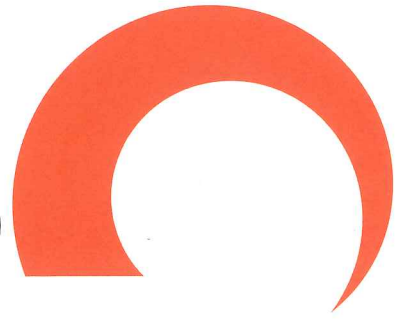


INTERNATIONAL EDITION

January 2015

Tunnels

AND TUNNELLING



OHIO OVERFLOWS

The Black River team endure severe winter weather

North America • Logistics • Insurance

Efficient

EPB Shield S-764 with an electrical drive and independent culvert gantry for laying the tunnel floor, from the start making continuous headway – up to **126m a week**.

14.4 m

Intermediate breakthrough for 'Alice', whose large diameter makes it **one of the biggest TBMs in the world**.

Mega Project

Auckland Waterview Connection: New Zealand's largest-ever road project counts on the **reliability and expertise** of market leader Herrenknecht. Our 14m+ diameter TBMs have completed more than 51km of road tunnels worldwide.

Contractors:

- > Fletcher Construction Ltd.
- > McConnell Dowell Constructors Ltd.
- > Obayashi Corporation

Pioneering Underground Technologies

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CHINA DECIDER

IN DECEMBER Australia's multi-industry contracting giant Leighton Holdings announced the impending sale of John Holland to the fourth largest construction company in the world (see page 14). The buyer, state-owned China Communications Construction Company (CCCC) stressed that it would be "business as usual" for John Holland customers, that it perceived growth opportunities in Australia. Normal commentary during a takeover.

And while the Chinese company's further remarks about interest in a dynamic market, the desire to put its financial backing behind John Holland, and a desire to learn from one another are also standard fare, it's more interesting when looked at against the backdrop of wider Chinese spending.

In 2011, Australia had been the largest recipient of Chinese foreign direct investment (FDI – the purchase of an active, controlling interest in a foreign company) for a number of years. This was largely fuelled by a flourishing demand for Australian natural resources, combined with a concern for securing supply to its hungry industry, and so focused on that sector. Not a labour-intensive industry, or one caught up in a complex supply chain, China's business interests were relatively straight-forward and did not require much engagement with the Australian corporate or cultural environment.

Still, Australia was excited to have its resources economy driven forward by the Asian powerhouse. Although it seemed that China was only interested in Australia's generous endowment of resources, other sectors were taking notice. This led KPMG, one of the 'Big Four' auditors, to partner with The University of Sydney's China Studies Centre to publish the first of a series of studies into Chinese investment in the country.

By 2013, following the economic downturn, and Chinese growth falling below double digits, Australia fell behind the United States to become the second largest recipient of Chinese FDI. China had begun to diversify its foreign interests to a greater degree. This gave opportunities for new sectors of the Australian economy to nurture relationships with investors.

The November 2014 KPMG-University of Sydney report

editor@tunnelsonline.info

What do you think? Send your views to the editor and join the debate




Alex
Conacher
Editor



on Chinese investment was based off a survey of Chinese investors, and concludes that although they are drawn to Australia as a natural and historical trading partner, they feel limited by a lack of integration into Australia's public and private sector.

Australia is an interesting proving ground for these investors. Integration into Australia's marketplace could set them up for success further afield. This is part of a global strategy, not an isolated move into a single welcoming market.

President Xi Jinping recently said Chinese FDI would grow from USD 660bn in 2013 to USD 1.23tn within a decade. It's worth noting, that at the turn of the millennium, USD 1.23tn was more than value of the entire Chinese economy. And with the Chinese economy due to overtake the USA (in purchasing power terms, if not nominal/value terms) in the next couple of years, further investment from China is not in doubt.

The repercussions of Chinese state ownership of foreign companies remain to be seen. In our industry it's a very new phenomenon. But in this case it's simple, Leighton Holdings was looking to sell, and CCCC was looking to buy 

This month...

20 YEARS AGO

The 9.5m diameter Lovat EPBM mining the St Clair River Tunnel in the US broke through last month, chalking up several technical milestones along the way. The tunnel is the world's largest subaqueous railway tunnel, and involved the first North American use of compensation grouting. *Tunnels and Tunnelling, January 1995, p.7*

30 YEARS AGO

A new 2.3km-long section of the Prague Metro, linking the city centre with the northern suburbs was opened in November. This brings the total length of the network up to 22.3km with 25 stations. The new section passing under the River Vltava has two stations and cost GBP 200M. The Prague Metro is a Czechoslovak-Soviet 'Friendship' project. Some 60km will open by the year 2000. *Tunnels and Tunnelling, January 1985, p.7*

40 YEARS AGO

In its drive to consolidate the growth of pipe jacking as an accepted method of tunnelling in the right circumstances, the UK's Pipe Jacking Association has launched three initiatives. Firstly, a joint code of conduct has been published, soon to be followed by standard contract conditions, and finally it is producing a design and specification bulletin with the Concrete Pipe Association. *Tunnels and Tunnelling, January 1975, p.11*



Cover

The front cover is a photo from the Black River Tunnel project in Ohio, USA. Teams have endured a severe winter

Next issue

In the next issue, Tunnels and Tunnelling looks to the Asian tunnelling market, with a feature on Hong Kong's deepest and largest diameter tunnel. Also featuring an article on the future for EPBM design and a technical focus on tunnelling induced settlement

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NEW EPBM FOR ISTANBUL METRO

Turkish contractors Gülermak, Kolin and Kalyon in Joint Venture have selected TERRATEC to design and manufacture the new EPB Tunnel Boring Machine for the construction of the rapid transit line in Istanbul between Mecidiyekoy and Mahmutbey.

TERRATEC takes pride in this achievement by expanding its sales coverage to Middle East and Europe. The Company currently has a subsidiary in Dubai covering the sales and after sales activities in the region.

TUNNELLING SOLUTIONS | METRO



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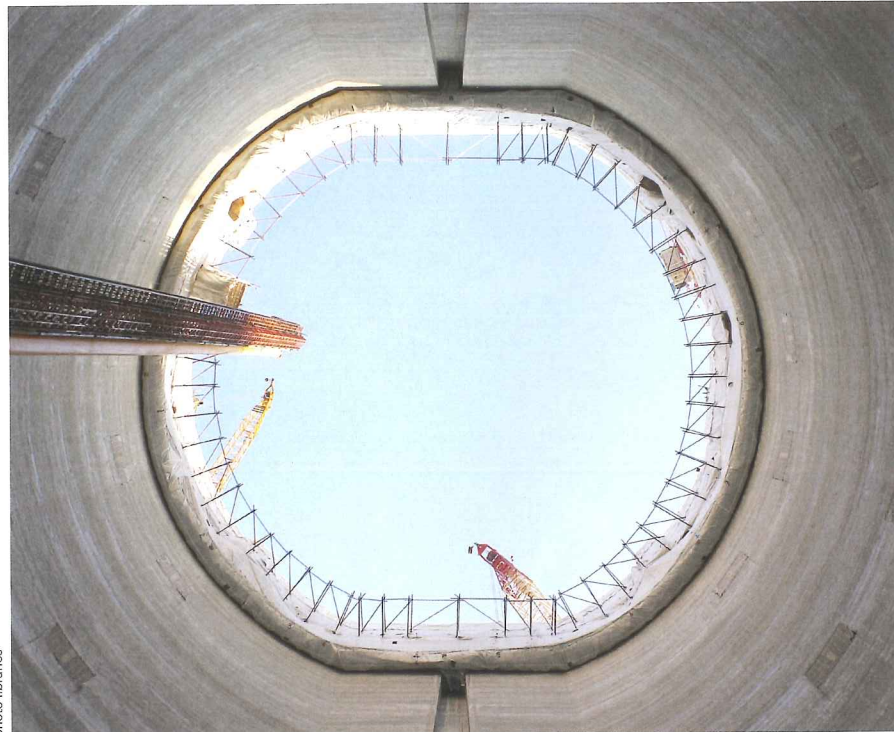
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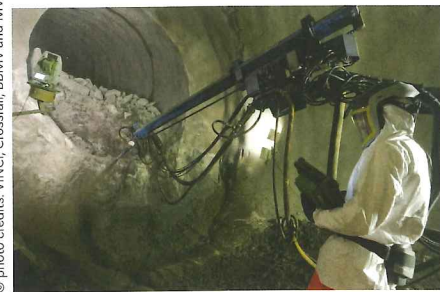
Contributors

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Warren is a client director in Aon's Construction and Power division in London, heading up the Project Finance team and also having direct involvement in other major project placements. He has over 20 years insurance experience and extensive practical experience in construction related insurance.

GARY BRIERLEY
Gary has been involved with two successful start-up design practices; Brierley and Lyman and Brierley Associates. He has served as President of the American Underground Construction Association, Chairman of the Underground Technology Research Council, and as a member of the US National Committee on Tunnelling Technology.



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GRANDS PROJETS

Coca Codo hydro collapse kills 13

ECUADOR — A collapsed pressure well on an Ecuadorian hydropower plant killed 13 people last month and injured a dozen more. Sinohydro Corporation of China is constructing the Coca Codo project in joint venture with local company Coandes, and two consultants: Yellow River and Geodato.

The plant is located on the Coca River, on the border between Ecuador's Napo and Sucumbios provinces.

A spokesman for the Chinese embassy in Quito said, "We ask Chinese companies to reflect on this event, learn from this painful lesson, take appropriate measures, and increase safety to better protect Chinese and Ecuadorian workers."

The USD 2bn contract for the 1,500MW plant was awarded in 2009. Under terms of the deal with Ecuador, Sinohydro financed 85 percent of the cost. Ecuador financed the remaining 15 percent through oil sales to China.

India to build second longest tunnel

INDIA — State-owned national rail operator Indian Railways has proposed the construction of the country's second longest tunnel. The 8km tunnel would form part of the Kolhapur to Rajapur link close to the country's west coast, south of Mumbai.

At the time of writing, the Pir Panjal tunnel is the longest in operation at 11km, and the Karbude tunnel at 6.5km is the second longest.

Local media reported that business support for the tunnel was strong, with lobbyists visiting railway minister Suresh Prabhu to get his support. Sources reported that Prabhu expressed interest in the link, which would be the first east-west connectivity across the Sahyadri mountain range.

There are environmental concerns, as a "significant section" of the route runs through the Sahyadri Tiger Reserve. Railway officials claimed that they would go ahead with the project because they will take steps to keep animals off the track.

HONG KONG WEST ISLAND LINE OPENS TO THE PUBLIC

HONG KONG — The West Island Line (WIL) has opened. The 3.3km-long extension to the Island Line connects three new stations: Sai Ying Pun, Hong Kong University, and Kennedy Town, to the existing route at Sheung Wan Station. Kennedy Town is a cut and cover station, while Sai Ying Pun and Hong Kong University are deep cavern stations.

These were the first station caverns built for an MTR project in over 25 years.

The densely populated western district leant weight to the cavern option, as there was limited surface space available. Atkins China and Geodesign Consulting Engineers worked out concept designs with very little local precedent.

The Sai Ying Pun Station is 225m long and comprises a 187m long cavern and a 38m long platform tunnel.

The cavern is located approximately 40 to 65m below ground. It has an excavation span of 22.8m and a height of 16m, and will be built with a moderate rock cover of 50m at the western end and a rock cover of only 10m at the eastern end.

The Hong Kong University Station comprises a 240m long cavern with an excavation span of 22.4m and a height of 16m. The overall depth of the cavern is similar to that of Sai Ying Pun Station and varies between 48 and 80m below ground level. However, the rock cover is greater and is anticipated to be around 65m at the western end and 25m at the eastern end of the cavern.

Modifications at Sheung Wan were carried out by Sun Fook Kong Construction; Sheung Wan to Sai Ying Pung tunnels by a Dragages-Maeda-BSG joint venture; Sai Ying Pun and Hong Kong University Stations, and Sai Ying Pun to Kennedy Town tunnels by a Gammon-Nishimatsu joint venture. Kennedy Town Station and overrun tunnel construction was awarded to Gammon Construction.

The first proposals for a western extension to the Island Line, known as the West Island Line were submitted in May 2002. A groundbreaking ceremony was held in August 2009 after a number of revisions to the original project vision were deemed necessary.



The first MTR caverns in decades

News briefs

USA

The TBM mining the tunnel below Lake Mead made its breakthrough on 10 December into the concrete wall of the project's intake structure.

Contractor Vegas Tunnel Constructors, a joint venture of Impregilo and its subsidiary S.A. Healy, have driven the 23.5ft (7.2m) diameter machine some 4.5km as part of a project to take a third intake at Lake Mead, providing water for the region. The project faced difficult ground, and has seen pressures as high as 14.5 bar. Vegas Tunnel Constructors launched the machine in 2011, following a number of faults requiring realignment of the starter tunnel.

MALAYSIA

MMC-Gamuda will spend MYR 100M (USD 28M) on a TBM refurbishment facility. The need stems from the conclusion of work on Sungai Buloh to Kajang (SBK) Line, and preparations for the company's upcoming jobs.

The intention is to refurbish the entire fleet working on SBK, to lower future project costs according to reports following a local media visit to the plant last month. As Tunnels and Tunnelling went to press, there were no MMC-Gamuda projects in need of the machines.

ANDEAN TUNNELS APPROVED AT TWO-GOVERNMENT SUMMIT

CHILE/ARGENTINA — An agreement has been signed approving the Las Leñas Pass road tunnel project. The 6 January agreement created a “bi-national entity” responsible for delivering the project. The two signees were Chilean foreign minister Heraldo Muñoz and Argentinean ambassador Gines Gonzalez Garcia. The accord was signed in Santiago. It is the third tunnel planned under the 2009 Maipu Integration and Cooperation Treaty, which aimed to ease freight and movement of people between

the countries. Sub-textually, it also aimed to ease territorial and political friction.

The other projects are the Agua Negra road tunnel, and an as yet unnamed “low-altitude” rail tunnel, a trans-Andean base tunnel. Discussion and feasibility studies have been ongoing, but local media suggests there is political will to improve connectivity between the two countries. The relevant bi-national entities have been formed.

For the Las Leñas project, data will now be gathered from both sides of the

border to decide an optimal alignment.

More detail is known about Agua Negra, which has called for expressions of interest. It will be a twin 13.9km twin tunnel road project with 70m² excavation faces some 40 to 50m apart. The Argentinean portal is at 4,085m above sea level, while the Chilean portal is at 3,620m; an average gradient of 3.37 per cent. It is expected to cost approximately USD 1.4bn. Over two thirds of the route falls within Argentina, so it will pay close to USD 1bn of the cost.

Beijing Metro Line 14 East Section opens

CHINA — The Phase 2 East Section of Beijing Metro's Line 14 opened last month. The Beijing MTR released the news that the 14.8km section was open to the public through the website of (Hong Kong based) MTR Corporation. This is the third metro line to be operated by Beijing MTR, which is a joint venture of MTR (49 per cent), Beijing Capital Group (49 per cent), and Beijing Infrastructure Investment Corporation (2 per cent).

The route traverses 12 stations between Shangezhuang and Jintailu. Two of the stations were not open as Tunnels and Tunnelling went to press. Line 14 is a CNY 50bn PPP project, with civil construction work undertaken by the Beijing Infrastructure Investment Corporation. Beijing MTR is responsible for M&E systems as well as rolling stock. Its concession will last 30 years.

Richard Wong, manager of Beijing MTR said, “The 12.4km Phase 1 section opened in May 2013, and patronage has been growing steadily. The Phase 2 East Section will help ease congestion in the area.”

BaT tunnel revision

AUSTRALIA — Brisbane's Bus and Train Tunnel project plan has been updated to eliminate an existing ‘eyesore’ in the city. The Australasian Tunnelling Society reported last month that an underground station, previously to be located next to the Roma Street Parklands, will now be housed beneath a redeveloped Brisbane Transit Centre. The USD 4bn project will run 4km from Drutton Park to Spring Hill in Brisbane to ease a bottleneck in south east Queensland's rail network, the Brisbane hub. The concept is a 15m-wide, double-decked single tube to deliver combined rail and bus travel. There will be three underground stations, and the maximum depth along the alignment will be 58m. At each end of the combination, the bore will split into routes for trains and buses respectively. The tunnel will be excavated by hard rock TBM, with the possibility for some roadheader work depending on contractor wishes. Vertical station shafts would likely be constructed top-down with rock breaker equipped excavators and possibly drill and blast. Caverns will be excavated by roadheaders and drill & blast.

Geneva in second vote over lake tunnel crossing

SWITZERLAND — The residents of Geneva canton are set to vote on a road tunnel under the city's Lake Geneva.

The vote comes just a few months after a 1.5km tunnel was rejected by 63 per cent of ballots.

The committee behind the initiative hopes that a longer, 4km tunnel would ensure traffic doesn't end up crossing the city and causing congestion at other main lake crossing points such as the Mont Blanc bridge.

The project is expected to cost USD 2.5bn to USD 3.3bn, but would not open before 2030 at the earliest.

Local, publicly-owned media reports that the Swiss government does not see financing a large infrastructure project in Geneva as a priority.

However, a bridge vs tunnel debate has been raging in Geneva for years.

Prior to the recent vote, in 1988, local voters agreed in principle to the proposal for a new lake crossing, but then in 1996 they subsequently rejected either a bridge or a tunnel option by a two-thirds majority.

Bheri Babai Diversion Multipurpose Project to commence

NEPAL — A Tunnelling work on the Bheri Babai Diversion Multipurpose Project will begin in Q1 2015. Funding for the combined irrigation and hydropower scheme was halted three years ago amid concerns over the effect of drill and blast work on the environment.

The China Overseas Engineering Group (COVEC) has been awarded the construction contract for the headrace tunnel, which will be 12km-long and 4.2m in diameter.

It was the lowest bidder at USD 90M according to project director Shiva Kumar Basnet. The total cost of the project is USD 160M.

The project will now be completed with a TBM powered by a 4MW diesel-fueled generator complex.

When complete, the project will be capable of irrigating 60,000ha. (600km²) and generate 48MW of electricity.

The government is working to boost the agricultural output of Nepal, and solve a food crisis in the region.

Basnet stated, “Assured year-round irrigation is a crucial factor for the agricultural development of Nepal, where surface water is the main source of irrigation water.”

“Despite the abundance of water resource from the numerous river systems, which is estimated to be about 225Gm³, Nepal has so far been able to utilise less than 10 per cent of this resource for irrigation purposes. The main reason for this under-utilisation is a lack of appropriate infrastructure to manage the huge [topographical variation].”

The project is part of a wider Nepalese Irrigation Five Year Plan specifically targeted at harnessing the potential of snow-fed river systems.

DC Water launches second TBM

USA — The District of Columbia Water and Sewer Authority (DC Water) held a naming ceremony on 12 December for the Herrenknecht TBM that will mine 4km along the Potomac and under the Anacostia Rivers. The machine's cutterhead is 7.9m in diameter and is constructing part of a 21km network of 23ft diameter tunnels in DC to relieve CSOs.

The machine joins DC Water's first 7.9m-diameter TBM used for the Blue Plains Tunnel). DC Water reports that the TBM cost USD 25M to build, and that the 350ft-long (107m) machine is expected to average 16 to 20m per day.

A JV of Impregilo-Healy-Parsons has a USD 254M design-build contract with DC Water for this second portion of the tunnel system, which was awarded in 2013 and includes six shafts and three diversion structures.

International Tunnelling Association president assesses year

INTERNATIONAL — Søren Degn Eskesen, International Tunnelling Association (ITA) president for 2013-2016, has sent an open letter to the industry detailing ITA successes.

In it Eskesen highlights the implementation of the ITA Strategic Plan at the 2014 World Tunnel Congress in Foz do Iguassu, Brazil as a key step, as well as the creation of an International Young Members Group for the first time.

Eskesen vowed to continue visiting as many member nations as possible to promote knowledge sharing, and stressed that personal relationships are vital to this.

The ITA stated that the coming 12 months are expected to be another year of growth, not just in the industry, but also in the number of conferences, as well as activity from the various ITA working groups.

XE-PIAN XE-NAMMOY HYDROPOWER PROJECT TBM SENT

LAOS — A double shield TBM is on its way to the Xe-Pian Xe-Nammy hydropower project. The project calls for the construction of two central cored rock fill dams, waterway tunnels with a vertical shaft and a powerhouse generating capacity at 410MW.

The main contractor for the work is SK Engineering & Construction of Korea, who subcontracted the tunnelling work to Seli Overseas of Italy. This mainly covers an 11.5km low-pressure headrace tunnel.

The 5.74m-diameter machine successfully completed factory testing on 6 December. Representatives from the contractors were in attendance.

A spokesman for TBM manufacturer Terratec said, “The TBM will bore through mudstone, siltstone and sandstone and for that propose, the cutterhead was designed to be robust and versatile, mounting heavy duty 17” disc cutters and keeping four large bucket openings.

The 2,000kW Electric VFD Main Drive will allow the cutterhead to cut efficiently the hardest rock zones at the maximum speed of seven rotations per minute and also to deliver an exceptional torque of 8,000kNm to cope with those fractured parts of the alignment.

“Other features on the TBM include high-speed re-gripping system, a single shield advance mode, and a high-pressure emergency thrust among others.”

The project is located in the southern part of Laos on the Bolaven Plateau, around 80km east of Pakse and 35km northwest of Attapeu.



Terratec TBM destined for Laos



Swiss voters have a comparatively large amount of control over tunnel projects

SWISS PETITION FORCES REFERENDUM ON GOTTHARD

SWITZERLAND — Opponents of plans to build a second road tunnel through the Gotthard in central Switzerland have gained enough signatures from the public to force a referendum on the issue.

A Swiss public-owned media agency reported that the country's parliament had approved the CHF 2.7bn (USD 2.65bn) needed to build a second tunnel and renovate the existing bore later this year.

The objections mostly focus on environmental issues, the fear that additional traffic might be generated, the cost of the project, and a previous decision to put all future transalpine traffic through rail links. Supporters, mainly from the centre-right and right side of the political spectrum argued that a second tunnel is in the interests of road safety and could boost the Gotthard region.

However, several political parties, as well as 50 special interest groups are campaigning against the tunnel. And while 50,000 signatures were required before 15 January 2015 to force a referendum on the issue, the 'No to the Second Gotthard Tunnel' group announced on 19 December that it had already accrued more than 100,000 signatures. "We are very pleased that we have the referendum succeeded so well and so quickly," says Caroline Begley, co-president of the association.

A vote could take place as early as June this year. The project was due to start in 2020 and take seven years to complete. The tunnel work was to come first, which was then to be followed by renovation of the existing tunnel.

WestConnex tunnel plans extended

AUSTRALIA — A Plans for the WestConnex Stage Three motorway tunnel in Sydney have been revised to include a 1km extension. Australia's minister for roads and freight Duncan Gay revealed the changes last month.

Originally the alignment ran under Parramatta Road through Haberfield, Leichhardt and Petersham towards St Peters. Now the tunnel will follow the route of the existing City West Link Road, which Gay said was at capacity, before turning south to St Peters.

Despite increasing from 7km to 8km, the Australian government does not expect a cost increase, as fewer properties need to be acquired. It also alleged better operating efficiency. "Stage Three of WestConnex brings together the upgraded M4 and M5, it is the key to this project," Gay added. Opposition parties criticised lack of detail in the plans.

Tennessee weighs road tunnel option against alternatives

USA — The Tennessee Department of Transportation (TDOT) has identified a tunnel option for Corridor K/US 64 through the Ocoee River Gorge, it was announced in December.

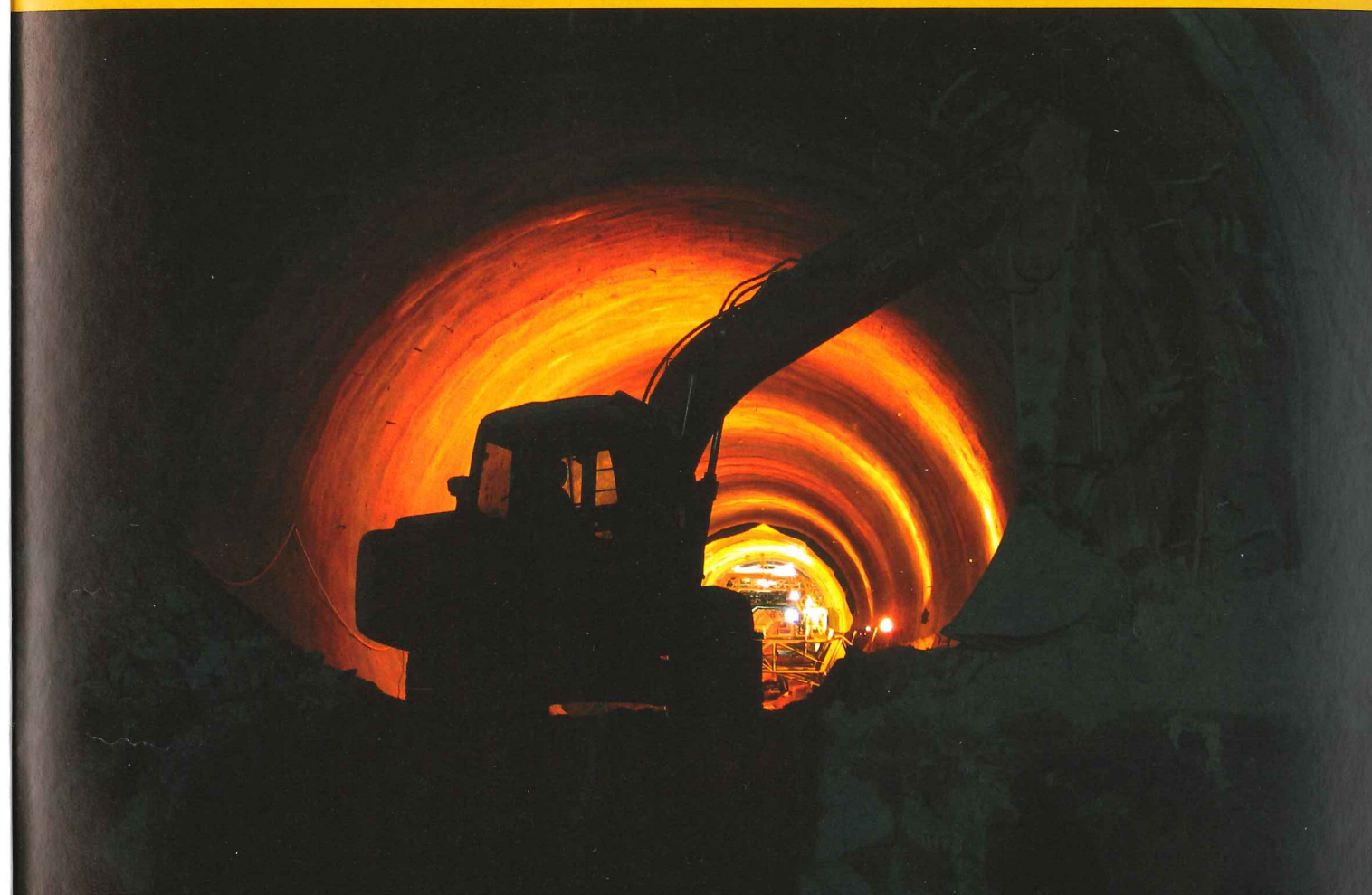
A white paper by the TDOT in preparation for a new Draft Environmental Impact Statement (DEIS) alternative considers tunnelling as opposed to alternatives previously examined that concern surface road options with, in some cases, short sections of tunnel.

The TDOT said it now wishes to consider options that include tunnelling and add an approximately 6-mile-long (9.65km) tunnel alternative to the project's DEIS.

The tunnel would extend 20,860ft (6,358m), then emerge to cross a creek on a 500ft (152m) bridge, and re-enter a second tunnel for 8,940 feet (2,725m).

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Investors blamed rotten beams for the collapse
PHOTO: VIETNAMPHOTOS / SHUTTERSTOCK.COM

ROTTEN CEILING BEAMS CAUSE FALL

VIETNAM — Rotten ceiling beams caused the Da Dang-Da Chomo hydropower tunnel collapse according to a project investor. The chairman of the plant's board of investors apologised to Lam Dong Province authorities for the collapse last month.

According to local media, Vo Nhat Thang, chairman and general director of Long Hoi Electricity Construction and Investment JSC said the wooden ceiling molds used during the construction of the tunnel had decayed, causing rocks and concrete to fall.

"Ongoing rains for more than a month also contributed to the collapse," Thang said.

And also blamed the area's poor geological integrity for the incident, which happened early on 16 December during a heavy storm. Twelve workers were trapped inside a tunnel as the water rose.

They all were freed on 19 December by a team of 750 rescue workers.

"The geological formation in this area is very complicated. Two experienced contractors – Lung Lo and Vinaconex – began work on the tunnel, then quit for that reason," said Thang.

Minister of Construction Trinh Dinh Dung has sought government permission to investigate the cause of the tunnel collapse. "This accident was complicated. It was linked to problems with the surveying, design, construction, and supervision of the project. For these reasons, we want to lead the probe instead of the provincial authorities," said Dung.

The project's design consultant is China's Nanning Hydropower Irrigation Design Institute.

Mesaimeer tunnel approaches halfway

QATAR — Almost 50 per cent of works on the first phase of the Mesaimeer tunnel project in Doha have been completed, according to local media. The project will discharge surface and groundwater into the sea once it has been completed.

The current phase of the 9.5km project will complete in Q3 2015 and the USD 120M project by the first quarter of 2017.

The main tunnel will run along F-Ring Road from the Mesaimeer roundabout (Waqod petrol station) and reach the sea to the south of Hamad International Airport, according to the report.

Flooding in parts of the Salwa Road following heavy rainfall in March was attributed to the lack of an outlet to dispose of the excess water that had accumulated in the drainage system.

Bay Delta tunnels design changed to appease locals

USA — Designs for proposed water diversion tunnels in the Sacramento-San Joaquin Delta in northern California will be revised to remove pumps. The new concept relies on gravity to allay the concerns of local residents.

The USD 25bn Bay Delta Conservation Plan calls for a pair of 12.2m diameter tunnels, that would draw water out of the Sacramento River and route it 50km away to existing diversion canals. The goal is to improve reliability of water supplies drawn from the estuary while also restoring its natural environment.

Instead of giant electric pumps, the plan now calls for water to enter the three huge intakes by gravity flow. Most tall buildings can be eliminated at each intake.

Also, power lines for TBMs were going to be permanent to serve the pumps, but no longer have to be.

MRT appoints underground reference design consultant

MALAYSIA — A Mass Rapid Transit Corporation Sdn Bhd (MRT Corp) has appointed Arup Jururunding as the underground reference design consultant for Klang Valley MRT Line 2, also known as the MRT Sungai Buloh-Serdang-Putrajaya Line (SSP Line).

In a press statement, MRT Corp said that the MYR 44.4M contract, stretched over 32 months, is the first contract to be awarded for the SSP Line.

Datuk Wira Azhar Abdul Hamid, MRT Corp CEO, said the appointment of design consultant signalled that the preliminary work for the MRT Line 2 has started.

"With progress for the Sungai Buloh-Kajang Line having past its midway point, it is vital that preparatory works for Line 2 starts," he said.

The MRT Line 2 will have 40 stations, nine of which will be located underground. Arup Jururunding's scope of work covers the reference design for the underground section of the Line 2. This includes eight new underground stations and fitting up of the Tun Razak Exchange Station which was built as part of the MRT Sungai Buloh-Kajang Line as the interchange station between the two lines.

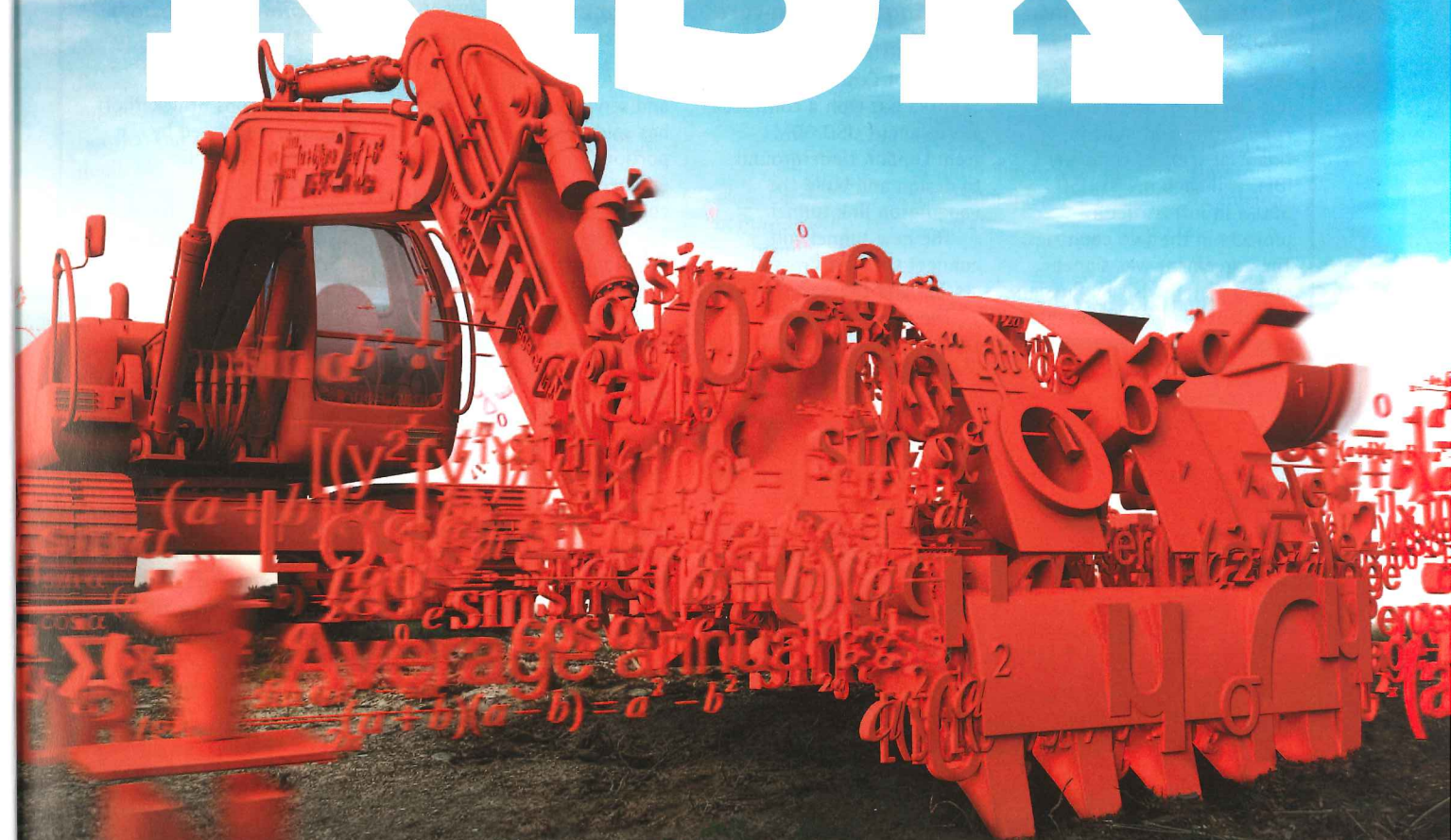
Arup Jururunding will also produce the reference design for all other operational buildings and structures such as tunnels, portals, shafts, cross-overs, sidings and ventilation, it added.

Under the contract, Arup Jururunding will assist MRT Corp, the line's developer and asset owner, with the tender process for the underground works package.

Arup Jururunding, one of seven companies which submitted tenders for the contract, was chosen based on their technical and financial submissions.

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CHINESE CONSTRUCTION GIANT SWOOPS FOR AUSTRALIAN CONTRACTOR JOHN HOLLAND

AUSTRALIA — John Holland is to be acquired by China Communications Construction Company (CCCC). Leighton Holdings announced last month that it had entered into a binding share sale agreement with a CCCC subsidiary, CCCI. The value of the deal is approximately AUD 1.15bn (USD 930M).

The state-owned Chinese corporate giant, the fourth largest construction company in the world by revenue, has a market value of around USD 19bn and gains a solid foothold in the Australian market with the deal.

John Holland MD Glenn Palin said: "We are excited about the opportunity that joining with CCCI presents for our business."

President of CCCI, Lu Jianzhong

said: "This is a momentous step for our company. We believe there are very significant growth opportunities in the Australian market."

"From our perspective, ownership of John Holland is the optimal way for CCCC to participate in this dynamic market as part of our aim to be a global transportation infrastructure business. We have a very high regard for the existing senior management team and its technical staff and value their relationships with John Holland's customers."

"For customers, employees and suppliers it will be very much business as usual but with the added benefit of the resources of CCCC to support them."

Lu added that CCCC planned to

share its specialist skills with John Holland and in turn expects there will be opportunities to export John Holland's particular skills, especially in road, rail, tunnelling and water infrastructure.

Leighton Holdings acquired a 70 per cent stake in John Holland in 2000. This increased to 100 per cent in 2007.

Leighton Holdings estimates that the indicative impact on the group is: a reduction in gearing of approximately 10 per cent; a reduction in Leighton's annual revenue of approximately USD 3bn and work in hand of approximately USD 4.38bn; and approximately 4,100 employees to transfer with the business.

The sale is subject to customary approvals including by the Foreign Investment Review Board.

Russia and India sign cooperation deals

RUSSIA/INDIA — A The Russian Direct Investment Fund (RDIF) and Indian financial services company IDFC will each invest USD 500M in infrastructure projects in the two countries. The agreement was signed during a state visit by Russian president Vladimir Putin last month.

Concurrently, a memorandum of understanding was signed between the RDIF and Tata Power to "develop investment opportunities" in the Russian energy sector. Tata Power's experience in constructing various non-petroleum energy generation plants (thermal, hydro, solar, wind) is key for Russia.

Kirill Dmitriev, CEO of the RDIF said: "RDIF has identified the energy sector as one of its key priorities for increasing Russia's economic efficiency and sustainability. [This deal will] provide opportunities to leverage Tata Power's expertise in renewable energy."

Anil Sardana, CEO of Tata Power, said: "Tata Power looks forward to working with [RDIF] on identifying opportunities across the energy chain."

Paddington Link award

GREAT BRITAIN — A joint venture of Costain and Skanska has won a contract worth about USD 60M from London Underground to design and build the Paddington link tunnel.

The new tunnel will connect the new Crossrail station and the Bakerloo line.

The procurement process for the contract made use of the innovative contractor engagement (ICE) model, which allowed contractors' bids to be evaluated for the value that their proposal adds to the scheme.

According to calculations, the proposal by the Costain-Skanska joint venture would enhance the Bakerloo line link's value by 25%, mainly by cutting down passenger journey times compared to initial designs.

Crossrail programme director Simon Wright said: "The Bakerloo line link, being delivered by London Underground, is an integral part of Crossrail. From Paddington, passengers will be able to reach Tottenham Court Road in four minutes, Liverpool Street in ten minutes."

The new link is expected to be completed by the end of 2018.

Bilfinger sells construction business

GERMANY — Engineering and services group Bilfinger has sold "significant portions" of its civil engineering business – its construction division – to Switzerland-based Implenia. The transaction is subject to approval from German and international anti-trust authorities and completion is expected in the first quarter of 2015.

A Bilfinger spokesman said the company is focusing on engineering and services for industrial facilities, power plants and real estate and had put its civil engineering business up for sale in May 2014. With regard to its remaining Polish construction business, Bilfinger is in contact with other interested parties. On the deal, the spokesman added, "Net proceeds from the sale of the Construction division, after deducting transaction-related expenses, are expected to be in the magnitude of EUR 230M [USD 272.63M], depending on the annual financial statements for 2014 of the units to be sold. An internal Group loan from Construction will be partially repaid upon completion of the transaction."

Parsons Brinckerhoff recognised for sustainability

USA — Parsons Brinckerhoff has been recognised by the American Public Transportation Association (APTA) for its sustainability practices with a Silver designation, as part of APTA's Sustainability Commitment program.

Public transit businesses that voluntarily participate in the APTA Sustainability program commit to implementing processes that create improvements in environmental, social, and economic sustainability. APTA President and CEO Michael Melaniphy stated: "We are proud to award Silver designation to one of the pioneers of the APTA Sustainability Commitment."

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MINES AND MONEY MEETING DOWNBEAT

Tony Lynn of *Drill Tech Drilling & Shoring* reports from the most recent Mines and Money meeting in London as the sector battles through a slump

MINES AND Money is a series of meetings periodically held in different locations around the world to bring together investors and mine owners needing capital. The most recent meeting was held in London from 1 to 4 December 2014.

The meeting was less optimistic than meetings past. Mining is in a slump. Commodity prices have fallen and mining stocks even more so. Gold has fallen from a high of USD 1913/oz. in August of 2011 to a recent low under USD 1200/oz. Iron ore has done worse, declining from a high in February 2011 of USD 187/ton to a recent low of USD 69, a 63 per cent loss. The "FTSE" index of mining stocks is down from a high of 26,832 in July 2011 to a recent low of 14,291, a 47 per cent decline.

So the hurdles were high for the hundreds of prospective mine developers gathered from around the world. Still, investors at the meeting insisted they had money they were ready to invest, but that the opportunities they were looking for must not be just good, but extraordinary.

There was much discussion of risk in mining ventures, particularly as it affects the willingness of financiers to invest. A main source of risk was identified as potential cost overruns and delays in the physical construction of the mine. The benefits of rapid on-budget construction were emphasized.

It is of particular interest to tunnelers that several of the mines presented at the meeting featured access via a spiral decline. This is a continuously curving tunnel spiraling downward at a grade of around one in seven, about 14 per cent. In general, the pitch of the spiral corresponds to the desired separation between mining levels with adits taking off into the ore deposit at each 360 degree turn of the spiral. A primary advantage of this approach is that the mine can get into production long before the decline reaches bottom. Ore production and extending the decline ramp can go on at the same time, so access to deeper levels can be developed while the previous level is mined.

Compared to vertical shaft access, declines offer further advantages: Ore is loaded into trucks at the face or drawpoint. The trucks transport the ore through the mining section adit, up the decline, and all the way to the processing facility with no re-handling. In-mine crushing, hoisting equipment, and cross-country conveyors are all unnecessary. Disassembly and reassembly of underground equipment is not required; heavy equipment can be driven to wherever needed inside the mine. Once ramp access is built the construction of vertical shafts for additional haulage or ventilation can be done more simply using raise boring.

A mining company representative at the Mines and Money meeting reported that a good progress rate for a 5.5m spiral decline in Australia is about 150m a month. This would be a goal for the mines own crews. He said he would probably hire a contractor if that contractor could advance the decline at more than 200 meters a month. Therein lies a market for proficient and ambitious tunnelers.

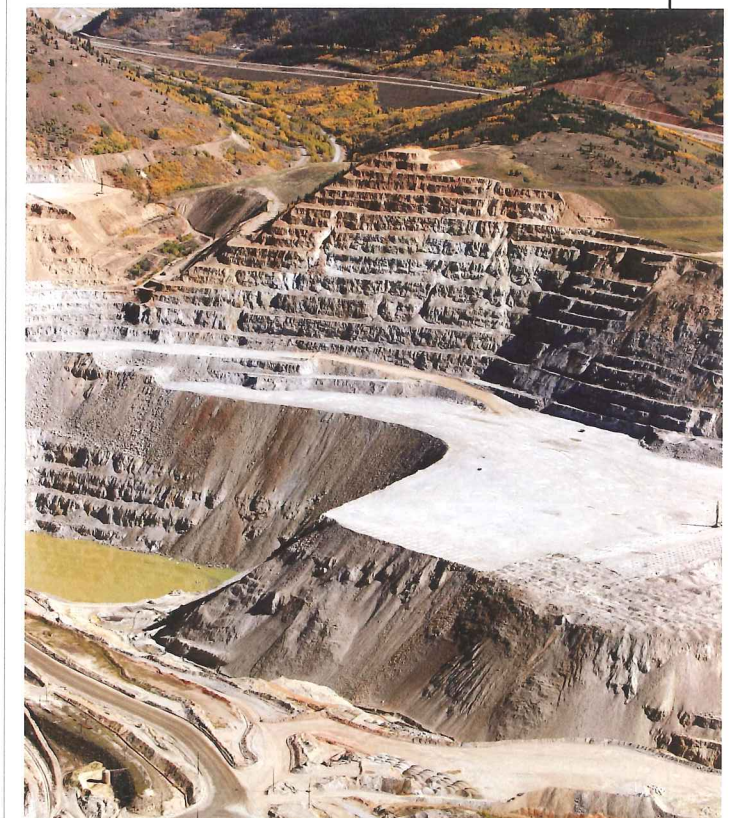
In conversations about sinking vertical shafts, mine owners

seemed to think that specialty contractors should generally be hired. A sinking rate of about 6m a day may be expected in good geology without major water inflows.

Some of the most dispassionate investors at the Mines and Money London gathering were at length to point out that mining has always been cyclical. And it is at the bottom of downturns that mine properties should be getting ready for the following upturn. Those investors would point out that the constriction of the present mining slump, although closing marginal properties, will clear the way to development of new mines based on the newest technologies. There will be plenty of upcoming opportunities for advanced tunneling and shaft sinking in the mining sector.

Below: Open cut mining will increasingly give way to bored projects in future

Tony Lynn
Drill Tech Drilling & Shoring



This machine, for contractor JCM North Link LLC (a joint venture of Jay Dee, Coluccio, and Michels) is excavating on the North Link Project, an extension of Seattle's light rail system. The project required twin 5.8km tunnels through glacial till and sand. JCM utilised a refurbished Hitachi Zosen machine in its fleet for the first tunnel, which launched in summer 2014, and this Robbins EPBM for the second



TAC REVIEW

The Tunnelling Association of Canada's regional directors give their annual reports on the industry

THE TUNNELLING Association of Canada (TAC), has published its annual regional report. The four regional directors take a look at the country's current marketplace for tunnelling and underground construction, as well as taking a look back at industry milestones from the past year.

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Ontario

Upcoming tunnelling projects in Ontario include the Fairbanks-Silverthorn Trunk Storm Sewer System and the City of Toronto is currently prequalifying Design-Build Contractors. The project consists of 2.2km of approximately 4m diameter EPB tunnelling, 540m of 1.65m diameter microtunnelling, along with shafts, open cut and other work.

The City of Ottawa has CSO Tunnels in progress, possibly coming out to tender the fourth quarter of this year.

In Windsor the Detroit River Rail Tunnel has completed the EA and the project is progressing. A tender date is currently not known.

Halton Region, Zone 1 interconnecting watermain tunnel, part of mid-Halton wastewater scheme, has completed prequalification and continues until November 2014.

For the Twinning of the West Trunk Sewer, Contract No. 2, City of Mississauga, Region of Peel, the project is scheduled to tender during this year.

Design is completed for the Upper Centennial Parkway, for the City of Hamilton, and the project should be out to tender in the third to fourth quarter of this year

Recently awarded projects in Ontario include construction of RR#25, Halton Region – Awarded to Varcon Construction, and tunnelling will be performed by C+M McNally.

The Hanlan Feedermain, Contract 1 – has been awarded to McNally Construction, with construction underway. And the Hanlan Feedermain, Contract 3 – has been awarded to Southland-Technicore JV, with construction underway.

McNally Construction has also secured the contract for Twinning of the West Trunk Sewer, Contract # 1, and construction is underway.

The Eglinton Scarborough Crosstown Light Rail project, East twin tunnel contract was awarded to an Aecon-Dragados JV. Construction has commenced, but no tunnelling yet.

There is a very active Microtunnelling market in Ontario with projects from Kingston to Guelph. There are many large microtunnel project pre-qualifications that have closed and contractors are waiting for the projects to hit the streets, such as Twinning of Etobicoke creek (under Pearson airport) and the Rebecca Trunk Wastewater project

It's still a very hot and active market place in Ontario, with plenty of activity that will continue into next year.

In general news Brian Garrod is retiring after an extensive career at Hatch Mott MacDonald, and is also stepping down from the Ontario TAC director position. Nominations for the new Ontario TAC director were held and the outcome is yet to be announced.

CAT Tunnelling has sold assets and intellectual property to LOVSUN of China, which hopes to start operations in October.

The Ontario Chapter is planning to hold a tunnelling workshop in Ontario in 2015, please watch for more details to come.

TAC Ontario holds its general meetings the last Thursday of every month at Moxie, all active members are welcome to attend. Keep a look-out for our regularly scheduled events and our yearend social.

Walter Trisi, VP director of Ontario TAC

Trisi is general manager and vice president of CRS Tunnelling Canada

Quebec

On the Romaine-3 Hydro-electrical complex (395 MW), a drill and blast project, there were four contracts: the river diversion tunnel, the powerhouse, the spillway-intake-dams and the pressure tunnel. The river diversion D-shaped tunnel is 100 per cent completed, its length is around 351m, and is 13m wide and 12m high. The rock plugs were blasted and removed in May and the tunnel is presently in operation.

The excavations for the surface powerhouse, the spillway and the intake are ongoing and almost completed with the final benches still left to be removed. Foundation treatment have begun for the dam (95m high) and the dyke (33m high). The pressure tunnel is a D-shaped excavation and the work is just beginning with the starting portal excavation advanced of 20m. The tunnel is 1,675m long, and is 18m wide and 12m high. The maximum head is 119m and the steel penstock is planned to be 60m long.

The McGill North East Utility Tunnel, construction of a new tunnel associated with its hospital operations at the McGill University's downtown Montreal campus, is currently underway using the drill and blast method. The tunnel passes directly beneath and adjacent to buildings that house sensitive facilities and equipment, research laboratories, medical treatment rooms and patients that are undergoing or recovering from various medical procedures and surgeries. It will house new utilities to replace those currently in use that have reached the end of their service lives as well as address overcrowding of pipe material within the existing tunnels.

In order to maintain all University activities during construction, the contract documents call for drill and blast excavation in accordance with certain constraints related to peak particle velocities, blast air-overpressure and audible blast noise measured at selected locations. The need to operate within these limits had a direct impact on blast design elements including overall powder factors, charge weights per delay, and round lengths. On the other hand, the contract documents allow the opportunity to conduct test blasts, which may permit the relaxation of blast design criteria.

The tunnel will be approximately 202m in length and 3m in width, with one access

shaft and three riser shafts.

The construction of McGill North East Utility Tunnel that is currently underway using drill and blast excavation required careful planning and execution to minimise disruption to the University operations that house sensitive medical and research equipment as well as patients. The design approach used to include a cautious but feasible controlled blasting base-case drowned from extensive experience to address the need to limit vibration, air-overpressure and noise is being implemented and is proven to be effective. It first allowed realistic baseline that were used during the bidding process and it also provides the contractor with flexibility to adjust its means and methods while staying within specified monitoring limits. An effective risk assessment and risk management process allowed identifying key risks and implementing risk control measures that are being implemented during construction activities. The project teams include program management by WSP, tunnel design and CM services by HMM, and the contractor is Neilson with BBA for the contractor blasting specialist.

A hard rock TBM tunnel for a water main is being built in Montreal. The project involves the excavation of a 3m diameter water main tunnel to reach to existing Rosemont reservoir of 227,000m³. The tunnel is 3.98km long and is excavated within the generally hard Trenton limestone of Ordovician age. An open Robbins TBM is being used for the job and the tunnel is planned to be completed within 10 months. The bedrock is generally of good to excellent quality but it crosses several intrusions structures such as dykes and sills related with the Mont-Royal intrusion of Cretaceous age. Foraction is the sub-contractor of Les Entreprises Michaudville inc., the general contractor, with an awarded contract of CAD 73M (USD 66.67M). The project begun in May with the shaft excavation and is schedule to last a total of around 28 months from the beginning of the shaft excavation to the final pipe installation and valve chamber construction.

Additional reporting: Mylène Sansoucy, Hydro-Québec; Jean Habimana, HMM

Andre J. Rancourt
Hydrosys



Alberta and Praries

Alberta tunnellers have been active during this past year, thanks to a booming economy and an ever growing population in Calgary and Edmonton. The City of Calgary is in the process of completing a feasibility study for a 5km-long, 10m-diameter tunnel, which is being considered as a flood bypass structure from the Glenmore Reservoir to the Bow River. The tunnel would help mitigate the impact of future floods like the one in June 2013, and is one of three alternatives being considered. The City is also proceeding with investigations for numerous 2-3m diameter sewer and water tunnels up to 1.8km long, which are part of the Nose Creek sanitary upgrades, and relocations associated with the upcoming construction of the Southwest Ring Road. The trenchless crossing of the Bow River in Bowness is being tendered at the time of writing, and involves twin 1050mm-diameter tunnels, 200m long each; anticipated to be constructed using slurry microtunnelling.

In Edmonton, in addition to the usual

abundance of small diameter municipal tunnels, the CAD 1.8bn (USD 11.65M), 13km-long LRT Valley Line is proceeding as a P3 project, and will include construction of twin 400m-long tunnels on the north side of the North Saskatchewan River crossing. Five teams responded to the City's RFQ released in April and three have been shortlisted to submit a bid to design, build, operate, maintain and partially finance the project.

The shortlisted teams are TransEd Partners (almost a dozen companies, including Bechtel, EllisDon and Bombardier Transportation Canada), Moving YEG (made up of 10 firms that include ACS Infrastructure Canada, Hochtief PPP Solutions North America, and Stantec) and River City Transit (composed of about eight firms including SNC-Lavalin, Kiewit and Alstom). Final proposals are expected in the fall of 2015 with the successful team selected by the end of 2015. Major construction is expected to begin in 2016.

Heinrich Heinz
Thurber Engineering



British Columbia

The tunnelling industry is active in BC, with a number of planned, ongoing and completed projects in Greater Vancouver and other regions of the province.

Metro Vancouver's Seymour-Capilano Twin Tunnels Completion Project is currently under construction. These 7.1km long, 3.8m diameter twin tunnels have been constructed between Metro Vancouver's Capilano Reservoir and the Seymour Filtration Plant. Tunnelling was carried out by the Seymour-Cap Partnership (joint venture of Aecon, JF Shea and Frontier Kemper), who were awarded a contract in April 2009 to complete the tunnels. Both Tunnels were complete by November 2010 and the two shaft excavations (by raise bore) were completed in April 2011. Final shotcrete lining in portions of the Tunnels and steel liner installation is 100 per cent complete as of August. Surface steel pipe installation is underway and the Project is scheduled to be completed this autumn.

The Port Mann Water Supply Tunnel project is a water supply tunnel connecting the Greater Vancouver suburbs of Coquitlam and Surrey, which is being undertaken by Metro Vancouver. The project consists of two slurry wall shafts, each approximately 60m deep and located on either side of the Fraser River, connected with a 1km-long, 3.5m-diameter tunnel. Excavation and construction of the permanent structural lining of the south and north shafts are now complete. Excavation of the tunnel is being carried out using a CAT EPB TBM, and at the time of the magazine going to press, approximately one half of the tunnelling has been completed. Construction is being undertaken by the McNally-Aecon Joint Venture.

The Second Narrows Water Supply Tunnel Project is a proposed 1.1km-long water supply tunnel connecting the Greater Vancouver suburbs of North Vancouver and Burnaby, which is also being undertaken by Metro Vancouver. The approximately 5.7m-diameter tunnel will be driven through variable soils and bedrock beneath Burrard Inlet.

Preliminary design of the project is currently underway, with construction planned to commence in 2017.

The Annacis Main No 5 Water Tunnel is a proposed water supply tunnel beneath the Fraser River connecting the Greater Vancouver suburbs of New Westminster and Surrey. Conceptual design is currently underway for the project. Construction is planned to commence in 2018.

The Evergreen Line Rapid Transit Project will be an 11km extension to Greater Vancouver's rapid transit system. The project includes a 2km-long, 10m-diameter bored tunnel. The design-build-finance contract was awarded to EGRT Construction and the tunneling work is being conducted by SNC-SLI Joint Venture (SSJV). The tunnel is being excavated with a CAT EPB TBM and is 12 per cent complete as of early August. Tunnel boring is expected to be completed early 2015.

BC is also currently experiencing an increase in activity in hydroelectric project

development. AltaGas recently completed the 195 MW Forrest Kerr Hydro Project on the Iskut River in northern BC. The project consists of an extensive amount of underground work, including over 5,000m of access, tailrace and power tunnels. The project also includes an underground powerhouse cavern (144m long, 17m span, 26m height). Tunnel construction was carried out by Procon Mining and Tunnelling of Burnaby, BC. The project is now in service.

AltaGas is also constructing the 66 MW McLymont Creek Hydro Project, which is located approximately 10km downstream of the Forrest Kerr Project. This project includes an intake, surface powerhouse and a 2.7km-long Power Tunnel. Tunnel excavation commenced in Q2 2013, with tunnel excavation being carried out by Procon Mining and Tunnelling. The project is scheduled for completion in mid 2015.

The proposed John Hart Generating Station Replacement Project is owned by BC Hydro and is located in Campbell River, on Vancouver Island. The CAD 1bn (USD 0.91bn) project, for which the principal contract was awarded earlier this year to inPower BC (SNC-Lavalin), includes the construction of a 2.1km-long rock tunnel, an underground powerhouse, and associated shafts and access tunnels. Underground construction is scheduled to commence this fall.

Innergex Renewable Energy is constructing the Upper Lillooet Hydroelectric Project approximately 72km northwest of Pemberton BC. The project includes two facilities, Upper Lillooet River Hydroelectric Facility (HEF) and Boulder Creek Hydroelectric Facility. The Upper Lillooet River HEF is a 81.4 MW plant consisting of over 2,500m of power tunnel and approximately 1,600m of 3.6m-diameter steel penstock. The tunnel is constructed by drill and blast methods and is 5.5m high x 6m wide. Tunnel construction is being carried out by CRTEBC (S.E.N.C.) of Quebec. Tunnel excavation work began in August, with overall project completion scheduled for mid 2016.

The Boulder Creek HEF is a 25.3 MW plant being constructed on a tributary of the Lillooet River. This tunnel is approximately 2,900m long and is also being constructed by drill and blast methods, and is 3.5m wide x 4.5m high. The tunnel is being constructed by the same contractor, CRTEBC. Tunnel excavation began in June, with project completion also intended for 2016.

A third and separate project being constructed by Innergex is the Big Silver Hydroelectric Project, located approximately 40km north of Harrison Hot Springs in BC. The Big Silver tunnel is 5.5m high and 6m wide, with a total length of 1,800m.

Tunnelling for this project is scheduled to begin later this year with the equipment and crews from the Boulder Creek HEF project mobilizing to Big Silver during their winter shut down period. In addition, tunnels are associated with a number of planned hydroelectric projects and planned mining projects in BC.

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CHIMICALS EQUIPMENT D-BOLT SUPPORT

CONTINENTAL COMMITMENT

A public-private partnership could break ground on a new rail tunnel under the Detroit River, making a freight connection between Canada and the US that would see much of the billions of dollars the two countries trade. **Nicole Robinson** reports

Nicole Robinson
Managing editor of *Tunnels North America*
Nicole is based in Minneapolis, Minnesota



Right: The proposed tunnel project area

Below: An illustration of the higher-clearance rail cars



MORE THAN 100 years ago a rail freight tunnel opened beneath the Detroit River between Windsor, Ontario, and Detroit. It was the first successful trench-and-tube tunnel ever constructed in the world, 1.6 miles (2.6km-) long and originally designed for electric trains. **J**

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The Windsor-Detroit corridor accounts for nearly 30 per cent of the total Canada-US trade. The current tunnel carries more than 400,000 rail cars a year, within limits. A proposed modern rail freight tunnel to replace the original would allow for high-clearance rail cars and significantly improve trade between the two countries.

The Continental Rail Gateway (CRG) operates the rail freight tunnel under the Detroit River. It's a public-private partnership of the Windsor Port Authority, Borealis Infrastructure (a division of the Ontario Municipal Employees Retirement System or OMERS) and Canadian Pacific.

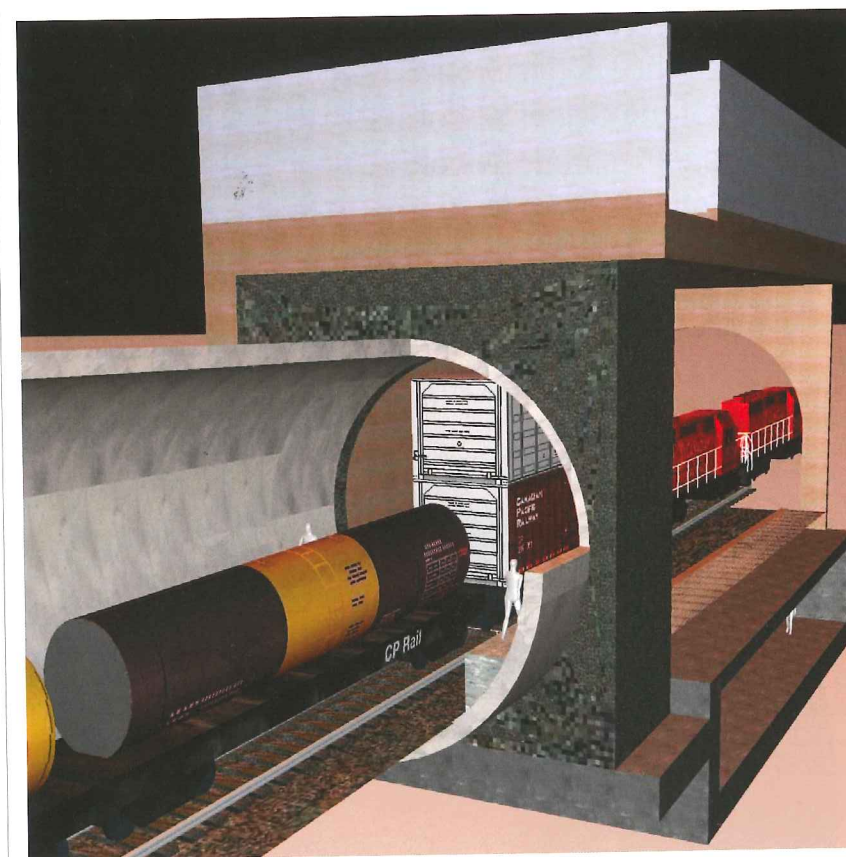
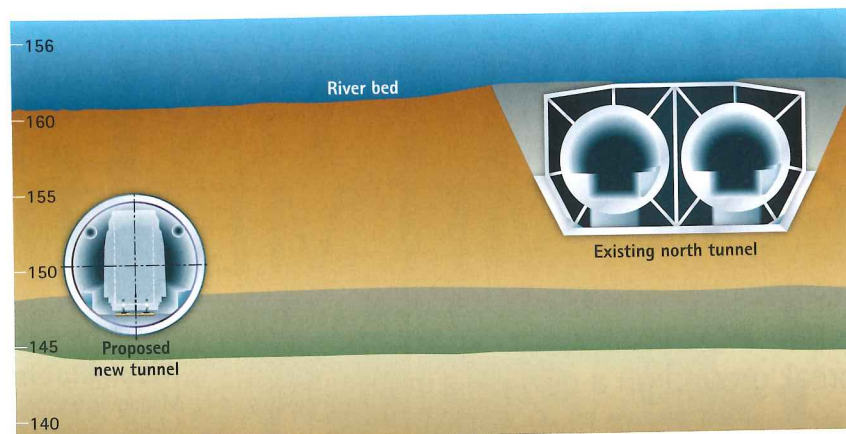
"While this tunnel is in great shape, it is too small for the larger double-stacked 9 feet 6 inch [2.9m] container trains and other modern rail cars," CRG says. It plans to build a replacement rail tunnel adjacent to the existing tunnel.

Once the replacement is completed, all rail traffic, including large rail cars unable to pass through the existing rail tunnel, will be transferred to the new tunnel. Construction could start as early as the first quarter of 2015. The next step hinges on financing, which is coming from a number of directions including two federal governments.

MODERN DESIGN

Building a replacement tunnel dates back to the early 2000s and the Detroit River Tunnel Partnership, a joint initiative of Borealis Infrastructure Trust and Canadian Pacific. In 2002 it proposed building the larger tunnel and turning the existing tunnel into a cargo truck route. The idea was later scrapped when the US, Michigan and Canadian governments chose to build a new Detroit River bridge.

According to *Railway Technology* the Detroit River Tunnel Partnership spent around USD 100M on engineering and acquired 20 acres of land for the project from Detroit in 2007. The project has also been called the "Jobs Tunnel" in the



period between 2002 and when CRG revived the tunnel in 2010 (see timeline).

For this project a 2.5km-long tunnel will be mined by TBM below the river and parallel, some 45m to the west, to the

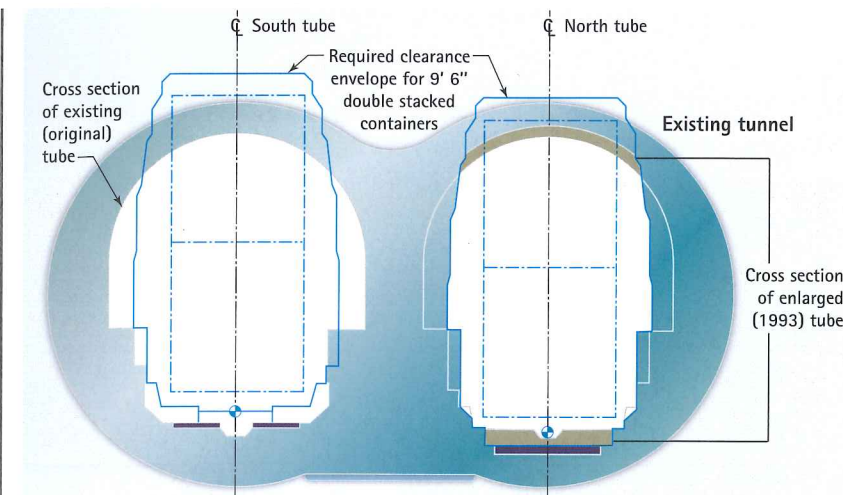
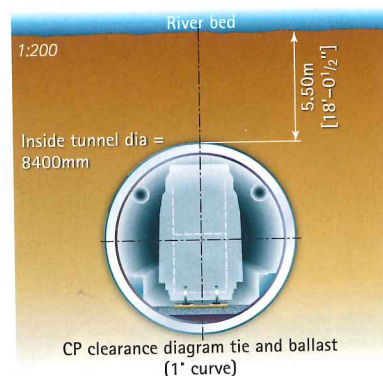
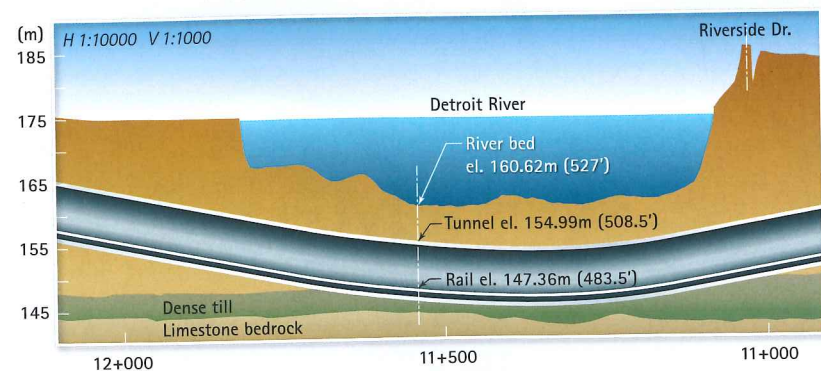


Table 1. Tunnel dimensions

Internal Diameter	27.5ft (8.4m)
Tunnel Length	9,334ft (2,845m)
Sub-River Length	2,640ft (750m)
Maximum Grade	2.15 per cent
Lining Thickness	1.6 ft (0.5m)
River Depth	49.2ft (15m)
Minimum Cover – River	18ft (5.5m)
Minimum Cover – Land	13.1ft (4m)
Operating Speed	50 mph (80 kph)

Source: CRG

Table 2. Timeline

August 2014	CRG is awaiting presidential permit from the Obama administration, and cabinet approval from the federal government of Canada.
Q2 2014	CRG received USD 10M from Michigan Department of Transportation.
April 2014	Project is awaiting funding and regulatory approvals.
December 2013	Planning activities underway.
February 28, 2013	Detroit River Tunnel Partnership has applied to the Canadian Transportation Agency to construct a replacement railway tunnel and railway line to be known as the Continental Rail Gateway Tunnel.
June 18, 2010	CRG submitted the environmental assessment description of the project to Transport Canada.
Q1 2010	CRG announced plans to develop the Continental Rail Gateway Tunnel.

Source: Construction Intelligence Center, Timetric

Above: The current tunnel and its 1993 enlargement

Opposite, top: The replacement tunnel in relation to the existing tunnel

Opposite, middle: A cross section of the proposed larger tunnel

Opposite, bottom: The tunnel's profile below the Detroit River

river depth of 49.2ft (13m), which is about 30ft (9.1m) deeper than the tubes of the existing tunnel. The length of the new tunnel will be 2,845m, which is 700m longer than the existing tunnel, and it will be 500m longer on the Canadian side and 200m longer on the Detroit side. The internal diameter of the tunnel will be 8.4m with a lining thickness of 0.5m.

The tunnel is designed to allow the operation of modern double-stacked large container rail cars with an operating speed of 80kph. Upon completion of the new tunnel, the existing tunnel can be used for passenger trains, which will create a Quebec City to Chicago link.

MONEY TALKS

For the most part design, engineering and permitting work has been completed and the necessary environmental assessment approvals secured. There still remains presidential permit from the Obama administration, and cabinet approval from the federal government of Canada.

The project is estimated to cost USD 400M, which includes building the 2.5km tunnel, installing electrical and mechanical equipment, installing safety equipment and constructing other facilities. The project partners will fund 50 per cent of the project cost and the remaining 50 per cent will come from government sources.

CRG expects to receive USD 10M from the Michigan Department of Transportation, which would leave USD 100M from the Canadian government and USD 90M from the US government.

SIZE MATTERS

In addition to the 9ft 6in (2.9m) containers there are new generations of multilevel rail cars used by shippers and auto manufacturers. The existing freight tunnel clearance was enlarged once in 1994 and can't be further expanded, says CRG.

Meanwhile expansion work at the Port of Montreal since 2010 will steadily increase the container traffic out of the port to more than double by 2020.

For Windsor there is the potential for 1,700 – 2,200 direct, indirect, and induced jobs over the duration of development and construction of the tunnel. It also makes the region more competitive as a multimodal center between Canada's key ports and America's midwestern markets.

CRG points out the new tunnel will offer an "ideal alternative to trade over highways"

A 30-year contract with Detroit expired this year allowing the City of Flint, Michigan, to pursue another source of raw water. Along with neighbouring communities, it is building a new pipeline and intake at Lake Huron to take control of water costs, **Nicole Robinson** reports

Nicole Robinson
Managing editor of *Tunnels and Tunnelling North America*, Nicole is based in Minnesota



OPPORTUNITY COST

In 2001, it cost Michigan's Genesee County Drain Commissioner USD 8M to purchase water from the Detroit Water and Sewerage Department (DWSD). In 2013, to purchase basically the same volume of water the bill came to USD 25M.

"By Detroit's own projections it would double again in the next 10 years to USD 50M just to purchase water," says Jeff Wright, CEO of the Genesee County Drain Commissioner.

On top of the rising cost of purchasing water, there are concerns about the reliability of the current pipeline, which is nearly 60 years old. "For the same price of being on a 60-year-old pipeline we could be on a brand new pipeline that we own ourselves," he explains.

In partnership with other cities and municipalities in the region a new 84-mile pipeline will supply water from Lake Huron in 2016. The project is worth USD 274M.

As water becomes a scarcer, more valuable commodity, planning, conveyance and treatment for raw water will be a growing concern. New infrastructure, whether it's the increase of reuse plants or severing ties with a long-term provider, much like these communities in Michigan, will require tunnel work.

PRICE IS RIGHT

Wright deflects the question of why water rates have increased to Detroit. According to current DWSD director Sue McCormick, the DWSD has a USD 6bn debt, due to rampant corruption under the previous director's management. In 2013 she attributed much of the rate increases in the last decade to servicing this debt and promised to get the finances back on track.

Genesee County Drain Commissioner is part of the recently-formed Karegnondi Water Authority (KWA), which includes the City of Flint, Genesee County and many other groups in the region. This municipal water supply system will provide and distribute raw water to the region in Michigan commonly referred to as the 1-69 corridor. This encompasses more than a half a million people. The KWA was incorporated in 2010 and began its first fiscal year on October 1, 2010. It is the owner of the new pipeline project.

These communities have had contracts to purchase water from the DWSD, signed decades ago by all of Detroit's customers, with rates based on a distance and elevation formula. Wright explains, the further a customer is from Detroit, the more it pays. The same goes for elevation—the higher a customer is, compared to the rest of the system, the more it pays.

Flint and Genesee County are the furthest distance from Detroit, and they are also the highest elevation.

"So when somebody in Detroit gets a two per cent increase, ours would be a 6-7 per cent increase. For last 10 years our increases have been in the 10-11 per cent range, per year," Wright explains.

He is adamant to point out this is not the fault of McCormick, nor the current board. "They inherited this formula," he says.

Detroit has said because of the age of the existing pipeline, a second one needs to be built. Initially negotiations focused on attempting to partner to build the new pipeline, which didn't work out.

"We also tried to get a better price to stay with them but Detroit's hands are tied because the distance and elevation formula has been used for so many years," Wright says. "It's been used in court cases where their water rates have been challenged in the past, and those court cases have upheld the use of it."

Making any change away from the formula may jeopardise

Pipeline project components

- 78-inch (1.98m-) diameter lake intake
- Lake Pump Station and Intermediate Pump Stations
- 25 miles (40km) of 66-inch (1.7m) Spiral Weld Pipe
- 26 miles (42km) of 60-inch (1.5m) Spiral Weld Pipe
- 15 miles (24km) of 36-inch (0.9m) Ductile Iron Pipe

the DWSD's whole contract structure. According to Wright, Detroit has more than 100 community customers, all of which have a "me too clause." Had Detroit tried to figure out a way to give Genesee County a financial break, all the other customers would be entitled to the same.

"They were really in a box," he says. "There wasn't much they could do to lower rates currently. But because the distance and elevation formula has stood the test of the legal system, they couldn't just toss that. We arbitrarily get a much higher rate increase when anybody else gets one and it got to the point where it made it financially feasible for us to build our own system as opposed to purchasing water."

MICROTUNNELLING

Primarily the new 84-mile pipeline runs above ground, with approximately 2

Below: Crews remove the TBM from Lake Huron off a barge



miles (3.2km) of microtunnelling, and approximately 1.5 miles (2.4km) of the alignment's length is below Lake Huron where KWA is constructing its intake. For this portion of the project KWA awarded a USD 24M contract to L. D'Agostini & Sons, of Macomb Township in early 2013.

The contractor declined to comment for the article.

Wright, and his colleague, John O'Brien talk about the challenges of boring under Lake Huron, one of the Great Lakes, from the potential for mixed face soil to potential natural gas leakage and removing the TBM from the lake. They note in the 1960s a tunnel project for a water intake by the City of Detroit in a similar area beneath Lake Huron hit a methane gas pocket, costing 22 people their lives.

"Because of that we were very cautious," Wright says.

"We went at a much shallower depth with our tunnelling operation so we could avoid the potential for methane at a higher percentage. There was still a potential but we weren't as deep underground as the Detroit project."

O'Brien explains the ground conditions are basically sand, clay and then rock formations. KWA purposely chose to stay out of the rock formation, and the potential methane. "We went up into the clay and sand and that's why we had concern over mixed face material in the tunnelling operation," he says. "We purposely avoided methane but then had the issue of mixed face boring."

Wright says, the bottom line is, the mixed face soils were a concern, but the contractor was able to work through that and finished the tunnelling operation on time and on budget.

From a barge crews removed the TBM from Lake Huron this summer. It was the second of two TBM removals for the project. The TBM launched on its first drive in late 2013 from a 58ft (17m) deep shaft, mining below land. After a retrieval the TBM launched from the shaft to do the drive under the lake.

The bore was 92in in diameter, with a 78in pipe, the majority of which is reinforced concrete; otherwise a small amount is pre-stressed cylinder pipe.

KWA has four other contracts for construction of the pipeline, of which each has some element of underground construction, O'Brien says. There are several 36in diameter jack and bore drives under roadways at locations along the pipeline.

The final contract of the five total construction contracts is expected to bid the first week of October.

FLINT'S BOOST

Pipe for the project is owner-supplied and KWA received bids from three manufacturers. In September 2013, a bid opening revealed American Cast Iron was the lowest bidder, at USD 79.4M. That following November American announced plans to build a new spiral-welded pipe facility in Flint, which would initially support the KWA project and then other regional water infrastructure projects.

The Alabama-based company had previously operated solely in the southern tier, but had future plans to expand in the northern states. The KWA project created an opportunity for that. The new 180,000sqf facility will be capable of making 48in to 120in diameter spiral weld steel pipe.

"That's icing on the cake," Wright says. "It's a big boost to moral for the whole area. It's produced a lot of construction jobs up front, and will produce a lot of permanent jobs as we go forward."

American Cast Iron will supply 60 miles of spiral-welded pipe, 17 miles of ductile iron pipe and 24 large diameter Flex-Ring gate valves.

DETROIT'S LOSS

Flint's 30-year contract had expired and was purchasing water on a year-to-year basis from DWSD, which expired in April of this year.

A statement issued by the DWSD in April 2013 says the estimated immediate net revenue shortfall from Flint's separation from the Detroit system is approximately USD 22M, or six per cent of total DWSD water revenue.

According to a report issued this spring by Fitch Ratings, Flint was DWSD's second largest water wholesale customer, which it officially lost on April 25, when Flint started supplying and treating its own drinking water.

"While Flint's water contract with DWSD expired on April 16, 2014, the department had expected that Flint's actual departure from the system would happen sometime over the next three to five years."

Genesee County, which previously purchased its water from Flint, is currently negotiating a full service contract with DWSD until the KWA pipeline to Lake Huron is built (within three-to-five years). At that time, Genesee County expects to maintain a standby emergency service contract with DWSD.

DWSD projects that revenues from Genesee County should total approximately USD 12M-USD 13M for fiscal 2015; not enough to offset the estimated USD 25M loss from a full year without Flint, the report says. Beginning in fiscal 2016, the balance of uncovered Flint costs is expected to be reallocated among remaining customers.

When Flint confirmed on May 1, 2013, to reject DWSD's final offer in favor of joining KWA, one of the reasons states, "does not guarantee a rate structure if system regionalizes or DWSD regionalizes or Detroit enters bankruptcy."

This summer Detroit mayor Mike Duggan campaigned to create a regional water authority for the city and surrounding suburbs. He issued a statement on October 10 announcing unanimous approval to form the Great Lakes Regional Water Authority (GLWA).

What this means is that Detroit will retain ownership of the system while leasing infrastructure for a USD 50M annual fee for 40 years. This money is slated for water and sewer line repairs and upgrades.

Oakland, Macomb and Wayne counties will each appoint one member for the GLWA, in addition to two from Detroit, and one appointed by the Governor. Five votes out of six will be required for major decisions, giving the counties more say in the operations.

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EXCELLENCE SINCE 1977



Work on an EPA-mandated tunnel will clean up an urban Ohio waterway. **Desiree Willis**, technical writer for *The Robbins Company* reports on the construction, TBM and the severe winter weather of the Black River tunnel project

LORAIN, OHIO, situated alongside Lake Erie, is a city still recovering from the global recession and affected by the waning local steel industry. With unemployment wavering between 7 and 10 per cent, the city was in need of an employment generator—a need that was answered with a large, EPA-mandated tunnel project whose construction began in 2012. The Black River Conveyance and Storage Tunnel is the city's answer to prevent sanitary sewer overflows into the waterway. City officials have said the tunnel will also help cut down on residential basement flooding during heavy rains.



BANKING ON IT

Desiree Willis
Desiree has covered a range of topics for *Tunnels*, as Robbins' technical writer



In 2000, the Ohio EPA ordered the City of Lorain to address overflows that violated the City's National Pollutant Discharge Elimination System (NPDES) permit. After studying options, including the construction of an equalisation basin in downtown Lorain, a deep tunnel option was selected. In order to construct the tunnel, the city required the assistance of a USD 65.87M loan from the Water Pollution Control Loan Fund through Ohio EPA's Division of Environmental and Financial Assistance.

VISION

Originally, the tunnel was planned as a component of a plan to move the city's Black River Waste Water Treatment Plant from the river mouth to a site upriver behind steel mills. However, a regional wastewater study recommended several cities join and use Lorain's Philip Q. Maiorana Wastewater Treatment Plant for sewage treatment, making it unnecessary to move the Black River

Above: Despite difficult ground including layered and laminated shale, the crew were able to mine an average of 21m per day, breaking through about six months after launch.

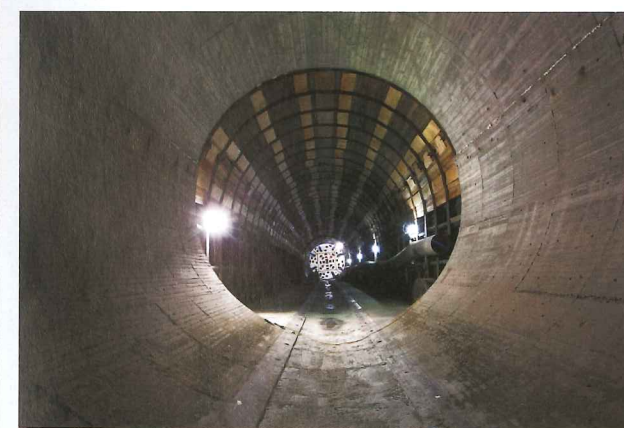
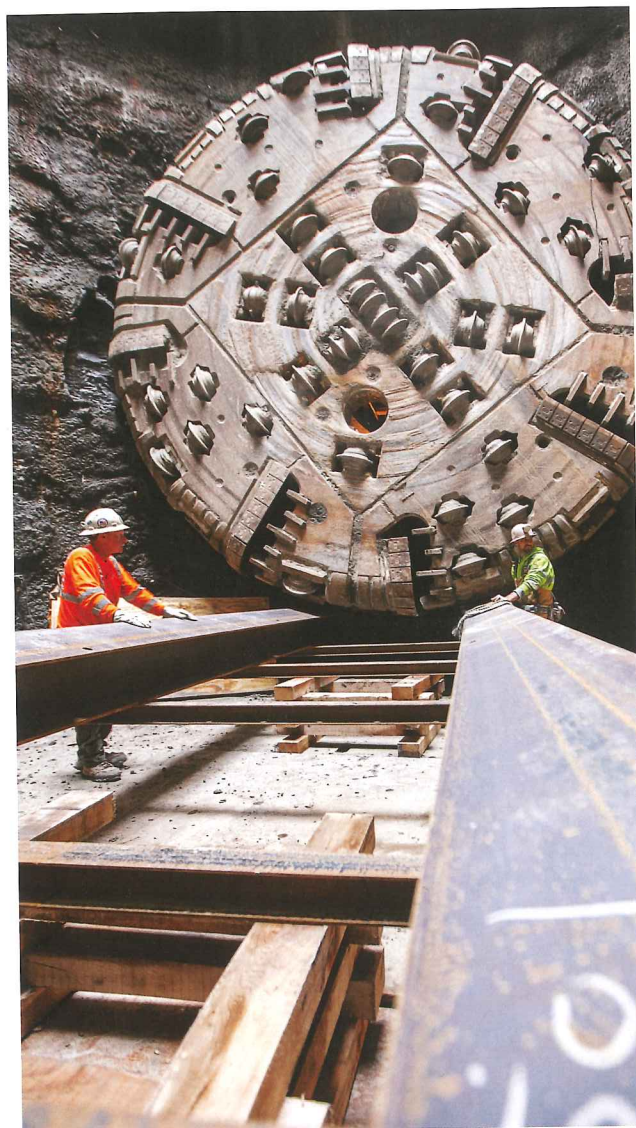
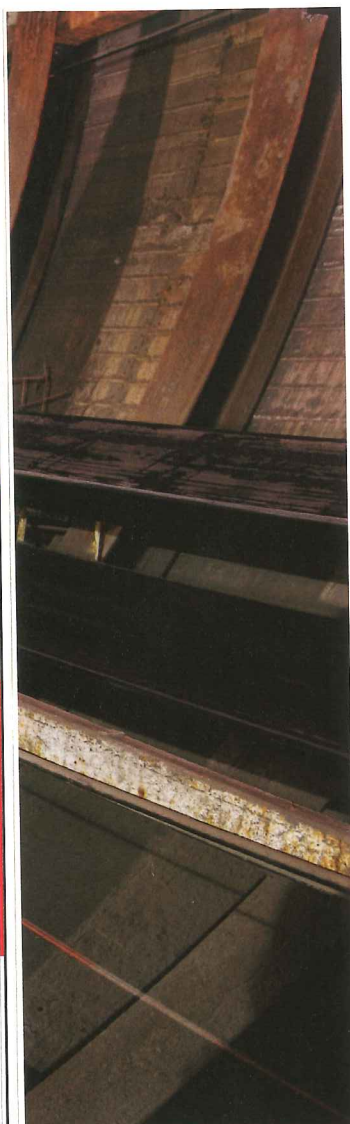
Plant.

The major components of the Black River Tunnel include the launch shaft and reception shaft – approximately 11m in diameter and 50m deep – and the main 1.7km-long tunnel with a finished diameter of 5.8m. The project route runs along city property roughly parallel to the Black River, beginning at the launch shaft near the Black River Wharf and terminating near the Black River Wastewater Treatment Plant. A screening facility will be built at one end near the wastewater treatment plant, where water will be diverted into the storage tunnel, and a pump station will be constructed at the launch shaft site. When complete, the pump station will move water from the storage tunnel back into an existing sewer interceptor.

WORK BEGINS

A joint venture of Walsh, Chicago, and Super Excavators, of Menomonee Falls, Wisconsin, was the low bidder for the project in 2012 with a bid of USD 52,000,243. Electrical work under a separate contract brings the total construction bid price to USD 55.4M. Ric-Man Construction was subcontracted to build the shafts.

Construction of the main tunnel began in late Autumn 2013 with a 7m diameter Robbins Double Shield TBM and continuous conveyor system running at the site. The mammoth machine was built using Onsite First Time Assembly (OFTA) – a



Robbins-developed method that saves contractors in shipping time, costs, and man-hours worked.

Using the OFTA approach, individual systems are tested prior to delivery but the machine is never fully assembled in the shop. Robbins field service technicians work on location with the contractor to assemble the machine and provide support. Launch of the TBM took place on November 18, 2013 – approximately three months after assembly began.

“OFTA was a challenging process for everyone onsite. We had to make numerous adjustments. Regardless, our team worked diligently to overcome challenges, and we were able to get the TBM assembled and launched relatively close to schedule,” said Mike Garbeth, project manager for Super Excavators. In addition to the TBM, Robbins supplied an in-tunnel continuous conveyor system and space-saving J-type vertical conveyor to provide more open area in the launch shaft.

SPEEDY SHALE

The double shield machine was used in a unique manner during boring. “The shale is soft, so we are experiencing minimal cutter wear. We are installing ring beams and lagging, and there will be a final monolithic pour after tunnel completion,” said Gregg Rehak, tunnel supervisor for Super Excavators, of the excavation during the winter of 2013/2014.

Above: Mining was completed on April 29, 2014 when the TBM broke through into a receiving shaft

Rather than concrete segments, ring beams were erected within the tail shield for installation as the machine passed. The lagging was spaced at 450mm intervals with wire mesh panels.

By February 2014, the machine had excavated about 40 per cent, or 640m, of its 1,700m bore, averaging 15m per 10-hour shift, with some shifts reaching up to 24m of advance. “We are in Cleveland shale, with some raveling seams. We’re just moving right along,” said Rehak of the operation at that time. He continued: “The shale is so soft, we can fly right through it and sometimes the conveyor has a hard time keeping up with it. Overall, it’s a good system, and it’s getting the job done for us.” With record cold temperatures last winter plunging to -15°F (-26°C) without the wind chill factor, the crew had to be watchful for equipment freezing up, but wound up having minimal issues and no major breakdowns.

By the time of the machine’s

breakthrough on April 29 the TBM was averaging 21m per day, and getting up to 24m per day for multiple days in a row. Contractor Super Excavators was proud of the TBM’s success, and that they were able to use local help to build the tunnel.

“Our team was able to adapt and learn,” said Rehak. “We were able to hire locals and do on-the-job training with them.” Not only did this boost the town of Lorain’s economy by creating jobs, but it also gave local construction workers experience in the tunneling industry.

Cleveland shale made for speedy excavation; so fast that it was

Above (top): A Robbins continuous conveyor system including a space saving, J-Type vertical belt removed muck behind the TBM

Above (bottom): The Robbins machine was assembled and launched from a 50m deep shaft and starter tunnel

challenging for the continuous conveyor system to keep up at times. The contractor confirmed that the TBM was mining so fast it could not excavate at its maximum rate. Rehak explained that the fairly soft ground also made for minimal cutter wear: “We only changed seven cutters during the bore, four of which probably could have made it to the end, but were changed for precautionary reasons.”

As for the biggest challenge, Rehak cites the ground conditions: “There were sections of tunnel that gave us a hard time but we were able to get steel ribs jacked up into place and do some excavation behind them.”

He estimates about 13 sections of bad ground 30m across, or about 25 per cent of the soft shale geology, made ground support difficult. Those sections consisted of layered and laminated rock that broke from the tunnel crown before ring beams could be expanded, requiring extra chipping and rock relief to expand each rib to the correct diameter.

Once workers fine-tuned the technique, they were able to do 12 to 14 rings per day – compared to just one or two rings before the process was refined – even in the sections of bad ground. In more stable sections production averaged 18 to 20 rings per day – a rate the contractor considers very good considering they were erecting steel ribs.

Now that tunneling is complete, a final monolithic pour will solidify the lining.

“The Robbins machine performed quite well,” commented Rehak at the time of breakthrough. “Now we have to remove the TBM, which will take about four weeks; then rebar tying and concrete pouring can start.” Final completion of the tunnel to bring it online is expected in spring 2015.

When finished, the tunnel will have a storage capacity of 42 million liters (11 million gallons) per day, providing a significant boost in water quality for the Black River.

UNDERGROUND UTILITIES

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ARE WE THERE YET?

Moving materials to a jobsite in the centre of a major city or hauling TBM components up steep mountainous routes has its challenges, which can affect a project's cost and timescale. **Rhian Owen** investigates the increasing importance of an effective logistics system from the beginning

AS THE industry continues to evolve, with tunnelling projects becoming increasingly ambitious, delivering a TBM to a jobsite as well as the logistics at the site itself is becoming more complex. With projects commencing in highly urbanised areas worldwide as well as remote alpine environments, logistics play an ever-important role in project success and can affect the time and cost of a project.

"One of the biggest costs we have is the cost of transportation," says Mike Kolenich, project manager for Robbins. "I think the cost of transporting equipment has gone up; 10 years ago it had to be considered but it didn't seem like a prominent factor and now it is. Even when we manufacturer parts, transportation seems to be the higher costs associated with the manufacturing and delivering of the TBM."

CITY TUNNELLING

The tunnelling construction operations in urban environments are increasing due to an increased density within major cities. The construction of tunnels in urban areas is to a large extent carried out in confined sites, which enhances the importance of an effective logistics system.

Kolenich says: "When we look at some of the projects we've worked on – such as the Downtown Line for Singapore's Land Transportation Authority (LTA) and the metro for Mexico City – we have to look closely at the area in which we can assemble the machine as it's usually a small footprint."

With New York City's East Side Access (ESA) project, which involves construction of a new subway line needed to relieve heavy traffic congestion between the boroughs of Queens and Manhattan, Kolenich explains that the transportation of the TBM as well as the logistics on the site made for a complex project, involving a lot of coordination and management on both fronts.

"Manhattan and Queens will be connected under the East River via the 63rd Street tunnel, a submersed double-deck tube," says Kolenich. "We shipped the TBM into Queens and transported the machine underneath the river and finished the assembly underground; the main reason for that is otherwise you would have to dig a shaft in the middle of downtown Manhattan and that would have been nearly impossible. Another issue we had was it was a small jobsite. We had to coordinate our shipping with Cleveland to New York, which is about 1,000km. We would get a day's notice of what parts were needed and they would be at the location in a day or two."

Indeed, the transportation of the TBMs to an urban jobsite can be challenging. Roger Gibbs, commercial manager at WWL Abnormal Load Services (WWL ABS) explains some of the issues that can materialise: "Central urban projects including transport, sewage and flood relief projects, usually involve finding delivery solutions that circumvent existing infrastructures and services. For example, over and under bridges with weight and height restrictions, street furniture,

Rhian Owen

As a journalist and technical writer Rhian began working with *Tunnels* in 2011



restricted road widths and turning radii, disruption to public transport, suspension of parking facilities and approvals from statutory authorities."

WWL ALS transported a Herrenknecht TBM from Germany to the UK for the National Grid London Cable Tunnelling Project. It took six days for delivery of the main components, using a combination of road transport, barge

Below: Site supply by lifts along a cable car system





500
Hours taken by logistics and design teams to design the underground moving system for a TBM on the East Side Access Project in New York

Getting the equipment to the Røssåga site was a challenge. The logistics were complex for bringing the TBM, conveyor system, spare parts, and cutters from all over the world to almost 'the top of the world'. "The greatest challenge was the remote location, there wasn't any standard access," says Kolenich. "We transported the machine to Oslo. Then we transported the parts on another ship to the port Mo i Rana, which has only a couple of docks and ships visit infrequently, so since it is not designed to handle the large break bulk components we had to make other plans. We had to charter our own vessel that had its own equipment on board. After this, parts were transported by truck or rail. The parts had to be handled many times, and while it only took three to four weeks, it took several months of planning."

Before recommending a machine, TBM manufacturers will look at the logistics of getting to the location and myriad other details of the project. The design of the TBM is therefore impacted by the logistics of getting to a worksite location or the logistics of assembly. Kolenich explains this is considered in the initial design stages. "If it's a small job site where large pieces can't be brought in or if there is a weight restriction, then the TBM



Above: Some sites require a more novel approach when designing a logistics solution

and ro-ro ferry.

The final leg of the journey, in London, involved six police escort vehicles, three private escorts plus one pilot car from Tilbury port via A13 and the M25 and through North London to the Haringey job site during late evening to minimise disruption to other traffic. Preceding this, surveys were required in the UK to secure a suitable route, which avoided multiple bridge weight and height restrictions in East and North London.

ALPINE ENVIRONMENTS

Rural projects, such as cutting through mountains, have their own set of potential problems. "As far as alpine tunnels go that brings on a whole new different set of potential issues," says Kolenich. "Several projects we've done run into seasonal restrictions – if you're working up a mountain when winter sets in it makes it impossible to transport equipment. So we're often up against tight the deadlines with shipping to the jobsite due to the weather; we don't want to have to assemble the machine in ice and snow."

Gibbs adds: "Projects in more remote locations, transport and power station project for example, frequently require delivery solutions that have to circumvent the absence of

existing infrastructure and services. For example, a lack of suitable discharge port facilities, or inadequate road access to accept the required load weights and dimensions, which can require the use of more sophisticated transport equipment."

Located in northern Norway less than 100km from the Arctic Circle, the Røssåga Hydroelectric Project involves an overhaul and addition to existing power stations. A new powerhouse, headrace and tailrace tunnel will be added. Constructed with TBM, the project will thereby have Norway's first TBM-tunnel since 1993. The TBM being used for the project is a 7.2m Robbins Main Beam machine, was assembled using Onsite First Time Assembly due to steep inclines up to the site and the weight of the machine.

will be designed in a particular way to accommodate that. For example, with Røssåga, the largest piece had to fit through a tunnel and so the piece had to be designed with that in mind," Kolenich says.

With the ESA project, which involved moving the TBM underground from Queens to Manhattan, the machine had to be designed with the rolling stock system for efficient jobsite logistics. "The logistics and design team had to work together closely; we spent over 500

hours designing the moving system.”

THE SHIPPING JOURNEY

Kolenich says that when designing the machinery, the company also looks at trying to fit as many parts into shipping containers as possible. “Most posts around the world only want to handle containers and don’t want to handle break bulks. You pay for the space you consume on the vessel unless you’re chattering your own vessel, which becomes very expensive unless you can justify it and you’re moving a lot of material. If you require an open top container and you’re moving out of the west coast of the US they aren’t readily available, so you have to schedule them almost a month in advance. This all needs to go in the schedule with the costs considered. If you need to use open top containers it becomes difficult to ship components as you get limited on which ports you can use and that can affect your cost; if you have to move a break bulk component out of a certain port they know this so the port charges you more for this service.

“Most ports are geared towards

“Materials management has been **researched frequently** over the last years and it is usually agreed that effective management on the jobsite has great positive impacts on projects.”

moving containers, so these specialised pieces cost a lot more. Therefore, we try to design the machines to break down into smaller parts to fit into containers. However, we have to weigh the shipping cost with the assembly and disassembly time at the job site. If we can deliver the machine nearly assembled to the job site and it saves us a month of assembly, it might merit more spend on the shipping.”

Gibbs explains that at WWL ALS they offer a ‘one stop solution’ and manage every element of the delivery process. One of the most obvious benefits with utilising third party logistics is that it can reduce the logistic costs for the firm.

“We have extensive experience of delivering TBMs and back-up components and locations have ranged from central London to the highlands of Scotland, and to Spain and Argentina. We have a reputation for identifying the most cost-effective and efficient solutions, and for close supervision of every stage of the planning and delivery process, utilising all available means of transport – by road, rail, sea, river, canal and air.”

For the Network Rail project, WW ALS arranged for the transportation of five break bulk components plus 17 standard trailer loads by road from Herrenknecht’s manufacturing site in Schwana, crane lifting from trucks to barge in Germany and



from barge to trucks at ferry port, and onward transport by ro-ro ferry and road to job site. The ferry company had to send their ship to a special berth in Zeebrugge as the normal berth was not strong enough for the 183 GVW trucks.

AT THE SITE

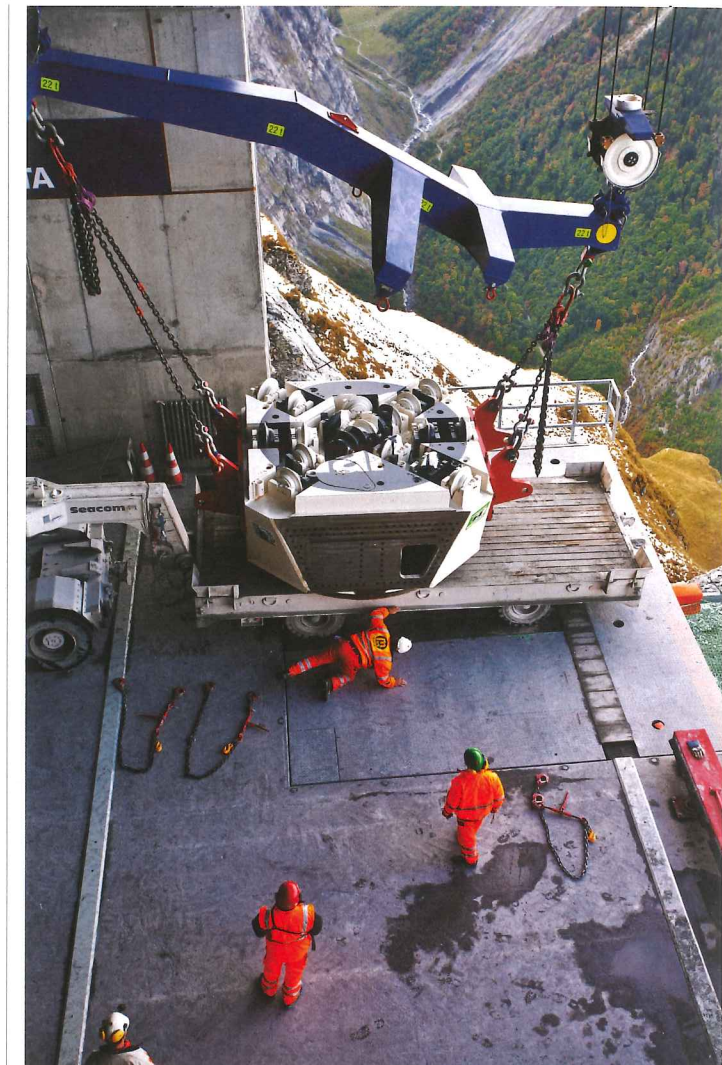
Detailed assembly plans need to be created in highly urbanised and remote locations as the machine design progresses. For tunnelling projects the concept of logistics is largely about taking deliveries at the right time. Storage locations are often required due to the small footprint of the jobsite and therefore the logistics of part delivery to the site needs to be in place.

Kolenich notes that using storage locations requires a significant amount of management. “If you have equipment stored at different job sites there’s a lot of coordination that has to happen,” says Kolenich. “With the Downtown Line for Singapore’s LTA project we shipped all the parts from our shop in Shanghai and stored them at an alternative site and moved the parts to the job site as we needed them. In this case, a lot of double handling was involved with impacts on cost, and we had to work closely with the job site as they were assembling the machines to bring the parts from the storage site as need.”

Excellent management of materials at the construction site is vital. Crane and lifting requirements, or special tools or procedures that may be required, need to be detailed and factored into the timeframe. For the Niagara Tunnel Project, an ambitious project carried out by contractor Strabag to tunnel 10.4km from the Sir Adam Beck Generating Complex to above Niagara Falls with a 14.4m diameter hard rock TBM from Robbins, a 650t crane was needed to assemble the machine.

The crew had a window of around one month when the crane was available so needed to make sure all the major components of the TBM were ready. “Moving the crane into the job site required 23 permitted truck loads and it took about a week to assemble the crane,” says Kolenich. “It turned out we needed to bring a different crane back in as we weren’t ready for one of the parts – the cutter head of the machine – so we needed to bring in a different crane a month later to finalise the assemble, which was an additional cost.”

Material management in the tunnelling industry has been researched frequently over the last years and it is usually agreed that effective material management on the jobsite has great positive impacts on projects, since materials makes up of a large part of the total cost in a typical project.



All: Careful positioning of a component in a precarious situation

Poor material management becomes even more obvious at confined sites for several reasons; the ability to hold inventory is small, therefore increasing the risk of shortages during production. While bad management of the storage at the site further increases congestion if unnecessary large quantities or material not matching the schedule is held at the site.

Kolenich agrees. “Firstly, when you ship those parts you have to pack them in a manner of which they are going to be assembled at the site – you don’t just want to throw everything in a box. You want to thoughtfully put the parts together in the containers, as at the job site you have to be able to stage those parts logically. Furthermore, all the parts need to be checked in. You need to manage when the parts are needed and that these parts get to the right people when required. If you’re missing a part, if it disappears, it could cause severe delays and result in increased costs. The most critical part is the one you need when you don’t have it”



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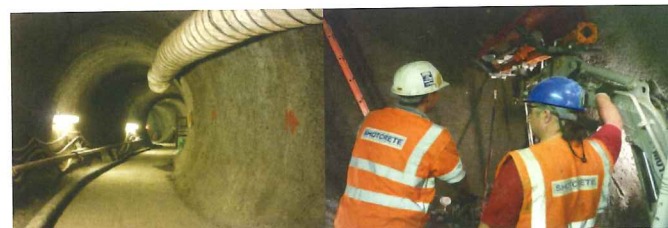


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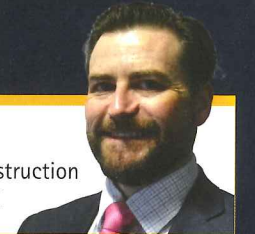
PLAYING IT SAFE

The insurance market for tunnel construction projects has changed dramatically in recent years. **Warren Beardall**, client director for *Aon* gives an overview of the changing nature of insurance in the sector, and the main concerns facing projects

IT IS now twenty years since the Heathrow Tunnel Collapse triggered a dramatic change in the relationship between the insurance market and the construction industry specific to tunnelling construction risks. This loss still represents a significant reference point on the insurance landscape. At the time there was an immediate threat of future tunnelling work being uninsurable, which instigated significant collaboration between construction and insurance industry and a large-scale review of both risk management approach to tunnelling work, and to insurance policy coverage available.

Warren Beardall

Warren is a client director in Aon's Construction and Power division based in London, UK



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GLOBALISATION

Twenty years on and both the insurance market and tunnelling construction market look very different. Dramatic consolidation has arisen in both markets and globalisation of business has meant a sharing of technological advancement, best practice, and expertise across the world. International contracting firms now compete for project work on an ever more global platform and often bring with them a consolidation of expertise gathered from wherever major civil engineering projects are in highest demand. With this has come a significant level of best practice sharing. It also presents new challenges: capability stretching and technological breakthroughs in more challenging ground conditions and environments; risks of supply limitations and cost impacts – including finite skilled and professional labour force resource seen as a key risk of future project management; all competitively stretched and mobilised across geographically diverse regions wherever investment liquidity or sovereign capital is supporting demands for infrastructure upgrade.

Insurance markets are similarly globalising. Historic strong insurance centres remain competitive and highly capitalised, but are increasingly challenged from localised insurance hubs. Behind the lines much of this globalisation remains interlinked, and influences greatly the basis of insurance cover most easily available. Insurers own views on best practice are

similarly shared and globalised accordingly, but it also allows comparison where such practices have been slower to be adopted.

High levels of capacity invariably impacted price, and insurance premiums have been falling consistently for a number of years now. Accordingly it is perhaps appropriate to reiterate the fact that regardless of high levels of insurer capacity, and the resulting premium savings being enjoyed by the Construction industry generally, the fundamental expectations of insurers have not changed and best practice is still a key focus of any complex insurance programme.

How insurers assess the relative merits of a project

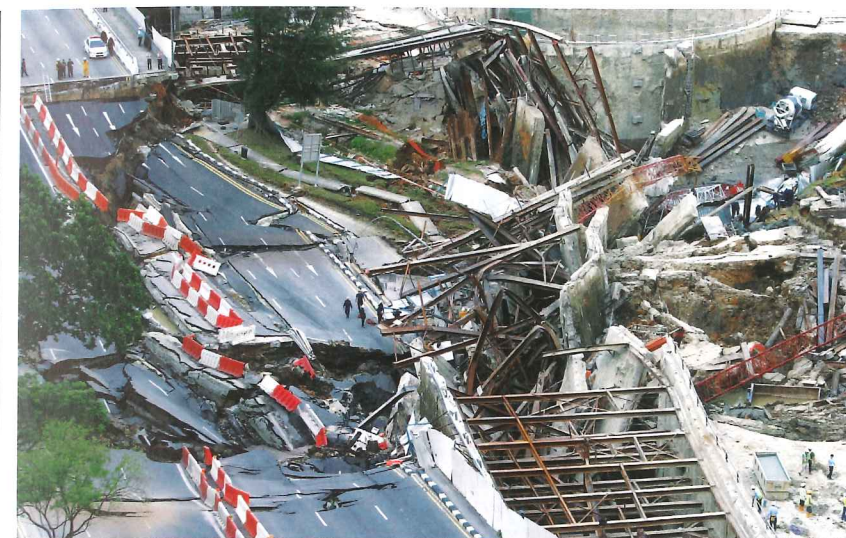
Despite these current high levels of insurer competition, underlying underwriting views remain consistent in what represents tunnelling best practice. Insurers continue to be most amenable to the broadest forms of insurance coverage available for those projects which represent the demonstrable adoption of best practice. And it may surprise some to read that better cover itself does not have a direct impact on insurance cost, it is however not offered to all and the relative merits of a particular construction project need to be represented to achieve these best cover results.

In representing the relative merits of a particular construction project to insurers, there are few more powerful messages to insurers than being able to represent a high calibre team of tunnelling professionals, working collectively across commercial boundaries to deliver a complex and unique tunnelling project. The capability and interlinking of the project team becomes a central focus in the risk assessment made by insurers. From the list of key areas of analysis insurers will focus upon, the interaction and experience of the professionals can arguably sit within almost all.

Capabilities and knowledge of key parties

Both corporate and individual CV's are an important factor in insurers determination of the desirability of insuring a major tunnelling project. The collective knowledge of these people and organisations is paramount to demonstrating a breadth of capability to manage the many complications and challenges many of these vast projects represent.

Below: The SR99 shutdown convinced local US media that "even the world's largest drill" can be stopped by unforeseen elements



Above: The Nicoll Highway collapse in Singapore, 2004

Paul Hampshire of Liberty International Underwriters says, "We look to understand who is delivering a project, their expertise and experience in delivering projects of similar technical complexity in similar working conditions, even down to looking at the resumes of people in key positions."

It is not unusual for insurers to therefore review individual CV's in the senior roles within the project teams proposed and by extension review in detail the structures of management and communication between the collective construction, design and employer interfaces within the overall project group.

Similarly, some employers have long and successful lists of projects they have procured, managed and delivered with world class contracting counterparties. This can create significant opportunity to consider options around insurance solutions as such experience can lead to appetite to handle a greater level of risk before insurance steps into a major event.

DESIGN AND TECHNICAL CHALLENGE

Technical innovation is an important part of any industry and the tunnelling world continues to develop viable solutions through ground conditions and for example using larger and more complicated TBM technology. Insurers can support much of this advancement and embrace such developments where there is confidence in the robust testing of these innovative solutions. Where such solutions are being put forward to the insurance market a high level of engagement is advised to be able to demonstrate the suitability of what has been proposed.

To highlight the importance of design interfaces, Munich Re estimate that 41 per cent of all tunnelling losses by value come from design error. From a project perspective this is therefore a key area of necessary focus. It is also important to therefore both have at hand detailed explanation of what is being proposed and how risk is being managed to mitigate likelihood of loss from this source. It is also important to understand the interface between physical damage and professional indemnity insurances as it is quite easy to have an element of such risk excluded, or be underinsured.

LIVING WITH JCOP

Tunnelling Joint Code of Practice is still a universally useful tool and one which insurers use as a benchmark to define best practices in tunnel construction. In reality, a number of broader risk management standards now incorporate much of this code of practice within their doctrine, but being able to demonstrate this application is still crucial. Fundamentally,

insurers wish to see evidence not only of its reference in procurement literature and construction planning, but also its integration into risk identification and analysis, application through recording planned mitigation and eradication of risk via risk registers, real time monitoring and planning around inevitable variations to ground conditions, water ingress, pressure variations, encountering of obstacles, on tunnelling drives.

PLANNING & INVESTIGATION

It is acknowledged that geotechnical investigation and study can be a very expensive upfront cost in the planning a new tunnelling project. It is also a commercially sensitive subject between employer and contractor where much of the ground condition risk is potentially being transferred. The management of this risk, the manner of identification and testing of assumed baseline positions, monitoring through construction, and ultimately the commercial retention or transfer of cost variation, all key concerns to insurers. Paul Hampshire of Liberty International Underwriters says, "It is in the interests of all parties to undertake an early investment in evaluating and defining the project geotechnical conditions, and thereby establish some form of agreed common baseline from which to allocate and agree ground risk."

The greatest comfort is afforded to insurers where full and complete disclosure of ground condition investigations by the employer have been shared with contracting parties. The collective investigations over potentially many years by an employer adds invaluable insight into underlying risk issues and design and construction solutions best equipped to deal with specific requirements arising.

ALL PARTY COLLABORATIONS

The manner and motivations behind the engagement of all parties is important. Construction expertise, their legal, engineering, and technical professional consultants and risk and insurance practitioners alike. And it is often the manner with which these human as well technical and commercial interfaces are managed which influences the insurance markets perception of a good project risk or otherwise.

Risk identification, and planning around mitigation, ultimately requires documented risk ownership and procedural clarity.

These allocations of risk are also key

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when insurers are considering the merits of a project. Hartmut Reiner at Munich Re summarises three key areas of interest when considering a tunnelling contract:

- A clear fair contract with contingencies
- Owner willingness to retain major geological risks (retained anyway in the form of his reputation)
- A risk register has to be kept and made available to all project parties”

In the context of ground condition variations as an example, insurers are keen to see both how cost impacts of such variations have been allocated between parties, but also how efficiently this is lived with. For example how effective is communication of a recognised variation of ground conditions from TBM drive face through to control room management to instigate real time decision making.

TIME/COST VARIABLES

If insurers are presented with a programme chart that has little or no room for flex, or with a cost margin that is tight and where ground conditions variation risk for example rests heavily with the Contractor, insurers may well conclude a higher level of risk inherent simply because of these factors. Patrick Bravery of Talbot Underwriting says, “The challenge is to weigh the technical requirements the ground imposes upon you against the commercial realities of trying to deliver the project on time and on budget – that’s where tension can arise.”

How to select the right insurer

In an environment where insurers consider the tunnelling experience and capability of project teams to be an important indicator to future success, the same consideration to the tunnelling experience, connectivity and capability of the insurance professionals you are engaging is similarly justified. Specific pockets of the insurance market has a wealth of experience of tunnelling projects globally, often learned through the sharp end of complex examples of project recovery post large scale loss. When engaging insurers with these experiences, significant benefit can be seen in the sharing of such knowledge and background (particularly in the post placement interactions with the project teams that will be on offer). Building relationships with fellow specialists from an insurance background can therefore prove invaluable through a project construction, a factor that becomes

Cover considerations

Have you been advised of the difference between standard cover and good cover? Subtle differences in wording can have a huge impact on what is excluded from a policy and what is not. Some examples:

Basis of tunnelling inner limit

Tunnelling losses in the 1990’s demonstrated that the rebuild cost of a tunnel can far exceed the original construction cost. Specific remedial measures such as ground freezing can have a huge additional cost impact but restricted access, mitigating actions to contain the loss, debris removal, and ultimate reconstruction costs can all inflate the ultimate cost of reinstatement below ground. These increased costs are now restricted by insurers by introducing an inner limit for losses associated with tunnelling works. The basis of this inner limit can therefore be key to determining whether or not a project is underinsured post a loss event.

Particular attention should be paid to the manner of inner limit being applied. A percentage of per meter construction value can quickly be eroded particularly where applied to too broad a spectrum of works; applied to too narrow a definition of damaged area (for example where flood water breach is not considered damage in itself); or where applied to an average meter of construction cost rather than actual costs being incurred in the ground conditions of the time. Setting a monetary limit in close dialogue with the project engineering team best able to determine the worst-case scenario loss offers a better means to ensuring any inner limit of cover is appropriate for the project.

Attention should also be given to what perils such an inner limit may be applied to and the works to which it applies. Ground movement is the key risk exposure to which this limit should apply but often wordings are less precise and will therefore include fire or flood for example within the restriction. Works definitions are also often too broad and instead should limit the application to specific underground works and not include electrical and mechanical works and any other fit out contracts.

Therefore, as insurance buyers or the recipients of insurance packages from counterparties in a project, beware of “standard wording” and “standard exclusions” as better insurance solutions may be available. In late 2014 the London Engineering Group released what they consider to be the new benchmark of standardised wording for these inner limits, and in some ways have offered a welcome clarity on coverage. Specific consideration to cover is needed for any particular project and comments above remain valid. This new standardisation could have far reaching consequences as it is anticipated that this clause will influence the previous benchmarks set by leading reinsurers such as Munich Re and their MRe 101 Tunnelling Clause. In turn this will therefore influence reinsurance offerings to local markets, and therefore the off-the-shelf available wording internationally. It is yet to be seen whether market forces will allow the inclusion of these new provisions in insurance policies. Coverage is an area that needs to be looked at closely in conjunction with your professional insurance advisers. Aon has tremendous experience of negotiating broad terms that match our clients insurance requirements and careful consideration needs to be given to this aspect of the insurance purchase process in order to ensure the best policy cover is achieved and problems or misunderstandings avoided at a future date.

Insuring TBM’s as part of the project insurance vs. standalone

Following a major tunnel collapse the project site will be immediately taking action to stabilise the ground and could be incurring significant additional costs in protective or preventative emergency measures. If both the tunnel works themselves and Tunnel Boring Machine are insured together the one insurance policy can be used to fund immediate repairs and actions needed to protect the immediate damaged area. If both elements are insured separately, it may not be immediately obvious whether the tunnel works or TBM insurance needs to respond or how to apportion funding. For some time post the initial event. A single policy avoids the division of loss arguments where emergency measures need to be taken and paid for. It also only requires a single point of dialogue to a claims team.

even more paramount should a loss arise and speedy claims resolution be achieved.

In the simplest of terms large scale tunnelling projects cannot be insured from a single insurance company. And



on the more complex and high profile projects there are only a handful of insurance companies who would be respected contact points to broker the right insurance package. Even where local legal, cultural or market relationship expectations demand local insurance participation the reality is these same handful of insurers will be dictating coverage terms and conditions behind the scenes. It therefore makes sense to be identifying these decision-making insurance personalities first, and to tactically approach these parties at the place where decisions are ultimately made. From this tactical point in an insurance placement your broker is then best placed to seek insurance terms and leverage the result based on market appetite, coverage options and form, and most importantly post placement servicing and claims management. It is not unusual to therefore be broking a project in a number of insurance markets from London to Singapore, Zurich and

Above: Engineers on the SR99 project in Seattle took flak from local and international media following disruptions

Below: Costs relating to the Blanka Tunnel collapse in Prague passed USD 2bn

Munich, Tokyo, New York and beyond. Both broker and client leverage can play an important role here and the selection process should be very much a globally tactical approach. Post an insurance placement, these parties will continue to have contact with a project team and offer additional insight into the application of best practices and their own wealth of experience on projects that have gone well, but also those that have not. The experience of these insurance experts should also be seen as something to take advantage of. From an insurance perspective you are aligning yourselves with fellow professionals to best deliver highly complex works.

THE POWER OF PEOPLE

Insurers give specific consideration to who is involved in a project and the expertise they bring with them, the interplay of procurement strategy and risk allocation, application of risk management principles and procedures, and interaction of holistic project teams, when assessing project risk.

At a time when insurance premiums are at an all-time low, but with coverage still a matter of negotiation; and input of your broker and insurers a potential added value post an insurance placement; it is therefore quite justifiable for the tunnelling industry to be making the same assessment of the credentials of the insurance professionals they are engaging.



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AUSTRIAN TENACITY

NATM use as a tunnelling method is widespread. But disagreement rages over contract practices, definition of the process, and even whether it counts as a method. **Gary Brierley** of *Doctor Mole Incorporated* presents his views on the spread of NATM

MTENACITY IS defined as adhering to a concept with vigor, and tenacity can be described as a virtue under certain circumstances. However, it depends upon what you are being tenacious about. For instance, no one doubts the tenacious adherence that Austrians have for their beloved tunneling method commonly referred to as the "New" Austrian Tunnel Method (NATM.) No matter what anyone says or how any project turns out the Austrians just keep beating the NATM drum, and to their credit, they have procured an enormous number of tunneling assignments for themselves throughout the world. If things go well, they declare victory and publicise the hell out of the project. If things do not go well, they blame Mother Nature, the contractor, the construction manager, bad luck, etc. and declare that if only more Austrians had been involved with the project then "so and so" never would have happened. Hence, the Austrians must be duly recognised for their tenacity.

However, just what is it about the NATM that demands such a singular adherence to a particular method for making a hole in the ground? Prior to the 1950's the majority of rock

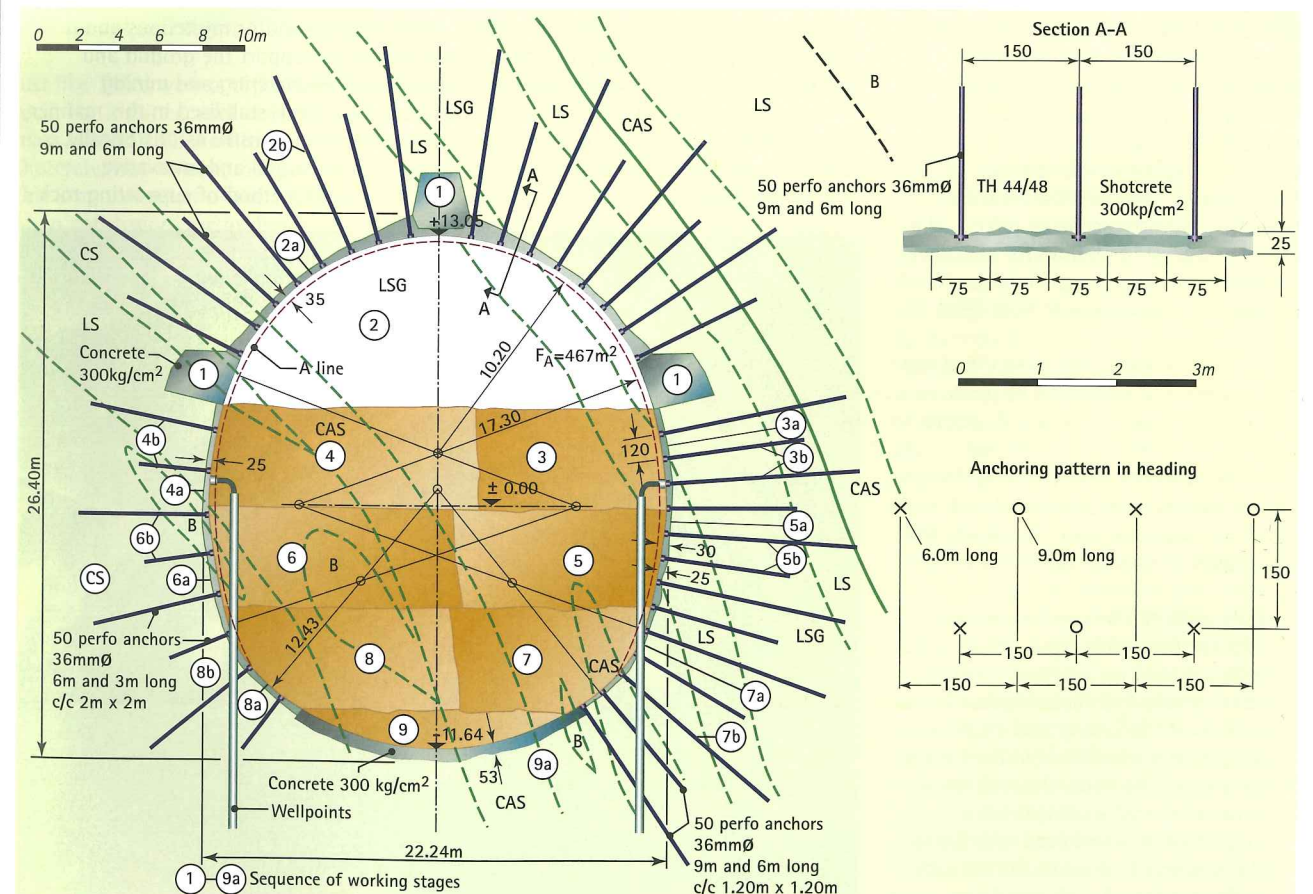
Gary Brierley

Gary is president of Doctor Mole Incorporated, and has served as chairman of the US Underground Construction Association

tunnels were excavated by drilling and blasting and supported by rather crude methods involving mostly wood but also steel ribs, bricks, or dressing stone. Soil tunnels were advanced using shields under sometimes difficult circumstances that required compressed air in order to control the face.

As pointed out in my paper on the history of tunneling (Tunneling: A Historical Perspective, August 2014 Tunnel Business Magazine) it is truly amazing to realise what tunneling professionals accomplished prior to the

Below: Example cross-section of NATM tunnel construction

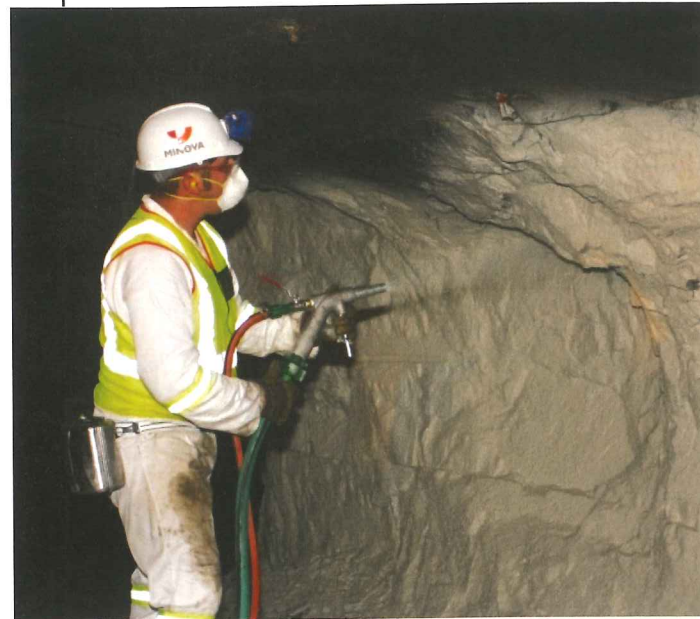


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1950's with the tools available to them at that time.

During the 1950's, however, several significant tunneling advancements began to materialise that revolutionised tunneling for civil engineering projects. Foremost among those advances was the use of Tunnel Boring Machines. As a result of numerous technological

"There is nothing either magical and/or mysterious about using rock bolts and shotcrete to support the ground, and **literally thousands** of both civil engineering and mining openings around the world have been stabilised in this manner."



Above: A nozzleman applying a thin lining

Below: NATM tunnelling for the Shis Tunnel, UAE



greatly facilitate rock arching and cause the ground to support itself to a large degree.

- Finally, rock bolts prevent large nonuniform loads from impacting the tunnel lining. In the old days, it was possible for large blocks of rock to shear through the lining and come crashing down into the tunnel. Rock bolts, when used properly, prevent this from happening.

Similarly for shotcrete. Shotcrete is cast-in place concrete that is placed pneumatically and the pneumatic placement of concrete produces many advantages that are particularly applicable to tunneling projects. For instance, pneumatically placed concrete can be placed in thin layers that serve as temporary support.

With time, this layer can be increased in thickness as the ground loads increase and/or as the opening is made larger. Indeed, the thickness of pneumatically placed concrete can be increased to the point where it constitutes a final lining just like concrete placed behind a form. Probably the biggest advantage of pneumatically placed concrete is that there is no doubt that the concrete is in firm contact with the rock mass and is therefore available to form a stable arch that will work together with the rock mass in order to support very heavy ground loads.

There is nothing either magical and/or mysterious about using rock bolts and shotcrete to support the ground and literally thousands of both civil engineering and mining openings around the world have been stabilised in this manner without any input or assistance from Austrians. Historically, rock bolts and shotcrete were a natural and innovative advancement for the conventional method of supporting rock

advances it became possible to make circular holes in rock using with roller cutters into which a shield could be advanced. Hence, both the method for excavating the ground and the methods for supporting the ground were streamlined to a considerable degree. As a result of TBM development, the tunneling industry began to refer to the drilled and blasted method for advancing a tunnel as "conventional" in order to differentiate those tunnels from TBM tunnels.

It was also during the 1950's that the civil engineering profession began to take notice of rock bolts and shotcrete. Prior to the 1950's, rock bolts and shotcrete had been used primarily for various mining applications but civil engineers also recognised the significant advantages of rock bolts. For instance:

1. Rock bolts can be used to create a safe opening. With blocky rock, rock bolts are used on a pattern basis to make certain that loose blocks of rock do not fall down and create a dangerous environment in the tunnel.
2. Rock bolts also allow the rock mass to be reinforced so that it can support itself. Reinforced rock is just like reinforced concrete. Curved rock arches reinforced with rock bolts



Above: Formwork for cast in-situ lining at the Rohtang Tunnel project in India

just like TBMs were a highly innovative method for excavating rock. For instance, rock bolts are often used to support a rock mass behind a TBM which is sometimes supplemented with shotcrete, but no one, except maybe a few Austrians, claim that this is an extension of the NATM.

In conclusion, the author of this article believes that there are several aspects of the Austrian's tenacious adherence to their tunneling method that many tunnelling professionals find infuriating. For instance:

1. NATM is not a "method" of tunnelling any more than any other method associated with the conventional excavation and support of rock masses.
2. Rock bolts and shotcrete have been understood and used by tunneling and mining professionals throughout the world for many decades; most of whom have never set foot in Austria.
3. Austrian designers have been able to convince impressionable tunnel owners to specify Austrians for work on a project to the detriment of other fully capable and knowledgeable tunnel designers.
4. The Austrians would like the world to believe that they "invented" some mysterious method for supporting the ground back in the 1950's that only Austrians understand and that only Austrians can put into service. There are two problems with this claim: Number 1, lots of different designers from lots of different countries participated in the historical development of using rock bolts and shotcrete to support the ground, and Number 2, those concepts are now so well established that they are readily available to every

well-educated and well-experienced tunnel designer.

FINAL THOUGHTS AND MOVING FORWARDS

So, there you have it. While the author of this article is willing to recognise the Austrian's tenacious devotion to self-promotion he is equally perturbed by their claim of having invented a "method" of tunneling and of having some magical power over the behavior of rock bolts and shotcrete. The author also firmly believes that the Austrian engineers might find it exhilarating once in a while to actually specify a TBM tunnel, or to use an open face shield in the proper ground condition.

The expression "When all you have is a hammer, every problem looks like a nail" certainly applies to the NATM.

In the final analysis, it seems that it would be highly beneficial, both for the tunnelling industry as a whole, and also for the Austrians, if they simply stopped blabbing about how smart they are and just stated designing safe, stable, and cost effective underground openings like tunnel designers from the 200 or so other countries around the world

WE'VE NEVER HAD IT SO GOOD

Bill Grose reacts to the UK's *National Infrastructure Plan 2014* and Chancellor's Autumn Statement

Bill Grose

Bill is a senior civil engineer working in his own practice following many years at Arup. He is a former BTS chairman

MOST UK engineers with a career in tunnelling will, like me, have spent time wondering where the next job is coming from - bemoaning the lack of continuity, the stop-start nature of the business, the "will it happen or won't it?" uncertainty of major projects. We all know why that is: big projects or programmes require big budgets which need to be carefully considered before committing, and most will span changes in government which bring with them differing priorities for public spending. But recent years have seen a change that gives tunnellers a great opportunity to build on the best work outlook for several decades.

Of course, the stop-start nature of UK tunnelling work has had benefits. We have travelled overseas looking for work, with considerable success, and UK tunnellers can be found on many international projects, particularly in East Asia and Australasia. Tunnelling has been a fast-developing industry and there's no doubt that a global approach, underpinned by international working, has reaped rewards. Tunnelling has become one of the most innovative and efficient processes in the construction sector.

But the downsides of a discontinuous workload in the UK have come at a price. Project knowledge disappears, lessons are not learned or consolidated, great teams disperse and the next major project tends to start closer to square one than it ought. Of course we have professional publications, academic papers, project reports and the like (which we've been getting much better at recently) and we have the individual experience of the people involved, but this is a long

Right: The UK's National Infrastructure Plan is updated annually

way away from an efficient transfer of appropriate knowledge from one project to another. [Clients and suppliers have also become more risk averse. Together with the stop-start approach this has led in some cases to solutions that are more costly than we were producing a couple of decades ago]

So, I view the National Infrastructure Plan 2014, launched alongside the Autumn Statement, with satisfaction and enthusiasm. Satisfaction because I see the efforts of ICE, IUK, BTS and many other organisations and individuals, and my own involvement, at last bringing a tangible, and what I hope to be a lasting, change. And enthusiasm because of the opportunities we now have ahead of us.

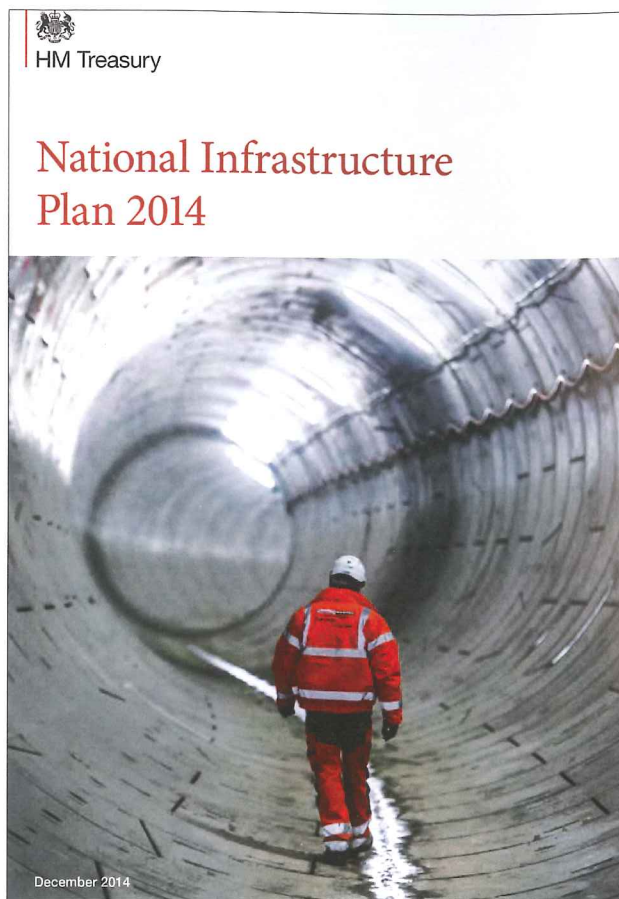
The Autumn Statement showed that we now have a better understanding, in the industry and Parliament, of the value of economic infrastructure. We also see an intention to plan strategically, spanning government terms with all-party support. And we can see the results of those: a project pipeline into the future, investment in skills

development and training, and a proper valuing of engineers' and technologists' contribution.

All of which brings me back to tunnelling. Many of the major projects in the National Infrastructure Plan involve tunnels, quite rightly. And the tendency will be for more underground infrastructure in the future. We have the opportunity now to build on this - to address skills shortages, to lead on innovation, to engage with the creation of societal value.

We've been asking for these conditions for a long time, and right now is the closest we have been to having them. As I said in my Harding Lecture in 2012, we need to work hard to respond but the future looks rosy - this is the tunnellers' time in the sun ☺

Bill Grose is an independent Chartered Civil Engineer, formerly a founder and director of Arup Tunnelling and a Chairman of the British Tunnelling Society. He is a member of ICE Council and was part of the HM Treasury team that published the Cost Review in 2010.



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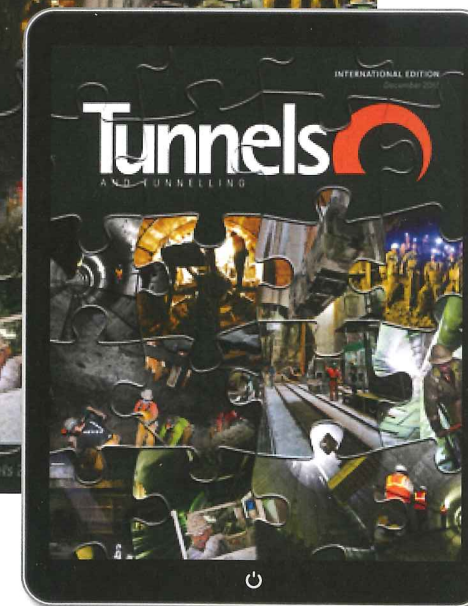
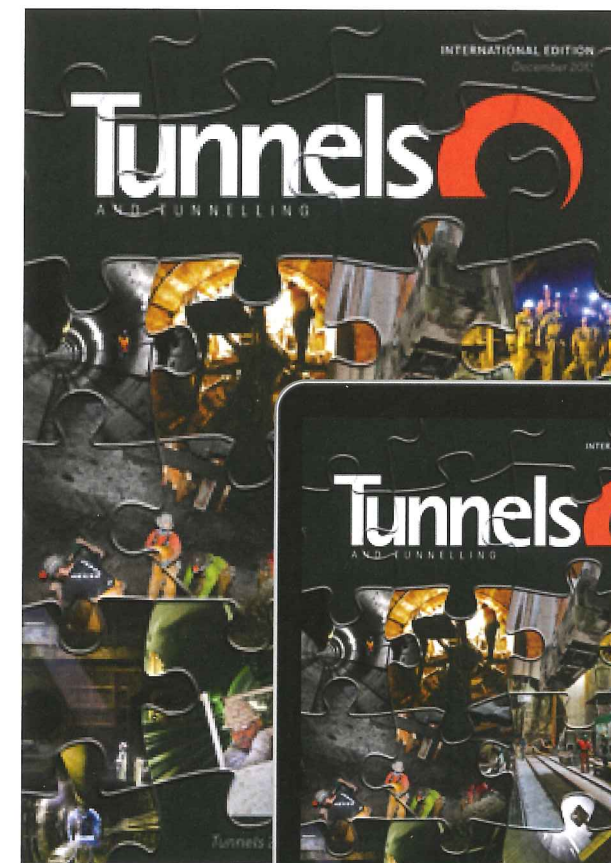
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George A. Fox Conference

27 January 2015
New York, New York
In recognition of his accomplishments, the UCA of SME holds this annual one-day conference.
www.smenet.org

Shotcrete conference and exhibition

29-30 January 2015
Tyrol, Austria
Wolfgang Kusterle and his team welcome you to the Conference and Exhibition Shotcrete 2015 at the Alpbach Conference Centre. Knowledge and experience do not help, if they remain hidden. This platform has gathered shotcrete specialists for 25 years.
www.spritzbeton-tagung.com

ICETUS 2015

3-5 March 2015
Subang Jaya, Malaysia
Following the successful International Tunnelling and Trenchless Technology Conferences held in Malaysia in 2006 and 2011, the Tunnelling and Underground Space Technical Division of The Institution of Engineers, Malaysia, is holding its third conference to coincide with KVMRT developments.
www.icetus2015.iemtc.com

ISRM Congress 2015

10-13 May 2015
Montreal, Canada
Held in conjunction with the CIM Convention for 2015, the International Symposium on Rock Mechanics is an international conference every four years.
www.ISRM2015.com

World Tunnel Congress 2015

22-28 May 2015
Dubrovnik, Croatia
WTC 2015 heads to the Dalmatian Coast as the event returns to Europe. Further details to be confirmed.
www.wtc15.com

RETC

7-10 June 2015
New Orleans, Louisiana
The Underground Construction Association's biennial conference.
www.smenet.org

49th US Rock Mechanics / Geomechanics Symposium

28 June-1 July 2015
San Francisco, California
The 2015 program will focus on new and exciting advances in rock mechanics and geomechanics and encompasses all aspects of rock mechanics, rock engineering, and geomechanics. Field trips and technical tours are planned.
www.armasymposium.org/

Eurock 2015 & 64th Geomechanics Colloquium

7-10 October 2015
Salzburg, Austria
The Austrian Society for Geomechanics has the pleasure to invite you to the ISRM Regional Symposium EUROCK 2015 Future Development of Rock Mechanics, to be held in conjunction with the 64th Geomechanics Colloquium in Salzburg.
www.eurock2015.com

25th World Road Congress

2-6 November 2015
Seoul, South Korea
The World Road Congress has been held every four years for more than 100 years. Since the first meeting in Paris in 1908, it has toured the member countries of the non-government organization, Permanent International Association of Road Congresses (PIARC).
www.aiprseoul2015.org

Post-2015 Framework for disaster risk reduction

14-18 March 2015
Sendai, Japan
UNISDR is facilitating the process of developing a post-2015 framework for disaster risk reduction. This process will culminate at the 3rd United Nations World Conference on DRR
unisdr.org/we/coordinate/hfa-post2015

Stuva Conference

1-3 December 2015
Dortmund, Germany
Held every two years, this conference sees 1,500 participants and visitors from about 20 countries. It is numbered among the world's leading get-togethers for underground construction experts. In 2015 the chosen venue for this premier event is Dortmund.
www.stuva-conference.com

2016

World Tunnel Congress 2016

22-28 April 2016
San Francisco, USA
WTC 2016 heads to the Golden State as the event heads to North America. Further details are to be confirmed.
www.wtc2016.us

Underground Construction Prague 2016

23-25 May 2016
Prague, Czech Republic
Past conferences confirmed that the Prague conference, thanks to its scientific programme, venue and social programme found a firm position among similar European conferences. The 2016 event will also be enhanced by the Third Eastern European Tunnelling Conference (EETC 2016).
www.ucprague.com

British Tunnelling Society

The BTS has a membership of almost 700 individual and 60 corporate members. It is one of the most vibrant gatherings of professional tunnellers in the world and traces its history back to its founding in 1971. Regular BTS monthly meetings are hosted at the Institution of Civil Engineers in London from 5.30pm every third Thursday of the month. In recent years, the BTS Young Members have also begun hosting a programme of evening lectures.

BGA John Mitchell Lecture: Going Underground? The Past, the Present and the Future.

13 January 2015
Colin Eddie will present his own perspective on the tunnelling industry. He will start by looking at the utilisation of underground space and the development of increasingly sophisticated construction techniques. He will examine some of the challenges encountered when tunnelling beneath urban areas before turning to the future and considering the challenges that will be faced by the upcoming major projects proposed for London and how the UK tunnelling industry can overcome them and maintain their position in the international market. Prior booking is required for this event.

If you have a topic or project you feel would be suitable for a BTS evening presentation, please contact either:
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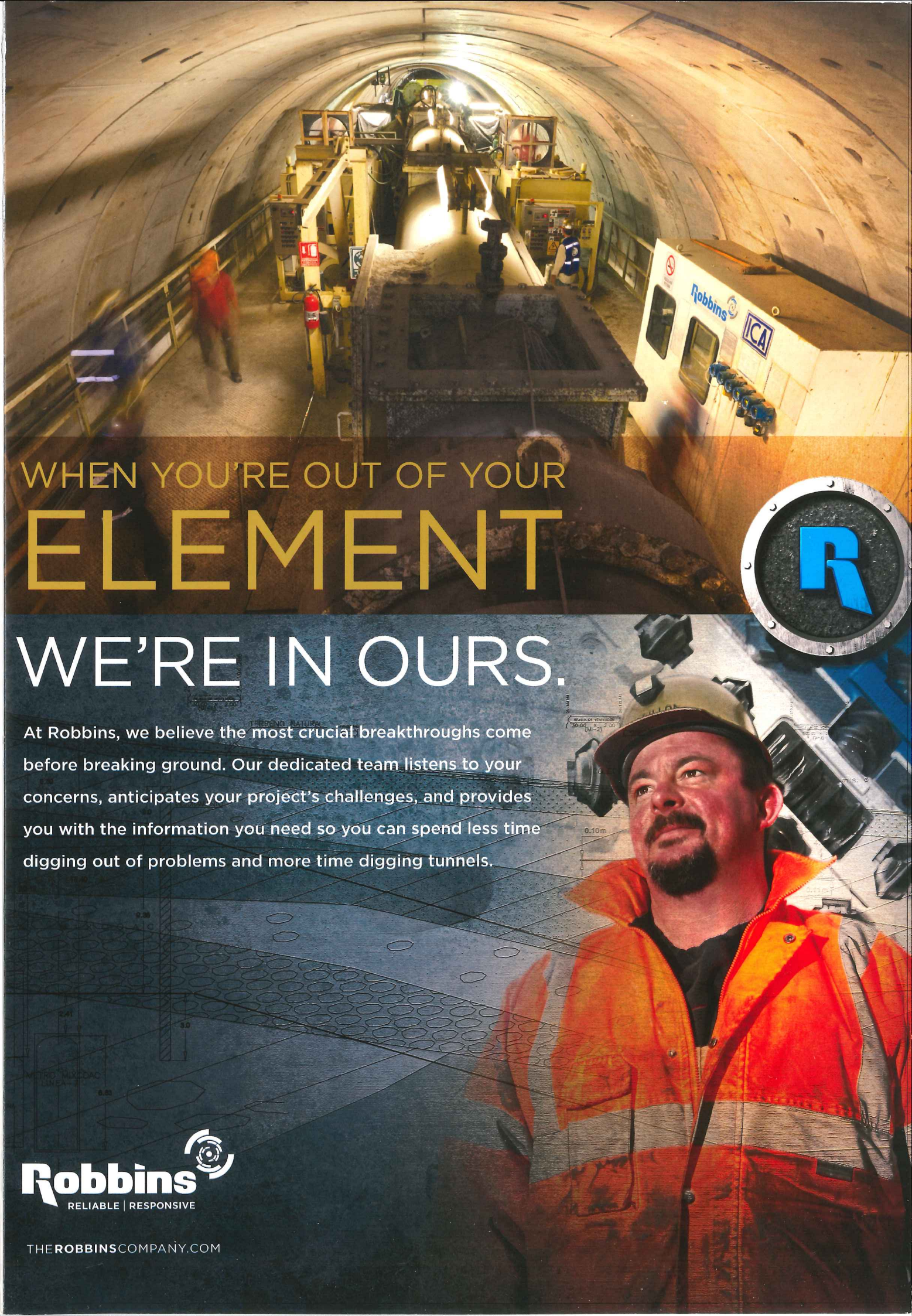
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