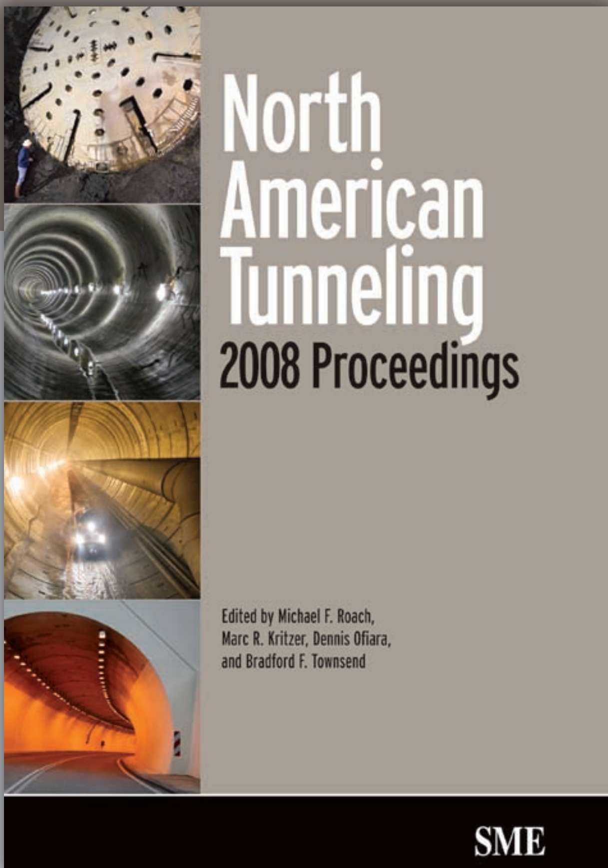
# T&UC
TUNNELING & UNDERGROUND CONSTRUCTION

THE OFFICIAL PUBLICATION OF UCA OF SME WWW.TUCMAGAZINE.COM VOLUME 2 NO 2 JUNE 2008


## PROGRESS AT NIAGARA TUNNEL PROJECT

### Tunnel Demand Forecast

Special Editorial Section from the publisher of *Mining Engineering*




# North American Tunneling 2008 Proceedings

*North American Tunneling* is a "must read" for any professional involved in the underground construction industry. You'll get a down-and-dirty look into dozens of case histories from throughout the world. You'll learn about the challenges faced by designers, contractors, suppliers, and business owners, and how they worked together to overcome them.

Taken from a collection of papers presented at the 2008 North American Tunneling Conference in San Francisco, you'll benefit from the latest thinking on technical advances, new solutions to old problems, fire safety and risk management, design considerations, complex systems, overcoming changes, construction management, cost estimating and scheduling, and tunnel rehabilitation and repair.

Whether it's pipe jacking under the Leipzig train station, boring a water tunnel beneath New York Harbor, or tunneling under glaciers in British Columbia, these internationally recognized experts share their real-life experiences and insights into this rapidly evolving industry.

You'll also get a sneak peak into major projects on the drawing boards, projects that will be making big headlines in the months and years ahead.

## North American Tunneling 2008 Proceedings

**Edited by Michael F. Roach, Marc R. Kritzer, Dennis Ofiara, and Bradford F. Townsend**

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## CHAIRMAN'S COLUMN

# Recognizing those who are working for us

Time is flying and we have all never been busier. On May 5 and 6, the joint ITA-UCA Workshop on Waterproofing was held Newark, NJ. A strong showing of 110 attendees for the lectures were on hand for the first day and more than 30 attendees attended the field demonstration on day two. There are many to thank for this successful event but I will name only a few of the hardworking volunteers who made significant contributions to the success: George Yoggy, Tom Peyton, Dave Klug, Carol Cudworth and Tara Davis.

The updated *Better Contracting Practices for Underground Construction (BCPUC)* is ready for your consumption (page 24). Bill Edgerton and the *BCPUC* committee achieved a speed record for the tunneling community taking this document from the mid-1970s version into the 21st century. They were ably assisted by scores of UCA members who participated in the review and comments sessions during the last couple of years. We can all recommend this to our clients and colleagues. Pick one up at the North American Tunneling Conference (NAT).

The NAT is upon us and the UCA conference planning committee — masterminded by Greg Raines and the track chairs Michael Roach, Marc Kritzer, Bradford Townsend and Dennis Ofiara, as well as the session chairs — have put together a comprehensive and knowledge-packed conference program. Throughout the five-day conference, there will be three workshops with professional development hours or continuing education credits. A full three-and-a-half-days of professional talks are planned, along with a popular field trip to the Devil's Slide Tunnel. We are hoping for record crowds with our location in San Francisco, CA.

New this year at NAT: UCA is holding a student paper competition. The winner(s) will receive a monetary award, as well as travel expenses and conference registration. The award-winning students will present their papers at the UCA breakfast scheduled for Tuesday morning. Please come and recruit these students, but be polite to your competing colleagues.

At the banquet, we will be presenting the UCA awards to our industry's finest (page 26). Congratulations go out to Dr. James Monsees, of Parsons-Brinckerhoff, the Lifetime Achievement Award recipient this year in recognition of his numerous years of tunnel design experience and numerous contributions to the industry and to UCA. Dr. Ray Henn, of Lyman-Henn, is the UCA recipient of the Outstanding Individual Award for his 37 years of energetic contributions to the industry and to the UCA organization. Ray was former AUA chair and recipient of the 2002 ASCE Roebling Award. He is also the author of two books on grouting. Dr. Tor Brekke, retired professor from University of California, Berkeley and tunnel consultant, is the recipient for the Outstanding Educator Award. This is in recognition for his more than 30 years in academia where he inspired many of us to enter the world of design and underground construction through his curriculum and time through his propensity for telling his underground stories combining theory and project lessons. Please extend congratulations to Jim, Ray and Tor.

We are revamping the UCA Web site and making it easy to update and for you to report and celebrate your startups, milestones, records and hole-throughs.

**Brenda Bohlke,**
**UCA of SME Chairman**

# North Shore Connector project bids are 40 percent higher than expected

Under its original plans, the North Shore Connector project in Pittsburgh, PA would extend the Port Authority's Light Rail Transit System, the T, 1.9 km (1.2 miles) in twin bored tunnels below the Allegheny River to the North Shore.

It is a significant regional investment that will support the revitalized downtown Pittsburgh and North Shore. The North Shore Connector will also enable the authority to construct future extensions of the T to other destinations within Allegheny County.

However, plans could change after the lowest construction bid for the next phase of the $435 million subway expansion came in at least 40 percent higher than the agency estimated, the *Pittsburgh Tribune-Review* reported.

The authority would pay $48.9 million for construction of a new Gateway Center T Station if it accepts the apparent low bid from North Shore Constructors II, the joint venture now tunneling under the Allegheny River.

Only two groups submitted bids for the downtown station, and the agency plans to review them before making a decision. It could accept the low bid or choose to seek new bids, possibly changing the scope of the work to entice more contractors.

The second bid, from Joseph B. Fay of West Deer, PA, was $55.7 million.

The Port Authority's contingency account for the project was about $22 million. That's not counting other cost increases, which totaled about $2.8 million because of increasing material prices and a problem with unstable soil.

North Shore Constructors II is a joint venture of Trumbull Corp. of West Mifflin and Obayashi Corp., based in Tokyo, Japan.

The same pairing — under the name North Shore Constructors — won the authority's first contract, for $156.5 million, to dig twin tunnels between downtown and the North Shore by digging under the Allegheny River. Tunneling started in January near PNC Park, and the boring machine has started to pass under the river. It was expected to reach downtown in May. ■

# Caterpillar acquires Lovat

In the 80-plus years that it has been in business, Caterpillar has grown to be the world's largest maker of construction and mining equipment, diesel and natural gas engines, and industrial gas turbines and now, through its purchase of Lovat, Caterpillar is expanding underground.

Since 1972, Lovat has specialized in the custom design and manufacture of tunnel boring machines (TBMs) that are used in the construction of metro, railway, road, sewer, water main, penstock, mine access and telecommunications tunnels. Founded and run by the Lovat family, the company's extensive experience, advanced technology and continued development provide the solutions for any tunneling challenge on any project.

Lovat's international success was built on the foundation of innovation, efficient design management, manufacturing excellence and the guarantee of quality service.

"This acquisition is Caterpillar's entry into the rapidly expanding tunnel boring machine business, and it represents an excellent strategic fit for our companies and the customers we serve around the world," said Stu Levenick, Caterpillar group president.

"Lovat customers are already familiar with seeing Caterpillar products working as support machines at tunnel boring projects, and we intend to leverage our global business with continued investment in the Lovat product line and in the tunnel boring business," said Chris Curfman, Caterpillar vice president with responsibility for mining and underground products.

The financial details of the acquisition were not released. Rick Lovat, president and chief executive officer of Lovat, will join Caterpillar's Global Mining Division and will have responsibility for growing the tunnel boring business within Caterpillar.

"We are honored to be part of Caterpillar," Lovat said. "Our customers should look forward to the integration of Lovat into Caterpillar."

Caterpillar Global Mining supplies support equipment to the surface mining sector and is the world's leading provider of production, support and technology solutions for surface and underground hard-rock mining. ■

# Underground construction is crucial to success of Olympic Games venues

When the 2008 Olympic Games begin in Beijing, China is September it will not only mark the end of the journey for the Olympic torch and the thousands of participating athletes, but the games will also mark the culmination of a massive amount of construction in the city.

On display for the world to see will be 31 new and refurbished venues including the 91,000-seat National Stadium called the “Bird’s Nest” and the aquatics center, called the Water Cube.

What will not be featured as prominently on the television cameras broadcasting the games around the world will be the network of tunnels built beneath the city. But that infrastructure of rail lines will be of critical importance to the games.

While preparing to host the world, China added a subway tunnel that will include four stops in the Olympic Park. The 4.4-km (2.7-mile) subway line that runs through the complex of stadiums, gymnasiums and parks began trial operations in June.

Prior to the opening of that line, Beijing's No. 5 subway line, which runs through the heart of the city from north to south, opened in October. That 27.6-km (17-mile) line took nearly five years to build and includes 23

**Olympics,** continued on page 8

**Canadian Premier Gordon Campbell, blue shirt, celebrates Lovat’s breakthrough in Vancouver, Canada.**

**Olympics,** continued from page 7

stations. It runs from Tiantongyuan North Station in northern Beijing's Changping district to Songjiazhuang Station in southern Fengtai district. Construction of the new subway line began in December, 2002 at a cost of about US$1.6 billion.

The work done for the Olympics is part of a larger plan for the city that includes its subway system expanding to 560 km (348 miles). When the games begin in September, China will have 201 km (125 miles) of subway lines.

Similar preparations are also under way in Vancouver, Canada, site of the 2010 Winter Olympic Games.

The joint venture of SNC Lavalin Constructors Pacific and SELI achieved the breakthrough of the second of two tunnels for the Canada Line in Vancouver.

On March 4, a 440-t (485-st) Lovat RME238SE Series 22400 earth pressure balance tunnel boring machine (TBM) broke through the ground into the future site of Canada Line's Waterfront Station. The breakthrough completes the second of two side-by-side bored tunnels.

The twin 2.45-km (1.5-miles) long tunnels will form part of a transit connection between the Vancouver International Airport and Richmond City Center with downtown Vancouver.

Geological conditions encountered consisted of sandstone (containing volcanic dykes) and glacial till-containing large granitic boulders, clay and cohesionless sands and silt. A Lovat Ground Conditioning System using foam additives was implemented to cope with the varied geotechnical conditions.

The 6.1-m- (20-ft-) diameter TBM attained average production rates of approximately nine rings daily, with a best daily production of 21 rings (29.4 m or 96 ft). Best weekly and monthly production rates were 105 rings (147 m or 482 ft) and 331 rings (463 m or 1,519 ft), respectively.

The transit line is expected to be in operation for the commencement of the 2010 Winter Olympic Games.

Lovat is also involved with the 2012 Summer Games in London, where a Lovat TBM was used to move power lines underground in advance of the 2012 games. The 3.2-km (2-mile) stretch of a tunnel that will carry power lines underneath London's 2012 Olympic Park was completed on April 4, 2007. That tunnel is part of one of two 9.6-km (6-mile) tunnels that will be used in place of 52 pylons that were removed from the east London skyline in Lower Lea Valley. The tunnels will enable the power needed for the games, and the future, to be carried underground. Four such tunnel stretches were completed in 2007.

Further along on the Olympic schedule, tunnel drilling specialists at Wirth were among those celebrating when the 2014 Winter Games were awarded to Russian candidate Sochi. Russia is using state-of-the-art technology from Erkelenz to establish the infrastructure at the Black Sea.

Russia committed to spending more than 9 billion euros in order to transform the Black Sea resort Sochi into a winter sports mecca in just a few years.

For this key international project, the Russian organizers used two Wirth T3.20 roadheaders for construction of the large bypass tunnel to relieve traffic in the center of the city. The T3.20 is a powerful and highly reliable roadheader that is specially designed for operation in medium-strength to hard rock up to 150 MPa. ■

# East Side Access contract awarded

Jacobs Engineering Group and its joint venture partner, LiRo Engineers, received a contract from the Metropolitan Transportation Authority Capital Construction Co. to provide consultant construction management services for the East Side Access project in New York City.

Officials estimate the value of the seven-year contract to be $75 million.

The project involves boring nearly 11 km (7 miles) of railroad tunnels in Manhattan and Queens; laying 15,000 m (50,000 ft) of track; building a new terminal under Grand Central Terminal and building a new commuter station in the Sunnyside Yard in Queens in addition to extensive infrastructure work, Jacobs said in a statement.

The new tunnel and track system will provide an alternative route for the Long Island Railroad (LIRR) trains that currently travel underground to Pennsylvania Station on Manhattan's West Side into the new terminal under Grand Central Terminal on the East Side. The connection will increase the LIRR's capacity into Manhattan and shorten travel time dramatically for commuters traveling from Long Island and eastern Queens to the East Side of Manhattan.

The project requires using giant tunnel boring machines to excavate more than 1.6 km (1 mile) of hard-rock, dual-bored tunnels under Park Avenue in Manhattan and to bore four soft-ground tunnels to the Sunnyside Yard in Queens. In addition to building the concourse under Grand Central Terminal, the project includes construction of new entrances, ventilation buildings and substantial surface work that will be completed during ongoing rail activity in Sunnyside Yard.

Jacobs Group vice president Kevin J. McMahon said, "We are delighted to have been selected with our joint venture partner for this project. We look forward to continuing our relationship with the Metropolitan Transportation Authority by providing the services needed to support its goals of promoting economic development and improvements in services for its customers, which help improve the quality of life in the New York metropolitan region." ■

# Robbins completes tunnels at Po Shan

On March 17, a 3.5-m-(11.5-ft-) diameter Robbins tunnel boring machine (TBM) completed two drainage tunnels in Hong Kong without a conventional backup system. The short tunnels, measured just 244 m (800 ft) and 165 m (541 ft) in length.

The Po Shan Road project is a landslide prevention project aimed at controlling ground water accumulation during storms. The tunnels, for the China State/China Railway joint venture, were TBM-driven due to the location of condominium buildings less than 50 m (164 ft) from the jobsite. Boring restrictions in the heavily populated area also limited TBM excavation to eight hours a day. During the night shift, Robbins-supplied maintenance personnel performed routine upkeep of the machine.

The majority of new design elements on the Robbins TBM were customized for the short tunnels and small jobsite. The entire launch area for the machine measured 25 m (82 ft) wide by 27 m (88 ft) long, with the tunnel portal just 50 m (164 ft) from the busy Po Shan Road.

**The unique Robbins machine was designed for use on the small Po Shan jobsite (just 25 m wide by 27 m long or 82 ft wide x 88 ft long).**


Muck removal was accomplished using a series of conveyors on wheels, which emptied into a steel silo for removal by dump trucks. Though slower than conventional setup, the TBM still excavated a best day of 22 m (72 ft) in less than six hours. Electrical transformers and control cabinets remained at the tunnel portal as the machine bored, connected by umbilical cables containing power and electrical control cabling.

Several hundred subvertical drainage holes are now being drilled from the inside of the bored tunnels. Water will eventually be drained from the hillside into the drainage tunnels by these subvertical holes. A modified drill rig and hydraulic hammer are being used to drill the holes and install slotted drainpipes. The amount of drainage needed will be continuously monitored using standpipe piezometers fitted with automatic loggers. The meters will transfer data to engineering offices in real-time. Water collected inside the tunnels will be channeled to a nearby public storm water drainage system. ■

# Financing set for $1.6 billion Ontario Road project

Construction of a $1.6-billion, 12-km (7.4-mile) access road linking Ontario's Highway 401 to a planned new international bridge over the Detroit River at the Detroit-Windsor border crossing is expected to start in 2009. The Ontario and Canadian governments announced this month that they will finance the capital cost on an equal basis.

While the six-lane, below-grade highway will go through Windsor and adjacent communities, the below-grade construction will minimize noise and keep the trucks out of sight. "There will not be any traffic lights," said Transport Canada spokesperson Mark Butler. With 11 tunnel sections totaling 1.8 km (1.1 miles) and 97 $hm^2$ (240 acres) of parkland that will be created on adjacent property, the Windsor Essex Parkway will be five times more expensive per kilometer than any highway previously built in Ontario.

The Detroit/Windsor gateway is North America's busiest commercial border crossing, with an estimated 8,000 to 12,000 daily truck trips. Those trucks are forced to travel along Windsor's streets and local county roads, as Highway 401 dead ends about 12 km (7.4 miles) short of the border.

An environmental assessment being carried out by URS Canada, Markham, Ontario, will be submitted to the Ontario Ministry of the Environment and the Canada Environmental Assessment Agency later this year. No decision on the construction delivery method has been made and property acquisition has not started, said Butler.

"We have been down for a long time as the decline of manufacturing in our area has hurt the construction industry," said Jim Lyons, executive director of the Heavy Construction Association of Windsor.

An estimated 12,000 construction jobs, two-thirds of them in Windsor, will be created by the five-year construction project, said the Detroit River International Crossing Group, a special bi-national committee working to improve transportation links between Canada and the United States. It recently announced the preferred route.

Transportation planners in both countries are working out ideas for the second bridge to be located down river from the Ambassador Bridge. Several site options are being considered and final selection is expected in a few months, said Butler. ■

# Museum to celebrate Colorado tunneling history

The Western Museum of Mining and Industry will celebrate the 35th Anniversary of the Eisenhower Tunnel with an exhibit called, Colorado Tunneling. The exhibit will launch June 20, 2008. It will feature modern tunneling methods with photographs of transportation and water tunnels constructed throughout Colorado. Temporarily on loan from the Colorado Department of Transportation (CDOT) is a scale model of the construction for the Eisenhower Tunnel. The Kiewit Construction Co. is loaning a scale model of a state of the art tunnel-boring machine. Denver Water, CDOT, BT Construction, Mine Development and Engineering Corp., Deere & Ault Consultants and Lyman Henn Inc. are supplying construction photos. The exhibit is organized by Raymond Henn of Lyman Henn, Inc. in Denver and will run through August 30, 2008. Henn can be reached at 303-534-5789 ext. 3212 or by e-mail at rhenn@lymanhenn.com. Customary admission applies.

Contact the Western Museum of Mining & Industry; phone 719-488-0880, Web site www.wmmi.org. ■

## Herrenknecht nominated for Hermes Award 2008

Tunnel boring machine (TBM) builder Herrenknecht was nominated as one of the five finalists for the international technology prize, the Hermes Award 2008.

Herrenknecht was nominated for its innovative new pipeline laying technology, Direct Pipe, that simplifies the underground laying of long pipelines. The five nominated companies were presented with their nomination certificates at the Hanover Trade Fair on April 21, 2008.

Herrenknecht was selected from a field of more than 50 applications as one of the top five companies for the Hermes Award 2008. This internationally prestigious award is awarded every year at the opening ceremony of the Hanover Trade Fair. To be eligible for entry, products must meet the following conditions: they must be being exhibited for the first time at the 2008 Hanover Trade Fair, they must have been tested in industrial use and/or be in actual industrial use and they must be regarded as particularly innovative from a technical and ecological standpoint. Wolfgang Wahlster, director and chief executive officer of the German Research Center for Artificial Intelligence (DFKI) and chairman of the jury, judged the quality of this year's entrants to be extremely high. "It was a neck and neck race for the first five places. All five nominated products are quite outstanding." ■

## Leadership change to come at Frontier Kemper

After more than 35 years in the construction industry and more than eight years and president and chief executive officer (CEO) of Frontier-Kemper, Galyn "Rip" Rippentrop will retire effective July 4, 2008.

Rippentrop began his career in the underground construction industry in 1978 as a project engineer with Peter Kewitt and Sons (PKS) at a the Virginia Pocahontas Mine No. 5 and No. 6. He remained with PKS for 23 years and joined Frontier Kemper in 1999 as president and CEO.

Rippentrop led Frontier Kemper through three changes in ownership and a strategic plan for growth into new markets.

In a statement released by Frontier-Kemper, the company said, "We regret and respect his decision to watch the future development of the company more from a distance, and are glad that he will continue to add value to the company by remaining on FKCI's board.

"We are also pleased to announce that W. David Rogstad, current vice president and chief operating officer (COO), has accepted the position as the company's president and CEO, effective July 4, 2008."

Rogstad joined Frontier Kemper as an estimator in the company's Evansville, IN office in 1995. He was promoted to vice president and president of the company's Northwest Division Office. Two years later, he was promoted to senior vice president and COO in 2007. He has been involved with all aspects of the business including serving as an officer of the company on the board of directors for the past eight years.

Rogstad's career began 29 years ago with a position of estimator with Genstar Construction in Bellevue, WA. Since then, he has had many titles with a variety of companies at many construction projects. ■

# CALL FOR PAPERS

RAPID EXCAVATION AND TUNNELING CONFERENCE

# RETC

## RAPID EXCAVATION AND TUNNELING CONFERENCE

**June 14-17, 2009 • Las Vegas, Nevada**

## INTRODUCTION

RETC is the premier international forum for the exchange and dissemination of developments and advances in underground construction. RETC provides innovative solutions to the unique challenges associated with the tunneling industry.

Since the first conference in 1972, RETC has been recognized as the premier international tunneling conference for contractors and engineers. Conference attendance exceeds 1,000 professionals from more than 30 countries. Industry sectors include: construction, mining, geotechnical engineering, exploration, environmental, economics, manufacturing, government, land, water/wastewaster, and transportation.

## CALL FOR PAPERS

The 2009 RETC Organizing Committee has issued a Call for Papers. Prospective authors should submit the following by June 15, 2008:

- Abstract of 100 words.
- Contact author, address, phone, fax, and email
- Please indicate project name.

*The ideal paper presents an interesting or unique challenge and the solution or outcome of that challenge.*

TOPICS

- Contracting Practices
- Design and Planning
- Design /Build Contracts
- Difficult Ground
- Environment/Health & Safety
- EPB/Slurry Shield Tunnels
- Geotechnical Considerations for Underground Work
- Ground Improvement/Rehabilitation/ Water Control
- Ground Support and Tunnel Linings
- International Projects
- Large Rock Tunnels
- Microtunneling
- Mining Applications
- NATM Tunnels
- New and Innovative Technologies
- New Projects
- Shafts and Raises
- TBM Case Histories
- Water and Gas Control

*Additional topics of interest will be considered.*

FORWARD TO:

RETC
c/o SME
Attn: Tara Davis
8307 Shaffer Parkway
Littleton, Colorado 80127 USA
Fax: 303-948-4265
Online submissions: www.retc.org

Authors will be notified of acceptance by September, 2008. Final manuscripts from accepted authors are due January 15, 2009. Manuscripts are mandatory for inclusion in the program and will be included in the proceedings volume distributed on-site to all full registrants.

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Construction Institute of American Society of Civil Engineers

| TUNNEL NAME | OWNER | LOCATION | STATE | TUNNEL USE | LENGTH (FEET) | WIDTH (FEET) | BID YEAR | STATUS |
|---|---|---|---|---|---|---|---|---|
| ESA GCT Caverns Project | NYCTA (MTA) | New York | NY | Station | 5,000 | Various | 2007 | Awarded with NTP 04/01/08 |
| County Grounds Tunnel | Milwaukee MSD | Milwaukee | WI | Flood Management | 2,700 | 17 | 2007 | Rebid late 2008 |
| Lake Mead Tunnel #3 | SNWA | Las Vegas | NV | Water | 15,500 | 20 | 2007 | $447 million bid by Impregilio |
| Bi-County Water Tunnel | Washington Suburban Sanitary Commission | Laurel | MD | Water | 28,000 | 10-12 | 2008 | Advertising May 2008 |
| Lake Mead IPS 2 Connection | Southern Nevada Water Authority | Las Vegas | NV | Water | Tunnel 600<br>Shaft 380 | Tunnel 14,<br>Shaft 28 | 2008 | Bidding |
| River Mountain Tunnel #3 | Clean Water Coalition | Las Vegas | NV | Wastewater | 44,000 | 15 | 2008 | Design |
| CWC Reach 3 | Clean Water Coalition | Las Vegas | NV | Wastewater | 7,500 | 15 | 2008 | Design |
| DRO-2 | Detroit Water and Sewer Department | Detroit | MI | Wastewater | 6,400 | 21 | 2008 | Bid date 05/29/08 |
| Mission Trails<br>#1 Tunnel<br>#2 Tunnel | SDCWA | San Diego | CA | Water | 2,000<br>2.,875 | 11<br>11 | 2008<br>2008 | Advertising April 2008 |
| New Crystal Springs Bypass Tunnel | S.F. Public Utility Commission | San Francisco | CA | Water | 4,200 | 13 | 2008 | Advertising June 2008 |
| Bay Tunnel | S.F. Public Utility Commission | San Francisco | CA | Water | 25,000 | 9 | 2008 | Advertising August 2008 |
| Harbor Siphons Tunnel | NYC-DEP | New York | NY | Water | 10,000 | 10 | 2008 | Advertising late 2008 |
| Port of Miami Tunnel | Florida DOT | Miami | FL | Highway | 4,000 | 36 | 2008 | Awarded, in |
| Port Mann | Great Vancouver Regional District | Vancouver | BC | Water | 3,300 | 10.5 | 2008 | Advertising Nov. 2008 |
| SVRT BART | Santa Clara Valley Trans. Authority | San Jose | CA | Subway | 22,700 twin | 20 | 2009 | Under design |
| Upper Rouge River CSO<br>North Segment<br>South Segment | Detroit Water and Sanitation Authority | Detroit | MI | CSO sewer | 18,500<br>21,200 | 20<br>32 | 2009<br>2008 | Advertising late 2008<br>Kenny/ Obayashi low bid |
| Univ. Link Light Rail Extension | Sound Transit | UW Tunnels<br>Capitol Hills | WA | Rail<br>Rail | 12,000 x 2<br>3,800 x 2 | 22<br>22 | 2009<br>2009 | Advertising Dec. 08 and July 09 |
| Sewer replacement | Miami Dade | Miami | FL | Sewer | | 5 | 2008 | Under design |
| Market St, Drainage Improvements | City of Charleston | Charleston | SC | Sewer | 3,000 | 10 | 2008 | Under design |

There is an extensive list of upcoming projects in the New York City area available on the Internet at www.mta.info under the Capital Construction, Procurement link. These are projects for the NYCT, MNR, LIRR, MTACC and B&T.
For more information see http://www.mta.info/mta/capital/eotf-allagency.htm.

| TUNNEL NAME | OWNER | LOCATION | STATE | TUNNEL USE | LENGTH (FEET) | WIDTH (FEET) | BID YEAR | STATUS |
|---|---|---|---|---|---|---|---|---|
| South River Tunnel | City of Atlanta | Atlanta | GA | Wastewater | 9,000 | 14 | 2008 | Advertising in late 2008 |
| Hudson River Crossing | NJ Transit Board THE Program | Newark | NJ | Subway | 8,000 x 2 | 20 | 2009 | Under design |
| Hudson River Crossing | NJ Transit Board | New York | NY | Rail | 21,600 + | | 2009 | Under design |
| W. Corridor Light Rail Tunnel | Transit Authority | Denver | CO | LRT | 280 x 2 | 18 | 2009 | Under design |
| Drumanard Tunnel | Kentucky DOT | Louisville | KY | Highway | 2,220 x 2 | 35 | 2010 | Under design |
| Drumanard Tunnel - Pilot Tunnel | Kentucky DOT | Lousiville | KY | Highway | 2,200 | 12 x 12 | 2008 | Bid 2007 - bids rejected |
| New Irvington Tunnel | S.F. Public Utility Commission | San Francisco | CA | Water | 18,200 | 12-13 | 2009 | Advertising May 2009 |
| Caldecott 4th Bore | CALTRANS | San Francisco | CA | Highway | 5,000 | 50 | 2009 | Advertising Feb. 2009 |
| Near Surface Interceptors | Narragansett Bay Commission | Providence | RI | Sewer | 19,500<br>11,000 | 3-6<br>3-6 | 2010 | Preliminary design |
| Alum Creek Relief Sewer (1st of 3 phases) | City of Columbus | Columbus | OH | Sewer | 26,000 | 10 | 2010 | Under design |
| Water Tunnel # 3 KCT Tunnel | NYC Dept. of Envr. Protection | New York | NY | Fresh Water | 24,000 | 20 | 2010 | Under design |
| ESA Queens Tunnel | NYCTA-MTA | New York | NY | Subway | 10,500 | 20 | 2008 | Bids due June 2008 |
| Corvalis to Fox Mill Water Main | Fairfax County Water Authority | Fairfax | VA | Water | 8,600 | 8 | 2008 | Advertising mid 2008 |
| Lockbourne Interceptor System Tunnel | City of Columbus | Columbus | OH | Sewer | 10,000 | 12 | 2009 | Under design |
| LBJ Highway Tunnel | Texas Dept. of Transportation | Dallas | TX | Highway | 5,300 x 2 | 60 x 35 | 2010 | Under design |
| Kicking Horse Canyon Tunnel | BC Dept. of Transportation | Golden | BC | Highway | 4,800 x 2 | 45 x 32 | 2010 | Under design |
| Belmont-Southport Plant Connection | City of Indianapolis DPW | Indianapolis | IN | Sewer | 29,000 | 12 | 2009 | Mid 2009 bid |
| Palisaides Tunnel | NJ Transit THE Program | Newark | NJ | Subway | 5,400 x 2 | 20 | 2009 | Under design |
| New York City Tunnel | NJ Transit THE Program | New York | NY | Subway | 6,000 x 2 | 20 | 2010 | Under design |
| THE 34th St. Cavern & Station | NJ Transit THE Program | New York | Ny | Subway | 2,200 | 60 x 60 | 2010 | Under design |
| Western Reg. Conveyance Tunnel | Northern KY Sanitation District # 1 | Covington | KY | Sewer | 36,000 | 13 | 2008-12 | Bid date 2009-2010 |
| Waller Creek Tunnel | City of Austin | Austin | TX | Highway | 5,300 x 2 | 60 x 35 | 2010 | Under design |

The editor's of Tunneling & Undergound Construction encourage UCA of SME members to submit projects to the online Tunnel Demand Forecast at www.smenet.org, log in as a member. The items will be posted on the online TDF once they are verified.

FEATURE ARTICLE

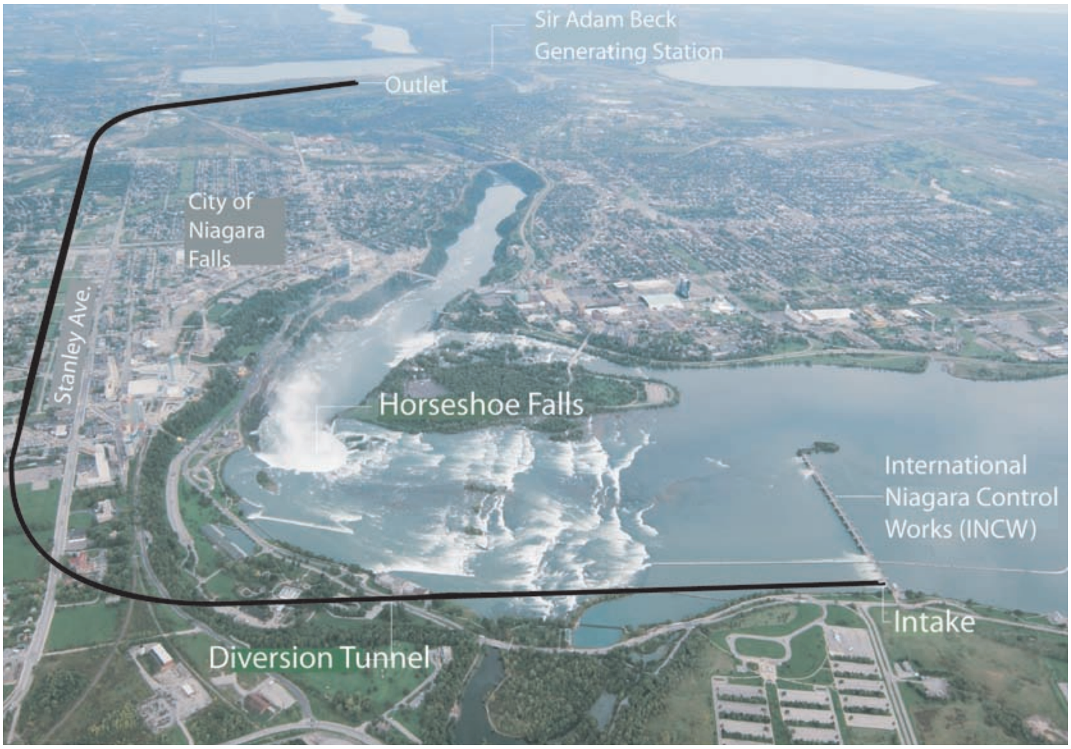
# World's largest TBM keeps Niagara Project on track

The Niagara Tunnel Project (NTP) is a 10.4-km- (6.5- mile-) long, 14.4-m (47.5-ft) bored tunnel that will run under the city of Niagara Falls from the Upper Niagara River to the Sir Adam Beck power station.

The completed project will enhance the capacity of the Sir Adam Beck power station by adding 500 $m^3$/sec (17,657 cu ft/sec) of water through the tunnel.

**FIG. 1**

**Tunnel route.**




The project uses the world's largest hard-rock tunnel boring machine (TBM) at 14.4 m (47.5 ft) in diameter to excavate the tunnel. Features of the project include the use of a high performance (HP) main beam TBM, state-of-the-art ground support and tunnel logistics systems. A continuous conveyor is used for muck transport from the TBM to the disposal area.

In June 2004, the Ontario government announced that Ontario Power Generation (OPG) had been given approval to proceed with the third tunnel under the city of Niagara Falls — the first two tunnels were constructed in the 1950s using drill-and-blast techniques.

The third tunnel, appropriately named the Niagara Tunnel Project (NTP), consists of a 10.4-km- (6.5-mile-) long TBM-bored, concrete-lined tunnel with a finished diameter of 12.5 m (41.1 ft).

Doug Harding

**Doug Harding,** is vice president The Robbins Company, 29100 Hall Street, Solon, OH 44139, harding@robbinstbm.com.

In August 2005, OPG the selected of Strabag of Austria, one of the largest construction companies in Europe, as the contractor to build the NTP at a price of C$600 million.

In September 2005, Strabag selected The Robbins Co. of Solon, OH to design, manufacture and deliver a new 14.4- m- (47.5-ft-) diameter high performance, state-of-the-art main beam hard rock TBM to be used in the excavation of the tunnel. To meet the aggressive construction schedule as requested by OPG/Strabag, the TBM needed to be supplied as ready-to-bore within a 12-month period after the contract was awarded to Robbins.

### Description of the Niagara Tunnel Project

The Niagara River is 59 km (35 miles) long and runs in a north-south direction from Lake Erie to Lake Ontario. It is an international boundary between Canada and the United States. The average flow of the river is estimated to be 6,000 $m^3$/sec (212,000 cu ft/sec).

Under the terms of a 1973 treaty, all excess waters available for water diversion for power generation is divided equally between Canada and the United States. An exception allows Canada to divert an additional 142 m³/sec (5,000 cu ft/sec) of water from the Welland Canal or the Niagara River by a 1940 government agreement.

To best use the water available for diversion, the New York State Power Authority (NYSPA) and Ontario Power Generation (OPG) signed an agreement in 1965 to share generation capacity. Both power companies have rented available power generating capacity from each other to maximize utilization of their respective shares of water available for power production. This agreement allows each company to minimize the costs of equipment outages and to provide for the handling of ice or other power delivery problems. In simple terms, when OPG-Sir Adam Beck power stations (Canada) has surplus water shares available for diversion and no extra generation capacity, they rent the generation capacity available at NYSPA-Robert Moses power station for power.

To meet increased demand, and to increase the power output of the Sir Adam Beck power station, a new tunnel to supply additional water capacity and upgrading of the 16 existing generators will be done. This new tunnel, NTP consists of boring a 14.4-m (47.5 ft) tunnel at a depth of 150-m (492 ft) below the city of Niagara Falls.

Currently, 1,800 m³/sec (63,566 cu ft/sec) of water are available to be diverted to the Sir Adam Beck generating stations for power production. The Niagara Tunnel will allow an additional 500 m³/

**FIG. 2**

**TBM general assembly.**

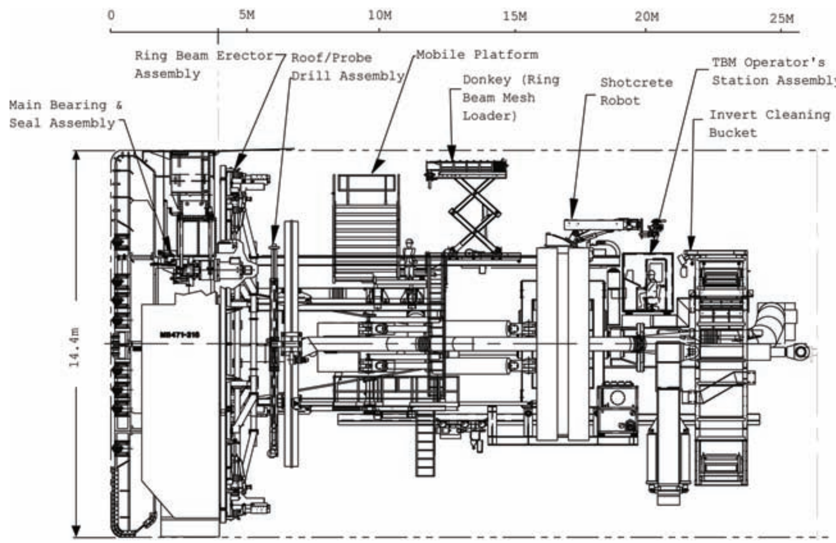


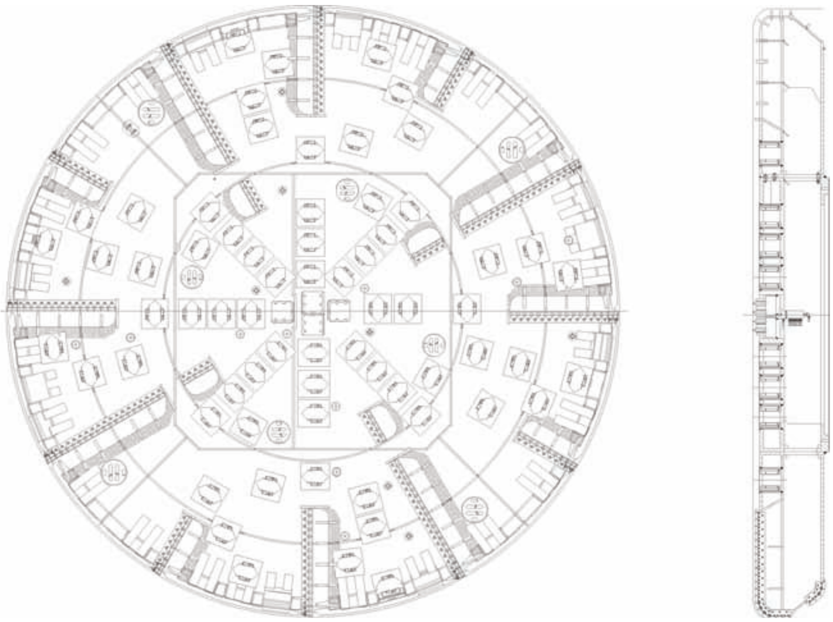

Table 1

**TBM specification sheet.**

| | |
|---|---|
| **TBM type** | Robbins HP 471-316 |
| **Year of manufacture** | 2006 |
| **Machine diameter (new cutters)** | 14.44 m (47.2 ft) |
| **CuttersFace** | Series 508 mm (20 in.) |
| **Center** | Series 431.8 mm (17 in.) |
| Number of disc cutters | 85 |
| Nominal recommended individual cutter load | 35 t /cutter |
| **Cutterhead** | |
| Cutterhead drive | Electric motors/safe sets, gear reducers |
| Cutterhead power | 6330 HP (15 °— 422 HP) |
| Expandable to 16°— 422 HP | |
| Cutterhead speed | 0–5.0 rpm |
| Approximate torque (low speed) 0–2.4 rpm | 18,800 kNm |
| Approximate torque (high speed) 5 rpm | 9,025 kNm |
| **Thrust cylinder boring stroke** | 1,729 mm (68 in.) |
| **Hydraulic system** | 300 HP (225 kW) |
| System operating pressure at maximum | 275.7 bar (4,000 psi) |
| Recommended cutterhead thrust | |
| Maximum system pressure | 310 bar (4,500 psi) |
| **Electrical system** | |
| Motor circuit | 690 VAC 3-phase, 60 Hz |
| Lighting system/control system | 120V/24 VDC |
| Transformer size | 4°— 1,700 kVA + 1°— 1,000 kVA |
| Primary voltage | 13,800 V 60 Hz |
| **Machine conveyor** | |
| Width | 1,370 mm (54 in.) |
| **TBM Weight (approx.)** | 1.1 kt, excluding drilling equipment |

**FIG. 3**

**Cutterhead configuration.**



sec (17,657 cu ft/sec) of water when available to be diverted for power generation.

## Project alignment

The Niagara Tunnel will follow the same basic route as the existing two tunnels, parallel to Stanley Ave. (Fig. 1).The new tunnel starts on OPG property at Queenston with a minus 7.82 percent decline for a length of approximately 1,500 m (4,921 ft) reaching a depth of up to 150 m (492 ft) below the city of Niagara Falls. There, the tunnel proceeds with a relatively horizontal plane for a about 7,400 m (24,278 ft).The alignment will follow a horizontal curve radius of more than 1,000 m (3,281 ft) in length. The tunnel ends on the Niagara River at the International Water Control Dam located 1.6 km (1 mile) upriver from the Horseshoe Falls with an incline gradient of +7.28 percent over the final 1,500 m (4,921 ft).

The inside diameter of the finished tunnel will be 12.8 m (42 ft). It will be lined with 60 cm (24 in.) of unreinforced concrete with double layer seal and prestressed injection concrete.

## Geology

The geology is varied, consisting of limestone, dolostone, sandstone, shale and mudstone. The rock strength ranges from 15 to 180 MPa (2,100 to 26,000 psi), with most of the rock in the 40 to 100 MPa (5,800 to 15,000 psi) range. With the exception of sandstone, the geology is basically nonabrasive. Most of the muck (approximately 30 percent) removed from the tunnel will consist of Queenston shale.

## Project approach

For the construction of the NTP, Strabag purchased a new Robbins HP main beam TBM, and a new HP backup system provided by Rowa Tunnel Logistics of Wangen, Switzerland.

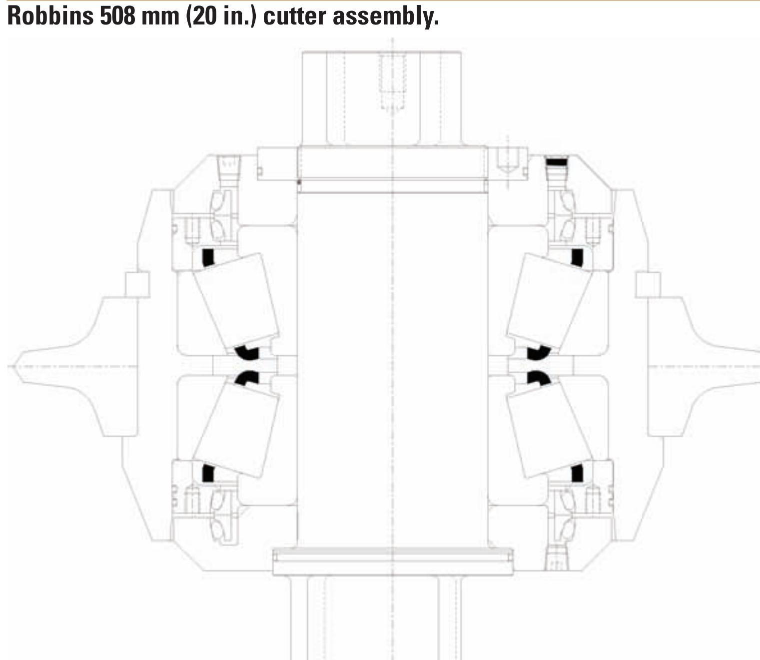
The TBM Model 471-316, nicknamed Big Becky, is the world's largest hard-rock TBM ever manufactured. Design of the HP machine includes the use of 508-mm (20-in.) rear-mounted cutters, high cutterhead power and state-of-the-art ground support equipment (Fig. 2). Specifications for the TBM are in Table 1.

## Cutterhead design

The cutterhead design for the NTP project consists of a six-piece bolted and doweled hard-rock configuration that includes 12 muck buckets with radial face and gage openings. Grill bars, abrasion resistant carbide buttons and abrasion resistant boltable bucket teeth are provided along the bucket openings. An abrasion-resistant faceplate and gage plates along with periphery grill bars have been provided on the cutterhead structure. Foam nozzles and rotary swivels have been provided to avoid problems if sticky ground is encountered and to assist with the flow of the material and

**FIG. 4**

**Robbins 508 mm (20 in.) cutter assembly.**



avoid plugging of the buckets. The finished weight of the cutterhead is more than 400 t (440 st) (Fig. 3).

The cutterhead is equipped with 85 cutter discs. It includes Robbins 508 mm (20 in.) wedge lock cutter assemblies with a nominal thrust capacity of 35 t (39 st)/cutter and an operating capacity of 50 t (55 st)/cutter. Overcut is provided by shimming of the outmost gage cutters should squeezing ground be encountered (Fig. 4).

Even though the Niagara geology is primarily soft rock, Strabag and Robbins agreed to provide the higher capacity cutters and 508 mm (20 in.) rings to reduce the need for cutter changes. In addition, the 508 mm (20 in.) cutters and HP TBM configuration will allow the use of the TBM on future hard-rock projects.

**FIG. 5**

**TBM and backup assembly in launch pit.**

## TBM assembly

To comply with the aggressive construction program outlined by OPG/Strabag, the supplied TBM system had to be designed, manufactured, assembled and made ready to bore within 12 months after contract award.

The project team achieved this by the preassembly of the major critical components in a workshop and final assembly and commissioning of the complete machine at the project site. By doing this, the workshop assembly was done at the jobsite using the operating personnel. Robbins supplied experienced supervision and specialty labor, while Strabag supplied the local labor.

This practice of jobsite assembly achieved a 12-month, ready-to-bore schedule, which saved approximately four to five months on the TBM delivery schedule. In addition, there were project cost savings associated with labor and freight, as these operations only needed to be done once and not multiple times as with a workshop assembly (Fig. 5).

## Ground support

The design concept of handling the ground support is to bring the primary support into the tunnel and handling of the support on top of the TBM. This allows the invert to be clear, which allows free access of equipment for cleanup of the invert area. Contract requirements necessitated several different support systems based on the type of ground encountered. Rock support types ranged from

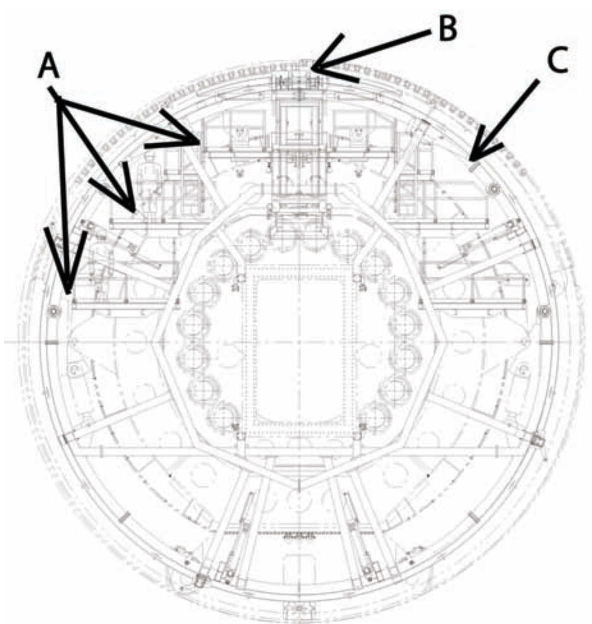
Table 2

**Rock support based on the type of geology encountered.**

| Rock type | Ground support required |
|---|---|
| Type 1 | Steel wire mesh<br>Shotcrete—50 mm thick |
| Type 2 | Steel wire mesh<br>Steel profile—UNP 100<br>Rock bolts—2.4 m long<br>Shotcrete—70 mm thick |
| Type 3 | Steel wire mesh<br>Steel profile—UNP 140<br>Rock bolts—3.6 m long<br>Shotcrete—100 mm thick |
| Type 4 | Steel wire mesh<br>Steel profile—UNP 140<br>Rock bolts—3.6 m long<br>Shotcrete—150 mm thick |
| Type 5 | Steel wire mesh<br>Steel beam—IPB 160<br>Rock bolts—6 m long<br>Shotcrete—200 mm thick |
| Type 6 | Steel wire mesh<br>Steel beam—IPB 260<br>Shotcrete—100 & 200 mm thick |

**FIG. 6**

**Ring beam erector. Arrows B and C show the ring beam erector assembly, respectively.**




Type 1 to Type 6 and are documented along with ground support methods in Table 2.

## L-1 area rock support

The L-1 area is located directly behind the TBM cutterhead support, which is approximately 4.1 m (13.5 ft) from the rock face. The installation equipment includes the following systems:

**Ring beam erector.** A rotary-type ring beam erector is provided, with provisions to hydraulically lift the ring beam or channel section into place and hydraulically expand the steel sections against the bored rock. The ring erector is located directly behind the TBM cutterhead support. It allows placement of the ring beams under the protection of the roof shield fingers. The erector control functions are operated by a radio control system, allowing the operator the mobility to move along the top or bottom work areas as the ring is being erected (Fig. 6, arrow A points to the work platforms). Design and operation of the steel erector allows installation of the ring beams or channel sections during the mining stroke (Fig. 6).

**Wire mesh erector/material handling cart.** A dual-function handling cart, known as the donkey, is located on the top section of the TBM main beam. The donkey transports the steel sections and wire mesh forward into the L-1 working area. Supply of the donkey includes a hydraulic lifting device to handle the wire mesh and steel sections to the crown where they can then be installed. Operation of the unit is by radio control and is independent of the boring stroke of the TBM.

**Rock drills.** Two Atlas Copcp 6.4-m- (21-ft-) long BMH 6000 series hydraulic drills with powerful COP 1532 hydraulic hammers were installed. The drills are installed on a rotary positioner, which allows independent operation of each drill. The positioner allows the various drill positions to be achieved to install the 6-m- (20-ft-) long rock bolts per project requirements. Design of the system allows the bolts to be installed during the boring operation (Fig. 7).

**Work platforms.** To assist the tunnel operating personnel in the installation of the rock support, there are various stationary and mobile work platforms located in the L-1 area. These platforms allow rock scaling, wire mesh and other ground support functions to be performed (Fig. 8).

**Shotcrete robot.** Should shotcrete be needed in the L-1 area, a shotcrete robot has been installed and integrated into the work platforms. The robot has been supplied by Rowa (Wangen, Switzerland)/Meyco-BASF (Switzerland, TX). It includes a boom to allow shotcrete coverage over a 180° section of the tunnel crown and at a rate of 15 $m^3$ /h (530 cu ft/hour).

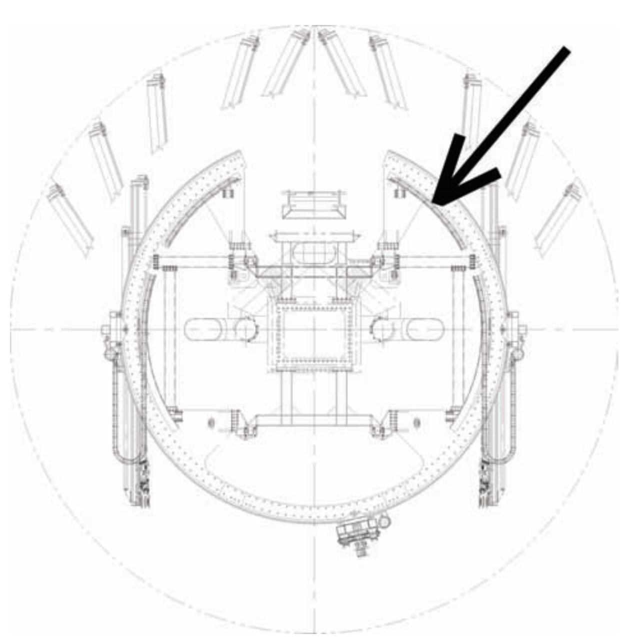
## L-2 area ground support

The L-2 ground support has been provided as part of the Rowa backup supply.

Included in the supply is the following:

**FIG. 7**

**Roof drill positions.**



**Rock drills.** To complement the forward L-1 drills, two additional 6.4-m- (21-ft-) long BMH 6000 series hydraulic drills were installed on a rotary drill positioner to allow installation of 6 m (20 ft) long bolts.

**Shotcrete robots.** Two remote controlled shotcrete robots were installed in the L-2 area. The units consist of a Meco-BASF spray head attachment, which allows 360° coverage. Each unit is independently controlled and has the ability to travel 6 m (20 ft) in the longitudal direction. The robots are charged by two Meco-BASF shotcrete pumps that deliver the shotcrete at a rate of 15 $m^3$/hour (530 cu ft/hour) per pump.

**Muck haulage.** Muck haulage is achieved by the use of a continuous conveyor system. As the backup is advanced, sections of conveyor are installed to allow continuous operation of the system. Muck is transported to the portal on the continuous conveyor where it is then discharged to an overland conveyor and to the storage area located adjacent to the jobsite.

## Project status

At the time of the writing, the TBM had advanced 1,977 m (6,486 ft) since startup.

During the first 200 m (656 ft), problems were encountered including higher than expected water inflows and handling of the water due to the 7.82-percent decline. The water removal system has been modified and the progress has increased to the expected advance rates.

After 850 m (2,780 ft) of excavation, the TBM entered the Queenston shale formations. Horizontal banked layers, which were not able to arch until rock support was placed, led to huge overbreak and caving up to 3 m (10 ft) above the roof shield in the L1 area. Strabag designed a special ground support method with grouted umbrella spiles to mine through this geology.

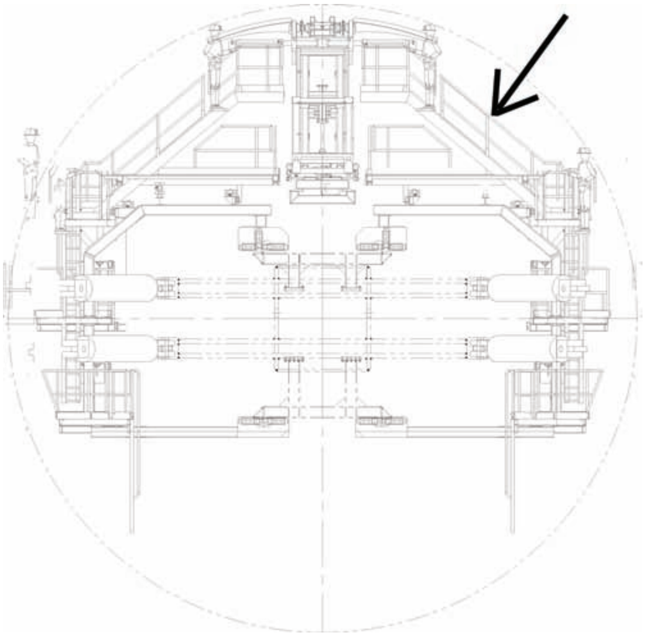
Other major changes to the TBM L1 area became necessary to reach the caved areas, including the addition of two hydraulic man baskets and special drill rigs, mesh and anchors. These changes were made incrementally as TBM progress allowed it.

With the new method, the overbreak could be limited to 0.5-1 m (1.6-3 ft), though the excavation process slowed to a maximum 5 m/d (16 ft/day). The geological situation to date remains the same.

As part of the logistics process, Strabag will pour the final invert section underneath a bridge system designed and supplied by BMTI (Austria), a sister company owned by Strabag. Once the TBM has advanced approximately 2.5 km (1.6 miles), the balance of the final concrete section will be installed on a secondary working bridge, also supplied by BMTI. This system allows the final lining to be installed independent of the TBM boring operation.

**FIG. 8**

**Work platforms — arrows point to the work platforms, L-1.**



## Conclusion

The complete system used on the Niagara Tunnel Project has the capacity to achieve good advance rates and complies with the high standards of construction for a large diameter water pressure tunnel as required by OPG, the project owner.

The most important aspects to the project include the selection of a state-of-the-art TBM, ground support systems and backup system. The onsite assembly allowed for a quick startup and cost savings. Strabag's installation of the in situ lining concurrent with the TBM boring operations will allow the project to be optimized per the aggressive construction schedule required by the owner. The assembly and technological innovations being used on the project have been successful to date because of proper up-front planning and partnering by the owner, contractor and equipment supplier, as well as the dedicated personnel who operate and maintain the systems on a daily basis, and take great pride in the project. ■

## Acknowledgments

The author thanks Ernst Gschnitzer, Robert Goliasch, Christian Berger and Alex Herz of Strabag A.G. and Jost Wenk of Rowa A.G. for the information and assistance in providing data for this paper.

## References

Ontario Power Generation website: www.opg.com
Office of Public Affairs, Niagara Plant Group.

FEATURE ARTICLE

# Los Angeles tunnels are expanded with help of TBM monitoring system

During the last 20 years, more than 80 km (50 miles) of tunnels have been constructed in the Los Angeles, CA area.

Recent projects include The East Central Interceptor Sewer (ECIS), completed in 2004. It spans more than 18 km (11 miles). The Northeast Interceptor Sewer (NEIS), completed in 2005, spans 11 km (7 miles). And the 2-km (1.3-mile) Metropolitan Transportation Authority's Gold Line Eastside Extension (MCGLEE) was completed in 2006.

All of the tunnel routes lay beneath heavily populated urban environments so minimizing ground surface settlement was critical to the success of the projects. Previous tunneling efforts in the Los Angeles area using open shield methods resulted in significant settlement that damaged roads, utilities, buildings and other structures. Earth pressure balance (EPB), or slurry machines, were specified for these projects to reduce subsidence risk. The contractors chose EPB tunnel boring machines (TBM) for the work. The closed and pressured face of the EPB TBM reduces loss of ground at the tunnel face and, when the machines are used in combination with gasketed pre-cast tunnel liners and backfill grout behind the installed segments, losses from over-cut of the excavated surface are also reduced.

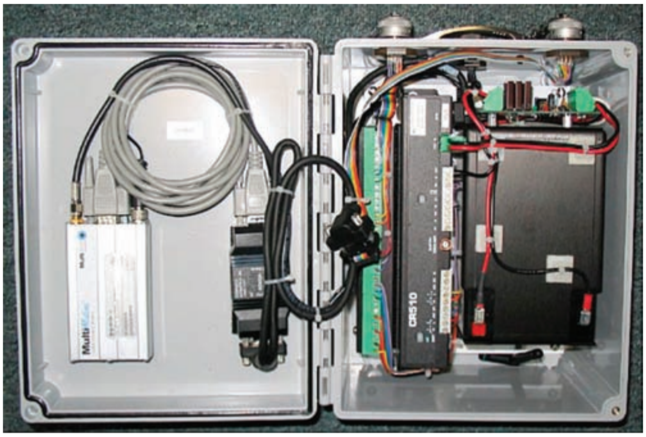
Map of tunnels under the greater Los Angeles, CA area.


To monitor the specified maximum allowable settlements for all three contracts the projects included comprehensive settlement monitoring along the paths of the TBM's. This was accomplished using Multiple-Position Borehole Extensometers (MPBX's) with three anchors. The lower anchors were installed 1.5 m (5 ft) above the tunnel crown; surface anchors at 1.5 m (5 ft) below ground surfaces and middle anchors installed between upper and lower anchors. The MPBX's were installed at 15 m (50 ft) intervals in high-risk areas and at 75m (250 ft) intervals in lower-risk areas. Conventional survey of settlement points was also undertaken in conjunction with the automated monitoring to verify the data.

The three tunneling projects combined utilized approximately 360 MPBX's to monitor thousands of surface settlement points along the various routes. Most of the extensometers and survey points were installed/located at traffic lanes and streets. This allowed a definitive analysis of tunneling performance during the excavation process and provided for development of action plans in the event of subsidence exceeding approved limits.

The MPBX's were installed above ground to follow

Canary Systems CDMA cellular modem package.



the path of the TBM's underground. This required drilling and installation of manholes in high traffic urban areas to accommodate the extensometers, the head assembly with transducers and the data collection package.

The MPBX's were equipped with vibrating wire transducers to provide stable and highly reliable displacement measurements.

Canary Systems was tasked with the design and supply of the automated data acquisition platforms. During the course of working on all three projects, Canary Systems provided several versions of the automated data collection packages. The improvements were a reflection of advances in wireless communications. All three versions used a Campbell Scientific CR510 with power supply (to provide for up to three months of operation without charging) and sensor interface packaged to fit beside the extensometer head in the manholes. Field personnel would periodically visit the manholes and collect data by connecting a portable data storage module that automatically collected data. The second version included a spread spectrum radio that allowed the field personnel to drive to the vicinity of the manhole and, with a base station radio attached to a personal computer, data were collected wirelessly. This provided a safer method of collecting data as most manholes were located in high-traffic areas. The last version included a CDMA cellular modem which provided for data collection from the contractors office.

Canary Systems also supplied its MultiLoggerDB software package with Insite client data access software for managing the systems and the data collection from all locations. With the CDMA equipped units, data collection and reporting was completely automated ,thereby saving time and money and providing near real time monitoring.■

# UCA membership dues and you

## How it works

Since UCA of SME was initiated in 2006, there has been some confusion about the UCA membership dues billing process. The following outlines the basic billing process for each type of UCA membership.

There are two basic types of membership; Individual and Corporate/Sustaining. Which type of membership you hold determines the particulars of your dues bill.

## Individual dues

Annual dues for individual members of UCA are $130 for the year 2008. The first billing is sent in September for the coming year. All individual members of UCA are sent a dues bill through traditional mail. The dues bill has the UCA of SME logo on the top along with the header, "This is Your 2008 Membership Card." The dues bill itemizes your charges and any credits or debits you may have. It also allows you to change your address and other demographic particulars.

Along with the bill, you will receive a wallet-size membership card with your UCA member number. Members may choose to pay their dues online or by traditional mail in a pre-addressed return envelope.

Many members of UCA are also members of the International Tunneling Association (ITA). For those UCA members that are also ITA members, the first UCA dues bill includes ITA dues. This will be itemized on the bill.

It is important to note that members of UCA are not automatically members of ITA. However, an individual must be a member of UCA to be a member of ITA. ITA is a separate association with distinct benefits, procedures and fees. A link to the ITA Web site can be found at the UCA Web site at www.uca.smenet.org.

If the individual member does not pay the first bill, he/she will receive another in mid-October. The final dues bill is mailed in late November. If membership dues are still not paid after the third billing, the member's December issue of *Mining Engineering* magazine will include a false cover stating that the December issue will be their last until dues are paid.

## Corporate/sustaining dues

UCA corporate/sustaining memberships are available to any company in the tunneling business.

A corporate membership is $750 and includes two complimentary individual memberships.

A sustaining membership costs $1,500 and includes five complimentary individual memberships.

The two or five complimentary individuals are identified by the official company contact as the individuals holding the complimentary memberships. Although your company may have a corporate/sustaining membership, you may or may not hold one of the complimentary memberships. If you are not one of the complimentary members, you are not a member of UCA unless you purchase and individual membership.

Corporate/sustaining membership renewal notices are sent only to the official company contact on record. The complimentary individual members do not receive a dues bill of any kind. The renewal notice indicates which individuals are included in the company's complimentary allotment and provides the opportunity to change or update that information. The official company contact does not need to be one of the complimentary individual members.

## The bottom line

If you receive a UCA of SME dues bill, you are on record with UCA as an individual member and responding to that bill continues your membership into the next calendar year. If you have questions regarding your dues bill, please contact us at: membership@smenet.org, 303-973-9550. Thank you for your continuing support of UCA of SME. ■

NEW MEDIA

# North American Tunneling 2008 Proceedings

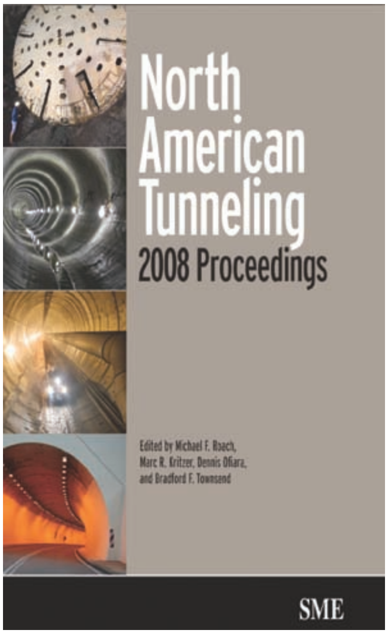
**2008, edited by Michael F. Roach, Marc R. Kritzer, Dennis Ofiara and Bradford F. Townsend, SME Customer Service: 8307 Shaffer Parkway, Littleton CO 80127, phone 1-800-763-3132, 303-973-9550, fax 303-933-6269, e-mail cs@smenet.org, Web site www.smenet.org, ISBN-13: 978-0-87335-263-5. Book order no. 263-5, 2008, 896 pages plus CD, 4 lbs, $139 SME Member, $139 Student Member, $189 Nonmember/List.**

*North American Tunneling* is a "must read" for any professional involved in the underground construction industry. It provides a down-and-dirty look into dozens of case histories from throughout the world. Readers will learn about the challenges faced by designers, contractors, suppliers and business owners, and how they worked together to overcome them.

Taken from a collection of papers presented at the 2008 North American Tunneling Conference in San Francisco, readers will benefit from the latest thinking on technical advances, new solutions to old problems, fire safety and risk management, design considerations, complex systems, overcoming changes, construction management, cost estimating and scheduling, and tunnel rehabilitation and repair.

Whether it is pipe jacking under the Leipzig train station, boring a water tunnel beneath New York Harbor or tunneling under glaciers in British Columbia, these internationally recognized experts share their real-life experiences and insights into this rapidly evolving industry.

The book also provides a sneak peak into major projects on the drawing boards, projects that will be making big headlines in the months and years ahead.



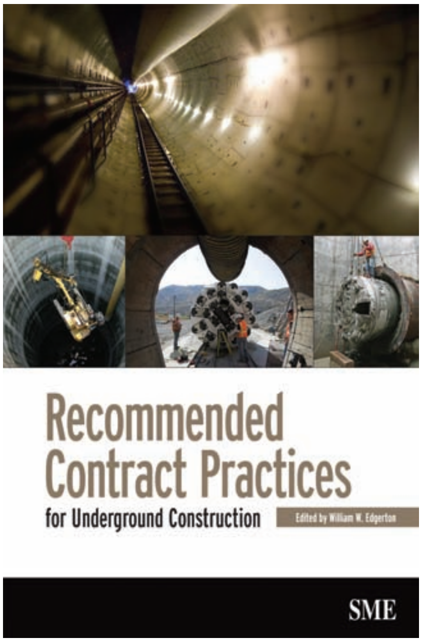

Contents include sections on technology, design, project planning and implementation and case histories. ■

# Recommended Contract Practices for Underground Construction

**2008, Edited by William W. Edgerton, SME Customer Service: 8307 Shaffer Parkway, Littleton CO 80127, phone 1-800-763-3132, 303-973-9550, fax 303-933-6269, e-mail cs@smenet.org, Web site www.smenet.org. 156 pp, 2 lbs. ISBN-13: 978-0-87335-262-8, Book order no. 262-8, $79 SME Member, $69 Student Member, $99 Nonmember/List.**

Underground construction is more complex than ever. Demand for space is increasing, new technologies are constantly evolving and more stakeholders are asserting influence. Yet one of the most challenging and frustrating characteristics of underground construction remains: often, contract language does not account for the unique nature of building underground.

*Recommended Contract Practices for Underground Construction* is the first industry-wide effort to improve contract procedures in more than 30 years. Commissioned by the Underground Construction Association of the Society for Mining, Metallurgy and Exploration (UCA of SME), this manual is an indispensable resource for contractors, consultants, suppliers and owners anticipating underground projects. The authors suggest better practices during all stages of a project, when decisions are made that can affect the contract positively or negatively.




Part one focuses on the practices and disciplines that build the foundation for effective contracts during the early phases of a project. Part two discusses best practices for contract provisions, payment mechanisms and dispute resolution.

By following these recommendations, the reader will reduce the mistrust and costly disputes that often arise from the contract process.

The result will be improved relationships, better contracts and, most importantly, projects that are more cost-effective for owners and more profitable for contractors. ■

NEW TECHNOLOGY

# Traffic monitoring system to be used in Beijing

The challenges of transporting three million Beijing Olympic athletes, media and spectators efficiently to more than 300 sporting events and 1,000 cultural activities will be eased by a technologically sophisticated underground traffic system from Stratus Technologies Inc.

Stratus servers will host the traffic control, monitoring and management software for the underground transportation system linking Beijing's Olympic venues. The underground system is a circular 5.5-km (3.4-mile) roadway connecting surface roads and vast underground parking facilities with the Beijing Olympic Park where major Olympic sporting venues are located. A computerized tunnel intelligence management system located in the mission-control monitoring center provides real-time information that enables accurate, reliable and rapid response to ever-changing conditions in the loop.

System integrator and application provider, Shanghai Hi-Tech Control Systems (Hite) of Nanjing and Shanghai, partnered with the regional Singapore office of U.S.-based Stratus Technologies to provide a complete traffic control and management solution on a fault-tolerant server platform. The configuration includes two Stratus(R) ftServer(R) 4400 systems for database and I/O processing; a variety of workstations for operations, engineering, network management and maintenance; ethernet switches; data acquisition devices; and other components and peripherals.

The constant collection of information from video monitoring and data collection devices throughout the tunnel system to the I/O server makes possible immediate analyses of input, evaluation of conditions, multi-point communications and proactive traffic management. Large video screens in the control center also display this data and video information to workers and supervisors on duty in real time. All information is stored to a unified database and used for data mining, activity reporting and operations management.

Each ftServer system contains the equivalent of two tightly coupled industry-standard x86 servers that run simultaneously in lockstep, with each processing the same data at the same time. Should one half suffer an issue that causes it to take itself out of service, the other half continues to run the operating system and application software without interruption. Stratus server uptime availability is field-proven to be better than 99.999 percent, the server industry's highest uptime reliability for Windows and Linux applications. ■

# UCA honors three outstanding members

## Outstanding Individual Award to Ray Henn

Ray Henn has received the Outstanding Individual Award from the UCA of SME. This award recognizes individuals who have made significant contributions to the field of tunneling and underground construction and to UCA during the last two to five years, as well as sustained involvement in UCA activities and its various committees.

HENN

Henn is a principal with Lyman Henn Inc. of Denver, CO. The firm specializes in geotechnical and tunnel engineering and consulting. After serving in the U.S. Army with a tour of duty in Vietnam, he entered college and received an A.A.S. in construction technology. He continued his education on a part-time basis over the years, completing his Ph.D. in mining engineering in 2005.

Henn has 37 years of experience in the heavy civil and underground construction industry. The first 25 years of his career were spent in the field working for contractors and on construction management assignments. He has worked as a field engineer, superintendent, construction manager and, most recently, as a consultant. His consulting assignments included leading tunnel design teams, serving on dispute review boards, serving as an arbitrator and mediator, serving as a member on value-engineering teams and as a member of technical consulting boards.

Henn still finds time to give pro bono lectures at the Colorado School of Mines, as well as talking with individual students about careers in the underground construction industry. He has published two text books and is working on a third on tunnel grouting. He is past president of American Underground Association and was the NAT 2004 Conference chair. He received the American Society of Civil Engineering's (ASCE) 2002 Roebling Award in construction engineering. Henn is a 33-year member of SME and holds memberships in ASCE, the Moles and the Beavers. ■

## Lifetime Achievement Award to James E. Monsees

James E. Monsees, Ph.D., P.E., is the recipient of the Lifetime Achievement Award from the UCA of SME. The award recognizes outstanding achievements in underground design and in the construction industry. These outstanding achievements were accomplished through the design or construction of civil underground facilities.

MONSEES

Monsees is an expert in the design and construction of underground structures and in soil and rock mechanics. His wealth of experience encompasses project management, construction engineering, detailed design, on-site consultation and geotechnical investigations for a multitude of projects.

Monsees is a senior vice president with Parsons Brinckerhoff and is the company's technical director on worldwide projects. These include transit and water tunnels, nuclear-waste disposal in geologic media, geotechnical studies, studies in tunnel and protective structures and field and laboratory testing of soil and rock. He also has participated in the design of major subways and numerous tunnel projects throughout the United States. For the Los Angeles Metro, he developed a new approach to the seismic design of underground structures, an approach that has been refined and used on projects around the world. For the SSC, he was design manager for all underground structures.

Monsees' work includes feasibility studies; conceptual, preliminary and final designs; geotechnical investigations; development and review of criteria and policy; and oversight of projects in progress. He is a member of many review boards of major tunnel projects, In 1991, he was elected to the National Academy of Engineering. He has served as member and chair of the organization's Award Committee and as a member of the Nominating Committee. He is an internationally recognized expert in tunneling and an invited speaker on the subject at national and international conferences. ■

## Outstanding Educator Award to Tor L. Brekke

Tor L. Brekke is the recipient of the UCA of SME's Outstanding Educator Award in recognition of his exceptional contributions and dedication to the U.S. underground construction industry.

Brekke has been a professor emeritus at the University of California-Berkeley's Department of Civil Engineering since 1993. He served as a professor of geological

(**Brekke**, Continued on page 27)

## OBITUARY

### ROBERT J. JENNY

Robert J. Jenny, founder and chief executive officer of Jenny Engineering Corp., Springfield, NJ, died Feb. 23, 2008. He was 76. He was one of the world's preeminent experts in the planning, design and construction management of tunnels and underground structures.

Jenny graduated from the Newark College of Engineering, New Jersey Institute of Technology (NJIT), with a B.S. degree in civil engineering. He also earned an M.S. degree in civil engineering with specialization in geotechnical engineering. He was a licensed professional engineer in 33 states and in Canada. He was a land surveyor in New York and New Jersey and a licensed professional planner in New Jersey.

In 1965, Jenny founded Jenny Engineering Corp. and pioneered the use of innovative tunneling techniques. In 1970, Jenny Engineering introduced the first fully encapsulated, epoxy resin ground support dowels for tunnels in the United States. And in 1992, the company pioneered the New Austrian Tunneling Method in soft ground for underground stations and tunnels in the United States.

JENNY

Jenny was responsible for the design and management of many noteworthy projects worldwide. He led the company in the design of tunnels, shafts, substations and underground structures on 26 tunnel sections of the Washington Metro. He was consulted on the design of the undersea crossover cavern in the English Channel Tunnel and on the construction of the Shanxi Wanjiazhai Yellow River diversion project in China. He served as project director for geotechnical engineering and construction management contracts for the construction of New York City's Water Tunnel No. 3.

Jenny lectured widely on tunnels and underground construction and co-authored two books: *Tunneling-The State of the Art* and *Tunneling — The State of the Industry*. He was a member of many professional organizations and committees and received many of their awards. He was a recent appointment to the NJIT Board of Overseers. He was named the Engineer of the Year in 1993 by the American Society of Civil Engineers and New Jersey's Small Business Person of the Year in 1988 by the U.S. Small Business Administration.

A decorated Army veteran of the Korean War, Jenny served in the 117th Mechanized Calvary Reconnaissance Squadron of the New Jersey National Guard. He was an active volunteer in the U.S. Coast Guard Auxiliary as a flight observer. In 2004, he served as flotilla commander of Flotilla 10-20, Air Station Caldwell. And in 2006, he was appointed to the position of a national staff officer as branch chief, Public Information.

Jenny is survived by his wife, Marcelline; his son Mathew of Madison, NJ; his daughter Barbara of Portsmouth, NH; and four grandchildren. ■

## AWARDS

**Brekke** (Continued from page 26)

engineering at UC-Berkeley from 1976-1992. Since 1960, he has consulted on several hundred projects including underground power plants, hydroelectric power plants, dams, subways, highways and mining projects. His consulting work included geological site investigations, design of rock stabilization systems, selection of excavation methods, specifications for underground openings, preparation of geotechnical interpretive reports, design of repositories for nuclear waste and service on dispute review boards.

Some of his notable projects include: the Helms pumped storage project; the Eisenhower and the Glenwood Canyon highway tunnels in Colorado; the Crosstown Storm Water Interceptor in Austin, TX; the Waste Heat tunnel under the Gota River, Sweden; the Renton Metro Sewer Project in Seattle, WA; the Europipe Landfall Tunnel in Germany and the Superconducting Super Collider project. Most recently, he has been involved in the design of pressurized gas storage in unlined caverns and design strategies for pressure tunnels and shafts.

Brekke is an author or coauthor of 85 publications and has served on several editorial boards for refereed journals and on research review panels. He is a member of the American Society of Civil Engineers, the Association of Engineering Geologists, the U.S. Committee of the international Commission on Large Dams and the UCA of SME. He is a past chair of the U.S. National Committee of Tunneling Technology. In 1977, he was elected to the Royal Swedish Academy of Technological Sciences.

During Brekke's tenure at UC-Berkeley, he inspired many students to pursue a career in the field of underground design and construction. He made time to interact with the undergraduates and showed a genuine interest in their academic and professional development. Many of his students are leaders in the field today. ■

## Miller Electric diesel welding machine provides more power

The next generation PRO 300 diesel welding generator from Miller Electric features improved reliability through fewer and more robust electronic components. An optional four-cylinder, 18-kW (24-hp) Deutz engine provides more power for using larger electrodes and gouging with carbons up to 6.35-mm (0.25-in.) diameter. More power also compensates for less oxygen when working in higher elevations.

The improved PRO 300 also offers better E6010 performance for downhill pipe welding, as well as better MIG, flux cored and TIG arc starts. Designed for construction fleets, small contractors and pipe welding applications, the PRO 300 provides 20 to 410 amps of welding power, as well as 12,000 W of peak generator power.

The PRO 300 design features a single-circuit board. Miller's unique vault was created out of two aluminum halves sealed with silicone. It provides a clean circuit board environment and protects the electronics of the machine in heavy industrial applications.

When stick welding, the PRO 300 has a four-position control A, B, C, D positions that adjusts stick arc force.

To improve MIG/FCAW performance, Miller added digital voltage control, that enables operators to pre-set and maintain voltage.

The PRO 300 also features better TIG arc starts and stops. An enhanced lift-arc function creates more consistent and positive arc starts.

The PRO 300 now features a low fuel shutdown function that shuts down the engine before fuel runs out. This eliminates a potentially long re-priming process when restarting the engine. A new maintenance alert meter indicates the number of hours between oil change intervals, helping operators adhere to a routine maintenance schedule. The meter also indicates a high temperature or low oil pressure condition.

**Miller's improved PRO 300 welding generator.**

**www.millerwelds.com**

## Hilti drill offers lightweight option for concrete work

Built to withstand harsh jobsite conditions, the powerful new Hilti TE 2 rotary hammer drills efficiently transform 650 W of motor power into superior drilling performance.

Ideal for a variety of applications, including installation work on concrete and masonry, TE 2 rotary hammers offer high drilling performance over the entire drilling rage of 4.7 mm to 19 mm (0.1875 to 0.75-in.). With a performance to weight ratio unique to its class, the TE 2 weighs only 2.4 kg (5.3 lbs).

With a compact, ergonomic design, TE 2 rotary hammers offer high working comfort and convenience.

It is available in two models that are efficient in drilling anchor holes and through holes in concrete and masonry. In addition to full hammering power, the TE 2-S also features an innovative, fine hammering setting for drilling in fragile, brittle materials. This technology reduces impact energy by about 70 percent while drilling at full speed, enabling the user to drill neat holes in ceramics and masonry. With constant motor cooling, the TE 2-S is designed for extended use in fine-hammering applications. ■

**Hilti TE 2 rotary hammer drill.**


**www.hilti.com**

# T&UC COMING UP

## August 2008

• **25-27, Wireless Communication in Underground & Confined Areas,** Val-d'Or, Québec, Canada. Contact: International Conference on Wireless Communications in Underground and Confined Areas, 450, 3e Ave., local 103 Val-d'Or, Québec, Canada J9P 1S2, phone 819 874-7400, fax 819 874-7166, e-mail lrcs@uqat.ca, Web site www.icwcuca.ca.

## September 2008

**17-18, IUT Fifth Annual International Underground and Tunnel Fair,** VersuchsStollen Hagerbach PolistraBe 1, 8893 Flums-Hochwiese, Switzerland. Contact: GmbH Stormarnstrabe 47, 22844 Norderstedt, Germany, phone 49-0-040-35-72-32-0, fax 49-0-40-35-72-32-90, e-mail info@deltacom-hamburg.de, Web site www.deltacom-hamburg.de.

**22-27, ITA-AITES World Tunnel Congress 2008,** Agra, India. Contact: G.N. Mathur, phone 91-11-2611-5984, fax 91-11-2611-6347, e-mail sunil@cbip.org, Web site www/cbip.org.

**23-26, InnoTrans 2008,** Berlin, Germany. Contact Mary Jo Balve or Franz Balve, 33 Prince Place, Little Silver, NJ 07739, NJ, phone 732-933-1118, fax 732-741-6437, e-mail mjbalve@globaltradeshow.com, Web site www.innotrans.de.

## October 2008

• **23-25, Underground Urban Infrastructure 2008,** Worclaw University of Technology, Worclaw, Poland. Contact: Andrezej Kolonko, phone 48-71-320-2914, fax 48-71-328-1889, e-mail andrezej.kolonko@pwr.wroc.pl, Web site www.pwr.wroc.pl.

• **27-28, 20th National Conference, Tunneling Technology & The Environment,** Sheraton Fallsview Hotel, Niagara Falls, Ontario, Canada. Contact: Steve Skelhorn, e-mail tac2008@mcnallycorp.com, Web site www.tunnelcanada.ca.

## November 2008

• **10-12, International Conference of Deep Excavations (ICDE) 2008,** Suntec International Convention and Exhibition Center, Singapore. Contact: AV Consultants Pte, 1-B Aliwal Street, Chenn Leonn Building, Singapore 199894, phone 65-6735-6255, fax 65-6392-4090, e-mail events@avconsultants.com.sg, Web site www.icde2008singapore.org.

## May 2009

• **23-28, 35th Annual ITA-AITES World Tunnel Congress,** Budapest Congress and World Trade Center, Budapest, Hungry. Contact: phone 36-1-214-7701, fax 36-1-201-2680, e-mail sectretariat@wtc2009.org, Web site www. wtc2009.org/00entry.htm. ■

**More meetings information can be accessed at the SME Web site — http://www.smenet.org.**

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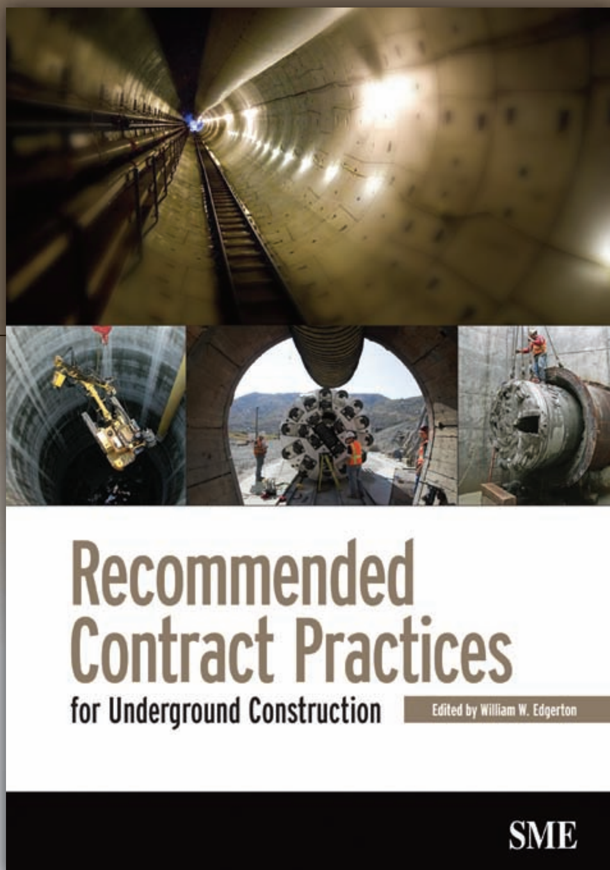
W W W . T U C M A G A Z I N E . C O M

# Recommended Contract Practices for Underground Construction

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