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Cover photo:
Waterview TBM Alice
Courtesy of Well Connected Alliance

Australasian Tunnelling Society is a Technical Society of Engineers Australia and affiliated with Australasian Institute of Mining and Metallurgy, the Institute of Professional Engineers New Zealand.

The ATS Journal is the official journal of the Australasian Tunnelling Society.

Chairmans Foreword

This last year has seen the society working closely with Safe Work Australia towards the development of a National Code of Practice for Tunnelling and with Austroads with their Guide to Road Tunnels.

The ATS continues to support the development of young engineers. Our Young Representative on the Executive Committee, Jurij Karlovsek, is working closely with the British Tunnelling Society (BTS) and International Tunnelling Association (ITA) to develop the better involvement of young engineers.

Since 2003 the ATS has held tunnelling courses in Sydney, Melbourne and Brisbane and a soft ground seminar in Perth. In August the ATS held Queensland's Fourth Underground Space Workshop. The theme of the Underground Space Workshop was "Underground Space in Brisbane – Let's Get Started." The purpose of the workshop was to highlight the need and opportunities for underground space in Brisbane over the next few decades.

The 15th Australasian Tunnelling Conference will be held on 17–19 September 2014 in Sydney. The theme of the conference is "Underground Space – Solutions for the Future" and submission of abstracts is now open.

The Executive of the ATS has been working closely with Engineers Australia to develop regulations and guidelines for Technical Societies and we are looking forward to the positive impact of communication upgrades and on-line membership renewal amongst other changes currently being rolled out within EA.

Simon Knight – Chairman Australasian Tunnelling Society

EDITOR'S NOTE

This latest edition of the journal gives an update of tunnel projects in Australia and New Zealand, as well as in Asia and interesting projects from around the world. I try to identify those projects from around the world that may have an impact on our own planned or current projects. Whilst we have seen a down turn in underground mining projects over the last 12 months we have seen some exciting developments and the use of civil tunnelling techniques in the mining industry. At the Tunnelling Course in Melbourne earlier this year a number of mining industry representatives expressed an interest in getting more information on such developments. Alan Robertson the AusIMM representative on the Executive Committee has agreed to take this forward. This issue also includes the winner of last year's David Sugden Award as well as a copy of the British Tunnelling Society's Harding Prize winner after Jurij Karlovsek (the David Sugden Award 2012 winner and Young Engineer's Representative on the Executive Committee) met up with David Clayton at the Lee Tunnel in the UK after the ITA World Tunnel Congress in Geneva. I hope you enjoy it.

David Lees – Editor ATS Journal

AUSTRALASIAN TUNNELLING SOCIETY

THE DAVID SUGDEN YOUNG ENGINEERS WRITING AWARD 2014

SPONSORED BY ATS

Win a chance to attend the 2015 ITA World Tunnel Congress in Dubrovnik, Croatia

- The competition is open to all ATS Members and University Students under 35 years of age (as at 31 August, 2014)
- The task is to write a technical paper on any subject related to tunnelling and underground construction — not less than 2,000 words and not more than 5,000 words.
- Best paper to be judged by the ATS Executive Committee.
- Closing date **30th June 2014**
- Winner announced by 31 August, 2014
- The prize includes complimentary conference registration fees and $2,000 towards personal travel and accommodation costs at the ITA World Tunnel Congress to be held in Dubrovnik, Croatia from 22–28 May 2015.

For more information contact Stephanie McMullen
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Legacy Way

Excavation of the 4.6 kilometre Legacy Way Tunnel in Brisbane is complete with the two Herrenknecht Double Shield TBMs currently being dissembled and tunnel fit out underway.

Joyce TBM concluded the boring of the eastbound tunnel on 24 April 2013, taking 7 months to reach breakthrough and Annabell TBM concluded boring of the westbound tunnel on 13 June 2013, taking 10 months to reach breakthrough. Both TBMs bored in the same direction from the Mt Coot-tha roundabout, Toowong, toward the Inner City Bypass at Kelvin Grove. The tunnel is due to open in 2015.

City East Cable Tunnel

Ausgrid is constructing a new cable tunnel running from the corner of Albion Street in Surry Hills to the new City North zone substation on the corner of Sussex Street. Stage one involves construction of a 150 metre extension to the existing City South Cable Tunnel and stage two involves construction of the 3.2 kilometre City East Cable Tunnel.

With a diameter of 3.5 metre, the tunnel will connect the existing City North substation in Sussex Street to a new substation in Riley Street, Surry Hills. The CECT project also includes the construction of two concrete lined connectors, an extension to the City South Cable Tunnel and installation and commissioning of all tunnel mechanical and electrical services

Thiess have procured a bespoke tunnel boring machine for the excavation and lining of the cable tunnel and are using a high flow water cooler to recycle water used in the TBM cooling system to enable average savings of 26 mega litres a month. Groundwater is treated for reuse in the grout batching operations, reducing the need for using potable water. Work on the project began in late 2011 and is planned for completion in 2015.

The completion of the City East Cable Tunnel will complete Ausgrid's "ring main" for the Sydney CBD, linking both the existing City South Cable Tunnel and the City West Cable Tunnel.

Cross River Rail

Cross River Rail is a proposed new 18 kilometre north-south rail line in Brisbane's inner city and includes the construction of two running tunnels from Yeerongpilly in the south to Victoria Park in the north, under the CBD and Brisbane River. Construction will also include four new underground stations at Woolloongabba, Boggo Road, Albert Street and Roma Street.

Following the announcement that the Federal Coalition will not fund Brisbane's Cross River Rail project; Engineers Australia called for increased transparency in the scheduling and provision of major infrastructure projects and this needs to be kept at arm's length to political succession. "It is imperative that federal and state governments work together to avoid election-led boom/bust investment cycles. Critical infrastructure projects like the Cross River Rail should go ahead and sooner rather than later," said Simon Orton Engineers Australia Queensland Division President. "Major infrastructure projects like the Cross River Rail promote employment, increase productivity and underpin Queensland's future economic growth. Any delays to an infrastructure project of this magnitude will lead to labour force planning implications and place increased pressure on the engineering profession and the Queensland economy. A large proportion of Australia's 250,000 strong engineering workforce is employed in delivering major infrastructure projects. We need to avoid acute demand spikes across specific locations and engineering specialisations and provide far more certainty to those employed in the delivery of major infrastructure projects. Australia must avoid the boom/bust infrastructure cycles seen in recent years. Simply put, the political cycle and the infrastructure delivery cycle need to be as separate as possible," said Mr Orton.

M2 upgrade complete

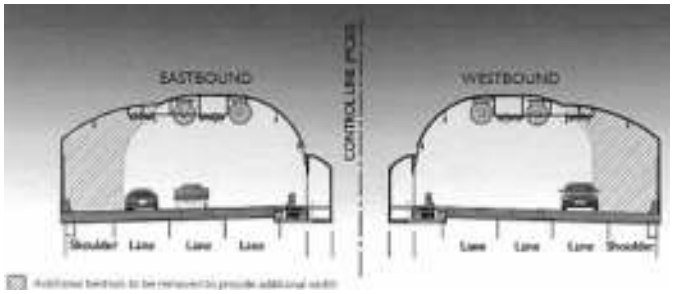
Leighton Contractors has announced that the $550 million Hills M2 upgrade has been officially completed with the finished motorway open to full capacity. This completes two and a half years of construction on the Sydney road project.

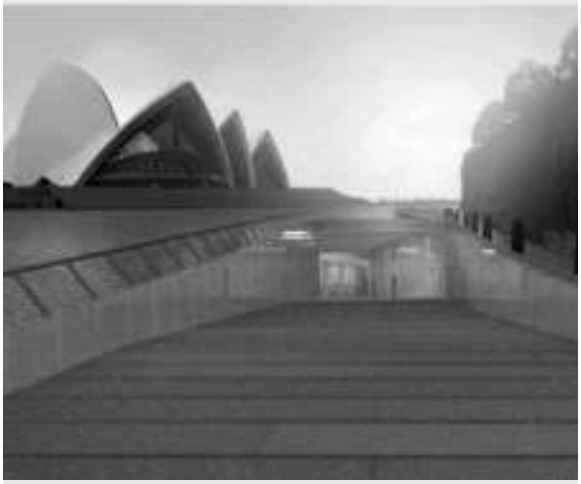
The project was the largest of its kind carried out on an operational motorway in Sydney. It employed up to 185 site staff and over 600 workforce personnel at peak production (in late 2012) and widened 14.5 kilometres of motorway from Baulkham Hills to North Ryde in Sydney's northwest.

Leighton Contractors commenced construction in January 2011. In this time the Hills M2 Upgrade team managed over 95 million traffic movements, installed over 6,500 night-time temporary traffic installations on the motorway and achieved a 99 per cent satisfaction level in terms of lane availability by the project's 5:30am curfew.

The project produced a number of engineering achievements including the widening of the existing Norfolk Tunnel in North Epping. The twin tunnels underwent tunnel widening while remaining operational to traffic. Additionally, the project team modified the Beecroft Road overpass from a three-span structure to a two-span structure while live traffic flowed underneath. The Beecroft Road Bus Ramp, an eight span concrete bridge spanning the westbound carriageway near Beecroft Road, was also demolished to provide room for an additional lane in each direction.

AECOM acted as consulting engineers for the upgrade.





Sydney Opera House VAPS project

To enhance tourist and visitor safety at the Sydney Opera House a purpose built underground roadway and loading dock is being built to remove heavy vehicle movements from the forecourt. This will allow pedestrians to have safe and exclusive access to all the Sydney Opera House facilities at forecourt level. The Vehicle Access and Pedestrian Safety (VAPS) project has an approximate value of just over $100 million and work commenced in January 2012.

The tunnel excavated by roadheader broke through on 12 July 2013 after 12 months of excavation.

F3–M2 Link

Three consortia had been invited to tender for the F3 and M2 tunnel on 8 August 2013. The important 8 kilometre missing link in Sydney's motorway network is planned to be completed by 2018. The federal government will contribute $400 million to help deliver this project in partnership with the NSW government.

The NSW Government received an unsolicited proposal from private motorway operator Transurban and the Westlink M7 shareholders last year to build a link along the Pennant Hills Road corridor. "In June this year more than 30 infrastructure and construction experts attended an industry briefing with the NSW Government and Transurban on the proposal to build the F3-M2 link.

Transurban started an expression of interest process in July with interested bidders and has shortlisted three consortia who will be invited to tender for the design and construction of the project. The companies are:

- Thiess John Holland Joint Venture;
- Lend Lease Bouygues Joint Venture; and
- GlobaLink Joint Venture consisting of Ghella Pty Ltd and Acciona Infrastructure Australia Pty Ltd.

If approved the proposed link will be jointly funded by Transurban, Westlink M7 shareholders, the NSW government and federal government. It will include tolls. The project has a target price of $2.65 billion. Initial investigations and studies have started for the environmental assessment of the proposed link with further work to continue until early 2014. The NSW government and Transurban hope to have a conditional preferred tenderer selected by early 2014.

The F3-M2 link would provide a continuous motorway between Western and South Western Sydney and the Central Coast and Hunter.

WestConnex

A four kilometre tunnel from Strathfield to Ashfield and a widened M4 motorway will be the first segment built of the O'Farrell government's WestConnex motorway. This part of the motorway will cost between $3 billion and $4 billion. Motorists will pay a toll to use it but the amount has not yet been specified.

The tunnel will run under Parramatta Road from the start of the existing M4 at Strathfield to near Wattle Street at Ashfield where it will have to connect to the City West Link and the eastern section of Parramatta Road to the city. The tunnel will be dug with three lanes in each direction, making it potentially larger than the four kilometre M5 East. It would require at least one – but probably two – exhaust stacks.

The government received the business case for the entire 33 kilometre WestConnex motorway late last month, but may wait until after the federal election on 7 September before it announces the sequence in which it will build the project.

It is understood that the business case recommends the first segment should include both the widened M4 from Parramatta to Strathfield, which will have tolls re-introduced on it and the tunnel from Strathfield to Ashfield. It also recommends more apartments be built in a high-density corridor above the tunnel and is said to include plans for an authority to take control of development proposals along Parramatta Road.

The business case has been worked on by officials from Roads and Maritime Services as well as advisers from a large number of consulting, finance and construction firms, including Ernst & Young, Macquarie Bank, AECOM, Leighton Contractors and Ferrovial Agroman.

At 33 kilometres WestConnex would be the largest motorway project in Australia and one of the biggest transport projects in NSW history. On what the government has released so far, it would involve a widened M4 from Parramatta to Strathfield, extend under Parramatta Road ultimately to Camperdown, run under the inner west to the airport at Mascot, and then duplicate the existing M5 East tunnel. It will be built in three stages. The other two sections include the eastward extension of the tunnel under Parramatta Road and the inner west, and the other M5 East tunnel and link to the airport.

The original plan for the Parramatta Road section of the motorway, released by the former heads of Infrastructure NSW Nick Greiner and Paul Broad in October, was for it to be carved in a ''slot'' within the existing road. But this proved too difficult, partly because of the cost and disruption of removing utilities and services beneath Parramatta Road.

The government has faced criticism for committing to the WestConnex motorway instead of public transport, not extending the motorway to the trucking hub of Port Botany and for signing up to the project with neither a detailed business case nor patronage figures. It is understood even when the business case is released the document will be thin on patronage figures. The federal government has said it would chip in $1.8 billion but insisted on conditions that would cost multiples of that.

The M5 East motorway has only one emission stack but sources said the best engineering solution for WestConnex would be to have one stack at each end.

Melbourne East-West Link and Melbourne Metro

East-West Link – The East-West Link in Melbourne is considered vital to reduce congestion on the city's roads. The Victorian government allocated $294 million in its 2013 Budget for the first stage of the project—a 6 kilometre tunnel from Hoddle Street, Clifton Hill to CityLink at Parkville—with work due to begin at the end of 2014 and be complete by 2019. The federal opposition has pledged $1.5 billion towards the project.

Melbourne Metro – Melbourne Metro involves the construction of a 9 kilometre rail tunnel through inner Melbourne that will link the Sunbury and Pakenham/ Cranbourne rail lines. The project will include five new underground stations to be located at Arden, Parkville, CBD North, CBD South and Domain. The rail tunnel will join the Dandenong corridor to the east of South Yarra Station and the Sunbury line west of South Kensington Station. Geotechnical investigations are currently underway in locations along the proposed project alignment as part of the planning and development phase of the project.

Pros and Cons

Building the Melbourne Metro rail project would improve train times, tackle disadvantage and boost productivity by almost $400 million, according to high-level advice prepared for state and federal governments. As Premier Denis Napthine pushes ahead with plans for an east-west road between Clifton Hill and Flemington, an economic report has argued in favour of the alternative rail proposal: an underground train line between South Yarra and Kensington.

The report was prepared last year for the Council of Australian Governments reform council. It says the Melbourne Metro would improve travel times, reshape employment opportunities, and ''significantly'' mitigate disadvantage in Melbourne's west by giving people more access to work. ''The Melbourne Metro potentially represents a 'step change' in the development of Melbourne's spatial economy,'' says the report, produced by SGS Economics and Planning. ''As well as improving service coverage and quality for public transport users, this investment is likely to lead to a significant redistribution of future employment growth, favouring the inner west in particular.''

The Melbourne Metro would allow an extra 24,000 passengers every hour by building a new train line to complement the city loop, with five underground stations: Arden, Parkville, CBD North, CBD South and Domain. But the business case warns that unless construction begins within two years, all train lines except Sandringham will be so busy that passengers will increasingly be left behind during the morning peak.

The Napthine government says it supports the rail project, but its immediate priority is building the first stage of the east-west link: an $8 billion tunnel to ease pressure for motorists using the Eastern Freeway.

A Public Transport Victoria spokesman said the length and complexity of the rail project ''far exceed anything undertaken in Victoria before, including the Melbourne underground rail loop, the CityLink tunnels and the East-West Link''.

History

Like the East-West Link, the idea of a cross-city Melbourne Metro was first outlined years ago, as part of a sweeping report by infrastructure tsar Sir Rod Eddington. The newly elected Federal Government has pitched $1.5 billion towards the road tunnel in its first term, but has ruled out funding urban rail projects.

Northbridge tunnel widening

Graham Farmer Freeway was constructed between 1996 and 2000, Stage 1 involved construction of the tunnel and was undertaken by a Clough/ Baulderstone joint venture. The Northbridge Tunnel is Western Australia's only freeway tunnel it is 1.6 kilometre long and was built with two lanes of traffic in each direction and a breakdown lane.

During several weekend closures in April 2013, the existing breakdown shoulders were removed to accommodate an extra lane of traffic in each direction, without modifying the tunnel's structure. The removal of the breakdown lanes was criticised by the State Opposition, and the RAC raised concerns about emergency response times. As part of the upgrade, Main Roads Western Australia implemented an Incident Response Plan, including a dedicated towing service, and the fire control and ventilation systems were upgraded. The new eastbound lane opened on 16 April, a day after it was originally scheduled to open, due to delays in commissioning the new Lane Use Management System. The third westbound lane opened on 29 April, as scheduled. The works were designed to improve the traffic flow in the Perth CBD, which will be affected by construction projects such as the development of Elizabeth Quay.

Sydney CBD and South East Light Rail

Cut and cover tunnels have been proposed for the Sydney CBD and South East Light Rail beneath Surry Hills and through under Anzac Parade through Moore Park. Following feasibility investigations and consultation with key stakeholders, the NSW government is proceeding with a new light rail line extending from Circular Quay along George Street to Central Station then to Kingsford via Anzac Parade and Randwick via Alison Road. The project is estimated to cost approximately $1.6 billion. Subject to planning approvals, work is expected to commence in 2014 and is expected to take five or six years to complete.

A 2.2 kilometre tunnel under Moore Park, the Eastern Distributor and Surry Hills was considered for the project. However it is understood that this option is not being taken forward as it will not provide a stop in Surry Hills, costs more and presents significant engineering and environmental challenges. The government has determined that the best route for light rail is along the surface of Devonshire Street in Surry Hills. This will give local residents access to frequent and reliable public transport, provide substantial benefits for the area through urban renewal and provide easy access for customers to businesses in Surry Hills. Transport for NSW is now developing the detailed design of the project, which will include the precise alignment of the route and the location of stops. Preliminary survey and investigation work is being undertaken to help inform the detailed design work.

Perth City Link

Perth City Link will reconnect the CBD with Northbridge for the first time in 100 years, and in the process create a vibrant new mixed-use precinct that will revitalise our city and dramatically change the face of Perth. It involves sinking the Fremantle rail line from Perth Station to Lake/King streets, undergrounding of the Wellington Street Bus Station and creating five new connections between the CBD and Northbridge.

Construction commenced on 25 August 2011 and is expected to be completed in mid 2014. After two years of construction, the Fremantle Line tunnel is now complete. The construction required major shutdowns of the rail network.

The first shutdown from 12–17 July impacted all train lines, and allowed critical work to be completed to connect the new Fremantle Line tunnel to the Transperth rail network. This saw the first trains travelling through the new tunnel on Thursday, 18 July 2013, marked by an event with WA Transport Minister Troy Buswell. The Minister along with 185 passengers including staff and children from the Citiplace Childcare Centre were given the opportunity to travel on a special service.

The last major shutdown was carried out from 31 July – 4 August to allow trains to switch between the Fremantle and Joondalup line tunnels, and begin piling work in preparation to build cover over the entrance to the Joondalup Line tunnel.

Successfully completing the Fremantle Line tunnel brings a 100 year vision to connect Perth and Northbridge to life. Above-ground developments will be built on top of the tunnel, as the second stage of the overall Perth City Link project.

The two shutdowns involved many months of planning and hard work, and now the Perth City Link Rail Alliance team is one step closer to completing the project.

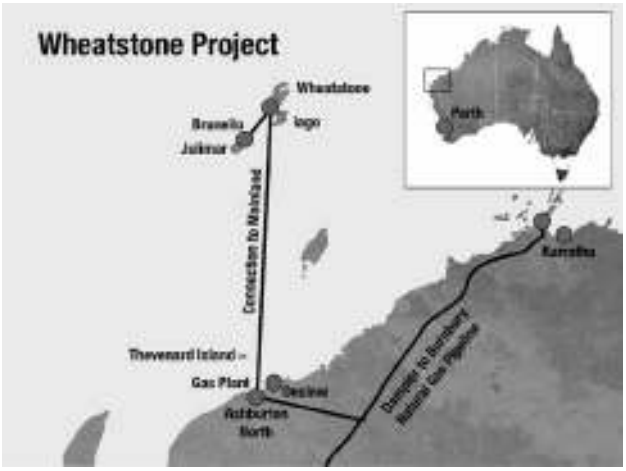
Work will continue to build the new pedestrian underpass from Perth Underground to Perth Station and finish upgrades inside the station, until the project is complete mid-2014. The new underground tunnel allows construction to begin above ground for a new retail and commercial space in the heart of the city.

Wheatstone Project

The Wheatstone Project is one of Australia's largest resource projects – providing greater security of supply and significant economic benefits such as employment, government revenue and local business opportunities. In conjunction with the Gorgon Project, it reinforces Australia's position as a leading natural gas supplier and liquefied natural gas (LNG) operator in the Asia-Pacific region.

The Wheatstone Project will include an onshore facility located at Ashburton North Strategic Industrial Area (ANSIA), 12 kilometres west of Onslow in Western Australia's Pilbara region. The foundation project includes two LNG trains with a combined capacity of 8.9 million tonnes per annum (MTPA) and a domestic gas plant.

The project includes a 1.2 km long tunnelled shore crossing under the ocean. The microtunnel will be



2.5 metres in diameter and will be constructed by TBM and lined by pipejacking. The microtunnel will accommodate a 1.1 metre diameter pipeline to deliver gas from Chevron's Wheatstone and Iago reserves. Construction on site will commence after the cyclone season in 2013.

NW Rail Link

The NW Rail Link in Sydney has been proposed in many forms since 1998 including a heavy rail corridor and a metro line. The current scheme is a passenger rail to connect Rouse Hill to Epping via Castle Hill. Cherrybrook, Castle Hill, Showground, Norwest and Cudgegong Road stations will be underground, whereas Kellyville and Rouse Hill will be above ground.

The twin tunnels between Epping and Kellyville, at 15.5 kilometre long, will be the longest and deepest rail tunnels in Sydney. Most of the tunnel will be bored, although the section at Kellyville will be constructed using cut-and-cover techniques. The tunnelling contract was awarded in June 2013 and tunnelling is expected to begin in 2014

A joint venture between Thiess, John Holland and Spanish company Dragados has been selected by the New South Wales Government to construct the tunnels and excavate new underground stations for Sydney's North West Rail Link. Under the AUD$1.15 billion Tunnel and Station Civil Works contract, the companies will construct twin 15 kilometre tunnels, which will run between Bella Vista and Epping. These will be the longest rail tunnels ever built in Australia.

Four custom-made Tunnel Boring Machines (TBM) will be used to construct the 6 metre diameter tunnels, with the first of the TBMs to be in the ground by the end of next year. The team is also gearing up for a proactive community engagement effort to limit disruption and inconvenience while providing information on the long term benefits of the project.

Work will start shortly to prepare the three major tunnelling sites at Bella Vista, Showground and Cherrybrook, with contract completion scheduled for first quarter 2017.

When completed in 2019, the North West Rail Link will connect Epping with Cudgegong Road at Rose Hill in Sydney's North West (23 kilometres apart), and will include 15 kilometres of tunnelling, 4 kilometres of "sky rail", regular above ground rail and 8 new stations.

THE SCENIC RAILWAY UPGRADE

The Scenic Railway located at Scenic World in the Blue Mountains descends 310 metres through a cliff-side tunnel, emerging into ancient rainforest at the Jamison Valley floor. It has been operating since 1945, and has thrilled 25 million passengers on nearly 700,000 journeys.

The Scenic Railway was originally constructed for a coal and oil shale mining operation in the Jamison Valley in the 1880s, in order to haul the coal and shale from the valley floor up to the escarpment above. From 1928 to 1945 it carried coal during the week and Passengers at weekends. The coal mine was closed in 1945 after which it remained as a tourist attraction.

It is the steepest cable-driven funicular railway in the world, with the steepest incline of 52 degrees over a total incline distance of 310 metres. The current train carriages were installed in 1994 and have made over 400,000 journeys. The new Swiss-designed railway carriages will comprise the fifth vehicle to operate on the former coal mine track since 1945.

The Scenic Railway has invested $30 million in a redevelopment that included new train carriages with new train tracks, bigger buildings, a new winch and all new control systems. This has required additional excavation of the existing tunnel to accommodate the new carriages. Other works included in the upgrade are new top and bottom passenger platforms and an historical interpretation.

The upgrade works will retain the character and history of the railway, but will allow the necessary safety upgrades. Scenic World engaged Grindley Construction to carry out the building and construction works, and Sinclair Knight Merz, as the structural and geotechnical consultants. The RIX Group was engaged in October 2012 to carry out the tunnelling works.

Rix specialist personnel were used to install rock-fall safety mesh and protection measures, and to de-scale approximately 2000 square metres of the rockface. Access was provided utilising rope access from above the chasm which exists at the southern end of the tunnel.

Enlargement at the upper front portal to the tunnel was carried out by hand excavation in 2.5 metre increments, including drilling and installing 3 metre long rock anchors, mesh and shotcrete. Rix were also required to remove the existing concrete support slab in the tunnel while keeping the overhanging rock mass stable with rock anchors punched through from the area above.

To accommodate the new trains the tunnel needed to be reshaped. This involved hand excavation and installation of 100 millimetres of mesh reinforced dry shotcrete, with 1.8 metre, 2.1 metre, and 3 metre long rockbolts depending

on the location and access, as the floor to roof dimension sometimes did not allow for the installation of the longer bolts. About 140 ton of dry shotcrete was used.

An 8 metre long, by 2 metre deep, by 2 metre wide service tunnel was also excavated by hand under the top platform to allow access for the maintenance fitters to the underside of the train.

Micropiles and rock pins were drilled and installed along the entire length of the incline to secure the new rail footings and drainage material was also installed at 300 millimetre centres to handle the excessive inpours of water that occur during heavy rains.

The works were completed within time for the tourist attraction to be opened again for Easter 2013.

Toowoomba Range train tunnels upgrade

The locations of the Toowoomba Range train tunnels to be expanded. The Queensland Government will spend $17 million on building larger train tunnels through the Toowoomba Range and Lockyer Valley.

Member for Toowoomba South John McVeigh said the engineering works would provide a significant future boost for the agricultural industry across the Darling Downs. By lowering the floor on 11 tunnels it will allow rail transport to compete with trucks which have been carrying the larger hi cube for several years.

Member for Lockyer Ian Rickuss said the use of the larger 9'6" hi cube containers had grown significantly in recent years, replacing the standard 8'6" containers. "This will be a challenging engineering task because 9 of the 11 tunnels along the western and south western rail corridors have historic characteristics which need to be maintained. "By addressing the height constraints for agricultural freight we will be able to provide capacity improvements needed for future growth."

Preparations are already underway to build two additional passing loops on the Range to allow more services for cotton and grain and this will now allow even more freight capacity to the Port of Brisbane.

NARROWS CROSSING

Santos GLNG officially launched the start of tunnelling on the Thiess Narrows Crossing Project on 15 April. This was a significant milestone for the multi-billion-dollar Santos GLNG project as the tunnel being built by Thiess will encase the gas transmission pipeline used to link the mainland to Curtis Island.

Santos GLNG Pipeline Manager Greg Jones said the tunnel would allow connection of the 420 kilometre underground gas transmission pipeline with the LNG Plant. "A team of 12 people worked for around six weeks to assemble a 100 metre long and 277 tonne tunnel boring machine on-site which will be used by Thiess to excavate through rock and soil and install the concrete tunnel lining," Mr Jones said. "This is a complex process that will take around 12 months to complete and will involve the creation of an approximately 4.3 km tunnel with a 3.4 metre internal diameter, and then placement of pipe."

Thiess Tunnelling General Manager Steve Wille said the expertise Thiess has developed on Australia's major road and rail tunnelling projects is now being applied to benefit of the oil and gas industry. "The Tunnel Boring Machine (TBM) is a precision tool and our highly skilled team will guide it with pin-point accuracy to its destination across The Narrows. "The TBM cuts and removes the soil and rock, then lines the tunnel with pre-cast concrete segments in a remarkably seamless operation," Mr Wille said.

Once the tunnel has been constructed, Saipem the main contractor constructing the pipeline will pull the pipe through the tunnel. All the segments for this part of our 420 kilometre pipeline have been triple welded and are being stored at the marine crossing until the tunnel is complete.

The tunnel boring machine is continuing to make good progress underneath The Narrows. It has travelled about 2300 metres since beginning its journey in April and there is now only two kilometres of the tunnel to complete, linking the project's LNG plant on Curtis Island.

The tunnel has recently built a locomotive rail switch within our tunnel so that two carts can fit into the tunnel at the one time.

At the reception pad on Curtis Island where the tunnel boring machine will end its journey, piling works are complete and beam reinforcement and form work are underway. Other progress includes the site's longest plant module, a propane condenser as long as 17 cars, being installed on Train 1 in August. Another structure that is nearing completion is the 100 metres tall flare tower. The loading platform for the product load-out facility in Gladstone Harbour now has its first layer of concrete on the deck slab and its loading arms will soon be installed. International vessels will berth alongside the product load-out facility in the harbour from first gas date in 2015, and LNG will be transferred on board via the loading arms.

Port of Brisbane Freight Tunnel

As part of their election promises the Coalition announced $300 million in funding over three years to finalise plans for the 1800 kilometre inland track which promises to revolutionise freight movement in the eastern states. This will include an underground freight tunnel to be carved through Brisbane's southside as part of the ambitious $5 billion plan to build an alternative rail line connecting the Queensland capital to Melbourne.

Central to the project is 25 kilometre of new track between Acacia Ridge in Brisbane's southwest and the Port of Brisbane – mostly underground. Because of the geographical challenges and rapid advances in tunnelling technology, the state government believes the best option is to put most of it underground, surfacing at the Gateway Motorway.

The $5 billion project – due to be completed by 2026 – includes updating existing train tracks, and building three new tracks from Yelarbon to Oakey, Rosewood to Kagaru and Acacia Ridge to the port.

For years the project has been on the drawing board, with the Port of Brisbane previously signalling interest in a freight line to Melbourne. The Coalition funding announcement is also expected to take some of the heat off the Federal Coalition for its refusal to match Labour in allocating money for the Cross River Rail project.

The state government has promised to contribute $467 million to the project.

Transport Minister Scott Emerson said the tunnel would have multiple benefits for southeast Queensland such as freeing up capacity for passenger services on the Ipswich and Beenleigh lines and taking controversial coal trains out of southside suburbs.

Planning will take up to three years followed by a 10 year construction period for a proposed delivery date of 2026. Once completed, the line will be able to carry 25 million tonnes of freight a year – the equivalent of up to 812,000 B-double truck movements.

St Helena Tunnel

Work on the centrepiece of the Ewingsdale to Tintenbar Pacific Highway upgrade – the St Helena tunnel – finally began on 28 May 2013.

In a joint statement, the then Federal Transport Minister Anthony Albanese and NSW Roads Minister Duncan Gay said workers building the 434-metre long tunnel are expected to dig through rock that has not been disturbed since it flowed as magma from Mount Warning about 23 million years ago.

The tunnelling is expected to take 10–12 months and when complete in 2014, will accommodate three lanes of traffic in each direction. Work began excavating the tunnel using drill and controlled blast methods to get through the strong basalt rock. This state of the art technology will help break though rock that is believed to have originated from lava flows from a volcano centred on Mount Warning roughly 23 million years ago.

Mr Gay spelled out the enormous logistics of the project. "The tunnels will require 30,000 cubic metres of permanent concrete, more than 40,000 square metres of waterproofing membrane, contain more than 3000 steel rock bolts, and have 32 reversible jet fans for ventilation and 2.4 million litres of water stored in tanks to supply the tunnel's fire deluge system," Mr Gay said. "Safety features of the tunnels will include three emergency exit cross passages between the twin tunnels, an automatic fire deluge system, a ventilation system and air quality monitors."

The tunnel was a source of controversy when the first route options for the upgrade were proposed, partly because it anchored the upgrade's northern end and limited the ability to look for alternate routes.

The Ewingsdale to Tintenbar upgrade is expected to be finished next year and will create an uninterrupted dual carriageway motorway between Ballina and Brisbane.

Join the ATS Forum

New on the ATS website is a forum to allow members to discuss issues of importance or to seek advice from experts within the industry.

It's free to join – just register on the page

http://www.ats.org.au/index.php/forum/welcome-mat/2-welcome-to-the-new-ats-forum

Tunnel Boring Australia

Tunnel Boring Australia continues with the tradition of executing complex microtunnelling and pipe jacking projects for major players in the civil infrastructure and mining sectors. The past three years have also been a period of further growth for the company in the field of installation of deep steel segmental shafts.

NRW-NYFL Joint venture, Cape Lambert Port B project, Rio Tinto Iron Ore Projects and Development

In January this year, in collaboration with Sinclair Knight Merz (SKM) and the NRW-NYFL joint venture, Tunnel Boring Australia (TBA) completed the installation of two 116 metre, 2,250 millimetre diameter HOBAS GRP Jacking Pipe stormwater tunnels on the Rio Tinto Cape Lambert Port B project near Karratha in the Pilbara. Cape Lambert Port B is a new greenfield iron ore port facility located on the west side of the Cape Lambert site, alongside the existing Cape Lambert Port (Port A). The project is one of the largest resource projects ever undertaken in Australia, involving the development of a new iron ore port facility.

The stormwater pipe jacked tunnels were installed utilising open face jacking methodologies in the area of Sam's Creek, to mitigate flood risk to Rio Tinto's railway operations. The uninterrupted continued operation of the five railway lines under which the culverts were installed was crucial to all stakeholders. SKM, the engineering procurement and construction management contractor, was involved in finalising the design for the pipe jacking operation, from the launch pit works to the choice of the HOBAS Jacking Pipe, which was the pipe material best suited to the difficult ground conditions.

NRW, in a joint venture with the Ngarluma and Yindjibarndi Foundation Limited (NYFL), is the head earthworks contractor responsible for constructing the stockyard and car dumper bulk earthworks. In the Sam's Creek project, the NRW-NYFL JV's site management team was strongly focused on the safe and uninterrupted completion of the construction of the launch pit and pipe jacking operation.

The project was one of the most complex ever undertaken by TBA, however the completion was a success due to the continued support from all parties involved.

John Holland, Glenfield to Leppington to Railway project, NSW Government

In mid 2012, John Holland awarded TBA the contract to install a total of 720 metres of 406 millimetre MS casing, utilising laser guided and vacuum extraction microtunnelling as part of the Glenfield to Leppington Railway project in Sydney. The scope of work consisted of installing a canopy of nine separate bores, each 80 metre long, in Sydney's Hawkesbury sandstone. The canopy was part of the tunnel works under the Hume Highway and, due to the importance of this highway, very strict deviation tolerances were set by the Roads and Maritime Services NSW government authority. John Holland project manager for the works in question Steven Kotevich said that TBA was capable of fulfilling the conditions set by the project and that the already existing relationship between the two companies has been further strengthened.

Deep Steel Segmental Shafts

TBA first installed a 12 metre deep, 6 metre diameter steel segmental shaft as part of the Thiess John Holland Airport Link project in Brisbane in 2009. Since then, the methodology has continued to be implemented on several high profile projects such as the Queensland Urban Utilities (QUU) Woolloongabba Sewer Augmentation Project undertaken for BMD, the QUU Oxley Sewer Manholes Upgrade undertaken for Veolia Water Networks and the Queensland Gold Coast Light Railway Project undertaken for McConnell Dowell contractors. TBA uses the deep steel segmental shafts launch and retrieval pits on projects where the utilities are at depths that warrant the commercial advantage over traditional shoring methodologies, such as boxes or sheet piling. Steel segmental shaft shoring system is also very practical during the building of deep manholes. The methodology is fully certified in terms of structural engineering design.

Replacement of damaged steel corrugated culverts

TBA's partnership with the Queensland Department of Transport and Main Roads (DTMR) and its subcontractor arm Roadtek continues all over the state in the massive project of replacement of damaged steel corrugated under road stormwater culverts with reinforced concrete jacking pipe. In general, corrosion due to standing water causes loss of steel sections in the culvert walls and due to structural failure and danger of sudden collapse, the repair of the culvert is considered a very high priority.

The repair methodology by cutting the existing steel pipes and immediate replacement by reinforced concrete jacking pipes proposed by TBA was first accepted by the DTMR in 2007, when the replacement of a culvert consisting of three large-diameter pipes under the Gateway arterial in Brackenridge was completed. Since then, TBA has completed a large number of replacement projects under the Warrego and Bruce Highways.

TBA is one of the most experienced contractors in the Australian trenchless industry, with over 30 years of experience. The company mainly manufactures its own equipment and specialises in large-diameter pipe jacking, as well as in small-diameter laser guided microtunnelling, auger boring and the installation of deep steel segmental shaft shoring systems.

Clem7 tunnel traffic projections legal brawl

A legal brawl has broken out over who was responsible for the Clem7 Tunnel traffic projections. The cross claims against the National Institute of Economic and Industry Research have been lodged with the Federal Court of Australia, as part of AECOM's defence against a class action brought by 656 investors.

Law firm Maurice Blackburn will run the $150 million class action and special counsel Richard Ryan said they would endeavour to ensure the cross claims did not delay the case.

"It is alleged that the traffic forecasts in the product disclosure statement were misleading or deceptive and not based on reasonable grounds and this continues to be the basis of our class action," Mr Ryan said.

RiverCity Motorway went into receivership in February 2011 with debts of $1.3 billion after traffic using the Clem7 fell drastically short of forecasts. Rather than 90,000 vehicles using the $3 billion tunnel every day within a year of opening, fewer than 23,000 vehicles paid the toll. That figure has risen only slightly to about 27,000 vehicles a day since the opening of the connecting Brisbane Airport link just over a year ago.

In documents lodged with the Federal Court, AECOM's lawyers said investors should have known that the forecasts were "only AECOM Australia's best judgments, at the time of future tunnel traffic volumes. Traffic modelling and forecasting is not a precise science … and is subject to obvious risks, inherent risks and intrinsic uncertainties," the documents said. "AECOM Australia could not, and did not, guarantee that the estimates, assumptions and forecasts upon which the forecasts were based would, in fact, be correct or accurate."

The cross claims allege that AECOM relied upon NIEIR's forecasts in preparing its own projections. "If AECOM has any liability to any class member, then this is because the conduct of NIEIR in producing and distributing NIEIR's forecasts ... was misleading or deceptive ..." the document said.

NSW to chase Cross City Tunnel tax bill

The NSW government has confirmed it will appeal a Supreme Court ruling revoking a $60 million stamp duty bill for Sydney's Cross City Tunnel, making it more likely the tunnel will fall into receivership. Minister for Finance and Services Andrew Constance said the Chief Commissioner of State Revenue will appeal the court's decision, made in early August.

"The Chief Commissioner of State Revenue has a responsibility to administer taxation law in NSW and collect all tax considered to be payable," Mr Constance said. "The NSW government strongly believes that every business should pay its taxes." The Office of State Revenue has lodged an intention to appeal.

The tunnel's owners – Royal Bank of Scotland, Leighton Holdings and the UK's EISER Infrastructure Partners – were hit with the tax bill after acquiring the road out of receivership in 2007 for $695 million. The Commissioner of State Revenue charged the new owners stamp duty on the transaction. The tunnel's owners have been trying to refinance some $79 million in debt due at the end of the month. The refinancing efforts have been hampered by the stamp duty court case.

Now that the government has confirmed its appeal and prolonged the issue, it seems unlikely the Cross City Tunnel will be able to refinance its debt and as such was placed in voluntary administration on Friday 13 September.

The tunnel first fell into receivership in 2006 due to poor traffic flows. Although traffic has since improved, it does not generate enough income to pay the stamp duty bill as well as refinance the tunnel's debt. Bankers say the tunnel could avoid paying the stamp duty by going into receivership before the appeal takes place because senior creditors would rank above the tax claim. Cross City Tunnel said it remained in talks with banks with the aim of refinancing its debt by the end of the month.

Meanwhile Sydney's Cross City Tunnel is attracting only about half the number of cars its first owners said would travel through it eight years ago and weak traffic numbers mean the motorway continues to struggle financially, and is facing receivership for the second time since it opened in 2005. Lenders to the consortium that owns the motorway are understood to be considering putting the tunnel into receivership.

Patronage forecasts by the tunnel's first owners predicted 70,000 cars would be using the tunnel daily in 2005 and more than 90,000 a day by 2013. The tunnel opened in 2005 at a cost of $680 million and went into receivership in 2006. Annual reports issued by its current owners, who bought it out of receivership in 2007, show toll revenue growth has increased only at the rate of inflation since 2009.

HOBAS – A solution for any project

HOBAS is a leading supplier of high performance GRP pipe systems for applications such as potable water, wastewater, hydropower penstocks, cooling water lines, irrigation and drainage.

HOBAS jacking pipe systems are unique and have a variety of installation benefits that give them advantages over other jacking pipe materials. Smaller outside diameters mean that major savings can be realised from reduced tunnel and bore sizes from the corresponding reduction in excavation for the same nominal bore. The light weight of HOBAS pipe translates into longer drives for auger style installations and a smaller project footprint in general.

Although HOBAS has been used by water authorities throughout Australia for decades, in recent years it has really established itself as a market leader in jacking pipe.

"It's easy to understand why it is a favourite jacking pipe for contractors," says Rob Carr Construction Manager Brett Everard. "With their high factors of safety and tight tolerances, a contractor can be less concerned about the risk of cracking or breaking. HOBAS jacking pipe has always performed exactly as we expected and has never been the cause of costly delays."

Installation under new precincts

In 2012, the creation of a new, more advanced and higher capacity sewer main to support the growing needs of Melbourne's Docklands required the use of technologically advanced products that would stand the test of time.

The tricky ground conditions due to the presence of Melbourne's infamous Coode Island Silt required a specialised team in order to complete the project, with HOBAS and Thiess at the helm.

Thiess Services Project Manager Dean Larrassey said he had worked with HOBAS pipe numerous times overseas so knew the product could stand up to the challenges of the project.

"I had worked on various projects in Europe where HOBAS was very widely known, and HOBAS regularly exceeded the project requirements."

"Because of the high volume of traffic experienced along Lorimer Street, we knew jacking was the way to go, so we used a micro-boring machine to jack approximately 500 metres of HOBAS pipe through the notoriously difficult Coode Island Silt.

"The HOBAS pipe was easy to install in that it performed exceptionally well in the less than favourable ground conditions and we were able to complete the project right on schedule."

Installation under railways

A ground breaking project for HOBAS pipe in Western Australia's Pilbara was completed at the end of 2012.

The Pilbara Region is located in the North Western corner of Australia in what is known as one of the hottest and at times wettest parts of the world.

Today, the Pilbara region is home to the rail and port infrastructure needed to transport ore from this remote region. With most of the ore being exported, large ports have been built to accommodate the ore transport; one of the largest of these ports is Rio Tinto's Cape Lambert. Trains travel in from Rio Tinto mines throughout the region, carrying around 80 million tonnes of iron ore per year into Cape Lambert for processing and ship loading.

At present, the port is undergoing an infrastructure upgrade that will see the transportation capacity of Cape Lambert port more than double by mid-2015.

An integral part of the of the overall upgrade is the "Sam's Creek" stormwater drainage lines, which run under the existing rail lines and allow the release of stormwater during the wet season. Any upgrades to these drainage lines needs to allow the existing rail lines above to stay in constant operation to maintain continual loading of ships.

The design of the new drainage culvert specified two rows of 2,100 mm internal diameter pipes at approximately 100 m long, each with an additional row of 2,100 mm internal diameter pipe for services.

Both the client and contractor were surprised to learn that the lead-time for HOBAS was substantially shorter than that of locally supplied concrete pipe. Given the tight timeframe for the project, the decision to use HOBAS was easy.

Tackling challenging projects

Executive Director Andy Holman of Global Pipe, Australia's distributor of HOBAS pipe, said HOBAS CC-GRP jacking pipe is regularly selected to complete notoriously difficult projects due to its well established behaviour in pipe jacking and its very long asset life.

"HOBAS has been used internationally for over 30 years and is now the product of choice among the largest engineering companies in Europe and North America.

"The HOBAS centrifugal cast pipe uses patented technology to provide the most efficient, long-lasting and highest quality CC-GRP pipe currently in the world.

"The design has a 100+ year life span which means it can typically outperform old-world products such as concrete or steel in corrosive environments such as sewer systems," Mr Holman said.

Auckland tunnel to 'future proof' NZ

A $4.6 billion six-lane road tunnel, with capacity for a future rail link, has been announced as a new harbour crossing for Auckland by the Government in June 2013. Prime Minister John Key announced the underwater tunnel as part of a $10 billion infrastructure package to improve transport links in and around the country's largest city.

Crucial details – including what route the tunnel will take, how it will be paid for, and whether it will be tolled – have yet to be finalised, but both Key and Auckland mayor Len Brown said the announcement was a "strong commitment" to the future of the city and a happy day for it residents. "This is all about future-proofing both Auckland and New Zealand as best we can," Mr Key said. "The reality is we've got some big infrastructure that just needs to be built, if we don't build it we'll be behind the curve, and long term, we'll actually pay for that with lower levels of productivity, lower levels of growth and high levels of inflation."

Three major transport projects make up the "ambitious" infrastructure programme – a Waitemata Harbour tunnel crossing; a combined Auckland Manukau Eastern Transport Initiative (AMETI) and the East-West Link; and the City Rail Link.

The Waitemata tunnel project is essential to the future growth of Auckland and New Zealand, the Prime Minister said, with the current Harbour Bridge already nearing capacity. "The Auckland Harbour Bridge is one of the most critical transport links in the country. But forecasts indicate it won't be long before demand exceeds the bridge's capacity," Mr Key said. Congestion on the bridge is already a problem during peak periods. Traffic forecasts indicate that, as the Auckland economy grows, this will increasingly spread throughout the working day, he said. The estimated price tag of the tunnel is $4.6 billion, around $800 million more than building a new bridge, Mr Key said.

"Our view is that it would be very difficult to consent a bridge as opposed to a tunnel," he added. "We will also try to future-proof that so that it's ready for anything else that might occur. "I don't anticipate that we will be putting rail onto the North Shore anytime soon, it's a very expensive process, but it would be foolish of us to build a tunnel at the better part of $5 billion and not leave that option there for future Government's to consider."

Mayor Brown said the new harbour crossing will take the form of two 15 metre in diameter tunnels, each with three road lanes. Underneath this will be additional space to add a rail network in the future if needed. It is hoped the tunnel will be completed by 2025 to 2030.

The New Zealand Transport Agency is set to confirm the preferred alignment and protect the anticipated route by December this year.

Waterview Connection

McConnell Dowell, in partnership with Fletcher Construction, was awarded the Waterview Connection project by the NZTA on 19 August 2011 as part of the Well Connected Alliance. The Waterview Connection is a Road of National Significant (RoNS) project that provides the 'missing link' between SH20 and SH16. Once completed, it will provide a 48 kilometre motorway route that links Manukau, Auckland, Waitakere, and North Shore and provides an alternative state highway route through the Auckland Region. The project includes construction of 4.5 kilometres of new motorway, 2.5 kilometres of which will be built as two 3-lane tunnels – a first for New Zealand.

The Challenge

The construction of a major infrastructure project in an urbanised area is a challenging task which will result in some impacts on the surrounding environment. The Alliance is committed to mitigating the effects of motorway construction and facilitating improvements to the surrounding environment by:

- Constructing 2.5 kilometres of motorway underground (more than half of the new section of motorway);
- Minimising the number of properties affected through the project design process;
- Replacement of public open space impacted by the project along with amenity improvements, including planting and landscaping and restoration and rehabilitation work; and
- Implementing stringent construction management practices to minimise effects on the local environment, traffic network and communities

The Solution

A 3,600 tonne, 14.5 metre diameter Herrenknecht EPB TBM will bore twin tunnels at depths of between 10 metres and 45 metres – the largest diameter tunnel to be built in Australasia and 11th largest TBM constructed to date worldwide. The TBM will arrive in segments and be assembled in the southern approach, 30 metres below the surrounding ground. Boring will commence from the southern portal in the southbound tunnel and drive northbound for 2.4 kilometres. When the TBM reaches the northern portal it will be turned around on a turntable platform, moved across to the north bound alignment and relaunched to complete the drive back to the southern portal. Tunnel spoil will be transported by conveyor back down the south bound tunnel to a loading facility at the southern portal. This will involve a 180 degree u-turn of the conveyor at the northern portal.

Largest ever TBM to be used in the southern hemisphere

In a city obsessed by its groaning transport infrastructure, Alice, the giant TBM custom-built by Herrenknecht for the Waterview Connection motorway project, arrived in late July to the sort of welcome generally reserved for visiting dignitaries and One Direction. The project will complete Auckland's long-awaited Western Ring Route, providing a motorway alternative to State Highway 1 which runs, or more often crawls, through the city and across the Harbour Bridge.

At just over 14 metres in diameter, the TBM will be the largest ever to be used in the southern hemisphere, and of a size almost unimaginable to most New Zealanders. To help provide a sense of scale, the NZ Transport Agency installed a specially-commissioned, 14 metre piece of traditional Maori art at the Port ahead of its arrival. Titled Te Haerenga Hou ("A New Journey"), the artwork depicts the journey from the Manukau Harbour along the volcanic landscape route of what is now State Highway 20, to the feet of Owairaka (Mt Albert). This is where the new tunnels will be bored to take travellers a further 2.5 kilometers out toward the Waitemata Harbour, where it will connect to State Highway 16 and thereby complete the motorway ring route.

Having arrived in pieces, Alice, named after the Lewis Carroll character through a competition for Auckland primary school children, was transported to the construction site through a series of carefully-planned manoeuvres – many of which were carried out in the dark. The largest and heaviest loads, including the 260-tonne main drive, had to be moved overnight and

required the temporary removal of various bits of street furniture to get through. TBM assembly began at the beginning of August, with the project team targeting a ready-to-bore date of the end of October.

Tunnelling of the twin tunnels is expected to take two years, including the turn around after the first drive, with project completion targeted for early 2017. Not only will the completed ring route ease reliance on the existing infrastructure, it will provide for the first time a direct motorway link between the CBD and International Airport, saving time and creating a more compelling first impression for visitors to a city aspiring to be known as world-class.

The $1.4 billion Waterview Connection project is being delivered for and alongside the NZ Transport Agency (NZTA) by the Well-Connected Alliance. Comprising NZTA, Fletcher Construction, McConnell Dowell Constructors, Parsons Brinckerhoff, Beca Infrastructure, Tonkin and Taylor, and Japanese construction company Obayashi Corporation – the Well-Connected Alliance brings together the knowledge and strong, home-grown reputation of leading New Zealand engineering companies with the world-class tunnelling expertise of its international partners. The Well-Connected Alliance has formed further partnerships with Wilson Tunnelling (NZ) and SICE (Spain) to manage the construction of the tunnel segments and long term maintenance and operation.

You can follow the adventures of Alice the TBM at www.facebook.com/aliceTBM

Tunnel segment factory

The factory that will produce more than 24,000 concrete segments to line the motorway tunnels for the NZ Transport Agency's Waterview Connection project has been officially opened by Auckland's mayor, Len Brown. The 6000 square metre factory in East Tamaki has created 70 new jobs, and it is the most modern pre-cast concrete manufacturing facility in Australasia.

The Transport Agency's Highway Manager, Tommy Parker, says that during the next two years, the factory will manufacture the linings for Waterview's twin 2.4 kilometres long twin tunnels with to-the-millimetre precision, and the strength and durability to withstand 100 years of demanding use. "It is an entirely new facility, built by a partnership between the tunnel project's Well-Connected Alliance and Auckland company Wilson Tunnelling and equipped with some of the most up to date concrete batching and moulding equipment in the world. Next to the tunnels themselves, the pre-cast factory is probably the Waterview Connection project's most exciting story," Mr Parker says.

The lining for the Waterview tunnels will comprise 2,414, 14 metre diameter rings of concrete, each two metres wide and each comprising 10 segments. Nine of the segments will weigh 10.5 tonnes while the tenth "key" segment will be a smaller. Mr Parker says production of the individual segments for each ring began in August. It is planned to have 180 rings completed by the time "Alice" – the project's tunnel boring machine – is launched later this year.

Mr Parker says the tunnel boring machine will install six lining rings every 24-hours "Alice" is working (a total lining of 12 metres). The pre-cast factory will manufacture 40 rings (400 segments) per week using four sets of moulds specially designed and fabricated in France for the Waterview tunnels. In addition to tunnel lining segments, the pre-cast factory will produce 2,400 culvert units to go beneath the motorway through the tunnels and 279 1500 millimetre deep bridge beams for new ramps at the Great North Road motorway interchange on State Highway 16.

KEY FACTS ABOUT THE EAST TAMAKI PRE-CAST FACTORY
On order: 24,040 tunnel lining segments
2,406 culvert units
279 bridge beams
Equipment: Concrete batch plant imported from the USA
Four sets of specially designed steel moulds for tunnel lining segments, imported from Europe
Segment Carousel for automated production.
Employment: 85 people employed by the pre-cast factory, including 70 new jobs
Materials required: 95,000 cubic metres of concrete
3,500 tonnes of conventional reinforcing
4,500 tonnes of steel fibre reinforcing

Auckland Central Interceptor wastewater tunnel

Watercare is proposing to construct a new 13 kilometre long wastewater tunnel to collect and carry wastewater from Western Springs through to the Mangere Wastewater Treatment Plant.

Along the proposed route it will connect to the existing trunk sewer network to divert flows and overflows into the tunnel. If approved, this new wastewater tunnel will be called the Central Interceptor.

The concept design of the Central Interceptor was completed at the end of 2011. Watercare is applying to the Auckland Council for consent and the regulatory approval process includes public consultation.

The 13 kilometer tunnel will store polluted storm water and sewage from as far afield as Western Springs to reduce overflows into the Waitemata Harbour nearly every time it rains.

The tunnel will leave the isthmus to go 40 metre under the Manukau Harbour to the shore at Mangere where a new pump station will lift the contents out of the main tunnel and send them to the nearby Mangere Treatment Plant.

Watercare Services proposes that the pump station have an emergency pressure relief structure which can be activated to stop a full tunnel overflowing at other shafts on the route.

Mount Victoria quake work completed

NZ Transport Agency has completed putting in new rock anchors at each entrance of the Mt Victoria Tunnel, and installing beams to further strengthen them.

Rod James, from NZTA, said the tunnel was a vital part of the region's transport network. "Last year, we completed the removal of old ceiling panels, installed new monitoring cameras and new fire safety equipment, including a high capacity water deluge system and heat detection system. Strengthening the portals was the next step, and we're pleased with the results."

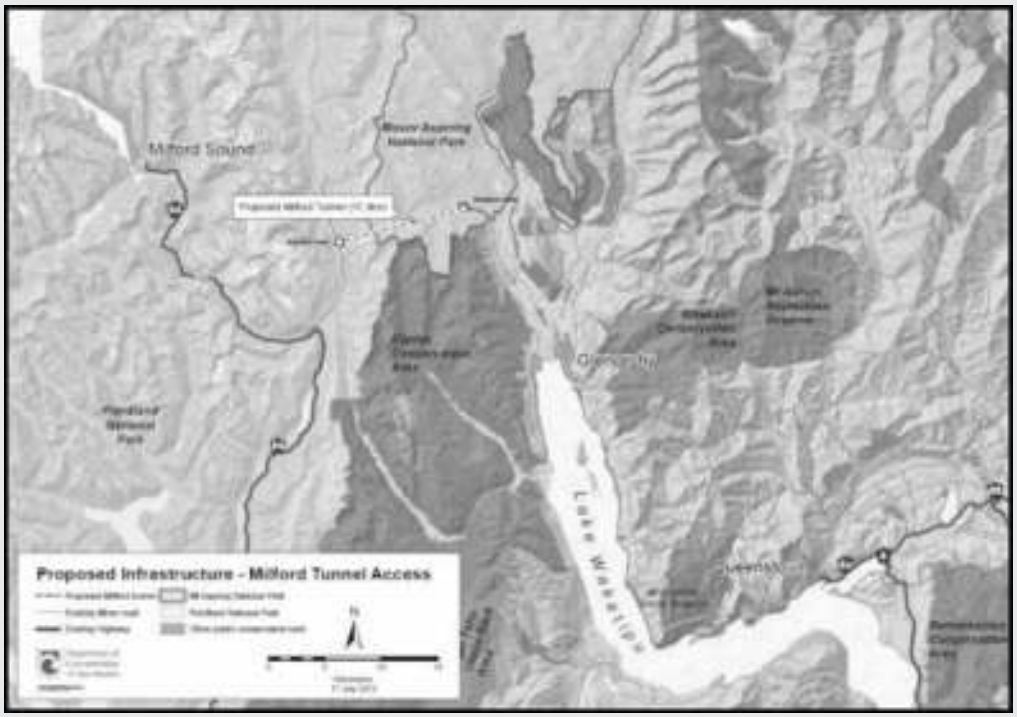
Final works included cosmetic upgrades such as painting and planting. "The Mount Victoria Tunnel is a busy route, and we have done our best to do this work with as little disruption as possible," Mr James said.

Homer tunnel reopens fulltime

The Milford road from the Homer Tunnel to Milford Sound is officially open 24/7 again after being closed at night for several months because of rock fall risk at the western entrance of the tunnel.

NZ Transport Agency Southland area manager Peter Robinson said snow and ice had "locked up" the faces of the rock and debris field above the western entrance to the tunnel. This including the site where a 2000-tonne section of unstable rock was removed in June. High-magnitude blasts, like the one used in June, usually caused rock behind the blast zone to "relax" and was likely to create some more loose debris over time, he said. That debris was expected to be removed over the spring and summer, once the weather improves.

Until that work is done, the temporary portal extension at the tunnel will remain. The work would be done in a way that minimised disruption, Robinson said. The agency would speak with Milford Sound business operators to discuss timing.



Minister declines Milford Dart Tunnel proposal

The tunnel project proposed by Milford Dart Limited, through the Fiordland and Mt Aspiring National Parks, has been declined,.

"I am declining this tunnel proposal because the environmental impacts are significant and beyond what is appropriate in two of New Zealand's most spectacular National Parks and a World Heritage Area," Conservation Minister Dr Nick Smith announced on 17 July.

The five-metre diameter, 11.3 kilometre long, one lane bus tunnel was proposed between the Dart Valley, adjacent to the Routeburn Track, through to Hollyford Valley. The $180 million project would have halved the travel time for the 420,000 visitors per year who visit Milford Sound.

"This is a significant decision and I have given it a great deal of thought and consideration. I have met the applicants, studied the major reports, sought thorough advice, visited the site, and weighed up strong views of both the supporters and opponents," he says.

"There are three major reasons for declining this tunnel application. The first is that depositing half a million tonnes of tunnel spoil would permanently damage the natural and landscape values in Hollyford Valley. The second is the impact of the new roads and portals at each end, and particularly the impacts on visitors at the entrance to the Routeburn track. My third concern is that the engineering works and tunnel are inconsistent with the Fiordland and Mt Aspiring National Park Management Plans.

"I also have concerns about the economic viability and safety of this tunnel proposal. These issues are interrelated in that making a long narrow tunnel safe requires huge investment in ventilation and emergency systems. I am not satisfied that the tunnel can be safely built for a price that makes it economically viable. The risk for the Government under these circumstances is that corners are cut or the project is left half-completed with a clean-up liability for the public.

"Milford Dart Ltd late last week outlined an alternative tunnel that would be approximately two kilometres longer and which would relocate the eastern portal about three kilometres south east. This is a significantly different proposal on which I have not received any technical advice, and of which neither the public nor the hearing commissioner has had the opportunity to consider. I have determined that I have insufficient information to make a decision on this alternative.

"I appreciate my decision will be a disappointment to the applicants and their supporters. I do not in any way criticise them for their entrepreneurial spirit or ambition to ease access for the hundreds of thousands of people who visit Milford Sound. This is a conservative decision in which I have decided that nature deserves the benefit of any doubt."

Plan to re-enter Pike River tunnel

Mining officials are considering a plan to re-enter Pike River coalmine. The plan would see Mines Rescue Trust workers enter the 2.3 kilometre tunnel as far as a rockfall which occurred during the November 2010 disaster which left 29 miners dead. If successful, this could lead to a further plan to re-enter the main workings of the mine beyond that. Most, if not all, of the men's bodies were believed to be entombed in that area.

Earlier reports that the plan was for a body recovery were incorrect – state coalminer Solid Energy's drift re-entry project manager, Mark Pizey, had stressed the plan was only to re-enter the 2.3 kilometre tunnel earlier this month. However, Pike families had long clung to hopes that some of their men's bodies might be retrieved from the unexplored 700 metre section of the tunnel, dying while trying to flee the blast.

Minister for Labour Simon Bridges confirmed he was seeking advice from the High Hazards Unit before taking the proposal to Cabinet. "I have received correspondence from [Solid Energy] and I'm in the process of getting advice and working through the issues, and that's we're at right now. I've always said – and is still the case – I don't want to muck around on this. I think it's important for the victims and their families that we move as expeditiously as we can, but unfortunately it's part of the facts of life that we have to do this right."

The first stage was to get to the point of collapse in the mine. From there, getting past the rockfall was still being discussed.

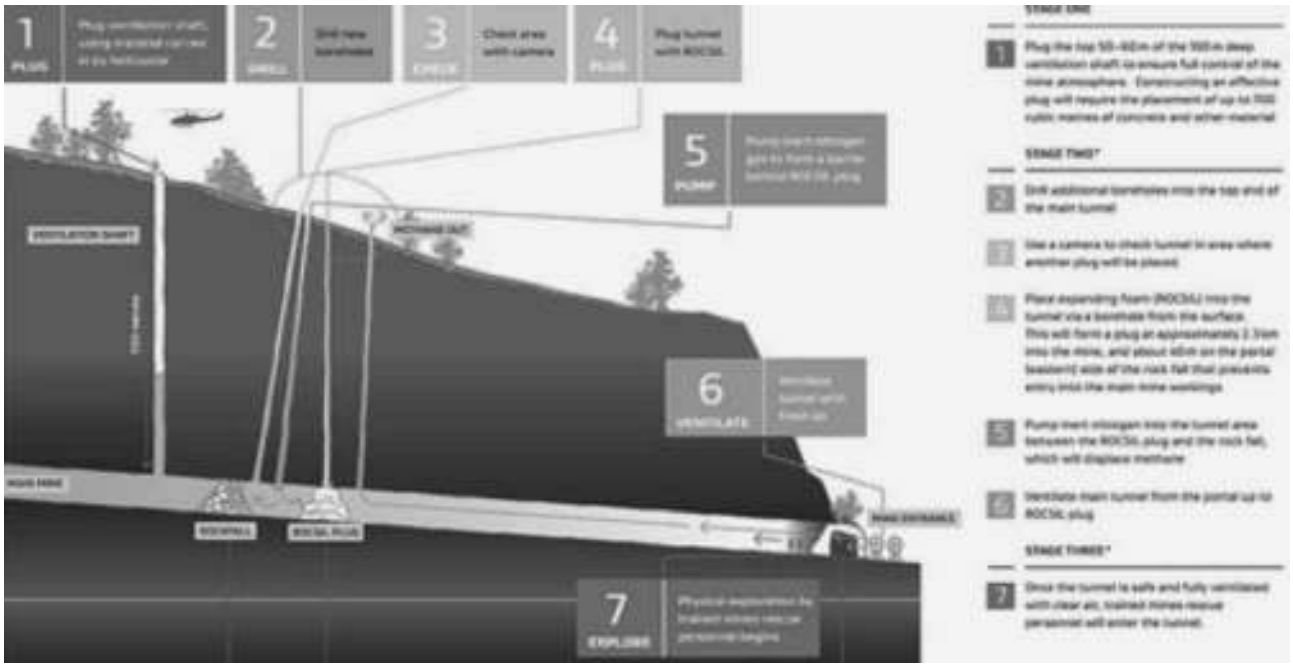
Representative of the victims' families Bernie Monk said he was hopeful the bodies would be out by Christmas – but he admitted it could take longer. "It's something everyone's worked extremely hard on for the past four or five months and I can only thank the Government on all that they've done and also Solid Energy... "

"We haven't been finalised yet, nothing's been said to us personally and we've been down this track before so I'm just waiting really. It's something that... we've always said this can be done, and it's something we've fought for. It looks like it might be coming to fruition.

Monk said it should not have taken this long to get to this point. "Our experts said with tears in their eyes, 'Bernie this should have been done 18 months ago. The Government has always said 'bring us a plan', and I think we had the right experts in the right places, and as soon as the Government came on board and started to help us with this, things started to happen."

He said he thought the damage wouldn't be as bad as everyone had made it out to be. If teams could get beyond the mine drift, and pump nitrogen in, Monk was hopeful it could be made safe enough to retrieve their family members' bodies. Monk said there was a lot of work that needed to be done before re-entry was possible. Christmas was a hopeful target, but probably not possible.

Grey District Mayor Tony Kokshoorn said it had been a long time coming. "It's been three years now, so we've been waiting patiently for a re-entry into the mine – something we always hoped was going to happen within



the first few days. We're excited by it and at least it will eliminate one way or another whether there's bodies down beyond where the robot finally got to."

He said the plan was to seal the ventilation shaft first. "There's also another porthole there which they used to take methane samples – they are going to put grout down through that, into the drift which would expand when setting and seal the entire mine, and allow them to force nitrogen or oxygen down it."

It was hoped that would make the mine safe enough for a Search and Rescue team to explore where the men's bodies might be.

Kokshoorn said at a meeting with Prime Minister John Key and receivers in February last year, the government committed $10 million to the recovery mission, and the receivers $5 million. "John Key's money is on the table, but the receivers, I wonder if they actually stuck it in the bank account for a rainy day – that's just arriving."

He said this point should have been reached earlier. "I don't know why it didn't happen earlier, and I think the

reason, if you're looking for one, is probably in the fact that Pike went into receivership and Solid Energy basically went the same way. I think that probably slowed everything down." He also said that while Pike River legislation had made health and safety regulations "that much more stringent", it hasn't helped their cause in getting the men returned to their families.

New Lyttelton Tunnel Control Building

Work is underway building the new Lyttelton Tunnel Control Building. Christchurch-based Higgs Construction has been awarded the $1.5 million contract to construct the 310 square metre building, a purpose-built facility to manage the operation and maintenance of the Lyttelton Tunnel.

The NZ Transport Agency Highway Manager Christchurch Colin Knaggs says as it's almost two and a half years since the original Peter Beaven-designed building was badly damaged by the Canterbury earthquakes, it is good to at last see work getting underway on the site.

"Considerable time was spent investigating options to repair and retain the original building but the cost could not be justified. It was demolished earlier this year under the Canterbury Earthquake Recovery Act 2011."

He says the new building will be built closer to the tunnel, in an area at less risk from rockfall and to 180 per cent of the Building Code to ensure it can continue to operate in the aftermath of any future earthquake.

The new Lyttelton Tunnel Control Building is expected to take six months to complete and is scheduled to be officially opened during the Lyttelton Tunnel's 50th anniversary celebrations in February next year.

Terratec Unveils Third TBM for Delhi Metro Phase III

After a successful performance of the workshop testing, Terratec delivered the third of six (6) TBMs for Delhi Metro Phase III on Thursday, 31 January 2013. The TBM was officially unveiled at a ceremony that included representatives from the client – a joint venture between J.Kumar Infraprojects Ltd. of India and China Railway Third Group (CRTG) of China.

The TBM will be utilised in the execution of the tunnelling works between Lajpat Nagar and Hazrat Nizamuddin Stations – all part of Delhi Metro Contract CC-24. Both stations are part of the underground works for Mukundpur – Yamuna Vihar corridor – Phase III of the Delhi MRTS project. The JV intends to use a total of 2 TBMs for the project, which is expected to be completed by 2016. Terratec will deliver the second TBM for this project six weeks later.

The customised Tunnel Boring Machine is a Ø6.61m EPB Shield. The TBM is comprised of state-of-the-art features such as the VFD electric driven CutterHead, a versatile design of the cutting tools that are interchangeable with 17'' roller disc cutters, the active type articulation for the shield, and the tail's built-in 2-Liquid backfilling system.

For the first time in Delhi Metro history, the tunnels will pass below existing underground Metro tunnels. The segment lining will be made of universal type RC segments with an outer diameter of 6,350 millimetres, inner diameter of 5,800 millimetres and width of 1,400 millimetres. The total combined distance that each TBM will bore to is approximately 3,400 metres.

Delhi is India's fastest growing city and as such, there is a growing demand for additional transportation as the population grows and expands outward. Phase III focuses on more of the outer lying areas of New Delhi and will have a total of 28 underground stations. Once Phase III is completed, the Metro will cover 70 per cent of Delhi.

India's biggest rail tunnel opened in Kashmir

Indian Prime Minister Manmohan Singh opened the country's longest railway tunnel during a rare visit to troubled Indian Kashmir in June, which has been marred by one of the deadliest militant attacks on soldiers in years.

Singh inaugurated a stretch of line that runs through the 6.8 mile (11 kilometre) long tunnel, part of an ambitious multiyear railway project in the region, as he wrapped up his first visit to the region in three years. "It took 7 years to complete," Singh said of this section of the project, during a speech in the town of Banihal, some 70 miles from the main city of Sriningar.

The tunnel and railway stretch have been added to a train line running through the valley, part of a 20-billion-rupee project that will eventually link Kashmir to the rest of India's vast railway network. Sections of the track have been drilled through the Himalayan mountains, and Singh said it was a "national dream" to link Kashmir with the network by 2018.

Hydro power development in the Himalayas

Of many hydropower projects underway in India, those awarded most recently include the Tapovan-Vishnugad plant in the Chamoli district of Uttaranchal state in the southern Himalayas.

Excavation of the 11.3 kilometre long x 5.4 metre diameter drill+blast headrace tunnel is awarded to the Alpine Meyreder/ Hindustan Construction Company (HCC) Joint Venture for a contract value of EUR 79 million. The run-of-the-river project, fed by a barrage on the Dhauliganga tributary of the Alaknanda River, also includes an underground powerhouse, to accommodate four 130 megawatt Francis turbines, two pressure shafts, four penstocks and a short tailrace tunnel.

HCC is also awarded Lot – IV of the Teesta Hydro Electro Power Project Stage – VI by M/s Lanco Infra Tech Ltd. The contract includes construction of an underground powerhouse cavern for four 130 megawatt Francis turbines, an underground transformer cavern, two 16 metre diameter x 60 metre high surge shafts, four 5.4 metre diameter pressure shaft, two 570 metre long tailrace tunnels and two 6.5 kilometre long headrace tunnels. The project, for the National Hydroelectric Power Corporation of the Indian Government, is located at Tarkhola near Rangpo in district South Sikkim. It is to be completed in 44 months.

Other hydropower projects with World Bank financial support in India include the 412 megawatt Rampur project downstream from the Nathpa Jhakri installation on the River Satluj in Himachal Pradesh, and the 444 megawatt run-of-river Vishnugad Pipalkoti scheme on the River Alaknanda in Uttarakhand. The Rampur Project is in the project appraisal stage and the Vishnugad-Pipalkoti project, in the same watershed as the Tapovan-Vishnugad project on which Alpine Meyreder/HCC are working, is in the early stages of preparation.

Chenani-Nashri tunnel project

Leighton has been awarded a contract to construct a major road tunnel project in Northern India. The tunnel is a key component of a fundamental road improvement scheme to an arterial route, NH1A, which links the northern state to the rest of India.

The project involves construction of approximately 9 kilometres of 2 lane (13.3 metre diameter) main tunnel along with parallel escape tunnel (5 metre diameter) in the lower Himalayan mountain range. The tunnel is located at an elevation of 1200 metres with an overburden of up to 1 kilometre and will be constructed using the NATM technique of sequential excavation and support.

The tunnel and approach roads provide a 10 kilometre alternative route for 41 kilometres of the existing NH1A which passes through steep mountainous terrain and has significant geometrical, weather and safety issues. The tunnel route therefore provides an all weather route that will provide a significant time savings to motorists. On completion this will be the longest road tunnel in India.

Leighton's scope of work includes total responsibility for design and construction of the tunnel and its associated approaches. This includes all civil, structural, architectural, mechanical, electrical works, power distribution, ventilation, lighting, SCADA, fire control system, video surveillance, traffic control, emergency call and communications works.

Kathmandu-Hetauda Tunnel Highway

Nepal Purwadhar Bikas Company (NPBC) has said that it will start the civil work of the Kathmandu-Hetauda Tunnel Highway immediately after the rainy season. The company which was set up to build the much talked about tunnel highway is currently busy putting together the necessary equipment and other resources.

NPBC received the government's go ahead in May 2013, however, it is yet to begin work on the tunnel project. "We are preparing to start construction as soon as the weather turns favourable," said Kush Kumar Joshi, president of NPBC.

Joshi added that they were busy carrying out campaigns to attract investment in the project and buying equipment required for the construction . The 58 kilometre highway project, estimated to cost around Rs 35 billion, will link the capital with the southern industrial city of Hetauda. The expressway will cut travel time to one hour. It is the biggest road project that the private sector is developing under the build-operate-own-transfer (BOOT) modality.

Minister for Physical Infrastructure and Transport Chhabiraj Pant has asked NPBC to complete the project within the target period of four years and win trust for conducting such other projects in the future. "It could be a pilot project for developing projects utilising local resources," he added.

The tunnel highway project is being executed under the private, public and people's partnership (4Ps) model based on the Private Financing in Build and Operation of Infrastructure Act 2006 (BOOT Act). As per the agreement reached with the government, NPBC will have to present the financial closure within a year to assure the government that it has the resources required to construct the highway.

NPBC has received investment commitments from commercial banks, non-resident Nepalis and the Prabhu Group. The company plans to sign an agreement with IME Nepal to invest remittances in the project. Around 200,000 members of the general public and a number of institutions including the Federation of Nepalese Chambers of Commerce and Industry, Federation of Contractors Associations of Nepal, banks and financial institutions, Nepal Association of Foreign Employment Agencies and local government bodies of Kathmandu, Lalitpur and Makwanpur will invest in the highway, according to NPBC.

Beauty World project Singapore

Almost a year after the Tunnel Boring Machines (TBMs) were installed, the twin Metro tunnels on the Beauty World Project have now been completed. As the final pieces of the 1000 tonne boring machines are being dismantled and demobilised from site, it is a good time to reflect on our achievements.

The range of geological conditions that these 6640 millimetre diameter 'monsters' bored through was as impressive as it was challenging. The geology ranged from unweathered 200 megapascals granites to completely disintegrated soils, including the hardest soil conditions of them all, 'Mixed Face'. This involved boring through hardrock and clay at the same time. The tunnelling teams and crews performed admirably in the trying conditions with almost all interventions (for TBM maintenance) performed under compressed air entry.

Despite these challenges, the advance rates for the TBMs were impressive, particularly in the later stages of operations. Importantly, the McConnell Dowell team at Beauty World is the first contractor on the DTL2 scheme to complete their tunnelling operations. We have completed all our tunnelling operations on program and Lost Time Injury Free.

We are now moving ahead with the technically challenging Cross Passages that link the twin tunnels, and completing the remainder of the underground Beauty World Station beneath the live traffic of Bukit Timah Road.

Penang-Butterworth tunnel project

The Malaysian authorities have awarded the contract to build the huge Penang-Butterworth tunnel project. The new link will cost in the region of US$1.92 billion to construct and the work includes building three bypass connections as well as the undersea tunnel.

The project will be handled by a consortium, Zenith BUCG while Astral Supreme Construction is assisting with the feasibility study for the work. The Penang-Butterworth sea tunnel will be 6.5 kilometres long. The project also includes a 4.2 kilometre link from Gurney Drive to Lebuhraya Tun Dr Lim Chong Eu and a 4.6 kilometre road connecting Lebuhraya Tun Dr Lim Chong Eu to Bandar Baru Air Itam.

THOMSON LINE

The Thomson Line (TSL) is a 30 kilometre underground train line in Singapore that is expected to be fully completed in 2021. The sixth MRT line will have 22 stations and 6 interchange stations which will link to the East-West Line, North-South Line, North-East Line, Circle Line and the future Downtown Line.

Construction and tunnelling contracts worth a combined $706 million have been awarded. The Land Transport Authority (LTA) has announced that Samsung C&T will construct the line's new Caldecott station and associated tunnels ($285 million), while Shanghai Tunnel Engineering Co will carry out tunnelling works between Woodlands Station and Woodlands South Station.

Caldecott station is one of 6 new interchange stations that will serve the new underground North-South Line. Caldecott station, which will connect to the existing Circle Line, is due to open in 2020, during the second phase of the 30 kilometre line's construction.

Shanghai Tunnel Engineering Co will construct twin-bored tunnels totalling 7 kilometres between Woodlands Station and Woodlands South Station, as well as between Woodlands station and the Mandai depot ($421 million).

Both Shanghai Tunnel Engineering Co and Samsung C&T are already involved in several mass transit projects in Singapore, including the Downtown Line, Marina Coastal Expressway and Tuas West Extension.

The Land Transport Authority (LTA) awarded the contract for the construction of Woodlands South Station to Woh Hup. Woh Hup was previously involved in several Circle Line projects, including the construction of Dhoby Ghaut, Bras Basah, Holland Village and Buona Vista stations.

An artist's impression of the Woodlands South Station entrance

The 22 station Thomson Line, stretching from Woodlands to Marina Bay, is scheduled to be completed in phases, beginning with 3 stations in 2019, followed by the second phase of 6 stations in 2020, and the last 13 stations in 2021.

Caldecott station, which will connect to the existing Circle Line, is due to open in 2020, during the second phase of the 30 kilometre line's construction.

Terratec Delivers New Microtunnelling System in Thailand

On Thursday 4 July 2013, TERRATEC successfully completed the Factory Acceptance Tests of a new DN1500 Microtunnelling System. The ceremony was held in TERRATEC new facilities in Thailand, in the presence of the representatives from the Buyer, Nawarat Patanakarn PCL. The new microtunnelling system built by Terratec is specifically designed for drainage projects in Bangkok.

The MTBM is a Pipe Jacking System designed to handle standard Concrete Pipes of I.D. 1500 millimetres, O.D. 1800 millimetres and 2500 millimetres in length to be used by the Contractor in different drainage projects of Bangkok Metropolitan Administration (BMA). The system is designed to excavate tunnel drives up to 350 metres in length with the assistance of one or two Intermediate Jacking Stations. TERRATEC scope of supply from include the Shield, the Main Jacking Station, Intermediate Jacking Stations, the Slurry Transport System, a digital Guidance System and a Control Room on the surface with the Operation Panel and Power Pack.

The system was designed by TERRATEC on its Engineering Centre in Hobart, Australia, and the production and assembly was done in TERRATEC's new plant in Thailand, with key components coming mainly from Australia and Japan. In the last two years, the Company has sold 14 microtunelling systems with diameters ranging from 300 millimetres to 1800 millimetres in the South East Asia Region, and the reason why the TERRATEC's management decided to set-up the production and maintenance centre of its Microtunnelling Division in Thailand.

TERRATEC is well known in the industry as Tunnel Boring Machines and Raise Boring Machines designer and manufacturer and with the current orders for Pipe Jacking Systems, the Company completes its range of tunnelling machinery and expects to become a lead supplier also in the small diameter tunnelling market.

China plans world's longest sea tunnel

China will invest 260 billion yuan, or about $42 billion, to revive a long-stalled plan to build the world's longest undersea tunnel across the Bohai Strait linking the country's eastern and north-eastern regions. The 123 kilometre tunnel will run from the port city of Dalian in north-eastern Liaoning province to Yantai city in eastern Shandong, the China Economic Net website says. The report does not say when the project will be completed.

China announced plans in 1994 to build the tunnel, at a cost of $10 billion, and set to be completed before 2010. But more than 20 years on, the project remains stuck in the planning stage, the website said, without elaborating. At the time, State media said the tunnel would shorten the travelling distance between the two regions by nearly 1000 kilometres.

The costs could be recouped in 12 years, said Wang Mengshu, a member of the Chinese Academy of Engineering, who estimated annual revenues from the tunnel at around 20 billion yuan, the website said. "Freight is very profitable," Wang said.

The report comes nearly a month after Nicaraguan lawmakers gave a Chinese company a 50-year concession to design, build and manage a shipping channel across the Central American nation that would compete with the Panama Canal.

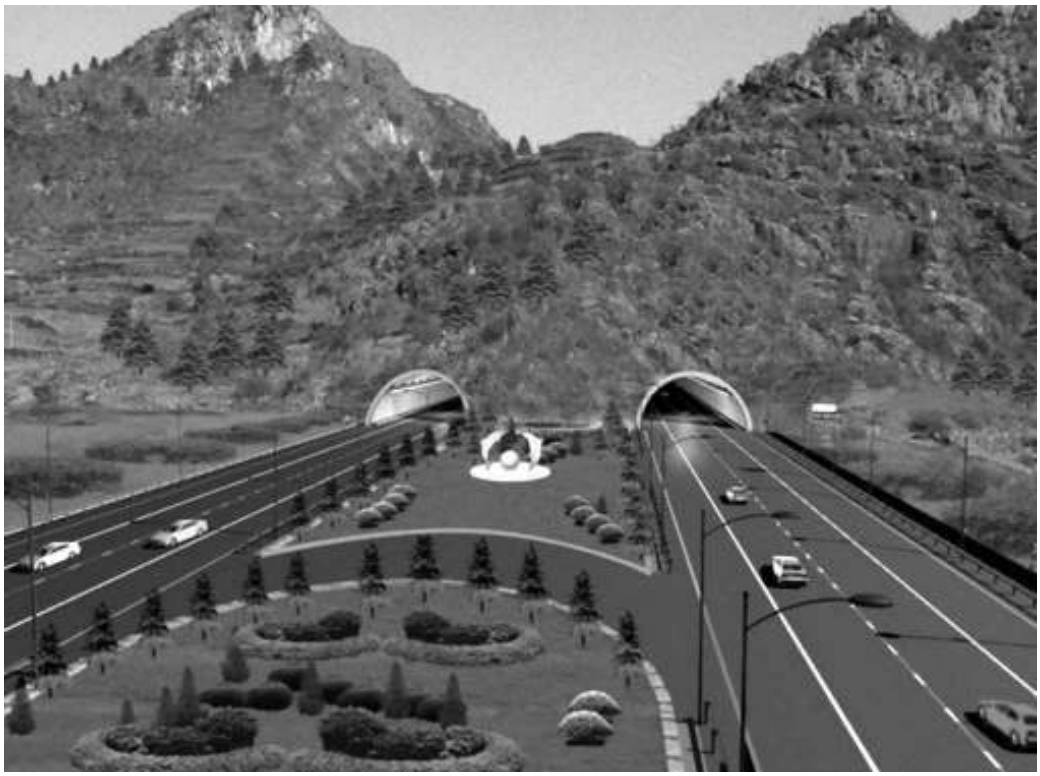
Japan has the world's longest undersea tunnel. The 54 kilometre Seikan tunnel links Honshu and Hokkaido Islands and started operating in 1988 after more than two decades of construction. The Channel tunnel between England and France is about 51 kilometres long.

World's 1st Dual-mode Inclined Shaft TBM

China Railway Construction Corporation said on 21 August that the world's first dual-mode mine inclined shaft TBM passed acceptance in Hunan Province on 19 August.

The TBM, co-researched and developed by China Railway Construction Heavy Industry Group, Shenhua Group and China Railway Construction 13th Bureau, will be applied to No. 1 mine of Shenhua to bear the task of one-time blind heading of a more than 6,000 metre mine tunnel.

This marks China as having made a major breakthrough in the application of tunnelling technology in coal mining.



Mountain tunnels for Phuket

The Expressway Authority of Thailand (EXAT), commissioned to roll out the Patong Tunnel project, has released a video highlighting the preferred route the tunnel will take through the Phuket hills separating the Kathu valley from the beachside resort town of Patong.

The preferred route was chosen after a panel of experts investigated three major factors in the selection process, explained Kanok Khemnak, managing director of Enrich Consultants Co Ltd, which was hired to carry out the evaluation of 7 possible routes.

"The first category of factors considered was engineering and traffic, in which we considered the length of the route, the aesthetics of the project, the efficiency of the construction to be undertaken and safety aspects," Mr Kanok explained.

The category was attributed 30 per cent weighting in the entire decision process, he added.

Also granted 30 per cent weighting were economic and investment factors, which included project cost and revenue-generating ability. "The last factor was the environmental effect. This was attributed 40 per cent weighting," Mr Kanok explained. "Route 2 is the best choice. It scored 72.49 from a maximum of 100 points. This is the route for which we will compile and present an Environmental Impact Assessment [EIA]," he added.

The route chosen and presented is the same one that stirred strong opposition from residents of Baan Mon in Patong in April, many of whom will have to be relocated from their family homes to make way for the mega-project.

"I have spent more than 10 years trying to improve Route 4029. The best solution is what you are looking at right now," Mr Kanok said. "We expect to propose this project to Cabinet before the end of this year. Construction will start in 2017 and we expect to complete the project in 2018 with a total budget of 6 to 7 billion baht," Mr Kanok said.

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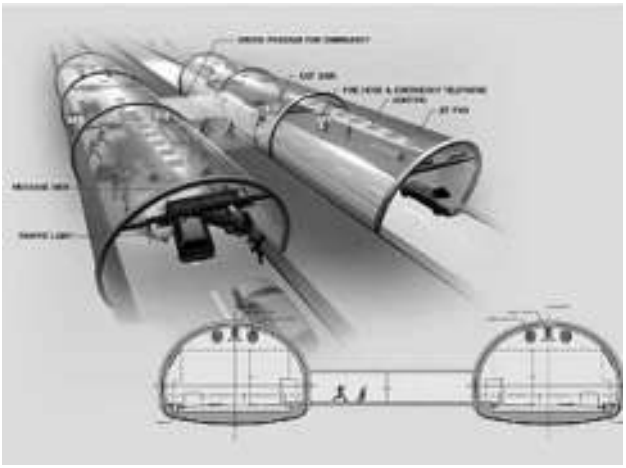


Hong Kong tunnel links the New Territories to Lantau Island

Dragages Hong Kong and Bouygues Travaux Publics, subsidiaries of Bouygues Construction, have been awarded the largest design-build contract in Hong Kong. The 1.15 billion (US$1.53 million) contract is for the construction of a 4.2 kilometre undersea road tunnel in the region.

The project consists of constructing an undersea twin-tube tunnel, each tube with two traffic lanes and 14 metres in diameter. The tunnel will link the New Territories, north of Hong Kong, to Lantau Island, where the international airport is located.

Two tunnel boring machines will bore to a depth of 50 metres below sea level – a record depth for Bouygues Construction. The two tunnel tubes will be connected every 100 metres by 42 cross passages. Ground-freezing technology will be used to provide a watertight environment to enable these passages to be bored.

Angry tunnel workers walk off Kwai Chung

More than 200 workers went on strike at the express railway construction site in Kwai Chung on 27 August after they were told to eat their lunch underground and warned their pay would be docked if they were late. But later that night the union said a consensus had been reached with their employer, Leighton Contractors (Asia), and that the company had retracted the new policy.

According to a notice at the site, staff who are five minutes late to work would lose 30 minutes' pay – HK$50 for a worker who earns HK$1,200 a day. Workers who are 15 minutes late would lose an hour's pay. A Labour Department spokeswoman said the penalties for being late were illegal and anyone imposing them could face a fine of up to HK$100,000 or one year in jail.

Work on the Cheong Wing Road site began in 2010, when the HK$3.2 billion contract was awarded to Leighton by the MTR Corporation. It is part of the high-speed railway that will link West Kowloon and Shenzhen. The MTR has maintained that the project is on track for completion by 2015. Yet in three years, just 41 per cent of it has been built.

MIAMI TUNNEL BREAKTHROUGH

The tunnel boring machine (TBM) "Harriet" successfully completed the second tube of the "Port of Miami Tunnel" at the beginning of May 2013. The TBM with a diameter of 12.86 metres mastered complex geological and hydrogeological challenges when crossing under the harbour twice. A machine concept was employed that Herrenknecht developed in collaboration with the client specifically for this ambitious project. The road tunnel will significantly alleviate the traffic congestion in the world's largest cruise port and the city centre of Miami (Florida).

Hundreds of spectators, numerous media representatives and project managers closely followed the breakthrough of Herrenknecht tunnel boring machine "Harriet". The EPB Shield (Earth Pressure Balance Shield, Ø 12.86 metres) from the southern Baden town of Schwanau excavated the two times 1.2 kilometre long tunnel directly under the fairway of the cruise ships in just 17 months. Top performances were 18.7 metres of excavated and lined tunnel a day and 100.5 metres a week.

"With this second breakout, we have successfully completed one of the most technically challenging tunnelling projects undertaken in the world to date", said project manager Louis Brais from the executing construction company Bouygues on the occasion of the breakthrough celebrations in Miami. From 2014 onwards, the twin-tubed tunnel with two lanes for each direction will connect the largest cruise ship port in the world with four million passengers a year with Interstate 395 and Interstate 95, thus relieving downtown traffic considerably. At the present time, around 16,000 vehicles make their way through the narrow streets of the city centre day after day. In addition to the cruise traffic, Miami is an important freight hub with around seven million metric tons annually.

The solution, developed specifically by Herrenknecht for Miami together with the client was to extend the application range of the EPB Shield machine type and adapt it to the unique geological conditions of the project. The aim was to safely control both the soft but stable grounds at the tunnel entrance and exit as well as the porous limestone containing corals subject to expected high water pressures beneath the middle of the fairway. The jointly developed system that ensured that the water pressure could be coped with and at the same time ensured transport of the excavated construction ground was referred to by the engineers as "Water Control Process" (WCP). The water-soil mixture is transported away via the screw conveyor with an attached Slurryfier box and an integrated stone crusher via the closed slurry circuit, rather than via the open belt conveyor commonly used in EPB Shields. "The TBM has done well", said the Herrenknecht project manager Georg Schleer. "The customer used the EPB mode on two thirds of the route and the WCP mode on the middle section where pressures were higher than three bar."

After the start of the construction work in November 2011, the TBM needed 9 months to build the first tunnel tube. Following breakthrough of the first tunnel in late July 2012, the 2,900 tonne machine was turned on Dodge Island and began its return journey for the excavation of the second, western tube in October.

Toronto airport pedestrian tunnel

The Pedestrian Tunnel Project has passed the halfway mark. The core of the pedestrian tunnel to Billy Bishop Toronto City Airport is now fully excavated, with tunnelling equipment having broken through to the island-side.

Excavation of the main pedestrian tunnel began in June 2013 with the creation of two 6 foot tunnels dug by Canadian-made tunnel boring machines dubbed 'Chip' and 'Dale'. Work on the 7 small "crown" shafts, 2 of which host new City of Toronto water and sewer mains, began in December 2012. The Project's next phase is the construction of the pedestrian tunnel skeleton, with completion of this element expected at the end of the year.

The Pedestrian Tunnel Project is being built through a public-private partnership model led by Forum Infrastructure Partners. An eight-part consortium is responsible for building, financing and operating the tunnel. The TPA retains ownership of the tunnel throughout the life of the P3 concession period.

When complete, the pedestrian tunnel will have 4 sidewalks (2 north and 2 south) moving at 2.3 kilometres per hour. From a bank of 6 elevators on the mainland side, passengers will go 100 feet down to access the tunnel and travel 800 feet underneath the Western Gap to escalators which take passengers to the airport's check-in area. The complete journey will take less than 6 minutes, and will dramatically improve passenger flows while removing the risk that ferry passengers have to wait for a second crossing during peak periods given the Marilyn Bell I's 200 passenger limit. Passengers will also notice shorter check-in and security screening lines as travellers will no longer be arriving at the airport terminal in 4 ferry "waves" per hour, as is currently the case.

Construction began on the Pedestrian Tunnel Project in March 2012. The pedestrian tunnel will link Billy Bishop Airport to the mainland and provide enhanced service and convenient access for airport.

San Francisco's Central Subway system

Tunnelling has started on San Francisco's Central Subway system, the first metro tunnel to be built in the city since the 1980s. Over the next 10 months, the tunnel boring machine (TBM) Mom Chung will excavate and construct the tunnel that southbound T Third Line trains will use when the Central Subway opens in 2019.

The second TBM Big Alma, arrived in San Francisco in August 2013. After about 6 weeks of assembly underground, she will begin constructing a tunnel parallel to Mom Chung's.

The tunnels are a key component in extending the Muni Metro T Third Line through SoMa, Union Square and Chinatown, vastly improving transit in these neighbourhoods.

Mom Chung and Big Alma will excavate and construct the 1.5 mile-long tunnels at a pace of approximately 40 feet per day, though their pace will vary based on ground conditions and other factors. Most of their journey will be through two major ground formations: the Franciscan complex, a bedrock formation that forms Nob Hill; and the Colma formation, a dense mixture of sand and clay.

MTA closes R train's tunnel

The MTA will shutter the R train tunnel between Manhattan and Brooklyn for 14 months from 8 July 2013.

The agency needs to close the tube, called the Montague Tunnel, in order to perform $100 million of repairs needed after damage wrought by Hurricane Sandy. New signals, lights, ducts, rails, and wiring will be installed, the MTA said.

Agency officials have posted 528 signs along in entryways and along platform edge signs at 60 stations to let riders know about service changes. The train will run in two segments, terminating at Court Street in Brooklyn and at Whitehall Street in Manhattan.

The Montague tube under the East River was one of 9 underwater tunnels that were severely damaged during Hurricane Sandy. While workers were able to get the line running through the tunnel 2 months after the storm, it was clear that the damage would require a more extensive repair effort, according to the Metropolitan Transportation Authority.

After the storm, 27 million gallons of water were pumped out of the tube, said Kevin Ortiz, a spokesman for the authority. But the damage was lasting. "Salt water and metal do not mix," Mr. Ortiz said.

The repairs, which include work on the tracks, lighting, pump rooms, circuit-breaker housing, signals and power cables, are expected to cost $308 million. The tunnel is not scheduled to reopen until October 2014.

Crossrail reaches half-way point

After starting her journey from Plumstead (UK) in May Crossrail TBM Mary has broken through into the station box at Woolwich, marking the half-way point of tunnelling south of the Thames. The 1,000 tonne machine has excavated almost 110,000 tonnes of material and installed 811 concrete rings to line the inside of the tunnel. She has joined her sister Sophia, who reached the Woolwich box in May and is being prepared to start on the second leg of the journey underneath the Thames to North Woolwich.

Sophia and Mary are constructing the Thames tunnel, which will run from Plumstead, via Woolwich and underneath the Thames to North Woolwich. They are different to the tunnelling machines being used elsewhere on Crossrail. These slurry machines are specially equipped to deal with the chalk, flint and wet ground conditions in south-east London.

As part of the tunnelling process, the excavated soils are pumped out as liquid slurry to a special site treatment plant at Plumstead. The slurry is separated into sand, gravel, water and chalk. The chalk comes out in "cakes" or slabs of filtered chalk particles.

Connaught Tunnel restoration

Crossrail has completed work to restore sections of the Connaught tunnel, re-flooding the Royal Docks in time for its September deadline. The Victorian-era tunnel will be brought into use for the first time since 2006 when Crossrail trains start serving London commuters in 2018, becoming the only existing tunnel to be used as part of the project.

Restoration works involved draining the Royal Docks so that a hole could be drilled in the crown of the tunnel to allow above-ground access for removing materials. Crossrail had until the first week in September to complete the work and refill the docks in time for ships making their way to the ExCel arena for a trade show.

Damaged central sections of the Connaught Tunnel have now been strengthened, widened and deepened to accommodate new Crossrail rolling stock. Linda Miller, Connaught Tunnel Project Manager said: "It was a race against the clock to get the work completed and the dock re-flooded, so it's great news that we've got it finished ahead of schedule. It's been a fantastic effort by the whole team to get the job done safely, quickly and effectively."

Robbins breaks into the Brazilian Market

As part of Brazil's massive metro program, Metro Fortaleza will be the first to utilize Robbins TBMs in the country. Four 6.92 metre Robbins Earth Pressure Balance Machines (EPBs) have been purchased by the Brazilian Government's Secretary of Infrastructure in the State of Ceara (SEINFRA) for Line 3 of Fortaleza's underground transit system. The new project is part of modernisation efforts to transform the city's small two-line metro system into a high-speed, multi-track system for reduction of road traffic.

Although the machines have been purchased, a contractor has yet to be named. The contracting tender opened in May 2013, and 5 contractors were invited to submit proposals: Acciona/Centenco; Construcap/Copasa; Mendes Junior/Isolux; Metrofor (consisting of Odebrecht and Andrade Gutierrez); and Mobilidade Urbana (consisting of Camargo Corrêa and Queiroz Galvão). The machines are anticipated to begin boring in 2014 once a contractor has been announced.

The machines are highly customised for the mixed ground project. Core drills underneath the city verified that challenging geology should be expected, including abrasive basalt and silty sand below the water table at water pressures up to 2.5 bar. Each machine is equipped with a durable mixed ground cutterhead powered by electric variable frequency drives (VFDs), and newly designed Robbins continuous foam and grouting systems for excavation in variable conditions. Behind each machine, Robbins continuous conveyors will maximise the safety and efficiency of the muck removal process.

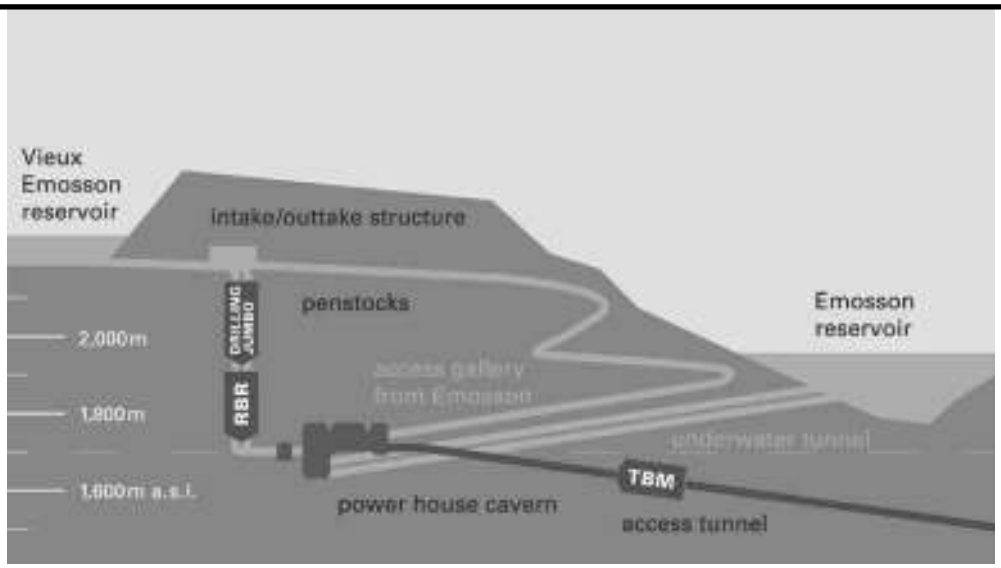
In addition to the machines, Robbins also designed the segments for the tunnel. The segments will be installed in a 5+1 universal arrangement, and allow for 17 MPa (2,500 psi) push pressure--the maximum push force of the machine. The exceptionally high maximum thrust force of nearly 62,000 kN (14 million lb) at 410 bar will enable the machines to keep moving even in sticky ground conditions. A trapezoidal ring configuration will allow the keystone to be placed at any one of 16 positions.

The four EPBs are being assembled in Robbins' new factory in Pudong, China using state-of-the-art components sourced mainly from European and U.S. suppliers. As of August 2013, two of the machines are in the process of being transported to Brazil, while the remaining two machines are in the assembly and testing process. Once the project commences, the machines will excavate sections of the Line 3 tunnel ranging from 4.3 kilometres to 5.8 kilometres long. The 12.4 kilometre long Line 3 will include 12 stations (11 of them running underground) from Chico da Silva to Edson Queiroz station within Fortaleza. The new line is part of a larger infrastructure development program for north-eastern Brazil, one of the highest population growth areas in the country.

Mixed ground cutterheads on the Robbins EPBs are designed to excavate through abrasive basalt and silty sand under water pressures up to 2.5 bar.

Each Robbins EPB was designed for difficult ground conditions, with a mixed ground cutterhead and newly designed foam and grouting systems.

The Robbins crew celebrates the successful testing of the first Metro Fortaleza machine in the company's new Pudong, China factory, seen here after the foam test.



Nant de Drance pumped-storage power plant

The new Nant de Drance pumped-storage power plant with a planned capacity of 900 megawatt is under construction in the Swiss canton of Valais. The construction of the Nant de Drance pumped-storage power plant in the Swiss canton of Valais is groundbreaking for the country's energy policy.

The share of electricity from nuclear power plants is to be gradually replaced by electricity from renewable energy sources. The Nant de Drance pumped-storage power plant will produce electricity from environmentally friendly hydropower from 2017 onwards, serving at the same time as a giant energy storage unit.

Three Herrenknecht machines are creating key constructions of the underground infrastructure.

Gripper TBM. Initially, Marti Tunnelbau AG excavated an access tunnel to the machine cavern located at 1,700 metres above sea level with a Herrenknecht tunnel boring machine (Gripper TBM, Ø 9,450 millimetres). The tunnel is the only safe winter access to the system during the construction phase and the subsequent operations. The Gripper TBM proved its worth under the direction of Marti already in the Lötschberg Base Tunnel project (2000–03; Switzerland, 10 kilometres of railway tunnels) and the San Pedro project (2005–06, Spain, 3 kilometres of railway tunnels).

Herrenknecht refurbished the Gripper TBM's drive (main bearing diameter 5,088 millimetres) at the Schwanau plant and delivered new roof bolting systems and other spare parts for the large-scale project on the high mountain jobsite. During excavation, the Swiss Herrenknecht subsidiary took over the refurbishment of the 17 inch disc cutters. The tunnel builders achieved peak performance at the end of October 2011: 220 metres of bored and secured tunnel in one week. At the beginning of September 2012, the tunnelling teams celebrated the breakthrough 600 metres deep in the mountain after 5.6 kilometres through gneiss, greywacke and granite.

Raise Boring Rig. In addition to the Gripper TBM, a Raise Boring Rig (RBR) from Herrenknecht is in operation in Nant de Drance (see picture 3).

The RBR600VF is drilling two 424 metre deep vertical penstocks. They connect the upper Vieux Émosson reservoir with the machine cavern. Marti Contractors Ltd. managed to complete the pilot borehole (Ø 381 millimetres) for the first shaft from the top down through rock with strengths of up to 150 megapascals, with best performances of up to 62 metres a day. The reaming (Ø 2,440 millimetres) started on 14 November 2012 and was successfully completed after only two weeks.

Records claimed at Sparvo

A world record has been claimed by Italian contractor Toto Costruzioni Generali following July's TBM breakthrough at the twin-tube Sparvo Tunnel in Italy.

The world's record-setting Herrenknecht EPBM has completed the first bore of the 2.5 kilometre long twin tube Sparvo tunnel on the new highway route between Bologna and Florence in Italy. Under construction since August 2011, the giant 15.615 metre o.d. "Martina", is the largest tunnel boring machine manufactured by Herrenknecht so far, and required just less than 12 months to complete the 2,413 metre two-lane road tunnel. The TBM showed top performances of 24 metres a day and 126 metres a week of driven and lined tunnel.

Excavation of the twin tube tunnel at Sparvo is regarded as the most demanding part of the overall project, not only on account of its sheer size but also because of the prevailing geological conditions. The geology on the tunnel alignment comprises mainly clay, claystone, sandstone and limestone. In order to achieve the requisite safety and speed during construction, the Italian client opted to use mechanized tunnelling technology. To this aim, Toto Costruzioni Generali SpA commissioned Herrenknecht AG to build the needed EPBM in 2010.

In view of the expected mine gases, designers had equipped the machine with explosion protection. Together with the client, the local authorities and universities a sophisticated safety system had been developed. The entire belt conveyor on the tunnel boring machine has a double-walled casing and is pressurized so that the excavated material containing methane can be removed from the tunnel safely. In addition, fresh air was permanently fed into all areas of the TBM using an efficient ventilation system. Both the tightness of this

casing and the gas concentration were monitored continuously.

The ring segments with their width of 2 metres and length of more than 4 metres were transported with an explosion-protected 24-wheel special vehicle from the Herrenknecht subsidiary Techni-Métal Systèmes. With a triple superstructure and a width of 2.5 metres, the multi-service vehicle is able to load a complete set of 10 segments. This provided the optimum supply of ring segments to the TBM with only one drive per segment ring.

Toto is the leading partner in a joint venture that includes Vianini Lavori SpA and Profacta SpA. At the first tube breakthrough, Toto reported a top advance rate of 22 metres per day building rings of 2 metre wide precast concrete segments, and confirmed the superiority of mechanised tunnelling when compared to conventional technology. This process involved the removal of 4,215 cubic metres of soil, which presented a major challenge for site management.

After completing the first drive at the end of July, TBM Martina was turned around to excavate the second tube on its 20 metre parallel alignment. The client Autostrade

per l'Italia SpA anticipates the tunnel opening in mid-2013. "This machine was intended to set new standards, including with regard to its features for particularly gaseous soil," explained Herrenknecht Project Manager Alexander Ell. Hand in hand with Toto and with the support of the local authorities, and the Universities of Bologna and Turin, Herrenknecht developed a complex safety system which includes explosion-protected equipment, a fully-enclosed conveyor belt, a permanent fresh air supply to all areas of the machine as well as permanent monitoring of gas concentrations. "The concentration of methane at the tunnel face was so high that fresh air had to be transported to the excavation chamber over longer periods of time," reported Ell. "So far, our new system has worked just the way we have anticipated," he added with satisfaction. With the world's largest TBM, we have become accustomed to setting new records, two of which are this machine's size and its advance rate," explained Alfonso Toto, CEO and Managing Director of project JV and tunnelling lead partner Toto Costruzioni Generali, during the first breakthrough celebrations.

As a leading manufacturer of mechanized tunnelling and shaft sinking equipment, the Herrenknecht Group achieved a total operating performance of €1,104 million in 2011, supplying 65 tunnel boring machines for road tunnels alone in the year. All in all, Herrenknecht equipment has completed 1,900 kilometres of tunnels in diameters of more than 4.2 metres since its establishment in 1977. The Herrenknecht Group employs about 4,000 people worldwide and has trained more than 240 young people. With 77 subsidiaries and associated companies in Germany and abroad, Herrenknecht offers comprehensive services tailored to the respective project and contractor.

The 2.4 kilometre long dual-tube Sparvo tunnel will accommodate two lanes each, including a third emergency lane. As part of the "Variante di Valico" extension project, a busy section of the A1 highway between Bologna and Florence is being extended. This alternative will significantly reduce the travel time for up to 90,000 vehicles a day.

Accident at Corrib Tunnel

Investigations are continuing after a German maintenance worker died as he worked on a tunnel-boring machine (TBM) at the controversial Shell Corrib tunnel.

Work on the 4.9 kilometre tunnel to bring gas onshore from the Atlantic Ocean off Co Mayo was immediately halted after the incident.

Lars Wagner (26) had worked for Herrenknecht, a subcontractor to the firm building the tunnel, and was believed to have been working as part of a machine maintenance support crew on the large, heavy TBM, which has an internal diameter of about 3.5 metre.

It is understood he suffered head injuries after a valve burst on the giant boring machine.

His body was later removed to Castlebar General Hospital for a post-mortem.

Both gardai and inspectors from the Health and Safety Authority (HSA) travelled to the scene at Aughoose in north Mayo after the incident was reported. A statement from Wayss & Freytag BAM Civil Joint Venture, involved in building the tunnel, said operations had been suspended immediately after the incident occurred around 1.8 kilometres from the shore end of the tunnel under Sruwaddacon Bay.

It confirmed a full, co-ordinated investigation had been launched into the incident and that it was co-operating with both the gardai and the HSA.

Mr Wagner was one of a number of German personnel working on the tunnel.

The victim had just returned from a holiday in Germany with his family, according to local sources.

SWISS PRIDE

Switzerland is so proud of its tunnelling achievements that the 33 foot tall, 225 ton circular cutting face of a borer known as Sissi, which was used in the Gotthard Base Tunnel, was unveiled outside the Swiss Museum of Transport in Lucerne at a June 2012 ceremony

During construction of the Gotthard Base Tunnel beneath the Swiss Alps (scheduled to open in 2016), visitors have had access to parts of the project and a visitors' centre.

The Gotthard AlpTransit Visitor Centre in Pollegio is the first of two buildings, which will stand at the two entrances of the Gotthard railway tunnel. These two buildings will be a token of the significance and the complexity of the construction of this railway tunnel in the advancing twenty-first century.

More than a simple exhibition space, the buildings will offer visitors an experience of the materiality of distance. In that sense, the Visitor Centre in Pollegio is more a transposition of matter into experience, rather than an exposition about matter. Visitors are not only shown the materiality of distance, but they actually enter that matter through which the tunnel is dug; they can feel its mass, its power, and the forces at work in the construction of the tunnel.

The outer structure of the Visitor Centre is built with the material excavated from the mountain. Millions of pieces of gneiss—the rock out of which the mountain is made—of 100 to 150 millimetres in diameter are lumped together in big steel nets to form two huge basket-like blocks. These two blocks create the impression of spaciousness of the Centre even as they render the astounding materiality of space. The main rooms of the Centre are distributed on two levels suspended on a steel structure anchored in the blocks. Glass walls suspended on that structure create a visually and sensorial independent unit; they also contribute to regulating the temperature inside the building. Service rooms, such as lavatories or storage spaces, are of massive reinforced concrete; they are either concealed by the blocks, or they run through the latter like tunnels.

In addition to the Visitor Centre itself, the building also hosts an exhibition area, a shopping area, a restaurant and a conference centre. Permanent and temporary exhibits about the construction of the tunnel will then be organised there.

Hard rock TBMS cutting through the Pyrenees

Two high-tech Herrenknecht tunnel boring machines completed an endurance test with bravura during long-distance tunnelling through the Pyrenees. After a total of 8.2 kilometres tunnelling through hard rock, the target line was reached with the final breakthrough in April 2013. The resulting cross-border tunnel project will be used for a high-voltage line to connect the French and Spanish electricity network with each other.

The Double Shield TBMs started at their launch portals in March and October 2012 to pre-drill and construct the 8.2 kilometre long tunnel through the hard rock of the Catalan Pyrenees. "Alberas" begun its mission in La Jonquera in Spain. "Canigou" advanced towards its sister machine from Montesquieu-des-Albères in France.

The two Double Shield TBMs from Herrenknecht were ordered by the Franco-Spanish joint venture, consisting of the tunnelling specialists Eiffage and Dragados. The challenge was to create an ambitious tunnel project within a demanding timeframe.

After 1.23 kilometres of tunnelling, "Canigou" reached the end of the lot, coming from France beneath the Massif des Albères, in March 2013. The "Canigou" machine was immediately dismantled in the protection of a tunnel section in stable rock without any lining under the supervision Herrenknecht specialists. After 7.01 kilometres of tunnelling "Alberas", coming from Spain, drove into the tunnel drilled by "Canigou" already on April 22, 2013, and the breakthrough was celebrated in superb style. The best drilling performance of the overall project was achieved by the tunnelling teams with TBM "Alberas" on the Spanish side: 53.5 metres per day with up to 1,040 metres drilled and built tunnel per month. "Alberas" was also dismantled in the drilled tunnel, and the components were removed through the north portal. The physical connection for the exchange of electricity is thus completed.

The cross-border power lines that connect Spain with France and the rest of Europe need to be extended urgently. The four existing connections do not have sufficient capacity to cope with bottlenecks or to compensate for fluctuations resulting from the use of renewable energy sources. As part of the bi-national project "INELFE" (INterconexión ELéctrica Francia-España) a 64.5 kilometre long, ultra-modern high-voltage direct current transmission link (HVDC) is being installed from Baixas, near Perpignan in France to Santa Llogaia near Figueras in Spain. The route passes under the Pyrenees on the Catalan Mediterranean coast.

For the "INELFE" project Herrenknecht prepared the back-up systems of the two machines for double storage: Logistics and storage facilities were designed in such a way that segments and grout could always be stored on the machine for two ring building sequences. Thus, the machine operators were able to exploit the potential of the Double Shield principle, without being limited by possible shortages in the material logistics. Due to the design of the machine components it was possible to dismantle them within the excavated drilling diameter without having to break out an additional cavern. The INELFE tunnel runs to a large extent parallel to the Le Perthus railway tunnel, built by Eiffage TP and Dragados S.A. from 2005 to 2007 with two large Double Shield TBMs from Herrenknecht (Ø 9.9 metre, total tunnelling length 16.4 kilometres).

Riyadh Metro contract awarded

The Arriyadh Development Authority (ADA) has awarded Louis Berger and Hill International the contract to provide project management and construction management services for the Riyadh Metro project in Saudi Arabia.

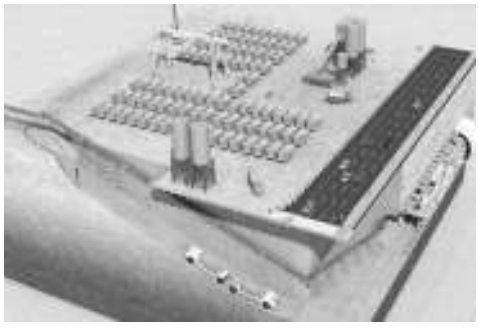
The US$265 million contract was awarded under the Riyadh Advanced Metro Project Execution and Delivery (RAMPED) joint venture, which Louis Berger is a 55 per cent majority partner and Hill is a 45 per cent partner.

As the intermediary between ADA and the design-build contractors, the joint venture will oversee design and construction deliverables through the project lifecycle for Package 3, which consists of three of six lines in the new Riyadh metro system.

The contract covers a five-year performance period and a 24-month defects liability period.

Package 3 includes Line 4, Line 5 and Line 6 and covers 67 kilometres of track with 48 kilometres of elevated alignment, 5.5 kilometres of mined tunnel, 22 stations and nearly 13 kilometres of bored tunnel constructed through some of the most congested districts in Riyadh.

Line 4 links to the King Khalid International Airport with a mix of elevated and at-grade sections. The Line 5 will run in a bored tunnel along King Abdulaziz Street, between King Abdulazziz Historical Centre and the Riyadh Airbase. The Line 6 runs in a half-ring from King Abdullah Financial District, passing by Iman Mohamed Bin Saud University and ending at Prince Saad Ibn Abdulrahman Al Awal Road.



New fire fighting system for Stockholm Bypass

A fixed fire-fighting system, which has not previously been used for fires in tunnels, will be tested by SP Technical Research Institute of Sweden. The system will be used in road tunnels in the Stockholm Bypass (Förbifart Stockholm), a project that will start in 2014.

Stockholm Bypass is a proposed new highway connection for E4 through western Stockholm. A large part of the road, about 50 kilometres, will pass through a tunnel and it is very important that adequate protection against fire is in place. The number of passing vehicles is large: Forecasts show that up to 145,000 vehicles/day may pass through the Stockholm Bypass.

"The amount of vehicles makes the tunnel a congestion risk and so the danger of fire occurrence is greater" says Haukur Ingason, professor and tunnel fire expert at SP.

The fixed fire-fighting system was developed by the Swedish Transport Administration and the fire consultant company Brandskyddslaget in collaboration with SP. It is a simple and relatively inexpensive solution where large water droplets are sprayed from nozzles in a tube mounted along the ceiling in tunnels.

"We strongly believe in the technology because it is so simple. Now we are going to test it and verify that it works as intended and designed."

"The new technology for fixed fire-fighting systems is key to the security of the Swedish Transport Administration modern urban road tunnels. It is very important that we can verify the function in full-scale", says Ulf Lundström from the Swedish Transport Administration.

The fire tests will be conducted in mid-September in the Runehamar Tunnel which is a disused road tunnel in Åndalsnes, Norway, where SP has previously conducted extensive fire tests. 420 wooden pallets will be placed in the tunnel to simulate the pay load of a truck. This fuel is expected to produce a fire that radiates energy at about 100 million watts. It is as much as 2.5 million ordinary 40 – watt lamps, giving an idea of how much energy a fierce fire can create.

"If the tests show that the technology works as intended, it will affect the vision around the world on how future fixed fire-fighting systems can be dimensioned" says Haukur Ingason .

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BOSPOROUS CROSSING

A large-diameter road tunnel will cross beneath the strait in Istanbul and expand the infrastructure bottleneck between Europe and Asia. The technical planning of the tunnelling operations poses complex challenges.

To get from the European to the Asian side of Istanbul, people and goods have to cross the Bosporus Straits. So far, two road bridges as well as ferries provide the only transport link between the two parts of the city and the two continents. The tense traffic situation for the nearly 14 million residents of the city and for international transit traffic should be improved considerably thanks to the construction of a new road tunnel under the Bosporus.

The route of the "Istanbul Strait Road Tube Crossing Project" runs around 100 metres below sea level at its deepest point, the interior diameter of the tunnel will be 12 metres so that two lanes in each direction can be accommodated. They will extend one above the other on two levels. 3.34 kilometres of the tunnel with a total length of 5.4 kilometres are being created by a Herrenknecht tunnel boring machine that will begin its underground mission from a launch shaft on the Asian side.

Extensive geological and hydrogeological preliminary investigations showed that the tunnel builders must reckon with water pressures of up to 12 bar. The executing Turkish-South Korean construction consortium YMSK, consisting of Yapı Merkezi İnşaat ve Sanayi A.Ş. and SK Engineering & Construction Co. Ltd., ordered a specially developed Herrenknecht TBM type Mixshield with a diameter of 13,660 millimetres for this project.

"The machine's engineering presented us with a real challenge," says Georg Schleer, summarizing the starting situation for the engineers from Schwanau. The main task: "Even if the pressure is extremely high up front at the tunnel face, the client must be able to change the cutting tools quickly and safely if necessary." The result was a new type of cutting wheel, where time- and cost-consuming access for maintenance work under pressurised air can be reduced. The complete cutting wheel is accessible from the rear of the machine under atmospheric pressure. From there, all disc cutters and a large part of the cutting knives can be changed safely. In addition, the Mixshield is equipped with a special, newly developed lock system. It allows pressurized air access at well over 5 bar where necessary.

To detect strong material wear early and to tackle necessary maintenance accesses in a targeted manner, wear detectors are integrated into the excavation tools as well as in the steel construction of the cutting wheel. Moreover, the disc cutters are equipped with the DCRM monitoring system (Disc Cutter Rotation Monitoring), which was developed by Herrenknecht. It provides data about the rotational movement and temperature of the disc cutters in real time to the machine operator in the control container. Thus, conclusions can be drawn regarding the condition of the tools and change intervals can be better planned.

In the Herrenknecht factory in Schwanau the Mixshield was named YILDIRIM BAYEZİD. This is the name of a sultan, who drove the expansion of the Ottoman Empire successfully forward at the end of the 14th Century.

The 13.6 metre giant, a Mixshield, was completed in early July 2013 in Schwanau and is now on the way to the jobsite in Turkey. After its dismantling, transport and assembly at the jobsite, the Herrenknecht Mixshield will start its tunnelling work in Istanbul at the end of 2013. Following the opening of the tunnel, the new quick link between Europe and Asia will initially be operated for 26 years by the Joint Venture "Avrasya Tüneli İşletme İnşaat ve Yatırım A.Ş. (ATAŞ)" and subsequently handed over to the government of Istanbul.

The Bosporus was crossed with a tunnel boring machine for the first time in the years 2008–09. An Earth Pressure Balance Shield (Ø 6,110 millimetre) from Herrenknecht was used for the construction of a water tunnel. In addition, a total of about 56 kilometres of Istanbul's metro are being built using machines produced in Schwanau.

Even if the pressure is extremely high up front at the tunnel face, the client must be able to change the cutting tools quickly and safely if necessary.