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Lasers lock University Link TBMs on target

- *The guidance system used by Sound Transit is expected to save hundreds of thousands of dollars on tunnel boring costs while keeping the TBMs constantly moving.*

By SAM BENNETT
Special to the Journal



Photos courtesy of Sound Transit [\[enlarge\]](#)

Both TBMs used for Sound Transit's Capitol Hill to Husky Stadium route are being guided with lasers and computers.

In the tunnel boring business, like all facets of construction and design, time is of the essence.

In tunnel boring, greater precision means greater savings.

Miles Haupt, a construction manager with Sound Transit, said the newest guidance systems are invaluable to making deadlines and shaving costs. "In the end, there's less wasted effort used in excavating," he said.

For Sound Transit's nearly \$2 billion University Link tunnel boring project connecting future light-rail stations at Husky Stadium and Capitol Hill, the contracting team of Traylor Frontier-Kemper is using a tunnel boring machine guidance system that deploys the most accurate laser technology to get the job done.



[\[enlarge\]](#)

Operators control a TBM from a cabin inside it. Distance is measured by a laser and fed into a laptop computer.

Mike Krulc, a project manager with Traylor Frontier-Kemper, said the guidance system, made by the English company ZED Tunnel Guidance, will knock “hundreds of thousands of dollars” off the total cost of the boring project.

Traylor Frontier-Kemper is mining two tunnels on the Husky Stadium/Capitol Hill portion of Link light rail, advancing about 40 to 50 feet every day. Each tunnel is about two miles long and 21.5 feet wide, ranging about 65 to 110 feet deep.

The boring project is about 40 percent complete this week, according to Sound Transit. It is expected to be finished by June, and the Link light-rail system is scheduled to be operating by 2016.

The ZED system allows the operator to monitor the TMB's progress on a laptop in the machine's cabin. Krulc said new advances in laser-guided technology allow information to be constantly fed into the machine operator's computer.

“All calculations are done so quickly that we don't have to shut down the operation at all,” he said.



[\[enlarge\]](#)

The guidance system keeps tunnel alignment within millimeters.

The laser “target unit” on the ZED guidance system is a small metal box mounted on a bulkhead on the TBM, Haupt said.

The tunnel alignment is programmed into a computer that plots points 1 foot apart for the tunnel's length. The points are recorded in three dimensions.

As the TBM moves forward, a laser at the tunnel entrance projects a beam to the target box on the TBM.

The laser's coordinates provide information to the guidance computer, telling the operator which direction to steer the machine. As tunneling continues, the laser advances with the TBM to maintain a line of sight to the target.

The guidance screen that the operator uses has a three-dimensional plot of the alignment. The alignment, provided by Sound Transit, is shown as a series of target cross hairs that the operator uses to steer the machine within millimeters of the designed alignment.

The system can be adjusted to factor in hard and soft rock, as the TBM makes its way.

Krulc said the TBMs will come within a couple millimeters of the exact target after boring 11,400 feet from Capitol Hill to the UW.

Although lasers have been an industry standard in tunnel boring for several decades, Krulc said it wasn't until the mid-1990s that advances in software allowed the laser systems to feed information directly to the operator's PC in the cabin.

He said advances in the ZED and other laser guidance systems means contractors can save money on surveyors and engineers.

Still, both disciplines are needed to help plot the ZED system's overall course. A tunnel surveyor is responsible for the entry of all initial system setup parameters and ongoing adjustments and checks during excavation.

Haupt said the ZED system has high tolerances that allow it to be remarkably accurate. That was a baseline for Sound Transit.

“We required an industry-standard guided system, and our expectation was that they would use the most current technology for a guidance system,” Haupt said.

According to ZED's website, the company's system can be found throughout the world. It was used on the 200-mile Yellow River diversion tunnel in China.

A ZED spokesperson could not be reached for comment.

Even with the highest technology at their fingertips, Sound Transit officials realize that anything can happen where computers are involved, Haupt said.

“A lot can go wrong with a computer-controlled system,” he said. “We've been lucky, so far, on this project.”