



MAY 2019

# ITA MEMBER NATION Activity Reports 2018





FOLLO LINE, NORWAY

# A THOUSAND TONNES OF INGENUITY

Four Double Shield TBMs running in parallel, rock strengths of up to 268 MPa, and managing potential water pressures of up to 12 bar – Follo Line is undoubtedly a technical and logistical top-class project. Smart engineering, unshakeable willpower and mutual trust between all partners are necessary to make Norway's biggest infrastructure project a success. Final double-breakthrough in February 2019.

► [herrenknecht.com/hardrock/](https://herrenknecht.com/hardrock/)

**Contractors:**

- › Acciona Infraestructuras
- › Ghella ANS

**PIONEERING  
UNDERGROUND  
TOGETHER**

**HERRENKNECHT**



**Tunnelling Systems**



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## Tarcisio B. Celestino ITA President



The model adopted two years ago of publishing the Annual Activity Reports produced by the Member Nations in a separate magazine has proven very successful. The Executive Council once again received very positive feedback from the Member Nations and members of the tunnelling community. For this reason, we decided to repeat the publication in 2019 and will probably adopt it regularly in the future. It is great to think that perhaps because of this new way of disseminating their activities, the Member Nations became more motivated, as the number of reports received this year is an impressive 46!

The previous method of presenting only parts of the reports during the General Assembly was very limited. The wealth of information simply could not be digested due to the time restrictions on the presentations and the lack of availability for later consultation. Good examples of current active Member Nations are the best motivation for new actions in other parts of the world. The value to the industry of the information relating to potential or new projects is also very significant. It will benefit not only our industry but society itself. I do encourage all Member Nations to submit their reports next year.

## Olivier Vion ITA Executive Director



For the third year, the activity reports are presented here, in this dedicated magazine. This year we have received reports from 46 Member Nations out of the 75 Member Nations. Thanks to the work done by each Member Nation, the ITA secretariat and Tunnelling Journal, we can share with all of you the various activities carried out by the ITA Member Nations, as well as discover more about present and future tunnelling activities all over the world. This magazine will be given out to all delegates attending the WTC in Naples. We do really hope you enjoy reading this magazine and invite you to share your comments so it can be constantly improved.



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# Argentina



**Name:** Asociación Argentina de Túneles y Espacios Subterráneos (AATES)

**Type of Structure:** non profit, open association

**Number of Members:** 45 members, 6 corporate members

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In 2018 the Argentine Tunnelling Association continued working to show society the benefits of the underground environment, both through the implementation of technical events and training courses, and the dissemination of materials via technical and social media.

In September, a 3 Day Tunnelling Congress was held under the title "Progress of Large Underground Works - Sharing Experiences", with the participation of the ITACET Foundation, for the development of a training session about "Management of (User) Safety in Underground Facilities".

Two online webinars were developed for the Argentine Construction Chamber, the first dealing with "Construction of Tunnels with Tunnel Boring Machines" and a second with the use of the "Pipe Jacking Method".

For the Water Company of Buenos Aires, AYSA, a 1 day classroom course was held, focussing on the same technical topics but for site inspectors and foremen. Due to the number of representatives from the company, the course was repeated twice.

## CURRENT TUNNELLING ACTIVITIES

### Extension of Metro Buenos Aires, Line H - Buenos Aires

North section: 4 new stations constructed with the NATM method, featuring single large caverns of approx. 18m width and approx. 2km single tube double track running tunnels. By the end of 2017 the first 3 stations of this extension were opened to operation, whilst the last one, the end station Facultad de Derecho, was inaugurated in May 2018.

South section: 2 garage and 1 workshop caverns are already in operation; the second workshop cavern is still in construction. The remaining station Saenz, at the South end, is expected to be constructed using PPP, but is yet to be tendered.

### Undertunnelling of the Sarmiento Railway Line - Buenos Aires

Replacement of the present Railway Line "Sarmiento", running from the Western

Head Station of Buenos Aires (Station Once) to Station Castelar, located at a distance of approx. 22km, via double track tunnel, mainly excavated by 12m diameter EPBM, and also with a short NATM section. Along this section lie 9 stations, 7 of them mined and 2 in cut & cover. The NATM mined stations have a length of approx. 240m and a cross section of 280m<sup>2</sup>. During 2018 most of the drainage works for the stations were finished and some of the access structures advanced. The running tunnel construction progressed steadily, reaching a total length of approx 6.5km and approaching the intermediate shaft at station Villa Luro. During this year the contractor JV has moved along the basic design of all superficial and underground components of the project and the detail design of all structures which are directly associated with the construction of the running tunnels.

It was decided that the mined stations caverns will be excavated after the passage of the EPB Machine.

### Sewer Left Margin Riachuelo River and Emissary - Buenos Aires

This project comprises the construction of two main sewers: one located parallel to the Riachuelo River, on its left, with approx. 9.5km length, and an inner diameter of 3.2m, and the second coming from the city, 5.2km long with a 4.5m diameter, both to be excavated with an EPBM.

Additionally, the project features a Treatment Plant and an Emissary of approx. 12km length with 4.3m inner diameter to be excavated into the La Plata River, also with an EPBM. Three contracts were awarded in 2015 (sewers, plant, emissary), which presently are all in construction. During 2018 the construction of the treatment plant was initiated, after a large landfill. The excavation of the emissary progressed continuously, reaching a total length of 6km. The slurry shield machine used to excavate the left side sewer will begin excavation this year. The EPBM for the construction of the sewer section to the city of Buenos Aires has advanced 2km.

### Relief Tunnel of the Vega River - Buenos Aires

This project comprises the construction of a relief tunnel for the existing underground "Vega River", with a total length of 8.4km (6km with a Herrenknecht EPBM of 5.3m i.d.) and the rest by 2.4m i.d. pipe jack, using an AVN 1600 slurry machine, also from Herrenknecht). Additionally, the project comprises other secondary galleries in NATM and various shafts. The project was awarded mid 2016 and is in progress. The break-in of the main EPBM took place in April 2018 and since then, to the end of 2018, approx. 3000m have been excavated, which is half of this tunnel section. The pipe jacking slurry machine started work at the end of August 2018, and completed the second jacking section of 435m length of the total 800m, before Christmas. Meanwhile, some other NATM galleries and intermediate shafts are partially completed.

### Underground Water Main "Río Subterráneo Sur" - Buenos Aires

This project will provide a new potable water distribution main, fed by the Grl. Belgrano water purification in Bernal, to the southern area of Buenos Aires, feeding a population of 2.5M people. It consists of a 23km long underground river and 2 large pumping plants, which was tendered for construction by the water company AYSA in 2 contracts. The first, awarded in September 2017, comprises an initial 13.5km long section of the 4.6m dia. main and the pumping station N°1. A Terratec EPBM has already been purchased for this contract, which will start excavation from a launch shaft, currently under construction, in October 2019.

### 2 Road Tunnels on the National Highway 75 - Province of La Rioja

The project's objective is to bypass a road section aligned within a creek, featuring beautiful gardens and weekend houses, by the construction of 2 bidirectional road tunnels of 560m and 890m in length. The construction is by conventional tunnelling with a shotcrete lining and a prefabricated inner lining. The excavation of the shorter tunnel started in August 2017, with the second commencing in 2018. To the end of 2018 approximately 100m of the top heading section of the first tunnel was completed.



### Several Sewer projects in Buenos Aires

Within Buenos Aires a large quantity of sewer projects are being implemented, by means of pipe jacking, as requested by the Water and Sanitation Company AYSA. In 2018 there were eight active projects using pipe jacking in Argentina, with lengths between 2000m and 5000m. Typical diameters used range between 0.8m and 1.5m, with jacking sections between 200m - 300m.

### Highway "Paseo del Bajo", City of Buenos Aires

This new highway runs alongside the coast of Buenos Aires, closing the circle around the city. Its central 8km long section, located between the "Puerto Madero" neighbourhood and the city downtown, features an alignment located within a trench, with frequent crossings where it is covered. This highway is scheduled to be inaugurated mid 2019.

### FUTURE TUNNELLING ACTIVITIES

#### Red de Expresos Regionales (RER)

In 2016, the present national government presented this very challenging project, featuring the underground inter-connection of the 3 main railway head stations in Buenos Aires: West Station "Once", South Station "Constitución" and North Station "Retiro".

The project comprises 20km of new railway lines, approx. 85% in an underground alignment with the rest on viaducts. Besides the underground enlargement of the head stations, 4 new underground stations will be constructed with the NATM method with approx. 280m<sup>2</sup> cross section. During the present year, all three viaducts were initiated and are fairly advanced, with completion set for mid-2019. However, the first 2 contracts for the underground section between Head Station Constitución (South) and Head Station Retiro (North), comprising the extension of the Roca and Belgrano railway lines, tendered in 2017, were delayed. These contracts cover the underground Station Constitución and the Central Roca Station, together with approx. 8km of 2 track running tunnels. Presently this section is being adjusted by the Authority to optimise it from a technical-economical point of view. As a part of this process it was decided not to incorporate the Belgrano railway in the first phase. The date for a new tender is still not defined, but it will be in either 2019 or 2020. The investment

for this section of the RER project is budgeted for US\$3.5bn. In parallel, the tender design of the section between the Head Station Once (West) and the Head Station Retiro, crossing the Section at the Central Roca Station, is being developed, which will be tendered in a second construction phase. The whole project will take at least 8 years, with an estimated budget of US\$5bn.

### Bi-National Trans Andean Tunnels - Argentina - Chile

Agua Negra Tunnel: This 14km long, twin tube Road Tunnel is the project of the highest priority for both countries. Its financing will be provided by the IDB for the Argentine part, whereas Chile will finance its part without the support of the bank. A new pre-qualification process for contractors was launched in 2017, with the short list of companies published in 2018. According to the latest developments, it seems that both countries still do not agree on a final technical solution for this project. Meanwhile, the bi-national Authority EBITAN is fairly advanced in the preparation of the tender documents, a process which is supported by the IDB. Corredor Bi-oceánico del Aconcagua: This Private Initiative, featuring a railway connection between Mendoza (Argentina) and Los Andes (Chile) with a 52km long base tunnel, developed so far to a preliminary design, was finally approved by both countries. According to our present knowledge, no further design activities are in progress by the private group who developed this initiative.

Las Leñas Tunnel: This approx. 11km long, twin tube Road Tunnel is officially recognized by both countries as the second most important bi-national base tunnel. It has been decided that a tender will be launched for the development of a geological survey and a revision of the currently proposed alignment and tunnel concept. This tender was published in December 2018 and is presently in progress. The associated study would have a duration of approx. 1.5 years.

Tunnel Cristo Redentor - Second Tube: With the support of the IDB during the present year the design of the second tube of the existing Cristo Redentor road tunnel, of approx. 3.1km length, was completed and prepared for tender for construction. This second tube will be constructed as an enlargement of the existing single track "Caracoles" railway tunnel, which was part of the

Transandean Railway from Buenos Aires to Valparaiso and has been out of operation since 1978. To the end of 2018 both countries did still not agree on the final version of the tender documents, which means that this project is also expected to commence in 2019.

### Metro Buenos Aires

For 2019 onwards the Buenos Aires city government is planning to construct the new Metro Line "F", a circumferential line which crosses most of the existing lines, and also extend both Lines "H" and "E", one of them probably to the domestic city airport "Aeroparque".

## STATISTICS

### 1. Length or volume excavated - % mechanized/% conventional during 2018

- Length excavated: approx: 17.5km (not including small diameter pipe jacking galleries)
- % Mechanized: 97% - conventional: 3%

### 2. Amount (USD or EUR) of tunnelling/underground space facilities awarded in 2018

- There were no large tunnelling contracts awarded during 2018

### 3. List of tunnels completed:

- There were no tunnelling contracts completed in 2018

### 4. List of tunnels under construction

- Undertunnelling of the Sarmiento Railway, Buenos Aires
- Relief Tunnel of the Vega River, City of Buenos Aires
- Sewer tunnel Riachuelo and emissary into the Rio de la Plata River
- 2 Road Tunnels on the Highway 75 in the Province of La Rioja
- "Río Subterráneo Sur", water main, in Buenos Aires

## EDUCATION ON TUNNELLING IN THE COUNTRY

Postgraduate Course of Design and Construction of Tunnels and Underground Works at the Engineering Faculty of the University of Buenos Aires, held for the first time in 2018, with a duration of 32 hours. Both lecturers, the engineers Ezequiel Zielonka and Jorge Laiun, are members of AATES.



# Australia



**Name:** Australian Tunnelling Society (ATS)

**Type of Structure:** The ATS is an industry based Technical Society of Engineers Australia (EA) and is affiliated with the Australian Shotcrete Society, the NZ Tunnelling Society and the International Tunnelling Association (ITA).

**Number of Members:** 640 Members, 54 Gold and Silver Corporate Members and 6 Platinum Sponsors.

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

During the last year the Australian Tunnelling Society (ATS) has continued to promote the benefits of the underground environment through a range of activities, events, publications and working groups.

**Activities and Events:** During 2018 the ATS held its Tunnel Design and Construction Short Course in Melbourne in which featured technical presentations by leading experts on topics relevant in Australia and with a knowledge of international practices. The David Sugden young tunneller's Award was presented to Matthew Bennett. The top three 2018 David Sugden paper authors (including the winner) and the recipient of the 2017 Neyland Award will undertake a speaking tour of ATS Regional Groups in 2019.

The ATS holds monthly technical sessions run by its Regional Group and is involved with initiatives undertaken by the Australian Shotcrete Society (AusSS) such as the use of shotcrete for ground support. Two one day workshops were run in 2018, one discussing the "Emerging trends in tunnelling" and the other, in conjunction with the AuSS, "Lessons from recent Sydney tunnels"

The ATS is a contributor to the Austroads Tunnel Task Force which consists of jurisdictional representatives from around Australia and New Zealand. The Task Force is responsible for considering all aspects of tunnel planning, design, construction, operation and maintenance. It co-ordinates updates to the Guide to Road Tunnels and co-ordinates the development of technical research projects.

**Publications:** The ATS Journal was published twice in the last calendar year in conjunction with Tunnelling Journal. The Air quality working group published a suite of 12 information documents on

"Managing Silica in tunnels". The ATS has also completed the digitising of historical papers from all Australian Tunnelling

conferences, these now being available on the ATS web site for members only.

**Working Groups:** During 2018, the ATS Air Quality Working Group (AQWG), a collaborative platform enabling industry and regulatory bodies to work together, have been developing information on health strategies for managing silica dust exposure in tunnels which will be publicly launched early 2019.

The ATS has a number of members active in ITA Working Groups with 1 Animator, 2 Vice Animator, 7 Participating members and approximately 8 Corresponding members.

## CURRENT TUNNELLING ACTIVITIES

**Image 1:** CPB/Samsung/John Holland JV is continuing with the design and construction of the \$A2.7bn M4 East project (WestConnex Stage 1B) in Sydney. The project includes twin 3-lane road tunnels, each 5.5km in length and utilised 18 roadheaders to mine the tunnels through Hawkesbury Sandstone and Ashfield Shale. The project is planned for completion by 2019.

**Image 2:** LendLease/Bouygues JV is continuing with the design and construction of the \$A2.65bn NorthConnex

in Sydney, twin 9km long road tunnels linking the M1 to the M2 and M7 motorways. The project is planned for completion by 2019. The project utilised 17 roadheaders during tunnel excavation.

**Image 3:** CPB/Samsung/Dragados JV is continuing with the design and construction of the \$A4.3bn New M5 project (WestConnex Stage 2) in Sydney. The project includes twin 3-lane road tunnels, each 9km in length and has utilised 18 roadheaders to mine the tunnels through Hawkesbury Sandstone and Ashfield Shale. The project is due to open to traffic in 2020.

**Image 4:** Salini-Impregilo-NRW JV has commenced the design and construction of the \$A1.15bn Forrestfield Airport Link in Perth. The project includes twin 8km tunnels excavated by two TBMs and three stations. TBM excavation is underway.

**Image 5:** Sydney Metro City and South West Tunnels and Station excavation contract has been awarded to the John Holland/CPB/Ghella JV. The contract involves the design and construction of twin running tunnels, each 15km long, between Chatswood and Sydenham and six new underground stations. Five TBMs have been ordered and four commenced excavation during 2018.

**Image 6:** In December 2017 the CPB/John Holland JV was awarded the West Gate Tunnel Project which includes the design and construction of twin three lane road tunnels under the suburb of Yarraville in Melbourne. Two 15.5m diameter TBMs have been ordered for the excavation of the 2.8km long eastbound tunnel and the 4km long westbound tunnel and will commence excavation in 2019. The project







is scheduled to be completed by the end of 2022.

**Image 7:** In December 2017 the Melbourne Metro Tunnels and Stations PPP contract was awarded to the Cross Yarra Partnership comprising John Holland/Lendlease/ Bouygues and Capella Capital. The contract involves the design and construction of twin running tunnels, each 9km long, between Footscray and South Yarra and five new underground stations. Four TBMS will commence the excavation of the running tunnels during 2019. The section between the two CBD stations will be mined by roadheaders.

**Image 8:** In June 2018 the M4-M5 Link Main Tunnel Works Contract (WestConnex Stage 3A) was awarded to the Lendlease-Samsung-Bouygues JV for the design and construction of twin 3 and 4 lane road tunnels each 7.5km in length. The project is planned to open in 2023.

**Image 8:** In December 2018 the Rozelle Interchange Contract (WestConnex Stage 3B) was awarded to the John Holland-CPB Contractors JV for the construction of a predominantly underground interchange to link the proposed M4-M5 Link Tunnels with the existing Anzac Bridge, Iron Cove Bridge and the future Western Harbour Tunnel. The project is planned to open in 2023.

## FUTURE TUNNELLING ACTIVITIES

### Kidston Pumped Storage Hydro - Queensland

The 250MW Power Station will include



1.5km of tunnels, three 250m deep shafts and an underground power house. Contract award is expected in May 2019.

### Cross River Rail - Brisbane

The tender for the Tunnels, Stations and Development PPP contract closed in October 2018 and is expected to be awarded in Q2 of 2019. This contract will include the construction of twin running tunnels each 5.9km long and four underground stations.

### Snowy 2.0 Hydro Project - New South Wales

Tenders for the 2000MW civil works contract which will include 27km of TBM tunnels closed in November 2018. Contract award is expected in Q1 2019.

### North East Link - Melbourne

There will be a road link between the existing M80 Ring Road and the Eastern Freeway. It will include twin tunnels each 5km long. Tenders are expected to be called in the second half of 2019.

### Inland Rail Project - South East Queensland

The 126km long Gowrie to Kagaru section of the Inland Rail Project in south east Queensland will include three single track rail tunnels totalling 8.5km in length. The Inland Rail Project is a 1700km freight rail link from Melbourne to Brisbane. Tenders for this section of the project are expected to be called in the second half of 2019.

### Western Harbour Tunnel - Sydney

Tenders for the second under harbour road tunnel in Sydney to connect the proposed Rozelle Interchange

(WestConnex Stage 3b) with the existing Warringah Freeway on Sydney's North Shore are expected in 2020.

### Northern Beaches Link - Sydney

This road tunnel will connect the northern beaches area of Sydney with the Warringah Freeway and the proposed Western Harbour Tunnel.

### F6 Extension Stage 1 - Sydney

Twin 3-lane road tunnels, each 4km long, from the New M5 (WestConnex Stage 2) at Arncliffe to Kogarah. Tenders are expected to be called in Q3 2019.

### Sydney Metro West - Sydney

This will be a new metro style underground rail line between Parramatta and the Sydney CBD which will include twin running tunnels, each 22km long.

### Shoalhaven Pumped Storage Hydro - New South Wales

The 235MW power station will include 1.2km of tunnel and a 580m deep shaft. Tenders are expected in Q1 2019.

## STATISTICS

### 1. Length or volume excavated - % mechanized/% conventional during 2018

- Length of bored tunnels by TBM completed in 2018 (excluding pipejacking): 6,546m
- Volume of mined tunnels completed in 2018: 2,833,727m<sup>3</sup>

### 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018

- USD5,050 million or EUR4,470 million

### 3. List of tunnels completed:

- No tunnels completed during 2018

### 4. List of tunnels under construction

- NorthConnex, Sydney, NSW;
- WestConnex Stage 1B (M4 East), Sydney, NSW;
- WestConnex Stage 2 (New M5), Sydney NSW;
- Forrestfield Airport Link, Perth, WA;
- Sydney Metro City and Southwest, Sydney, NSW;
- WestGate Tunnel, Melbourne, Vic;
- Melbourne Metro Rail Project Tunnel and Stations PPP, Melbourne, Vic;
- WestConnex Stage 3A (M4-M5 Link), Sydney, NSW;
- WestConnex stage 3B (Rozelle Interchange), Sydney, NSW.



# Austria



**Name:** Austrian national committee of the International Tunnelling Association

**Type of Structure:** non profit

**Number of Members:** Only the 5 tunnel related organisations of Austria are allowed to be members of the association; these organisations are a) Austrian Society for Geomechanics, b) Forschungs-gesellschaft Straße Schiene Verkehr, c) Austrian Society for construction technology, d) Austrian Tunnelling Association, e) Österreichischer Ingenieur- und Architektenverein

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

### The Austrian Tunnel Day, October 10th, 2018 in Salzburg

The conference covered the topics of:

- Special challenges at large projects. Important standards for tunnelling
- Innovation and tunnelling 4.0 - the future of tunnelling

### ÖGG: 67th Geomechanics Colloquium, October 11th and 12th, 2018 in Salzburg

Numerous participants from more than 30 countries accepted the invitation to the congress in Salzburg.

Topics of the Colloquium were

- Special measures for geotechnical problems - lessons learned
- Relevant parameters for the selection of TBM's
- Model selection for design and construction
- New developments in tunnel supports

## CURRENT TUNNELLING ACTIVITIES

Regarding the Baltic-Adriatic Trans-European (TEN) rail corridor, which will connect Poland, the Czech Republic, Slovakia, Austria and Italy, good construction progress was made on the Austrian section, called the Southern Railway Link.

One of the main projects along this



Fig. 2: Shaft sinking machinery for Semmering Base Tunnel at Fröschnitzgraben [Foto: SWIETELSKY]

route is the 27km long double tube Semmering Base Tunnel. Tunnel works, which are split into 3 lots are being carried out by ARGE Implenla-Hochtief, ARGE Swietelsky-Implenla and Marti AG.

The other main project is the 32.9km long Koralm Tunnel, where tunnelling works were also split into 3 lots. Lot KAT1 is already finalized. Lot KAT2 is being carried out by ARGE STRABAG-Jäger and Lot KAT3 by PORR. The breakthrough succeeded in August 2018 for the southern tube. In KAT2 about 90 percent of the 19km long TBM section has been driven by two double shield TBMs. Within the 11km long western section KAT 3, about 90 percent of NATM works are done; the EPB Shield in the North Tube has been running since October 2015 and has been adapted for the hard rock section.

### BBT - Brenner Base Tunnel

To underpass the Alps running west-east, the longest railway tunnel in the



Fig. 4: Schematic layout of the Brenner Base Tunnel [BBT SE]



Fig. 1: attendees of the 67th Geomechanics Colloquium in Salzburg



Fig. 3: The Koralm Tunnel (2 x 33km long)



world, the Brenner Base Tunnel with a length of 64km, is under construction. The connection will close the gap and bring a very efficient European north-south link that will strengthen the connection between Germany, Austria and Italy. In 2018 several open days were organized attracting thousands of interested visitors.

#### **Research@ZaB - Research and Development as well as Training and Education Centre Focusing on the Construction and Operation of Underground Structures**

The creation of sustainable infrastructure is increasingly being developed

in underground facilities. In terms of construction and maintenance this leads to greater challenges for construction-, transport- and energy providing companies. The same goes for the emergency organizations who must ensure the safety for the users of the infrastructure. With the project "Research@ZaB—Zentrum am Berg" an underground facility for research, development, education and training purposes will be established. The centre will meet the requirements of public institutions, whilst also being a "development factory" for private companies as well as universities.



Fig. 5: construction site area of ZaB - Zentrum am Berg, the underground research- and development as well as training and education center



Fig. 6: rescue training at construction site area of ZaB - Zentrum am Berg

#### **FUTURE TUNNELLING ACTIVITIES**

##### **68th Geomechanics Colloquium on October 10th and 11th, 2019, Salzburg Congress, Austria**

The Austrian Society for Geomechanics invites scientific and professional audience to the Salzburg Congress located in the center of the city.

Presentations regarding the following topics will feature at this colloquy:

- Urban tunnelling: a technical and logistical challenge
- Challenges during the construction of the Brenner Base Tunnel
- Long-term experience with retaining structures
- Research and development in tunnelling

##### **Young Researchers Day, October 9th, 2019, Salzburg Congress, Austria**

The Young Researchers Day will constitute a forum for scientific and professional attendees prior to the Colloquium dealing with the subsequent topics:

- Presentation of Master, Doctoral theses, and research projects
- Requirements of maintenance and operation on the design
- Handling of risks in geotechnical engineering

##### **Austrian Tunnel Competence Center (ATCC), November 29th, 2019, Graz, Austria**

The ATCC succeeds the former Südbahntagung as a venue to exchange experience, know-how and ideas. The subjects of the symposium will be aligned to the contributions submitted by scientific and industrial underground construction experts.

#### **EDUCATION ON TUNNELLING IN THE COUNTRY**

Include graduate courses, post graduate courses, technical courses / name of University, School....

- Master and PhD-Programme for Mining and Tunneling at Montanuniversität Leoben, ending with a MSc or PhD respectively (contact: subsurface@unileoben.ac.at)
- Postgraduate Programme for NATM-Master of Engineering - Construction, Rehabilitation and Operation of NATM- & TBM-Tunnels (contact: Thomas.Marcher@tugraz.at, Robert.Galler@unileoben.ac.at)



# Belarus



**Name:** Tunnel Association of Belarus

**Type of Structure:** Non-profit, open association

**Number of Members:** 7 organisations

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In Minsk (Republic of Belarus) on 28.09.2018, the Tunnel Association of Belarus together with the Tunnel Association of Russia, JSC Minskmetroproekt, pack Minskmetrostroy held a Scientific-technical forum on "Trends, problems and prospects of development of underground construction"

## CURRENT TUNNELLING ACTIVITIES

In Minsk the construction of 1 Section 3 of the subway line continues. The length is 8.49km with 7 stations. In 2018, 918m of tunnel and 4 metro station were built. Also, 1473m of 2.1m diameter sewers and 1014m of 1.2m sewer tunnel were built.

In 2018 Minskmetroproekt developed 'Justification of investments for

construction of 2 of the 3 phase lines with a length of 8.44km and 7 stations.

## FUTURE TUNNELLING ACTIVITIES

NA

## STATISTICS

**In 2018, 1775m of subway tunnel were built: 52% mechanised, 48% normal. Also, 2487m of utilities tunnel was created.**

## EDUCATION ON TUNNELLING IN THE COUNTRY

At the Belarusian National Technical University, for Tunnels and Subways, 250 students have trained.

# Belgium



**Name:** ABTUS-BVOTS (Association Belge des Techniques et de l'Urbanisme Souterrains - Belgische Vereniging voor Ondergrondse Technieken en Stedebouw)

**Type of Structure:** non profit, open association

**Number of Members:** 19 individual members, 50 corporate members

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In 2018 the Belgian Tunnelling Association continued to promote underground solutions to resolve congestion problems, crossing of waterways and sensitive areas. Several site visits were organised, as well as our annual study day with this year's topic 'Belgian Tunnel Expertise Worldwide'. In corporation with the Dutch Member Nation KIVI-TTOW, the COB, KPT, the Flemish engineering association ie-net & AWV/TOV, we organised the European Conference Beyond a Tunnel Vision that had 350 participants (<http://beyondatunnelvision.eu>).

For the first time, we organized the official Belgian #worldtunnelday on the 4th of December. This initiative will be continued. We launched our new website <https://www.abtus-bvots.com/>

We continued our close cooperation with the French Tunneling Society AFTES, with who we share the same magazine T&ES.

## CURRENT TUNNELLING ACTIVITIES

In 2018, the following activities were ongoing:

- A site visit to the Victory Boogie Woogietunnel (project Rotterdamse Baan) in The Netherlands (Rotterdam). The diameter of the TBM is 10.15m and it is being built by W&F Ingenieurbau AG as part of the group BAM Infra, W&F Ingenieurbau & Volker Wessels.

- In order to improve the safety for evacuation in case of a fire incident, a new excavation shaft with a diameter of about 11m is built near the existing Kennedy railway tunnel (a double track railway tunnel under the river Scheldt).
- In Uccle in the south-west of Brussels a TBM was used to build a 1.3km underground storm water tunnel. With an inner diameter of 4.2m, the basin can contain 20,000m<sup>3</sup> and will avoid floods during heavy rainfall.
- In Brussels the rehabilitation of the road tunnels on the city's inner ring was started. These old tunnels are completely refurbished and will get an up-to-date control system.
- In Brussels the existing north-south railway link is renovated. It will be brought to modern standards with







new control and safety systems. The works were visited by the BEFIPS Board members and BEFIPS young engineers!

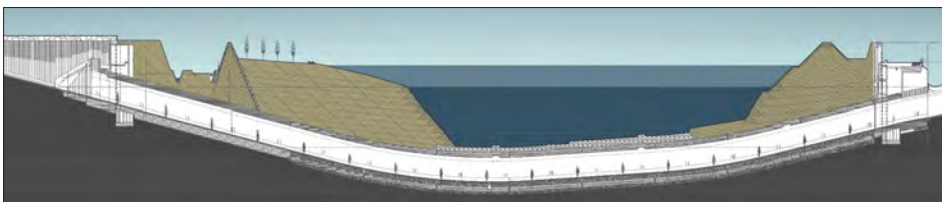
- On the 4th of December 2018, the first official Belgian #worldtunnelday was organized and will be continued.

#### **FUTURE TUNNELLING ACTIVITIES**

- In Brussels the tender for the extension of the metro from the north station towards the new NATO-building will start up. At the same time the existing metro line will be adapted at the south station, so that the whole line can be changed into a fully automated subway system.
- In Antwerp the works for the

Oosterweel Connection (closing of the northern motorway ring) are starting up, commencing with the adaptation of the interchange at the left bank of the Scheldt river. During this year the tenders for the immersed tunnel under the Scheldt river as well as the cut-and-cover tunnels under the Straatsburg dock will start.

- On the 26th of March 2019, our annual seminar will be held with this year's topic 'Belgian seminar on immersed and floating tunnels'.
- In a more distant future, the second railway track from Antwerp's main shunting station towards the hinterland will become necessary. This will be done via 2, 16km long tunnels



underpassing the Albert canal and several motorways and to avoid an interference with the dense urban area on the surface.

- In Brussels the existing north-south railway link with its 6 tracks has reached saturation point. The link needs to be extended by 4 extra tracks (each in a separate tunnel of some 10km long) that will be bored by TBM under the existing ones. The need is there but the funding will determine the start of this project.
- The road tunnels of the Brussels inner ring will be further rehabilitated.

#### **STATISTICS**

##### **1. Length or volume excavated - % mechanized/% conventional during 2018**

- Roughly 400.000m<sup>3</sup> were excavated where of 10% mechanized and 90% conventional

##### **2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018**

- About €75M (most part of the investments is situated in tunnel renovation)

##### **3. List of tunnels completed:**

- Rehabilitation with a heat and smoke control system of the north-south railway link in Brussels. It will be in service and commissioned by June 2019.

##### **4. List of tunnels under construction**

- Renovation of the road tunnels in Brussels



# Brazil



**Name:** Brazilian Tunnelling Committee (CBT)

**Type of Structure:** CBT is a committee of the Brazilian Society for Soil Mechanics and Geotechnical Engineering (ABMS). It is an open society based on membership

**Number of Members:** 254 Individual Affiliate Members and 23 Corporate Affiliate Members.

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

### Events:

CBT Talk, March - Lawyer Júlio César Bueno, from Pinheiro Neto Advogados, Legal criteria for the geological - geotechnical risks division in large infrastructure contracts and projects involving underground works of tunnels. São Paulo.

**March, 14th** - Posthumous homage to Don Deere and Richard Bieniawski. Attended by 50 people, including representative from ISRM, ITA, ABMS, ABGE and CBMR.

**CBT Talk, April, 19th** - Serra do Cafezal Tunnels. Talks about the Project, by the owner and designer. 110 participants. São Paulo.

**May, 23rd** - Young members event. Tunnel monitoring from the space. Invited companies IDS Brasil and TRE Altamira, represented by geologist Carolina de Athayde and engineer Javier García Robles. São Paulo.

**June, 14th** - Echo from the Dubai event. Event for local associates to hear from those that attended WTC in Dubai. São Paulo. 45 participants plus 100 participants online.

**June, 23rd** - Young members, site visit with 15 participants to line 4 São Paulo Subway.

**July, 6th** - Workshop organized by WG12 - Recommended Practices for Fiber Reinforced Concrete, by professor Antônio Figueiredo. São Paulo.

**July, 18th** - Lecture: shotcrete: cement/additive compatibility, microstructure and mechanical properties. By professor Antônio Figueiredo, USP, São Paulo.

**July, 19th** - CBT joined 10th International

Symposium on Field Measurements in Geomechanics - FMGM, Rio de Janeiro, with the section Civil tunneling: instrumentation and quality assurance, 100 participants.

**August, 02 and 03rd** - Course. Practical aspects on tunnel construction. By engineers Sergio Martins and Julio Di Dio Pierri. São Paulo.

**September, 13th** - Contractual tunnel practice seminar. Brasília, DF.

**October, 10th** - Lecture: Practical and theoretical aspects on tunnel boring machines, with Herrenknecht AG.

**October, 18 and 20th** - Young Members, Lectures at Santo André Engineering Foundation. Santo André, SP. During academic week from civil engineering course. Attended by 50 participants.

**October, 22nd** - Young Members, Lecture at Mackenzie University. Innovation on underground excavation. By Fernando Abreu.

**November, 08th** - Round table about risks on underground projects. By: Luiz Guilherme de Mello, Eloi Angelo Palma Filho, Fernando Leyser Gonçalves, Marcio de Souza Santos, Pedro Teodoro França and Tiago Ern. With 77 participants. São Paulo.

**November, 28th** - CBT attended Summit

M&T Expo 2018, with 2 presentations: New technologies and equipment for underground mining, by Odilon Mendes from Normet, and TBM evolution on mechanized tunnels, by Edson Peev, from Herrenknecht AG. São Paulo.

**December, 4th** - Tunnel Day. More than 160 participants plus 60 online participants on this already established event organized by CBT. 2018's topic was shotcrete on underground construction. Realized in São Paulo.

**Publication** - Journal: Soils & Rocks ([www.soilsandrocks.com.br](http://www.soilsandrocks.com.br)), in English, published by the Brazilian Society for Soil Mechanics and Geotechnical Engineering (ABMS), the Brazilian Association for Engineering Geology and the Environment (ABGE) and the Portuguese Geotechnical Society (SPG). Three issues are released per year. As a sample, the following papers were published in 2018:

- Volume 41, N. 2, May-August 2018

<http://www.soilsandrocks.com.br/soils-androcks/SR41-2.pdf>

**Case Study** - Stability Assessment in Underground Excavations at Vazante Mine - Brazil L.T. Figueiredo, A.P.Assis 203 DOI: 10.28927/SR.412203

**WG:** no activities

## CURRENT TUNNELLING ACTIVITIES

Due to the economic crisis in Brazil the year of 2018 was quite weak regarding infrastructure activities. Our numbers of tunnels show that roads and mining are the main areas for the length drilled during 2018. Nevertheless the services tunnels, mainly in sanitation projects, are also being constructed.

## FUTURE TUNNELLING ACTIVITIES

Metro de Fortaleza is one of the projects expected for 2019, and the ring road around Florianópolis. There are a number of unfinished tunnels to be continued,



Gal Costa Avenue, Salvador BA, tunnel 4 and 2.



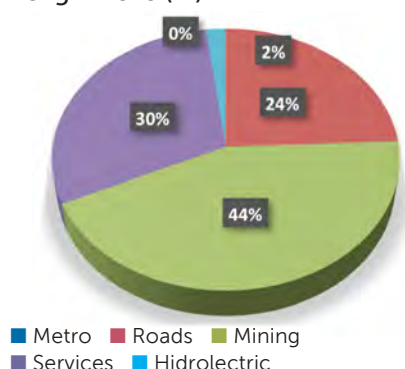
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The economic activity is expected to improve in 2019, and it should reflect directly on the tunnelling activity. But we cannot give numbers for it.

Volume 2018 (m<sup>3</sup>)



Length 2018 (m)



## STATISTICS

- 1. Length: total 56.094m (30% mechanized and 70% conventional)**
- 2. Volume: total 1.446.706m<sup>3</sup> (1.1% mechanized and 98,% conventional)**
- 3. Amount (US\$ or EUR) of tunnelling/underground space facilities awarded in 2018: estimated US\$ 330.000.000,00**

### 4. List of tunnels completed

Rodoanel Norte SP, Avenida Gal Costa Salvador BA Túnel 1, Avenida Gal Costa Salvador BA Túnel 2, Avenida Gal Costa Salvador BA Túnel 3, Avenida Gal Costa Salvador BA Túnel 4, Marginal Pinheiros, PCH Itapocuzinho 2, Pilar de Goiás, Mina Corpo Pequizaço e Ingá.

### 4. List of tunnels under construction

Metrofor CE, Nova Tamoios SP, Contorno de São Sebastião SP, PCH Rabo do Macaco SC, Coletor Tronco Cidade Nova RJ, Projeto TIETE SP, Programa Pró-Bilings, Coleta de Esgoto Rio Grande da Serra, Coleta de esgoto Goiás, Coleta de esgoto Rio de Janeiro, Coleta de esgoto Santa Cruz, Coleta de estogo Barueri, Projeto Tietê, BR 116 Serra do Cafezal, PCH Quebra Dentes RS, PCH Vila Galupo PR, Mining in MG and BA.

## EDUCATION ON TUNNELLING IN THE COUNTRY

No undergraduate courses in Brazil focus on tunnel yet. Some universities have one or two disciplines related to underground construction, like Makenzi, USP, UNB. On post graduate courses, our references in Brazil are Brasilia Federal University and São Paulo University, São Carlos Engineering School. Efforts to spread the knowledge in tunnelling are carried out mainly by CBT.

## An American First!

### Blacksnake Creek Combined Sewer Overflow Tunnels

#### A 100% BarChip Synthetic Fibre Reinforced Segmental Tunnel Lining

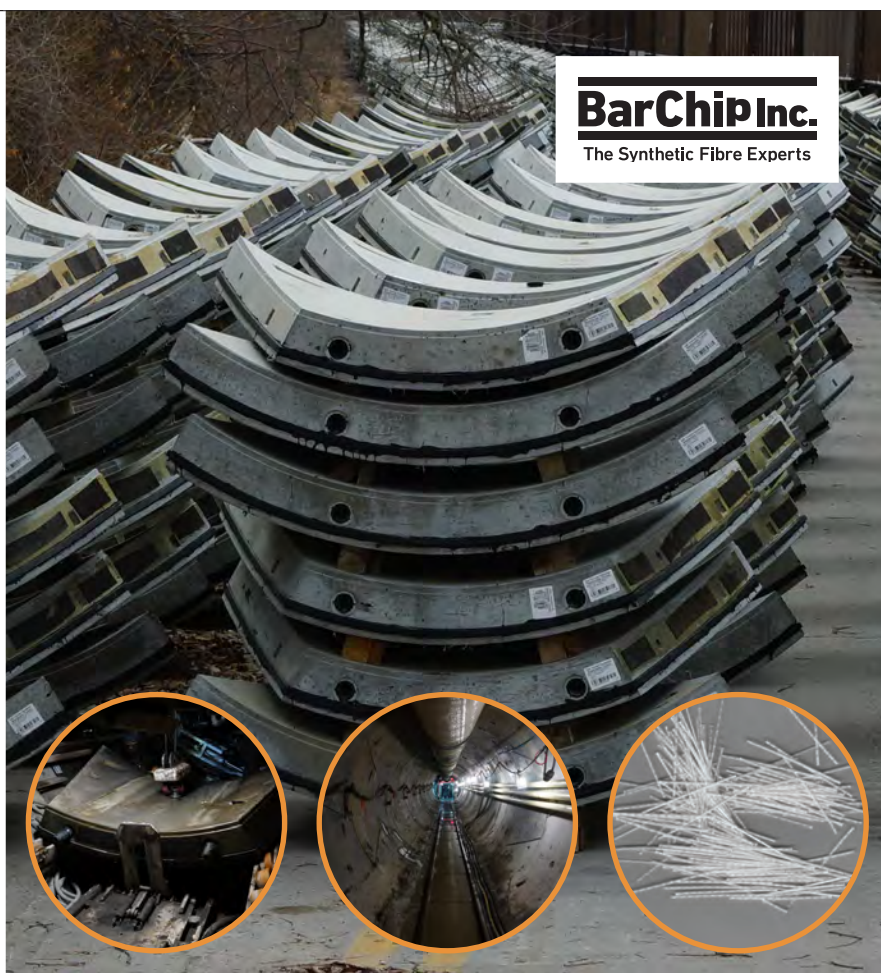
##### Segmental Lining

- Composed of 6 trapezoidal segment. Each 19.05 cm thick, 1.2 m wide, with an internal diameter of 2.74 m and an aspect ratio of 8.1.
- Concrete class of C40/50 (f'c 48 MPa) at 28 days age, with a stripping strength of 14 MPa. Residual strength was specified to 3.2 MPa at I/150 according to ASTM C1609.
- The solution has proven very robust, with no issues during transportation, handling, launching, installation and shoving processes.
- The 100% BarChip fibre reinforced segments are the first of their kind to be used in North America.



**TOUGH AS STEEL  
& DOESN'T RUST**

[www.barchip.com](http://www.barchip.com)



**BarChip Inc.**  
The Synthetic Fibre Experts



# Canada



**Name:** Tunnelling Association of Canada (TAC)

**Type of Structure:** Federally incorporated not-for-profit society

**Number of Members:** 412 (310 full, 45 corporate, 9 retired, 48 student)

**Board of Directors (2019):**

**Officers:** Erik Eberhardt - President, Rick Lovat - Immediate Past President, Bruce Downing - Vice President West, Steve Skelhorn - Vice President East, Michelle Richards - Treasurer, Derek Zoldy - Secretary

**Directors:** Stephanie Robillard - BC Region, Remco Kleinlugtenbelt - Alberta, Jason Mann - Manitoba and Prairies, Dan Ifrim - Ontario, Jean Habimana - Québec and Maritimes, Nichole Boulton, Andrew Caruana, Mark Diederichs, Connor Langford, Boro Lukajic, Andre Solecki, Seamus Tynan

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

### 2018 TAC/NASTT-NW Tunnelling and Trenchless Conference - Innovation in Underground Infrastructure

Over 300 tunnelling and trenchless technology professionals met November 8 and 9 in Edmonton to participate in keynote lectures, concurrent technical sessions, and panel discussions on:

- Case Histories - Lessons Learned
- Condition Assessment and Rehabilitation
- Ground Characterization and Ground Improvement
- Planning and Design
- Procurement and Delivery
- Research and Innovation
- Urban and Environmental Challenges.

The conference was preceded by a Design Considerations and Case Studies workshop on November 7.

### TAC 2018 Awards Dinner

The Tunnelling Association of Canada presented achievement awards in 2018 recognizing deserving individuals and projects in the Canadian tunnelling industry. TAC's Canadian Lifetime Achievement Award was presented to long-time TAC member and former TAC President, Garry Stevenson. The Eisenstein Scholarship (value of \$6,000 CAD) was presented to Pasquale Basso Trujillo of Université Laval. Full 2018 TAC Achievement Awards details are posted on the TAC website at [http://www.tunnelcanada.ca/awards\\_2018.php](http://www.tunnelcanada.ca/awards_2018.php).

### Chapter Activities

TAC's Ontario and British Columbia chapters continue to be very active

running up to eight meetings (each) annually and featuring presentations on Canadian and international tunnelling projects. The BC Chapter opened the year in January with a combined meeting with the Vancouver Geotechnical Society. The Ontario Chapter closed the year with a December social. Both functions were attended by over 100 members.

### TAC Young Members

TAC had a successful year running student and young member events. The number of Young Members (<35 years of age) is steadily increasing, with an active Facebook page and groups in BC and Ontario. Student membership in 2019 is expected to increase to over 70, and total YM's is estimated to increase to over 200.

## CURRENT TUNNELLING ACTIVITIES

The Canadian market is seeing steady activity. A sampling of current projects across the country, from the east to west coast, includes:

- Coxwell By-pass Tunnel, Toronto, ON: Construction of a 10.6km long, 6.3m diameter tunnel at a depth of 55m in soft rock, together with 5 tunnel shafts/chambers, 11 drop shafts/adits and 2 diversion chambers. The tunnel is being constructed using a single-shield/EPB dual mode TBM.

- Burnhamthorpe Water Project, Peel Region, ON: Includes a 3.7km, 1,500mm diameter tunnel to house a watermain, constructed using conventional tunnelling, and a 1.5km, 600mm diameter microtunnel for a sanitary sewer.
- Ashbridges Bay Outfall Tunnel, Toronto, ON: Construction of a 3.8km long, 6.8m diameter tunnel in soft rock using a shielded TBM, together with tunnel shafts and over 50 risers into the lake.
- Réseau Express Métropolitain (REM), Montreal, QC: Construction of 67km of automated light rail to link the south shore to the city centre as well as the airport and western suburbs (Fig. 1). Works include tunnelling underneath the airport and integrating the 100yr-old Mont Royal tunnel.
- Garage Cote Vertu, Montreal, QC: Involves 2.5km of tunnels and caverns, excavated using roadheaders, to house an underground maintenance facility connected to an existing metro station.
- Lavigne Retention Pond Tunnel, Montreal, QC: Construction of 2km of tunnels and a 40m wide, 25m deep storage shaft to control and avoid wastewater runoff during major storm events.
- Northeast Interceptor Sewer River Crossing, Winnipeg, MB: Includes shaft construction and a 900mm diameter sewer siphon crossing below the Red River, via microtunnelling in carbonate rock.
- Cockburn and Calrossie Sewer Relief Works, Winnipeg, MB: Involves 500m of drainage sewers ranging from 1.5 to 2.1m diameter and 1.4km of new land drainage laterals 300 to 750mm in diameter, installed via trenchless methods to provide sewer separation.
- Inglewood Sanitary Trunk, Calgary, AB: Construction of a 3.5km microtunnel in coarse gravels and boulders under the



Figure 1



Figure 2



water table using microtunnelling and open cut construction.

- St. Albert North Interceptor Sewer, Edmonton, AB: Involves a 3km long microtunnel with 1.5m diameter to add sewage capacity.
- Kemano T2, Kitimat, BC: Completion of the remaining 7.6km of a 16km secondary power tunnel for Rio Tinto's Kemano Generating Station, using a combination of drill and blast and TBM tunnelling.
- Site C Diversion Tunnels, Fort St. John, BC: Construction of two diversion tunnels for BC Hydro's Site C Dam (figure 2), with diameters of 12 to 15m, excavated by roadheader.
- South Surrey Interceptor - Johnston Road, Surrey, BC: Includes an 800m long section with 3m diameter being constructed using an AVN microtunnelling machine.
- Douglas Trunk Sewer, Burnaby, BC: Includes three microtunnels with a combined length of 1km through silts, sands and gravel with some of the trenchless sections in lean clay and fills.
- North Shore Conveyance, Vancouver, BC: Construction to link the new North Shore Waste Water Treatment Plant

with the existing outfall below the Lions Gate Bridge, including 9 microtunnels: 3 at 1,500mm diameter, 5 at 2,400mm and 1 at 3,000mm. Project challenges include a 420m curved microtunnel alignment for the 3,000mm MTBM.

### FUTURE TUNNELLING ACTIVITIES

The outlook for Canadian tunnelling continues to be strong. Examples of projects on the horizon include:

- West Vaughan Sewage System Project, York Region, ON: Currently in design, will involve a 14km tunnel with 3m diameter to be constructed by TBM. Expected dates for start of tunnelling range from 2022 to 2024.
- Massey Creek Tunnel, Toronto, ON: Will consist of 6km of 4.4m diameter soft ground tunnelling with depths from 12 to 60m. Two shielded TBMs are envisioned to be used. The project is currently in design; the RFQ is expected in 2021 and construction in 2024.
- Louis-H. La Fontaine Tunnel, Montréal, QC: Major safety upgrades and rehabilitation work to a 1.5km long double tube immersed tunnel, using a Design-Build-Finance delivery method. Preliminary design was completed in Fall 2017 and responses to the RFQ were submitted in September 2018. The RFP for the tender design is expected in early 2019.
- Blue Line Extension Project, Montréal, QC: Will add five more stations and maintenance facility to the city's metro system. The civil contract will be procured under a Design-Build-Finance delivery method, while the system contract will be procured by a Design-Bid-Build contract. The project will extend the existing Blue Line to the eastern part of the city for approximately 6km.
- Cockburn and Calrossie Sewer Relief

Project (Contract 5), Winnipeg, MB: Will involve installation of 1.2km of tunnels with diameters of 2.1 to 2.4m.

- Green Line LRT (City Centre), Calgary, AB: Will add 4km of tunnels and underground stations to the city's LRT network. Funding from various government levels is in place, and is

expected to begin construction in 2020. The RFQ will be issued in Q2 of 2019 under a Design-Build-Finance model.

- Millennium Line - Broadway Extension, Vancouver, BC: Will add 6km of TBM tunnel and 6 underground stations to city's subway and SkyTrain network (Fig. 3). The RFQ is anticipated in early 2019 as a Design-Build-Finance project, with the start of construction expected in 2020.
- Second Narrows Water Supply Tunnel, Vancouver, BC: Metro Vancouver's next major marine crossing to secure its water supply in event of a large earthquake. Will include a 1.1km long, 6m diameter tunnel under the Burrard Inlet. Access to the tunnel will be via a 70m deep shaft in complex soils on the north side of the inlet and 100m deep rock shaft on the south side. Set to begin in 2019.
- Stanley Park Water Supply Tunnel, Vancouver, BC: Will replace a section of the Capilano water main through Stanley Park via a 1.4km rock tunnel that includes 3 shafts and 2 tunnel drives through weak sandstone. Detailed design began in mid-2018 and construction is to begin in 2021.
- Eagle Mountain Gas Pipeline, Greater Vancouver, BC: FortisBC and Woodfibre LNG are undertaking the construction of a 47km gas pipeline. Will include a 6km long tunnel, of which, 3km will be in soft ground with a pressurized face and 3km in hard rock. The project is currently under design with RFP to be released in 2019, and construction to start in 2020.

### EDUCATION ON TUNNELLING IN THE COUNTRY

McGill University - MIME521: Stability of Underground Openings

Queen's University - GEOL873: Tunnelling and Advanced Rock Engineering

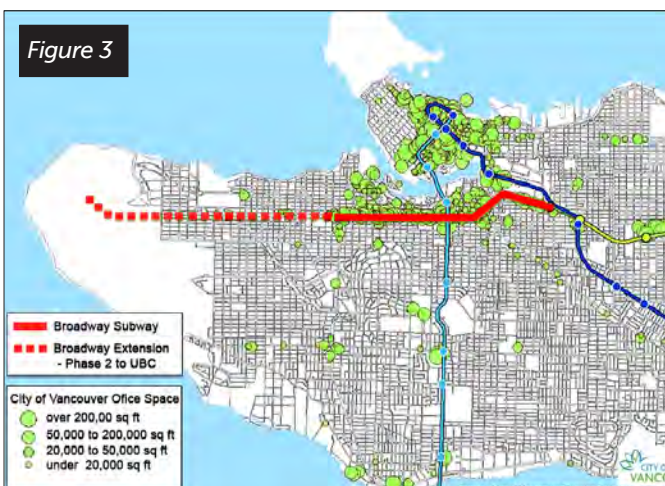
Univ. of Alberta - EXGEN4800: Geotechnical Consideration for Underground Trenchless Construction

University of British Columbia - EOAS547: Tunnelling and Underground Construction

University of Toronto - EdTech (Online): Tunneling Methods

Western University - GRC71414: Tunnels and Underground Structures in Rock

Figure 3





# China



**Name:** China Civil Engineering Society (CCES)

**Type of Structure:** Non profit, open association

**Number of Members:** Total number 44064 people, number of corporate members 967 group members.

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

- 1) From May 26 to 27, 2018, Seminar on Technical Challenges of Extra Super Tunnel Projects in the Future — the 10th Parallel Session of the 20th Annual Meeting of the China Association for Science and Technology was held in Hangzhou International Expo Center
- 2) From September 18 to 19, 2018, the first international tunnel conference between China and Malaysia - SEASET 2018 was held at in Hilton Hotel in Selangor, Malaysia
- 3) From September 14 to 15, 2018, China Summit Forum for Tunnelling Technology over Four Decades After Reform and Opening-up was held in Nansha, Guangzhou
- 4) From November 5 to 6, 2018, the opening ceremony of the 2018 CTUC and the 20th Annual Meeting of Tunnel and Underground Works Branch of China Civil Engineering Society was held in Chuzhou, Anhui Province
- 5) On November 7, 2018, ITA 2018 Annual Award Conference was held in Chuzhou, Anhui Province, China. 289 participants from 20 countries attended the Awards 2018 conference and 310 participants for Awards 2018 ceremony.

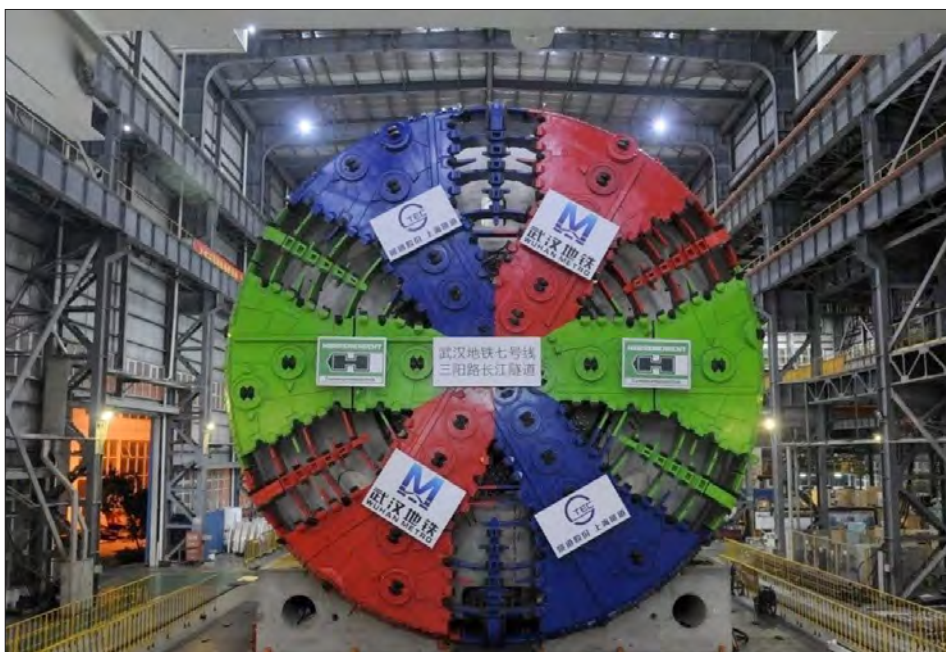
The Society's Journal Modern Tunneling Technology has published 150 articles covering reviews and discussions, theoretical researches, analysis and calculation, planning and design, construction technology, construction equipment and materials in 6 issues, reflecting the current research trend and hot-debated and challenging issues of the tunnel industry. In addition, the editorial office also edited and published

Supplement 1 for Modern Tunneling Technology in 2018, including 29 papers focusing on the construction technology of Chengdu-Lanzhou Railway Tunnels. In the Supplement 2 for Modern Tunneling Technology, the editorial office edited Collected Papers for 2018 CTUC and the 20th Annual Meeting of Tunnel and Underground Works Branch of China Civil Engineering Society, which include 168 papers.

## CURRENT TUNNELLING ACTIVITIES

### Railway Tunnels

According to a recent report of the railway infrastructure system, by the end of 2018, a total of 15,117 railway tunnels have been put into operation in mainland China, with a total length of 16,331km. In 2018, there were 550 new railway tunnels being put into operation, with a mileage of 1,005km. Currently railway tunnels under construction add



SEASET 2018-Southeast Asia Symposium & Exhibitions on the Challenges and Strategic Solutions of High Profile Projects on Tunnels 2018



up to about 7,465km. Among them, the Gaoligong Mountain Tunnel on the Dali-Ruili Railway is the longest railway tunnel under construction in China with a length of 34.54km. With an underground construction area of 36,000m<sup>2</sup>, the Badaling Underground Station of the Beijing-Zhangjiakou High-Speed Railway

is by far the largest underground station for high-speed rail in the world. The crossover tunnel at both ends of the station has an excavation span of 32.7m and is the largest single arch span in China. At present, the total length of railway tunnels in China's construction planning reaches 15,634km.



Badaling Underground Station



ITA Tunnelling Awards 2018

### Highway Tunnels

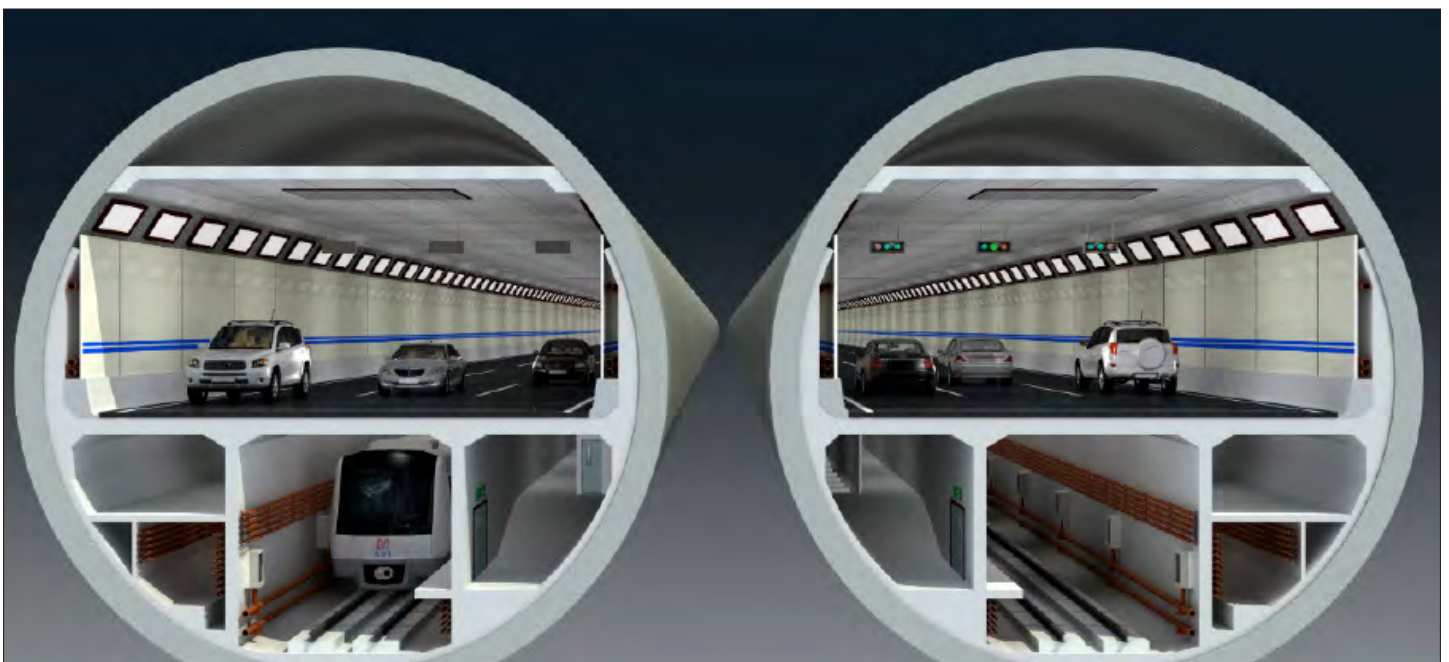
According to preliminary statistics from relevant highway administrations, by the end of 2018, there were more than 16,500 tunnels on highways of various classes in mainland China, with a total length of 15,940km. In the past five years, the length of the new highway tunnels put into operation has exceeded 1,000km per year. The longest highway tunnel under construction is a 17.10km long tunnel located in Muzhailing, Gansu Province. With a length of 5.66km and a maximum underwater depth of 44m, the recently connected immersed tube tunnel on the Hong Kong-Zhuhai-Macao Bridge Link is by far the longest undersea immersed tube tunnel in the world.

### Metros

According to the latest rail transit network report, by the end of 2018, rail transit has become available in 35 cities in mainland China, with a total mileage of 5,766.6km (including 4,511.3km of metros). The newly added rail transit in operation reaches a length of 734.0km.

### EDUCATION ON TUNNELLING IN THE COUNTRY

Tongji University: Tunnel engineering;  
Tsinghua University: Tunnel engineering;  
Central South University: Tunnel engineering;  
Southwest Jiaotong University: Tunnel engineering; etc;



The cross-river section of Yangtze River tunnel



# Colombia



**Name:** The Colombian Tunnelling Committee

**Type of Structure:** The Colombian Tunnelling Committee is a non-profit association that has some of the biggest companies in the country involved in tunnels and underground works as members.

**Number of Members:** The Colombian Tunnelling Committee represents over 2000 engineers.

- Ruta del sol I, 3 short tunnels, 3500m
- Tesalia, 2 tunnels, L= 3500m each.
- Mulatos, L = 2500m.
- Irrá, L = 450m
- Amagá L=3600m.
- Oriente Tunnel 1, L= 786m
- Oriente Tunnel 2, L= 8200m
- Pamplona - Cúcuta road, 5 tunnels. 5200m total length.

Colombia has the following hydroelectric projects in the study, design and pre-construction phase which includes underground works:

- Hydroelectric Project El Buey, 190MW.
- Hydroelectric Project Chapasia, 385MW
- Hydroelectric Project Upia- Chapasia, 400MW.
- HPG Hydroelectric Project Samaná, 183MW.

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

The Committee participated in the WTC 2018 in Dubai with members of Working Group 3 (Contractual practices in underground construction) and Working Group 2 (Research)

Some members were part of a joint Task Group (TG 10) and developed the FIDIC Standard Form of Contract for Underground Construction Projects

The Committee was designated by the Colombian Society of Engineers to be part of the review team of the Tunnelling Design Manual Developed by Invias (Roads National Institute).

- The Youth Work Group added members from all over the country who developed a series of conferences with the purpose of expanding the Group.
- The committee organized a conference on Grouting Technology for Tunnels type TBM and Fiber Reinforced Concrete, with visiting lecturer Carlo Campinoti, technical manager at LATAM TM Concrete.

The committee WG developed technical talks on scientific knowledge of the engineering activity in the construction of tunnels and use of underground space.

WG3	Contractual practices in underground construction
WG6	Maintenance and repair of underground structures
WG12	Sprayed concrete use
WG15	Underground and environment
WG19	Conventional tunnelling
YM	ITA Young Members Group

## CURRENT TUNNELLING ACTIVITIES

In Colombia in 2018 important works were carried out associated with tunnels and underground space. Colombia has the following tunnels under construction

- La Línea main tunnel, L=8.600m d= 14m

- La Línea national road, 15 Short tunnels, 3.225m total length.
- El Toyo, L=9.840m.
- Buenavista 2, L=4.500m.
- Occidente 2, L=4.600m.
- Ruta 40 national road: 4 short tunnels, 2.077m total length.





- HPG Hydroelectric Project Cañafisto, 1200MW.
- HPG Hydroelectric Project Nechi, 588MW
- Hydroelectric Project Palagua, 99MW.
- Hydroelectric Project Talasa: 150MW.
- Hydroelectric Project Saldaña:
  - El Vergel, 137MW
  - El Placer, 65MW
  - Maracaibo, 86MW
  - Mitaca, 99MW
  - La Estación, 99MW

### FUTURE TUNNELLING ACTIVITIES

- The committee will organize the "Tunnelling Symposium" in 2019, in which all Working Groups will participate in topics covered during the year
- The committee will publish an academic article about tunnelling based on the local working groups research
- In 2019 the committee will organize more short talks with invited experts, which will be open to all interested members of the community.



### STATISTICS

**In Colombia about 3% of GDP is invested in infrastructure**

**In 2018 fourth generation (4G) roads had a total investment of US\$ 145bn, with 30 projects awarded, 22 under construction and 15 credit agreements.**

**75% of freight transported within the country is mobilized by land. 58km of tunnels throughout the country.**

### EDUCATION ON TUNNELLING IN THE COUNTRY

Application of geology and geotechnics in the design of tunnels - EAFIT University

# Costa Rica



**Name:** ACROS - Asociación Costarricense de Obras Subterráneas

**Type of Structure:** Private non profit, open association

**Number of Members:** 35 individual members, 3 corporate members

### ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

- Two day Seminar: "Use of the underground for mass transportation"
- One day course: "Planning of underground works"
- Strategic Planning Workshop
- Working Group for the drafting of a national technical regulation for the development of underground works
- Two meetings with the First Lady of the Republic
- Meeting with ITA Latin America National Groups in Colombia
- Preparation of II National Congress on Underground Works, to be held in March 2019

### CURRENT TUNNELLING ACTIVITIES

- During 2018, only minor works for hydroelectric tunnels (repairs) were developed at the Reventazón Hydroelectric Power Plant (which involved the construction of a new

gallery 6m in diameter and 200m deep, excavated using NATM) and the Río Hydroelectric Plant Male (a new tunnel of 1000m length and 4m diameter, also by NATM).

- In the process of constructing a hydroelectric tunnel of around 2km in length and 6.5m in diameter.
- Construction of about 2km of micro tunnels with pipe jacking.
- Start of a new underground pass under the circumvallation route

### FUTURE TUNNELLING ACTIVITIES

In order to call the attention of the authorities and the political class, we have launched the call for the Second Costa Rican Congress on Underground Works, CCROS 2019. It is a space for technical, financial, legal and political analysis of the development of the underground space in the country. It will evaluate the opportunities this presents and promote the mechanisms that will intensify its

use to solve some of the serious environmental problems that we face on the surface of the national territory.

Unfortunately, for much of the region myth prevails that underground works are too expensive. This conclusion is reached when an adequate evaluation of its benefits is not made. For this reason, the event reaches out regionally and we hope that people interested in Central America and the Caribbean can also participate. We will have renowned speakers who will contribute their experiences and knowledge to help consolidate the underground industry in the country and in the region.

### STATISTICS

#### 1. Length or volume excavated - % mechanized/% conventional during 2018

- % mechanized = 0%
- % conventional = 100%

### EDUCATION ON TUNNELLING IN THE COUNTRY

Course on Underground Works, as part of the Master Science Program on Civil Engineering of the University of Costa Rica (UCR)



# Croatia

**Name:** Croatian Association for Tunnels and Underground Structures - ITA Croatia

**Type of Structure:** Society, non-profit organisation

**Number of Members:** Persons : 20 Corporate : 5



## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

### Book publication:

"Tunnels 2 - Collection of 6 ITA/AITES Guidelines on Tunnelling" Prepared for: SEE Countries.

### E-book, with printed cover and contents Planned publishing volume:

600 pcs 1st issue: 200 pcs, Jan 10, 2018  
2nd issue: 100 pcs, Oct 15, 2018  
Promotion planned for: Sarajevo, Bosnia, April 2018. Podgorica, Montenegro, May 2018  
Opatija, Croatia, June 2018

### Tunnel Grič

- In the city centre of Zagreb the renovated pedestrian tunnel Grič re-opened on July 6, 2016
- The tunnel was constructed in 1943, during WWII and was used as a shelter during air raids
- Nowadays is used for artistic installations, exhibitions and is a part of the Christmas celebration in the city's performance
- The tunnel will be used as a performance location and exhibition space for the "Museum of senses"
- Length: 350m with a wider central hall L=100m.
- Width 3.5m, height 5.5m
- Exits: 2 portals and 4 side exits onto the main street
- Info: wikipedia

### Tunnel Učka, 2nd tube

- Second tube of the high-speed road Rijeka-Pula
- Length = 5630m, axis distance 25-30m to the first tube
- At the moment the design procedure and permissions are finished and the project is going into construction
- Construction should start in the conventional way
- It will enable a full highway profile connection from Rijeka to Istria peninsula
- It is part of the Istrian Ypsilon highway concession
- BINA Istra is the concessionaire

- The concessionaire is collecting finances to start with construction

### Tunnels on the highway Zagreb-Macelj, AZM concession, toward Slovenia

- 6 tunnels on the highway as part of the regular concession



Tunnel Učka, 2nd tube

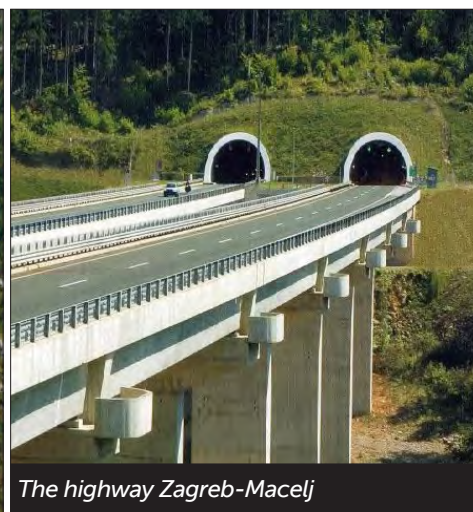
- There are 6 tunnels on the route, 2 of them with one tube: Sv.Tri Kralja (1725m) and Brezovica (590m) that are expected to be constructed in 2nd phase of construction

### Tunnels on the Peljesac Peninsula

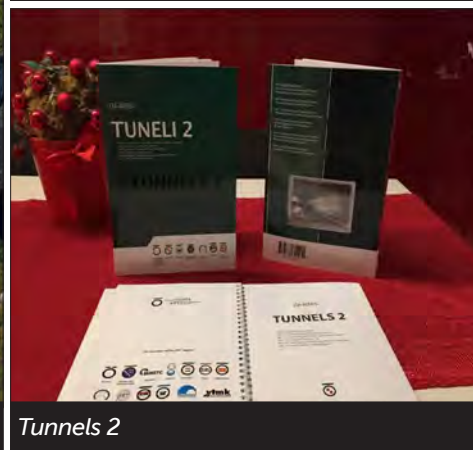
- 4 tunnels should begin construction on the Peljesac peninsula with lengths of: 0.5km, 2.5km, 1km and 1.5km, all in limestone, with single tube, and double track

### Tunnels on the Zagreb - Rijeka and Zagreb railway Junction

- All in design with underground parts at Zagreb junction and approaching Rijeka



The highway Zagreb-Macelj



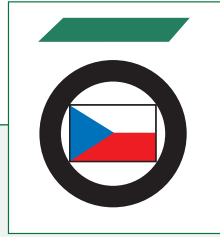
Tunnels 2

## FUTURE TUNNELLING ACTIVITIES





# Czech Republic



**Name:** Czech Tunnelling Association

**Type of Structure:** non profit, open association

**Number of Members:** total number: 92  
number of corporate members: 41

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

- 1) In 2018 the Czech Tunnelling Association (CzTA) continued with organising the "Tunnelling afternoons". The lectures were on the themes:
  - Historic Underground Workings
  - Current Tunnel Construction Project Abroad
- 2) CzTA continued publishing "Tunel" journal (four issues).
- 3) CzTA organised a technical excursion to Stockholm in Sweden to the construction site of the Stockholm bypass road (E4 The Stockholm Bypass Project).

## CURRENT TUNNELLING ACTIVITIES

In 2019 the Czech Tunnelling Association (CzTA) will continue with these activities:

- 1) On June 3-5, 2019: The 14th International Conference Underground Construction Prague.

- 2) "Tunnelling afternoons" will be held on the topics:
  - Prague Historical Underground Workings
  - Foreign Tunnel Projects II
- 3) CzTA will hold a technical trip to the Brenner Base Tunnel.
- 4) The publishing of the "Tunel" journal will continue - four issues per year.
- 5) Members of a CzTA WG are preparing a publication on conventional methods of tunnelling.

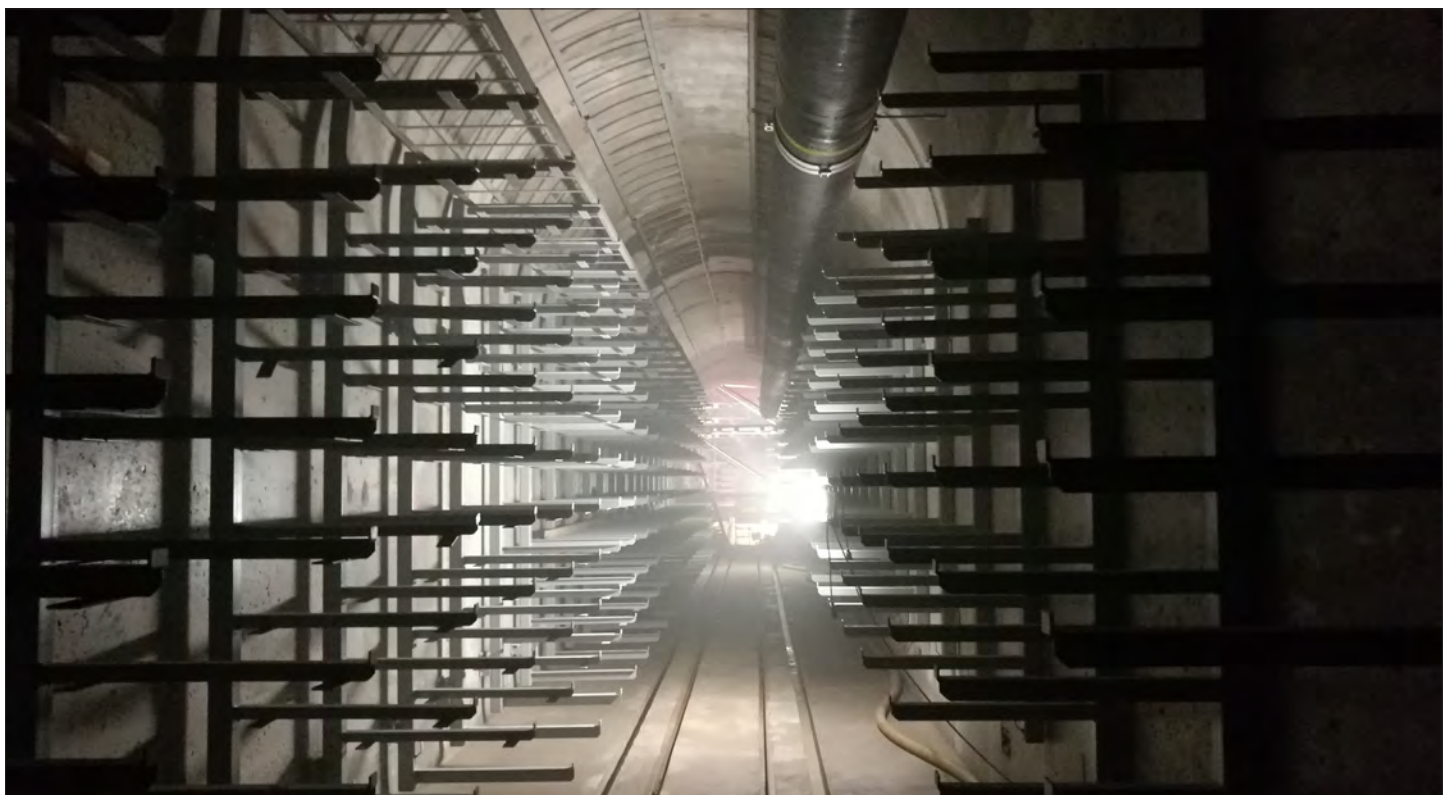


## STATISTICS

1. Length or volume excavated - % mechanized/% conventional during 2018 - 0
2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018 - 0
3. List of tunnels completed:  
Hlávkův Bridge Utility Tunnel
4. List of tunnels under construction - 0

## EDUCATION ON TUNNELLING IN THE COUNTRY

1. **Czech Technical University in Prague, Faculty of Civil Engineering**  
Bachelor and Master and Doctoral Study Programmes - Structural and Transportation Engineering  
Doctoral Study Programme - Building and Structural Engineering
2. **Brno University of Technology, Faculty of Civil Engineering**  
Bachelor, Master and Doctoral studies - Civil Engineering, Structures and Traffic Constructions
3. **VSB-Technical University Ostrava, Faculty of Civil Engineering**  
Bachelor, Master and Doctoral studies - Geotechnics





# Denmark



**Name:** Danish Society for Tunnels and Underground Works

**Type of Structure:** non-profit, open association, NGO

**Number of Members:** 35 corporate members, 230 individual participants

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In 2018 the Danish Society for Tunnels and Underground Works worked actively to promote the use and awareness of tunnelling and underground construction both towards the industry and society as a whole. This has included participation in the ITA Committees and working groups on the international level and on the national and regional scene including arranging 5 events and member meetings, including a workshop on BIM for tunnelling.

The Danish Tunnelling Society's Young Members group arranged 2 presentations and site visits

## CURRENT TUNNELLING ACTIVITIES

### Copenhagen Metro Extension Southern Harbour

The Copenhagen Circle Metro which is due to open its 17 underground stations for operation in 2019, will be extended by 8km of TBM tunnels and 5 underground stations to include the southern harbour residential area within the metro network. The Civil works contract was awarded in February 2018 and construction will start later in 2018.

### Copenhagen Metro Extension Northern Harbour

In the Northern Harbour area the metro extension work is progressing well and in 2018 the TBM tunnels were completed. Works on the above ground section of the metro as well as the 3 stations is on-going.

### Damhusledningen Storm Water Tunnel

In the Copenhagen suburb of Hvidovre the last 800m of the Damhusledningen project consisting of a 1.6m diameter EPB and 6 circular shafts is being constructed.

### Strandboulevarden Storm Water Tunnel

In Northern Copenhagen the Strandboulevarden Storm Water Tunnel consisting of 900m of 2m diameter TBM tunnel and 220m of 2.5m diameter TBM tunnel including 4 shafts is under construction.

## FUTURE TUNNELLING ACTIVITIES

Expected projects in the coming 5 years

**The Fehmarn Belt Fixed Link** - 18km immersed tunnel for road and rail connecting Denmark and Germany. The work has been contracted. Actual start of work is awaiting Authority approval in Germany. The tunnel will be the world's longest immersed tunnel.

**Road tunnel below the Northern Harbour in Copenhagen** - 1.5km of immersed or cut & cover tunnel under the northern harbour of Copenhagen is in the planning process. It will contain 2x2 road lanes and be a continuation of the Nordhavnsvej tunnel opened to traffic in December 2017.

**Storm water tunnels** - several projects with > 15km of TBM tunnels for flood control due to heavy rain.

### The Svanemøllen stormwater project

The project in Copenhagen consist of 8km of tunnels with an internal diameter up 4.3m, and 9 shafts with diameters up to 25m, and 30m depths. A number of other storm water control projects are expected to also start within the next 5 years.



Secant piling for Metro station

# Egypt



**Name:** Egyptian Tunnelling Society

**Type of Structure:** Non Governmental, non-profit, open association

**Number of Members:** 328 members, 13 corporate members

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In 2018 the Egyptian Tunnelling Society continued working to show society the benefits of the underground environment, both through the implementation of technical events, and the dissemination of materials via technical events.

Several activities, like Lectures and Presentations at engineering events were developed through 2018. The lectures titles were:

- 1) Geo environmental Impact of Egyptian Soil Formations on the Safety of Structures.
- 2) The 10th Ramadan Railway Project.
- 3) The Role of Numerical Modelling in Tunnel Rehabilitation
- 4) Small Holes - Major Consequences, tunnels and deep excavation in sand.
- 5) Innovative Methods and Concepts around Sprayed Materials Technology for Sustainable Construction Solution.

Additionally, a mini-symposium was organized in collaboration with the ICCEE2018 conference at Hurghada (24-26/11/2018). Preparation for the ETS Conference & Exhibition 2019 (<http://icgi2019-ets.org/>) started earlier in 2018.

## CURRENT TUNNELLING ACTIVITIES

**The Greater Cairo Metro Line 3** is 47km in length of which nearly 29km are underground together with 38 stations. The route extends from Cairo Airport to Imbaba. An additional branch to Mohandeseen of 6km, has been added which will also be constructed underground. The line crosses the River Nile twice. The planned capacity of the line when completed is 2.1 million passengers/day. Phases 1 and 2 are already finished and under operation. Phases 3A, 3B and 3C are currently under construction since December 2016, Phase 4A is finished and in operation as of December 2018, while phase 4B will be delivered in April 2020. The tender document for phase 4C is currently

under preparation and planned to start in November 2019.

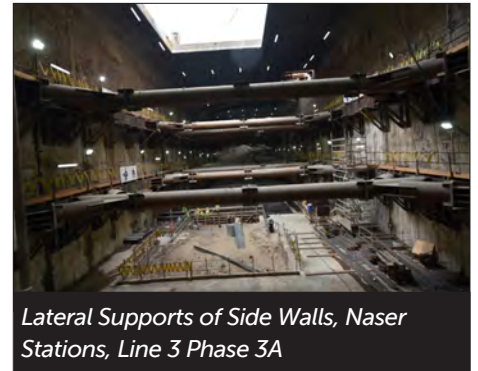
**The Line 4, phase I of the Cairo Metro** is already tendered and planned to start in July of 2019. The Study Area is defined by: Phase 1 of the proposed Metro Line 4, running from a depot/workshop via the Grand Egyptian Museum to El Malek El Saleh Station with a length of about 19km; and Phase 2 route between El Malek El Saleh and New Cairo with a length of about 22km, namely "Northern Route".



*The Tunnel Part between Attaba and Naser Stations, Line 3 Phase 3A*

## FUTURE TUNNELLING ACTIVITIES

- Greater Cairo Metro Line 4, Phase 1 and 2. The total length of Phase 1 is about 19km. Line 4 Phase 1 will cross the Nile river and crosses Line 1 at El Malek El Saleh Station and Line 2 at El Giza Station. The total number of stations in Phase 1 is 17. Phase 2 of the proposed Line 4 route starts from Fustat Station to New Cairo with a length of about 23.5km. The total number of stations in Phase 2 will be 19.
- Extension of Line 2 of the Greater Cairo Metro To Qalyoub with a total length of 8.8km.
- The studies of Greater Cairo Metro Line 5 with a total length of about 20km and 17 underground stations.
- LRT 10th of Ramadan Railway
- Rehabilitation of Cairo Metro Line 1



*Lateral Supports of Side Walls, Naser Stations, Line 3 Phase 3A*

## STATISTICS

1. Length or volume excavated 4km - % 100mechanized/0 % conventional during 2017
2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018  
€1.66bn
3. List of tunnels completed:  
Metro Line 3 Phase 4A
4. List of tunnels under construction  
Metro Line 3 Phases 3A, 3B,3C & 4B

## EDUCATION ON TUNNELLING IN THE COUNTRY

The basic courses for the analysis and design of underground structures especially with the Cut and Cover Technique are being implemented in all Egyptian universities at the undergraduate stage. Only a few universities are offering specialized tunnelling courses in both undergraduate and post graduate stages (Minia University, Ain Shams University, ..etc.) The ETS are currently investigating the different courses in all universities to prepare a database for tunnelling education in Egypt. However, the ETS is responsible for offering a practical training for some students and young engineers at NAT projects periodically.



*A finished station on Line 3*



# Finland



Maanalaisten Tilojen Rakentamisyhdistys  
Finnish Tunnelling Association

**Name:** Finnish Tunnelling Association - MTR - FTA

**Type of Structure:** non-profit, independent association

**Founded:** 1974

**Number of Members:** 111 Individual Associate Members, 27 Corporate Affiliate Members

**Incomes:** Annual fees and conferences as a main source of income

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

- Seminar of Urban Development Projects 10.4.2018
- Nordic Grouting Symposium 2019 in Finland: organizing committee work
- 3 Scholarships for students active in studies, working life as well as position of trust
- Participating in the work of FISE Qualification of Professionals in Building, HVAC and Real Estate Sector in Finland
- In co-operation with the Finnish Association of Civil Engineers RIL: Applied and received the host of ACUUS 2020 - Conference to Finland. Agreement under negotiation.

## CURRENT TUNNELLING ACTIVITIES

### Blominmäki Underground wastewater treatment plant (under construction):

- The treatment plant will process the wastewater of 400,000 residents (2020)
- By 2040: 150,000m<sup>3</sup> of wastewater will flow through the new treatment plant daily
- More info: <https://www.youtube.com/watch?v=D9PwTx4rQ0>

### Helsinki Metro Western Extension to Espoo (under construction):

- Helsinki metro will be extended to the west in two phases: 8 + 5 new stations.
- The first phase was ready in autumn 2017.
- The metro will operate on a rail line of

21km, all underground in two parallel tunnels.

- In addition to the stations, a total of 23 shafts will be built for pressure equalization, ventilation and smoke extraction. The shafts will also be used as emergency exits.
- More info: <https://www.lansimetro.fi/en/home/>

### The Helsinki Olympic Stadium (under construction):

- Modernization and renewal project 2016 - 2019
- Total excavation volume 145 000m<sup>3</sup> including tunnelling
- More info: [www.stadion.fi](http://www.stadion.fi)

### Töölö Parking Facility:

- Underground parking facility in Helsinki City Centre for 800 cars
- Will be ready 2019

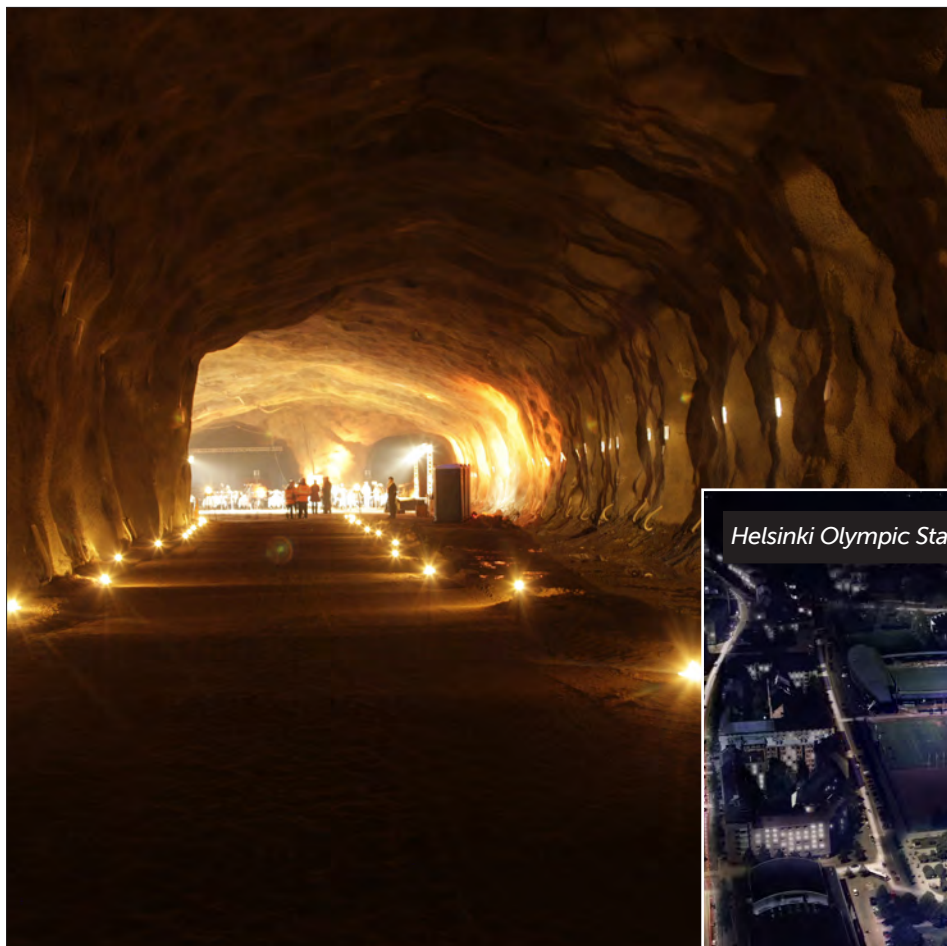
### Waste Water Treatment Plant Mikkeli:

- The Waste Water Treatment Plant in Mikkeli is responsible for producing drinking water and treating wastewater for about 55,000 inhabitants in the city and its surrounding areas.
- Expected to begin operating in 2020.

## FUTURE TUNNELLING ACTIVITIES

### Jokeri Light Rail (Planning):

- One of the key projects for orbital cross-region public transport in the capital area
- The City Councils in Helsinki and Espoo approved the construction of the Jokeri Light Rail in June 2016. The aim is to start construction work on the line in 2019.
- The planned length of the line is approximately 25km (15.5 miles), the line will have 33 stops.
- More info: <https://raidejokeri.info/in-english/>

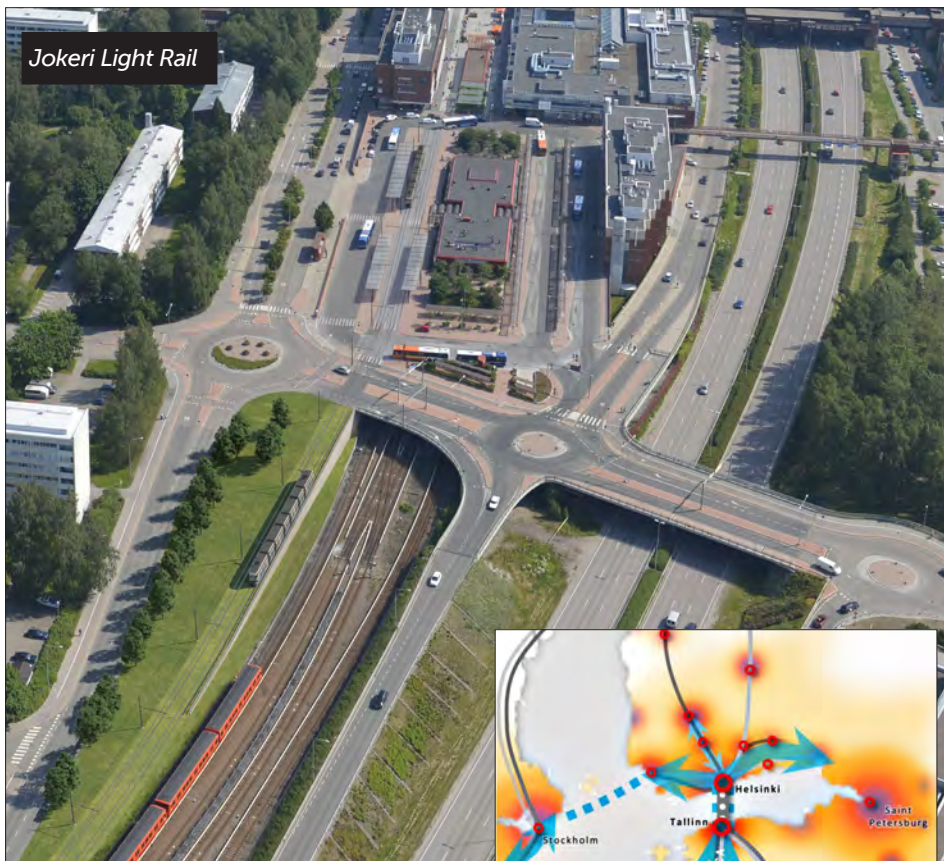


Helsinki Metro Western



Helsinki Olympic Stadium





#### City Rail Loop Pissarata (Waiting for the decision)

- The City Rail Loop is a planned urban railway line for commuter trains under Helsinki city centre.
- The city plan has been approved but the decision on the construction has not yet been verified.
- More info: <https://www.liikennevirasto.fi/pisara#.WgrnFU32SM8>

#### FinEst Link (Feasibility study):

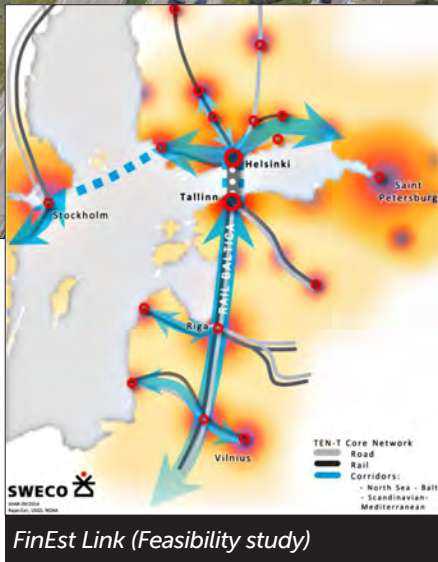
- Information, statistics and research about the cities of Helsinki and Tallinn and the increasing mobility between them.
- A proposal to build a 85km under-sea railway tunnel linking Finland and Estonia
- Construction 2035-2045?
- More info: <http://www.finestlink.fi/en/>

#### Esplanadi waste water tunnel (Planning, waiting for decision on construction)

- Improve the waste water service in the centre of Helsinki
- Length 1km

#### Underground Parking hall in Katajanokka (Planning, waiting for decision on construction)

- Excavation volume of 90 000m<sup>3</sup>
- 500 car slots
- €25M
- Construction 2020-2021



#### Garden Helsinki (Planning, waiting for decision on construction)

- Event arena providing sports and culture events, shopping facilities, apartments
- Private funding
- Excavation volume of 800 000m<sup>3</sup>
- Construction 2020/2021
- More info: <http://www.gardenhelsinki.fi/en/>

#### Traffic tunnel in Sörnäinen (Planning, waiting for decision on construction)

- Two parallel tunnels
- Length of 800m
- Excavation volume of 270 000m<sup>3</sup>
- €160M
- Construction 2021-2025?

#### Underground Distributor Street Project (Planning, waiting for decision on construction)

- Located in the central city
- Excavation volume of 2 000 000m<sup>3</sup>
- Length of 4.2km
- Construction: 2027 - 2032?

## STATISTICS

### Underground (UG) Spaces in Helsinki:

- Area 2 073 725m<sup>2</sup> = 2,074km<sup>2</sup>
- Volume 12 657 457m<sup>3</sup>
  - UG spaces altogether 336 pieces
  - Helsinki's surface area 215,12km<sup>2</sup>
  - 1m<sup>2</sup> UG space for each 100m<sup>2</sup> surface area i.e. 1 %
- Tunnels altogether 293km
  - 194km of technical tunnels
  - 34km of traffic tunnels
  - 30km of tunnels with secondary purpose as emergency shelters
  - 14km of parking caverns
  - 22km of tunnels for other purposes.

## EDUCATION ON TUNNELLING IN THE COUNTRY

### Aalto University

- GEO-E1010 Engineering Geology
- GEO-E1040 Rock Excavation
- GEO-E2030 Rock Mechanics
- GEO-E2040 Rock Construction
- GEO-E2060 Seminar in Geoenvironment
- GEO-E2090 Project Course in Geoenvironment

### Tampere University

- RAK-22410 Rock Engineering
- RAK-23410 Advanced Course in Bedrock Engineering

### University of Oulu

- Rock Mechanics
- Mining Technology
- Rock Blasting
- Applied Rock Mechanics
- Rock Dynamic and Applications

### Lapland University of Applied Sciences + Kajaani University of Applied Sciences

- Rock Excavation and Mining Technology
- Rock Engineering

### Metropolia University of Applied Sciences

- Soil and Rock Construction

### Saimaa University of Applied Sciences

- Rock Excavation and Safety Regulations for Blasting Works
- Underground Excavation and Rock Reinforcement Methods
- Rock Mechanics

### Turku University of Applied Sciences

- Rock Engineering



# France



**Name:** Association Française Des Tunnels Et De L'espace Souterrain French Tunnelling And Underground Space Association

**Type of Structure:** non profit, open association

**Number of Members:** 1029 members - 548 French individuals, 149 foreign individuals, 74 retired, 39 students, 121 French collectives, 9 foreign collectives, 31 others (schools, bookshops), 16 Young members, 42 Master TOS.

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

### AFTES coordinates its activity with 6 committees:

**Technical Committee:** The Technical Committee leads twenty active working groups, i.e. approximately 200 members involved. A new edition of recommendations has been launched in 2018. The recommendation GT 16 FR about impacts of tunnelling on the surrounding buildings was the 1st one to be edited and the recommendation GT 35 FR entitled "The management and use of excavation materials" will be published very soon in early January 2019.

**Underground Space Committee:** The 2nd phase of the national research project on underground space use has published its latest report leading to more than 36 research reports already edited, in addition to which are communications such as symposia or seminars. All this information is gathered on the national project website ([www.ville10d.fr](http://www.ville10d.fr)): socio-economic approach, environmental

approach, societal approach, data management visibility, transversal and synthesis. The Committee has also been very active in involving architects and urban planners around the topic of underground space use.

**Education Committee:** The twelve students enrolled in the 2017-2018 Master's degree in tunnelling in Lyon all received their diplomas at the end of the year, and all were hired immediately after their internship. The 2018-2019 promotion (8th promotion) includes seven students. Some modules of the Master's degree are open to everybody. The Committee is also involved in the setting up of specific training and courses; the need for competence is currently very high due to our huge tunnelling construction programme.

**Materials, Equipment, Products Committee:** The committee has played its role in serving manufacturers and suppliers by proposing and organizing presentation booths at congresses or

exhibitions: AITES WTC in April 2018 in Dubai, Savoie Fair in September in Chambéry, PIARC International Congress in Lyon in October. The committee also organised a technical conference on tunnelling boring machines.

**Congress Committee:** The committee is in charge of the preparation of the AFTES triennial International Congress that will be held from 21 to 23 September 2020 at the Palais des Congrès in Paris. The general theme chosen is "The underground, a space for innovation"

**Young members Committee:** A committee for young members has been set up in 2018. It is very active to gather more and more young professionals and involve them in our collective actions.

And AFTES is still publishing its Tunnels & Underground Space magazine in French and English. A lot of information is also available in both languages on the website <http://www.aftes.asso.fr>.

## CURRENT TUNNELLING ACTIVITIES

### Paris Eole

The extension of the railway line RER E to the west includes the construction of 8 km of tunnel between Saint-Lazare and Nanterre in a very dense urban area.

### Paris Extension of Metro line 14 North and South

From Saint-Lazare to Mairie de Saint-Ouen, 2 TBMs are on the home stretch of boring the 5.8km tunnel of the Northern extension of Line 14. The Southern extension to Orly Airport is just starting.

### Great Paris - Metro: Line 15 South

Two TBM have already been launched in 2018. The first one, from Champigny, will excavate 2.17km, the second 4.9km. Up to 10 TBMs will be mobilized to dig this 33km long new metro line from Noisy-Champs to Pont de Sèvres in the South of Paris.

### TELT Lyon - Turin

The 57.5km long international railway tunnel linking France and Italy is a major European issue. Initiating this huge project, the TBM Federica is digging 9km of exploratory gallery in the axis of the future base tunnel.

### ANDRA - Bure

Construction work on the underground laboratory began in 2000 in the commune of Bure. The experimental



commune of Bure. The experimental laboratory, 445m deep, is composed of a set of galleries where tests and studies have been conducted.

#### **SYTRAL - Line B of the Lyon metro**

The Lyon metro company, SYTRAL, began construction work of the 2.5km long extension on the Metro Line B between Oullins and Hôpital Sud.

#### **Rennes - Metro: Line B**

Completion of the civil works for the second automatic metro line for Rennes. Line B will connect the southwest and northeast of the city and will serve 15 stations by 2020

#### **FUTURE TUNNELLING ACTIVITIES**

##### **Great Paris - Metro: Line 16-17**

After line 15 South, the work programme will be extended to Lines 16 and 17. Lot 1 and Lot 2 of Line 16 have already been awarded, meaning the imminent start of construction of 25km of tunnel with 8 stations from Saint Denis Pleyel to Clichy Montfermeil.

##### **Toulouse: Metro: Line 3**

Line 3 (Aerospace Express) from Colomier to Labège is 28km of infrastructure including 18km in tunnel. Twenty stations are planned.

##### **Marseille - Metro: Extension of the Line 2**

A 13.8km long project between the Captain Gèze to St Loup Pagnol stations, including an underground section of approximately 4.8km with 5 stations.

##### **Meudon - Railway evacuation gallery**

Creation of an evacuation gallery, approximately 1km long, parallel to the existing in service railway tunnel, to allow the evacuation of RER C users via two emergency exits in the event of an accident.

##### **Lyon - Road**

The Grand Lyon Metropole is currently carrying out studies for the Ring of Science project. The first phase of this project will include a section of 14.6km, of which 12.9km is underground, west of Lyon.

##### **Lyon - Metro: New Line E**

SYTRAL has prepared preliminary studies for a 12km metro project linking the City centre to Tassin-la-Demi-Lune.

#### **STATISTICS**

##### **1. Length or volume excavated - % mechanized / % conventional during 2018**

10km (80% mechanized and 20% conventional)

##### **2. Amount (USD or EUR) of tunnelling/underground space facilities awarded in 2018**

€1000M

##### **3. List of tunnels completed:**

Nice tramway, Rennes Metro Line B

##### **4. List of tunnels under construction**

Paris Eole, Great Paris Metro, TELT Lyon - Turin, ANDRA - Bure Lyon Metro line B

# UNDERGROUND SOLUTIONS SEMINAR



## London, UK

Save the date

## 29th October 2019



### More information online on

[www.bm-underground.com/seminars](http://www.bm-underground.com/seminars) or  
preregister via [uss@bm-underground.com](mailto:uss@bm-underground.com)

### Organized by

**Bekaert Maccaferri** Underground Solutions

Because we are tunnelling

[www.bm-underground.com](http://www.bm-underground.com)



# Germany



**Name:** Deutscher Ausschuss für unterirdisches Bauen e. V. (DAUB, German Tunnelling Committee)

**Type of Structure:** Registered non-profit and restricted association (limited to 30 individual members)

**Number of Members:** 30 members

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

### Activities

- DACH-meeting (German, Austrian, Swiss Tunnelling Committees) in Austria (technical seminar and site visit)
- Sealing of buildings by injections; Information on post-sealing of concrete structures, geotechnical sealing injections, 21-22 November 2018
- Munich Tunnel Symposium, 8 June 2018
- InnoTrans, Tunnel Forum, 18-21 September 2018, Leading int. trade fair for transport technology
- Several Meetings with workshops for Young Engineering Professionals "STUVA YEP"

### Working Groups

- Financing of tunnels via PPP/BOT-projects

- Recommendations for contracts with low potential for conflicts
- Requirements for refuge chambers
- Life-cycle costs calculation
- Face Support Pressure Calculations for Shield Tunnelling in Soft Ground
- Design, production and installation of segmental rings
- External communication of DAUB
- Digitization and Building Information Modelling (BIM) in tunnelling
- Selection of tunnelling machines
- Planning and implementation of occupational health and safety concept on underground worksites

### Publications (recently finished)

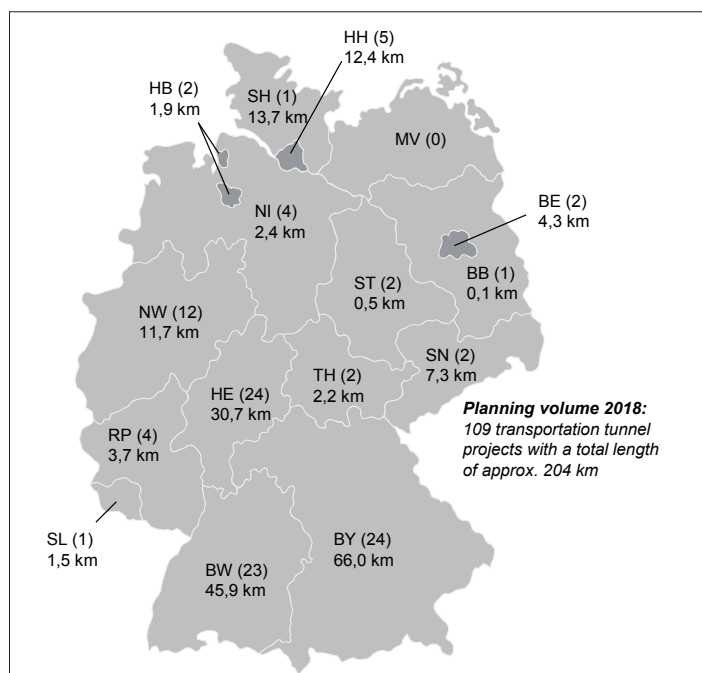
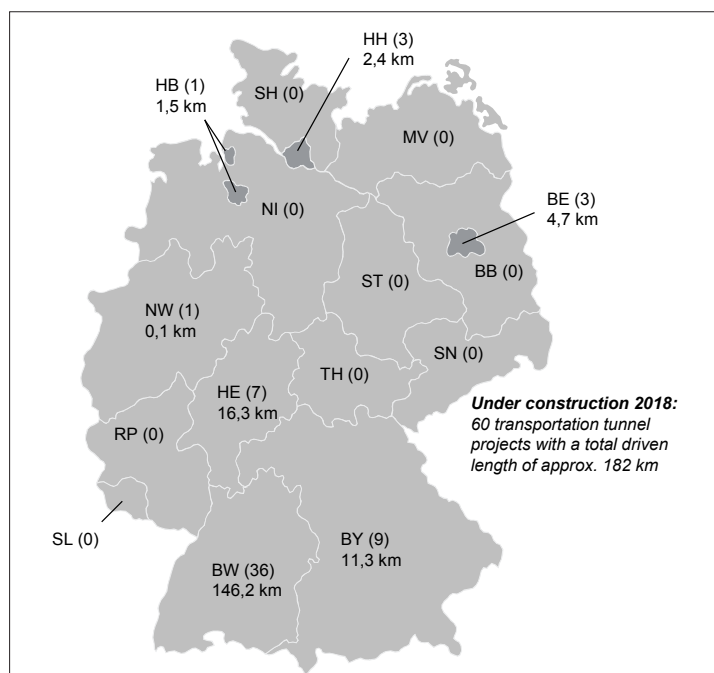
- Recommendations for the Life Cycle Costing of Road Tunnels
- Recommendations for the Use of Refuge Chambers on Underground Construction Sites
- Rehabilitation Strategies and Procedures for Traffic Tunnels

### Publications of DAUB can be found in/on

- Journal "tunnel" ([www.tunnel-online.info](http://www.tunnel-online.info))
- German Handbook of Tunnelling ("Taschenbuch Tunnelbau", published annually)
- Recommendations are available for download from the website ([www.daub-ita.de](http://www.daub-ita.de)); the majority is bi-lingual (German/English)

### Future Activities

- Regular meetings with Austrian and Swiss colleagues
- STUVA-Conference 2019, Separate Segments on "Tunnelling" and "Tunnel Operation", 26-28 November 2019, Frankfurt



Length-related classification according to federal states for transportation tunnel projects under construction, with the number of registered transportation tunnel projects given in brackets

Length-related classification according to federal states for future transportation tunnels, with the number of registered transportation tunnel projects given in brackets



*Conventional drive for the Oberau road tunnel in Bavaria*

### CURRENT TUNNELLING ACTIVITIES

About 182km of traffic tunnels are under construction in Germany in 2018.

- This year, the main activities relating to inner-urban rail tunnelling - just like last year - are taking place in Stuttgart, where some 10.6km of urban and rapid transit tunnels are under construction (at the turn of the year 2017/2018). This is followed by Karlsruhe (4.7km), Frankfurt/Main (4.4km) and Berlin (3.2km). Further tunnelling projects amounting to less than 2km are underway in Nuremberg, Hamburg and Dortmund.
- The main-line rail tunnels largely relate to DB Netz AG tunnelling works in and around Stuttgart. Of the tunnelling projects currently being implemented (a total of 121km), almost 52km are accounted for by the major project "Stuttgart 21 rail hub" and some 59km by the new Wendlingen-Ulm rail route. Further main-line tunnels are being produced in conjunction with the upgraded/new Karlsruhe-Basle section. Currently, 33% of main-line tunnels are being constructed using NATM, whereas TBMs account for 61% of the driven volume.
- The drive-up length in road tunnel construction in 2018 was approx. 36km throughout Germany. More than 50% of the drive-on length was accounted for by the federal states of Baden-Württemberg and Bavaria. NATM predominates in the majority of cases as far as trenchless projects are concerned.

### FUTURE TUNNELLING ACTIVITIES

About 204km of traffic tunnels are projected but not yet started in 2018.

- There has been a marginal increase in the number of underground, urban and rapid transit tunnels planned (58km). In this context, the planned volume for the city of Munich, comprising a good 30km, is still conspicuous among the projects being planned. Almost 10km of tunnels are being planned for the Hamburg Metro (partly at the pre-planning stage). Leipzig is engaged in the pre-planning of 7km and further tunnelling activities involving less than 3km are foreseen for the cities of Frankfurt/Main, Nuremberg, Berlin,

Düsseldorf, Stuttgart and Dortmund.

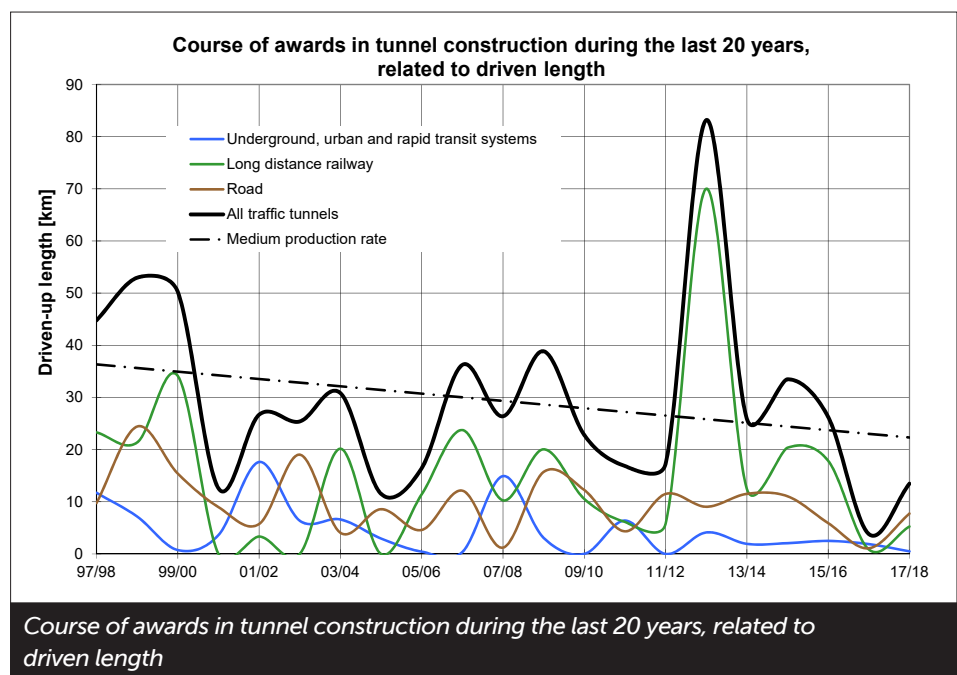
- Regarding the planned volume of main-line rail tunnels (40km), it should be noted that practically half is accounted for by the tunnels approved for the new/upgraded Karlsruhe-Basle rail line (driven length: some 19km). Further tunnels are planned in conjunction with the new/upgraded Rhine/Main-Rhine/Neckar route (9km) and on the Nuremberg-Fürth rail line (7km).
- The planned volume of projected road tunnels (106km) has again decreased slightly, due primarily to a lack of awards. On account of the German state's revamped planning requirements, the scheduled volume has dipped considerably in recent years.

### STATISTICS

Detailed statistics available at <https://www.stuva.de?statistik>

### EDUCATION ON TUNNELLING IN THE COUNTRY

Many Universities and Universities of Applied Sciences offer numerous courses on tunnel related topics and provide extensive possibilities for interested persons (see e.g. MSc "Geotechnics and Tunneling", 4 Semester Mastercourse in German language at the Ruhr University Bochum, BSc Civil Engineering required).



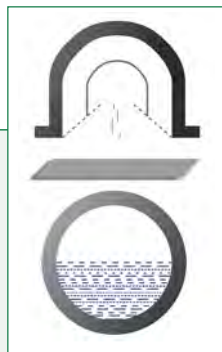


# Greece

**Name:** Greek Tunnelling Society

**Type of Structure:** non-profit association with membership

**Number of Members:** 360 members, 10 corporate members



## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In 2018 the Greek Tunnelling Society (GTS) continued working to promote the environmental, social, technical and economic advantages of the construction and operation of tunnels and underground space.

The Council Board executed monthly meetings for the organization of GTS activities as well as for the restructuring of its whole profile (a search for sponsors who could be directly promoted via the web-site as well as the electronic magazine which is published at least three times per year).

Three issues of the Greek Tunnelling Society's electronic magazine were published.

The Young Members Group promoted tunnelling news, research results, new projects etc both in Greece and abroad via social networks (facebook page).

An evening lecture on 6-2-2018 was co-organized with i) the ELLINIKI ETAIRIA - Society for the Environment & Cultural Heritage and ii) the Interdepartmental Program of Post Graduate Studies of AUTH for "Protection, Conservation and Restoration of Cultural Monuments" for the Eupalinos tunnel of Samos.

A half-day conference was organized for the 16th-1-2019 titled "Licensing

- Monitoring/Surveillance Methods -Experiences from the Operation of the Greek Tunnels Motorways". The lectures were delivered by representatives of the main motorway concessionaires as well as by a representative of EGNATIA ODOS S.A.

## CURRENT TUNNELLING ACTIVITIES

### ATTIKO METRO (Athens METRO)

Since March 2012 the construction of Athens METRO Line 3 extension to Piraeus. The 7.6km long new Metro line 3 will consist of 6 modern Metro Stations, 6.5km of the tunnels were constructed using TBM. The Metro Extension to Piraeus will serve approximately

132,000 passengers on a daily basis. Tunnelling excavation works are completed, and works are currently under way for the construction of the stations.

### Thessaloniki METRO

The main Thessaloniki Metro line includes: 13 modern centre platform stations arranged along 9.5km of tunnels (in two independent single track tunnels) constructed mostly (~80%) by two EPBMs and a 50,000m<sup>2</sup> depot in the Pylea Region. The excavation and final lining of the twin single-track tunnels is complete.

In 2013, the contractor was assigned for the construction of the extension line to Kalamaria which includes 5 stations and 4.78km tunnels. The excavation and lining of the twin single-track tunnels is almost completed.

### Athens - Thessaloniki Railway

The 106km long new railway alignment section "Tithorea - Lianokladi- Domokos" became operational in late December 2018. It includes the 9.036km long Kalidromo twin tunnels and the 6.4km long twin tunnels which pass through Othrys Mountain and leads to the Xiniadas plain.

### Central Athens railway Station - Three bridges area.

The €66M project involves the

construction of a 2.36km long four-track rail corridor, 60% of which will be through a fully underground alignment.

### Athens - Patras railway: Psathopyrgos - Patras (Bozaitika area) section

The project involves the construction of infrastructure for the new 10.5km double-track railway line. It includes infrastructure works, installation of the track bed of the new railway line, as well as construction of structures, the most important being the 2 cover & cut tunnels, one in the Ag. Vassileios area, 62597m long, and one in the Rio area. The project is 39220m long. There are 9 Railway Bridges and approx. 33 Overpasses of the intersecting road network, and 3 Road Bridges for the side road network

### Athens - Patras railway: Rododafni - Psathopirgos section

The project involves the construction of the infrastructure for the new double railway line, 21.5km long, between ch. 91+500 to ch. 113+000 and includes the Panagopoula twin tunnels (approximately 4,800m long each).

### Halkidiki mining project

Underground mining works in Chalkidiki, northern Greece.

## FUTURE TUNNELLING ACTIVITIES

### New Athens Metro Line 4 - Section A "ALSOS VEIKOY - GOUDI" - a €1.6bn Design and Built Contract.

The 13km long, fully automated new Athens METRO line 4, will consist of 15 stations. The project includes tunnelling works, underground stations, station fit-out, mechanical and electrical systems, rail Infrastructure and rail systems.

The Invitation to Tender for the Main (Design & Build) Contract (Stage B) is estimated to be completed in 2019. The planned construction period will be 8



Central Athens Railway Station - Three bridges area

years starting in midsummer 2019. The Tender will be conducted in accordance with the stipulations of Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors (E.E.L94/243/28032014) and in line with Greek Law 4412/16. The criterion for the Contract award will be the most advantageous offer, in financial terms, on the basis of best quality-price relationship.

**Underwater road link connecting Salamina - Perama in Attica region - Estimated cost ~ €400.**

A competitive dialogue process is underway between the three preferred interested parties. The project concerns the design, construction, financing, operation, maintenance and exploitation



Tithorea Domokos Railway Tunnel

of an approximately 15km long highway which includes a 1.2km long immersed tunnel and three tunnels with a total length of 2km.

**North Motorway of Crete (BOAK)**

A concession project concerning the design, construction, financing, operation, maintenance and exploitation of an approximately 200km long motorway which includes a significant number of tunnels (total length ~20km). The project is split in 2 separate competitions i) a concession agreement for the section between Chania and Hersonissos and ii) a PPP project for Hersonissos-Neapolis section. The costs have been estimated at around €1.1bn for the concession project and €359.6M for the PPP project. The tendering process involves a Competitive Dialogue. Currently the Contracting Authority (Ministry of Infrastructure and Transport) is examining the technical skills of the interested parties.

**Immersed road tunnel connecting Lefkada island - Aetoloakarnania**

A project which concerns the design, construction, financing, operation, maintenance and exploitation of an approximately 4km long highway which includes an 0.6km long immersed tunnel

(plus 0.5km entrance and exit). The project is currently under planning.

**STATISTICS**

- 1. Length or volume excavated - % mechanized / % conventional during 2018 - 90%**
- 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018 - €63.2M**
- 3. List of tunnels completed:**  
Kalidromo tunnel
- 4. List of tunnels under construction**  
Athens METRO extension to Piraeus, Thessaloniki METRO

**EDUCATION ON TUNNELLING IN THE COUNTRY**

**National Technical University of Athens**

Postgraduate Course  
*Design and Construction of Underground Works*  
Schools: Mining and Metallurgical Engineering/Civil Engineering  
(more info: <http://tunnelling.ntua.gr/>)  
*Bochum, BSc Civil Engineering required*).

# Guatemala



**Name:** Asociación para la Construcción e Investigación Subterránea de Guatemala (ACISGUA)

**Type of Structure:** non profit, open association

**Number of Members:** 25

**ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE**

- Seminar in the Chamber of Civil Engineers of Guatemala about Aspects of Underground Construction; (07/2018)
- Presentation of a Law Initiative for Permitting Municipal Concessions for Underground Space Use and Infrastructure; (11/2018)
- Presentation of a Conceptual Project for a Metro Mass Transportation System for the City of Guatemala;
- Presentation of the Conceptual Project Corredor Este-Oeste of the Metropolitan Region of the City of Guatemala;

- Presentation of the Prefeasibility Study of the Corredor Oriente Metropolitano (COM) as a private city road infrastructure project;

**CURRENT TUNNELLING ACTIVITIES**

- Currently there are no tunnelling activities in Guatemala.

**FUTURE TUNNELLING ACTIVITIES**

For the coming years, as a result of planning and development activities in the fields of mass transportation and infrastructure, the tunnelling sector will be growing. If the legal framework will pass successfully through parliament during the coming months, by the

end of 2020 the privately developed and financed City tunnel "Corredor Oriente Metropolitano" (COM) will start construction.

The City Development Plan 2020-2040 foresees the construction of a City Tunnel crossing the centre of Guatemala Downtown taking traffic out of the Downtown area to the West side of the City.

The local Brewery is about to start a project for an access tunnel to an underground water well pumping station. The infrastructure for the well foresees a Chamber 20m x 12m x 10m at the end of a 1km access tunnel.

**EDUCATION ON TUNNELLING IN THE COUNTRY**

**General Course about Tunnel Construction and geomechanical characteristics of Guatemala City underground space**



# Hungary



**Name:** Hungarian Tunnelling Association

**Type of Structure:** non-profit, open association

**Number of Members:** 65 members, 21 corporate members



Work on the reconstruction of Metro line 3.

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

- The XXIVth Széchy Károly Memorial Lecture to the Hungarian Academy of Sciences in Budapest, February, 2018 (with the Hungarian Academy of Sciences: Section of Engineering Sciences, Geotechnical Department of Hungarian Chamber of Engineers, and Hungarian ISSMGE).
- In 2018 the Association held 2 General Assemblies: the annual General Assembly of the Association was held on 1st of March, and on the 10th of May.
- Geotechnika 2018 conference (8-10 October 2018).
- The biennial conference of the Hungarian Tunnelling Association was held in Budapest, 7th of November.

## CURRENT TUNNELLING ACTIVITIES

Currently the main tunnel work is the reconstruction of Metro line 3. Renewal of track, security system sealing of the tunnel and other maintenance works. The deadline of works is 2020. During this period there was no tunnelling (mechanised or traditional). There are pending infrastructure investments (motorways and railways) with tunnels in different phases of planning. The most important projects in the planning stage:

- M0 motorway North section (around

Budapest) - planning is finished and the project awaits the construction tender announcement

- M 100 motorway (Esztergom - M 1 motorway) tunnel design announced in TED (Tenders Electronic Daily) with the winner starting the geotechnical and environment protection study.
- M21 motorway (Hatvan - Salgótarján) - planning started in 2018

## FUTURE TUNNELLING ACTIVITIES

There is no expected tunnelling (mechanised or traditional) in 2018. Perhaps after the planning of the above-mentioned design works the construction of the planned tunnels could start in the coming years.

## STATISTICS

- 1. Length or volume excavated - % mechanized / % conventional during 2018 - 0%**
- 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018 - € 0**
- 3. List of tunnels completed:**  
There are no tunnels completed.
- 4. List of tunnels under construction**  
M85 Sopron " Bécsi hegy" motorway tunnels see below

# Iceland



**Name:** Icelandic Tunnelling Society

**Type of Structure:** Independent Society of corporate and ordinary members, founded 1974

**Number of Members:** 45 members, 17 corporate members

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

Four board meetings and an annual meeting with invited speakers.

## CURRENT TUNNELLING ACTIVITIES

### Vadlaheidi Road Tunnel, 7.2km

Project completed in December 2018 after a delay of two years due to geothermal activity and hot water inflows (up to 65 °C), fault collapse and a large inflow of cold water.

### Dyrafjörður Road Tunnel, 5.3km

Excavation continues on this road tunnel in Northwest Iceland which started in September 2017. Breakthrough is expected in spring 2019 and completion expected 2020.

## FUTURE TUNNELLING ACTIVITIES

- Some future tunnelling projects are being planned such as the Fjardarheidi Road Tunnel, an approximately 13km long road tunnel in East Iceland.
- Some underground hydroelectric projects also being planned.

## STATISTICS

- 1. Length or volume excavated - % mechanized / % conventional during 2018**  
Approximately 3.3km, drill & blast
- 2. Amount (USD or EUR) of tunnelling/underground space facilities awarded in 2018 - None**
- 3. List of tunnels completed:**  
Vadlaheidi road tunnel, 7.2km.
- 4. List of tunnels under construction**  
Dyrafjörður Road Tunnel, 5.3km.

# India

**Name:** Tunnelling Association of India

**Number of Members:** 300 members



## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

### Main activities:

- Organization of Conference
- Seminar
- Workshop
- Training Programmes

### TAI Awards

### TAI Young Member Group Launched

### Publications:

- Preparation of Manual and Guidelines  
TAI journal – 2 Nos. (Half yearly)

### TAI Publications:

- Guidelines for Precast Fibre Reinforced Shotcrete Segment;
- Guidelines for Geophysical Investigations for Tunnels

### Proceedings of the Workshops

- NATM & TBM Tunnelling including Risk Management
- Tunnelling in Himalayan Geology
- Tunnel Design and Construction: Issues & Challenges
- Innovation in Tunnelling Technologies
- Ventilation in Long Tunnels and Fire Safety
- Risk management in Tunnelling
- Observational approach in tunnelling : evolution, Issues and Challenges
- Drilling and blasting in tunnelling operations

### Proceedings of Tunnelling Asia'2019 Conference

## CURRENT TUNNELLING ACTIVITIES

The tunneling industry comprises around 1500 tunnels spanning over 3,000km. Of these, 900 spanning 1500km are operational and over 600 covering 1500km are under implementation. Hydropower tunnels account for the biggest share (around 60% in terms of no. of tunnels and 72% in terms of length). By 2030, the number of tunnel projects planned in different States in India will require an investment of US\$58bn.

### Hydropower Tunnels:

Considerable tunneling activity is involved in the hydropower projects and it is bound to accelerate since major thrust has been laid by the Govt. of India for harnessing available hydropower potential of 2,44,000MW including Pumped Storage development out of which so far about 40,000MW has been developed. Construction of these hydropower projects will involve extensive tunnelling, underground caverns and other connected infrastructure on a much larger scale of more than 1000km practically in every type of strata. Hydro power dominates the tunnelling industry both in number and length of tunnels as 980 major hydropower tunnel works covering over 2,165km. A typical hydropower tunnel project is an expensive venture, with an average cost of US\$10M/km. In terms of investment, the hydro tunnel market in India is estimated at US\$22bn.

### Metro Rail Tunnels

The Government of India has decided that cities with a population of more than 2 million will have metro rail such as Delhi & NCR extensions, Chennai, Bangalore, Mumbai, Kolkata, Hyderabad, Ahmadabad, Pune, Surat, Kanpur,

Lucknow, Nagpur, Indore, Coimbatore, Patna, Kozhikode, Raipur, Bhopal, Trivandrum, Chandigarh, Navi Mumbai, Ludhiana, Jaipur, Kochi etc. There are more than 21 cities which fall under this category where metro rail work is being executed/planned involving a total route length of 1391km, out of which 400km has been planned in tunnels involving an investment of about US\$25bn.

### Railway Tunnels

Railway tunnels account for a 29% share in overall tunnel length i.e. 453 railway tunnels is covering 332km. About 316 tunnels covering 138km length have been completed. About 137 tunnel works covering 194km are underway on various rail line projects. Important national projects already planned involve the construction of several tunnels of about 420km length and an investment of US\$6.3bn. On an average, a typical railway tunnel costs US\$15M/km.

### Irrigation, Urban Water and Sewerage Tunnels

Irrigation has the biggest market for tunnelling in the water and sewerage segment. Over 72 irrigation, urban water and sewerage tunnels spanning over 350km and water and sewerage tunnels spanning over 42km are planned to in Maharashtra and Tamil Nadu. The Ministry of Water Resources is planning tunnel projects of about 200km as part of river linking projects. There will be an investment of US\$0.6bn.

### Road and highway tunnels

Road and highway tunnels are more useful in the Himalayan region and Western Ghats. About 30 roads and





highway tunnels covering over 120km are planned to be awarded and implemented at an investment of about US\$2.5bn.

#### Underground caverns development:

Phase-I of the Indian strategic crude oil reserve programme involves construction of storage units of 5.33 million metric tonnes (MMT) at an expenditure of US\$0.6bn. Phase-II involves stocking of strategic reserves by Govt. of India involve storage units of 12.5 MMT at an expenditure of US\$2bn.

#### North East Frontier Railway

- As per 'Vision 2020' of Indian Railways, North East Frontier Railway (Construction) is executing a number of new projects to connect the capitals of the North Eastern states. Since the projects mostly pass through difficult terrain with deep gorges and high hills, construction involves a large number of tunnels..
- Jiribam-Tupul – Imphal New Line Project (110.62km): Out of total 59.5km of tunnelling involved, 42km has been completed. Construction is in full swing to complete the balance of 17.05km. The longest tunnel is between Tupul – Imphal, which is 11.55km.
- Bhairabi – Sairang New Line Project (52.35km) in Mizoram: There are 23 tunnels with a total length of 9.26km. The longest tunnel is 1.76km. Underground excavation and primary support in 5.2km has been completed and final lining is in progress.
- Dimapur – Kohima New Line Project (88km): About 30km of tunnelling is involved in this project.
- Barnihat- Shillong New Line Project (108km): There are 31 tunnels with total length of 39.06km, the longest tunnel is 4.11km.
- Sevok-Rangpo New Line Project: About 38.55km of tunnelling is involved in this project.
- Salonia – Khumtai New Line Project: (99km): About 17.65km of tunnelling is involved in this project.

#### Delhi Metro Phase- III project

- For the first time on the Delhi Metro, two of the tunnel drives have been completed by dragging the TBMs through a station. Naraina station box was completed with a temporary base slab on which both the TBMs were dragged through for completion of a small length of tunnel on the other side of the station.
- 45 EPBMs have been deployed by the



contractors. 26 worked simultaneously at the peak period, 20 are still working.

- There are total 74 tunnel drives out of which 57 drives have been completed and remaining 17 are in progress. Overall, present progress of tunnelling is 91%. The internal finished dia. of all the tunnels is 5.7 to 5.8m.
- Precast segmental lining has been used, with each ring comprising 6 segments including one key segment. Length of ring varies from 1200mm to 1500mm. The precast tunnel lining segments are with M-50 concrete with use of mero silica. These have been cast in 13 state of the art segment casting yards developed by different contractors with steam curing facilities to reduce the de-molding time and increase the production capacity.
- Total 53725 no. of lining rings have been used in Phase-III.
- Tunnel drives below old buildings have been completed with minimum effect on a structures.
- Tunneling in line No. 6 has been successfully completed through an area having many heritage buildings.

#### Chennai Metro Rail Project

Phase I of the Metro consist of two corridors approximately 45km in length, with 32 stations of which 19 are underground and 13 are elevated. The route within the main city area is proposed as underground with twin tunnels connecting the underground stations whilst the southern section will be constructed on viaducts between the elevated stations. Generally the underground stations have two levels with a concourse above platform level and the tunnels are at about 12m to 16m below ground level. Twin tunnels are bored using state of the art TBMs.

There will be a total of 37km of tunnels,

of which 36km (single tunnel length) will be bored using EPBMs and 1km will be constructed by cut and cover. As part of Phase II, CMRL will be developing an underground network of 80.5km as part of Corridor 3, 4 and 5.

#### Plans for the Mumbai Metro are ongoing and will have the following corridors:

1. Versova-Andheri-Ghatkopar (11km)
  2. Charkop-Bandra-Mankhurd (33km)
  3. Colaba-Bandra-SEEPZ (33.5km) under construction
  4. Charkop - Dahisar (8km)
  5. Wadala-Ghatkopar-Teenhat naka (21km)
  6. SEEPZ-Kanjur Marg (7km)
  7. Andheri(E) - Dahisar(E) (18km)
  8. Andheri - Ghatkopar –Mankhurd (16.5km)
  9. Sewri – Prabhadevi (5km)
- Total: 153km

#### Highway Tunnels

The Zojila Road Tunnel in J&K to Leh: Length of tunnel is 14.1km, in a single tube road tunnel with two traffic lanes and a parallel egress tunnel (14.2km). The maximum overburden is approx 660m; the Civil Construction Cost: Rs 5486 Crore without approaches and the construction period is 7 years  
Pir-Ki-Gali Tunnel in J&K, NH-244: The main tunnel length is approx 8.508km with egress tunnel length of approx 8.508km. The maximum overburden is approx 660m. The civil construction cost is Rs 4185 Crore and the construction period is 79 months.

#### FUTURE TUNNELLING ACTIVITIES

##### Conferences:

- Tunnelling in Infrastructure Development: Issues and Challenges at Guwahati

##### Workshop:

- NATM & TBM Tunnelling including Risk Management
- Health and Safety in Tunnel and Underground Construction
- Software Application in Tunnelling

#### Training Programme for Young Engineers

- Tunnel Design and Construction
- Conventional Tunnelling
- Mechanized Tunnelling
- Sprayed Concrete
- Innovation in Tunnelling Technologies

##### Publication:

TAI Journal: Half Yearly



## FAT ceremony of two $\Phi 6.71\text{m}$ CREG EPB TBMs for Singapore Circle Line 6 was held on 23rd February in Zhengzhou, China.



### TBM Specification

- ◎ Machine length: approx. 98 m
- ◎ Max. advance speed: approx. 80 mm/min
- ◎ Breakout torque: 7500 kN.m
- ◎ Geology: mostly in JURONG FORMATION, and a large section of the alignment is S III S IV S VI S VII
- ◎ Drive type: electrical drive
- ◎ Max. thrust: 46,530 kN
- ◎ Rated rotation speed: 1.9 rpm

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# Iran



**Name:** Iranian Tunnelling Association (IRTA)

**Type of Structure:** non-profit, open association

**Number of Members:** 785 (non-student) members, 500 student members, 185 corporate members

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

- Holding monthly technical seminars
- Publishing "Tunnel" Magazine quarterly
- Publishing the bi-annual "Tunnelling and Underground Space Engineering" Journal with Shahrood Technical University
- Holding technical meetings with contractors and consultants on current project challenges
- Preparations for the 13th Iranian Tunnelling Conference to be held in November 2019 entitled "New Horizons in Tunnelling"

## CURRENT TUNNELLING ACTIVITIES

- Several Metro Lines are being designed or are still under construction in Tehran, Karaj, Mashhad, Shiraz, Tabriz, Isfahan and Ahwaz. These include:
  - Tehran's Metro Line 6 southern extension with 6km tunnel length of which 1400m is constructed
  - Tehran's Metro Line 4 western extension with 4km length of which 1000m is constructed
  - Tehran's Metro Line 10 with a total length of 10km is currently being designed
  - Karaj Metro Line 2 with a total length of 25km is under construction
  - Shiraz Metro Line 2 with a total length of 12km of which 4500m is constructed
  - Tabriz Metro Line 2 with a total length of 22km of which 5000m is constructed

- Mashhad Metro Line 2 with a total length of 12km construction finished
- Water transfer Tunnels: More than 154km of Water Tunnels are being constructed including the Kerman water tunnel with 37km total length, the Kanisib tunnel with 36.5km total length (%76 progress), the Zagros Long Tunnel with 49.7km total length, the Konjancham water tunnel section 1 completed with 5km length and section 2 with 12.06km total length and 10km completion, the Bazideraz tunnel 8.9km total length, and the Azad tunnel with 10km total length.
- Rail Tunnels: Approximately 144km of single line Railway Tunnels were constructed including the 13.3km in the Azarbaijan province, 24.25km in the North and 18.1km in the North-west of Iran, and 27.8km in the Zagros area; and approximately 29km of double line Railway Tunnels including 16km in Hormozgan province, 3.3km in Fars province, 8km in Tehran.
- Completed the Zarbalizadeh Shallow Tunnel Construction underneath Operating Railways in Tehran. This 11.9m high and 14m wide double line tunnel had a total length of 105m which was constructed in 12 months. This award winning (ITA Tunnelling Award 2018) tunnel was constructed just 3m below ground surface where Tehran's railway was operating.

## FUTURE TUNNELLING ACTIVITIES

- Completing and expanding the road

and railway networks

- Completion and development of metro lines in numerous cities
- Completion of water transfer tunnels including section 2 of Konjancham water transfer tunnel and construction of Lar-Kalan water transfer tunnel

## STATISTICS

### 1. Length or volume excavated - % mechanized / % conventional during 2018

- Approximately 165km of water tunnels were constructed during 2018 of which 152km were excavated by mechanized means;
- Metro Lines: Approximately 30% of the metro lines listed in the above activities were constructed by mechanized means
- Rail Tunnels: Constructed mostly by conventional methods

### 2. List of tunnels completed

- The award winning Zarbalizadeh shallow urban tunnel project below Tehran's operating railway line
- Konjancham water tunnel section 1 completed
- Mashhad Metro Line 2 with a total length of 12km completed

## EDUCATION ON TUNNELLING IN THE COUNTRY

**Tunnelling as a field of Study is being held at Postgraduate level (Master's Degree) in the following Universities:**

- 1) Amirkabir University of Technology;
- 2) Shahrood University of Technology;
- 3) Tarbiat Modares University;
- 4) Urmia University of Technology.

Tunnelling is also taught at Bachelor level in form of study modules in Mining and Civil Engineering fields in numerous universities.



Zarbalizadeh Shallow Tunnel





## DSI Supplies Safety

Reliable Ground Support

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# Italy



**Name:** SIG – Società Italiana Gallerie

**Type of Structure:** non profit, open association

SIG is a scientific non-profit association, founded in 1974; it mainly promotes and coordinates studies and research in the field of tunnelling and underground construction works. SIG is a founding nation of ITA

**Number of Members:** 700, 85% individual members and 15% corporate members

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In 2018 the Società Italiana Gallerie (SIG) continued working actively as a reference point for Tunnelling and Underground Works in Italy, promoting dialogue within the industry, sharing knowledge and best practices and providing training. SIG organized the following technical activities in 2018:

### SIG Conference - Naples, May 11th, 2018

Via per Montes Excisa: Underground works meet Archaeology, Architecture and Art

### SIG international Conference & Expo - Bologna October 18th - 19th, 2018

Tunnelling 4.0: Digital Innovation, Automation and application of New Technologies in Tunnelling and Underground Construction

### SIG Conference for Santa Barbara 2018 - Milan, December 3rd, 2018

1<sup>st</sup> Lecture Adolfo Colombo - Design and constriction aspects of the Venezia underground station for the Milan railway pass - Lecturer: Prof. Pietro Lunardi

SIG is currently working on the organization of the WTC 2019 in Naples.

The association also organized several technical site visits to relevant underground construction sites, in Italy and abroad and to the Santa Lucia highway tunnel (EPBM 15.87m diameter), to the Rome Metro C construction sites, and to the Saint Martin la Porte construction site on the Turin Lyon high speed railway line.

SIG is also Sponsor of the Level II Masters in Tunnelling and Underground Constructions, held in Italy at

the Politecnico di Torino and at the Politecnico di Milano and of the Level II Masters in Geotechnical engineering at the Sapienza University in Rome and at the Federico II University in Naples. These

collaborations aim to bridge the gap between Universities and Industry, in order to support the growth of future Industry leaders.

During 2018, the Young Member Group of the Italian Tunnelling Society, which was founded in 2016, reached 180 members. The group has been very active either participating at SIG WGs or organizing the international conference on October 2018 in Bologna during SAIE (that was the 1<sup>st</sup> SIG YMs Conference), which explored the digital transformation and the impact of 4.0 technology in tunnel and underground space design and construction.

## CURRENT TUNNELLING ACTIVITIES

### Railway Projects:

#### Milano – Genova High Speed Railway:

Also known as Terzo Valico dei Giovi, and representing one of 30 European priority projects, this is a new HS line that will improve railway connections between the Liguria port system with the main railway lines of Northern Italy and the rest of Europe. The project is part of the Rhine-Alpine Corridor, which is one of the corridors of the trans-European transport network (TEN-T core network). The project involves the construction of two single-track tunnels, with a total length of 37km, connected by cross passages every 500m. The tunnels, which are excavated for 65% via conventional methods and for 35% by TBM, are located in the complex Apennines range between Piedmont and Liguria.

**Brenner Base Tunnel:** The BBT runs for 55km between Tulfes/Innsbruck and Fortezza and when including the Innsbruck by-pass, runs for a total of 64km, making it the longest underground railway in the world. The works include the construction of two single track tunnels (9m dia.) with underground safety areas every 20km and

an exploratory/service tunnel (6m dia.). Two of the main sites are on the Italian side - Section Mules 2-3, which is the last stretch on Italian border, and - the Section under passing the Isarco river, which is the southern segment of the Brenner Base Tunnel, before it enters the railway station at Fortezza.

#### Turin – Lyon, Mont Cenis base tunnel:

The new railway link from Lyon-Turin is the main project through the whole Mediterranean corridor and is highly strategic as it is the main missing link in the corridor connecting southwestern Europe with Central and Eastern European Countries. The Mont Cenis base tunnel includes two 57.5km long tubes, 45km on the French side and 12km on the Italian side, with about 170 communication bypasses located every 333m. Four intermediate accesses, five central ventilation systems and three underground security areas are also planned. Complementary works such as the Maddalena survey gallery, in Chiomonte, Susa Valley, were completed in February 2017.

**Napoli Bari High Speed Railway:** The new Naples-Bari high speed/high capacity railway line is an important and strategic project for both national and international connections with the South of Italy. It has been included in the 'Scandinavia – Mediterranean' corridor of the Trans-European Railway Network (TEN-T) that sees Naples as the central dividing point of the Corridor in both the south direction, with the stretch Naples-Palermo, and the south-east direction with the Naples-Bari line. Six construction sections are foreseen with the overall cost of investment valued at €6bn. The six are: Napoli – Cancelli, Cancelli-Frasso, Frasso Vitulano, Apice-Irpinia, Irpinia – Orsara and Orsara – Bovino. The first two sections are currently under construction, the second two are in the tender process and the last two are in the design phase. All sections have many kilometres in tunnels, underpassing the Appennini mountain chain through difficult geological & geotechnical conditions.

### Highway Projects:

**Variante di Valico (A1 Bologna – Florence), Santa Lucia Tunnel:** Expansion of the Appennine section of the A1 motorway, between Bologna and Florence, which is a strategic stretch that links northern and southern Italy and plays a major role in the movement of people and goods between Europe and the Mediterranean. The entire

project consists of 66.6km with about 50% of the alignment excavated by TBM and conventional tunnelling. The Santa Lucia Tunnel length is about 7.6km and is being excavated by an EPB machine which has a diameter of 15.87m and represents Europe's largest TBM.

#### **Metro Projects:**

**Naples Line 1 and 6:** The Naples Metro Lines 1 and 6 are included into an integrated metro system serving the whole city that today includes six underground railway lines and four funiculars. This is one of the largest infrastructure projects currently under construction in Italy and it will see, at last, the service expanded with two rail lines, 93km of track and a further 30km of new light rail connecting 114 stations together.

**Rome Line C:** Line C is the third Metro Line in Rome. It is one of the strategic infrastructure projects in Italy and it is one of the biggest European construction projects. The overall investment is about €3.8bn. Line C is the first metro line in Italy to be fully automated. Line C crosses the entire city of Rome like a backbone, from the east to the north-west. It extends for about 25.5km (18km underground), with 30 new stations (20 underground).

**Milan M4:** The new Line 4, is built entirely underground and runs 15km from Linate to Lorenteggio. It will provide a fast connection along the east/south-west route passing through the historical centre of the city. It involves a light and fully automated driverless metro system, with automatic platform screen doors and a CBTC signalling system.

#### **FUTURE TUNNELLING ACTIVITIES**

##### **Railway Projects:**

**Napoli Bari High Speed Railway:** The alignment has an overall length of about 178km from Naples to Foggia with 121km of railway line still to be built to complete the line that will run mainly underground (about 68km in bored and cut and cover tunnels). As mentioned before the sections Irpinia-Orsara and Orsara-Bovino (40km) are in the final design phase and 37km out of 40km are in tunnel. The most complex underground works are in this section, not just for the length of the longest tunnel (the 27km Hirpinia Tunnel will be the longest railway tunnel in Italy), but mainly because of the geological and geotechnical context in which the tunnels have to be constructed. The Hirpinia tunnel crosses reliefs in the Southern

Apennines structurally complex formations (scaly clay) featuring methane gas and a high level of tectonisation with particularly critical mechanical behaviors due to swelling and squeezing conditions together with geomorphological conditions linked to a high level of surface erosion, slipping and complex landslides typical of Apennine reliefs and the high seismic condition. The Tender process is scheduled for 2019 and the completion of the work for December 2026.

**Palermo-Catania-Messina new railway line:** The Palermo-Catania-Messina line is part of the Scandinavian-Mediterranean Core Corridor no. 5 (Helsinki-La Valletta) on the Trans European Networks-Transport (TEN-T). The alignment has an overall length of about 110km from Fiumetorto (close to Palermo) to Catena Nuova (close to Catania) where a new single line will be built with a length of about 40km between Catena Nuova and Catania and 42km between Fiumefreddo (close to Catania) and Giampilieri (toward Messina) where the existing single track line will be doubled. Eight functional and construction sections are foreseen for an overall cost of investment of about €8bn. Nearly 50% of the alignment will be built in tunnel and all the tunnel sections (7 out of 8) are currently in the design phase. The tender process for the first tunnel section (Fiumefreddo-Giampilieri with 37km of tunnels out of 42km of line and with the new underground railway station of Taormina), is scheduled in 2019.

**Verona-Fortezza new railway line:** As part of the Southern Access to the Brenner Base Tunnel, four functional lots have been identified, priority has been given to the sections that currently have limits of performance and speed. Section 1 from Fortezza to Ponte Gardena has a length of about 23km and is currently in the final design phase: The tender (design and build) is scheduled for 2019. The section includes the Scaleres Tunnel (about 16km long), and the Gardena Tunnel (about 6km long), separated by a short stretch on a viaduct crossing the Isarco River. The overall length of all the underground works is approximately 62km, including the 2 twin bore tunnels, connection tunnels, lateral adits and complementary works. The main tunnels will be bored with a maximum overburden of 800m, in the Bressanone Granite and Quartz Phyllites with good geotechnical properties, except for fault zones. Both conventional and TBM excavation is foreseen.

#### **Highway Projects:**

**Gronda di Genova:** The project, called "Gronda di Ponente", foresees the construction of a new carriageway, the widening of the existing A10 highway in the section that crosses the municipality of Genoa, as well as the strengthening of the A7 and A12 highways. The project consists of over 70km of road, of which 53km are in 25 tunnels, 12 of which are on the highways and 13 on the interchanges. There are 21 bridges and viaducts, of which 11 are new and 10 are existing.

#### **Metro Projects:**

**Rome Line C:** The T3 stretch of construction is currently in progress (3km of twin single-track tunnels, 2 new stations and 2 multi-functional shafts) in the historical centre of the city. In 2018 two EPBMs will start from San Giovanni Station toward the Fori Imperiali Area. In mid 2019 the TBMs will pass near the Colosseo and the Basilica di Massenzio. Important consolidation and protection interventions have been carried out to protect the archaeological area's monumental heritage.

**Metro 2 Torino:** The first phase of the preliminary design of line 2 of the Turin Metro (MTO2) was completed in November 2018. The final route of the MTO2 is about 27km long with 33 planned stations. The route will connect the south-west part of the metropolitan city of Turin (Orbassano) with the north and north-east areas of San Mauro T.se and Rebaudengo, crossing the metro line 1 at the Porta Nuova railway station. The construction works of the line will commence in 2022 with completion expected by 2038.

#### **WTC 2019**

3-9 May – Tunnels and underground cities: engineering and innovation meet Archaeology, Architecture and Art

#### **Technical Visit on job-sites:**

- April 2019 - Naples Underground Lines 1 and 6
- June 2019 - Milan Underground Line 4
- July 2019 - Milan – Genoa high speed railway line (Genoa)
- September 2019 - Brenner Base Tunnel (Fortezza)
- November 2019 - SS 652 "Fondovalle Sangro" road (Chieti)
- SIG Conference for Santa Barbara December 2019



# Italy (continued)

## STATISTICS

### 1. Length (km) of tunnels excavated during 2018

<i>Railway</i>	<i>Highway</i>	<i>Metro</i>	
<b>7.7</b>	<b>2.5</b>	<b>7.4</b>	<i>TBM</i>
<b>9.8</b>	<b>5.0</b>	<b>0.7</b>	<i>Conventional</i>

### 2. Amount (EUR) of tunnelling / underground space facilities awarded in 2018: €1.5b.

#### 3. List of tunnels completed

##### *Railway*

Palermo Railway Junction  
Section B

Catania Circumetnea railway  
Nesima - Monte Po Section

##### *Highway*

A01 (Milan - Naples)  
Boscaccio Tunnel

##### *Metro*

Rome Metro. Line C  
San Giovanni - Ambaradam Section

Turin Metro. Line 1  
Lingotto-Bengasi Section

#### 4. List of tunnels under construction

##### *Railway*

Brenner Base Tunnel  
Isarco River underground pass lot

Brenner Base Tunnel  
Main Section (Italian side) "Mules 2-3" lot

HC Genoa-Milan  
Main line  
Voltri connection lines  
Lateral adit tunnels

HSR Brescia  
Verona

Florence HSR Underpass  
Railway Station and Railway Tunnel

HSR Napoli  
Bari: Cancellò-Frasso section

Palermo Messina Railway line  
Ogliastrello-Castelbuono section -  
Cefalù (6.7 km) S.Ambrogio (3.4 km) and  
Malpertugio (0.1 km) tunnels

Palermo Railway Ring Giachery  
Politeama - 1° section  
Catania Circumetnea Railway - Stesicoro  
Aereoporto Section

##### *Highway*

Agrigento  
Caltanissetta A19-SS 640  
Porto Empedocle

SS 106  
Jonica Megalotto 3

SS 106  
Variante all'abitato di Palizzi - 1° lotto

SS 4  
Salaria  
(Micigliano-Gole del Velino) 1° lotto

SS 4  
Adeguamento tratto Acquasanta  
Terme - Trisungo Lotto 1° - Stralcio 2°  
dal km 151+000 al km 153+780

SS1  
Nuova Aurelia - Viabilità di accesso  
all'hub portuale di Savona

Variante alla S.S. n° 1 Aurelia (Aurelia  
Bis)  
Viabilità di accesso all' hub portuale di LA  
SPEZIA

##### *E78*

Tratto 1° Grosseto -Siena - Lotti 5-6-7-8

##### *SS 20*

Nuovo tunnel del Col di Tenda

##### *SS 95*

Variante di Tito Brienza - 6° lotto

##### *SS 45*

Variante di Val Trebbia - 1° stralcio  
funzionale dal km 31+500 al km 32+445

Itinerario Nord - Sud SS 117 Centrale  
Sicula

Lavori di ammodernamento e  
sistemazione del tratto compreso tra km  
32+000 e km38+700

##### *SS 51 di Alemagna*

Variante di Vittorio Veneto

Maxilotto 2 Quadrilatero Marche  
Umbria  
sub lotto 1.1 - 1.2

##### *S.S.27 del Gran San Bernardo*

Lavori di sistemazione tra Etroubles e  
l'Innesto Autostradale per il Traforo del  
San Bernardo

##### *SS 219*

Mocaiana Umbertide

Barberino-Firenze nord 3rd lane

A01 (Milan-Naples)  
Del Colle Tunnel

A01 (Milan-Naples)  
Santa Lucia Tunnel

##### *Metro*

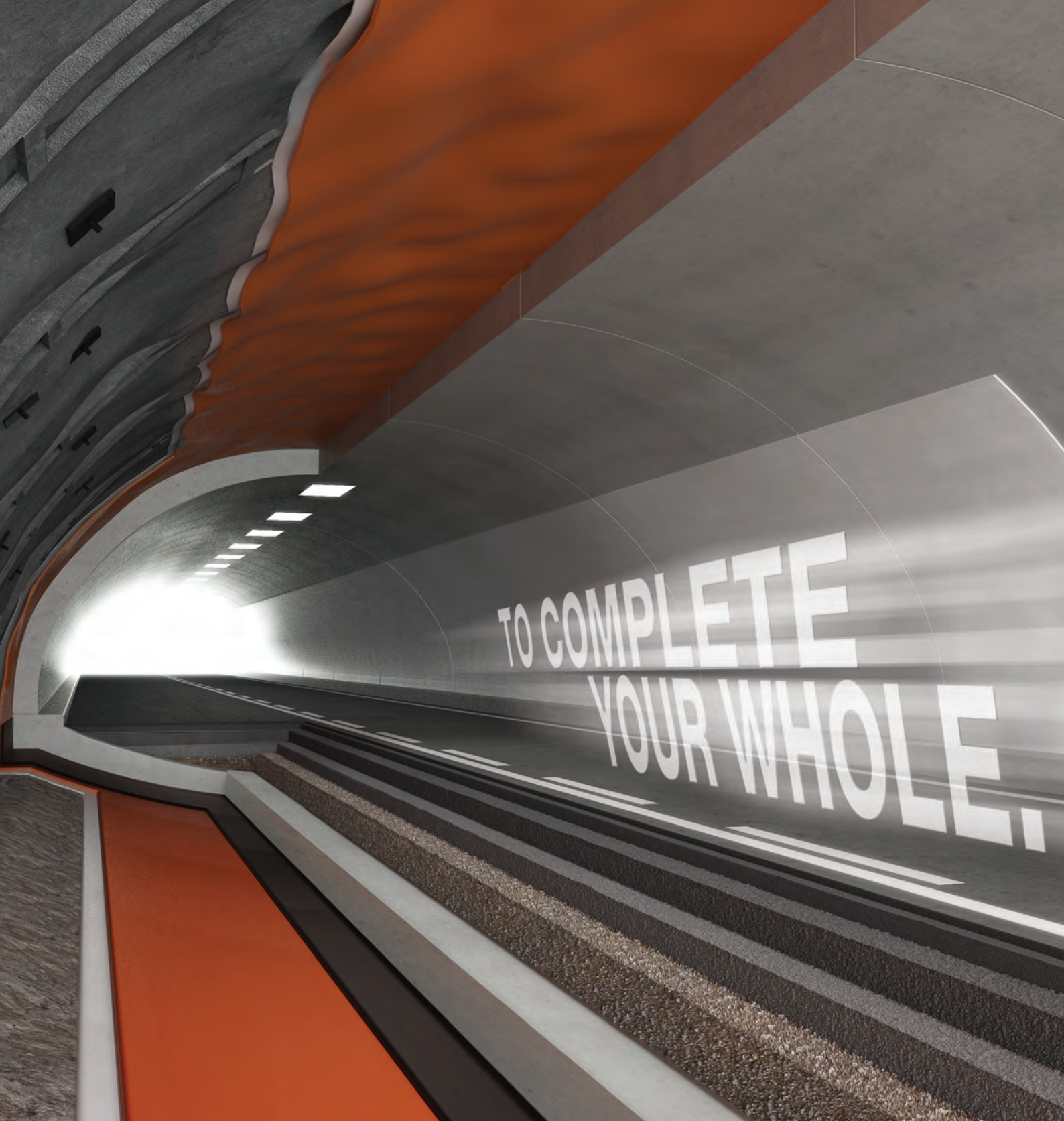
Milan Metro line 1

##### *Metro Milan*

San Cristoforo - Linate. Line 4

##### *Rome Metro*

Extension line C: Ambaradan-Colosseo  
Section



TO COMPLETE  
YOUR WHOLE.

## Technology for underground construction

- **Alkali-free set accelerators for shotcrete**
- **Products for mechanized tunneling:** foaming agents for soil conditioning, polymers, sealants, lubricants
- **Products for grouting and consolidating**
- **Products for concrete repairing, protection and coating**
- **Products for waterproofing:** synthetic waterproofing membranes, waterproofing accessories



# Japan

**Name:** Japan Tunnelling Association

**Type of Structure:** Non profit organization

**Number of Members:** Total number 1481,  
number of corporate members 205



## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

WGs: JTA consists of the following four committees and each committee has WGs and task forces. Technology/International Communication /Events/Public Relations  
In each committee, the main activities are:

- Investigation, research and information exchanges on general techniques and on subjects of specific projects.
- Meetings such as lectures, symposiums, workshops, training and site visits :  
"Two-days seminars", "Site Visits" and "Lectures on topics of the year" (organize by Events committee)
- Publication of reports and documents Monthly journal "Tunnels and Underground"
- International cooperation

## CURRENT TUNNELLING ACTIVITIES

### Large-scale improvement project for MINAMISUNAMACHI-St and KIBA-St in TOZAI line (Tokyo metro)

TOZAI line, which is 30.8km in the length, started operation in 1969. The average number of passengers per day is about 1.43million and congestion rate is almost 200% during rush hour. This is one of the most congested lines on the Tokyo metro and train delays are becoming chronic especially during morning rush hour. Non-structural measures such as time schedule revision and large-scale improvement project are currently under way.

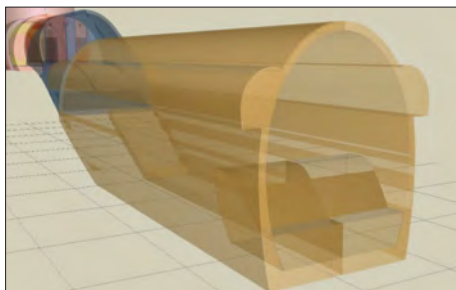
MINAMISUNAMACHI-St. project is one example of a large-scale improvement project. This station is composed of

1 layer 2 spans, with an island platform serving 2 tracks. This station will be renewed to 2 layer 4 spans, and to 2 platforms serving 3 tracks to improve safety and convenience. The station was constructed under a canal with the caisson method in the 1960s but the surface was land-filled so now it is located under a road and private land. Due to the extremely soft and cohesive ground, groundwater lowering was not used to minimize the negative impact on the surroundings environment. As a

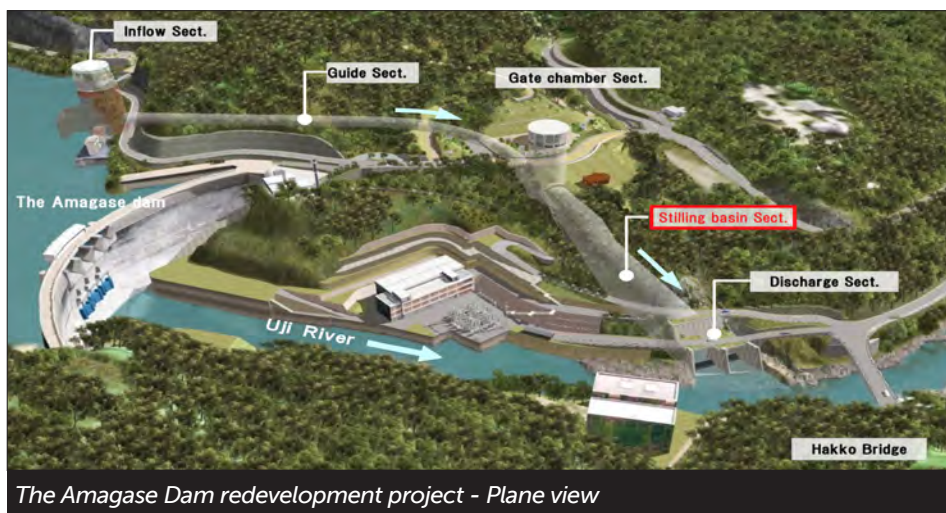
countermeasure, ground improvement and a very rigid, reinforced concrete diaphragm wall using the most suitable construction sequence was carried out.

### The Amagase Dam redevelopment project

The Amagase Dam located downstream of Lake Biwa, the largest lake in Japan, is a Concrete Arch Dam, and a multipurpose one for flood control, water supply and hydroelectric power generation. The redevelopment of Amagase Dam is to construct a discharge tunnel on the left bank of the Dam to strengthen it. This discharge tunnel is a waterway tunnel composed of a section for inflow, guide, gate chamber, stilling basin and a discharge. The discharge section is an extremely large cross-section tailrace tunnel (maximum excavation cross section 650m<sup>2</sup>, height 26m, width 23m.



*The Amagase Dam redevelopment project - Enlarged stilling Basin Section*



*The Amagase Dam redevelopment project - Plane view*

This part crosses the fracture zone (around 10m in width) at the accretionary prism of the Paleozoic to Mesozoic era. The tunnel passes through a low soil covering position of about 40m in depth. This section is excavated by the NATM, drill & blast, bench cut method with pilot side and central drifts.

## FUTURE TUNNELLING ACTIVITIES

### The Tokyo Ring Road (Kan-etsu Expressway – Tomei Expressway Section)

The Tokyo Ring Road (Gaikan) is approximately 85km long and connects areas within an approximate 15km radius of the center of Tokyo. By dispersing the inflow of traffic that passes through the center of Tokyo, the Tokyo Ring Road will eliminate the chronic traffic congestion in the Greater Tokyo Area. Through a smoother flow of traffic, the traveling speed of vehicles on the road will increase and a large reduction in emissions is expected, creating a more comfortable and convenient city. Ring Road No.8 which is parallel to the planned Tokyo Ring Road has traffic congestion of about 18 times higher than the national average. Approximately 10% of vehicles flow into the surrounding residential roads, and traffic accidents are 5 to 11 times higher than those of municipal roads in the city. By constructing the Kan-etsu Expressway – Tomei Expressway Section, it will not only alleviate congestion, improve the environment, enhance international competitiveness, and revitalize communities, but also allow Tokyo to continue to function as the capital in the event of a major disaster by facilitating smooth support and recovery operations. For the 16km section that runs between the Kan-etsu Expressway and Tomei Expressway, a 15.8m diameter deep-bore

tunnel structure (up to 40m) has been adopted. Currently 4 TBMs with diameters of 16m (the largest in Japan) are currently in full excavation. At the merging point of the ramp and main lane, a non-open cut tunnelling method is adopted to enlarge the tunnel underground. Under high pressure deep in the ground, construction will be carried out to extend 200 to 400m in one place. In the future after ground freezing has been carried out, 2 TBMs will dock underground near Inokashira Street.

### Hokkaido Shinkansen (between Shin-Hakodate-Hokuto and Sapporo terminal)

The Hokkaido Shinkansen is a high-speed rail services starting from Aomori city, passing through Hakodate city to Sapporo city. The section between Aomori to Hakodate is already in operation while the extension to Sapporo is currently under construction. The extension consists mainly of tunnel sections which comprise 168.7km (~80%) out of the total 212km length. Upon completion, one of the tunnel section (Oshima tunnel, 32.7km) will be the longest mountain tunnel (NATM tunnel) on land in Japan and other sections will pass through Sapporo city (Sasson tunnel) with length of 26.2km. In general, most of the excavation method is by mountain tunnelling (NATM). Some sections such as the Youtei tunnel will be constructed by SENS\* method while the Sasson tunnel will be excavated by Shield (EPBM/Slurry) Method.

*\*SENS (Shield ECL NATM System: Excavation is conducted by maintaining the stability of the face with the shield tunnelling method, while aiming for early closure with primary support that applies the extruded concrete lining (ECL) method. The tunnel is completed by casting concrete for the secondary lining after the displacement convergence of the ground, as in the case of spraying concrete with NATM)*

## STATISTICS

### 1. Length or volume excavated

35 % mechanized  
55% conventional during 2018

### 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018 - US\$3.5 bn

### 3. List of tunnels under construction

	No. of construction section	Total length (km)	Contract amount (US\$bn)
Road	252	362	19
Railway	66	179	5
Waterway	129	208	4
Overseas	24	88	5
Others	46	77	2
<b>Grand total</b>	<b>517</b>	<b>914</b>	<b>35</b>

## EDUCATION ON TUNNELLING IN THE COUNTRY

### The following four universities' example below

#### Kanazawa Institute of Technology

Classes on "Tunnel and tunneling technology" are implemented as follows:

Tours of tunnel construction sites such as Shinkansen (high-speed rail) and the exchange of views at the site. Lectures on planning, designing, construction and maintenance of tunnel projects on expressways. Lectures on planning, designing, construction and maintenance of tunnel projects on railroads. Lectures on diagnostic technology of old tunnels. Study of the repair techniques of the tunnels deteriorated over a long period of time.

#### Kyoto University

In the undergraduate program, the mechanism of tunnel excavation, the construction methods of mountain tunnels (NATM) and urban tunnels (TBM) are introduced in the class for Rock Mechanics and Geotechnical Engineering. In the post graduate program, the advanced mechanism of tunnel excavation and the auxiliary methods of tunnel excavation are introduced in the class for Construction Engineering. These classes include the field visit of actual tunnel construction sites. In addition, in the class for River Engineering or others, the public uses of underground space, such as underground discharge channel, urban redevelopment, carbon capture and sequestration, nuclear waste disposal issue, are introduced.

#### Nagaoka University of Technology, Civil & Environmental Engineering Department

As for the subject concerned with tunnelling, the following classes are offered.

##### 1. Special lecture (laboratory basis), 3rd year, undergraduate school.

In this class, tunneling methods are introduced briefly and the overview of mechanized tunnelling method are provided.

##### 2. Geological engineering, 4th year, undergraduate school.

This class provides the basic aspects of rock engineering and geological engineering, which are used to construct large scale civil engineering structures and tunnels. This class also introduces the case records of conventional tunnelling method.

##### 3. Special seminar (laboratory basis), graduate school.

In this class, the selected recent topic on tunnelling is introduced briefly, and the feature of the topic is discussed among the students in the laboratory.

#### Tokyo Metropolitan University

Delivers two lectures regarding tunneling, both for undergraduate and graduate students. The former lecture aims to help understand the fundamental concept and the latter one gives both theoretical and actual knowledge.

##### 1) Fundamental Tunnel and Underground Space Technology (for undergraduate course)

Underground space and structures should be effectively used in Japan because of the narrow land space and low plane area. The actual state of underground space usage with domestic and foreign examples is firstly introduced and the relation between the stability of structure and characteristics of ground is delivered. Also the difficulty of grasping the physical characteristics by ground survey is shown and the design and construction of underground structure and its influence is explained. Fundamental knowledge of surveying, design, construction and maintenance of tunnels and underground structures is introduced.

##### 2) Advanced Tunnel and Underground Space Technology (for graduate course)

The behavior of underground structures such as tunnels, underground cavities and space is not only influenced by its surrounding rock and ground, but also by both movements interacting at the same time. The geological condition in Japan is extremely complex and the design and construction of underground structure needs to be done using insufficient data because the accuracy of surveys for construction is limited. The detail of various kinds of actual tunnel and underground construction, with consideration for the condition of underground, is delivered, in addition to the theory of mechanical characteristics and the concept of load evaluation. Also, the concept of underground structure design is explained, on the basis of complexity of geology, limitation of survey and the characteristics of construction. Advanced maintenance methods of underground structure, the effect of various facilities considering the human characteristics inside tunnel and the damage of tunnel against earthquake in Japan are also introduced.



# Korea

**Name:** Korean Tunnelling and Underground Space Association

**Type of Structure:** Non profit open association

**Number of Members:** 2832 members, 72 corporate members



## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

Established in 1992 as a non-profit incorporated association, KTA is the tunnel-oriented national organization that complies with the international aims of ITA. Most of the KTA members are tunnel engineers, but not limited to the civil engineering field and recent expansion into the field of fire, disaster prevention and ventilation within tunnels, among others, are noteworthy.

In 2018, KTA hosted several domestic conferences and forums. The short list is as follows:

- 2018 KTA General Assembly & Annual Conference  
2018.04.12, Seoul (207 domestic participants)  
Election of the new KTA president, Prof. Hankyu Yoo
- The Joint-Forum on Tunnel Safety and Future Technology  
2018.09.14, Seoul (333 domestic participants)
- KTA-Kwater MOU  
2018.10.05, Seoul
- 2018 KTA Tunnel Construction Policy Forum  
2018.11.08, Seoul (105 domestic participants)
- 2019 KTA Training Course: Sustainable Development of Future Underground Space  
2019.02.14-15, Seoul (54 educatees/trainees)
- A total 11 Working Groups in KTA  
- KTA-Annual WG Activity Reports: 7 WG activity reports

### Publications:

- Domestic technical journal "Tunnelling Technology" (6 issues with 78 papers in 2018)
- Quarterly magazine "Nature, Human Being and Tunnel"

## CURRENT TUNNELLING ACTIVITIES

### Boryung-Taean Subsea Road Tunnel Construction

- NATM passing through highly fractured faults

- Undersea route length of 6.92km connecting Route 77
- Max. depth of 80m

### Daegok-Sosa Railway Tunnel Construction

- TBM + NATM hybrid construction
- Dia. 8.1m twin shield TBM tunnel crossing the Han River
- Total length of 18.36km (2.85km under the Han River)
- Corner stone of South-North Korea economic cooperation



## FUTURE TUNNELLING ACTIVITIES

### Kimpo-Paju 2nd Seoul Outer-ring-road Project (passing Han River section)

- Connecting the 2nd Seoul outer-ring-road
- Total length of 25.3km (Han River section - 4km)
- Project cost will be about \$1.3bn

### Honam-Jeju Subsea Tunnel Project

- Connecting the Korean Peninsula and Jeju Island
- Total length of 167km (Undersea section of 73km)
- Project cost will be about \$15bn

### Youngjong Island 3rd Connection Way Project

- Connecting Incheon hub airport and Seoul metropolitan area
- The 3rd connection after previous two long-span marine bridges
- Consideration of transport security and weather accident



Youngjong Island 3rd Connection Way Project

## STATISTICS

### 1. Length or volume excavated - % mechanized / % conventional during 2018

Railroad tunnel: 69km  
Road tunnel: 185km

### 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018 - About 6.4bn USD

### 3. List of tunnels completed:

- Wonju-Gangneung High-speed Railway Tunnel
- Inje-Yangyang road tunnel
- Incheon (North Port) Subsea Road Tunnel

### 4. List of tunnels under construction

- Boryung-Taean Subsea Road Tunnel
- Jinhae-Guyjae Main Gas Pipe Line Tunnel
- Yulchon Thermoelectric Power Plant Tunnel
- Gunjang Energy GE-3 PJT Subsea Tunnel
- Daegok-Sosa Railway Tunnel

## EDUCATION ON TUNNELLING IN THE COUNTRY

### KTA Continuing Education and Training Course

- 2019 KTA Training Course: Sustainable Development of Future Underground Space
- 2019.02.14-15, Seoul (54 educatees/trainees)

# Macedonia

**Name:** Republic of North Macedonian

**Type of Structure:** Non profit open association

**Number of Members:** 50 members



## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In 2018 members of the Macedonian Tunnelling Association were mainly active in reviewing the main design of railway tunnels on the corridor VIII as follow:

- Section Kicevo – Border with Rep of Albania (11 tunnels)

- Section Beljakovce – Kriva Palanka (13 tunnels)
- Section Kriva Palanka – Border with Rep. of Bulgaria (22 tunnels)

Also some members of ITA Macedonia were consultants of the Macedonian Enterprise for State Roads concerning



tunnelling activities on two sections on corridor X:

- Motorway on section Kicevo – Ohrid (2 tunnels)
- Members of ITA Macedonia are involved in organization of "XVI Danube-European Conference on Geotechnical Engineering", and "Risk Analysis in Tunnelling" seminar which was held in June 2018.

## CURRENT TUNNELLING ACTIVITIES

Construction of the longest road tunnel in the Rep of North Macedonia, the Preseka on Motorway A2, section Kicevo-Ohrid tunnel. Two tunnel tubes, with lengths of 2.2km each. Almost 90% of the tunnel length was excavated in graphite phyllites in category V after Bienawski. Primary support system - pipe roof in combination with heavy steel arches IPB 200 and 30cm of shotcrete.

## FUTURE TUNNELLING ACTIVITIES

- Design of the tunnel Kolibari on motorway A2, section Gostivar – Kicevo, Corridor 8
- Tendering procedures for 13 tunnels on the Railway line Beljakovce – Kriva Palanka
- Organizing seminars for tunnel construction methods for the engineers which will be involved in realization of future tunnels in Macedonia.
- Members of ITA Macedonia will take an active role in the construction of future tunnels through the consultancy of Macedonian public enterprises for State roads and railways.

## STATISTICS

1. Length or volume excavated - % mechanized/100 % conventional during 2018
2. List of tunnels completed: €50M
3. List of tunnels completed none
4. List of tunnels under construction Tunnel Preseka on Motorway A2, section Kicevo - Ohrid

## EDUCATION ON TUNNELLING IN THE COUNTRY

- Tunnels on graduate studies, Faculty of Civil Engineering – Skopje
- Selected chapters of tunnels, post graduate studies, Faculty of Civil Engineering – Skopje



# Malaysia



**Name:** The Institution of Engineers, Malaysia

**Type of Structure:** A non-profit, learned society with its primary function is to promote and advance the science and profession of engineering in any or all of its disciplines and to facilitate the exchange of information and ideas related to engineering.

**Number of Members:** Over 40,000 members inclusive of corporate members, graduates, associates and students. It is the Secretariat of ASEAN Engineers, APEC Engineers and International Engineers.

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

Tunnelling and Underground Space Technical Division of The Institution of Engineers, Malaysia (IEM TUSTD) has been very active and continued to undertake activities related to the promotion and advancement of the science and engineering of tunnels and underground space technologies. Through 2018, 9 evening presentations/talks, 4 courses/seminars and 6 technical visits were organised for members and non-members, on different topics including case histories, new technologies, academic research etc.

IEM, together with China Civil Engineering Society (CCES), organised the CCES China - IEM Malaysia Joint Southeast Asia Symposium and Exhibition on Challenges and Strategic Solutions for High Profile Projects on Tunnels (SEASET2018) on 18-19 September 2018 at Petaling Jaya, Malaysia which was well attended by about 300 participants with international delegates including those from China. This event was organised as part of the publicity to promote WTC2020 to the participants. IEM also co-organized with ICE the 12th Brunel International Lecture on Tunnels & Tunnel Boring Machines, Transportation Infrastructure and Mega Projects Dreaming Big for Future of Civil Engineering on 23 November 2018. The Lecture was delivered by Linda Miller who is currently construction director on the tunnel and station excavation works on the Sydney Metro project. Sydney Metro is Australia's biggest public transport project, which, when complete, will deliver 31 Metro Stations and more than 66 km of new tunnels, including tunnels crossing under the iconic Sydney Harbour. Both SEASET2018 and 12th Brunel International Lecture events are endorsed by ITA and managed by IEM Academy. On 4-5 July 2018, IEM

organised Two Day Short Course on New FIDIC-ITA Conditions of Contracts and Practical Workshop on Tunnelling Best Practices - A Quantum Leap. IEM is committed to grow the tunnelling and underground space technology training and education. This event was also managed by the IEM Academy. IEM is currently working closely with ITA in jointly organising ITA-AITES World Tunnel Congress 2020 (WTC2020) and 46th General Assembly which will be hosted by Malaysia on 15-21 May 2020 at the prestigious Kuala Lumpur Convention Centre. An ITACET Training Session themed "Innovations in Tunnelling, Geotechnical Engineering and Project Management" is also scheduled to be held during the WTC2020. Another ITACET Training Session is being planned in Kuala Lumpur in Q3 2019 but with local Lecturers to make it sustainable.

## CURRENT TUNNELLING ACTIVITIES

2018 has been very challenging for Malaysia in light of the financial constraints and change of political landscape in Malaysia. No significant new works are reported for year 2018, only the continuation of works that were already ongoing, while some other infrastructure projects were being deferred.

Apart from some urban road/subway tunnels and underground construction works in the city areas, major tunnelling projects in progress are:

### Klang Valley Mass Rapid Transit (Line 2), SSP Line

SSP Line is the second line (MRT2) of the Klang Valley Mass Rapid Transit which began construction in 2016. With a total length of 52.2km, consisting of 38.7km of elevated tracks and 13.5km tunnels the line connects 35 stations and will serve a corridor with a population of 2 million people stretching from Sungai Buloh,

to Serdang and ends in Putrajaya. Phase one of the line is set to launch by July 2021, while the entire line will be fully operational by July 2022. The overall progress of the MRT2 is now close to 40% as of the end of 2018.

Currently, there are two Tunnel Boring Machines (TBMs) operating along the underground section from Bandar Malaysia to Chan Sow Lin, and six TBMs are scheduled to be launched between January 2019 and March 2019. Four of the TBMs will be launched from Titiwangsa with two going towards Sentul West and another two towards HKL Crossover. In addition to this, another two TBMs will be launched at HKL Crossover towards Ampang Park.

The mined tunnel works of the Southern elevated alignment also began in June 2018. This section, which is over high ground, is one of the three tunnel sections along the 38.7km of elevated tracks. The tunnel consists of a mined tunnel and cut and cover tunnel with a total length of 540m. The mined tunnel is a single twin track spanning about 182m. Meanwhile the cut and cover tunnel is a twin cell box structure covering both sides of the concrete lined tunnel with length about 197m on the upstream side and 161m on the downstream side. The mined tunnel will be constructed using New Austrian Tunnelling Method (NATM) with a permanent cast in-situ concrete lining and the entire section is targeted for completion by December 2019.

Since May 2018, the Government of Malaysia had embarked on a cost rationalisation exercise on MRT2. The Government had finally approved the continuation of the works to be executed by a turnkey contractor with a cost of MYR30.53bn compared with the original cost of MYR39.35bn, representing savings of MYR8.82bn or 22.4%. Apart from downscaling the station entrances, all above-ground stations will continue to be built as planned while two underground stations – Bandar Malaysia North and Bandar Malaysia South, will be postponed, bringing the total number of stations to 33 now.

### The Langat 2 Water Supply Project

The Langat 2, which is part of the Pahang-Selangor Raw Water Transfer project, will be the largest water supply scheme in Malaysia supplying 2260MLD of treated water. It will be carried out in two phases with each phase capable of treating and distributing 1130MLD of water to the targeted demand centres.

There are two drill & blast tunnels, namely the Sg. Besi tunnel (0.53km) and the Hulu Langat tunnel (2km). Both the horseshoe shaped tunnels will be sized for housing the bulk distribution pipes with space allowance for pipe laying and maintenance purposes. It is expected the construction for Sg. Besi tunnel will commence in 2019.

#### FUTURE TUNNELLING ACTIVITIES

The 350km Kuala Lumpur-Singapore High Speed Rail is expected to be resumed by the mid of 2020. The HSR express service is now expected to start

operation by 1 January 2031, instead of the original commencement date of 31 December 2026.

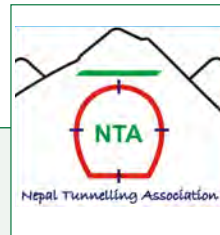
In the coming years, as the financial status in the country getting healthier, it is expected that the KVMRT Line 3 will be resumed, mostly for underground tunnels. Line 3, a circle line, is essentially aimed to interconnect all other transit systems and serve the key major developments surrounding the Kuala Lumpur central business district.

Construction of the East Coast Rail Link is currently under negotiation and

review by the Government of Malaysia and China. The original scope of the project involved construction of a total 49km of tunnel at 19 different locations with the longest 17.9km tunnelling at Bukit Tinggi – Gombak crossing the Titiwangsa mountain range.

The Penang Undersea Tunnel is a 6.5km tunnel which will connect Butterworth, Seberang Perai in the east to George Town, Penang Island in the west. If it is materialised, it will become the first undersea tunnel in Malaysia and second in the Southeast Asia. There will be a toll plaza at the undersea tunnel.

# Nepal



**Name:** Nepal Tunnelling Association

**Type of Structure:** Non-profitable organization

**Number of Members:** Total number: 110, number of corporate members: 8

#### ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

The Nepal Tunnelling Association conducted three days of tunnelling training with the theme "Feasibility Study of Road Tunnel" from 27th to 29th June 2018. The total number of participants was 18.

The Nepal Tunnelling Association conducted a one-day training program in association with ITACET on "Operation and Maintenance of Hydro-Tunnel" and the Nepal Tunnelling Conference 2018 with a theme "Multipurpose Use of Underground Spaces" on 14th Dec 2018.

The total number of participant in the Training and Conference in December 2018 was 121.

#### CURRENT TUNNELLING ACTIVITIES

So far, about 225km of tunnel including mainly hydro, water supply, irrigation, mining, road and sewerage have been excavated in Nepal. The following current tunnelling activities are going on:

- About 30 hydropower tunnels and caverns with a size ranging from 2.5m to 15m are under construction using the drill and blast method
- A 26km long water supply tunnel excavated by drill and blast, with semi-mechanized excavation is complete and the final lining and finishing works are in progress.
- A 12km long multipurpose tunnel of 5.2m diameter has been excavating by

double shield Robbins TBM with a segmental lining, 11km have been excavated without problem.

#### FUTURE TUNNELLING ACTIVITIES

Mainly hydro tunnels and a few road tunnels have been planned and are in the study phase initiated by the Government and private sectors. The following projects are under study:

##### 1. Hydro tunnel projects:

- About 25 hydro power tunnels sizes ranging from 2.5m to 11m

##### 2. Multipurpose projects (Hydroelectric and irrigation):

- Kaligandaki-Tinau Diversion Multipurpose Project: Tunnel = 30km
- Sunkoshi-Kamala Diversion Multipurpose Project: Tunnel = 16.6km
- Sunkoshi-Marin Diversion Multipurpose Project: Tunnel = 1km

##### 3. Road tunnel projects:

- Nagdhunga to Naubesi = 2.7km
- Hetauda to Bhimphedi = 3km
- Fast track Kathmandu to Nijgad = 7km (total 3 tunnels)
- Khurkot to Sindhuli = 6.4km
- Thansing to Toka (Kathmandu) = 4.2km
- Sanga pass crossing = 1.5km
- Yamdi (Pokhara) to Nayapul = 6km
- Dahune crossing (Butwal) = 6km

#### 4. Rail tunnel projects:

- Kathmandu metro = 66.1km
- East West Electrified Railway Projects with 10 tunnels of total length 26.7km
- Rasuwagadi (China boarder) to Kathmandu to Lumbini via Pokhara

#### STATISTICS

##### 1. Length or volume excavated

11,000m i.e. about 92% of the work is completed using TBM at the Bheri Babai Diversion Multipurpose Project; and about 25km by conventional method (Drill and Blast with semi-mechanized).

##### 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018

More than, US\$100M

##### 3. List of tunnels completed

Above

##### 4. List of tunnels under construction

Above

#### EDUCATION ON TUNNELLING IN THE COUNTRY

##### Tribhuvan University (TU):

Master in Engineering Geology/ Geology/Mining Engineering:

- 1.) Central Department of Geology, Kirtipur
- 2.) Tri-chandra Multiple Campus, Kathmandu.

Bachelor in Science (with Geology as major):

- 1.) Trichandra Multiple Campus, Kathmandu, Nepal
- 2.) Birendra Multiple Campus (BMC) Bharatpur, Chitwan Nepal and
- 3.) Central Campus of Technology Hattisar, Dharan Koshi, Nepal.
- 4.) Prithvi Narayan Campus, Pokhara



# The Netherlands

**Name:** Department of Tunnelling and Underground Works (TTOW) of the Royal Institution of Engineers (KIVI) in the Netherlands



**Type of Structure:** Non profit, The Royal Institution of Engineers in the Netherlands is an association with individual members who are also member of the various departments of the association. The Department of Tunnelling and Underground Works is one of the larger departments within the association.

**Number of Members:** 582

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In 2018 the Department of Tunnelling and Underground Works performed several activities:

- Lecture day 'Bored Tunnels, current status of projects in The Netherlands'. Theme session on Maintenance aspects of existing bored tunnels in the Betuwe route, construction status of Rotterdamse Baan and Rijnland route bored tunnel.
- Congress 'Beyond a Tunnel Vision' in Brussels organised in corporation with: COB/IE-Net/ABTUS-BVOTS/KIVI-TTOW/BESIX/TOV
- TTOW Young Members site visit to 'Rotterdamse Baan' Bored tunnel project, also invited to other TTOW activities.
- Visit to Scandinavia: The Bored tunnels on the Follo Line project in Oslo, Norway; Immersed tunnel in Gothenburg, Sweden; Existing tunnel on the Öresund link, Denmark. In cooperation with the Norwegian association NTT
- ITA presentation evening and annual meeting of TTOW
- The COB (Centre of Underground Space) has created an online overview of Dutch tunnels. It shows that twenty-eight tunnel projects (green = new, orange = renovation) have been scheduled for the upcoming ten years.

## CURRENT TUNNELLING ACTIVITIES

**Blankenburg connection: Maasdelta tunnel (immersed tube) & Aalkeettunnel (in situ)**

The Blankenburg connection on the new A24 motorway consists of 2 tunnels: the Maasdelta tunnel, which is an immersed tube tunnel under the Scheur (Nieuwe Waterweg) waterway and the Holland tunnel, an in-situ tunnel through a natural habitat called the Krabbeplass. 20

years of management and maintenance are incorporated in the project (DBFM contract).

The Maasdelta tunnel will be some 945m in length and the Holland tunnel about 510m. The whole connection will be partly paid for by toll collection. In 2018, works started for the Maasdelta tunnel with the construction of cofferdams for the building docks in which the two tunnel elements for the Maasdelta tunnel will be constructed.

## Victory Boogie Woogie (Rotterdamsebaan) – (TBM)

In the Rotterdamsebaan project, an additional entrance for The Hague is created via a TBM tunnel – the Victory Boogie Woogie tunnel. The TBM (just finished) is called Catharina-Amalia, named after one of the daughters of the King of the Netherlands. Durability

and sustainability has played a large role. The twin-tube tunnel is 1860m in length (drilled section 1640m) with an inner diameter of 10m. Each tunnel tube provides two traffic lanes. Every 250m there is a cross-passage.

## A9 Gaasperdammerweg (in situ)

A 3km long tunnel of 5 tubes in the A9 through the Southeast of Amsterdam. The main civil works for the tunnel finished in 2017. At the moment, tunnel installations is ongoing. The tunnel is equipped with fireproofing boards and the roof of the tidal flow tube is under construction.

## Rijnlandroute (TBM)

In the Rijnlandroute project, a connection between the A4 with the A44 motorways is established near Leiden. The twin-tube TBM tunnel is 2.5km in length. Each tunnel tube provides two traffic lanes. 15 years of management and maintenance are also part of the contract. The project is in the execution phase, the building pits for the ramps are ready and the starter pit is ready for the installation of the TBM, which is foreseen to start boring in June 2019.

## Zuidasdok Amsterdam (in situ)

The Zuidasdok project establishes an extension of the existing A10 Zuid motorway, the ring road of Amsterdam. In a combined approach, the existing public transport hub will be extended and the motorway will be led through a series



RijnlandRoute



Maasdelatunnel water works



Rotterdamse Baan TBM break through - Courtesy Frank Jansen

of new tunnels. There will be two tunnels, each about 1km long. Each tunnel has two tubes; one four-lane tube for transit traffic and one two-lane tube for local traffic. On top of the tunnels, new public space will be developed, also providing space for the expansion of the public transport hub. The project was awarded in 2017 and is currently in the preliminary design stage.

#### **Maastunnel Rotterdam (renovation)**

The renovation of the Maastunnel is currently in the second half of the second year of renovation. Works are still proceeding according to plan. Currently, the new traffic floor is nearing completion. The Maastunnel is a monument which requires a special approach in bringing the tunnel up to the latest standards.

In 2015, concrete damage was registered at a single immersion joint. It

turned out that many immersion joints were damaged. After analysis of the failure mechanism a renovation scheme started and in 2018 the first joints were successfully restored. The first tube is finished; the second tube is under construction.

#### **Other Renovation projects (renovation mainly tti):**

- IJtunnel & Schipholtunnel (scheduled finish 2019)
- Koningstunnel (renovation in progress)
- Heinenoordtunnel & Kiltunnel (in preparation)
- Roertunnel & Swalmentunnel (in preparation, tunnel safety systems only)

#### **FUTURE TUNNELLING ACTIVITIES**

##### **A16 – Rottemerentunnel (in situ)**

The A16 motorway from the traffic junction Terbregseplein will be lengthened and connected to the

A13 motorway near Rotterdam. In this connecting road, a new tunnel is required - the Rottemerentunnel (preliminary working name). The Rottemerentunnel is planned to be opened in 2024 and will be around 2235m in length. There will be two tubes with two lanes per tube and an emergency lane.

The project was awarded in 2018 and is currently in the critical design stage and construction works will start in the first quarter of 2019. The project has an energy-neutral design with optimal integration of the new road into its environment.

#### **Renovation Eerste and Tweede Heinenoordtunnel**

In 2023, the Heinenoordtunnel (1969) in the A29 near Barendrecht will undergo renovation. At the moment, research on the scope and impact of the renovation is ongoing.

#### **Renovation Kiltunnel**

Between 2020 and 2022, the Kiltunnel between Dordrecht and 's Gravendeel will be renovated. The tunnel safety installations will be renewed and the civil structure will be renovated where necessary.

#### **Other future renovation projects (renovation mainly tti up to 2022):**

- Eerste and Tweede Beneluxtunnel
- Buitenvelderttunnel
- Noordtunnel
- Sijtwendetunnel
- Westerscheldetunnel
- Drechttunnel
- Piet Hein Tunnel

### **STATISTICS**

#### **1. Length or volume excavated - % mechanized/% conventional during 2018**

Mechanized tunnelling (TBM) 258000m<sup>3</sup>. Conventionally excavated volume: 0m<sup>3</sup>

#### **2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018**

A16 Rotterdam: €984M

#### **3. List of tunnels completed**

North-South Subwaytunnel  
Amsterdam

#### **4. List of tunnels under construction**

See above list 'Current Tunneling activities'



# New Zealand

**Name:** New Zealand Tunnelling Society

**Type of Structure:** Incorporated Society

**Number of Members:** 70 including corporate members



## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

- Technical evening presentations for continuing professional development – 5 number through 2018 including ITA EXCO member Arnold Dix.
- Annual One Day Tunnelling Short Course for 50 industry professionals (November 2018).
- Working Group to draft a Good practice guide for Geotechnical Baseline Reports formed
- Submission to Industry Regulator on Implementation of Health and Safety at Work Act 2015 and in particular the Mines and Quarries Regulations and

future revisions of the Act.

- Members support activities to ITA Working Group 3 and Working Group 5.

## CURRENT TUNNELLING ACTIVITIES

### City Rail Link (Auckland)

- The US\$2.3bn CRL is a 3.45km twin-tunnel underground rail link up to 42m below the city centre transforming the downtown Britomart Transport Centre into a two-way through-station that better connects the Auckland rail network, and thereby doubling the network capacity. The CRL has been phased in delivery with Contracts 1 (modifications to Britomart station)

and Contract 2 the Albert St cut and cover tunnels awarded in 2015 as ECI contracts using NZS 3910 (these are approximately 80% complete).

- Two Tenders have been received by CRL the Crown entity established for project delivery) for C3 the main civil works. Contract C3 will include the TBM running tunnels and underground stations (two cut and cover, and one mined) and line wide systems package under a competitive alliance model similar to that utilised for the Waterview Connection. The C3 contract is due to be awarded in the second quarter of 2019 and the railway is due for completion in 2024. <https://www.cityraillink.co.nz/what-is-crl>

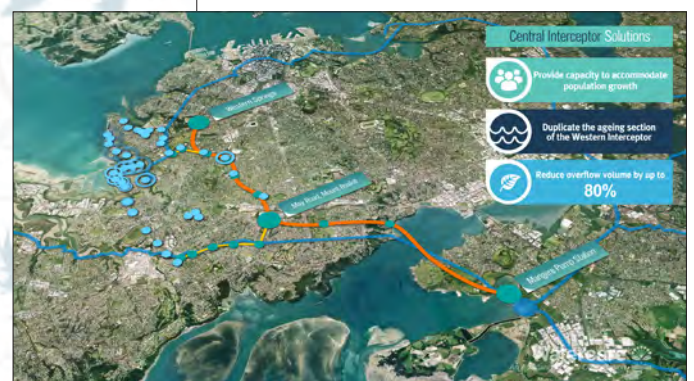
### Lyttelton Tunnel Fire Protection Upgrade (Christchurch)

The Lyttelton Tunnel was completed in 1964 and includes a semi-transverse ventilation system. This contract is for US\$20M to install a fixed fire suppression system and associated CCTV and smoke detection systems. This project will be completed in the second quarter of 2019. <https://www.nzta.govt.nz/projects/lyttelton-tunnel/fire-protection-upgrade/>

## FUTURE TUNNELLING ACTIVITIES

### Central Interceptor (Auckland)

The US\$800M Central Interceptor is a 13km long 4.5m diameter wastewater tunnel (TBM) with associated link sewers (2.1 to 2.4m diameter, 4.4km total length) and drop shafts that will run between Western Springs and the Māngere Wastewater Treatment Plant. The existing wastewater pipeline that passes under the Manukau Harbour was built in 1964 and is reaching the end of its operational life. Auckland is also undergoing significant population growth and must accommodate another one million people over the next 30 years. The Central Interceptor is critical to providing additional wastewater capacity for this



growth and enabling the connection of future wastewater projects in response to growth. Upon completion it is expected to reduce overflows into the Waitemata Harbour by 80%. The project is scheduled for completion in 2025. <https://www.watercare.co.nz/About-us/Projects-around-Auckland/Central-Interceptor>

#### **Terrace Tunnel and Mt Victoria Tunnel Duplication (Wellington)**

<https://www.nzta.govt.nz/projects/wellington-northern-corridor/mt-victoria-tunnel-duplication/>  
<https://www.nzta.govt.nz/projects/wellington-northern-corridor/terrace-tunnel-duplication/>

#### **Hunua 4 Section 11 Watermain**

<https://www.watercare.co.nz/About-us/Projects-around-Auckland/Hunua-4-watermain>

#### **Pike River Recovery**

<https://www.pikeriverrecovery.govt.nz/>

#### **Martha Underground Gold Mine Waihi – due to start 3rd Quarter 2019**

<http://www.waihigold.co.nz/mining/>

### STATISTICS

#### **1. Length or volume excavated - % mechanized/% conventional during 2018**

Approximately 25km 90%: 10%. The data is skewed by pipejacking in the 1-2.4m diameter range. New Zealand continues to address population growth and the ageing of assets with many stormwater/wastewater upgrades in the larger cities.

#### **2. Amount (USD or EUR) of tunnelling/underground space facilities awarded in 2018**

Approximately US\$50M. Broad estimate of the underground industry in New Zealand is around US\$200M per annum. This is set to increase to about \$500M per annum with both CRL and Central Interceptor over the next 5 years.

#### **3. List of tunnels completed**

Main North Line Kaikoura Rail Tunnels (\$US50M) (20 tunnels refurbished after the November 2016 earthquake). State Highway 1 Raramai and Paratitahi road tunnels widening (\$US 10M)

#### **4. List of tunnels under construction**

City Rail Link

### EDUCATION ON TUNNELLING IN THE COUNTRY

No formal professional tunnel education occurs at any of the main NZ engineering universities. This is a focus of the NZTS and Engineering New Zealand in 2019.

Training and assessment of individuals to undertake safety critical roles required by statute continues to be moderated by industry regulator Worksafe to support the growth in the industry.

# Nigeria



**Name:** Nigeria Tunnelling Association

**Type of Structure:** Non – Profit Organisation

**Number of Members:** 60 members, 2 corporate members

### ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

The Nigeria Tunnelling Association hosted its International Tunnelling and Underground Space Conference themed: The Socio Economic Benefits of Developing Tunnelling and Underground Space Infrastructure in Nigeria. A communique was presented to the public at the end of the conference.

#### **Awareness Creation:**

The engagement of the Nigeria National Assembly (through the committee the Land Transport Committee) where Tunnelling was adopted as part of the most recent bill on Land Transport, the Federal Ministry of Water Resources, the Federal Ministry of Transportation, the Federal Ministry, Power Works and Housing. The Nigeria Tunnelling Association through its Think Deep Naija

initiative partnered with the Lagos State Government through the Lagos City Resilient Office.

#### **International Engagements:**

Nigeria Tunnelling Association facilitated and provided guidance for Kenya in its bid to set up a dedicated Tunnelling Association.

### CURRENT TUNNELLING ACTIVITIES

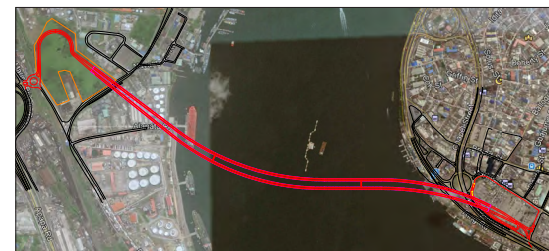
There are currently no live Tunnelling projects ongoing, there are however projects in both procurement and feasibility phases.

#### **Procurement**

The Mambilla Hydro power project is still in its last phase of procurement – The project comprises of 3 hydraulic tunnels totalling 33km over a vertical elevation of over 1000m

#### **Planning & Concept Phase**

- Lagos Harbour Tunnel, 2km of vehicular tunnel linking the mainland and island.
- Rail Tunnels as alternatives for Lagos Metro. Each approximately 30km
- Lagos Sewer Tunnel.
- Lagos Murtala Mohammed



Apapa to marina harbour tunnel

### EDUCATION ON TUNNELLING IN THE COUNTRY

Education is one of the strategic pillars set in place as part of the development of the industry in Nigeria. This is delivered through technical courses, seminars and workshops. The Tunnelling Association has set out a programme called “The University Campaign” to reach out to at least 1000 students every year.



# Norway



**Name:** Norwegian Tunnelling Society

**Type of Structure:** Non-profit, open society with members from the whole value chain, both corporate and personal members.

**Number of Members:** 1000 personal members and 100 corporate members (Including research institutes, academia, and public clients)

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

The Norwegian Tunnelling Society has a set of yearly events such as conferences, courses and evening meetings. Among these, the largest is Fjellsprengningsdagen, which gathers more than 700 rock blasting and TBM enthusiasts to share knowledge and the latest news.

Also, in 2018 Norway was among the finalist in several categories in the ITA Tunnelling Awards. Fredrikke Syversen as Young Tunneller of the Year, the Vamma project as Project of the Year Between €50-500M, and the Rock blasting museum at Hunderfossen as Innovative Underground Space Concept of the Year. The last went all the way to the top and brought a statue of Mr Brunel home to Norway.

The Society publishes handbooks and technical reports in Norwegian and one English publication every year. In 2018, a Norwegian technical report regarding Measurement While Drilling, in addition to the English Publication nr 27 "Safety in Norwegian Drill and Blast Tunnelling" was published.

## CURRENT TUNNELLING ACTIVITIES

The tunnelling activity in Norway is still very high and in 2018 we excavated 5,8Mm<sup>3</sup> rock under ground. The amount

of excavated rock has been steadily growing, but 2018 ended up being the first year with a decrease in volume since 2009. The decrease is due to large projects in the final phase of excavation, while the new ones have not yet started. We believe that this will also influence the volume in 2019. The major part of the activity is still concentrated around road and rail tunnels, with hydropower tunnels a significant amount of the activity.

In 2018 the rock excavation of the longest and deepest subsea road tunnel in the world, Ryfast, was completed.

The project will open for traffic later in

2019. In 2018, two major infrastructure projects were opened for traffic; The new highway E18 Bommestad-Sky, and the new railroad Farriseidet-Porsgrunn, both being projects where tunnels play an important part.

Nye veier opened its first project for traffic in August 2018, a complex project due to difficult logistics and relocation of existing traffic.

The largest infrastructure project in Norway so far, The Follo Line is of course an important part of the overall activity.

The project will open 22km of new railroad in 2022, and 26th of February 2019, a major milestone was celebrated with the two last TBMs having the breakthrough (see photos from the projects).

Nedre Otta and Leikanger are the two hydro powerplants with the highest volume of excavated rock in 2018.

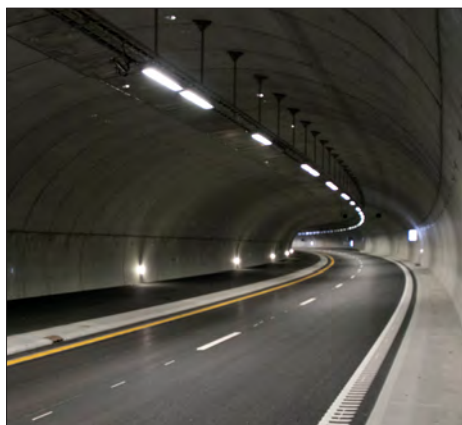
The powerplants are not yet open for production, but Nedre Otta will complete rock excavation in the first half of 2019.

## FUTURE TUNNELLING ACTIVITIES

The high activity within infrastructure



Breakthrough Follo Line - Photo Tone Nakstad NFF



E18 Bommestad - Photo Christian Aarhus Byggeindustrien



Lysebotn II - Photo Kristofer Ryde

development will continue in the years to come. As an example; the public budget for road development will on average be 10% higher for the next 6 years compared to the 2017-level.

Within rail, the Follo line project will continue for several years and will open for traffic in 2022. The next large infrastructure project will be the joint rail and road project, Ringerike Line and E16 Highway, which will include a 40km long tunnel for the railway in addition to some shorter tunnels both for rail and highway between Sandvika and Hønefoss.

Nye veier will continue the road building along the E18 from Porsgrunn to Stavanger. These projects will include both tunnels and rock blasting overground. The same goes for the new E6 between Hamar and Lillehammer, and new E6 both south and north of Trondheim.

The Norwegian Public Road Administration has started the first contract for Rogfast. This project will include the current longest and deepest subsea tunnel. The project is a part of the Infrastructure program "Ferry free connection between Kristiansand and Trondheim". This program will of course include many other tunnel projects as well.

Among the coming hydro power projects, we can find the Leikanger powerplant (13km), Tolga powerplant (10km), Opo powerplant (5km) and the Etne power plant (6km). In other words, the tunnel market in Norway is strong and will continue to be so in the years to come.

A new big project is under planning in the new water supply tunnel to Oslo from the Holsfjord west of the city into the existing net of water pipes.

### EDUCATION ON TUNNELLING IN THE COUNTRY

Norway has several universities giving both bachelor and master degrees within several aspects of tunnelling, the major ones being NTNU in Trondheim and University of Oslo. In addition to the higher degrees of education, Norway can offer a set of schools preparing the students through a four-year program for the certification for rock blasters. In addition to these educational institutes, you have a set of courses and classes with different level of classifications and certifications.

### STATISTICS

#### 1. Length or volume excavated - % mechanized/% conventional during 2018

13,640m with TBM and 72,184m with drill & blast. In total, 5,8 million m<sup>3</sup> rock was excavated in 2018

#### 2. Amount (USD or EUR) of tunnelling/underground space facilities awarded in 2018

(No number available)

#### 3. List of tunnels completed

The most important tunnels completed: E18 Bommestad-Sky, Farriseidet – Porsgrunn (several tunnels), Lysebotn II Hydropowerplant, E6 Langslett – Sørkjosen, E6 Langnesbukt – Storsandnes

#### 4. List of tunnels under construction

Among the largest tunnels under construction are The Follo Line, E39 Rogfast, E6 Soknedal, FV659 Nordøyveien and several hydropower plants.

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# Poland

**Name:** Subcommittee of Underground Construction of Polish Committee on Geotechnics

**Type of Structure:** Non profit, open association

**Number of Members:** 68 members, 6 corporate members



## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In 2018 the Polish Tunnelling Society (full name: Subcommittee of Underground Construction of Polish Committee on Geotechnics) continued working on the promotion of the underground space use in Poland. The Society co-organized and participated in the 3rd Conference Underground Structures 2018, which took place in April 2018 in Warsaw.

The representatives from Poland were present at ITA General Assembly and attended meetings of ITA Working Groups held during WTC 2018 in Dubai: Monika Mitew-Czajewska (president) - WG20, Anna Siemińska-Lewandowska

(secretary) - WG15, Dymitr Ganew - WG14.

Journals dealing with geotechnics and underground structures in Poland: Geoengineering - roads, bridges, tunnels (ISSN 1895-0426), Engineering and Construction (ISSN 0021-0315), Mining and Geoengineering (ISSN 1732-6702), Marine Engineering and Geotechnics (ISSN 0867-4299).

## CURRENT TUNNELLING ACTIVITIES

### Road Tunnel in Warsaw – a part of south city ring

The tunnel will be 2,700m long, with 3 lanes in each direction constructed by cut and cover. Construction works are in progress. Due date August 2020.

### Construction of 2nd metro line in Warsaw, extensions of the existing central part:

- In east direction (3 stations, 6.3km)
- In west direction (3 stations, 7km)
- Construction method: TBM + cut & cover. Due date 2019.



### Road Tunnel under Luboń Mały – south Poland

Over 2 x 2km tunnel on the S7 motorway from Kraków to Zakopane (polish skiing resort). Construction works in progress, 2200m executed, the method of construction - ADECO RS. Due date 2020.



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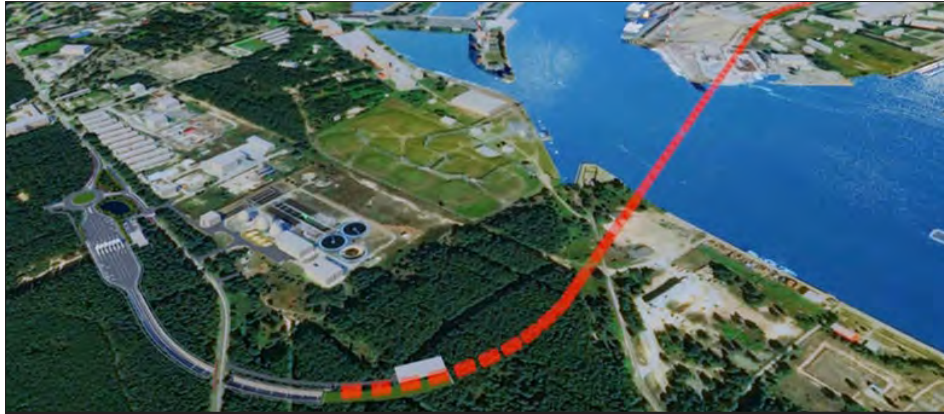
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### Construction of 2nd metro line in Warsaw, extensions of the existing central part:

- In east direction (3 stations, 8km)
- In west direction (5+1 stations, 12km)
- Construction method: TBM + cut & cover. Due date 2023.



Road Tunnel under Świna river in Świnoujście

### Road Tunnel on S3 motorway Bolków-Kamienna Góra – south Poland

2.3km tunnel on the S3 motorway from Bolków to the state border. Design and build. Contract was signed in September 2018, design works begun. Due date 2023.

### Road Tunnel under Świna river in Świnoujście – north Poland

The 1.44km long tunnel will connect the islands Uznam and Wolin. Construction method TBM – 12m diameter. Due date 2022. Design works begun.

### Rail Tunnel in Łódź – Tunnel connecting Łódź Fabryczna and Łódź Kaliska stations

Length of the tunnel – 3km of double track tunnel, 4.5km of single track/twin tube tunnels; 2 underground stations; Construction method TBM + cut & cover. Due date 2022. Design works are completed, construction should start in summer 2019. Two TBM's – diameter 13.04m and 8.76m - were ordered.

### FUTURE TUNNELLING ACTIVITIES

#### Two Road Tunnels on S1 motorway, the ring road of Węgierska Góra – south Poland

Two road tunnels (830m and 980m) on the S1 motorway from Bolków to the state boarder. The tender was announced in January 2018. In October 2018 the general contractor was chosen but after verification this decision was withdrawn. Final selection from the remaining bidders will be made in early 2019. Tunnels will be constructed using the sequential excavation method or ADECO. Due date 2022.

### Four Road Tunnels on S19 motorway, Via Carpatia, section Rzeszów - Barwinek

Four road tunnels (1.35km, 1.75km, 1.6km, 1.2km) on the S19 from Rzeszów to the state boarder. The conceptual design is under progress. Due date 2023.

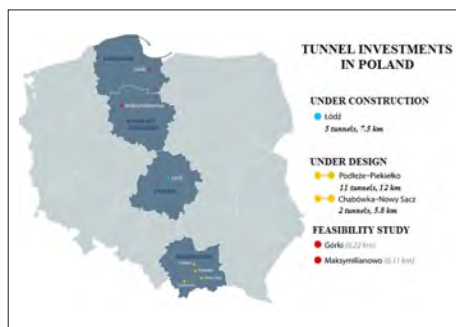
### Eleven (11) Rail Tunnels – 12km length in total on the planned 58km long new rail route Podłęże-Piekietko in the south of Poland. In addition two Rail Tunnels – 5.8km length in total on the rail route Chabówka – Nowy-Sącz, which will be modernized.

Environmental approval was obtained. The design works are in progress. Preparatory works and the design are to be completed by 2021. The construction and modernization is planned for 2020-2026



### Two short rail tunnels in Górki (0.22km) and Maksymilianowo (0.11km)

### A lot of short tunnels, under railway tracks, are currently being built across Poland.



## STATISTICS

### 1. Length or volume excavated - % mechanized/% conventional during 2018

9550m mechanized/2200m conventional/2500m cut & cover

### 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018

€1490M

### 3. List of tunnels completed (0)

### 4. List of tunnels under construction (7) + (19 design stage)

## EDUCATION ON TUNNELLING IN THE COUNTRY

Basics of Underground Structures (1st degree studies), Underground Structures I and II, Fire safety in tunnels – 2nd degree studies – Warsaw University of Technology, Faculty of Civil Engineering

Underground Construction (1st degree studies), Geotechnology of underground structures and tunnels, The impact of underground construction on surface and surrounding rock mass, Ventilation in selected underground facilities – 2nd degree studies - AGH University of Science and Technology, Faculty of Mining and Geoengineering

Underground Structures – 2nd degree studies – Wrocław University of Science and Technology, Faculty of Civil Engineering

Tunnels and underground passages – 2nd degree studies – Cracow University of Technology, Faculty of Civil Engineering

Elements of rock mechanics and underground structures – 2nd degree studies – Faculty of Civil and Environmental Engineering, Warsaw University of Life Sciences – SGGW

Underground structures – (1st degree studies) – Silesian University of Technology, Faculty of Civil Engineering

Underground structures (2nd degree studies) – Białystok University of Technology, Faculty of Civil and Environmental Engineering



# Portugal



**Name:** Comissão Portuguesa de Túneis e do Espaço Subterrâneo (CPT)

**Type of Structure:** Non profit association. A branch of Sociedade Portuguesa de Geotecnia

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

Underground Works and the New European Contracting Guidelines. Portuguese Situation and International Practices" was held in February 2018. A total of 120 attendees had the opportunity to learn from several national regulators, law offices, contractor managers and financial court judges how the new EU regulations on public contracts will impact the daily practice of underground works contracts in Portugal and abroad. Ing. Matthias Neuenschwander, Chairman of ITA-AITES WG 3 Contractual Practices and In. Rafaelle Zurlo (CEO of BBT, Galleria di Base del Brennero) presented two plenary lectures on "The new ITA/AITES-FIDIC Book project for underground construction" and "Contractual risk

management philosophy of the second longest railway tunnel in the world", respectively.

A joint venture between CPT and the Portuguese Association of Designers was signed aiming at the drafting "recommendations about contractual practices of underground works".

The event was endorsed by ITA-AITES.

## CURRENT TUNNELLING ACTIVITIES

Gouvães Dam hydroelectrical underground power scheme (2.5km of tunnel)

## FUTURE TUNNELLING ACTIVITIES

- Porto Metro Yellow Line extension and new line G (3.8km tunnels and 7 underground stations)
- Lisboa Metro Green line extension

(1.5km tunnels and two underground stations)

- Daivões Dam hydroelectrical underground power scheme (900m tunnel)
- Gouvães Dam hydroelectrical underground power scheme (2km m tunnel)

## STATISTICS

- 1. Length or volume excavated - % mechanized/% conventional during 2018 - 2.5km (conventional)**
- 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018**  
€415M (Yellow Line extension and new line G of Porto Metro; Green line extension Lisboa Metro)
- 3. List of tunnels completed**  
New Águas Santas road tunnel;
- 4. List of tunnels under construction**  
Refurbishment of Linha ferroviária do Minho (6 tunnels, 2.7km) (design); Refurbishment of Abrunhosa tunnel (500m) (design); Gouvães Dam hydroelectrical underground power scheme

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# Russia



**Name:** Russian Tunneling Association (RTA)

**Type of Structure:** Non profit

**Number of Members:** Total number - 58

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

**The following events were organized and held in 2018:**

- Thematic round table "Road and Railway Traffic Tunnels" (Moscow, March 22, 2018),
- Public workshop "Technology of Off-Form Manufacturing Traffic Tunnel Wall Structures by Placing Concrete Using Pumps on Secant Piles and Tangential Piles" (town of Shcherbinka, Moscow region, July 17, 2018),
- Scientific and Technical Forum "Trends and Problems of and Prospects for Development of Underground Construction" in partnership with the Tunnel Association of the Republic of Belarus (Minsk, Republic of Belarus, September 27-29, 2018).

**The following vocational competitions were also organized and held:**

- S.N.Vlasov Competition "Engineer of the Year of the Tunnel Association of the Russian Federation – 2018",
- Competition "The Best Use of Advanced Technologies for Construction of Tunnels and Underground Facilities",
- Competition of scientific papers (graduate theses) of students from higher education institutions.

*News bulletins of the Tunnel Association of the Russian Federation and the professional magazine "Metro and Tunnels" were put out (4 issues of the magazine were published).*



Moscow Metro Station "Rasskazovka"

## CURRENT TUNNELLING ACTIVITIES

17 stations were put into operation and 2 depots for rolling stock were built in Moscow in 2018 within the Moscow Metro Development Program. The excavation of 2-track main line tunnel (Ø 10.4m) between the under construction Metro Stations "Okskaya" and "Stakhanovskaya" on the Nekrasovskaya (Kozhukhovskaya) line was completed in the middle of December.

The Metro Stations "Novokrestovskaya" and "Begovaya" located near the stadium "Zenit – Arena" were put into operation in Saint Petersburg by the beginning of the 2018 World Cup, and another 3 stations ("Prospekt Slavy", "Dunaysky Prospekt" and "Shushary") on the extension of the Frunzensky Radius of the Saint Petersburg Metro were also prepared to be put into operation.

Corporate members of the Tunnel Association of the Russian Federation participate in large-scale programs intended to increase the capacity of the Trans-Siberian Railway and the Baikal-Amur Mainline. In 2018, the excavation of the second Baykalsky Tunnel leg was completed (its length is ca. 6.7km).

## FUTURE TUNNELLING ACTIVITIES

Works on the development of the Moscow and Saint Petersburg Metro will continue.

The planned total length of the Moscow Metro lines by 2022 is 450km.

According to the Saint Petersburg Metro Development Plan, the length of the Saint



Moscow Metro Station "Savelovskaya"

## STATISTICS

1. Length or volume excavated - % mechanized/% conventional during 2018 - N/A.
2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018  
N/A.
3. List of tunnels completed  
N/A.
4. List of tunnels under construction  
N/A.

## EDUCATION ON TUNNELLING IN THE COUNTRY

Major higher education institutions which train and retrain specialists in underground construction:

- Moscow State University of Railway Engineering (MIIT),
- Moscow State University of Civil Engineering (MGSU),
- Moscow State Mining University (MGU) of the National University of Science and Technology "MISIS",
- National Mineral Resources University "Mining University" (SPGU),
- Saint Petersburg State Transport University (PGUPS),
- Tula State University,
- Ural State Mining University (UGGU),
- Siberian State Transport University (SGUPS).

Petersburg Metro lines will increase from 113.6km to 155.5km by 2027. The number of metro stations will increase from 67 to 85 and the number of metro depots will increase from 5 to 7.

It is planned to resume the construction of the Krasnoyarsk Metro.

In the near future, it is planned to implement large-scale projects for the construction and reconstruction of railway tunnels within the reconstruction and development of the Trans-Siberian Railway and the Baikal-Amur Mainline (the development of the feasibility study for the construction of the second leg of the Severomuysky Tunnel at the Baikal-Amur Mainline will end).

The tunnel option for the construction of a railway crossing from the mainland to Sakhalin island may be adopted.



# Singapore



**Name:** Tunnelling and Underground Construction Society (Singapore) (TUCSS)

**Type of Structure:** Non profit, open association

**Number of Members:** 1208 members, 117 corporate members

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In 2018, TUCSS continued to promote tunnelling and underground construction through organising monthly evening seminars, training courses, conference & site visits for dissemination of tunnelling & underground related information and best practices, as well as conducting social networking events to bring together the practitioners from the different sectors of the industry. TUCSS continued to support the accreditation of tunnelling resident site supervisory staff during the year.

**18 January 2018** - Advanced Ground Support in D&B Tunnels - Richard Fuchs, DSI Underground

**22 March 2018** - Mined tunneling in soil: Use of pre-support techniques to limit deformations and surface settlements - Massimo Marotta, Land Transport Authority

**19 April 2018** - Structural & Fissure Grouting with Sovereign NOH2O - J D Park, SOVEREIGN-JEDA Pte Ltd

**17 May 2018** - Diaphragm wall Construction and Seepage Repair - Mr. Totapally Krishna Mohan Sharma, Tiong Seng Dongah Joint venture

**21 June 2018** - Crossrail C310 Thames Tunnel (London, UK) - Mixshield TBM Tunnelling in Alternating Ground Conditions with Low Overburden - Mr. Andreas Raedle, Arup Singapore

**19 July 2018** - Supervision of Bored Tunnelling Works using Slurry TBMs - Er. Sahabdeen Mohamed Mohideen, Mott MacDonald (S) Pte Ltd

**16 August 2018** - Tunnelling and Underground Construction for Improved Productivity and Safety - Dr. Nimantha Baranasuriya, Ackcio Pte. Ltd

**15 November 2018** - Artificial Intelligence and Physical Model Based Performance

Prediction of EPB TBM - Prof. Michael Mooney, Colorado School of Mines

### Annual Lecture

- TUCSS Annual Lecture was held on Friday, 12 October 2018 at NTUC Auditorium. The topic was "Recent Bored Tunnels Beneath the Sea in Hong Kong" by Dr. Leonard John Endicott. The Annual Lecture was attended by 305 TUCSS members.

### Hulme Prize Competition

- TUCSS Hulme Prize was held on 20th September 2018. The winners of the competition are:
  - 1st Prize: Ruben Duhme (Excavation Management of Slurry TBMs – Long Term Operational Accuracy Evaluation)
  - 2nd Prize: Russell Connors (Procedures to Minimise the Incidence of Decompression Sickness for Compressed Air Cutterhead

Interventions)

- 3rd Prize: Senthilnath GT (Effects of shallow over-crossing TBMs on existing tunnels and surface movements)

### Training Courses

- TUCSS held the "TUCSS Tunnelling Seminar 2018" on 13th April 2018 at Raffles City Convention Centre. It was well attended by 130 participants.
- TUCSS held the Half Day Workshop on Bored Tunnel Excavation Management on 26 September 2018. It was attended by 100 participants.

### UGS2018 Conference

- TUCSS held "Underground Singapore 2018" on Thursday & Friday, 27 & 28 September 2018, at Parkroyal on Beach Road. It was attended by a total of 350 participants with 37 papers presented at the conference.

### Annual Dinner

- TUCSS Annual Dinner was held on 5 October 2018 at Mandarin Orchard Hotel. The event was attended by over 600 guests and members.

### Golf Challenge

- TUCSS organised 2 golf tournaments in 2018:
  - 20 April 2018 at Singapore Island Country Club
  - 18 October 2018 at Sentosa Golf Club



### Site Visits

- TUCSS held Technical Site Visit to T226 Marina Bay Station & Tunnels on 11 August 2018. It was attended by a total of 51 TUCSS members.

### CURRENT TUNNELLING ACTIVITIES

#### Thomson-East Coast Line (TEL)

The TEL is a medium-capacity MRT line that is currently under construction, being the sixth line to be built. The 43km long TEL will add 32 new stations to the existing rail network, with 7 interchange stations, which will link to the other MRT lines. The integrated depot will stack three train depots together, with a bus depot built next to them. The entire depot will be housed within a single site of 36 hectares, thus saving 44 hectares of land. The integration of four depots is unprecedented. The TEL will be ready in stages from 2019 to 2024. In total, 27 Earth Pressure Balance (EPB) and 24 Slurry type Tunnel Boring Machines (TBMs) are being used for the tunnelling works.

#### Circle Line Stage (CCL) 6

The 4km CCL6 will close the loop for the CCL by connecting Harbour Front station to Marina Bay station. When the three

CCL6 stations of Keppel, Cantonment and Prince Edward Road are completed in 2025, the CCL will have a total of 33 stations, including 12 interchange stations with other MRT lines. In total 3 EPB TBMs will be used for the tunnelling works.

#### North East Line Extension (NELe)

The 2km long NELe will add one station, Punggol Coast, to bring the total number of stations on NEL to 17. It will serve Punggol North including the new Punggol downtown. It is expected to be completed by 2023. In total 2 EPB TBMs will be used for the tunnelling works.

#### North-South Corridor (NSC)

The North-South Expressway – originally conceived as a 21.5km expressway to connect towns in the north to city centre – is being redesigned as North-South Corridor to better enable cycling and walking. The NSC will be Singapore's first integrated transport corridor featuring continuous bus lanes and cycling trunk routes. NSC is expected to be completed by 2026.

#### Deep Tunnel Sewerage System Phase 2 (DTSS Phase 2)

This is a massive 100km used water conveyance tunnel network for

transferring sewage largely under the Expressway, crossing undersea at the South West of Singapore and ending at deep inlet shafts within the future Tuas Water Reclamation Plant. In total 19 Tunnel Boring Machines will be used to dig at depths of between 35m to 55m below ground and under the sea to create 40km of deep tunnels and 10km of link sewers. The remaining 50km of link sewers will be constructed using pipe jacking.

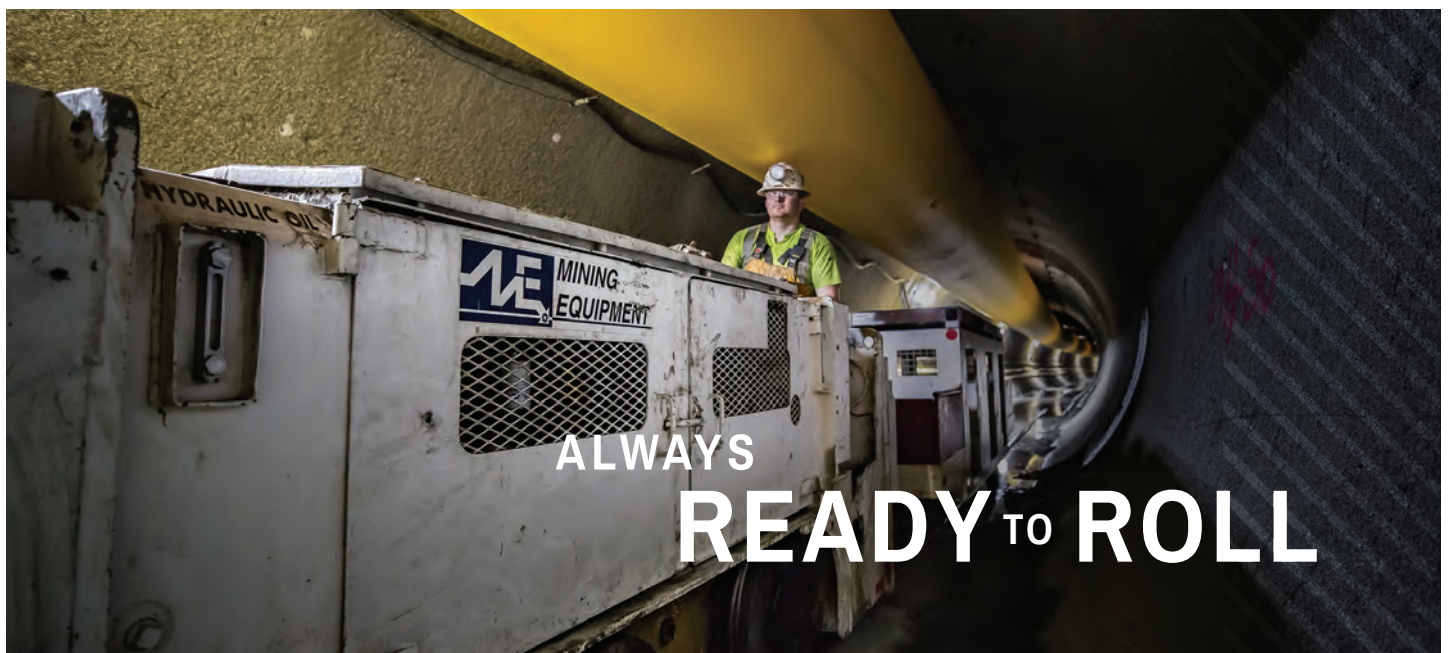
### FUTURE TUNNELLING ACTIVITIES

#### Changi East Development

In order to support airport infrastructure development Changi Airport Group is planning tunnels for underground roads, sewage transfer, common services, baggage handling and people mover systems. The construction is expected to commence during early 2020.

#### Cross Island Line (CRL)

Construction for the first stage of Cross Island Line (CRL) – Singapore's longest fully underground MRT line – will commence 2020 and will be completed by 2029. The first stage is 29km long and would have 12 new stations spanning from Changi East to Bright Hill.



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# Slovakia



**Name:** Slovenska tunelárska asociácia (STA)

**Type of Structure:** Association

**Number of Members:** 54 members, 49 of them corporate ones

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

A conference with an international attendance 'Tunnel and Underground Construction 2018' was held in May 2018 in the northslovakian town Žilina, more than 350 experts attended.

## CURRENT TUNNELLING ACTIVITIES

### Ovčiarisko and Žilina tunnels

There are two twin-tube motorway tunnels in the 13.2km long Hričovské Podhradie – Lietavská Lúčka section of the D1 motorway: the Ovčiarisko and the Žilina. The excavation of the 2367m long Ovčiarisko tunnel started on the 12th September 2014. Casting of secondary lining concrete in the north tube was finished in October 2017 and concreting of the secondary lining in the south tube in December 2017. The Žilina tunnel is a 687m long double-tube tunnel in the Hričovské Podhradie – Lietavská Lúčka section of the D1 motorway. The south tube and north tube breakthrough celebrations took place on the 5th December 2016 and the 9th February 2017, respectively. In both tunnel tubes including cross passages, the concrete roadway surface has been completely finished and coating of side walls has been completed in both tunnel tubes.

### Višňové tunnel

The 7.5km long Višňové tunnel is part of the Lietavská Lúčka – Višňové – Dubná

Skala section of the D1 motorway, running south of the town of Žilina. By the end of Summer 2018, after 40 months of excavation operations, the longest Slovakian motorway tunnel, Višňové, broke through. The aggregate length of the mined tunnel tubes amounts to 14,889m. Casting of the secondary lining concrete proceeded from both portals, in parallel with the excavation. Before the end of 2018 8352m of the upper vault excavation have been finished, representing approximately 60% of the length of the tunnel tubes.

### Prešov tunnel

The Prešov tunnel is located on the Prešov West – Prešov South section of the D1 motorway. The tunnel passes through the Malkovská Hôrka hill, which is formed by flysh sediments. The north tube and south tube will be 2230.50m and 2244.00m long, respectively. Driving the tunnel from the eastern and western portals started in August 2018.

### Diel and Milochovej railway tunnels

The Diel tunnel passes through the massif of Diel Hill, which forms the central part of the Váh River meander in the area of the Nosice Dam. The design length of the tunnel is 1082m. The Diel tunnel will have an escape gallery, which will end at the eastern portal area of the tunnel. Excavation operations in the

tunnel are gradually nearing completion. The total length of the Milochovej tunnel is 1861m. Excavation works are in progress.

## FUTURE TUNNELLING ACTIVITIES

### Soroška tunnel

The Soroška tunnel of the length 4.3km will be part of the R2 expressway in the south of Slovakia. The tunnel will be built with one tube and an escape gallery for the whole length of the tunnel. Building permits can be expected in 2019 with the start of construction in 2020.

### Korbelka and Havran tunnels

Two motorway tunnels, the 5.8km long Korbelka Tunnel and the 2.8km long Havran Tunnel are part of the motorway D1 section Turany – Hubova. Both tunnels are in design phase and start of construction expected after 2020.



Diel tunnel

## STATISTICS

### 1. Length or volume excavated - % mechanized/% conventional during 2018

Approx. 6km, 100% conventional tunnelling.

### 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018

No new contracts awarded in 2018.

### 3. List of tunnels completed

No tunnels completed in 2018

### 4. List of tunnels under construction

Žilina, Ovčiarisko, Višňové, Prešov, Čebrať, Milochovej, Diel.



Ovčiarisko tunnel

## EDUCATION ON TUNNELLING IN THE COUNTRY

- Slovak technical university, Faculty of Civil engineering
- University of Žilina, Faculty of Civil engineering
- Technical university Košice, Faculty BERG

# Slovenia



**Name:** Slovenian Society for Underground Structures

**Type of Structure:** Non profit, open association

**Number of Members:** 116 members, 32 young members

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

- Participation at WTC 2018 in Dubai
- Members Assembly and Elections
- Social events

## CURRENT TUNNELLING ACTIVITIES

### Karavanke Tunnel

Detail design for upgrading the existing single bidirectional transalpine base tunnel with a second tube to form a twin highway tunnel tube system. Total tunnel length is 8km with more than 1000m of overburden. The tunnel passes through very heterogeneous rock material from perm, carbon to Triassic formations, with squeezing ground and difficult hydrogeological conditions.

### Karavanke Railway Tunnel

Detail design for security and technical upgrades of the nearly 8km long Karavanke railway tunnel, which was put into service in 1906. The scope is to remove the double-track line in the tunnel and build a single-track line, restore the damaged parts of the structure, arrange drainage and the catenary and to set up an intervention corridor for signalling, safety and telecommunication devices as well as systems to ensure fire safety in rail traffic and for safe and efficient rescue in case of accidents.

### Second Track of the Divača-Koper railway line

Building permit design changes for upgrading the existing single track railway between Divača and Koper with a second track. The new railway line passes

through 8 tunnels (T1-T8) with a total length of 38km. All tunnels are single-tube tunnels; tunnels T1, T2 and T8 are designed with service tubes, which are to be used for rescue operations, while tunnels T4 and T7 have transverse exit tubes. The route of the second track runs on different formations of carbonate rocks characterised by numerous karst features (sinkholes, cracks, caverns, tunnels, underground caves, chasms etc.). The degree of karstification of individual areas is high.

### Tunnel Pekel

Detail design of a 1.5km long double-track railway tunnel, as an upgrade of the railway line Maribor – Šentilj – state border. The tunnel with a cross section about 135m<sup>2</sup> has a maximum overburden 90m and less than 10m when crossing the existing highway H2. The H2 crossing is the main challenge as the tunnel runs through a low-bearing layer of clay and highly weathered marl causing risk of road deformations. Therefore, a stiff support system with two sidewalls is foreseen.

### Tunnel Šentilj

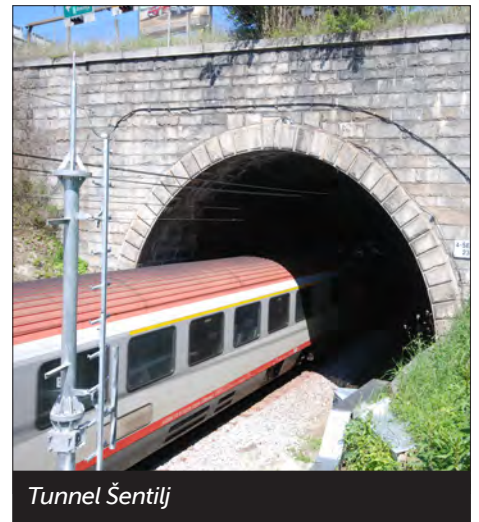
Rehabilitation of an old block lined railway tunnel. Installation of bottom slab, drainage and waterproofing.

## FUTURE TUNNELLING ACTIVITIES

### Karavanke Tunnel

Start of construction for upgrading the existing single bidirectional transalpine base tunnel with a second tube to form a twin highway tunnel tube system. Total tunnel length is 8km and has more

than 1000m of overburden. The tunnel



*Tunnel Šentilj*

than 1000m of overburden. The tunnel passes through very heterogeneous rock material from perm, carbon to Triassic formations, squeezing ground and difficult hydrogeological conditions.

### Third Development Axis – South

Building permit design for the execution of a new road link from the access point to Ljubljana–Obrežje motorway near Novo mesto to the Maline access point. Total length of the planned expressway amounts to 17.9km, and includes three bridges, four viaducts, two cut-and-covers, a 2.4km long tunnel under the Gorjanci hills, 10 overpasses, 9 underpasses and two lay-bys. The project is planned to be completed by the end of 2021.

### Second Track of the Divača-Koper railway line

Detail design for upgrading the existing single track railway between Divača and Koper with a second track. The new railway line passes through 8 tunnels (T1-T8) with a total length of 38km. All tunnels are single-tube tunnels; tunnels T1, T2 and T8 are designed with service tubes, which are to be used for rescue operations, while tunnels T4 and T7 have transverse exit tubes. The route of the second track runs on different formations of carbonate rocks characterised by numerous karst features (sinkholes, cracks, caverns, tunnels, underground caves, chasms etc.). The degree of karstification in individual areas is high.

## EDUCATION ON TUNNELLING IN THE COUNTRY

Department of Geotechnology, Mining and Environment (OGRO)/Faculty of Natural Sciences and Engineering, University of Ljubljana



*Second Track Divača-Koper*



# Sweden



**Name:** Swedish Rock Engineering Association

**Type of Structure:** Non profit, open association

**Number of Members:** 93 corporate members from public and private clients, contractors, suppliers, mining companies, consulting firms, institutions and research organizations

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

Four permanent working groups constitutes the backbone of the Swedish Rock Engineering Association (Svenska Bergteknikföreningen). These working groups are "Yearly Congress", "International", "Competence Development" and "Young Members". The association works towards a sustainable use and development of Swedish underground space. The main activity has been the annual Swedish congress. 2018 the two-day congress gathered 660 delegates. Young Members have successfully launched a mentor program and arranged a joint event in November with the Norwegian Young Members. The International group work towards an increased Swedish participation in ITA activities. During 2018 a Think Deep Sweden group has been established. The association is also actively participating in research and development projects with the purpose of developing the underground space industry. The Competence Development group arranged a webinar in November and is planning an international advanced grouting design course, to be held during autumn 2019.

## CURRENT TUNNELLING ACTIVITIES

### E4 Förbifart Stockholm (Stockholm By-pass)

This mega project includes an 18km long road tunnel with an excavation volume of 6,500,000m<sup>3</sup>. During 2018 construction activities have been ongoing along the complete route. Major tunnelling works are ongoing within several contracts.

### Västlänken, Gothenburg

Västlänken (West Link) is a large railway project in the center of Gothenburg to convert the present terminus into a through station for commuter trains. The project is built in a condense urban environment with very complex geotechnical conditions comprising a

mix of loose clay and hard rock. During 2018 work is ongoing on all four major construction contracts.

### Relocation of the city of Kiruna

Due to controlled collapses above the large Kiruna iron ore mine, the city needs to be re-located. This is a major undertaking that has been ongoing for some time. During 2017 construction activities related to the new city centre have been underway.

### Extended Stockholm metro

An extensive expansion of the Stockholm metro is planned with three new lines. This will include major tunnelling works (4 milj m<sup>3</sup>) and is the next mega project for the city. The first enabling contracts started during 2018 and construction works will be finalized in 2024.

### New bus terminal at Slussen Stockholm

Slussen is the area around the lock between lake Mälaren and the Baltic Sea. This is a hub in Stockholm and a very busy area and is now being re-constructed with new bridges, water works etc. In addition a large bus terminal will be built underground. The tunnelling works commenced during 2018.

### Varberg railroad tunnel

The West coast link is still missing a double track through the city of Varberg. During 2018 the ECI contract started with the design and planning. Construction will start during 2019 on the new 9km section, 3km of rock tunnel will be built.

### City Link tunnel

A tunnel with a length of 13.4km and a diameter of 5m is being built 50-100m below central parts of Stockholm by TBM. The project also includes six ventilation shafts, elevator systems and construction of technical buildings

for electrical equipment. The work is expected to start in January 2019 and is planned to be completed in 2024. The purpose of the project is to connect northern and southern parts of Stockholm with a new electricity supply.

## FUTURE TUNNELLING ACTIVITIES

### Ostlänken, the East Link high speed rail

New high speed rail in the south of Stockholm. Design and planning ongoing.

### SKB Forsmark, final repository nuclear fuel

Planning is continuing on Sweden's final repository for spent nuclear fuel. During 2018 the process of getting the necessary permits has been ongoing.

### New sewage tunnel through Stockholm

Due to decommissioning of the Bromma treatment plant in western Stockholm, wastewater will be conveyed to the extended Henriksdal plant in a new 14km tunnel blasted through the rock under Stockholm. Construction works are planned to start in summer 2019.

### Henriksdal sewage plant

In the Stockholm future wastewater project, an existing plant, Henriksdal, will be extended to double the treatment capacity to serve 1.6 million people to comply with more stringent treatment requirements. The expansion includes a new underground facility for pre-treatment under the Hammarbybacken ski slope and a complete upgrade of the Henriksdal plant. The project includes several complicated rock constructions, and blasting must be carefully controlled to ensure continuous operation of the treatment process and minimize disturbance to surrounding infrastructure and housing.

## STATISTICS

### 1. Length or volume excavated - % mechanized/% conventional during 2018

500,000m<sup>3</sup>. 100% conventional.

### 2. List of tunnels under construction

Stockholm By-pass  
Västlänken, Gothenburg  
Extended Stockholm metro  
New bus terminal at Slussen  
Stockholm



# OPERATOR TRAINING SIMULATOR LEARN ANYWHERE, ANYTIME

The new Sandvik operator training simulator is available for the DT922i tunneling drill rig. This light, compact, portable training solution acts like a real rig with authentic controls, enabling operators to be fully operational from day one through the use of various situations and exercises. Further boosting operational performance, it can be used to reassess operators regularly without impacting on site productivity, delivering gains of up to 5% in annual productivity.

The simulator is also available for other drill rig models.

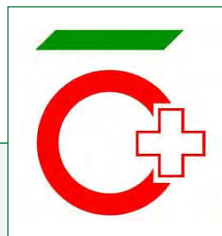


Explore Sandvik operator training simulator  
[ROCKTECHNOLOGY.SANDVIK](http://ROCKTECHNOLOGY.SANDVIK)





# Switzerland



**Name:** Swiss Tunnelling Society (STS)

**Type of Structure:** Non profit, open association

**Number of Members:** 513 members, 97 corporate members

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

**May** - General Assembly in Winterthur, Switzerland

**June** - Swiss Tunnel Congress (STC) in Lucerne, Switzerland

**September** - DACH Meeting in Reichenau an der Rax, Austria

**November** - STS field trip to third Gubrist tunnel tube construction site

**November** - BEFIPS Meeting in Brussels, Belgium

Additionally, the STS young members (STSym) hosted the following five events:

**March** - Field trip to Nant de Drance pump storage power plant construction site

**June** - Reception as part of STC 2018 in Lucerne

**August** - Field trip to Herrenknecht, producer of tunnel driving machines

**October** - Autumn workshop at ETH Zurich

**November** - Regional event to Brenner base tunnel construction site

## CURRENT TUNNELLING ACTIVITIES

### Galgenbuck Tunnel:

The Galgenbuck Tunnel runs over a total length of 1,138m (motorway A4, two lanes, bidirectional), and consists of two short cut-and-cover sections in the portal areas and a 1,061m long mined section. It contributes to relieve the transit traffic in the Schaffhausen area. The excavation method was both drill-and-blast and machine-supported. The start of construction was in July 2013, the main construction works are now completed and the opening is scheduled for the end of 2019.

### New-build project Albula Tunnel II:

breakthrough for the Albula Tunnel II was on 2 October 2018. After three years of tunnelling, teams advancing from Spinas towards Preda cleared the final rock at the 2,653m mark. The tunnellers had worked to a very high standard of precision: the bores from Preda and from Spinas were misaligned by just 1 mm vertically and 5 mm laterally.

That represents virtually the ultimate in engineering accuracy! This breakthrough is a crucial milestone in the construction of the 5,860m long tunnel, which can now progress to the next phase – lining and railway-installations. The tunnel is due to be inaugurated in 2022.

### CERN:

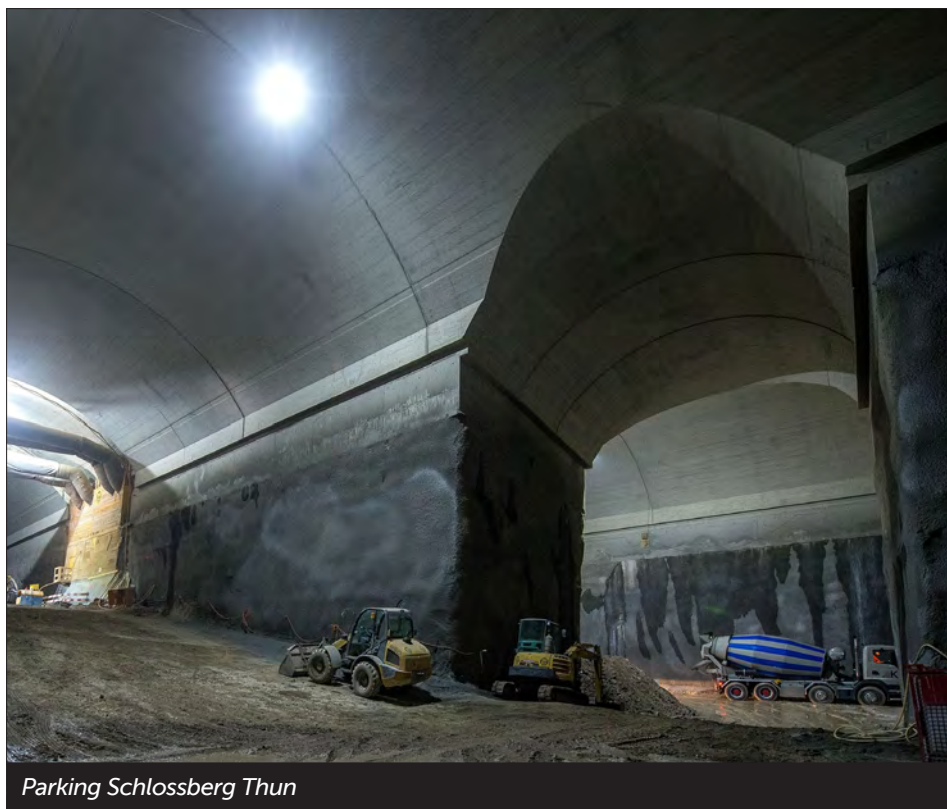
The Large Hadron Collider (LHC) is the most recent and powerful accelerator constructed on the CERN site. The LHC consists of a 27km circular tunnel, about 100m underground, with eight sites positioned around the tunnel's circumference. High-Luminosity LHC (HL-LHC) is a new project aiming to upgrade the LHC, at Point 1 (ATLAS in Switzerland) & Point 5 (CMS in France), in order to maintain scientific progress and exploit its full capacity with new underground and surface structures and consists for each point in an additional shaft and cavern, approximately 500m of tunnels connected to the LHC tunnel, and additional technical buildings at the surface. The execution of the underground works started in April 2018 and is scheduled to be finished by the end of 2021.

### Parking Schlossberg Thun:

On Friday, November 9, 2018, the official inauguration of the new underground "Parking "Schlossberg Thun" took place. The parking has 300 parking spaces located in two main caverns (width 15m, height 17m, length 78m) connected by means of three transverse caverns. The realization of the parking – which is beneath the historic old town of the Thun Castle – required about 3 years of construction works at a cost of about 45'000'000 CHF. The excavation occurred by means of a road header. The primary support consists of rock bolts and reinforced shotcrete. The definitive lining (reinforced concrete) was cast in-situ.

### Achievement of the civil work of the 900 MW pumped storage power plant Nant de Drance:

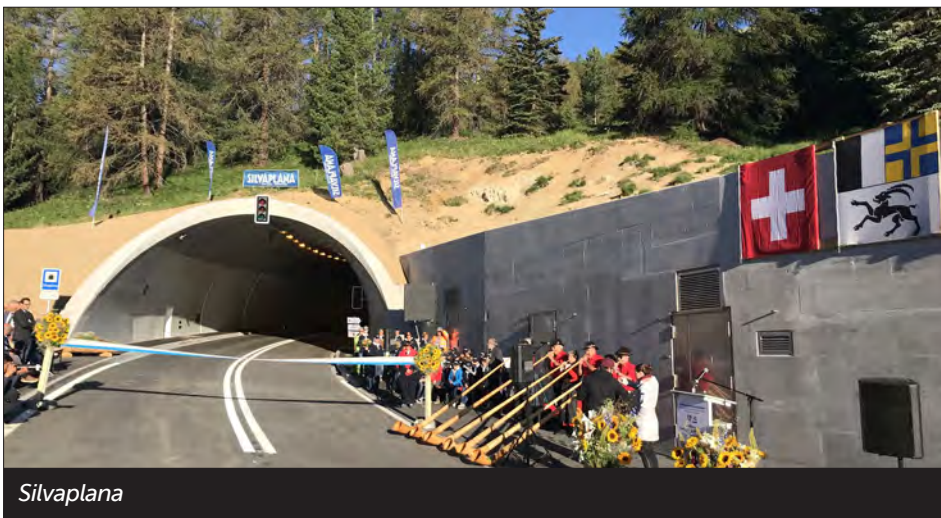
The civil engineering work that began in 2008 has now been completed. 17km of tunnels and 9 big caverns have been excavated for this project. The machine cavern that is 52m high, 32m wide and 194m long is now fully concreted and the installation of the 6 pump-turbines is well advanced. The two-parallel headrace tunnels and two 400m high vertical shafts will be completed in 2019.



Parking Schlossberg Thun



Albula tunnel



Silvaplana

During peak time 650 workers were employed on site. No fatal accidents have been reported in 10.5 years of civil construction despite a hostile alpine environment, overburden of over 800m and high water pressures.

#### Expansion of the Mont Terri rock laboratory:

The Mont Terri rock laboratory is located near St-Ursanne in the Canton of Jura and it is accessed via the safety gallery of the Mont Terri motorway tunnel. It is owned by the Canton of Jura and operated by swisstopo. The first experiment gallery was built in 1998 and expanded in 2004 and 2008. Currently, in order to create more space for upcoming research projects, the rock laboratory is again expanded by additional 600m of about 5.4m wide tunnels and niches. Excavation started on March 12, 2018 and up to the end of the year about 50% of the tunnels and niches have been excavated by roadheader mostly in the sandy facies of the Opalinus clay. Excavation works are planned to be completed in 2019.

#### By-pass road Silvaplana

The Silvaplana road tunnel is located in the mountain region of Engadin (Canton of Grisons, Switzerland). It connects the Julier pass to the heart of the valley. The goal of the tunnel is to relieve the village of Silvaplana from the heavy traffic through the majority of the year. The project consists of the realization of a multi-lane road tunnel, a safety gallery tunnel and 2 escape tunnels. The total length of the main tunnel amounts to 750m. The tunnel has been excavated by means of drill and blast. The excavation works were started on April 2015 and have been completed on August 2016. The tunnel has been opened to traffic at the end of June 2018.

#### FUTURE TUNNELLING ACTIVITIES

##### Rail Tunnels:

RBS Bern Station Expansion (RBS, 1,200m)

##### Road Tunnels:

Second Gotthard Tunnel Tube (ASTRA, 16,918m), Leissigentunnel (ASTRA, 2,200m), Gallery Schwamendingen

und Schöneichtunnel (ASTRA, 1,680m), Tunnel Cholfirst (ASTRA, 1,250m), Safety Gallery Kerenzerberg (ASTRA, 5,504m), Morschacher / Sisikoner Tunnel (Kt. SZ/UR, 7,680m), Vingelztunnel (Kt. BE, 2,300m), City Tunnel (Kt. BE, 900m), Porttunnel (Kt. BE, 1,700m), Tunnel Weidteile (Kt. BE, 1,300m), Tunnel Fäsenstaub (ASTRA, 1,460m),

#### STATISTICS

##### 1. Length or volume excavated - % mechanized/% conventional during 2018

8'000m / 35% TBM.

##### 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018

€500M.

##### 3. List of tunnels completed

Tunnel Silvaplana (Kt. GR, 750m), Safety Gallery Tunnel Viamala (ASTRA, 700m), Schlossberg Thun Carpark

##### 4. List of tunnels under construction

###### Rail Tunnels:

Ceneri-Basistunnel (ATG AG, 15,400m), 5 Tunnel der CEVA (SBB/ Kt. GE, 8,200m), Bözberg II Tunnel (SBB, 2,500m), Ruckhaldetunnel (AB, 725m), Eppenbergtunnel (SBB, 3,114m), Albulatunnel (RhB, 5,860m), Coldrerio (SBB, 96m), Dragonato (SBB, 30m)

###### Road Tunnels:

Tunnel Eyholz Haupttunnel (Kt. VS, 4,200m), Tunnel Ligerz (ASTRA, 2,483m), Safety Gallery Tunnel Sachseln (ASTRA, 5,084m), Galgenbuck (ASTRA, 1,138m), Tunnel Visp 2. Röhre (Kt. VS, 2,600m), Safety Gallery Tunnel Bärenburg (ASTRA, 1,028m), Sanierungstunnel Belchen (ASTRA, 3,200m), Gubrist 3. Röhre (ASTRA, 3,230m), Safety Gallery Tunnel Crapteig (ASTRA, 2,171m), Tunnel Riedberg (Kt. VS, S: 555m, N: 483m), Südumfahrung Küsnacht (Kt. SZ, 500m), Safety Gallery Tunnel Rofla (ASTRA, 1,017m), Tunnel de déviation des Evouettes (Kt. VS, 770m)

###### Other Projects:

Nant de Drance Pumped Storage Power Plant, CERN HILUMI LHC Project



# Thailand



**Name:** Thailand Underground and Tunnelling Group (TUTG), The Engineering Institute of Thailand under H.M. The King's Patronage

**Type of Structure:** Non profit organization

**Number of Members:** 60 members

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In 2018 the Thailand Underground and Tunnelling Group (TUTG) continued working to contribute the underground and tunneling education through the number of technical seminars, Technical Visit and Trainings.



## CURRENT TUNNELLING ACTIVITIES

**The activities during 2018 by TUTG are:**

1. Tea Talk Seminar was held on 30 May 2018 – "TBM Launching Tunnel Modification"
2. Tea Talk Seminar was held on 15 August 2018 – "Innovation for Sustainable Waterproofing in Tunnels and Underground Construction"
3. IPA Seminar on Press-in Technology in Thailand was held on 18 May 2018
4. Co-organizer of 4th Thai Geotechnical Conference 2018 (September 2018)
5. In-house Training for State Railway of Thailand, SRT (9-13 July 2017)
6. Organize the 3rd Training of
  - 'Tunnelling in Soft Ground' (13-15 June 2018)
  - 'Tunnelling in Rock' (21-23 November 2018)

**Continuing Activities from last year:**

Preparation of Shotcrete Guideline Publication

## FUTURE TUNNELLING ACTIVITIES

**The tunnelling activities program by TUTG are:**

- Co-organizer on the 14th International Conference on Shotcrete for Underground Support which will be held on 17-20 November 2019 at Nong Nooch Gardens, Pattaya, Thailand.
- 4th Training on 'Tunnelling in Soft Ground' and 'Tunnelling in Rock'
- Tri-monthly Tea Talk Seminar
- In-house Training for State Railway of Thailand, SRT (expected on September 2019)
- 6th Thai Geotechnical Conference (Co-organizer)
- Publish the Shotcrete Guideline







## STATISTICS

### 1. Length or volume excavated - % mechanized/% conventional during 2018

#### Flood Diversion Tunnel

Khlong Nong Bon to Chao Pha Ya River (The Bangkok Metropolitan Administration) – Approximately 500m (Mechanized)

#### Orange Line

East Section (Mass Rapid Transit Authority of Thailand) – Approximately 300m (Mechanized)

#### Mae Tang

Mae Ngud – Mae Kuang Water Diversion Tunnel (Royal Irrigation Department) – Approximately 2,597m (Mechanized), and 4,135m (Conventional)

### 2. Amount (USD or EUR) of tunnelling/underground space facilities awarded in 2018

Track Doubling North-Eastern Line – Mab Kabao – Thanon Chira Junction – 7.9km tunnel length (State Railways of Thailand (SRT)) US\$245M (Approximately).

Conversion of Overhead Line to Underground System, Rama III Project: Thanontok Terminal Station – Rama IX Bridge – 3.6km tunnel length (Metropolitan Electricity Authority) US\$60M (Approximately)

Conversion of Overhead Line to Underground System, Rama III Project : Rama IX Bridge – Chalerm Mahanakorn Expressway Section – 6.2km tunnel length (Metropolitan Electricity Authority) US\$47M (Approximately)

Replacement of the Overhead Line by the Underground Cable System (Nonsee Project) – 8.3km pipe jacking length (Metropolitan Electricity Authority) US\$86.5M (Approximately)

### 3. List of tunnels completed

Double track project on Eastern Seaboard Railway Contract 2: Wihan Daeng-Bu Yai with the railway tunnel. (State Railway of Thailand)

Blue Line Extension, (Mass Rapid Transit Authority of Thailand)

Flood Diversion Tunnel under Khlong Bang Sue (The Bangkok Metropolitan Administration)

### 4. List of tunnels under construction

Orange Line – East Section (Mass Rapid Transit Authority of Thailand)

Mae Tang – Mae Ngud – Mae Kuang Water Diversion Tunnel (Royal Irrigation Department)

Flood Diversion Tunnel – Khlong Nong Bon to Chao Pha Ya River (The Bangkok Metropolitan Administration)

Track Doubling North-Eastern Line – Mab Kabao – Thanon Chira Junction (State Railways of Thailand (SRT))



# Turkey



**Name:** Turkish Road Association

**Type of Structure:** TRA is an open association. Its function is to promote, coordinate and spread studies and research in the field of roads, highways, motorways, tunnelling and other underground works.

**Number of Members:** As of January 1st, 2019, TRA has 496 members of which 432 are individuals and 64 are corporate members which represent Universities, Consultants, Contractors, Manufacturers and some of the other Governmental Organizations.

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

"4th National Congress and Exhibition on Highways" was held on November 28-29, 2018 at the General Directorate of Highways Halil Rifat Pasa Conference Hall with great success.

## CURRENT TUNNELLING ACTIVITIES

### New Zigana Tunnel

The New Zigana Tunnel project in Turkey is currently under construction and when it is completed it will have a 14.5km length. The two lane tunnel will connect Gumushane and Trabzon provinces in Turkey's north east, and will be located at an altitude of over 1,200m above sea level. The construction of the tunnel will replace the existing route over the Zigana

Pass, which reaches an altitude above sea level of 2,032m.

### Camlica Tunnels

The Camlica Tunnels project has been planned within the scope of highway transportation projects of Camlica Mosque, which is under construction at Camlica Hill, Istanbul. The tunnel network consists of three single tube tunnels with a total of 2,177m long. The actual excavation and support work is completed and the electromechanical works are continuing.

### Dolmabahce-Levazim Tunnel

The Dolmabahce-Levazim Tunnel is the first tunnel of the Dolmabahce-Kilyos Tunnels Project. The excavation works

of this 3,872m long double tube tunnel are continuing. The design works of the remaining tunnels of the route are completed.

### Northern Marmara Motorway Tunnels (2nd and 3rd parts)

The remaining parts of the Northern Marmara Motorway project consists of 9 tunnels. A total of 16,438m long double tube four lane tunnels are under construction. In some tunnels both excavation and final concrete lining were completed.

### Dudullu-Bostanci Metro Line

The Dudullu-Bostanci Metro Line, planned to open in 2019, will be 14km long. The journey will take 21 minutes using the Dudullu-Bostanci Metro Line, which will have 13 stations. With the connection to be made at Kozyatagi Station, a transfer to Kadikoy-Pendik Metro Line will be provided.

## FUTURE TUNNELLING ACTIVITIES

### 3 Level Big Istanbul Tunnel

The 3rd tunnel project to be constructed under Bosphorus is the Big Istanbul Tunnel, which is a 3-storey multi-use highway and railway undersea tunnel. The tunnel will have a diameter of 16.8m. The middle storey will be used for metro, the rest will be used by cars. The length of tunnel is 6.5km. The deepest point will





be 110m under sea level, and 45m under the bottom of the Bosphorus. The survey, project and engineering services tender of the project is done. The project is now in the design stage.

#### **Dolmabahce-Kilyos Tunnels**

The Dolmabahce-Kilyos Tunnels Project consists of three sections. In this sections there are 6 tunnels, which will be excavated by NATM. The total length of these four tunnels is approximately 20.4km. The excavation works of the Dolmabahce-Levazim tunnel have started.

#### **Kagithane-Buyukcekmece Tunnels**

In the Kagithane-Buyukcekmece Tunnels Project there are 8 tunnels. Two different methods will be used for these tunnels. The first two tunnels will be excavated by NATM and the others will be excavated

by TBM. The total length of these eight tunnels is approximately 26.7km.

#### **Yenisahra-Bostanci-Kucukyali Tunnels**

The Yenisahra-Bostanci-Kucukyali Tunnels Project consists of two sections. In this sections there are 2 double tube tunnels with a total length of approximately 6km.

#### **ISKI Kagithane-Sefakoy Drinking Water Tunnel**

The ISKI Kagithane-Sefakoy Drinking Water Tunnel project consists of two lines. Line 1 is 7.7km in length between the Kagithane-Eyup (Munzevi) districts. Line 2 which is 13.1km long is between the Islambey-Sefakoy districts. The 19.56km part of the 20.81km long water tunnel line will be excavated using TBM, the rest will be excavated using NATM or SEM.





# United Kingdom

**Name:** British Tunnelling Society

**Type of Structure:** Non profit, professional membership body, learned society and Associated Society of Institution of Civil Engineers (ICE)

**Number of Members:** 857 members, 78 corporate members



## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

In 2018 the British Tunnelling Society continued to offer its membership technical lectures; training and development and engage and inform on the development and use of underground space.

The BTS continues to work closely with University of Warwick in the delivery of an MSc in Tunnelling & Underground Space

We are a focal part of the Industry working group – Transforming Tunnel Safety comprising BTS, Clients, Consultants and Contractors with the initiative to drive improvement in the health and safety performance of the tunnelling industry.

- 10 informal evening discussions – monthly apart from July and August.
- Various technical and social meetings and events arranged by the BTS Young Members
- Award of James Clark Medal to David Donaldson for his lifetime contribution to tunnelling.
- Lunch for James Clark Medal recipients
- Harding Prize competition for under 35's
- Annual dinner held each year in May.
- Co-badged events with numerous other organisations including ICE, IOM3, BGA, Concrete Society
- Holds the Biennial ITA supported Conference & Exhibition in London (next event - 2019)

The BTS jointly with the Institution of Civil Engineers supports a Parliamentary Group to engage with politicians and promote tunnelling and use of underground space as a sustainable form of infrastructure development. This has been reenergised and it is planned for future activities through 2019.

The BTS continues to work with and support Tunnel Skills. TunnelSkills (the industry training development forum) has developed a number of tunnelling

specific courses in conjunction with City & Guilds and CITB. Tunnel Entry, Loco Operators, Concrete Pump Operation and Tunnel Safety Training Scheme are some of the courses developed.

### Think Deep UK

This group has further developed its initiatives on the development of underground space in 2018.

The group has continued its series of workshops in 2018 and has published its first blue paper

- Investing in urban underground space – Maximising the social benefits.

### BTS Young Members

The young members continued to offer a wide range of activities including lectures, workshops and socials.

A key part of their work in 2018 was actively working on encouraging the younger generations to consider tunnelling as a career.

The BTSYM continue with monthly workshops on specific tunnel issues for the development of young engineers in the tunnelling industry.

They once again held their annual conference in March 2018 which proved yet again to be hugely successful

### CURRENT TUNNELLING ACTIVITIES

#### Northern Line Extension

November 2017 saw the completion of twin 3km of 5.2m diameter tunnel for the extension to the Northern Line to the future development at the Iconic Battersea Power Station Works continue on the stations at Battersea and Nine Elms and the connection to the existing network with Step Plate Junctions.

#### Thames Tideway Tunnel

2018 saw the start of tunnelling on the



Thames Tideway contracts comprising 25km of 7.2m diameter tunnel at depths up to 66m under the River Thames connecting the the previously constructed Lee Tunnel

### High Speed Two

2018 has seen the development of the ECI design phase for the main works civils contracts for the proposed high-speed rail line between London and Birmingham. These contracts comprise 35km of twin bored tunnel. Construction is due to commence in 2020 following the completion of the ECI stage 1.

Phase 2 for HS2 is currently under development and this currently comprises a further 21km of twin running tunnels giving a total of 56km which is approximately 10% of the total 561km length.

### York Potash

Project owner Sirius Minerals, which has commenced work on the 37km long tunnel to transport the high-grade potash (polyhalite) to the coast at Redcar. The tunnel will be at depths of up to 300m with associated access shafts and mine shafts up to 1500m deep will commence in 2019.

### Hinckley Point Nuclear Power Station

Work continues on the first new nuclear power station in the UK for many years. Part of the work on this will comprise intake and outfall tunnels; 9km in total

### Bank Station Capacity Upgrade

Construction work has continued on the upgrade to Bank Station, one of the largest underground railway complexes in the world

The works comprise new entrance, three ticket halls, six lifts, 10 platforms, two 94m travellers, 570m tunnel and a platform for the Northern Line

## FUTURE TUNNELLING ACTIVITIES

### 1. Silvertown Tunnel

Twin bored Tunnel under River Thames approximately 1.4km long and 12m diameter. The projects is currently out to tender and is to be procured as a PPP delivery model. Contract award and construction are due in 2019.

### 2. Crossrail 2

This project will comprise 72km of twin-bored tunnel and 11 underground stations. It is currently undergoing a review by Government prior to being taken forward to Hybrid Bill

### 3. Lower Thames Crossing

A proposed new motorway on the M25 to include 13 miles of road. This will also comprise 4km of twin tunnel beneath the River Thames East of London with a tunnel diameter of 16m. The project is currently in planning and due to be operational in 2027.

### 4. A303 Stonehenge Tunnel

This is a proposed 11km dualling of the A303 in the vicinity of the ancient

monument at Stonehenge. The works will comprise 2.9km of twin tunnels. The project is currently in planning and due to start on site in 2021

### 5. Bakerloo Line Extension

TfL is proposing to extend the Bakerloo line beyond Elephant & Castle to Lewisham, serving Old Kent Road and New Cross Gate, and would like to hear your views. This will comprise 4 new stations and running tunnels.

# Ukraine



**Name:** Ukrainian State Corporation on Construction of Underground and Tunnels

**Type of Structure:** Non profit

**Number of Members:** 18 corporate members

## CURRENT TUNNELLING ACTIVITIES

### Beskyd tunnel.

The new tunnel will replace the current single-track tunnel which is considered to be in critical condition. It does not comply with the overall dimensions of the current rolling stock, and due to an absence of waterproofing, it has permanent water leaks which turns into ice during cold periods. The Beskyd tunnel is a part of the 5th pan-European transportation corridor and is the only single-track part of the railway which significantly limits the capacity of railway transportation.

The new double-track tunnel will allow optimization of the train schedules. The current Beskyd tunnel will be used during the period of construction until the new tunnel is put into operation, it will be connected with pedestrian passages with the new tunnel and serve as a rescue exit during operation of the new tunnel.

### Construction of emergency exit on the operating pumped storage power station.

For the first time in the Ukraine at an operating power plant a unique construction project was implemented for the installation of a 1500mm diameter emergency exit 'well' from the pumping room at a depth of 67.5m through complex engineering and geological conditions. The construction was carried out using a unique drilling rig using hydro-pressing with Soilmec

R-940 pipes, and inventory casing pipes to the full depth.

The works were carried out from April 2018 to December 2018. The speed of construction was 0.5m per day.

The well is located in complex soils such as soils with clay filler, gravel soils of a dense composition, Zin'kovetsky argillites and aleurolites with layers of hard clay, thin Lyadovskiy argillites layers, medium-strength layers of hard clay, and Kosoutik strong sandstones with layers of aleurolite. This well was drilled with minimum deviations; up to 30mm in the the plan of the well, and vertically up to 80mm.

In the future there will be lift equipment, which will serve as a rescue service from the engine room of a pumping station.

## FUTURE TUNNELLING ACTIVITIES

Construction of 4 new underground stations and a depot in the Vynohradar district in Kyiv.

## EDUCATION ON TUNNELLING IN THE COUNTRY

- Dnipropetrovsk National University of Rail Transport
- Kharkiv National Automobile and Highway University
- National Transport University in Kyiv



# United States



**Name:** Underground Construction Association (UCA of SME)

**Type of Structure:** Open association

**Number of Members:** 1,398 members, 36 corporate members

## ASSOCIATION ACTIVITIES DURING 2018 AND TO DATE

Throughout 2018 and to date, the UCA of SME continued to promote the wise, efficient and sustainable development and use of underground space. Some of the ways that we are accomplishing this are:

- 2018 and 2019 George Fox Conferences. These one-day conferences provide concise information on emerging technologies, project updates, and future planning.
- Provided numerous student scholarships for attendance of the Rapid Excavation and Tunneling Conference (RETC).
- 2018 Cutting Edge Conference. Annual two-day conference to

explore technical advancements and innovations in the industry. This year's event featured a working site visit organized and promoted by our Young Members group.

- Our Young Members group also presented monthly webinars on various topics of interest to our developing associates.
- Published four editions of our magazine, "Tunneling & Underground Construction".
- Held the North American Tunneling (NAT) Conference, UCA's biennial technical event. With over 1,100 attendees, the 5-day conference offerings included short courses, technical sessions, panel discussions,

technical field trips and exhibits from the many suppliers and specialty subcontractors that service the U.S. tunneling industry.

- Held our inaugural "Teach the Professor" course in conjunction with NAT Conference. This course is designed to educate professors on the underground construction industry and give them a suite of instructional tools for direct integration into their university courses. This will result in additional exposure to tunneling careers at both the undergraduate and graduate student levels. Our first "class" featured 10 professors from various colleges and universities around the United States.
- Replenishment funding was approved for the joint UCA/ASCE "Tunnel Tour" program. This program is a key element of our education and student outreach initiative. In the short history of this effort, 25 underground construction projects and 15 university visits have been conducted.
- Realized a 7% decrease in membership within the past 12 months.

## CURRENT TUNNELLING ACTIVITIES

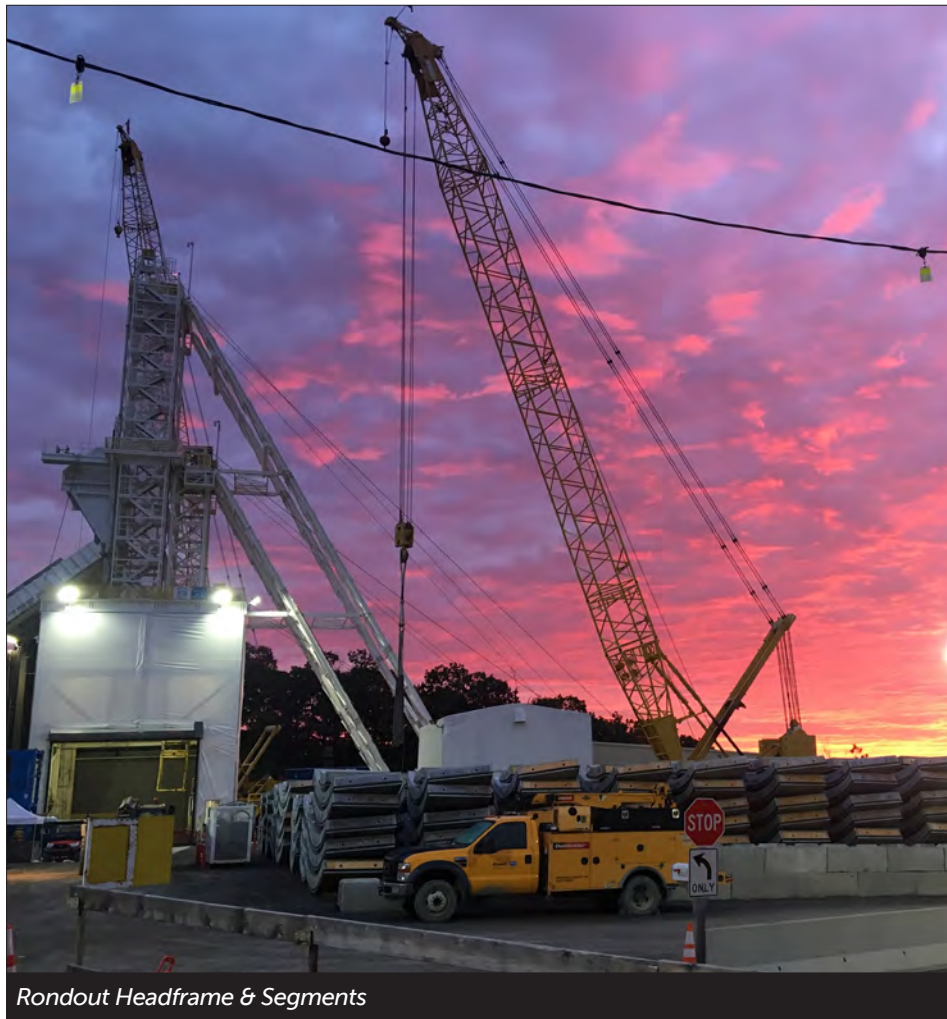
There are dozens of notable tunnels currently under construction in the United States. These include:

### Highway Tunnels

- The Parallel Thimble Shoal Tunnel project in Virginia Beach, VA is well underway, with tunneling expected to commence later this year. This EPB TBM excavation will twin the existing immersed tube tunnel under the Chesapeake Bay constructed between 1960 – 1964.

### Transit Tunnels

- Ahead of the 2028 Olympics, Los Angeles is the American hot bed for transit tunnels right now. Five major subway projects are currently underway; Crenshaw/LAX Corridor, Regional Connector, Purple Line Extension – Phase 1 and Purple Line Extension – Phase 2 and Purple Line Extension – Phase 3 (Tunnels). Phase 3 (Stations) of the Purple Line Extension has been awarded, with construction set to begin later this year. Combined, these projects will add 19 miles of new commuter lines and connect existing lines for shorter overall travel times.
- The Greater Seattle Area continues its "Sound Transit" expansion as the North Gate Link Extension project nears completion. TBM excavation is



Rondout Headframe & Segments



Alaskan Way

complete, with station construction well underway. East of Seattle, the Downtown Bellevue Tunnel (SEM) excavation is complete, with final lining and fit-out operations underway.

- A key component of the Maryland Purple Line Light Rail project is the Plymouth Tunnel. Excavation of this SEM tunnel is complete. Concrete final lining and fit-out operations are set to commence soon.

#### Water Supply

- TBM tunneling is underway beneath the Hudson River in upstate New York on the Rondout West Branch Bypass Tunnel. As the project name implies, this tunnel will bypass a deteriorating portion New York City's main water supply.
- The City of Atlanta is utilizing a novel approach to bolster its water reserves with its Raw Water Storage Program. A TBM driven tunnel, deep pump stations, adits and shafts will connect existing treatment and distribution facilities to an abandon quarry. When the project is completed, the quarry will be flooded to create an additional 2.4 billion gallons of on-hand storage.

#### Wastewater

Sewer and drainage tunnels continue to be the most prevalent tunnels being constructed in the United States.

- In Washington, D.C., tunneling for the Northeast Boundary Tunnel is now underway. The recent commissioning of the Anacostia River Tunnel places

#### 2018 TUNNEL PROJECTS CURRENTLY UNDER CONSTRUCTION (PARTIAL)

Project	Location	Use
Parallel Thimble Shoal Tunnel	Virginia Beach, VA	Highway
Downtown Bellevue Tunnel (E330)	Bellevue, WA	Transit
Crenshaw/LAX Corridor Project	Los Angeles, CA	Transit
Purple Line Extension - Phase 1	Los Angeles, CA	Transit
Purple Line Extension - Phase 2	Los Angeles, CA	Transit
Regional Connector Transit Project	Los Angeles, CA	Transit
Northlink TBM Tunnels	Seattle, WA	Transit
Purple Line Light Rail Project (Plymouth Tunnel)	Silver Spring, MD	Transit
Ohio Canal Interceptor Tunnel	Akron, OH	Wastewater
Spring/Fishburne - Tunnels and Shafts	Charleston, SC	Wastewater
Des Plaines Inflow Tunnel	Chicago, IL	Wastewater
Westerly Storage Tunnel	Cleveland, OH	Wastewater
London Road Relief Sewer	Cleveland, OH	Wastewater
East 140th Consolidation and Relief Tunnel	Cleveland, OH	Wastewater
Blacklick Creek Sanitary Interceptor Tunnel	Columbus, OH	Wastewater
Three Rivers Protection and Overflow Reduction Tunnel	Ft. Wayne, IN	Wastewater
Mill Creek Drainage Relief Tunnel	Dallas, TX	Wastewater
Reedy River Basin Sewer Tunnel	Greenville, SC	Wastewater
South Hartford Conveyance and Storage Tunnel	Hartford, CT	Wastewater
White River Tunnel/Pogues Run Tunnel	Indianapolis, IN	Wastewater
Ohio River Tunnel	Louisville, KY	Wastewater
Black Snake Creek Stormwater Separation Project	St. Joseph, MO	Wastewater
Deer Creek Sanitary Tunnel	St. Louis, MO	Wastewater
Jefferson Barracks Tunnel	St. Louis, MO	Wastewater
Maline Creek CSO Storage Facility	St. Louis, MO	Wastewater
Bergen Point Outfall	Suffolk County, NY	Wastewater
Northeast Boundary Tunnel	Washington, D.C.	Wastewater
Water Supply Program/Raw Water Storage Facility	Atlanta, GA	Water
Rondout West Branch Bypass Tunnel	Newburgh, NY	Water



## United States continued

both it and the Blue Plains Tunnel into service.

- Cleveland, OH has several wastewater tunnel projects ongoing, notably; the Doan Valley and East 140th Relief and Consolidation tunnels, and the Westerly Storage Tunnel.
- Los Angeles CA, Hartford CT, Akron OH, Ft. Wayne IN, Dallas TX and Louisville KY all have major wastewater and sewer tunnel programs underway.

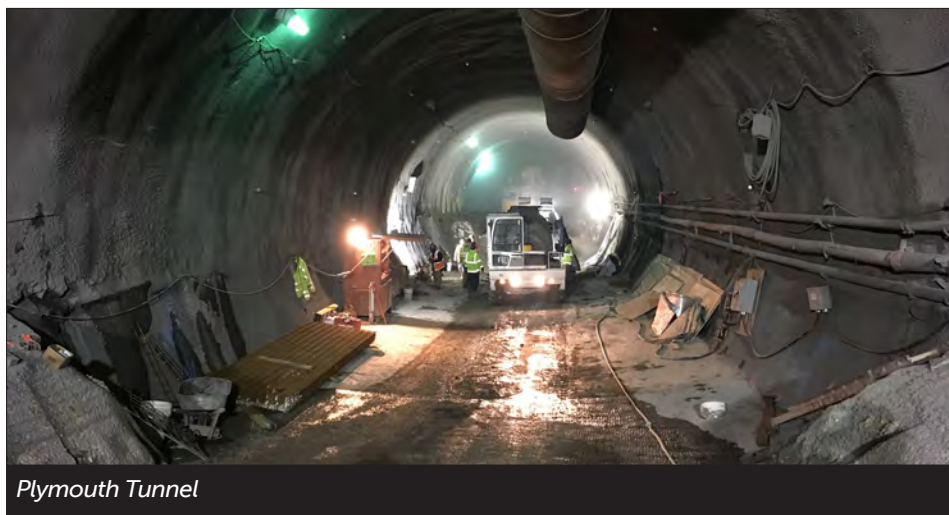
### FUTURE TUNNELLING ACTIVITIES

Several large tunneling projects are scheduled to tender soon in the United States.

- The Ship Canal Water Quality Project in Seattle will tender in 2019. This 18-foot diameter x 14,000-foot-long tunnel project will include the construction of five shafts.
- The Hampton Roads (Virginia) Bridge-Tunnel Expansion Project tendered in early 2019, with construction beginning later this year. This project will twin the existing highway tunnel near where the James River meets the Chesapeake Bay.
- Subject to available funding, the massive Bay Delta Water Conveyance Program may get started in 2019-2020, as several design and logistical contracts are scheduled for procurement. The entire project is

planned to consist of over 36 miles of twin 40-foot diameter tunnels. Recent state government decisions may reduce the scope of this project to a single bore.

- We may see elements of the Gateway Tunnels Project in procurement in 2019. These twin heavy rail tunnels will run under the Hudson River between New Jersey and New York to complement the existing and aging North River Tunnels. This project originally went into procurement in 2009 but was cancelled when the State of New Jersey withdrew funding. A follow-on project will rehabilitate the existing tunnels to effectively double current rail commuter rail capacity. The project continues to face major funding hurdles.
- The Santa Clara (CA) Valley Transportation Authority's BART extension to San Jose will go to tender later in 2019. Even though all previous BART tunnels are twin-bore, the larger single-bore option has been approved for the new line.
- Wastewater tunnels will continue to make up the majority of tunneling projects in the United States throughout 2019 and 2020. St. Louis, MO, Cleveland, OH, Providence, RI and Alexandria, VA are just some of the U.S. cities that will continue to expand their facilities.



Plymouth Tunnel

### STATISTICS

#### 1. Length or volume excavated - % mechanized/% conventional during 2018

We don't track this statistic.

#### 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2018

The value of major tunnel projects awarded in 2018 was nearly US\$2,000,000,000.

#### 3. List of tunnels completed

While many U.S. tunneling projects are nearing completion, the Alaskan Way Tunnel in Seattle is the major project to reach final completion in 2018. Boasting the World's largest EPB TBM (17.5m), the double-stacked highway tunnel was completed and is now open to traffic.

### EDUCATION ON TUNNELLING IN THE COUNTRY

The Colorado School of Mines (CSM) continues to be the hub of tunneling education in the United States, where an annual four-day short course is conducted each Fall. Covered topics include contracting methods, geotechnical investigations, risk management, hard rock tunneling, soft and mixed face tunneling, ground improvement, safety and cost estimation. The "Tunneling Fundamentals, Practice and Innovations" course is taught by practicing experts and is open to both students and industry professionals.

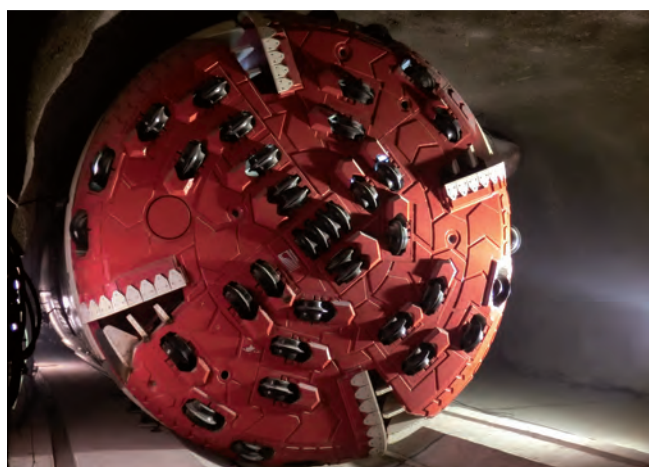
Additionally, students at CSM can pursue post-graduate degrees in Underground Construction and Tunnel Engineering. Some of the particular course offerings are:

- Tunneling
- Underground Design and Construction
- Underground Construction Engineering in Hard Rock
- Underground Construction Engineering in Soft Ground
- Construction Engineering and Management
- Engineering Geology & Geotechnics
- Underground Construction Engineering Laboratory I & II
- Applied Numerical Modelling for Geomechanics

Other schools, such as the University of Michigan and the University of Illinois offer courses in tunneling. Through our "Teach the Professor" program, we expect further course offerings around the country soon.

# ALWAYS ADVANCING

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With its headquarters and engineering centre in Australia, TERRATEC has six wholly own subsidiaries strategically located around the globe to cater to worldwide demand. At present, there are over thirty TERRATEC boring machines at work on sites across five continents.





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