation agencies, particularly when owners consider life-cycle advantages of underground systems."

The increased interest in underground transportation development is, in large part, due to the steady and incremental advancements in underground equipment such as tunnel boring machines (TBMs). The Japanese-built TBM that will be used on the SR-99 project in Seattle is currently the world's largest-diameter machine at 57.5 ft. However, the 63.1-ft-dia Herrenknecht Mixshield TBM, currently in development, is scheduled begin work on the 3,280-ft Orlovski road tunnel under the River Neva in St. Petersburg, Russia later this year.

While highway or mass transit tunneling projects and large-diameter TBMs receive a lot of the press, transportation is not the only growth area that will headline 2013 underground work. Ron Chilton, president and CEO of National Trench Safety, adds, "We see the underground market continuing to grow slowly for the typical water and sewer infrastructure projects."

The East & Westside Combined Sewer Overflows in Portland, Ore., and New York's Water Tunnel #3 are two such projects currently under way that require innovative underground engineering and construction.

Laughton adds, "The capacity in existing systems is falling short. Underground sewer tunnels allow storage and treatment of stormwater before discharging into waterways—and longevity is a big plus for underground structures."

In response to greater demand and needs for underground transportation and infrastructure, foundation contractors have adopted and adapted machines that are more versatile, invested in computerized drilling operations and turned to innovative engineering to create new options and opportunities.

Terry Tucker, president of Malcolm Drilling, explains, "Underground opportunities continue to emerge, and in most cases, general contractors are looking for a specialty foundation contractor who can support multiple activities related to excavation and ground stabilization."

Progressive foundation contractors continually look for multiple ways to use drilling equipment in innovative ways. For instance, Malcolm Drilling modified its largest drill rigs that are typically used for drill shaft construction to accept other tools that allow it to perform ground modifications, like soil mixing, for diameters and depths that were not possible five years ago.

Tucker adds, "In today's environment, the more competencies a foundation contractor has, the better positioned they are to support a project throughout the construction life cycle."

Laughton agrees, adding, "The capital cost to construct underground systems is relatively high as compared to a system with similar function on the surface. However, underground systems last twice as long and require