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ITC NEWS

- 43 - 2010

Two ITC 312 H1 in the Dulles Metrorail Transit System

Fig. 1: ITC 312 at the right portal entrance

Heading of two Subway tunnels

Break out section: 36 m²

Length: 800 m each

Conventional tunneling and heading acc. to NATM

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By Lisa ReinWashington Post Staff Writer
Sunday, October 18, 2009

The Dulles Corridor Metrorail project reached a major milestone recently, as excavation of a 2,400-foot tunnel under the busy Tysons Corner area of the Washington, D.C. suburbs began on October 12. This section represents the most complex engineering and construction challenge of the project.

The tunnel will connect two of the future Metro stations: Tysons Central 123 and Tysons Central 7. Construction crews will be using the cut and cover method called the New Austrian Tunneling Method to excavate the two bores of the tunnel. The excavation begun on the east side of the outbound tunnel; after completion of the first 150 feet, the excavation will follow on the inbound tube always keeping the 150-foot distance. Sensor technology will be used to monitor the tunnel and the surrounding area for possible ground movements. The tunnel will be built as the cars are driving above the tunnel through Tysons Corner, and as the businesses and residents are going about their daily routines.

Construction of the project began in March, 2009, with the signing of a $900 million grant from the U.S. Department of Transportation. "This milestone definitely marks a great step in the construction phase of the project. We are proud to be part of the transformation of transportation options in Northern Virginia," says George Morschauser, the project's executive director. "The project team is focused on delivering this project safely and with the highest quality."

Phase 1 of the project, currently being constructed by Dulles Transit Partners, led by Bechtel, will include five new Metro stations and 11.5 miles of new track. When Phases 1 and 2 are completed, it will add 23 miles of track to the existing Metropolitan Washington, D.C. area Metro system, and will extend the system to Dulles International Airport and on to Loudoun County. The project is owned and managed by the Metropolitan Washington Airports Authority.

Building a Metrorail Tunnel at Tysons Corner Takes Brute Force Applied With a Deft Touch.

Cars crawl down Route 123 in the afternoon rush. Forty feet below them, giant machines and men wearing yellow hard hats begin their advance under Tysons Corner to bring Northern Virginia commuters their holy grail: a new subway.

At $85 million, the half-mile tunnel is the costliest and most complex engineering feat of the 23-mile Metro extension to Dulles International Airport. It will be built while 3,500 cars and trucks cross its path each hour, while the Courtyard Marriott serves breakfast and guests swim in its pool, while hands are shaken over aerospace deals at BAE Systems. It will carry on under two miles of tangled utility lines that convey to Tysons everything from electricity to some of the nation's most secret intelligence. As of Friday, after three months of digging and prep work, workers had hollowed out the half-mile tunnel's first 18 feet.

One wrong move and the foundation of an office garage could settle, a top-secret communique through the U.S. Army's microwave tower right above the tunnel's path by Clyde's restaurant could be lost.

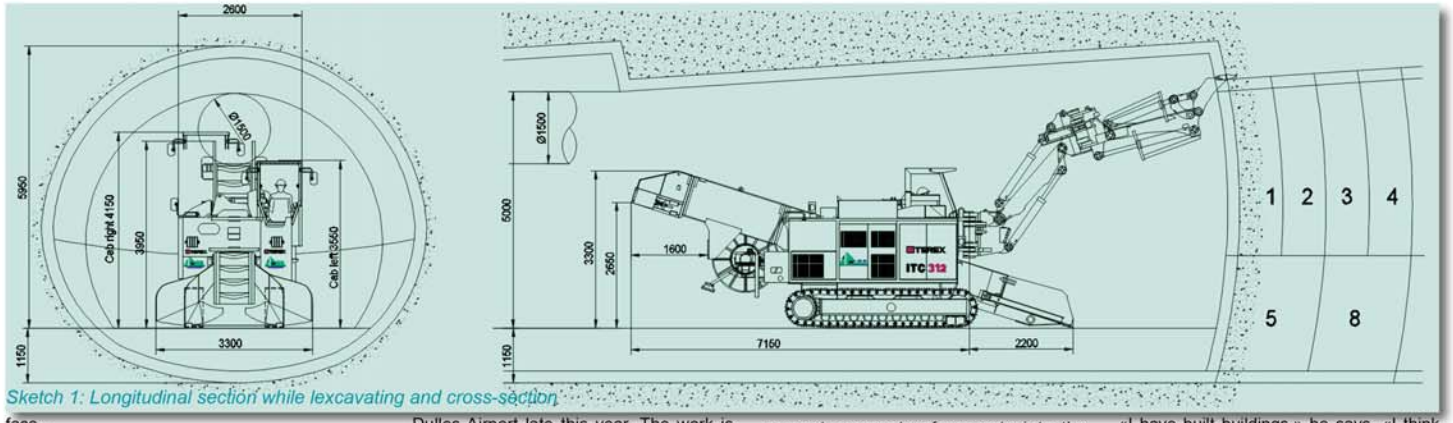
«You've got gas lines, water lines, drainage lines, electrical duct banks, black wires and a lot more in a busy urban area, which makes for a very challenging tunneling environment,» says Dominic Cerulli, the engineer for Bechtel in charge of building the tunnel. He guides visitors on the first tour of the project on a recent weekday. «I've been on jobs where you're tunneling out in the middle of a parking lot. Here you've got to keep businesses up and running.»

When it opens in 2013, the first leg of the rail line will extend 11.5 miles from East Falls Church through Tysons to Wiehle Avenue in Reston. The tunnel, scheduled for completion in late 2011, will connect two of the four Metro stations in Tysons. Cerulli likes to say his project is the toughest part of the line. «But don't say I said that, because the guideway is also complicated,» he jokes, referring to the elevated section, still 18 months off, that will carry the trains 55 feet above the Capital Beltway.

As the $3.2 billion project was submitted for federal money, many landowners and local officials had hoped for a four-mile tunnel beneath Tysons, but the cost threatened to sink it. «People are always surprised when they find out» a tunnel is still in the plan, says Marcia McAllister, spokeswoman for the rail project.

All summer, Cerulli's crews dug next to the intersection of Route 123 and International Drive so they could build the shorter tunnel's face...

Fig. 2: Geological horizontal layers



Sketch 1: Longitudinal section while lexcavating and cross-section

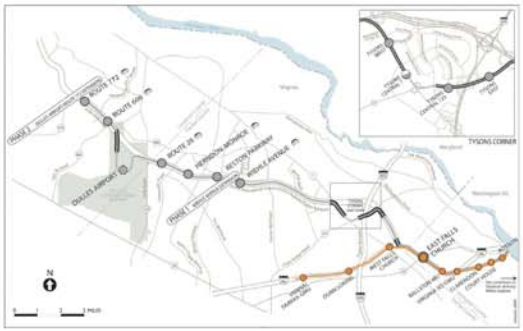
Next, it's down a narrow stairway to the face, two circles side by side wheels that will open the inbound and outbound tubes, each 22 feet wide. Before mining began, workers had to secure the top of each arch. Only then could they begin a tightly choreographed movement of concrete and earth, digging through the soft Piedmont soil three feet at a clip before it could cave back in. About 100,000 cubic yards of sand, gravel and clay will be excavated before the tunnelers emerge in the Route 7 median and the tracks continue along the Dulles Toll Road.

The 2,400-foot tunnel will solve one of the most vexing problems for engineers who designed the first stretch of the new Silver Line: It must navigate Fairfax County's summit, a slope that rises 515 feet above sea level in the middle of Tysons. The climb would have been too steep for the trains, and tracks for the subway would have intruded on the already crowded visual landscape.

The solution was to send the trains underground.

From the look of the drawings taped to the walls in Cerulli's construction trailer, it's a complicated endeavor. The task involves precision at every step, anticipating what-ifs, staying on schedule — «Saturday's my make-up day,» he says — and methodically ensuring the safety of workers once they start the dangerous work of crawling into small, unstable spaces.

At its peak, the Tysons tunnel will employ 70 laborers and a dozen engineers. The yellow hard hats are a tight and transient community, skilled workers from all over the world who go where the tunnels are. Cerulli, a 45-year-old civil engineer from Gainesville with «20 years pretty much focused on tunnels,» handpicked the crew from his last job, the four-mile AeroTrain that will start transporting passengers to gates at Dulles Airport late this year. The work is dawn to dawn, 24 hours every weekday.



«There's certain people down here with pedigrees,» he says as two men on the crew haul away muck on a conveyor belt. «They know how to read the face.»

Cerulli has gone over with them dozens of times how much soil they need to excavate before they can crawl under the earth and spray the tunnel walls with shotcrete, the Cadillac of concrete that will form 10-inch-thick arches to support the ceilings of the two tubes the trains will run through. A narrow service passage will run in each tunnel to allow for ventilation, maintenance and an exit.

Workers once mounted drills on legs and hand-powered them as they dug. This tunnel is being built with million-dollar rigs that can drill in pipes, spray concrete, remove muck, insert supports, pump in grout and spray water. Like the laborers and engineers that drive them, the electricity-driven machines come from far-off places and have exotic names to match: the ITC 312 «knuckle boom» from Germany; the Putzmeister Sika PM 500 from Spain; the ETC18, a.k.a. «drill jumbo,» from Sweden, a colossus that can bore through anything from bedrock to clay, Cerulli says. They're impressive. But, as Cerulli notes, «every one is operated by one or two guys.»

Other tunneling methods involve moving precast segments of concrete into the hole as it is dug. Or workers excavate soil, build the tunnel and cover it back up, the most straightforward method, used to build subways before development made that impossible. Seven hundred feet of the Tysons tunnel, half at each end, will be dug by the cut-and-cover method.

The machines are surpassed only by the technology that will watch for cave-ins or other movements of the earth. Cerulli will depend on surveyors and computers to analyze readings from lasers fixed to the tunnel wall, signaling to engineers whether a misalignment has occurred and how to correct it.

«Millimeters is okay. Feet is not okay,» says Howard N. Menaker, the rail project's communications manager.

One of the most sensitive gizmos is a little robot that sits on top of a beam 25 feet in the air. It turns hourly, detecting unwanted shifts in the earth to the millimeter. If there's unexpected movement in the ground, Cerulli's team can tell the crew they'll have to tighten the excavation area, going in smaller increments.

He loves the challenge and uncertainty. «I have built buildings,» he says. «I think it's boring.»

Main Data		
Basic machine Schaeff , Type	ITC	312 H1
Width of basic machine	mm	2400
Inside width of conveyor	mm	770
Electric drive, Power @ 480 Volt, 60 Hz	kW	98
Tramming speed	km/h	0-3,6
Conveyor chain speed	m/s	0,5
Conveying capacity	m³/h	250
Specific ground pressure	kp/cm²	1,0
Pulling force	kN	280
Global weight approx.	t	32

Fig. 3 Excavating the right bench

Fig. 4: Safe view with the slew cab

Fig. 5: Excavating the middle bench

Fig. 6: Excavating the left bench

Fig. 7: Excavating the middle bench

Fig. 8: Right side of the machine

TUNNEL HEADING and LOADING MACHINE Type ITC 312 H1

Fig. 9: ITC 312 front view

Fig. 10: loading

Fig. 11: Acurate profiling

Fig. 12: ITC 312 rear view

News_43_Dulles.PMD - V1 - 08.09.2010