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APRIL 2011

tunnels
& tunneling
NORTH AMERICA

Robbins

Special report: East coast
Tunneling on the US east coast including the
Second Avenue subway

**Insight: Rapid Excavation and
Tunnelling Conference**
Previewing the RETC in San Francisco

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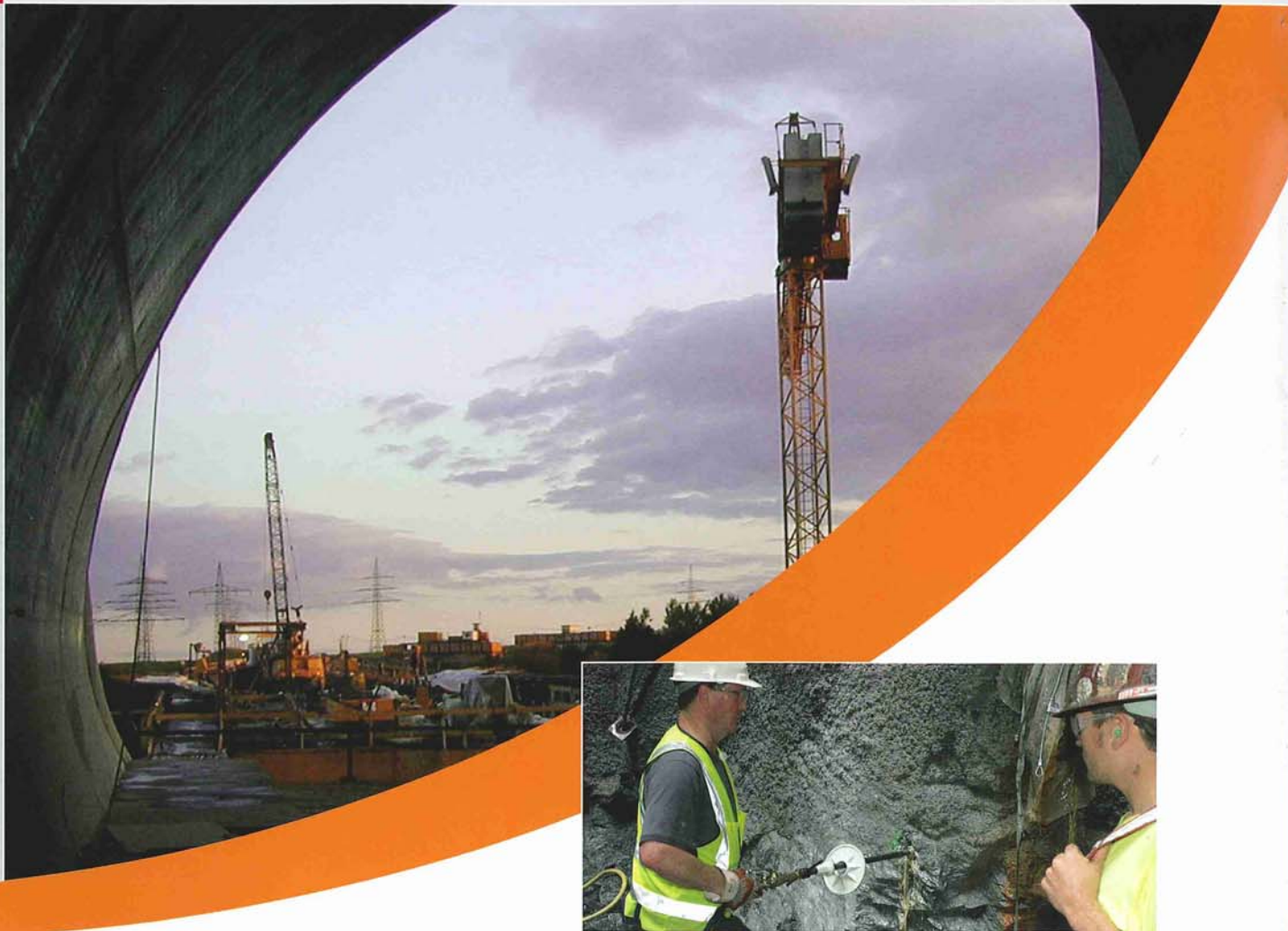


**Big Becky completes
Niagara headrace drive**

The giant 14.4m TBM was one of the earliest
TBMs to use on site first time assembly



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comment

Keeping on top of things

This winter has been harsh across the Northeast's infrastructure. Beyond being the nation's most densely-populated region, it seemed hardly a week could go by without another dumping of snow this year.

The sheer amount of work needed to keep up with the region's commuters, not to mention the massive influx of tourists, particularly in New York, is practically impossible to fully quantify. And then of course there's the biggest conundrum of all—it all needs to be paid for.

Planning for the Second Avenue Subway in Manhattan dates back nearly, if not more than, 100 years. Starts and stops have been a result of financial shortcomings, namely the Great Depression, but also in the 1970s. (One way that the significance of this can be measured is that with progress picking up again, the project has stirred up enough fascination for New Yorkers to inspire two separate blogs tracing its history and following its construction.) Now that the project has moved forward with Phase One, it goes unsaid how unfortunate it would be if the following three phases needed another 30 to 80 years to materialize.

Keeping on top of funding for major underground construction projects is as much the responsibility of the tunnelling industry as it is for those trying to secure the money. Thankfully the Great Recession of the late naughties didn't add another delay to the Second Avenue's legacy of stalls. Obviously not all other tunnelling projects were as fortunate.

Is there a better way to illustrate just how much the costs of construction escalate while a group of citizens hems and haws? Beyond increasingly showing clients the potential costs of prolonging a project, there is hopefully an option to reach out to hesitant voters. The Surgeon General has plastered cigarette packages with (albeit not so strongly-worded) warnings; perhaps cars should undergo similar treatment.

WARNING: Building a surface level solution can harm your commute. Or metro cars, WARNING: Maintaining the status quo will add 150 people per car per journey. Or politicians, WARNING: Elected official may not recall saying any of this later on, if necessary.

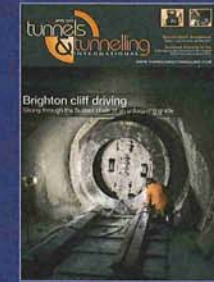
To help you keep on top of things going on in the underground construction industry check out page 29 of this issue; T&TNA has added a Dates & Events page focused on North America, plus major events related to tunnelling worldwide.

Nicole Robinson

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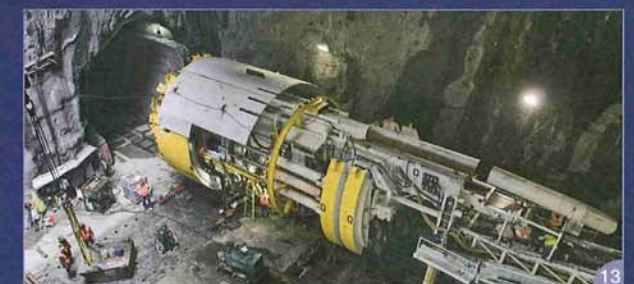
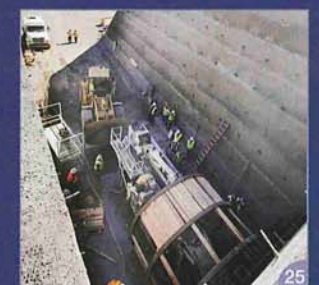
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HERRENKNECHT MIXSHIELDS FOR NEW YORK: SPECIALISTS FOR COMPLEX GEOLOGY GAINING GROUND IN THE US.

The Queens Bored Tunnels are part of the East Side Access project and the last major link in the tunnels from Queens to Grand Central Terminal in Manhattan. When completed, the East Side Access project will bring Long Island Rail Road service, the busiest commuter railroad in the country, into New York's Grand Central Terminal providing a direct route between Long Island and eastern Queens to Manhattan's eastside.

The Granite/Traylor/Frontier-Kemper Joint Venture's experienced tunnelling specialists have opted for two Herrenknecht Mixshields (diameter 6,840mm). They are the first machines of this type to be employed in New York. The machines are designed to bore through rock, mixed face and dense glacial till, crossing under busy railroad tracks. A total of 2.4km of tunnel, segmented in two drives by each machine, have to be bored and secured with concrete lining segments.

NEW YORK | USA

PROJECT DATA

S-558, S-559, 2x Mixshield
Diameter: 6,840mm
Tunnel lengths:
1,845m + 1,341m
Geology: glacial till, silt and sand, clay, gravel and boulders

CONTRACTOR

Granite Construction Northeast Inc., Traylor Bros. Inc., Frontier-Kemper Constructors Inc.



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News in brief

Promotions and restructuring at Indal WRTL
I-Tunnel announced the promotion of Steve Ebbrell to operations manager, responsible for all tunnel activity with in the UK for Indal WRTL. As part of the restructuring, Neil Morris has been promoted to director of sales for Indal WRTL, responsible for leading the sales team in the south. He will remain part of the I-Tunnel team and continue to offer technical support.

Lindsay joins MEYCO
Jim Lindsay has been appointed Regional Business Segment Manager, North America, for the Meyco Global Underground Construction business of BASF's Construction Chemicals division. Prior to this new position, Lindsay was a strategic account manager in the Construction Chemicals division.

Tacoma rescue
More than 30 workers from the Pierce County Chambers Creek wastewater treatment plant teamed up to successfully rescue a worker that had been swept into a sewer tunnel on last month. Entering at three access points using portable hoists, 2-man teams entered the sewer and the worker grabbed a rescue rope to be hoisted out by his harness.

Boston oversights
Rep. William Straus and Sen. Thomas McGee, Chairmen of the Joint Committee on Transportation, announced a series of Transportation Oversight Hearings to be held in Boston beginning in April. The meetings will address the winter service lapses experienced by commuters on the MBTA's Newburyport/Rockport line.

Breakthrough at Niagara Tunnel

CANADA

The 14.4m diameter hard rock TBM mining Canada's Niagara Tunnel completed an initial breakthrough on March 1.

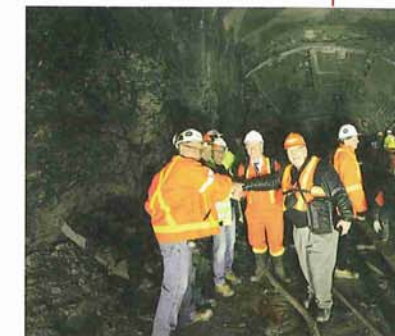
The Robbins main beam machine entered a pre-existing grout tunnel excavated using drill and blast. The TBM, for contractor Strabag, will continue boring another 300m up to the intake structure and make a final breakthrough in mid-April.

While the tunneling portion of the project is nearly complete, two years of work still remain. Approximately 30 per cent of the

continuous concrete lining was completed during tunnelling. The finished 12.8m diameter tunnel will be fully lined with both 600mm thick continuously poured concrete and a polyolefin waterproof membrane to prevent leakage.

The project, located in Queenston, Ontario, was initiated in June 2004 by provincially owned company Ontario Power Generation. The machine was launched in summer 2006.

The newest Niagara tunnel is the third headrace under Niagara Falls, and will supply up to 500 m³/sec of water for hydroelectric



generation—resulting in enough additional power to service 130,000 Canadian customers. The tunnel is expected to go into operation in 2014.

Seattle anti-tunnel group short on signatures

WASHINGTON

A group calling itself SCAT (Seattle Citizens Against the Tunnel) has failed to secure enough signatures to table a vote on its Initiative 101 opposing the bored tunnel replacement for the Alaskan Way Viaduct in Seattle.

The petition would put preventing the city from using right-of-way for building the tunnel to a public vote.

Although SCAT secured more than 27,000 signatures, and only 20,629 signatures were needed to qualify, the *Seattle Times* reported that only 19,128 had been verified, while 8,641 had been challenged as T&TNA went to press.

According to the King County Elections Office, challenged signatures included people who are not citizens of Seattle, not registered voters or who have signed twice.

SCAT will have 20 days after the final report is issued next week to collect enough valid signatures to qualify for the ballot.

Separately, 'Protect Seattle Now' is calling for a referendum on the tunnel agreements ordinance signed by the Seattle City Council on February 28.

This organization was trying to collect the required 16,500 signatures by March 29 as T&TNA went to press.

City report backs Edmonton tunnel

CANADA

A city report last month proposed a CAD 300M (USD 305M) Light Rail Transit (LRT) tunnel to ease traffic flow on a major arterial road in Edmonton, Canada.

The tunnel would run for 14 blocks from 142nd Street to 156th Street along Stony Plain Road, on which major intersections are already at

capacity. It would be part of the West LRT connecting Lewis Estates to downtown Edmonton, with journey times of 25-28 minutes.

Other suggestions included a CAD 30M (USD 30.5M) tunnel under the Bonnie Doon traffic circle, and a CAD 40M (USD 40.6M) LRT bridge on 87th Avenue.

The Edmonton City Council approved the West LRT Concept

Plan in January. The Transportation and Public Works Committee intended to discuss the results of the report and the future of the project at its March meeting due to be held as T&T went to press.

The City Council had a divided response to the report, some supported, while others questioned the ability of an LRT system to ease traffic if it requires a tunnel to keep roads free.

East Side Access TBM dedication

NEW YORK

Metropolitan Transportation Authority officials dedicated two slurry TBMs earlier this month.

The two TBMs were commissioned to excavate four tunnels under Sunnyside Yard in Queens, New York, for the East Side Access project. The drives will connect the tracks of the Long Island Rail Road Main Line with the tunnels under the East River that leads to Grand Central Terminal.

The TBMs were 22ft (6.71m) in diameter, 300ft (91.44m) long and weighed approximately 642 tons including the trailing gear of

storage tanks, electrical support and exhaust fans.

In contrast to the tunnel boring machines being used to cut through Manhattan bedrock, these were set up to deal with Sunnyside geology of a soil mixture of sand, clay and boulders with a high water table.

The machines were named Tess and Molina by sixth graders at the Oliver Wendell Holmes School, in Long Island City. Construction will begin in April under the contracting JV GTF, consisting of Granite Construction Northeast, Traylor Brothers and Frontier-Kemper Constructors.

"One hundred years ago, the



Above: Construction was scheduled to begin in April

tunnels under Penn Station gave Long Islanders easy access to Manhattan, essentially giving birth to Long Island as we know it today and leading to enormous growth in the region," said MTA Chairman Jay H. Walder.

"Today, East Side Access will

build on this growth and transform this region in a similar way. Commuters throughout Long Island and Queens will have more service to Manhattan and shorter travel times to the East Side—making these communities even more attractive places to live."

Tunnel widening recommended for I-70

COLORADO

The Colorado Department of Transportation (CDOT) recommended widening the eastbound bore of the I-70 Twin Tunnels to the Colorado Transportation Commission.

This tunnel expansion would allow for a third lane beginning at the east Idaho Springs Interchange and continuing to the base of Floyd Hill where eastbound I-70 currently becomes three lanes.

Included in this option was flattening a curve on eastbound I-70, just east of the Twin Tunnels,

to enhance safety and allow for an increased speed limit through this section. The cost of the 'Third Lane/Twin Tunnel' improvements is estimated at USD 55M, and no funding source has been identified at this time.

CDOT estimates it would take approximately two construction seasons—late spring to early fall—to complete. The recommendation follows a weeklong workshop in late February that included local, national and international construction and tunnelling experts to consider options for alleviating congestion in the Twin Tunnels area.

A Final Programmatic Environmental Impact Statement (PEIS) for the I-70 Mountain Corridor between C-470 and Glenwood Springs was made available for public review until April 11.

In all but one alternative, new tunnel bores are required at both the Eisenhower-Johnson Memorial Tunnels and the Twin Tunnels to accommodate improvements. And in one alternative for a six-lane highway, three new tunnels would be required. Current price estimates for the preferred alternative range from USD 16bn to USD 20bn.

News in brief

▼ Niagara two injured

Two tunnellers working for contractor Strabag on the new Niagara hydropower drive were taken to hospital last month following a pressurised grout pipe accident behind the TBM. Project manager Ernst Gschnitzer reported that injuries were not life threatening.

▼ Hitachi overseas orders

Hitachi received orders for four TBMs: two slurry TBMs for the Bangalore Metro in India, one EPBM for the Seoul Subway project in South Korea and one 6.44m diameter EPBM for the Seattle LRT extension in the US.

▼ Residents revolt against Pasadena highway link

South Pasadena Patch Officials faced another tough crowd at the second of three community meetings in South Pasadena in California, USA. The residents shared environmental concerns and contested the legality of the proposed project.

Port Mann tunnel contract award

CANADA

The CAD 167.3M (USD 171.08M) contract for the Port Mann tunnel project was awarded to a McNally and Aecon JV last month.

The 1km-long, 2.8m id tunnel will be driven by EPBM under the Fraser River in British Columbia, Canada through pressure reaching

up to 6-bar.

The tunnel, designed by the Sandwell/Jacobs/Golder JV, was predicted to encounter glacial tills and clay deposits at an average depth of 60m, 40m below water level.

Construction of two shafts of approximately 55m at the ends of the tunnel has been scheduled to begin in May. The shafts will then

be excavated and lined with a 1m-1.5m (3ft-5ft) thick heavily reinforced concrete final lining prior to tunnel excavation.

The Port Mann tunnel was envisaged as part of client Metro Vancouver's CAD 600M (USD 613.56M) water system upgrade. The project will double water supply capacity south of Fraser River. Completion by 2014.

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Public perspective

I am not a fan of tunnels, nor am I a fan of surface roadways or bridges. Rather, I support a rational look at the form and function of a particular solution to moving traffic into and through an urban core. I have found as an elected official, serving over 13 years on the Seattle City Council that often the public, media and elected officials get too attached to a particular form rather than the intended function of a proposed capital investment.

This struggle to separate form from function has been taking place in Seattle since 2001, when the Nisqually earthquake damaged the Alaskan Way Viaduct which provides a dedicated thoroughfare into and through our central

business district on State Route 99, carrying approximately 110,000 vehicles a day. Engineering studies concluded that repairing the viaduct would not be cost-effective, since it would cost 80 per cent of a newly built, longer lasting viaduct. And thus began an intense debate on whether to replace it with another viaduct, a tunnel or a surface road.

Since the viaduct was located on Seattle's waterfront, many considered that its massive presence resulted in excessive noise and visual blight that interfered with the public enjoying a potential major tourist destination. Even with the current viaduct in place, it was estimated that over two million enjoyed

Seattle's waterfront every year. With its removal new opportunities would open up for development taking advantage of an unobstructed magnificent panorama of the Olympic Mountains and Elliott Bay. Additional open space for the general public to enjoy would be another benefit.

With an image of a grander more open and potentially more pedestrian friendly waterfront, major groups, like the Downtown Seattle Association and key urban planning groups opposed the reconstruction of a viaduct. That led to the search for another option, the two most viable being either a surface road or a tunnel. A surface alternative would have taken all the traffic from the viaduct and plowed it onto our downtown street grid and a single major arterial with 28 stoplights. The freight carriers serving our port found that to be an unworkable solution for maintaining the flow of goods to and from the port. Since the port is a major economic engine for not only the city but the state, the state government would not support a surface option for fear of damaging the economy.

The tunnel option was initially presented as a cut and cover project. Opposition to it stemmed not just from cost, although it was more expensive than either the surface or aerial options, but also from the immense multi-year disruption to traffic along the waterfront and through the downtown core. The business community and the top elected officials, including the Governor, Seattle Mayor and King County Executive all came out in favor of a deep bore tunnel as a final solution.

Having been opposed to the cut and cover tunnel and the surface option, I saw the main problem with the deep bore tunnel as one of cost. However I also recognized that it provided the best functional alternative, since it would result in the least disruption during construction to our waterfront.

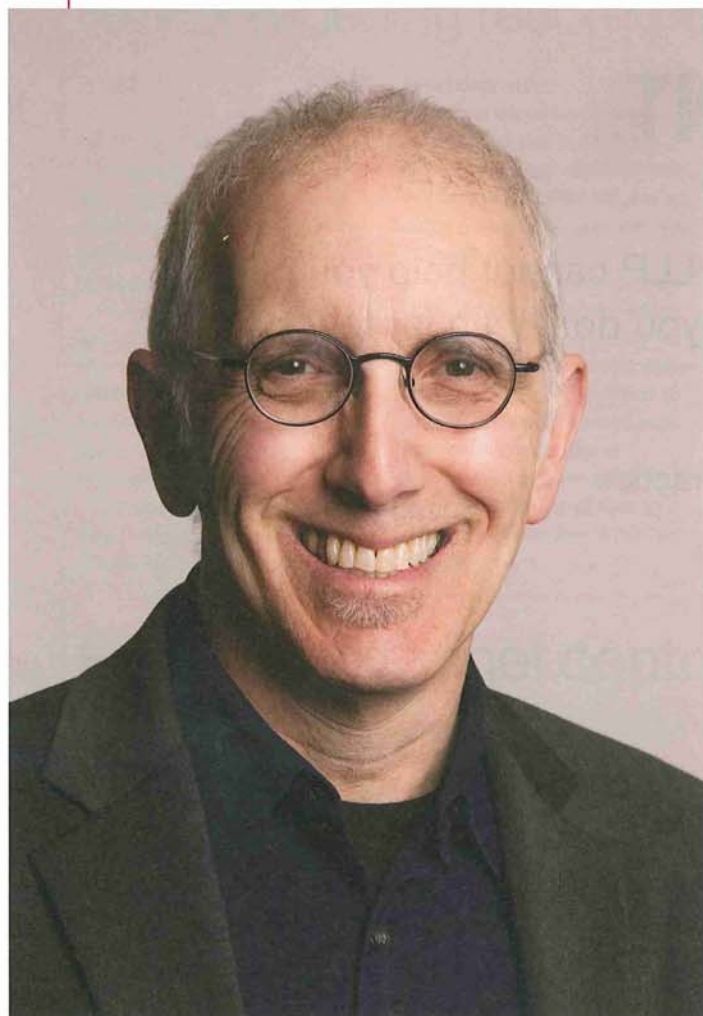
More importantly, it allowed the viaduct to remain in service until the tunnel opened.

Most opposition to the deep bore tunnel was spawned by the possibility that Seattle property owners benefiting from it would have to cover any cost overruns. The concern reflected wording in state legislation that was subsequently determined to be unenforceable by the state Attorney General. Continued opposition to the tunnel has also included various other concerns that range from it promoting global warming to not providing enough capacity. At times there seems to be a basic philosophical opposition to the tunnel because it is a highway project, although that has not been in the forefront of the main critiques, which remain concerned about cost overruns.

I see criticism of the deep bore tunnel emanating from opposition to the form of this traffic solution, i.e. it's a tunnel. The function of the tunnel, to provide unfettered traffic flow through the city, remains superior to options that do not. Much debate has been around form and not function. But the value of a particular solution to our problem of avoiding traffic gridlock downtown is best seen as a function that must be addressed through a form that best carries out the function. Consequently, a dedicated road way, whether elevated or buried, provides the best functional solution. With the political demise of the elevated solution, the tunnel option is the only one left that can meet our central business district's need for maintaining a flow of traffic through it.

Tunneling, while expensive and perceived as risky due to not having the certainty of knowing what will be dug up by a boring machine, offers the least disruptive construction method for facilitating an unencumbered arterial flow.

Nick Licata, Seattle City Councilmember



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Coasting along

As clients deal with financial constraints, the tunneling industry in the East Coast region may see limited growth over the next few years. But with all of the work in New York, plus clean water regulations elsewhere, the market should hold steady, Nicole Robinson finds

When looking at the east coast (specifically the mid Atlantic and New England) it's no surprise to hear the lion's share of the work is coming out of New York. Several projects are currently being undertaken—East Side Access, Second Avenue Subway and Seven Line extension—and of course there is whatever may come of options being weighed up for last year's cancelled ARC tunnel.

"Certainly New York has been, for the past decade or so, the center of that tunneling. But most of the big contracts in New York for tunneling are pretty much out and bid," says Greg Kelly, president of infrastructure at Parson Brinckerhoff.

From his perspective, the market on the east coast is steady, but not growing because clients face funding limitations. "That's not to say there is not a demand there," explains Kelly, who later adds that work is never complete in New York. "There is always a market in New York," he says.

Earlier this year, a joint venture of Schiavone, Shea and Skanska (S3) finished the first of two bores for the Second Avenue Subway's Phase One (see page 13). The Metropolitan Transportation Authority (MTA) has divided work on the two-track, 8.5mi (13.7km) line running below Second Avenue into four phases, some of will make use of existing tunnels that were built during previous attempts to

fund and construct the project. Running north to south along the city's eastside from 125th Street in Harlem to Hanover Square in Lower Manhattan, there will be 16 new stations upon completion. Phase One construction includes new stations at 96th, 86th and 72nd Streets, and new entrances to the existing Lexington Avenue/63 Street Station at 63rd Street.

Nearby, the East Side Access project will connect the Long Island Rail Road to Grand Central Station. This project sees work in both Queens and Manhattan as it completes tunnels either side of a 2.6km long existing stretch at 63rd Street—work that was stalled in the 1970s because of a lack of funding. A Dragados/Judlau joint

Left: New York City's East Side Access project Below right: The No. 7 Line extension; both photos © David Sailors

venture is constructing the 2.2km Manhattan Approach Tunnels and caverns beneath Grand Central Station. On the Queens side of the project, a JV of Granite Construction Northeast, Traylor Bros and Frontier-Kemper secured a contract to build 3.2km of tunnels using slurry TBMs.

Elsewhere in New York, tunneling finished last summer for the Seven Line's 2km twin tunnel extension from Times Square Station to a new station at 34th Street and 11th Avenue. The project is on track to be operational by December 2013.

The Seven Line extension project has caught the attention of New York City mayor Michael Bloomberg in the wake of New Jersey governor Chris Christie's decision to cancel the USD 8.7bn Access to the Region's Core (ARC) tunnel in October 2010. Citing concerns over potential cost overruns, the governor had suspended the project in September 2010 and subsequently called it off after US transportation secretary Ray LaHood offered different funding options.

The New York City Economic Development Corp. voted on 2 February to authorize Parsons Brinckerhoff to conduct a study assessing the feasibility of extending the Seven Line to Secaucus, New Jersey. The three-month contract is worth USD 250,000. This could be significantly cheaper than the ARC tunnel because underground work on the Manhattan side of a connection will have already been constructed for the current Seven Line extension. Just days later on 7 February, Amtrak announced it will spend USD 50M to begin preliminary engineering and design for the Gateway Project: two new trans-Hudson rail tunnels from Penn Station in Newark, New Jersey to an expansion at Penn Station in New York. According to Amtrak, the entire Gateway Project (which includes replacement and expansion of the Portal Bridge in New Jersey) could be completed in 2020 at an estimated cost of USD 13.5bn.

Meanwhile, the federal government had already provided USD 271M for work completed on the ARC tunnel project before its cancellation, and sent a bill to the state of New Jersey, which has retained Washington D.C.-based law firm Patton Boggs to fight the debt.

But the five boroughs aren't the only source of demand for the tunneling industry in this part of North America. The northeast has its fair share of CSO regulations to

meet and commuters looking to travel easily at home and throughout the region.

In Hartford, Connecticut, the Metropolitan District is tendering the contract for final design of the 13,500ft (4,100m) South Hartford Conveyance and Storage Tunnel. This is part of a total 26,250ft (8,000m) of tunneling and microtunneling for the city's Clean Water Project (page 22). The USD 1.6bn program will meet state and federal consent decrees for sanitary and combined sewer overflows (SSOs and CSOs) by 2020.

Before the end of the year, work should kick off on Phase II of the Narragansett Bay Commission's CSO projects in Rhode Island: The 19,150ft (5.83km) Woonasquackett Interceptor and the 11,200ft (3.41km) Seekonk Interceptor. Final design is in approval now with the Rhode Island Department of Environmental Management. The commission anticipates bidding the various components of Phase II beginning this spring, with notices to proceed later in the summer and early fall. The final components should go to construction in mid-late 2012.

CSO projects will also make use of tunneling in Washington D.C., specifically a deep tunnel system as part of the District of Columbia Water and Sewer Authority's USD 2.6bn Clean Rivers Project. Four main tunnels, for a combined length of 12.8 miles (20.6km), will be built before 2025. Tunnels will be on average 23ft (7m) in diameter, built between 100 and 120ft (30.5 and 36.6m) below ground.

Construction should start on the 23,600ft (7.2km) Blue Plains Tunnel this summer, once the design-build contractor is announced this spring. The second tunnel project, the 12,500ft (3.8km) Anacostia Tunnel, should start in November 2013. The remaining Northeast Boundary Tunnel and Northeast Boundary Branch Tunnels are scheduled to see construction in 2021 and 2018 respectively.



Elsewhere in D.C. tunneling is required for transportation needs such as the Dulles Corridor Metrorail Project, a 23-mile extension. Dulles Transit Partners (Bechtel and URS) is delivering Phase 1, which is primarily a surface level or elevated solution, but includes a 2,400ft tunnel that will connect two Metro stations in Tysons Corner. Tunnel construction began in October 2009, and mining completed in both the inbound and outbound tunnels by the end of 2010. Spray concrete and other final works for the tunnels of Phase One are expected to complete this year. Preliminary Engineering is underway for Phase Two, which will include a tunnel beneath Dulles International Airport, and will finish in 2011.

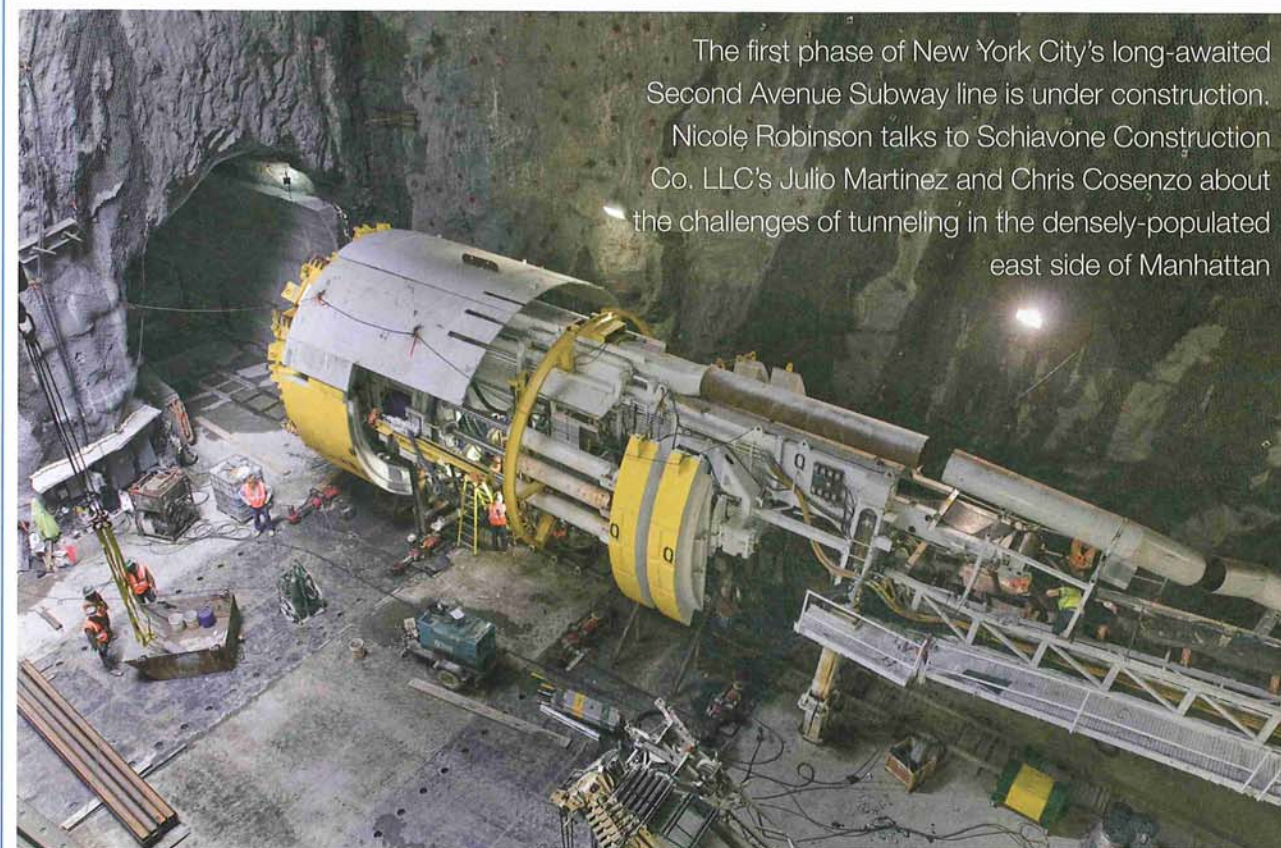
Other cities and metropolitan communities in the region face the same drivers as New York, just on a smaller scale, explains Kelly. "On the east coast there are some other activities out there, but you have to add all those up to come close to the amount of work that's going in New York now," he says.

But with President Obama's initiative to build a high-speed rail network, areas outside of New York may be poised to at least keep up. The northeast stands to gain from a recent trend of new Republican governors turning down federal funding for high-speed rail. Following the decision of governors Scott Walker of Wisconsin and John Kasich of Ohio, who turned down a combined USD 1.195bn before either even took office, Florida governor Rick Scott turned down USD 2.4bn for the high-speed rail line that would connect Orlando-Tampa.

Elected officials from states in the northeast, and California, contacted the U.S. Department of Transportation. Governor of Maryland, Martin O'Malley, for example, requested the money go for projects including replacement of the B&P Tunnel (Baltimore and Potomac)—leaving the agency to announce it will rebid the Florida funds. ■



Big city constraints



The first phase of New York City's long-awaited Second Avenue Subway line is under construction. Nicole Robinson talks to Schiavone Construction Co. LLC's Julio Martinez and Chris Cosenzo about the challenges of tunneling in the densely-populated east side of Manhattan.

Contrary to what its 'City That Never Sleeps' nickname may have you believe, people do actually sleep in New York. Surrounded by brownstones and high rises, the surface level operations for the TBM mining Phase One of the Second Avenue Subway fall quiet every night at 10. Underground is a different story. A joint venture of Skanska, Schiavone and Shea (S3 Tunnel Constructors) mines 24 hours a day, five days a week.

"We can't get deliveries and we can't hoist anything with a crane from 10pm to 7am because it's noisy. You almost have to plan with a military precision and have it set up. One has to foresee what will be needed precisely in order to coordinate material deliveries," says Julio Martinez, project engineer, Schiavone Construction Company.

In addition to a restriction on the hours for deliveries, spoil removal and other work in the launch box, there is a lack of space in

the construction area that complicates these cautiously organized deliveries. "We can't stack or store large volumes of materials. We have to truck them in and out of the tunnel as we receive them. It's a constant chess game to get materials into the tunnel and keep everything in a productive manner," adds Chris Cosenzo, tunnel superintendent, Schiavone.

With the first of two drives completed and the second to start this spring, the crews may be adjusting to the challenges of the operations, but they are also dealing with ground conditions arising from the shallow depths of the tunnel that have required ground freezing and slowed the pace of tunneling in general.

Challenges above ground

Proposals to build a north-south subway line along Second Avenue date back to 1929, and work has actually been undertaken several times in the past 70 years. Two elevated lines on Second and

Third Avenues were demolished in the 1940s and '50s, and tunnel segments were built following a plan introduced in the 1960s. However, construction was suspended in the 1970s for financial reasons.

A study launched in 1995 led to the current plan to build a two-track line along Second Avenue from 125th Street to the Financial District in Lower Manhattan, with construction divided into four phases (see box: Key dates from 1995).

Phase One will connect 105th Street and Second Avenue to existing services at 63rd Street and Third Avenue, with new stations at 96th, 86th and 72nd Streets. Although the full length of the Second Avenue line won't be completed, when Phase One finishes, the subway service is projected to carry more than 200,000 weekday riders.

The S3 contract involves new tunnels between 92nd and 63rd Streets, and excavation of the TBM launch box and access shafts at 69th and 72nd Streets.



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Key dates from 1995

- 1995:** MTA New York City Transit began the Manhattan East Side Alternatives (MESA) study to recommend a course of action to reduce overcrowding and delays on the Lexington Avenue Line, and to improve mass transit accessibility for residents on the far East Side of Manhattan.
 - August 1999:** MESA Draft Environmental Impact Statement Report issued for public review and comment. The public hearing showed an overwhelming preference for a full-length Second Avenue Subway from 125th Street to the Financial District in Lower Manhattan.
 - March 2001:** SAS Study published a Notice of Intent in the Federal Register to undertake a Supplemental Draft Environmental Impact Statement (SDEIS) to evaluate a full-length Second Avenue Subway.
 - April 2003:** The Second Avenue Subway SDEIS was published.
 - April 2004:** The Second Avenue Subway Final Environmental Impact Statement (FEIS) was published.
 - July 2004:** The Federal Transit Administration (FTA) issued a Record of Decision for the project, signifying that the requirements of the National Environmental Policy Act have been satisfied.
 - July 2004:** Preliminary Engineering for Phase One was completed.
 - December 2004:** Preliminary Engineering for Phases Two, Three and Four was completed.
 - April 2006:** Extended and Final Preliminary Engineering was completed.
 - April 2006:** The FTA authorized the MTA to begin Final Design of Phase One of the project and the Final Design contract was awarded.
 - March 2007:** The MTA awarded the first construction contract for building Phase One of the subway to a joint venture of Skanska, Schiavone and Shea.
- FUTURE PHASES:**
- Phase Two:** Construction will occur from 125th Street to 105th Street, and use an existing subway tunnel section from 110th to 120th Streets;
 - Phase Three:** Construction will occur from 72nd Street to Houston Street;
 - Phase Four:** Construction will occur from Houston Street to Hanover Square;

Below: The TBM was assembled in May 2010, and mined the western bore first



These shafts will be used for constructing the 72nd Street station, which is part of a different contract awarded to a joint venture of Schiavone, Shea and Kiewit (SSK Constructors) in October 2010. And rounding out Phase One, connection to existing tunnels from 99th to 105th Streets is being undertaken in separate contracts (Figure 1). A joint venture of DMJM Harris and Arup is providing design and engineering services, and Wang Technology is providing instrumentation and monitoring services under contract to S3.

Right in the very center of Second Avenue from 92nd to 95th Streets is the TBM launch box. Tunnelling started at 92nd Street to make use of the Manhattan Schist, which continues to the south (Figure 2). The tunnels range from 60 to 100ft (18.3 to 30.5m) depth from the surface, and each bore has a diameter of 22ft (6.7m) with an 18ft (5.5m) rock pillar separation between them. TBM excavation for the 7,215ft (2.3km) western bore finished this February at 65th Street. By April the TBM is expected to start the 7,793ft (2.4km) eastern bore, which will make a tight, westerly compound curve to hole-through into the existing 63rd Street Station.

The cut and cover excavation for the launch box measures roughly 810ft (247m) going north to south, approximately half in rock at the southern end and half in soil at the northern end. In the rock cut, the width is around 66ft (20m), and in the soil cut, the width is 58ft (17.7m). The box walls consist of two different types of construction, secant walls at the southern half and slurry walls at the northern half. The slurry walls at the middle portion of the box are founded within rock. Northward from there, the slurry walls are founded within the soil with approximately 40ft (12m) of toe below the final excavation limits. From the southern end to the middle portion of the box, the walls are constructed with secant piles founded within the rock.

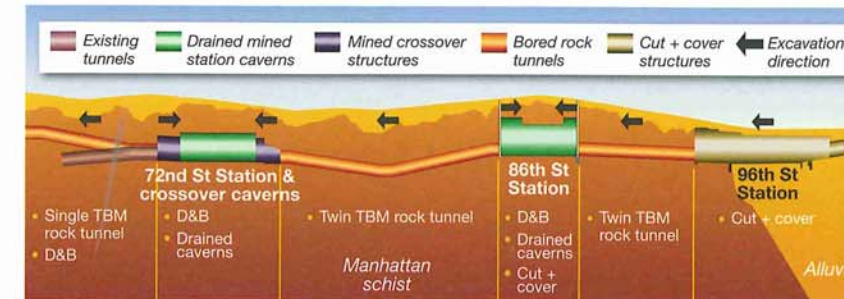
New York's Metropolitan Transportation Authority Capital Construction (MTACC) awarded the contract in March 2007, but it wasn't until early 2010 that the contractor was ready to do underground work. "We had to perform a significant amount of utility and other preparatory work in order to build the walls of the box and that took about a good year, year and a half," says Martinez. "And then we had to install decking on top of the future excavation since traffic still had to be able to transverse above us while we excavated within the box."

S3 elected to use one TBM for both



Above: Figure 1 - The Second Avenue Subway will be built in four phases; Phase One (inset) is schedule to be operational by 2016

Below: Figure 2 - Phase One TBM excavation started at 92nd Street to take advantage of the Manhattan Schist



bores to save space in the launch box and to avoid the logistics of doubling the electricity, water, ventilation and other services required. The JV is using a reconditioned open-face main beam gripper machine with 44 cutters, 17in in diameter, from Shea's fleet—a decision that saved time in a tight schedule. Working with Herrenknecht, it took roughly five to six months to rebuild the machine.

"We took advantage of it when we bid this work," Martinez explains. "And that's why we're the low bidder. Also we have experience with this machine on three other projects, thus we have very intimate knowledge of it. In addition, we do have the know-how and the facilities to refurbish the TBM ourselves."

Selected stretches of the tunnels between station caverns will receive a 13.5in (343mm) thick fiber reinforced concrete lining. MTACC let the contract with two options including the use of a shielded TBM with precast concrete lining.

"We made the choice to go with the gripper machine because there are gaps in the lining, and the space to have the pre cast segments wasn't available," he says. Noting again: "In addition the timely preparedness of the TBM was a critical schedule item."

With the 10pm to 7am noise restriction, it is imperative there is always enough room in the launch box to store spoil. Muck trains bring material to a hopper in the launch box; from there a belt brings the muck to the northern most part of the box for storage in a bin. Material from the muck bin is loaded into a vertical belt and taken to the surface, where it is stored in a truck hopper. During the approved hours, trucks are loaded on site. Otherwise, material is stored. The hopper has a 90t capacity.

Major access to the launch box is on the southern most part, on the east side. After the TBM was assembled to full function and tested at Schiavone's shop in New Jersey, it was disassembled and shipped to



the project site. With the west bore being excavated first, everything was lowered down the shaft in reverse order and moved to the back of the launch box. Down below, another crane assembled the machine. Then the contractor actually slid the machine from east to west and advanced to the face.

"Assembly of a machine of this size in the area we have—it is challenging, but it just goes back to being able to plan your moves very cautiously and very well thought out," Cosenzo says.

Challenges below

MTACC surveyed 225 buildings on Second Avenue that could be affected by tunneling work, and 51 buildings were deemed 'too fragile' in autumn 2010. These are primarily located near the TBM launch box, and are four to five-story brick buildings built in the 1800s with shallow foundations, supported on soil or timber piles.

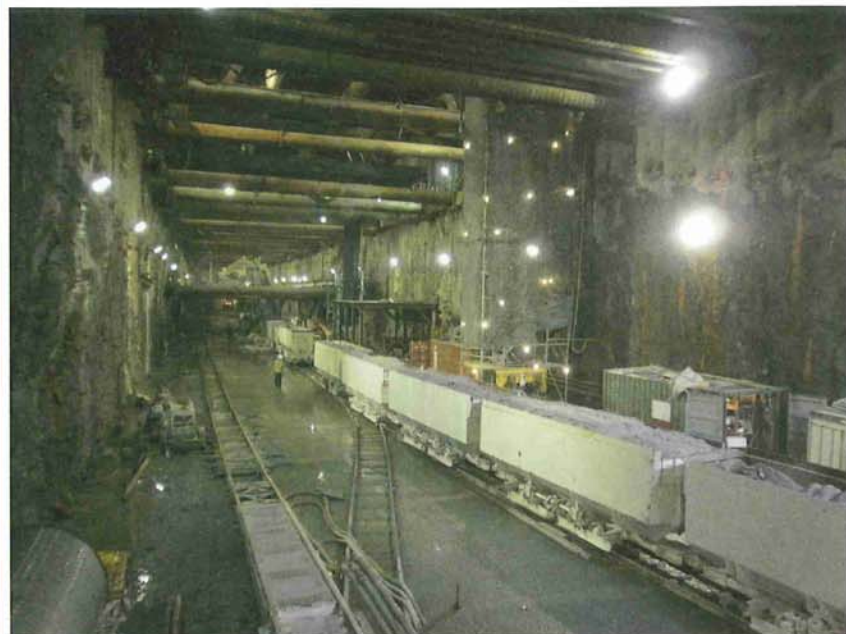
Martinez describes them as basically floating on the soil, which is a mix of sand, silt and clays. Only prior to the construction of these buildings, this part of Manhattan was shoreline, which was then reclaimed to amplify the city's limits. "This fill was not controlled. It wasn't compacted as fill is placed in modern times. So whatever soil you move, it's actually going to react much quicker," he says.

MTACC initially predicted a progress of 50ft (15m) per day, and T&T reported in November 2010, TBM excavation was progressing at 40ft (12m) per day. Besides buildings there are utilities overhead—between 2 and 40ft away as the tunnel's elevation changes through the alignment. Lengths and feed pressures on drilling and probing have to be less aggressive. "We've had to do more probes than what we normally would have with a machine at a deeper depth, which increased the mining cycle a little bit," Cosenzo says.

As T&T went to press, the TBM had

Below: Utility work along Second Avenue





Above: The muck removal system brings material to the launch box, where a bin is used to store it until trucking operations can start from 7am each day

completed the western bore and the contractor was removing the four segments of the cutterhead around the perimeter, the roof supports and the side supports. The machine will be fitted with transport dollies and towed back to the launch box via the use of locomotives.

"What this is allowing us to do is, we're bringing the machine back fully assembled with all the hydraulics and electrics still hooked up...When we come back and hit the launch box, there won't be much reassembly except for the shields and the cutter head segments," Consenzo explains.

He estimates tunneling will start in the eastern bore before the end of March, and should take around six to 10 months to breakthrough at the 63rd Street Station. Once the TBM is out of the western bore, select stretches of tunnel will be treated with a PVC membrane prior to receiving the lining.

There is an area approximately 147ft (44.8m) long at the portal of the east bore (around 91st Street) where Moretrench of New Jersey is providing ground freezing services. While doing secondary support for the starter tunnels S3 encountered soil and water.

"We notified the owner and performed exploratory borings. In the process we did find that part of the alignment, the crown, was in soil-like material. In light of these findings the owner prudently elected to freeze this stretch of the alignment," Martinez explains.

Approximately 110 freeze pipes of 3in (76.2mm) internal diameter have been installed around the tunnel alignment at depths of approximately 75ft (23m), at varied angles.

"We had to angle as much as 30 degrees off of the vertical in order to avoid water lines, gas lines, all the utilities," says Kenneth Wigg, senior engineer with Moretrench.

And the placement of freeze pipes created another problem, he explains. "We couldn't get exactly where we wanted to be. So we had to really look at the placement of the freeze pipes, and in some places we had to add freeze pipes, to get those pockets we couldn't reach because of the utilities."

The freeze started in January and uses calcium chloride brine. As the machine bores the east tunnel a thin interliner will be installed to seal off and support the tunnel crown prior to the thaw.

Wigg says it typically takes as long to thaw as the systems was running. When he spoke to T&T, it had been close to nine weeks, in counting.

At the end of the 7,793ft (2.4km) east bore, the TBM makes a tight compound curve to meet up with existing tunnels and train services at 63rd Street. "I think it's probably in the extreme range of what the machine can do. It's a pretty tight radius," says Martinez. "It starts around 830ft (252.98m) radius and ends about 620ft (188.98m) radius. The reason they had to

keep it so tight is because of eminent domain and zoning issues."

He hopes that by the end of 2011, S3 will be completing this eastern bore, and close to completion in the western bore with waterproofing and concreting. Phase One is expected to be finished in 2016. ■

Current contracts

Contract: C-26002
Contractor: Skanska/Schiavone/Shea JV (S3)
Award date: March 2007
Work: TBM tunnels between 92nd Street and the existing Lexington Avenue/63rd Street Station; construction of a TBM Launch Box from 92nd to 95th street and access shafts at 69th and 72nd Streets.
Bid: USD 337M

Contract: C-26005
Contractor: E.E. Cruz/Tully Construction Co. JV
Award: May 2009
Work: Utility relocation, demolition of existing buildings, underpinning, slurry wall construction, excavation, and station invert slab of the 96th Street main station box, entrances and ancillary facilities. (To be followed by Contract C-26010)
Bid: USD 325M

Contract: C-26006
Award date: January 2011
Contractor: Judlau Contracting
Work: Rehabilitation of 63rd Street/Lexington Avenue Station and construction of entrances
Award Amount: USD 176.5M

Contract: C-26007
Contractor: Schiavone/Shea/Kiewit JV
Award: October 2010
Work: Construction of the 72nd Street station cavern and G3/G4 tunnels to the existing 63rd Street/Lexington Avenue Station, includes tunnel mining, tunnel lining, station cavern, station entrance and elevator shafts.
Bid: USD 447.2M

Contract: C-26013
Contractor: J. D'Annunzio & Sons
Award: July 2009
Work: Utility relocation, open excavation and road decking for the 86th Street Station. The scope of this contract is to prepare the site and provide access for the subsequent Cavern and MEP contracts.
Bid: USD 34M

Recently opened:

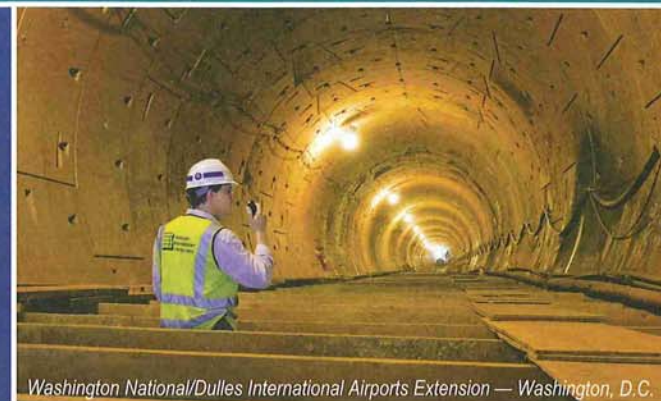
Contract: C-26008
Work: 86th Street Station cavern mining and heavy civil structure
Lowest bid: Skanska/Traylor JV of USD 301.86M

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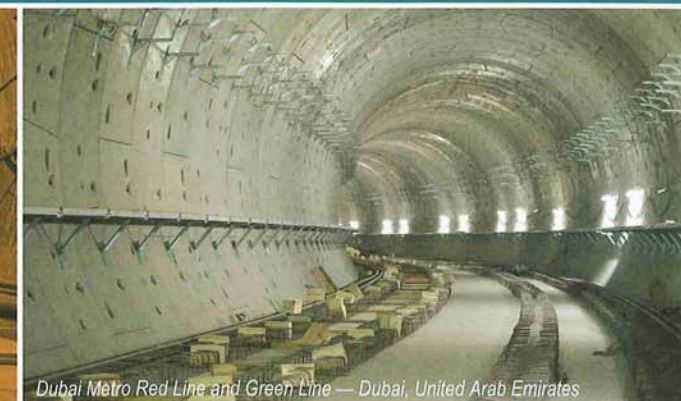
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Small diameter, big impact

Building the Bi-County Water Tunnel will bridge a gap in the east coast water system. One of the two drives has been completed for the compact, but deep alignment. Robbins technical writer Desiree Willis reports

At 2.1m finished diameter, tunneling at Maryland's Bi-County Water Tunnel is a tight operation. The water transfer pipeline, for owner Washington Suburban Sanitary Commission (WSSC), travels across a densely urban area and links up two existing water supply mains in Montgomery County.

"The length of the second drive, approximately 7km, without any intermediate access shafts, is what makes this project difficult. This, in combination with a small tunnel cross section, makes it logistically challenging to develop muck handling and ventilation plans," said Steven Pinault, Project Manager for WSSC. The entire tunnel stretches 8.5km, with the

shorter 1.5km long section having already been excavated by spring 2011.

Work is being carried out by the Oscar Renda, Southland, and SAK joint venture, with Black & Veatch as the primary designer. A joint venture of Jacobs Associates and EA Engineering Science and Technology is providing construction management services. The 3m diameter, contractor-owned Robbins Main Beam machine being used is one of the world's longest running TBMs in operation. The machine has been used on at least 10 different projects between 1973 and 2011, totaling nearly 50km of hard rock tunnels.

Supplying water to Washington
Though located in Maryland, the Bi-County

Water Tunnel will increase supplies of clean drinking water to eastern areas of two counties in both Maryland and Washington D.C. The increased water supply will alleviate current capacity limitations from an existing 1.37m diameter main. The tunnel will also serve as an additional high-pressure water source during peak-use periods, droughts and emergencies.

Long-term benefits

Plans for the Bi-County Water Tunnel were drawn from a long-term water supply project in the area, dating back to the 1970s. Original water tunnels under the same name were built in 1980 to 1981 using Jarva Kelly-Type TBMs boring 3m diameter tunnels.

Left: At 7km in length, a section of the Bi-County Water Tunnel being bored by a 3m diameter Robbins TBM is logistically challenging for both muck removal and ventilation.

Right: The TBM was launched on Maryland's Bi-County Water Tunnel in July 2010, from a main shaft at Connecticut Avenue.

"The tunnels were built in solid rock, and lined with shotcrete. Due to leakage rates and rock competency issues discovered during testing, the tunnel was not placed into service until it was lined with a 2.4m steel pipe in the early 1990s," says John Mitchell, project manager for WSSC.

These original tunnels, bored through quartz, gneiss, schist, and granite, have provided good capacity over several decades. However, the 1.37m diameter water main has continued to act as a bottleneck, particularly in recent years. Without additional capacity, water pressures are predicted to fall below two bar, affecting firefighting and emergency capabilities, as well as reducing performance when multiple appliances are used on one water line by consumers.

To prevent the problems, the next phase of the plan called for a final tunnel to tie two systems together, providing reliable water supply from the Potomac River to WSSC customers in Montgomery and Prince George's Counties. WSSC took into account average per capita consumption, along with a user increase of about 5,000 new accounts per year, to determine that the new tunnel would need to be in operation in 2013.

The alignment of the Bi-County project was decided upon following studies in 2004. The tunnel route follows the I-270 and I-495 ring roads around Washington D.C. Much of the area is urban and residential, resulting in limited access and a deep alignment between 27 and 84m below the surface. The depth also ensures relatively competent bedrock with a lessened risk of mixed face tunneling.

Because of the limited access, a 10.6m diameter, 50m deep shaft at Connecticut Avenue was identified as the only place from which to launch and remove a TBM. Smaller shafts would be constructed at either end of the line, at Tuckerman Lane and Stoneybrook Drive. "A tunnel boring machine was really the only option for us, in order to lessen environmental impacts,

Right: WSSC Bi-County Water Supply Main



particularly in residential areas near the Tuckerman site," says Mitchell.

Geologic testing

Extensive geological testing was performed along the tunnel alignment prior to excavation. WSSC took 21 core samples, from both vertical and inclined positions. "We performed acoustic televueing inside some of the bore holes. If we saw an interesting feature, we would lower equipment into the hole itself to look at potential rock foliation or shear zones," says Mitchell. An acoustic televueer is a type of technology that combines an

ultrasonic transducer and a downhole inclinometer to provide a high resolution, sonic image of the borehole wall. While several areas of concern were identified in the mainly granitic rock, designer Black & Veatch determined that rock bolts would be sufficient, and recommended this to the contractor as the primary method of support in the tunnel.

Boring with restricted surface access

The 3m diameter TBM, dubbed 'Miss Colleen', was launched in July 2010 from the main Connecticut Avenue shaft located





Above: The Renda/Southland JV broke through into an intermediate shaft in November 2010, and then removed some TBM components for launch in the opposite direction.

in the middle of the tunnel alignment. Starter and tail tunnels, totaling some 120m in length, were required for the machine launch. Work was done prior to the launch to boost the machine power from its previous project—an increase from 600 to 900kW in order to accommodate hard granite averaging 140MPa UCS. Contractor Renda/Southland also took measures to simplify the operator's cab and increase the bearing size to 2.5m in anticipation of the hard rock.

Tim Winn, principal in charge for the Renda/Southland JV, cites several reasons for the machine's long-running and consistent success: "The most important factor is probably the main structure of the TBM, which was built very rigid. It was definitely built for severe rock conditions. We also maintain the machine on a regular basis, checking the lube system, changing belts and hoses, and monitoring cutter wear."

The machine excavated its first 1.2km of tunnel, exiting into the Stonybrook shaft in November 2010. Ground support consisted of rock bolts, steel straps, and wire mesh being added in less competent ground. "We have had a variable amount of cutter changes, depending on the material. At times, the granite is inlaid with quartz and iron pyrite, which is very abrasive, dense material and can add significantly to our push times," says Winn. Despite the

challenges, the contractor averaged 12m per 10-hour shift.

Due to the small size of the Stonybrook shaft, it was not possible to resume tunneling from the location. Once the TBM broke through into the site, Renda/Southland began operations to remove TBM components from the Stonybrook shaft, and back the rest of the machine to the Connecticut Avenue launching area.

"We removed the cutterhead and lifted it out of the Stonybrook shaft. The machine was then backed out, using a specially built frame to make the trailing gear rigid. Once the TBM was at the main shaft, we essentially turned all the components 180 degrees and then pieced them back together," says Winn.

Turning the pieces around, particularly larger bolted-together components, required some maneuvering with a crane in the 10.6m wide shaft. Rebuilding of worn sections of the cutterhead, including the addition of hardened steel, was also done prior to launch. The entire process took approximately two months.

Launch of the TBM was accomplished the first week of February 2011 from the Connecticut Avenue shaft. By March 2011, the TBM had advanced more than 300m into its second 7.2km long drive, in the opposite direction towards Tuckerman Lane. Advance rates were averaging about

12m per 10-hour shift in ground conditions including granitic rock of 140MPa UCS, similar to that found in the first tunnel section.

Limited Space, Urban Area

The 7.2km length of tunnel with no intermediate shaft is the project's current challenge. "The diameter makes necessities such as adequate air movement and mucking very complex," says Winn. To remove an appropriate volume of air, 900mm diameter duct is run along the top of the tunnel. Scavenger fans also push air back from the boring face and towards the ducting that trails the machine. Air is removed by two 100 hp fans, then put through a silencer—a noise reduction device for work inside residential areas.

Muck is being removed from the tunnel using single track muck cars with California switches. A new switch is placed every 3km in the tunnel to allow multiple muck trains in a relatively small space. Full muck cars are then hauled out of the shaft for dumping on the surface. Proximity to the highways has resulted in restricted trucking and hauling hours, preventing muck haulage from 6am to 9am and from 3pm to 6pm daily. The excavated material is being stored at a firm nearby, to be reprocessed and used as fill on private property.

As of March 2011, work at the Tuckerman Lane Shaft was ongoing, with residential areas within 140m of the site requiring pre-blast surveys and surface monitors for noise and vibration. The 10.6m diameter, 42m deep shaft is being excavated using drill and blast charges, which have to date been well within specified limits.

Crews are also readying surface piping at Tuckerman Lane to tie into an existing 2.4m diameter line at the shaft site. At the Stonybrook site, crews are tying in the other end of the tunnel to the pre-existing 2.4m diameter Bi-County Water Tunnels, thus bridging the gap between the two systems.

All excavation is expected to be complete in 2012 and the pipeline will become operational in 2013. While no other tunnels are being planned by WSSC at the moment, Mitchell speculates that more are likely: "As this area continues to develop, there will be continuing concern about community and environmental impacts. Much of the infrastructure was built in the 1950s and 1960s, and these aging lines will eventually need to be replaced with new utility lines at larger diameters. All these trends are making TBM tunneling a very attractive option." ■

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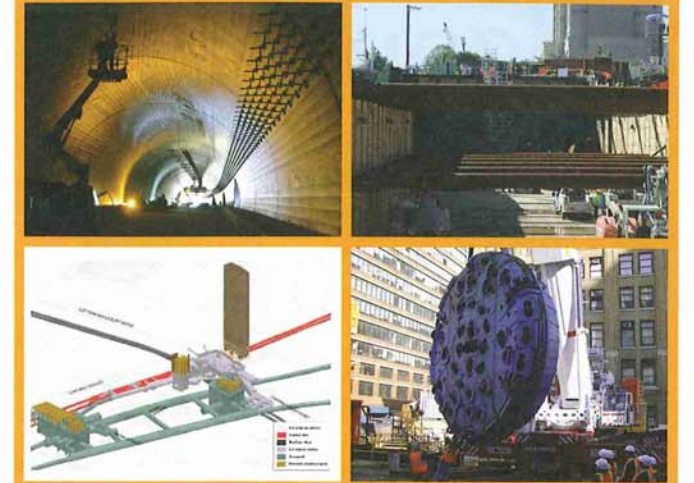
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Clean water, clear future?

Like much of the northeast, Hartford, Connecticut, is busily rehabilitating its sewer system. The Metropolitan District's Clean Water Project is one of the biggest sources of microtunneling in the region. Although just how much work will come from the project is still under consideration. Nicole Robinson investigates the tunneling hotspot of Hartford

For nine days in May 2010, a Herrenknecht micro-TBM mined a 600ft (83m) section of interceptor sewer with a 1,800ft (549m) radius curve in the middle. It arrived in the receiving shaft with an accuracy of less than 12mm.

The Homestead Avenue Interceptor Extension (HAIE) in Hartford, Connecticut, made history as the first curved microtunnel in the United States. It's the first trenchless project ever for the city, and to be followed by many more that the Metropolitan District (MDC) will tender for its Clean Water

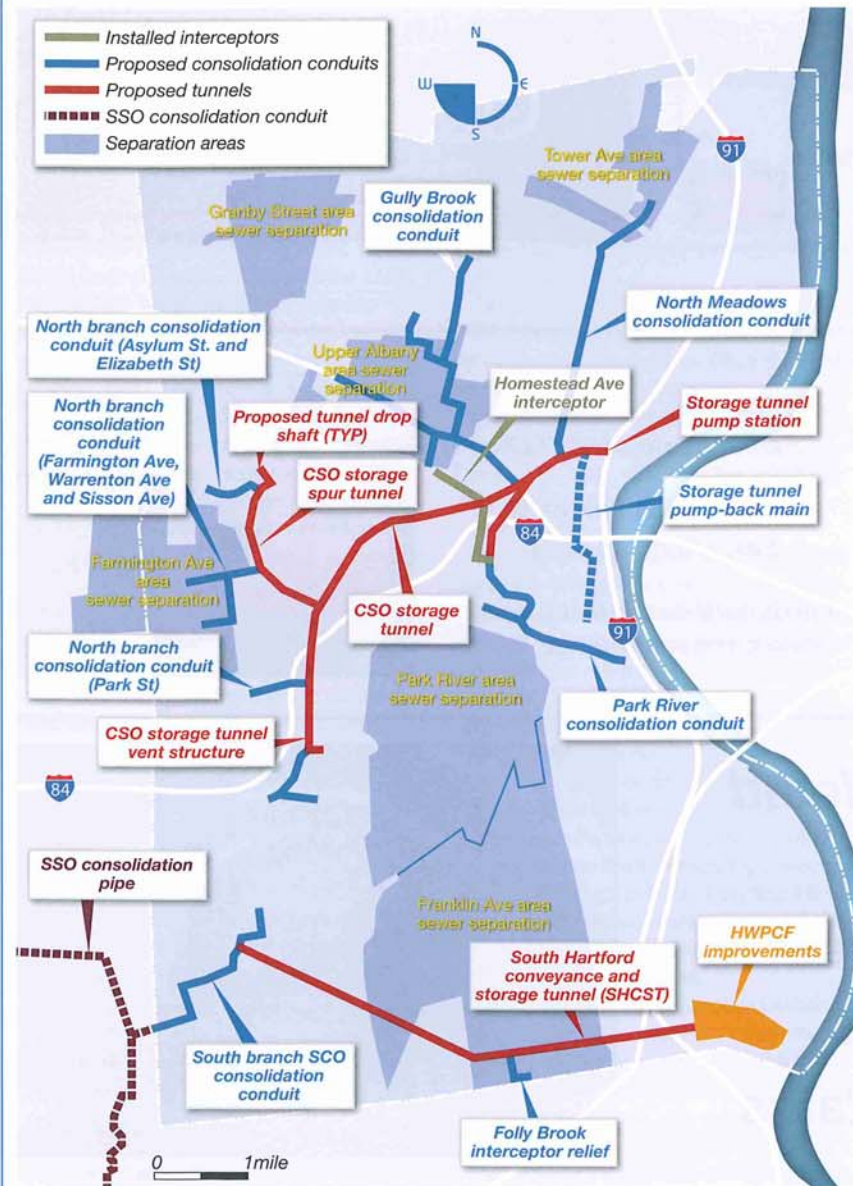
Project. The USD 1.6bn infrastructure program will meet state and federal consent decrees for sanitary and combined sewer overflows (SSOs and CSOs) by 2020, and will be delivered in two phases. Approximately 26,250ft (8,000m)—half of which will be deep rock tunneling, and the other half microtunneling—are planned for better conveyance and greater storage capacity. Although not all the projects have been designed yet, and that number doesn't include the final North Tunnel, of which the dimensions will be determined later (Figure 1).

South Hartford

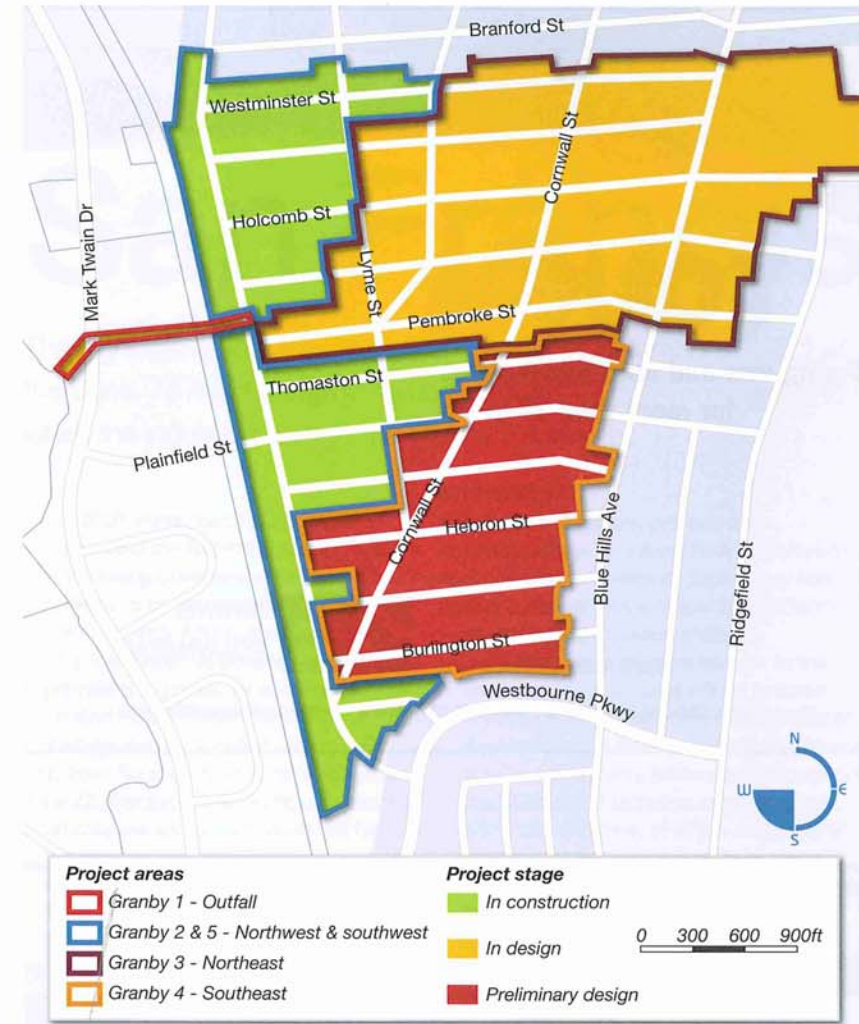
The 3,900ft (1.19km) HAIE was one of the program's first projects, and broke ground in 2009 (see box). It's part of Phase One, budgeted at USD 800M, along with the 13,500ft (4100m) South Hartford Conveyance and Storage Tunnel (SHCST), sewer separation and other pipeline work. At the end of February, the MDC issued a request for qualification for the final design of the SHCST and the consolidation conduits that will convey CSO and SSO flows into the tunnel.

Initially the MDC wanted to take advantage of existing tunnels for the Clean Water Project's storage requirements, but ultimately a tunnel in the southern part of the city would be the best solution to pick up overflows in the west. Scheduling has been influenced by improvements at the Hartford Water Pollution Control Facility to enable the plant to handle the additional flows. The SHCST cannot be operational until the plant is expanded and operational itself. "That is about to go in design this summer," says Bob Moore, chief administrative officer of the MDC. "It will be preceding the design of the tunnel by probably six to nine months."

Three major alignments were investigated during the preliminary design, each with one



Left: Figure 1: Some 8km of microtunneling is planned for Hartford to increase sewerage network capacity



Above: Figure 2: Works on the Granby Street area sewer separation are in various phases

end at the treatment plant and the other end in the general vicinity of the CSOs to be discharged into the tunnel. Ground conditions near the tunnel route include four major bedrock units: Portland Arkose (arkose, siltstone and shale), Hampden basalt, East Berlin formation (siltstone, sandstone and shale) and Holyoke basalt. One significant challenge in the design will be to address an artesian condition discovered at two borings along the route. A Geotechnical Data Report will be made available to prospective designers.

The preliminary design report recommends a 26ft (7.9m) diameter, concrete-lined tunnel approximately 13,500ft (4115m) long, constructed with a TBM. Final design is anticipated to take two years, starting in October.

During this period the number of construction contracts will be determined, with the expectation to advertise them in February 2014.

More microtunneling

Overall, the largest amount of microtunneling will be on the west end of the SHCST, which will pick up overflows from the area's SSOs and CSOs. Although not all the projects have been designed yet, there will likely be between 13,000 to 14,000ft (3,960 to 4,270m) of microtunnel.

"We're undergoing the sewer separation," says Bill Hogan, project engineer with the MDC. "We probably have about two-thirds of the contracts in design at this point in time. But there are some significant areas we have not started. So there may be additional microtunneling in those sewer separation areas."

One of the main components of the Clean Water Project is sewer separation in six different areas of the city. These projects will be delivered gradually. For example, Granby Street, in the north, is in various phases of construction (Figure 2). For this particular project approximately 2,510ft

Homestead Avenue

The Homestead Avenue Interceptor Extension (HAIE) will add 3,900ft (1.19km) to the existing interceptor. The USD 22.5M project will install a 72in (1.83m) diameter reinforced concrete conduit lined in PVC, at depths up to 40ft (12m).

The alignment goes beneath an active AMTRAK line and an elevated portion of Interstate I-84. There are also numerous utilities in the area that were relocated to accommodate shafts of between 18 and 45ft (5.5-14m) deep. In other instance, relocating utilities would have taken a significant amount of time.

Originally planned as open-trench work, contractor Northeast Remsco Construction suggested microtunneling would be better suited for the 600ft (83m) section of the sewer with the curve. The proposed shafts were on either side of a main thoroughfare, and traffic would be disrupted for not only the interceptor work, but several weeks of utility relocation as well.

Considering the wet, soft varved clay of the area, the contractor elected to use a Herrenknecht AVND 1800AB MTBM. Using microtunneling, NE Remsco completed the drive in nine days, whereas it had previously been estimated to take 30 days doing open-cut construction.

(765m) of sewer pipe (48-inch and 60-inch) will be installed by microtunneling, and 16,240ft (4,950m) sewer and drain pipe (8-inch to 60-inch) by open cut excavation.

Later this year, Northeast Remsco, as a subcontractor to Paganelli Construction, will undertake the microtunneling portion of the Garden Street Relief Sewer. Approximately 900ft (274.3m) of 48in (1.22m) reinforced concrete drain pipe will be installed, and to minimize road disruption, 750ft (228.6m) will be installed using a closed face slurry micro-TBM.

Microtunneling accounts for approximately 25 per cent of the USD 4.5M total cost for the Garden Street Relief Sewer Project. Open-cut work for sewer pipes, installation of a new junction chamber at the Homestead Avenue Interceptor and rehabilitation of 5,000ft (1,524m) of existing combined sewers are also part of the project.

North Tunnel

During wet weather events, consolidation conduits will pick up combined wastewater from throughout the system and discharge it to the North Tunnel. This final step of the program will be determined in further detail once all of the consolidation conduits, sewer separation projects and the SHCST are constructed. Only preliminary work, based on computer modeling, has been done for this deep rock CSO storage tunnel, estimated to be 30ft (9m) in diameter.



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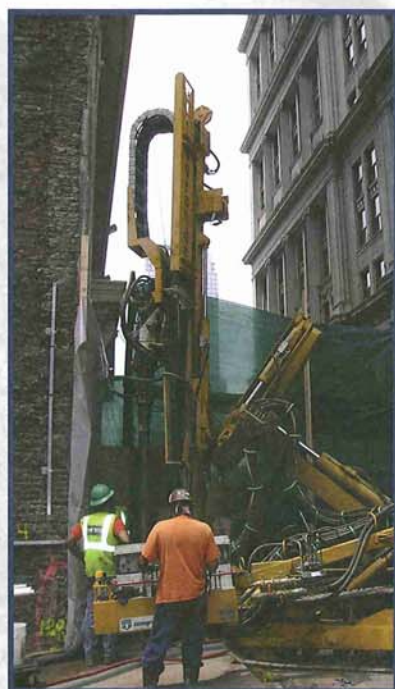
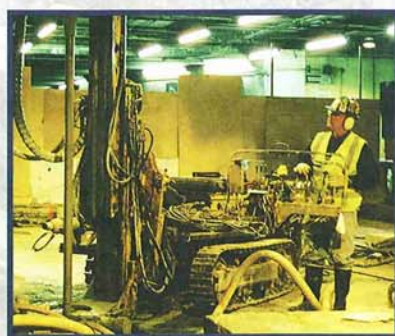
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Geotechnical Construction Coast to Coast

If you're going to San Francisco

The biennial Rapid Excavation and Tunneling Conference (RETc) will be held in San Francisco this June. *T&TNA* previews the conference program from papers to field trips and workshops, when the industry meets in the City by the Bay

In 2009, more than 1,300 people attended the Rapid Excavation and Tunneling Conference (RETc) in Las Vegas, a steady increase from 2007 event in Toronto. And organizers say the 2011 conference this June in San Francisco is promising to be just as successful.

Hosted by the Society for Mining, Metallurgy and Exploration (SME), RETc runs from Sunday, June 19 to Wednesday, June 22. The exhibit, all technical sessions, short courses and social events will be held at the Marriott Marquis. Deadlines for both hotel and advanced reservations are Friday, May 13.

The Conference will start off with two short courses on Sunday: Grouting in Underground Construction and Large Diameter Tunnelling Technologies. It should be noted that you do not need to register for RETc to attend the short courses, and at the same time, registering for the short courses does not include entry to the conference.

Monday through Wednesday are then dedicated to technical sessions running in the mornings from 8:30 to 11:30, and in the afternoons from 1:30 to 5:00 (Wednesday afternoon excluded).

The Alaskan Way Viaduct bored tunnel replacement, not surprisingly, will be featured in several topics, making it easy to catch up on the project at some point during the conference. Papers will be presented Sunday afternoon in the Contracting Practices/Costs technical session, Monday morning in the Large Span Tunnels/Caverns session and Tuesday morning in both the Geotechnical Considerations and the Design & Planning technical sessions. The Washington State Department of Transportation will also be presenting during the Owners' Forum on Sunday.

All in all, RETc offers a thorough

selection of papers, projects and presentations, and it will be a challenge to organize your schedule. Topics vary from Risk Management to Water & Gas Control, and include excavation methods.

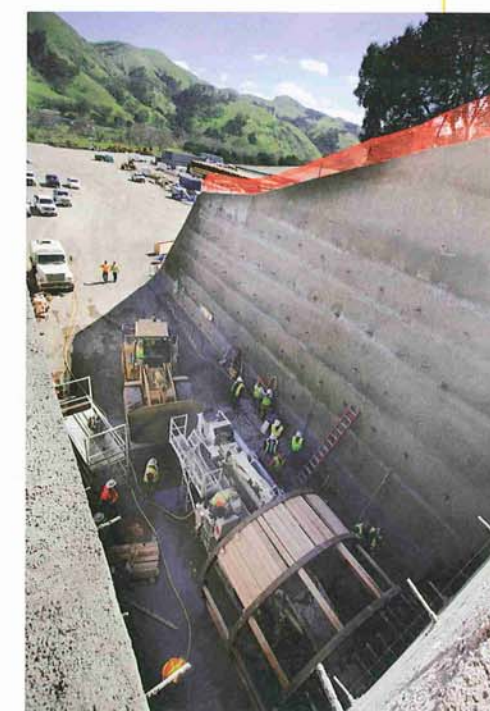
Looking local, projects specific to the San Francisco Bay area will be featured Monday morning including the Bay Tunnel, the New Crystal Springs Bypass Tunnel and the Central Subway (alternatively, check out the SEM/NATM technical session at the same day and time, of which a majority of the projects featured will be from abroad.)

Alongside technical sessions, will run the requisite social events. James Stefanic of Geotec Boyles Bros. will be speaking about the Chilean mine rescue at Monday's Welcoming Luncheon. The UCA of SME Breakfast on Tuesday will include a presentation by chair David Klug, who will introduce incoming UCA chair Jeff Petersen. Tuesday will conclude with the RETc Dinner, featuring Brian Olsen and his 'Art in Action' show.

Field Trips

A visit to the New Irvington Tunnel is scheduled for Sunday afternoon. In addition to multiple roadheaders, contractor Southland/Tutor Perini is excavating the 3.5-mile (5.6km) tunnel using controlled detonation. With an 8.5ft to 10.5ft (2.6m to 3.2m) diameter it will provide a seismically-designed connection between water supplies from the Sierra Nevada Mountains and the Alameda Watershed to Bay Area water distribution systems. This new tunnel will lay parallel to an existing one, which the San Francisco Public Utilities Commission (SFPUC) will take out of service and repair.

The tour, lead by SFPUC, will focus on one of the project's three main tunnelling locations, the Alameda West Portal. Participants will be able to walk into the



Above: RETc offers the opportunity to visit the New Irvington Tunnel. Photo courtesy of SFPUC

heading to observe tunnel support systems and the roadheader. The heading will be approximately 1,500ft (457.2m) from the portal.

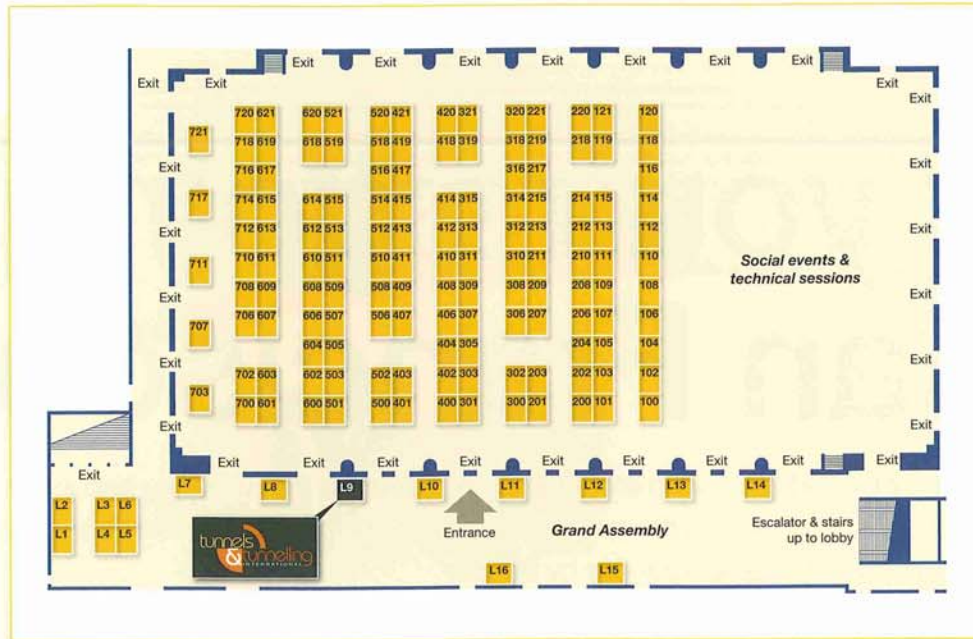
A second trip to the SFPUC's Sunnydale Auxiliary Sewer project will be held Wednesday afternoon.

Keep in mind

Although event details were correct at the time of publication, they are subject to change. Please be sure to check on-site programs and notices for final details. More information is available at www.retc.org

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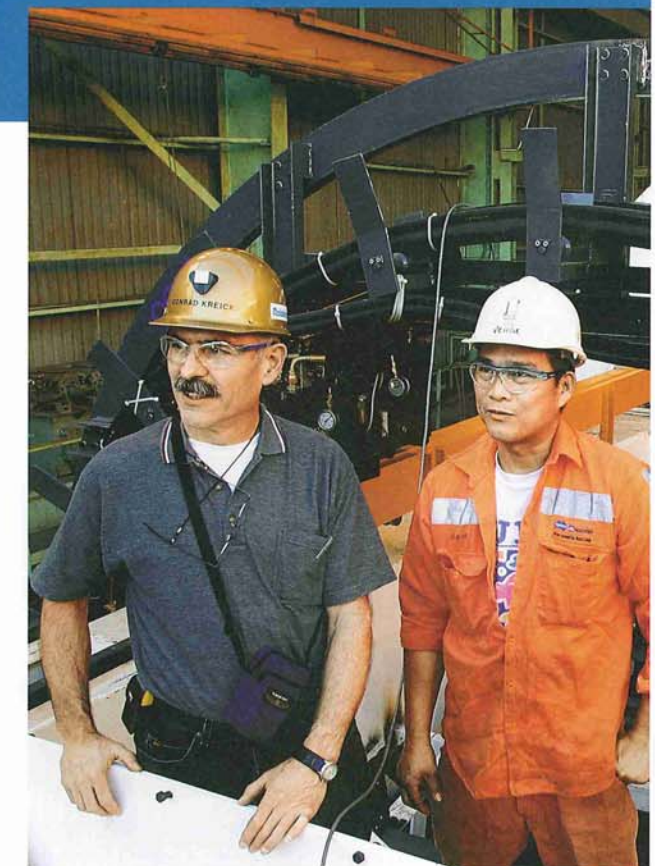
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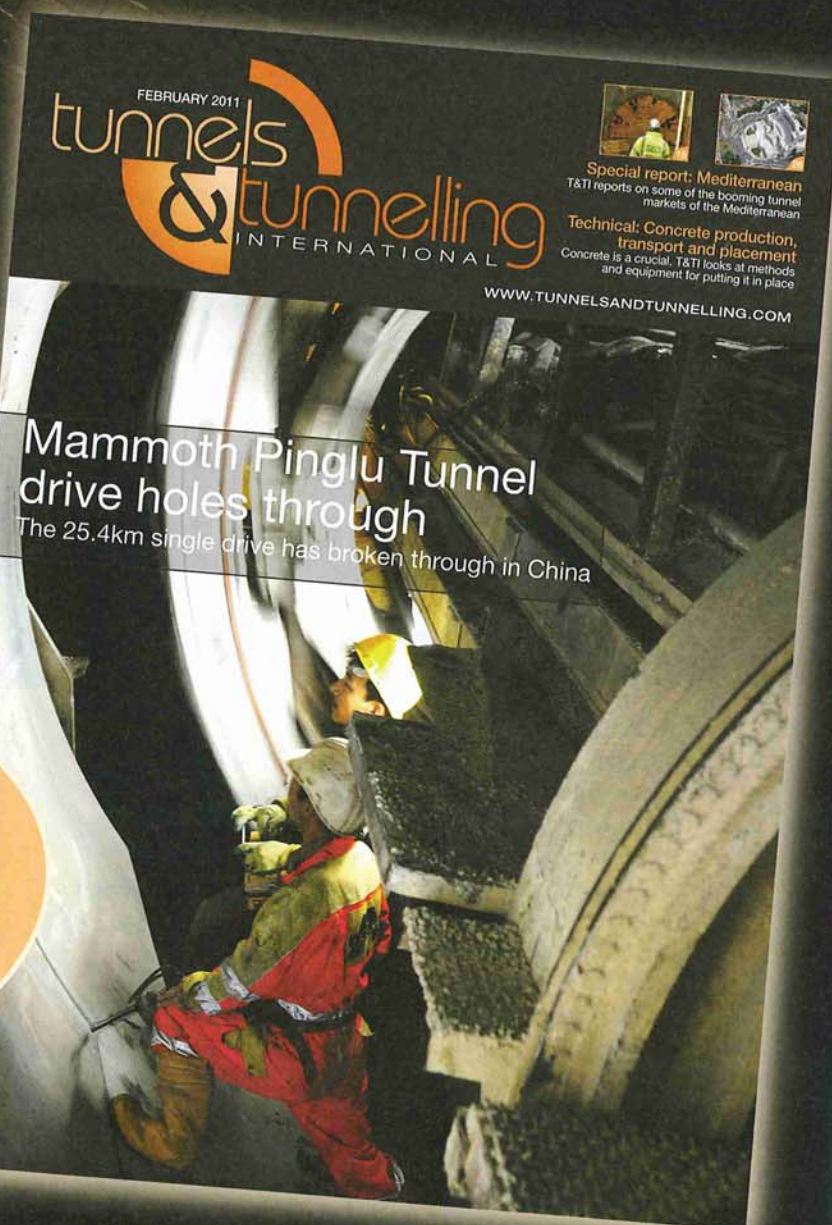
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dates & events

APRIL 29, 2011

Short course on Fundamental of Soft Ground Tunnelling, Red Lion Inn, Bellevue, Washington State

Led by Dr Ed Cording of Univ of Illinois, Urbana-Champaign with Dr Gregg Korbin, Robert 'Red' Robinson (Shannon & Wilson) and Sam Swartz (Jacobs Associates). 0.7 CEUs or seven professional development hours awarded to participants. More from Chada Ellithy on tel.: (206) 766-6466, email ghada.s.ellithy@usace.army.mil or see <http://www.seattlegeotech.org>

APRIL 30, 2011

'Soft Ground Tunnelling in Urban Environments' - 28th Annual Spring Seminar of the Seattle Section of the American Society of Civil Engineers (ASCE), Kane Hall, University of Washington

0.8 CEUs or eight professional development hours awarded to participants. More from Chada Ellithy on tel.: (206) 766-6466, email ghada.s.ellithy@usace.army.mil or see <http://www.seattlegeotech.org>

JUNE 13-17, 2011

Colorado School of Mines Grouting Fundamentals and Current Practice Short Course, Golden, Colorado

This course covers injection grouting as a method to improve soil settlement and strength characteristics, and to decrease permeability of soil and rock masses. Included in the curriculum is a field demonstration of compaction and permeation grouting, flow of ultrafine cement, grout mixing, use of cellular concrete in annular grouting, overburden drilling, grouting of rock anchors and use of packers. For more information about course content, please contact D. Scott Kieffer, Tel: 011-43-316-873-6370; E-mail: kieffer@tugraz.at; To register visit: <http://csmspace.com/events/grouting>

JUNE 19-22, 2011

RETC 2011 - Rapid Excavation and Tunneling Conference and Exhibit, San Francisco, California

RETC is an international forum for the exchange and dissemination of developments and advances in underground construction. For more information contact: RETC Exhibits, 8307 Shaffer Pkwy, Littleton, CO 80127; Tel: 303-948-4213; Email: gury@smenet.org

AUGUST 2, 2011

The Moles Clambake

The Clambake is held annually on the first Tuesday of August and is open to non-members. For more information go to: <http://www.themoles.info/>

AUGUST 17-18, 2011

2011 Beaverdilly

The beavers will be holding the annual Beaverdilly at the Silverado Resort, Napa, CA. For more information go to: <http://www.thebeavers.org>

SEPTEMBER 19-21, 2011

Colorado School of Mines Tunnelling Short Course, Golden, Colorado

The CSM's annual short course covering all aspects of conventional and mechanized tunnel design and construction in hard rock, soft ground

and soils. For more information about course content, please contact Levent Ozdemir; Tel: 303-526-1905; Email: lozdemir1977@aol.com; To register, visit: <http://csmspace.com/events/tunnelling>

SEPTEMBER 26-30, 2011

World Road Congress, Centro Banamex, Mexico City, Mexico

The World Road Association (PIARC) organizes a conference and exhibition every four years. The 2007 show was in Paris, and this year's show in Mexico will focus on roads and road transport. Tunnels are included in one or more technical sessions. For more information visit <http://aipormexico2011.org>

OCTOBER 4-6, 2011

ICUEE-The Demo Expo, Louisville, KY, USA

The largest demo show in North America for the construction/utility industries. The show features live, job-like outdoor demonstrations and indoor exhibits featuring the latest products and services available. For more information visit <http://www.icuee.com/>

NOVEMBER 16-17, 2011

Norwest Trenchless Conference, NASTT Northwest Chapter, Calgary, Alberta, Canada

The North American Society for Trenchless Technology - Northwest Chapter will be presenting the 15th annual Northwest Trenchless Conference in Calgary at the Coast Plaza Hotel. A short course will be held Wednesday, November 16. Registration for the short course is separate from registration from the conference, which will be held with the tradeshow on Thursday. General information is available from chair Nadeer Lalji. Email: nlalji@nastt-nw.com

JANUARY 24-26, 2012

Underground Construction Technology, Houston, Texas

Annual trenchless conference and exhibition focusing on underground utility infrastructure construction and rehabilitation. <http://www.uctonline.com/>

MARCH 14-16, 2012

5th Int Symp on Tunnel Safety and Security, New York

Forum over two and a half days with the themes of risk & security, human behaviour, passive fire protection & construction, active fire protection & fire fighting, ventilation and fire dynamics. Organised by SP Fire Technology of Sweden. Paper abstracts submission deadline 1 June 2011. For more information see www.istss.se, email info@sp.se or tel.: +46 10-516 50 00

A DATE TO REMEMBER...

If you know of a tunnelling related conference, event, seminar or exhibition that is not listed here, we would be delighted to hear from you. Please contact the editor by post, email, fax or through our web site: Editor, 'Tunnels & Tunnelling International', Boundary House, 91-93 Charterhouse Street, London, EC1M 6HR, United Kingdom. Fax: +44 20 7936 6826 Email: editor@tunnelsandtunnelling.com Web: www.tunnelsandtunnelling.com

REST OF THE WORLD

MAY 21 - 26, 2011: WTC 2011 Helsinki - Underground spaces in the service of a sustainable society

The Finnish Tunnelling Association awaits you in Helsinki. A boom in tunnelling is currently underway in Finland. In this exciting environment WTC 2011 has been organised. General subtopics to include: planning the usage of subterranean spaces, municipal services, operational technologies, traffic and logistics, geologic disposal of nuclear waste. Website: www.wtc11.org; Booking / accommodation enquiries: Tel: +358-9-5607500; Email: wtc11@congreg.fi

JUNE 22 - 23, 2011: Tunnel Design and Construction Asia, Sentosa, Singapore

Featuring best practices in geotechnical investigation, EPC contracting, project funding and risk management for Asia's tunnel infrastructure. The keynote speaker will be Heinz Ehrbar, chief construction engineer of AlpTransit Gotthard. Tel: +65 6722 9388; Email: enquiry@iqpc.com.sg

JUNE 29 - 30, 2011: Underground Construction Conference and Exhibition, London

The eyes of the global tunnelling industry are swivelling towards the UK with some of the world's largest underground construction projects getting underway. Event includes: technical and design developments in underground construction, tunnel operation and maintenance, sustainable development and minimising the impact of underground works, a world wide tunnelling perspective, UK projects - today and the future, ground investigation, treatment and monitoring. Tel: +44 (0) 207 973 6695; Email: g.stringer@hgluk.com

SEPTEMBER 12 - 16, 2011: 6th International Symposium on Sprayed Concrete, Norway

Main themes will be design, construction and durability of wet-mix sprayed concrete in underground structures. The Norwegian Concrete Association is currently revising the Publication No. 7, Sprayed Concrete for Rock Support. This will be debated during the symposium. Contact: Siri Engen Email: siri.engen@tekna.no

SEPTEMBER 14 - 15, 2011: IUT 2011, Sargans, Switzerland

The traditional IUT Evening on the first day of the fair, being held in a VSH cavern, will be a highlight: here exhibitors and visitors will be able to exchange views against a relaxed background and experience an unforgettable evening. Contact: Deltacom Projektmanagement +49 (0)40 35 72 32 - 0 info@deltacom-hamburg.de



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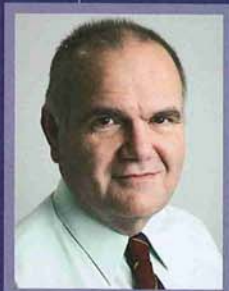
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Tunnels & Tunnelling International ISSN number 0041-414X is published monthly for US\$226 a year by World Market Intelligence Ltd (www.worldmarketintelligence.com), a Progressive Media Group company, John Carpenter House, 7 Carmelite Street, London

EC4Y 0BS, UK. Periodicals postage paid at Rahway, NJ.
POSTMASTER: send address corrections to Tunnels & Tunnelling International c/o BTB Mailflight Ltd, 365 Blair Rd, Avenel, NJ 07001.
US agent: BTB Mailflight Ltd, 365 Blair Rd, Avenel, NJ 07001.

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Tunnel & Underground Engineering

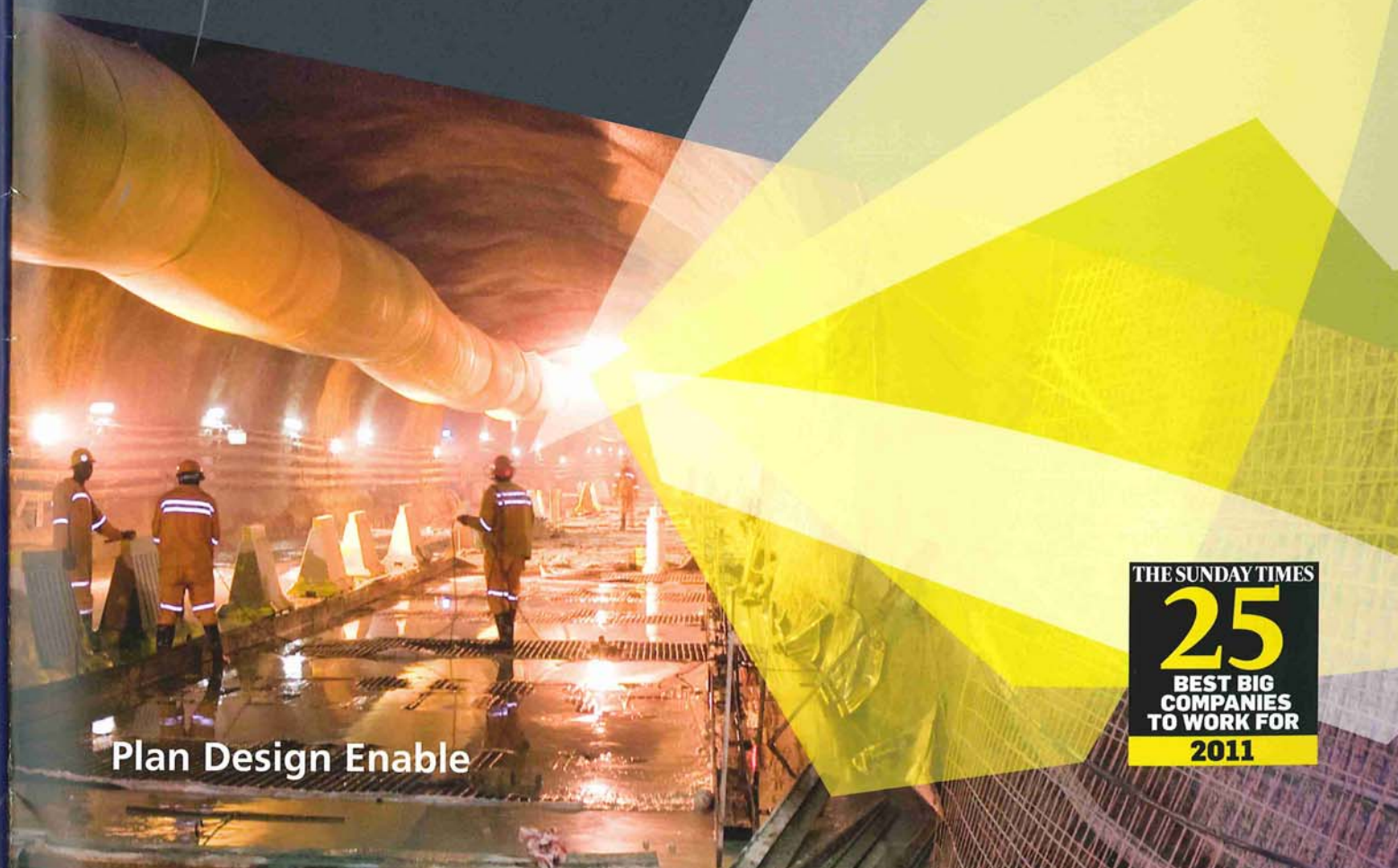
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