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TUNNELING & UNDERGROUND CONSTRUCTION
AN OFFICIAL PUBLICATION OF UCA OF SME WWW.SMENET.ORG VOLUME 1 NO 1 MARCH 2007

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COVER STORY

CONTENTS — The joining of SME and the former AUA created the Underground Construction Association of SME. Three leaders of the UCA of SME explain the marraige and its benefits to members, page 7. Also, the European tunneling community is using several innovative technologies that are beginning to catch on in the U.S., page 14.

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CHAIRMAN'S COLUMN

UCA of SME has its own magazine

Tell us what you think of *T&UC*

The Underground Construction Association of SME has its own magazine, *Tunneling and Underground Construction (T&UC)*. I have been told many times that you miss the former AUA Magazine. My answer has always been, be patient we will see a similar publication for UCA. Now it is here. We are committed to bringing you the information you need. Starting now and every quarter hereafter, you will see news of the industry, important happenings and even the Tunnel Demand Forecast better and more accurate than before.

UCA of SME replaces the American Underground Construction Association. But the primary mission remains the same: to promote the use of underground space, to act as a clearinghouse for information about the underground industry, to bring together the owners, contractors, designers and suppliers with an interest and stake in the underground and to represent the United States in the International Tunneling Association (ITA).

I will use this column to let you know what your board has been up to. The annual George A. Fox Conference was held on Tuesday, Jan. 30, 2007 in Manhattan, NY. About 200 people attended this year's event and were informed about the projects currently under construction in the East Coast as well as the current industry practice of waterproofing underground structures. Bob Palermo, the chair of this year's Fox Conference, announced that UCA of SME was able to provide six PDH credits to those attended. We had some very positive feedback about this conference.

The following day, the board met and decided on the composition of the board. It is to be as balanced as possible among contractors, engineers, owners and industry suppliers. The terms of each board member were set and the procedure for rotation of the board was established to allow fresh ideas and energies being brought to the board as member's terms expire.

We also are well into planning North American Tunneling (NAT) 2008 in San Francisco, CA. Greg Raines has agreed to serve as conference chair. He has established a committee to ensure that NAT will continue to be a successful industry achievement. There are also plans for a regional conference on the topic of fireproofing in tunnels sometime this fall. We will keep you updated on this as more details become available.

I am planning to attend the ITA World Congress in Prague in May and will have much to report on from that meeting in the June *T&UC* magazine.

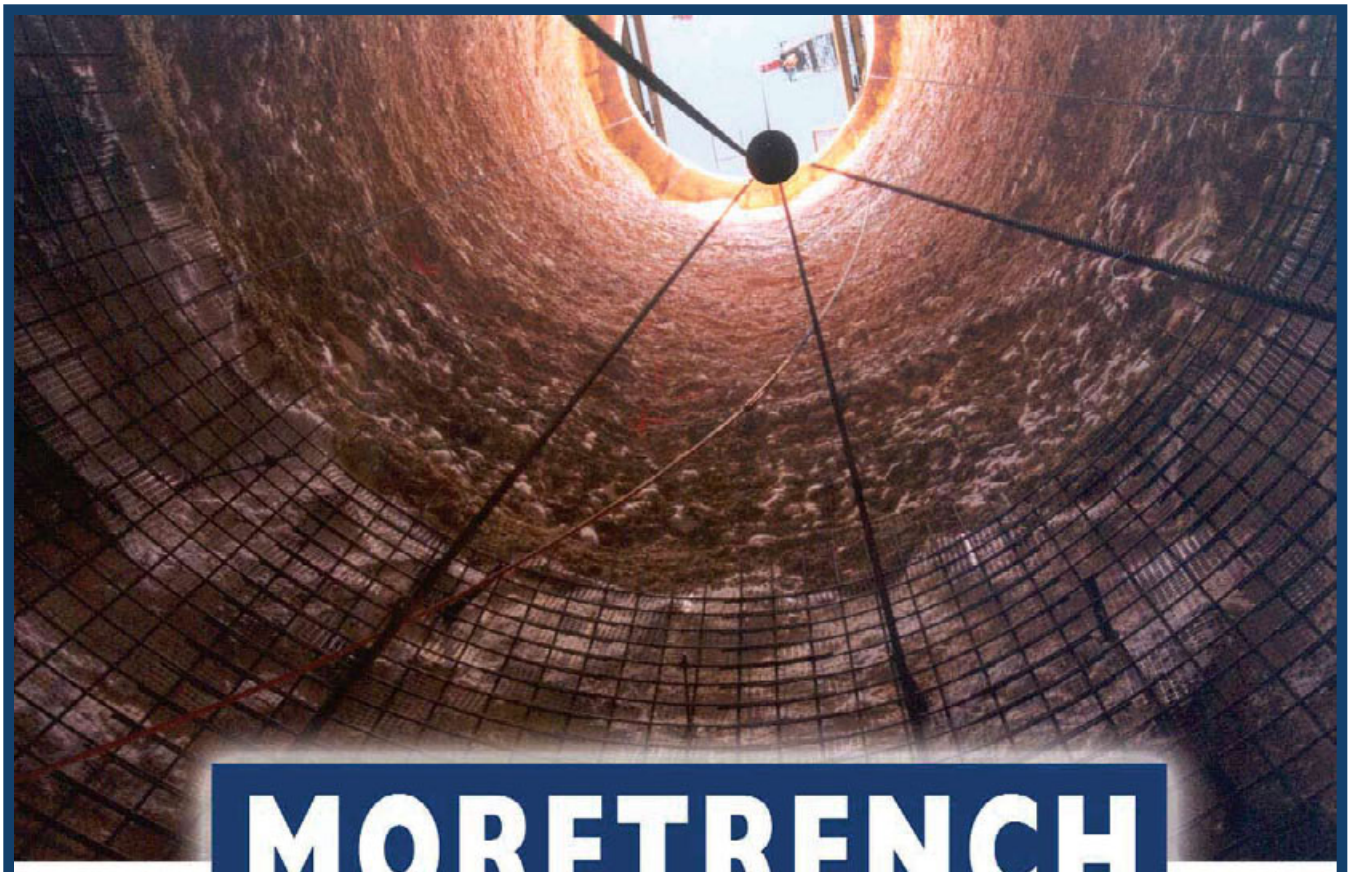
Tom Peyton,
UCA of SME Chairman

The editors of *T&UC* and *Mining Engineering*, along with the rest of the SME staff, welcome readers to this new publication.

In addition to feature articles and underground construction news, the magazine contains the Tunnel Demand Forecast. It will also be published and updated on the SME Web site, www.smenet.org, as will the entire magazine. My thanks to Phil Zeni for compiling the forecast, and to Dave Klug and Tom Clemens for their time in checking its accuracy.

I encourage readers to contact me with their likes, dislikes, comments or suggestions for future issues.

Steve Kral, Editor



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Synergies of UCA-SME marriage explained

In 2006, the Society for Mining Metallurgy, and Exploration, Inc. (SME) acquired the assets of the American Underground Construction Association (AUA), creating the Underground Construction Association (UCA) of SME. In this first issue of *Tunneling & Underground Construction,* UCA of SME committee members Thomas Peyton (Chairman), Bob Pond and Kirk Samuelson explain how the two organizations came together.

How did the marriage of the UCA and SME come about?

Thomas Peyton & Bob Pond: During 2005 it became apparent to the Directors of AUA (American Underground Construction Association) that the management and administration of the organization would have to be significantly improved, and considered several options for accomplishing that objective, including professional management. Several AUA Directors were also members of SME. One of the options the Directors considered was contracting with SME's Meetings Department to run the annual George Fox Conference in New York City and the biennial North American Tunneling Conference (NAT). Two Directors of AUA met with officials of SME in February 2006 to discuss this potential. Development of this concept during the spring and summer of 2006 resulted in SME acquiring the assets of AUA, including the NAT and Fox Conference. The Underground Construction Association (UCA) was formed as a standing Committee of SME to operate and expand upon the assets acquired. AUA has ceased operation and is undergoing an orderly winding up pending closure.

Kirk Samuelson: During the time I was on the RETC board working with SME, several of us could see the industries really needed to work closer together. After becoming aware of some recent issues challenging the future of AUA, several of us met with Dave Kanagy and SME's leadership. In that meeting it was agreed that the time was right to move forward in joining the efforts of AUA and SME-RETC. Tom Peyton (then president of AUA) along with Bob Pond quickly took the lead roles in making this happen. The result is UCA became the US's primary underground organization and organizer of the RETC, the NAT, and the other underground related conferences. Also the information and magazine efforts are combined with SME's.

What benefits has the UCA gained since becoming part of SME?

Thomas Peyton & Bob Pond: UCA is a new organization and has always been part of SME. The immediate benefit is the highly professional management of SME, not only its meetings department but also its accounting and publications departments. Members primarily involved in the civil tunneling will have greater opportunities to learn of appropriate mining techniques useful to civil projects.

Kirk Samuelson: UCA really needs to focus on the underground business and be relieved of the day to day administration distractions. UCA needs to spend its time convincing owners to do underground construction. They need to facilitate improving the engineering knowledge and methods, etc. In addition they need to work closer with the ITA as this is a global business.

The alternate year NAT and alternate year RETC now work in synch with each other as well as the many local seminars of UCA are also coordinated with both. The talks, the advertiser/booth rentals are coordinated, etc.

The industry now has a full time support group to deal with the referrals to get info on tunnel construction, the government agencies have a solid organization to refer to when needed. The owners have a sizeable organization to support their questions and students who are considering underground as a career have the SME student chapters to refer to. Companies and individuals that are looking to support furthering the underground industry have an organization to turn to, (ie we have been trying to get more colleges to include the underground construction in their curriculum and have even had private money interested in donating to the cause but have lacked the association to take the lead)

UCA also is supported by many mining engineers who were already very active in SME.

The skills in mining and mine development quite often are similar as those needed for civil tunnel and shaft construction so now there can be significant sharing of ideas and learning from each other.

Thomas Peyton, Bob Pond and Kirk Samuelson

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Why SME?

Thomas Peyton & Bob Pond: SME for many years has been the primary sponsor and manager of the biennial Rapid Excavation & Tunneling Conference (RETC). The RETC has long been "the" conference for tunneling companies worldwide and their suppliers. Also considered were the meetings department of some other associations, and private enterprise conference management firms. SME's advantages included the management prowess mentioned above, and the "no learning curve required" would allow them to instantly and effectively utilize the assets acquired and expand upon them to the benefit of the industry.

Kirk Samuelson: SME is a solid run industry organization with wide industry access.

SME has the background, the knowledge of RETC, etc that made it a natural fit together.

What does the UCA bring to SME?

Thomas Peyton & Bob Pond: UCA provides a new opportunity to build SME membership. The income gained by SME from the meetings will be put to work enhancing other SME programs as well as expanding those of UCA.

Kirk Samuelson: New group of people, businesses, advertisers, members, revenue, etc. (RETC has been a good source of funds for SME for years, and now with NAT combined, both the addition of NAT as well as both the RETC/NAT doing better from synergy and improved management, the amount of funds should go up even more.)

SME industry goes in cycles and the civil tunnel/shaft industry can level this out.

Underground Civil construction gives SME another business area to talk to advertisers for, to entice engineering students into, and to draw membership into. There is a lot of synergy. Civil underground construction companies are quite often used by mine owners for development work. ■

Phase Five pipeline at Jonah Field completed

A new pipeline looping project that was constructed as part of the Phase V expansion of the Jonah Gas Gathering System near Pinedale, WY has entered into service.

The joint venture of Teppco Partners, L.P. and Enterprise Product Partners L.P. built the pipeline that serves producers in the Jonah and Pinedale fields.

The Phase V project is expected to increase capacity of the system from 4.25 Mm^3/d (1.5 billion cu ft/d) of natural gas to 67.9 Mm^3/d (2.4 billion cu ft/d). It is also expected to reduce wellhead pressure in order to increase production rate and maximize recovery of reserves.

The pipeline looping project is the first segment of the Phase V expansion and includes 120 km (75 miles) of 91 cm (36-in.) diameter pipe and 19 km (12 miles) of 61 cm (24-in.) diameter pipe that transport natural gas from the Jonah and Pinedale fields to processing plants and interstate pipelines near Opal, WY. These new pipelines expand the gathering system's current capacity by 7 Mm^3/d (250 million cu ft/d) to 49.5 Mm^3/d (1.75 billion cu ft/d). Increasing the Phase V expansion capacity to 68 Mm^3/d (2.4 billion cu ft/d) will require the installation of approximately 117 MW (157,000 hp) of compression, which is expected to be completed in phases beginning in April 2007 and concluding by the end of 2007.

"The completion of the pipeline looping project, is particularly timely because the producers we serve now have additional gathering capacity to accommodate recent record production volumes, as well as expected future growth," said Jerry E. Thompson, president and chief executive officer of Teppco's general partner. "We are on track to complete the Phase V project as scheduled and realize the full 68 Mm^3/d (2.4 billion cu ft/d) of capacity by the fourth quarter of 2007. With the completion of the pipeline expansion, we have nearly quadrupled capacity on the Jonah Gas Gathering System."

Robert G. Phillips, Enterprise president and chief executive officer said, "This new gathering infrastructure supports increased natural gas production from the Jonah and Pinedale fields and provides additional supplies to Enterprise's Pioneer silica gel natural gas processing plant now in service and our Pioneer cryogenic natural gas processing facility, which is under construction and expected to be completed in the fourth quarter of 2007."

The Jonah Gas Gathering System presently serves more than 1,100 wells through almost 1,126 km (700 miles) of pipeline and is currently gathering approximately 47.47 Mm^3/d (1.5 billion cu ft/d) of natural gas, which represents more than 85 percent of current production from the Jonah and Pinedale fields. The system features four compressor stations that have a combined current capacity of 69.3 MW (93,000 hp), provides access to four major interstate pipeline systems, including Northwest, Kern River, Colorado Interstate Gas and Questar.

The Jonah and Pinedale fields are ranked as the sixth and third largest natural gas fields, respectively, in the United States in terms of proved reserves reported to the U.S. Energy Information Administration. Annual volume growth in the Jonah and Pinedale fields has averaged more than 30 percent during the past five years and more than 40 drilling rigs are currently active in the play. ■

Nancy Creek Tunnel earns civil engineering award

The Nancy Creek Tunnel and Influent pumping station in Atlanta, GA is the recipient of the Outstanding Civil Engineering Achievement Award in the large project category at the 2006 Georgia Section of the American Society of Civil Engineers (GA-ASCE) Annual Awards Banquet and Meeting, held Sept. 8 in Atlanta.

The Nancy Creek Tunnel Project was placed into service Dec. 31, 2005. From that point on it provided relief to thousands of Atlanta home and property owners affected by the previous capacity-limited Nancy Creek Basin sanitary collection system.

Jordan, Jones and Goulding (JJG), the Atlanta-based consulting firm, was the design engineer and construction manager of the tunnel for the City of Atlanta's Department of Watershed Management.

The Nancy Creek Tunnel was designed and constructed to store and transport wastewater to the R.M. Clayton Water Reclamation Center.

As a result, most of the sanitary sewer overflows in the Nancy Creek Basin have been eliminated. The highly accelerated design and construction of the US$131.5 million, 13.4-km (8.3-mile) long, 5.5-m (18-ft) diameter deep rock tunnel and its US$32 million, 6.3 ML/sec (100-million gal/d) pumping station were completed under budget and in compliance with the completion milestone specified in the consent decree. With its innovative design, the tunnel has become a prototype for the region. ■

DYWIDAG Systems acquires two companies

DYWIDAG-Systems International GmbH (DSI) acquired 100 percent of the shares of the German Contec Bausysteme GmbH.

Contec is headquartered in Porta Westfalica and has production facilities located in Porta Westfalica and Köthen, Germany. The company has 70 employees. It is a leading specialist supplier of formwork and sealing systems on the domestic market.

DSI is a global market leader in the development, manufacture and distribution of tensioning systems as well as geotechnical, tunneling and mining products. Headquartered in Munich, Germany, DSI employs more than 2,000 people worldwide in its operations across Europe, Asia-Pacific and the Americas.

The acquisition of Contec is both operationally and strategically important as it helps DSI in its continuous expansion of its worldwide activities as a leading supplier for the construction and mining industries. The global DSI network and the international business associated there with will open new markets and further growth potential for contec.

Also in January, DSI acquired Soprofint of Santiago, Chile, South America.

Soprofint is a market leader for the supply of ground support products to underground mines. It also sells products to the tunneling sector. The company has two factories located in Quilicura, Santiago.

All 120 employees of Soprofint are continuing with the company that will operate as DSI Soprofint in the future.

In three years, DSI has, through strong organic growth and the acquisition of strategically located companies, successfully established and expanded its activities in supplying strata control products to the mining companies and today is the global market leader.

Bob Bishop, chief operating officer of DSI Mining and Tunneling said "The acquisition of Soprofint gives DSI Mining a strong manufacturing and distribution base in Chile from which to service the expanding mining markets of South America. While Soprofint already supplies their high quality and well accepted products to several South American countries they will greatly benefit from having access to DSI's technical "know how," broader product range, and global market position. Soprofint has an excellent reputation in the market with well respected management and a desire to expand which makes them an excellent fit with DSI." ■

Colombia's La Linea pilot tunnel more than 50 percent complete

The La Linea Tunnel project in the Bogota-Buenaventura corridor of Columbia is more than half way done.

The tunnel crosses the central mountain range and forms part of the Bogota-Buenaventura corridor, which is one of the priority road links for the development of the country and its competitiveness. It is part of the road that leads, from the center of the country, to the southwest Pacific coast. The 8.5-km- (5.35-mile)-long La Linea tunnel will be the longest road tunnel of Colombia and South America and one of the highest, at 2,422 m (7,946 ft) above sea level.

The Conlinea consortium, formed by Conconcreto and Carlos Solarte, is building the pilot bore for Invias, the national highway institute. The final tunnel will be constructed in a second stage. The pilot tunnel is built from two attacks at each end. A crew progresses in the La Linea tunnel from Cajamarca (Tolima) while another tunnelling team advances in the opposite direction from Calarca (Quindio).

In December 2006, work advance in the La Linea pilot tunnel reached 50 percent after crews had drilled 2,827 m (9,275 ft) from Tolima and 1,458 m (4783 ft) from Quindio.

Other work includes 18 cross-connecting galleries to the future main tunnel. Each of those tunnels span 40 m (131 ft).

The tunneling method used by the contractors consists of drilling jumbos and explosives. An Atlas Copco two-boom H252 drill rig is used at each face, backed up by another jumbo on standby.

The supplier of the drill bits is Sandvik. ■

Final Brightwater Tunnel bid below estimate

The Michigan-based joint venture of Jay Dee/Coluccio/Taisei reportedly submitted the low bid on the final Brightwater tunneling contract in Washington.

Jay Dee/Coluccio/Taisei submitted a bid of US$10.1 million. The King County, WA, engineers' estimate on the third phase of the Brightwater treatment system project was US$105.5 million. The Kenny/Shea/Traylor joint venture submitted a bid of US$106.9 million and Kiewit/Bilfinger/Berger submitted a bid of US$124.5 million.

The three firms submitted bids on a contract to build the west portion of a 21-km (13-mile) conveyance pipeline for the US$1.62 billion Brightwater treatment system project.

The west segment of the Brightwater conveyance system includes a 6,400-m (21,000-ft) tunnel extending from Point Wells in unincorporated Snohomish County to Ballinger Way in Shoreline, WA. The selected contractor will excavate a 15-m (50-ft) deep portal at Point Wells to launch a tunnel boring machine. This machine will dig the 4-m (13-ft) diameter tunnel and build the pipe underground without disrupting the surface.

Construction on the plant began in 2006 and operations are expected to begin in 2010. The project will serve King and Snohomish counties.

The contractor of the west segment will also microtunnel a smaller 165-m (540-ft) effluent tunnel with a diameter of about 152-cm (60 in.).

Also included in the contract is the construction of a sampling facility in the portal at Point Wells to monitor treated wastewater going into Puget Sound, WA.

The county and its consultants will thoroughly review the bidder's qualifications before awarding the contract.

Construction was scheduled to begin in early 2007.

Jacobs Civil was already chosen to provide construction management services for the conveyance facilities. MWH/Jacobs Associates is desiging the system as a joint venture, and CDM conducted geotechnical work as part of tunnel design. Construction has been under way since March 2006.

In December 2005, Kenny/Shea/Traylor, an Illinois-based joint venture, was awarded a US$131-million contract to build the east segment of the Brightwater conveyance system, which includes a 4,267-m (14,000-ft) tunnel from the North Creek Business Park in Bothell to the treatment plant site at Route 9 north of Woodinville.

In July, Montreal-based joint venture Vinci/Parsons RCI/Frontier-Kemper was awarded a US$209.7- million contract to build a 9,753-m (32,000-ft) tunnel from North Creek Business Park in Bothell to Ballinger Way Northeast in Shoreline. ■

Bucyrus International acquires Lunen

Bucyrus International has signed an agreement to acquire Lunen, Germany based DBT GmbH, a subsidiary of RAG Coal International.

Bucyrus agreed to pay US$710 million in cash and issue to RAG 471,476 shares.

Bucyrus designs and manufactures walking draglines, electric mining shovels and rotary blasthole drills used by the surface mining industry.

DBT manufactures underground coal mining equipment including roof support systems, armored face conveyors, plows, shearers and continuous miners.

The combined company, now serving both the surface and underground mining industries and with more than 100 years of experience, will have a consolidated installed base of equipment of over US$20 billion. Tim Sullivan, president and chief executive officer of Bucyrus said, "We are extremely excited about combining Bucyrus with DBT and we believe that this is a unique opportunity to jointly build a stronger company for our customers, employees and shareholders. Both companies share a similar culture and history with a focus on technology, delivering high quality products, valued employee relationships and providing first class service to our customers."

The Bucyrus/DBT combination will provide significant geographic, product and end market diversification for Bucyrus. In addition to increased scale, DBT will greatly enhance Bucyrus' market in China as well as in the markets of other developing countries such as Russia and India. Tim Sullivan further commented, "We are very bullish on the long term fundamentals for coal and this combination will allow us to address 100 percent of the coal mined on a global basis."

Bucyrus will acquire DBT in a two-stage transaction. Bucyrus will acquire all of the holding company shares held by the Hamburg Trust by no later than 2009 Bucyrus and the Hamburg Trust will honor the prior commitments made by DBT with its German workers regarding facility and employee matters. ■

INDUSTRY PROFILE

Jacobs Associates involved in all aspects of underground construction

From a major mass transit project in San Juan Puerto Rico to quaint wine cave designs for developers and private owners in California and an underground project that will add millions of gallons of want to Southern California's water supply, Jacobs Associates is involved in almost all levels of underground construction and tunneling.

In 1954 Donavan Jacobs established the business as a one-person consulting firm. He took his first assignment in this role as project engineer for a consortium of Kaiser-Walsh-Perini-Raymond on a successful contract bid for the Snowy Mountain hydro electric tunnel project in New South Wales, Australia.

More than 50 years later, Jacobs Associates is one of the most successful contractors in America. The company was ranked ninth among all contractors by *Engineering News-Record* in 2006.

Jacobs Associates currently has seven offices and numerous projects in the works.

One of the largest current projects for Jacobs Associates is in San Bernardino and Riverside counties, CA. That is where Jacobs is working on the Inland Feeder's 72-km (45-mile) alignment of large-diameter tunnels and pipelines that will extend from the foothills of the San Bernardino Mountains to the Colorado River Aqueduct in Riverside County, CA.

The project will nearly double the delivery capability of the Metropolitan Water District of Southern California's (MWD) from the east branch of the State Water Project. It is expected to be able to provide southern Californians with as much as 2.46 GL/d (650 million gal/d) of additional water.

The project is comprised of the East and West contracts that are 9.6 km (6 miles) and 8 km (5 miles) tunnels, respectively. The tunnels are 5.7-m (19-ft) excavated and 3.7-m (12-ft) inside diameter.

Making the project challenging was the fact that the tunnels pass through granite, gneiss and marble rock formations.

Ground conditions in the tunnels range from massive, hard, strong and abrasive rock to very blocky and seamy rock and crushed ground. Additionally, the tunnel alignments cross active splays of the San Andreas Fault in three locations.

Control of ground water inflows is critical in order to avoid impacts to the San Bernardino National Forest and San Manwel Indian Reservation.

The tunnel lining for the Arrowhead Tunnels is designed to withstand an earthquake of magnitude 8.0. In addition, one portion of the alignment crosses an active splay of the San Andreas Fault, where a special lining section was used to accommodate fault rupture. A primary lining of bolted and gasketed precast concrete segments was designed to withstand a pressure of 274 m (900 ft) of hydrostatic head — the highest pressure ever considered in design of a segmental tunnel lining. Two closed-face tunnel boring machines designed to withstand a pressure of 91 m (300 ft) of hydrostatic load were used to excavate the Arrowhead Tunnels. In combination with the watertight primary and final linings, extensive probe-drilling and pre-excavation grouting ahead of the tunnel face is being conducted to protect the groundwater resources under U.S. Forest Service land.

Jacobs Associates provides wine cave design services for developers, private owners and wine cave contractors. With more than 20 years of wine cave design experience and 50 years of tunneling experience, the company is able to provide creative, functional designs that meet the varying code standards throughout California's counties.

While much of the work Jacobs Associates does is in California, the firm is not limited. One of it biggest current projects is the Rio Piedra Contract in San Juan Puerto Rico.

This job consists of a 1,500-m (4,921-ft) long underground rapid transit guideway with two underground subway stations.

Most of the project structures are located below the groundwater table and many of the tunnels pass beneath occupied historical buildings with less than 5 m (16 ft) of cover.

A unique aspect of this project is that different tunneling methods were used along the alignment, which yielded many lessons on the impact of these methods on the structures above. ■

TUNNEL NAME	OWNER	LOCATION		TUNNEL USE	LENGTH (FEET)	WIDTH (FEET)	BID YEAR	STATUS
Canal St. Wet Weather Relief	Milwaukee Metro Sewerage Dist.	Milwaukee	WI	Sewer	13,500	7	2007	
Barclay/4th/Chase MIS Replacement	Milwaukee Metro Sewerage Dist.	Milwaukee	WI	Sewer	11,000	4-6	2007	
Mission Trails #1 #2	SDCWA		CA	Fresh Water	 2,000 2,875	 11 11	 2007 2007	
LIRR East Side Access - 63rd St.	NYCTA (MTA)	New York	NY	Subway	5,500	20	2007	
Near Surface Interceptors	Narragansett Bay Commission	Providence	RI	Sewer	19,500 11,000	3-6 3-6	2008	
Detroit River Crossing	Detroit River Partnership	Detroit/ Windsor	MI	Rail	9,000	28	2008	
Caldecot # 4	Cal Trans	Oakland	CA	Highway	3,600		2009	
Alum Creek Relief Sewer (1st phase of 3)	City of Columbus	Columbus	OH	Sewer	26,000	10	2010	
Mt. Olympus San Diego Six	MWDSC	San Diego	CA	Fresh Water	33,000	11.5	2011	
WASA CSO Potomac Tunnel	Washington DC Water & Sewer Authority	Washington	DC	Sewer CSO	8,000	20	2014	
WASA CSO Rock Creek Tunnel	Washington DC Water and Sewer Authority	Washington	DC	Sewer CSO	2,600	12-15	2015	
East Side Access	NYCTA (MTA)	New York	NY	Subway	10,000	20	2016	
Manhattan West Side to LaGuardia Airport	NYCTA (MTA)	New York	NY	Subway	15,000	20	2016	
Priest Reservoir Bypass	City and County of San Francisco	San Francisco	CA	Pipeline	2,500	10	2002	Complete
Dulles Airport Walkway to Terminal B and C	Metro Washington Airport Authority		VA	Pedestrian			2003	Complete
Westside Storm Water Management Facilities	Raleigh-Durham Airport Authority	Raleigh Durham	NC	Storm Water	2,000	10	2003	Complete
Alameda Tubes	Cal Trans	San Francisco	CA	Highway	4,400	37	2003	Complete relining only
North Shore Connector Extension	Port Authority of Allegheny County	Pittsburgh	PA	Light Rail	8,500	22	2003	Under construction
Water Tunnel #3 Shaft 17B	NYC Dept. of Environmental Protection	New York	NY	Fresh Water	250	30	2003	Under construction
Habor Siphons Project	Milwaukee Metro Sewerage District	Milwaukee	WI	Sewer	13,000	16-17 OD	2003	Under construction

TUNNEL NAME	OWNER	LOCATION		TUNNEL USE	LENGTH (FEET)	WIDTH (FEET)	BID YEAR	STATUS
North Vancouver	Greater Vancouver Regional District	North Vancouver	BC	Fresh Water	Two at 25,000 each	11	2003	Under construction
North Dorchester Bay Conso. Conduit	MWRA	South Boston	MA	Sewer CSO	15,700	13	2004	Under construction
Second Ave. Subway	NYCTA (MTA)	New York	NY	Subway	42,280		2004	Under construction
Canada Line Rail Extension	Translink	Vancouver	BC	Light Rail	33,800			Under construction
Dulles Airport Concourse C Walkback	Metro Washington Airport Authority		VA	Pedestrian			2006	Under construction
Arrowhead West-East East Tunnel West Tunnel	MWDSC	San Bernadino	CA	Fresh Water	+60,000		2006	Under construction
Devil's Slide #041123U4	Cal Trans	San Francisco	CA	Highway	Two at 4,000	38	2005	Awarded
WASA CSO Anacostia Tunnel	Washington DC Water & Sewer Authority	Washington	DC	Sewer CSO	26,000	20	2005	Facility planning awarded, underway
Hudson River Freight Crossing	NYC Economic Devel. Corp.	New York	NY	Rail				Indefinitely Postponed
A9	North Carolina DOT		NC	Highway				Indefinitely Postponed
Seneca-North II	Rochester Pure Waters District	Rochester	NY	Sewer CSO	6,500			Indefinitely Postponed
Mount Hope Rosedale	Rochester Pure Waters District	Rochester	NY	Sewer CSO	8,500			Indefinitely Postponed
Lexington North	Rochester Pure Waters District	Rochester	NY	Sewer CSO	5,000			Indefinitely Postponed
Ft. Point Channel Storage Unit	MWRA	Boston	MA	Sewer CSO	1,500	10		Cancelled
Phoenix Airport People Mover	City of Phoenix	Phoenix	AZ	People Mover	12,850			Cancelled
Vancouver Fraser River Crossing	City of Vancouver	BC	BC	Highway	5,000			Cancelled
South Ottawa Mine Development Tunnel	US Silica Co.	Ottawa	IL	Slurry & traffic	2,500	18 - 22		Cancelled
Drumanard Tunnel	Kentucky DOT	Louisville	KY	Highway	2,200 x 2	35	2008	Under Design
Port of Miami Tunnel	Florida DOT	Miami	FL	Highway	3,900 x 2	36	2007	Bidding
Middlesex Tunnel	Middlesex CUA	Middlesex	NJ	Sewer	3,900	13	2007	Prequals submitted

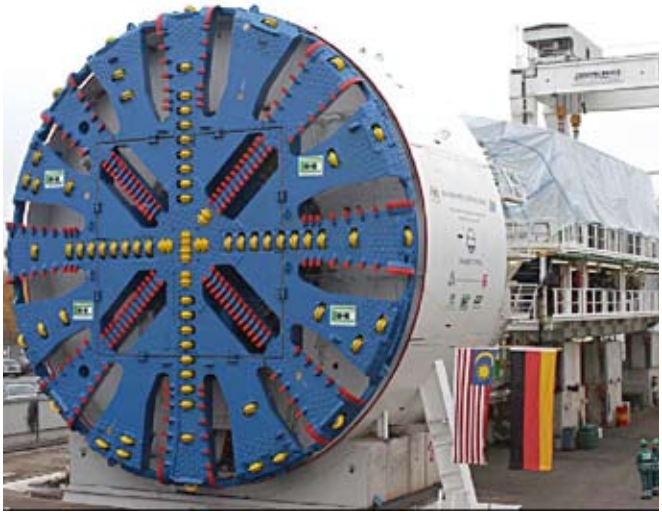
There is an extensive list of upcoming projects in the New York City area available on the Internet at www.mta.info under the Capital Construction, Procurement link. These are projects for the NYCT, MNR, LIRR, MTACC and B&T.
For more information see http://www.mta.info/mta/capital/eotf-allagency.htm.

FEATURE ARTICLE

European tunneling technology and methods

While tunneling in Europe has been a tradition for centuries, many companies and countries have embraced tunnel innovation with considerable vigor and creativity. Indeed, local needs and site conditions have provided the initiative for improved means, methods, materials and equipment to complete progressively more challenging projects. Many recently completed tunnels have expanded tunneling technology and contributed to the development of highly specialized and productive equipment — such as the mixed-mode tunnel boring machine (TBM) presently in operation at the SOCATOP A-

The fully assembled mixed mode tunnel boring machine (TBM) at the Herrenknecht factory in Germany is 13.2 m (43.3 ft) in diameter.



86 road tunnel and the high-pressure slurry TBMs for the Westerschelde Tunnel in the Netherlands and Hollandsas near Malmo, Sweden.

This paper describes some of the key technologies employed by European tunnel builders and designers including the New Austrian Tunneling Method (NATM), advanced earth pressure-balanced (EPB) machines, pressure-faced (slurry) tunneling machines as well as 'hybrid' or mixed-mode TBMs. While these tunneling methods and equipment generally involve significant equipment investment, they may also involve highly trained, experienced and specialized tunneling and support crews as well as materials and tools specifically developed to supplement or complement tunneling performance. For example, mechanized pipe arch placement substantially improves ground support measures and NATM advance and on larger tunnel cross-sections.

NATM fundamentals

Many notable tunnel projects have used the principles of the New Austrian Tunneling Method (NATM) for excavation and ground support. Owners and designers are constantly looking at longer, larger and more complex tunneling and underground projects that use this method. NATM has grown in popularity even for tunnels having a circular cross-section and in conditions with adverse geological conditions.

NATM relies on a sequential excavation process together with a progressive ground/shotcrete support system. It is an integrated and highly engineered interactive technical solution to tunnel, cavern or shaft construction that can be adapted to varying ground conditions including compressed air operations for ground water control. The actual excavation may be accomplished using a variety of methods.

NATM tunnel excavation means — European contractors generally follow a tried-and-true excavation and lining process — all dependent on predicted and as-encountered ground conditions and behavior. Whereas small tunnels (±20 m^2 or ±215 sq ft) may have only a top heading and bench excavation, larger tunnels (±60 to 190 m^2 or ±645 to 2,045 sq ft) may require multiple top headings, several benches and an invert excavation operation to fully excavate the full cross-section. Cavernous tunnel excavations may require nine or more separate headings to complete the full excavation in sequence with the installation of ground support systems having different materials

Brian Fulcher, Christian Neumann, Christof Metzger and Jean-Claude Amet

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and connection details. Typical methods of excavation include singularly or in combination the following:

- Mechanical excavators and hammers.
- Roadheaders and haul trucks.
- Drill and blast methods with loaders.
- Continuous loaders with haul trucks.
- Front-end loaders and haul trucks.

NATM initial support methods — Ground support placed sequentially as the various headings and benches are advanced include the following, with new materials and methods for installation being constantly developed:

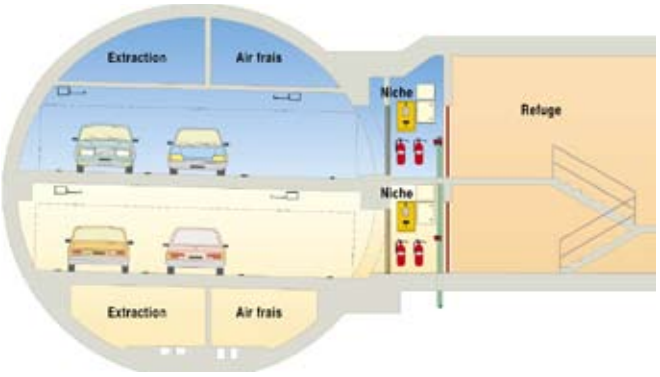
- Lattice girders in segmental sections.
- Shotcrete with and without steel fibers or welded wire mesh.
- Deformable sectional channel ribs.
- Rock bolts — steel and glass fiber.
- Grouted rock bolts.
- Cable bolts with grout encasement.
- Spiling — using solid bars and pipes.
- Barrel arch systems with or without grouted pipes and drainage pipes.
- Horizontal jet grouting.

It must be noted that the European NATM has evolved into a tightly integrated system of excavation and muck removal with ground support systems tailored to suit the geological conditions, excavation means and timing of the overall combined mining and initial lining (support) operations. In most NATM tunnels, only one primary heading — top or bench — is attacked at one time, although crews may frequently and rapidly alternate between headings using multiple fleets of equipment and versatile, skilled crews. This increases the efficiency of the overall operation and focuses on the availability of specialized plant and equipment since it will vary depending on the excavated dimensions and the ground conditions as well as pre-excavation ground treatment — if used. On long tunnels, however, concerted efforts have been made to set-up concurrent operations to reduce the overall project schedule time:

- Top heading and bench excavations.
- Primary (initial) support.
- Invert excavation and (initial) support.
- Invert concrete and waterproofing.
- Arch concrete placement.
- Tunnel outfitting and finishing.

NATM crews and manpower needs — Unlike comparable North American NATM projects, European NATM tunneling operations use fewer personnel in the heading and throughout the tunnel. This is because of more flexible labor work rules — crew composition and manning requirements as well as the experience level of the miners for this type of work.

A typical finished section through the twin-level SOCATOP A-86 highway tunnel and refuge chamber being constructed in suburban Paris, France.



Additionally, there are no service (support) crews in the tunnel. This was observed in the construction of the Achrain II highway tunnel in Austria, a 120- to 190-m_2 x 3,340-m- (1,290- x 2,055-sq ft x 10,960-ft-) long single bore presently under construction using mechanical excavation, haul trucks for muck removal and a concurrent invert and arch concrete placement operation as well as full circumference waterproofing membrane installation.

Earth pressure-balanced tunneling method

Several European TBM builders are truly pushing the limits of earth pressure-balance (EPB) tunneling technology with the successful construction of larger and more powerful machines. Additionally, they continue to research the excavation process with chemicals and mechanical system designs to not only penetrate the ground faster but to improve face stability, muck removal and segment erection times. The following will describe recent developments and projects where new EPB technology and equipment have been successfully used.

Earth pressure-balance tunneling equipment. The new world record for an EPB tunnel boring machine is 15.2-m- (50-ft-) diameter. This continues to increase as new and more challenging projects are schemed throughout Europe and elsewhere. Two of the world's largest machines of this type are presently operating in Madrid, Spain on the Calle 30 road tunnel. Some features of the machine include the following:

- 6-m- (19.6-ft-) diameter separate and independently operating center cutterhead. It can also be telescopically advanced.
- Separate drive and screw conveyors for the center cutterhead.
- Separate twin-screw conveyors for the main 15.2-m- (50-ft-) diameter cutterhead.
- Articulated forward shield for steering control.

Even though EPB machines have been constantly growing in size, their daily advance rates have not proportionally decreased. To maintain high rates of advance, these machines have been equipped with increasingly more sophisticated muck handling systems and related facilities. This is in addition to more complex and automated tunnel utility systems to support all essential operating systems. Successful tunnel utility systems require considerable design coordination and integration with the overall tunneling operation, equipment and controls. They must also be designed as well-balanced systems to support the overall TBM advance and maintenance needs.

Larger and, therefore, more technologically advanced EPB machines are being used for highway and transit tunnels throughout Europe. Some highway tunnels are being constructed large enough to enclose two separate levels of vehicle or rail traffic. The A-86 SOCOATOP tunnel, for example, has an internal diameter of 10.4 m (34 ft) and two roadway levels dedicated to car traffic only. A large utility enclosure is located below the lower roadway level. An extensive and sophisticated fire-life safety and ventilation system has also been incorporated into the design.

Typical NATM excavation showing a top heading, bench invert excavation using a mechanical excavator.

Ground support for EPB tunneling. Ground support of EPB driven tunnels has typically (exclusively) been with precast concrete segmental tunnel liners with bolted and gasketed connections. Whereas most North American precast segments make use of traditional reinforcing steel bars and welded mats, more frequently, European designers favor the use of steel fibers for more continuous and distributed reinforcement. Additionally, dowels and specialized alignment devices are popular and closely integrated into the initial segment design and the tunneling plan. Bolted connections may be disassembled and re-used per design allowances.

Precast concrete segment manufacturing. Vacuum lifting devices in segment factories, sites and tunnels are considered standard operating equipment. They have not yet gained wide acceptance in North America even though they are considered safe, reliable and very cost efficient.

Placement of typical precast concrete tunnel liner segments using a vacuum erector device on the TBM.

Automatic and programmable production carousels and high-precision molds from a number of European manufacturers are virtually standard for all significant tunnel projects requiring precast segments for ground support.

Ground treatment for EPB tunneling. Ground treatment for improved settlement and water control in EPB tunneling includes tried-and-true dewatering and grouting systems. Freezing and jet grouting are used in more severe conditions where ground water, local utilities or building settlement control are high risk factors and, therefore, critical elements of the tunnel design that must be addressed in the performance of the work and safety.

Slurry-face tunneling method

Slurry tunneling equipment development in Europe responds to the ever-increasing challenges, site and geological conditions that require unique solutions. Some of the more recently constructed tunnels used slurry tunneling systems in conjunction with mixed-mode operation — hard rock and EPB, to successfully excavate extremely variable formations such as found on the A-86 SOCATOP tunnel and the Groen Hart Tunnel in the Netherlands. European projects make frequent use of slurry TBMs in urban areas, sub-aqueous and rural locations in response to ground conditions and settlement control.

Slurry TBM technology development

Slurry TBMs have more recently been constructed to operate under as much as 10 bar pressure. Whereas the 11.34-m- (37.2-ft-) diameter Westerschelde Tunnel in the Netherlands was successfully constructed under as much as 6.9 bar, the 10.53-m- (34.5-ft-) diameter Hollandsas Tunnel in Sweden will see as much as 10 bar while operating and 13 bar in a static mode. Key elements to the success of this mining method have been the following:

- Slurry pressure regulation and control.
- Slurry density control and flexibility.
- Shield seals and sealing systems.
- Tail shield to segment wire brush seals.
- Rock crusher for cobbles and boulders.
- Cutterhead tool wear indicators.
- Compressed air intervention methods.
- Tool changes in free air conditions.
- Solids separation plant operation.
- Compatible segment design.

- Cross-passage design integration.
- Specialized TBM start and finish facilities.

Mixed-mode TBM tunneling method

Several unique tunnels are under way in Europe and elsewhere using European mixed-mode tunneling technology. The mixed-mode may be described as a combination of tunnel excavation capabilities including slurry, EPB and hard rock within the same machine assembly. These TBMs push equipment design technology to new limits and allow for the construction of tunnels in conditions that have in the past, prohibited underground construction in formations such as gravel with high ground water pressure.

Mixed-mode TBMs also combine 'hybrid' muck handling systems, ground support systems as well as compressed air for excavation and/or maintenance needs. The following will briefly describe and illustrates a successful project where mixed-mode TBMs have been used.

A-86 SOCATOP highway tunnel, Paris

The A-86 SOCATOP Tunnel is an 11.56-m- (38-ft-) diameter twin-level vehicle tunnel located in suburban Paris. It is situated in extremely variable geological conditions throughout its length. To be successfully driven, a multi-functional, mixed-mode, one-of-kind TBM was developed to handle the following conditions without excessive lost time:

- Hard rock - limestone formation.
- Slurry tunneling - sands and silts.
- EPB tunneling – clays.
- Compressed air tunneling as needed.

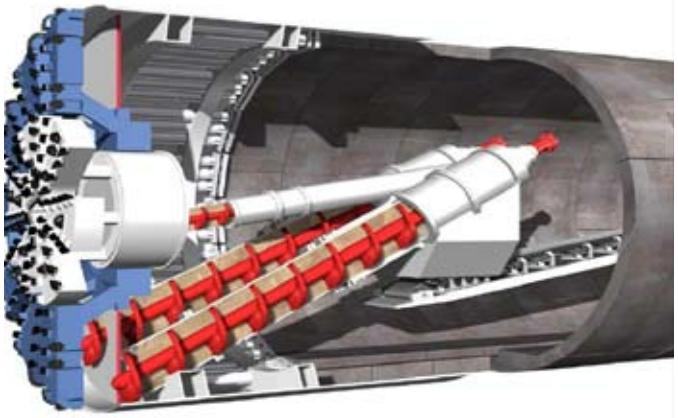
The TBM and supporting equipment was equally adaptable to handling the variable geological conditions using alternatively belt conveyors and pipelines in the tunnel for muck handling. A significant solids separation plant was installed at each of two portals to suit the tunnel excavation sequence.

Tunneling advance rates were reasonable given the ground conditions and while installing precast concrete segments during all modes of operation. Due to the extent of the ground cover and local surface development, pre-treatment for ground improvement was not possible. So the TBM was designed to be self-contained to handle all expected ground conditions, behavior and ground water flows.

Ground support systems

European tunnels have been located in ground and site conditions that are formidable in relation to their size (cross-section) and length (variable geology). Tunnel designers, contractors and material suppliers often collaborate early in the design stage to find practical and reliable and frequently innovative technical solutions. It should be noted that in the case of NATM tunnels, the design engineer (on-site) frequently has a major role in the analysis of the encountered rock conditions and the type and quantity of support needed to meet the design requirements. This is especially true on long tunnels and those having a large cross-section with variable geological conditions. The following will describe some of the more unique ground support systems currently in use for tunnels in different ground conditions.

Section through the 15.2-m (50-ft) diameter EPB tunnel boring machine for the Calle 30 tunnel in Madrid, Spain.



Precast concrete segmental liners

European tunnel designers and contractors frequently collaborate on the design and installation of innovative precast segmental tunnel liner systems. Recent improvements have included the following:

- Gasket design and placement.
- Bolted and dowelled connections.
- Steel fiber reinforcement.
- Precast concrete filler pieces for recesses.
- Alignment devices — spheres, sleeves and rods.
- Vacuum handling methods.
- Longer segments wherever practical.
- Integrated lining and grouting systems.
- Design and manufacturing standardization.

Precast segment design is also intimately linked to manufacturing and, therefore, mold design. Continuous production carousels have largely replaced static casting systems to increase productivity while maintaining high product quality standards. While the carousel segment casting method requires a greater initial investment in plant and equipment, it provides for a continuous production system with less labor cost per segment.

European and especially British design codes have embraced the use of steel fibers as the primary means of reinforcement for precast segments. In fact, there is presently a strong trend to make use of steel fibers over traditional forms of reinforcement. Other segment design

advances include the following:

- Connection details at the circle joints between rings where single action, non-slip dowels are preferred over threaded bolts for ease and speed of segment installation.
- Alignment spheres, sleeves and rods to assist with the placement of individual segments as well as ring-to-ring connections.
- Segment geometry improvements to speed erection and to suit the tunnel alignment.
- Development of ring-build positioning software to assist with segment installation and to optimize the tunnel alignment.

Shotcrete for ground support

Due to the popularity of NATM tunneling, shotcrete for initial (and final) ground support is well developed. But it is still subject to constant innovation in materials and equipment.

NATM tunnels demand frequent use of wet and dry shotcrete in large and small quantities. Indeed, the design engineer, who has considerable input into the actual performance of the work, may insist on larger or smaller volumes of excavation and, therefore, quantities of shotcrete for initial support — consistent with the actual ground conditions encountered. So equipment, means, methods and materials must be available and remain flexible to meet the variable and immediate needs of this popular tunneling method. Steel or polypropylene fibers may be used in the shotcrete mix together with or without welded wire mesh to suit the support design.

Typical equipment includes mobile robotic booms, fixed booms and even hand nozzle work for small quantities of dry or wet mix shotcrete — say for pocket excavations in particularly sensitive areas.

Shotcrete batching and conveying equipment includes state-of-the-art systems — typically installed underground for immediate supply. Slick lines are rarely used to convey shotcrete to the placing booms. Trucks and buckets are the preferred means of transporting wet shotcrete underground and especially in large cross-section and longer tunnels.

Shotcrete for immediate support has also been used successfully for TBM-bored and reamed tunnels. At the 9.43-m- (31-ft-) diameter Lotschberg Base Tunnel near Raron, Switzerland, for example, the trailing gear enclosed a fully-automated robotic shotcrete spraying station that provided initial support immediately behind the TBM shield.

Construction of the A-86 SOCATOP twin-level highway tunnel in suburban Paris, France.

Horizontal jet grouting

This method is being further developed for more widespread use in large and small heading tunnels where sufficient mechanical ground support cannot be provided by other means or where surface access is restricted. This system includes the following elements:

- Typically, a horizontal jet grouted hood is produced in the soil over the tunnel section to provide ground support.
- Very specialized equipment for drilling and grouting in confined spaces.
- Installation logistics must be worked into the overall advance cycle and schedule.
- Specialized supporting logistics are needed to operate the system.

Horizontal jet grouting is suitable for controlling running ground in variable geological conditions and where ground water pressure is a factor in controlling the face. It is considered expensive and time consuming and will likely extend the overall tunneling cycle times. However, this form of ground support may provide a reliable method to advance the face if surface access to implement other methods is not practical or available.

Pipe arch — barrel vault system. Several European suppliers have developed effective and mechanized pipe arch installation systems. These are used to install a barrel vault over the top heading in NATM tunnels. This system has already been used on at least two North American tunnel projects (Dulles Airport, Washington, D.C. and Beacon Hill in Seattle), but it has not yet gained wide acceptance. This ground support system makes use of the following materials and equipment:

- The pipe arch system is a series of small pipes (75 to 170 mm or 3 to 6.7 in. diameter) driven or drilled into place, then grouted solid to form a canopy over the crown of the advancing heading.
- Multiple canapies installed as needed.
- Drilling equipment is the same as used for the primary advance of the top heading, modified to suit the semi-automated pipe handling and drilling systems.

Once the pipe arch has been installed, successful and rapid excavation may then proceed underneath. A well installed pipe arch will develop a series of soil bridges between each pipe to retain the soil.

Deformable steel channels and elements

The European mining industry developed an effective product to support and arrest ground deformation for tunnels having high ground cover or located in squeezing or swelling conditions. This system is reliable, easy to install and has a predictable deformation rate and amount (partial collapse) while maintaining a safe working environment.

Deformable channel supports were patented decades ago and have found popularity in modern European tunnels where rigid supports were not applicable. In the Gotthard Base Tunnel, Sedrun section, for example, full scale load tests were performed to determine the dynamic characteristics of this material. In North America, they were included as part of the design for the Beacon Hill project in Seattle. Their standard features include the following:

- Various unit weights available and, therefore, mechanical properties per section.
- Simple and reliable mechanical connections that are easy to install.
- Special extendable segments suitable for tunnel and drift connections.
- Suitable for shotcrete and reinforcement installation for additional ground support.

At the Strengen Tunnel in Austria, fabricated steel compressible elements, instead of deformable channels, were used to control and arrest ground settlement following mining. They were placed in the initial lining of shotcrete and lattice girders as the heading was advanced.

Ground freezing

While ground freezing is not new to underground construction in North America, several European projects have made extensive use of this method for unique and especially challenging applications as a result of the tunnel design and site conditions.

The A-86 SOCATOP Tunnel for example, has used ground freezing in water-bearing soils to successfully excavate niches and cross-passages between the two roadway levels. In this case, local dewatering from the surface was prohibited and the ground could not be successfully grouted from within the tunnel. While the majority of the niches and cross-passages were frozen from within the main running tunnel, some sensitive areas could not be reached. As a result, a short parallel service tunnel was driven by shield from an auxiliary shaft to provide access for the freeze pipes to the extremity of the cross-passage excavations.

Ground freezing for niche and cross-passage excavation on the A-86 Tunnel near Paris, France.

The Storebaelt Tunnel in Denmark also made extensive use of ground freezing methods to complete the excavation of many cross-passages located under the sea and between the twin running tunnels. Ground freezing was seen as the only viable solution for ground support for this sub-aqueous tunnel. Grouting was deemed to be unsuitable in the soils and ground water conditions under the Storebaelt.

Conclusion

Advances in European tunneling technology, methods and equipment have provided a basis for safely constructing longer and larger tunnels shafts and caverns. These technological, material and equipment advances may be applied to suitable North American projects where conditions are similar and where contracting conditions will allow. In the case of NATM tunneling, contract language and labor rules may need to be reviewed and adjusted to take full advantage of technically advanced methods, materials and equipment while reducing risks, costs and schedule time.

European tunneling design and construction industries are market-driven and sensitive to the same cost factors as found on all North American projects. Early contractor involvement in the design development has provided considerable benefits to projects. European innovation plays a key role in the success of current and recently completed projects including some of the largest and longest tunnels in Europe. ■ (References are available from the authors.)

Acknowledgments

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FEATURE ARTICLE

Manhattan's transformation is talk of the town at Fox Conference

Where space is limited, as it is throughout most of the northeastern United States, new construction either takes place high above street level, or below it. In Lower Manhattan, NY both kinds of expansion can be found in abundance. That is good news for the nearly 200 attendees at the George A. Fox Conference, presented by the Underground Construction Association (UCA) of SME at the Graduate Center, City University of New York, on Jan. 30.

Construction at the World Trade Center site is just one of 59 projects above and below ground taking place in Lower Manhattan.

Among the many projects taking place in Lower Manhattan's massive transformation process, are expansions to the city's vast underground network of subways and other tunnels.

"New Yorkers either live on the ground or below it," said keynote speaker Charles J. Maikish while explaining how an attempt to build above street level walkways never caught on in the city. Maikish is the executive director of the Lower Manhattan Construction Command Center. His job is to oversee the $22 billion project that will transform the island by 2010. From the construction of Freedom Tower at the site of the fallen World Trade Center buildings, to the expansion of the Second Avenue Subway, the extension of the East Side Access, No. 7 line, the new trans-Hudson line and numerous waterway tunnel expansions, including City Water Tunnel No. 3, the task Maikish is charged with is a huge one. He is primarily responsible for coordinating the scheduling and staging of the overall rebuilding plan, along with the day-to-day coordination of construction work downtown. He places particular focus on mitigating impacts on the environment and mobility, maintaining and improving access and alleviating congestion of any kind related to construction.

At the time of the Fox Conference, there were 59 projects under way in Manhattan. All of those projects need things like concrete and steel delivered to sites in very tight working environments. And some need the equipment in even tighter spaces.

"This is not just about the recovery of Lower Manhattan (from the 2001 terrorist attacks) but this is a plan to restore it and to maintain its integrity," said Maikish. "I think that is the appropriate response to the terrorist attacks."

When Freedom Tower is completed, it will stand 541 m (1,776 ft) about the skyline. That will be a strong statement to the world about America's strength. But it is the work that takes place much lower that was of interest to the conference attendees.

On this respect, Maikish said Manhattan's efforts below ground aim to provide relief to the city's street level congestion and to make sure Manhattan — already essential to the economy of the United States and the world — stays current by upgrading the existing telecommunications and technological network while also allowing room for growth in that area.

Second Avenue Extension

One of the largest below ground projects is the Second

William M. Gleason, Associate Editor

Ave. Extension. The subway line extension will include a two-track line along Second Avenue from 125th Street to the Financial District in Lower Manhattan.

The Second Avenue Subway will be New York City's first major expansion of the subway system in more than 50 years. When completed, the line will stretch 13.7 km (8.5 miles) along the length of Manhattan's East Side, from 125th Street in Harlem to Hanover Square in Lower Manhattan. In addition, a track connection to the existing 63rd Street and Broadway Lines will allow a second subway line to provide direct service from East Harlem and the Upper East Side to West Midtown via the Broadway express tracks.

It will be a four-phase project. The first phase will begin in 2007 and is projected to carry more than 200,000 weekday riders when it is completed in 2013. It will be an extension of the existing service in Manhattan.

Phase Two will provide an extension of an existing line. Phase Three will introduce a new line, the T train, and Phase Four will extend that line.

East Side Access

The East Side Access project will connect the Long Island Rail Roads (LIRR) Main and Port Washington lines in Queens to a new LIRR terminal beneath Grand Central Terminal in Manhattan. The new connection will increase the LIRR's capacity in Manhattan and relieve congestion at Penn Station.

The LIRR is the largest commuter railroad in the country. It has a daily passenger load of 269,000 people. Of those, 240,000 use Penn Station.

Since work began on the East Side Access project in 2001, a number of jobs have been completed.

Fulton Street Transit Center

The Fulton Street project is an $880-million job that will improve access to and connections between 12 subway lines for thousands of daily commuters and Lower Manhattan residents and visitors. It will link New York City Transit facilities with PATH service and the World Trade Center site.

Construction of the Fulton Street Transit Center is under way and parts of the new station have already been opened for customer use. The project will be fully completed by mid-2009.

Work on New York City's No. 3 water tunnel began in 1970 and is not expected to be completed until 2020. It is the largest construction project in the history of New York City.

City Water Tunnel No. 3

It is the largest capital construction project in the history of New York City.

Construction on city Water Tunnel No. 3 began in 1970 and is not expected to be completed until 2020.

The four-stage project will total more than 96 km (60 miles).

The first stage went into service in 1998 and cost approximately $1 billion. The second stage, which is currently under construction, consists of two sections. The first section is the Brooklyn/Queens section. The Brooklyn and Queens legs were connected in 1997. They are expected to be activated in 2009. Each leg runs about 8 km (5 miles). The stage costs $750 million to complete.

The third stage is a 26-km (16-mile) section and is in the final planning stage. The final stage will be a 23-km (14-mile) run from the Valve Chamber in the Bronx under the East River and into Queens.

The first stage was completed using the drill-and-blast method. A tunnel boring machine was constructed for the second stage. The operation of City Tunnel No. 3 will allow inspection and repair of City Tunnels No. 1 and No. 2 for the first time since they were put into service in 1917 and 1936, respectively.

Other projects that were discussed during the conference included the massive Niagara Tunnel Project and a project at Dulles Airport in Washington, D.C.

That $985 million Niagara project began in 2005. The 10.4-km- (6.5-mile-) long Niagara Tunnel project will increase the output of power from Niagara Falls. It is estimated to cost $600 million with an additional $385 million for remedial and other work costs. It is expected to be completed in 2009.

The Dulles Corridor Rail project was discussed by Allan Sylvester, senior vice president of Clark Construction. The Dulles Corridor Metrorail Project is a 37-km (23-mile) extension of Metrorail. The first phase is 18 km (11-miles) long. It is expected to be completed in 2012.

"This is not just about the recovery of Lower Manhattan (from the 2001 terrorist attacks), but this is a plan to restore it and to maintain its integrity. I think that is the appropriate response to the terrorist attacks."

— George A. Fox Conference keynote speaker Charles J. Maikish

Maintenance of underground structures

The second half of the one-day George Fox Conference was dedicated to the maintenance of underground structures.

"Most problems for tunnels come from ground water intrusion," said PB America's Henry Russell in his introduction to the second half of the conference that focused on waterproofing for new underground projects.

The struggle to keep water out, or in, is a constant struggle for those who work in the tunneling industry.

It has been said that water is the best inspector of any tunneling project because it will always be able to find a crack or unsealed seam.

At the Fox Conference, all forms of waterproofing structures were discussed.

James R. Haggins spoke on behalf of owners. He is with the Washington Metro Area Transit Authority (WMATA). The WMATA is currently undergoing the project to connect the Washington D.C. area subway system with Dulles International Airport.

Speaking for owners, he knows the importance of proper waterproofing and keeping a tunnel dry.

Leon "Lonnie" Jacobs, project manager for Frontier Kemper, spoke from the contractor's perspective and Colin Lawrence, vice president of Hatch Mott MacDonald, spoke for designers. While designers, contractors and owners/clients might not always see eye to eye on every project, Jacobs, Haggins and Lawrence all spoke of the need to approach each project correctly.

The shared themes for all three presenters included the need to establish a plan for the project, to have a proper design and to take into account the environmental conditions such as weather and soil. Once the project begins, all three presenters stressed the importance of having constant inspections during the installation of waterproofing systems. It is also essential that a skilled and trained labor force is used for the job.

Attendees were treated to a number of photos showing water build up on floors and benches inside of tunnels and hanging ice from the ceiling of tunnels from projects in which the proper steps were not taken.

Waterproofing with shotcrete was discussed by Vojtech Gall of Gall Zeidler Consultants and Terry Mellors of Mellors and Associates. Robert Goodfellow of Black and Veatch spoke of various insurance issues in a presentation titled Project Application of the Code of Practice for Risk Management.

In one of the final presentations, David Caiden spoke of current trends in waterproofing technology. He spoke of new blends of concrete, new techniques to battle water and in a twist at the end of the presentation he pointed out that some of the best technology is also some of the oldest in the world. With a photo of the ancient Roman Aqueducts behind him, Caiden explained that cement mixture called Opus Caementicium was used on the structures. Those structures have stood the test of time and weather. For inside work, he explained that the Roman compound of Opus Signuim was used in the old roman baths.

"These methods are tried and trusted and there is no reason we should not be using it today," he said.

The George A. Fox Conference will return to the Graduate Center, City University of New York in 2008 on the final Tuesday of January. ■

Shanghai tunnel project will use the world's largest tunnel boring machine

The Chinese city of Shanghai is one of the fastest growing in the world. To keep up with the growth, two tunnels, three-lanes each, are being built beneath the Yangtze River to connect Shanghai with the Changxing River Island.

To complete such a large project, Herrenknecht Tunneling Systems was brought in to construct the largest tunnel boring machine (TBM) in the world.

The first Herrenknecht S-317 Mixshield has a diameter of 15.43 m (50.62 ft). It was built to construct one of the two 7.2-km (4.5-mile) tunnels.

The first Herrenknecht S-317 Mixshield to be used in Shanghai has a diameter of 15.43 m (50.62 ft).

The tunnels are part of the Changjiang Under River Tunnel Project and will be at depths of up to 65 m (213 ft) beneath the Yangtze River in Shanghai-Pudong.

These two tunnels are to be opened to traffic in April 2010, in time for Shanghai to host the World Expo.

More than 20 million people live in the Shanghai area. The area itself has been growing at an extremely rapid pace for more than a decade and is in need of more space. The search extended beyond the natural limits of the Yangtze River Delta.

As part of its incredible growth, 500 new vehicles are registered every day. The new tunnels will connect the Changxing River Island, with a population of approximately 600,000 people to the road traffic network. A bridge construction will also provide a traffic link between Changxing Island and the large island of Chongming.

Investments in the two tunnel projects and the bridge amount to approximately US$1.5 billion.

Herrenknecht AG was awarded the contract for the construction of the two Mixshields (slurry tunneling shields) in spring 2005.

Not only was it the first direct Chinese order for Herrenknecht´s most advanced tunneling technology, it is also the first time worldwide that two machines with a excavation diameter of this size have been built.

During tunneling, the machines will face water pressures of up to 6.5 bar.

To allow personnel to change tools at the cutting wheel in such extreme conditions without compromising high safety standards, the six cutting wheel arms are accessible from within the shield under atmospheric pressure. This minimizes the need for diving operations to change excavating tools.

The two machines were built at the premises of Herrenknecht´s partner STEC in Shanghai Pudong, 6 km (3.7 miles) from the planned construction site. With a total length of 125 m (410 ft) and a total weight of 2.3 kt (2,535 st), the machines were specially designed and developed for the project. The main hydraulic and electromechanical components, the process and control technology as well as the cutting wheels of the two TBMs were produced by Herrenknecht at its headquarters in Schwanau, Southern Germany. The main drive is cutterhead power: 3,500 kW, weighing a total of 170 t (187 st) and had to be offloaded with a specially provided floating crane. With the help of the steel construction and assembly experts from Herrenknecht's Chinese partner and customer Shanghai Tunnel Engineering, the first machine (Herrenknecht S-317) was handed over in time.

The Herrenknecht S-317 began tunneling on Sept. 8, 2006, in the launch shaft at a depth of 26 m (85 ft). The second tunnel, with a distance between centerlines of 23 m (75 ft), was driven with the Herrenknecht S-318 Mixshield. It began tunneling beneath the river on Dec. 8, 2006. The two machines will install a total of 7,500 lining segment rings beneath the Yangtze in two tunnels, each with a length of 7.5 km (4.6 mile). Each ring is made up of 11 segments, each weighing up to 16 t (17.6 st). By the time the two tunnels have been completed, 2.7 million m^3 (95 million cu ft) of earth will have been excavated.

The first Herrenknecht tunneling shield is expected to arrive at the target shaft on the river island of Changxing at the end of 2008. ■

Agimax concrete mixer fits well for tunneling and mining

Moxon Industries' Agimax concrete agitator and transporter is designed for mining and tunneling industries. It has a 163 cm (64 in.) wide profile and low overall height. The 10 m^3 (11 cu yd) Agimax Concrete Agitator/Transporter suits small bore tunnel and mining applications

The low height makes the Agimax concrete mixer ideal for tunneling.

The unit can be mounted to a rubber-tired vehicle or a rail car. It is equipped with electric, diesel air or truck PTO drive; and is hydraulically operated with controls for the agitation shaft, body vibrator, discharge gate and body hoist (for clean out).

The full sweep, bi-rotational agitator shaft rotates at 6 rpm and meets American Society for Testing and Material and American Concrete Institute standards for agitated concrete transportation.

www.hedland.com

Detector Duo detects pipes in the first swipe

The Detector Duo from IDS provides easy to interpret real time results of deep and shallow targets and locates the exact position of pipes and cable.

There is no need to replace the antenna and cover the same site twice. Users can detect shallow and deep targets with a single scan saving time and costs.

Simultaneous real-time display of deep and shallow targets combines superior resolution with extra soil penetration depth.

The Detector Duo is lightweight, comes with a collapsible trolley that makes it easy to transport and assemble.

It also features data storing and printing functions for easy report function. The user friendly software interface makes it suitable for all users.

It also features automatic calibration for quick start up and automatic recovery of soil type paramerters.

There is no need to insert propagation speed or soil dialectic constraints.

It also features an easy mark up tool for all types of pipes and cables.

www.idsgeoradar.com

The Detector Duo covers deep and shallow sites in a single pass.

Hole-Hog piercing tools hit hard for maximum performance

Allied Construction Products, has developed a new generation of Hole-Hog underground piercing tools starting with the HH-79 model.

This 8 cm (3 in.) class model HH-79 hits hard and runs fast as it delivers high impact energy of maximum performance. The length-to-diameter ratio and one-piece body design combine to provide a rapid percussion cycle that drives the HH-79 straighter and minimizes deflection.

The HH-79 is available with either a pierced nose or a threaded nose, with both versions having a tailpiece. The threaded nose version provides for mounting nose covers and expanders using a combination piercing and pulling nose cap. Both tool versions have an outside diameter of 7.8 cm (3.1 in.), operate on 1.27 m^3/min (45 cfm) of air to develop an operating pressure of 689 kPa (100 psi) and have a percussion rate of 440 blows per minute. ■

www.drilline.com

April 2007

• **15-20, North American No-Dig, 2007,** Town and Country Resort and Convention Center, San Diego, CA. Contact: Benjamin Media Inc., P.O. Box 190 Peninsula, OH 44264, phone 330-467-7588, fax 330-468-2289, e-mail mlyons@benjaminmedia.com, Web site www. nastt.org/NoDig.

• **23-25, First International Tunnel Safety Forum for Road and Rail,** Boscolo Plaza Hotel, Nice, France. Contact: Stephanie Whithan, Tunnel Management International, P.O. Box 452, Kempston, Bedford, MK43 9PL, UK, phone 44-0-1234-764630, fax 44-0-1234-764784, e-mail info@tmi-intelligence.com, Web site www.tmi-intelligence.com.

• **25-27, 4th Conference on Traffic and Safety in Road Tunnels,** Ramada Hotel Hamburg Bergedorf, Hamburg, Germany. Contact: Poyry Infra Traffic GmbH, Neur Wall 72, 20354 Hamburg, Germany, phone 49-0-40-369692-10, e-mail info@tunnelkongress.de, Web site www.traffic.poyry.de.

• **23-29, Bauma 2007**, New Munich Trade Fair Center, Munich, Germany. Contact: Munich Trade Fairs International Group, Messegelande, 81823 Munchen, Germany, phone 4989-949-20260, fax 4989-949-20269, e-mail info@bauma.de, Web site www.bauma.de.

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

May 2007

• **5-10, ITA World Tunnel Congress,** Prague Congress Center, Prague, Czech Republic. Contact: Georgij Romancov, WTC 2007, Metroprojekt Praha a. s., I.P. Pavlova 2, 120 00 Praha 2, Czech Republic, phone 420-296-337-171, e-mail: office-wtc2007@metroprojekt.cz, Web site www.wtc2007.org.

• **27-31, First Canada-US Rock Mechanics Symposium,** Sheraton Vancouver Wall Centre Hotel, Vancouver, British Columbia, Canada. Contact: e-mail info@canada-us-rockmechanics.ca, Web site www. canada-us-rockmechanics.ca.

June 2007

• **10-13, Rapid Excavation and Tunneling Conference, RETC 2007,** The Sheraton Centre, Toronto, Ontario, Canada. Contact: Tara Davis, SME, 8307 Shaffer Parkway, Littleton, CO 80127, phone 303-973-9550, fax 303-973-3845, e-mail davis@smenet.org, Web site www.smenet.org.

• **12-14, Tunnel China 2007,** The Shanghai New International Exhibition Center, Shanghai, China. Contact: phone 86-21-621-91-774, e-mail intexyyj@sh163.net, Web site www.tunnel-china.com. ■

Become a member today!

MEMBERSHIP APPLICATION

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UCA of SME

Membership Qualifications

PROFESSIONAL MEMBER

A person eligible for election or transfer into the class of Professional Member shall be either: (i) employed in a position of responsibility in an area relevant to minerals exploration, extraction, production, processing, economics or metallurgy, including employment as an educator, engineer, scientist (including chemistry or any related earth science) management (including but not limited to chief executive officer, financial, legal, or human resources personnel); or (ii) hold a baccalaureate degree, masters degree or doctorate degree in engineering, mineral economics or any related earth, chemical or environmental sciences; or (iii) employed or educated in mineral exploration, extraction, production, processing, economics or metallurgy; or (iv) actively involved, directly or indirectly, with mineral exploration, extraction, production, processing, economics or metallurgy, whether through engineering, scientific, related earth science, management, executive, financial, legal, or human resources experience; or (v) engaged in marketing or technical sales of equipment and supplies used in mineral activities. All persons who were, prior to the adoption of these Amended and Restated Bylaws Members, Associated Members, Legion of Honor Members, Senior Members, Life Members or Life Associate Members shall hereafter be Professional Members unless they apply for and become Registered Members.

If at any time your record of experience and/or education is questioned for qualification of member grade, you may be requested to provide an endorsement for membership by an SME member in good standing.

STUDENT MEMBER

A person eligible for election into the class of Student Member must be a full-time college undergraduate or graduate student in good standing. A Professional Member who subsequently returns to school for an additional degree cannot become a Student Member. All Student Members must be nominated by an existing Member.

REGISTERED MEMBER

A Registered Member is a scientist, engineer or technologist who is concerned in various ways with the discovery, extraction and utilization of minerals, metals and energy sources. The membership includes geologists and other geoscientists, mining engineers and metallurgists, environmentalist, other engineers and other scientists and technologists. A person eligible for election or transfer into the class of Registered Member shall have 1) a university degree from a U.S. accredited university or a recognized overseas university, **and** 2) a minimum of five (5) years of professional experience, of which at least 3 must have been in a position of responsibility, defined as one in which the individual was depended on for significant participation and decision making. University degree must be in fields related in various ways with the discovery, extraction and utilization of minerals, metals and energy sources. Applicants must submit a copy of their University Degree that you have signed or a copy of your transcripts that confirms graduation. **Professional experience must be in the mineral and extractive industries, or in government, educational, research, professional or commercial organizations concerned with those industries.** Every Registered Member shall observe and be bound by the SME Code of Ethics as published by SME from time to time. Any alleged breach of this code or any alleged unprofessional conduct by a Registered Member which may be brought before the Ethics Committee shall be investigated and, if proved, shall be dealt with in accordance with the outlined procedures.

REGISTERED MEMBER CONDITIONS

Applicants must satisfy at least one of the following:

REQUIRED

- ☐ **Licensed or Certified in a state in the United States that is a member of the National Association of State Boards of Geology (ASBOG), Mechanical or Civil Engineering is acceptable provided the experience gained by the applicant is clearly in the minerals industry.**
- ☐ **Certified by the American Institute of Professional Geologists (AIPG) as a Certified Professional Geologist.**
- ☐ **Professional Engineer licensed or certified in a state of the United States.** ***Must provide with this completed application a copy of your license or certification with a current expiration date.***

OR

- ☐ **You may apply if you do not meet the above criteria but will need to provide three endorsements. Those endorsing you must complete the Verification Form of this application. Those three Verification forms must be returned with your completed application.** ***Verifiers must be SME Members and licensed or certified.***

REGISTERED MEMBER SME CODE OF ETHICS

This list is not exhaustive and may be amended subject to approval by the SME Board of Directors.

1. The responsibility of members for the welfare, health and safety of the community shall at all times come before their responsibility to the profession, to sectional or private interests, or to other members.
2. Members shall act so as to uphold and enhance the honor, integrity and dignity of the profession.
3. Members shall perform work only in their areas of competence.
4. Members shall build their professional reputation on merit and shall not compete unfairly.
5. Members shall apply their skill and knowledge in the interests of their employer or client for whom they shall act, in professional matters, as faithful agents or trustees.
6. Members shall give evidence, express opinions or make statements in an objective and truthful manner and on the basis of adequate knowledge.
7. Members shall continue their professional development throughout their careers and shall actively assist and encourage those under their direction to advance their knowledge and experience.
8. Members shall comply with all laws and government regulations relating to the mineral industries, and with the rules, regulations and practices as established and promulgated by the U.S. Securities and Exchange Commission with respect to the official listing requirements for mining and other companies.

Interpretation of the Code of Ethics along with Admission, Resignation and Disciplinary Procedures can be obtained from SME or at www.smenet.org

PROFESSIONAL MEMBER DUES:

$120 PER YEAR *(plus)*
Entrance Fee: $20
Reinstatement Fee: $10

REGISTERED MEMBER DUES:

$195 PER YEAR *(plus)*
Entrance Fee: $20
Reinstatement Fee: $10

STUDENT DUES:

$21 PER YEAR
Entrance Fee: None

SME Membership was recommended to me by: _____

Become a member today!

Last Name: _____

☐ Approved — Do NOT Write In This Space

↑ FOR OFFICE USE ONLY ↑

I Am Applying for (check one):

- ☐ **Admission**
- ☐ **Change of Status**
- ☐ **Reinstatement +**

If Reinstatement:

Last Year of Active Membership _____

Year of Election _____

Previous Member Grade: _____

Membership Category* (check one):

- ☐ **Professional Member**
- ☐ **Registered Member****
  If you are an SME Member, please provide your member number _____
- ☐ **Student Member +**

* *Please refer to Membership Qualifications on page 1.*

** *Even if you are currently an SME Member, you must complete and remit application for review by the admissions committee.*

\+ *Reinstatement is not applicable to students.*

Prefix: ☐ Mr. ☐ Mrs. ☐ Ms. ☐ Dr. ☐ Male ☐ Female

(PLEASE PRINT)

Name: _____ (Last / First / Middle Initial)

Company Name: _____

School Name (if student) — DO NOT ABBREVIATE

Present Position Title: _____

E-Mail Address: _____ Birth Date: ____/____/____ (Month / Day / Year)

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Country: _____ Zip/PC: _____

Phone: _____ Fax: _____

Home Mailing Address

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City: _____ State/Province: _____

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Preferred Mailing Address: ☐ Home ☐ Business

Record of Experience

Include a record of employment for 5 years most applicable to the category of membership you are applying for. (**REGISTERED MEMBERS ONLY:** Must include all records of employment related to the minerals industry.) ***If additional space is needed, please enclose an additional sheet.*** Employment as a teacher in mineral-related field is considered responsible charge.
Please be very specific with your answers

		Position of Responsibility
From:	Title _____ Employer _____	☐ Yes
	Nature of employer's business _____	
To:	Primary responsibilities _____	☐ No
From:	Title _____ Employer _____	☐ Yes
	Nature of employer's business _____	
To:	Primary responsibilities _____	☐ No
From:	Title _____ Employer _____	☐ Yes
	Nature of employer's business _____	
To:	Primary responsibilities _____	☐ No

Education

Please list **all** schools, degree earned, major, and date of graduation. Student Members must be full-time students at a school approved by SME.
Registered Members ONLY must submit a copy of their Degree related to earth science or a document confirming graduation.

Name of School _____ Date of Graduation or Expected Date of Graduation _____

Degree Earned _____ Major _____

Name of School _____ Date of Graduation or Expected Date of Graduation _____

Degree Earned _____ Major _____

Name of School _____ Date of Graduation or Expected Date of Graduation _____

Degree Earned _____ Major _____

Become a member today!

Endorsement (Student Members Only)

Student Member applications must be endorsed by an SME Professional Member, Registered Member or Student Member in good standing.

Name: _____ Member #: _____ Date: _____

Signature (Registered Member Applicants)

I declare, by signing this application, that all statements made herein and on any appended sheets are true and accurate to the best of my knowledge, information, and belief. I shall abide by the Charter, Bylaws and Code of Ethics of the Society for Mining, Metallurgy, and Exploration Inc., and that I subscribe to and will abide by them and all provisions in them as now in effect or hereafter amended and that any untrue or incorrect statement knowingly made by me in this application or my failure to abide by the Charter, Bylaws and Code of Ethics, shall be grounds for my suspension or expulsion from the Society as may be determined and directed by the Ethics Committee.

I affirm adherence to applicable professional and ethical standards, have not had a certification, license, or similar qualification suspended or terminated for ethical or disciplinary reasons during my career, nor have I resigned for such designation in participation of or in settlement of proposed grievance or disciplinary proceedings.

I grant SME permission to contact listed employers, endorses, and others who may provide information concerning my qualification for membership, and to divulge information contained in the application, or obtained in SME's review, of my qualification, which is necessary for verification of my qualifications.

Name (print)_____

Signature_____ Date _____

Completed Applicant Verification Forms for my three endorser's are included. Endorsers must be SME Members. My three endorser's are (please PRINT LEGIBLY):

First Name _____ Last Name _____ Phone _____ E-mail _____

First Name _____ Last Name _____ Phone _____ E-mail _____

First Name _____ Last Name _____ Phone _____ E-mail _____

Signature (All Applicants)

If elected, I agree to abide by the bylaws and rules of the Society for Mining, Metallurgy, and Exploration, Inc. as the same are now in effect and as they may hereafter be modified while I am a member. I understand that under certain laws and regulations, SME must have my permission in order to communicate with me via fax or email. I hereby give SME Foundation, SME Local Sections and SME business associations permission to send me information and advertisements. If SME does NOT have your permission to communicate with you via fax or email, you may not have access to some of your electronic member benefits.

Signature: _____ Date: _____

Divisional/Technical Interest

Please indicate, in order of preference (1, 2, 3), a minimum of one and no more than three, technical interest categories.

Divisions:

_____ Coal & Energy (F)
_____ Environmental (E)
_____ Industrial Minerals (H)
_____ Mining & Exploration (Metallics) (A)
_____ Mineral & Metallurgical Processing (B)

Technical Interest Committees:

_____ Bulk Material Handling (M)
_____ Construction Materials & Aggregates (O)
_____ Education (J)
_____ Minerals Resource Management (K)
_____ Underground Construction Association (U)

Industry Sector

☐ Coal Mining (1B)
☐ Coal Processing (6)
☐ Economics (4)
☐ Education (3)
☐ Environmental (7)
☐ Geology/Exploration (8)
☐ Government (2)
☐ Industrial Minerals Mining (1C)
☐ Industrial Minerals Processing (1D)
☐ Manufacturing (5)
☐ Metallurgy (9)
☐ Metals Mining (1A)
☐ Metals Processing (10)
☐ Underground Construction/Tunneling (11)

Job Title

☐ Consultant (C)
☐ Educator (D)
☐ Engineer (E)
☐ GM/Vice President (G)
☐ Geologist (H)
☐ Marketing/Sales (M)
☐ Mine/Plant Manager (N)
☐ Owner (O)
☐ President/CEO/COO (P)
☐ Purchasing Agent (R)
☐ Scientist/Researcher (S)
☐ Student (T)

Optional Subscription

YES, I would like to subscribe at the members' price to:
Minerals & Metallurgical Processing Journal

☐ $ 99

Payment

DUES ARE PAYABLE ON A CALENDAR YEAR BASIS. PAYMENT MUST ACCOMPANY APPLICATION.

Please charge the following credit card:

(check one)

☐ American Express ☐ Discover ☐ **Check Enclosed**
☐ MasterCard ☐ Visa

Card Number _____

Expiration Date_____

Signature _____

DUES $ _____

REGISTERED MEMBER FEE $ _____

(**REQUIRED:** Attach a copy of your license or certification or three completed Applicant Verification Forms and a copy of your degree.)

ENTRANCE FEE $ _____

REINSTATEMENT FEE $ _____

M&MP SUBSCRIPTION $ _____

Dues Payable in U.S. Dollars Only **TOTAL $** _____

Rev. 1/07

www.smenet.org

REGISTERED MEMBER VERIFICATION FORM

Society for Mining, Metallurgy, and Exploration, Inc.
8307 Shaffer Parkway Littleton, Colorado 80127
(303) 973-9550 (800) 763-3132 Fax: (303) 948-4265 E-mail: sme@smenet.org

Applicant's Name _____
has filed an application with Society for Mining, Metallurgy & Exploration, Inc. (SME) for SME Registered Member Status. Qualification for this status depends, among other considerations, on the verification of the extent, diversity, and quality of the applicant's practical training and professional experience. Please assist us by supplying the information requested below, based upon your own personal, first-hand knowledge of the applicant. *Attach additional sheets if needed. Thank you!*

Verification of Applicant's experience: From _____ (Month/Year) To _____ (Month/Year)

Applicant's employer during this period: _____

VERIFIER MUST BE AN SME MEMBER. **Please provide your SME Member Number:** _____

Verifier must satisfy at least one of the following conditions:

☐ Licensed or Certified in a state in the United States that is a member of the National Association of State Boards of Geology (ASBOG).
If yes, specifiy State where licensed _____ and license expiration date _____ .

☐ Certified by the American Institute of Professional Geologists (AIPG) as a Certified Professional Geologist. Expiration date _____ .

☐ Professional Engineer licensed or certified in a state in the United States.
If yes, specify State where licensed _____ and license expiration date _____ .

Information on Verifier:

Name _____

Employer _____

Title _____ Nature of your current business _____

Business Address _____

_____

Office Phone _____ Email _____

Please provide detailed information to the following questions regarding the Applicant:

1. Profession and specialty (if any) _____ Years of Experience _____
2. What was your business or professional relationship to the applicant during the time frame indicated on this form? _____
3. Please state your opinion regarding the duration, extent, and complexity of the applicants job related tasks during the time frame indicated on this form. _____
4. Evaluate the job performance of the applicant during the time frame indicated on this form. _____
5. Please provide any additional comments. _____

I declare, by signing this form that all of the information provided is accurate to the best of my knowledge.

Verifier's Signature _____ Date _____

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