

# ITA Member Nation Activity Reports 2021

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BRENNER BASE TUNNEL, AUSTRIA – ITALY

# PUSHING LIMITS WITH VIGOROUS ENGINEERING

The new Brenner Base Tunnel represents a next level of trailblazing hard-rock tunnelling. With a total length of 64 kilometers and maximum overburden of 1,700 meters this high-impact project sets new records. So far, four tailor-made Herrenknecht hard rock machines are involved in the toughest mission worldwide, empowering our customers to push the limits.

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Contractors:

- › 1x Gripper TBM:  
Consortium H33 Tulfes-Pfons
- › 3x Double Shield TBM:  
Consortium Mules 2-3

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Tunnelling Systems

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## Jinxiu (Jenny) Yan ITA President



### ITA President's message for the ITA Member Nations Activity Report 2021

Despite the pandemic, the global tunnelling market has continued to grow, with many projects completed, ongoing, and in the planning phase. For example, nearly 15,000km of traffic (highway, railway and metro) tunnels were built over the past three years in China. In fact, more tunnels were built in 2020 and 2021 than in 2019 (5,610km in 2020 and 5,088km in 2021, compared with 4,219km in 2019).

Not only is the number of tunnelling projects impressive but also the scale. There are several ongoing large-scale binational tunnel projects, most notably, the 55km Brenner base tunnel, the 57km Mont Cenis base tunnel as well as the 18km Fehmarnbelt immersed tunnel.

In 2021, we were delighted to see the return of several large in-person conferences successfully organized by our Member Nations, such as AFTES, ATS, CBT, CCES, STUVA, TAC, UCA etc.

Thanks to this yearly activity report, our Member Nations can be kept up to date with global tunnelling activities. I would like to thank the Member Nations, the ITA secretariat, and Tunnelling Journal for their effort and contribution to this publication.

## Olivier Vion ITA Executive Director



2021 has been a difficult year for many of the ITA Member Nations. Even if the organization of events and the meetings of members had to take new paths, you will discover in this report that most of the ITA Member Nations have remained very active, developing new activities, promoting the use of underground space and tunnelling education.

The 45 reports received show that the tunnelling industry has continued to grow, despite the international pandemic. Not only in China, but in many parts of the world, tunnelling activity was higher in 2021 than in 2019, demonstrating the needs for new infrastructure and the benefits of better underground space. Thanks to Tunnelling Journal we are happy to share all this information with you.



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# Argentina



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

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

**Number of Members:** 44 affiliate members, 8 corporate members

## ASSOCIATION ACTIVITIES DURING 2020 AND TO DATE

October 27th - 28th saw the local Tunnelling Congress "Digital Tunnel – Digital Technology applied to Tunnels" held, with the participation of experts from various Latin America countries and three expert representatives from the ITACET Foundation, developing a training lecture on the same theme as the Conference.

Additionally, one online training course was developed for the Argentine Construction Chamber, dealing with "Fibre Technologies for Concrete Reinforcement".

## CURRENT TUNNELLING ACTIVITIES Tunnelling under the Sarmiento Railway Line – Buenos Aires

Replacement of the Sarmiento Railway Line running from Western Head Station in Buenos Aires (Station Once) to Station Castelar via approx. 22km of double track tunnel, mainly excavated using a 12m diameter EPBM, plus a short NATM section. Nine stations feature along this section, seven mined and two in cut & cover. Mid 2019 saw the first approx. 7km long running tunnel section excavated using the EPBM with the machine recovered in an open pit for maintenance. As stated in the previous reports, works have been interrupted due to a lack of financing. It is expected that the National Government will take a decision in early 2022 on whether to continue with the remaining approx. 4km of mined tunnel or not.

## Sewer on the left margin of the Riachuelo River and Emissary – Buenos Aires

This project comprises the construction of a main sewer located parallel to the Riachuelo River in two sections: a first approx. 9.4km long, 3.2m i.d. upper section excavated by EPBM, and a lower section of approx. 5.1km length and 4.5m i.d., excavated using a slurry machine. Additionally, the project features a Treatment Plant and an Emissary of approx. 12km length with 4.3m i.d. to be excavated into the La Plata River using an EPBM. Three contracts were awarded in

2015 (sewers, plant, emissary), which are all presently in construction. At the end of 2018 the construction of the treatment plant was interrupted but restarted at the end of 2019, after the project was awarded to a new contractor. At the end of 2019 the excavation of the emissary tunnel was concluded successfully. The EPBM excavated the 9.4km, whereas the slurry machine also finished the lower 5.1km long section. Secondary pipe jacking galleries of 800mm diameter and 1,100mm are also finished, with a total excavated length of 14km. Connections to the existing network are currently being built.

## Underground water main "Río Subterráneo Sur" – Buenos Aires

This project was designed to provide a new potable water distribution main fed by the Grl. Belgrano water purification system in Bernal, in the southern area of the Great Buenos Aires neighborhoods, feeding a population of 2.5M people. It consists of a 23km long underground water system with two large pumping plants, tendered for construction by the water company AYSA in two contracts. A contractor has been selected for the first section (Lot 1) of 13.5km, 3.9m i.d. tunnel and the pumping plant No.1. The project has two EPBMs of 4.66m diameter, erecting a universal segment ring 6+0, 1.4m wide, and 0.25m thick. The first TBM is currently in operation, launching from the four-lobed shaft located in the General Belgrano plant, and having excavated 4,360m to date, or some 55% of its length, and 32% of the total lot. The second TBM will launch from an intermediate quad-lobed shaft, currently under construction, with the start of construction of this second section of tunnel forecast for November 2022, to complete the tunnel to pumping plant No. 1 in Lomas de Zamora. The first contract is scheduled to be complete in August 2024. The second part of the project, (Lot 2) is still not awarded, but has been tendered.

## Two road tunnels on National Highway 75 – Province of La Rioja

The project's objective is to bypass a road section aligned along a creek, featuring

beautiful gardens and expensive weekend houses, by constructing two bidirectional road tunnels of 560m and 890m length using conventional methods with a shotcrete lining and a prefabricated inner lining. The excavation of the shorter tunnel was completed at the end of 2020. The excavation of the second (longer) tunnel started in early 2021 and is scheduled to be finished by the end of 2022. Finishing works and electromechanical and safety equipment fitting out of the first tunnel is in progress.

## Several sewer projects in Buenos Aires In recent years, Buenos Aires has

constructed a large quantity of sewer projects for the AYSA Water Company and Buenos Aires Government with some new ones in progress via the pipe jacking method. Typical diameters used range between 0.8 and 2.4m, with jacking sections in the range of 200 – 300m.

## FUTURE TUNNELLING ACTIVITIES Red de Expresos Regionales (RER)

In 2016, the national government presented this very challenging project featuring the underground connection of Buenos Aires' three main railway stations: West Station "Once", South Station "Constitución" and North Station "Retiro".

The project comprises 20km of new railway lines, approx. 85% in tunnel, with the rest on viaducts. Besides the underground enlargement of the existing stations, four new underground stations will be constructed using the NATM method with an approx. 280m<sup>2</sup> cross section. During 2018 and 2019 all three viaducts were completed. All underground works, however, were not initiated, due to financing restrictions. During 2019 the Transport Ministry modified the underground works, optimizing and downsizing them to make them more economical, but also scalable for construction. Since then, no action regarding the implementation of this project has been taken, due to a lack of financing, a situation which is expected to last for at least the coming two years (2022 and 2023).

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

Agua Negra Tunnel: This 14km long, twin-tube road tunnel is a project of priority for both countries. After a pre-qualification process for contractors was launched in 2017, with a short list of

companies published in 2018, no further action for the tender of the construction was implemented. This was mainly due to Chile's reluctance to develop the project. In fact, at the end of 2021 the Chilean Ministry of Public Works launched a new study of alternative corridors, which aim is to identify road tunnel options with a lower length, overburden, and overall cost, compared to the project so far developed by the Argentine Authorities. This new Chilean initiative was not discussed within the Bi-National Entity "EBITAN", and hence not supported by Argentina. It is expected that a bidder will be selected in 2022.

**Las Leñas Tunnel:** This approx. 11km long twin-tube road tunnel is officially recognized by both countries as the other priority bi-national base tunnel. At the end of 2019 a new feasibility study with the incorporation of detailed geological-engineering investigations was awarded by the Chilean Public Works Ministry to a consulting JV. Its aim is to develop a further design step in terms of tunnel alignment and functionality, upgrading at the same time the geological-geotechnical model,

allowing a more accurate cost estimate of the project. The study was completed at the end of 2021 and will be the basis for the next design step, scheduled to be a tender design.

**Tunnel Cristo Redentor – second tube (widening of Tunnel Caracoles):** With the support of the IDB in 2019, the design of the second tube of the existing 3.1km long Cristo Redentor road tunnel was completed and the tender for construction developed. 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 but has been out of operation since 1978. The tenders from the contractor JV's were delivered in 2019 for the construction of the Argentine part of the tunnel, with contract award to the winning contractor JV at the end of 2021. Since then, this JV has initiated all preparatory works to start construction in 2022. This tender will only cover the Argentine part of the tunnel, up to the Chilean border. The Chilean part of this tunnel has still not been tendered.

### Metro Buenos Aires and other underground projects in Buenos Aires

During 2021 the tender design for construction of the Colector Baja Costanera, a sewer tunnel along the coast of the La Plata River, was developed. Again, due to financing reasons, the process of tendering for construction has still to be launched. Similarly, the third and last rainwater relief tunnel for Buenos Aires, called the Medrano River, which was scheduled for a construction start in 2020, is still on hold.

### 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 second year in 2019, 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).

**Number of Members:** 703 members, 6 Platinum Sponsors and 61 Corporate Members

### ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

With the ongoing pandemic in 2021, the Australian Tunnelling Society's activities have become a hybrid of online and in-person events, where possible.

**Activities and Events:** Activities and Events: ATS technical presentations have remained online and in person events have been held where and when possible. The ATS has collaborated with several other societies including the Australian Geomechanics Society, British Tunnelling Society, NZ Tunnelling Society on engaging technical presentations. Online seminar attendance continues to exceed expectations and the hybrid model is proving successful.

Presentations have also been recorded and are available to members to view online. There are currently about 18 videos available to view. The 2021 David Sugden young

tunneller's Award was presented to Harry Buchanan.

The ATS biannual conference ATS2020+1, postponed from 2020, was held in Melbourne on 10th - 13th May, in person. The conference theme was "Innovating the next 50 years." There were technical and special seminar streams covering this topic as well as highlighting some of Australia's current major projects. The Gala dinner attracted over 500 of Australia's tunnelling community. The inaugural Women in Tunnelling Award was presented to Diane Mather and the Allen Neyland Tunnelling Achievement Award was presented to Tony Peach during the conference. The next conference will be held in New Zealand with the NZ Tunnelling Society in 2023.

With restrictions being reintroduced around the country toward the end of 2021 many events have either moved online or been postponed to early 2022.

The ATS will be running a short course on an introduction to tunnelling over two days in May which will also include in person events.

The ATS celebrates its 50th anniversary in 2022 and planning is underway for numerous events throughout the year, including localised dinners, an issue of the Journal focusing on outstanding tunnelling achievements over the last 50 years in Australia.

**Publications:** The ATS Journal was published twice in the last calendar year in conjunction with Tunnelling Journal International. The Journal will focus on 50th anniversary items throughout 2022 and a photo competition has been held for the front cover design.

The ATS Young Members developed and ran useful and insightful workshops through 2021 and 2022 on the ATS Tunnel Design Guidelines that were published in 2021. A second version is under development.

Work is being undertaken to further develop and enhance the ATS website to provide more value to members.

**Working Groups:** A Tunnel Operators focus group has been established and developed the content for the short course being held in May 2022.

The ATS has established a working

group to review Australian Standard 4825 Tunnel Fire Safety to ensure that it is current and up to date.

The ATS has also established several subgroups to work on several topics including technical sessions, 50th anniversary celebrations and Women in Tunnelling.

The ATS also continues to regularly participate in the Silica Working Party discussions, established by the Australian Government.

The ATS has eight members active in ITA Working Groups which includes shotcrete, shafts and BIM.

**CURRENT TUNNELLING ACTIVITIES NSW**

**WestConnex:** Stage 3A. M4-M5 Link under construction and planned to be open for traffic 2023. Stage 3B. Rozelle Interchange: Underground interchange linking the M4-M5 Link to Anzac Bridge, Iron Cove Link and the future Western Harbour Tunnel. The project is under construction and due for completion in 2023.

**Sydney Metro City & Southwest Tunnel and Stations Excavation:** Underground rail Link from Chatswood to Sydenham via Central Station which includes twin 15km long tunnels excavated by TBM. Due to be completed in 2021.

**Queensland**

**WestConnex:** Stage 3A – M4-M5 Link under construction and planned to be open for traffic 2023. Stage 3B - Rozelle Interchange: Underground interchange linking the M4-M5 Link to Anzac Bridge, Iron Cove Link, and the future Western Harbour Tunnel. The project is under construction and due for completion in 2023.

**Snowy 2.0 Hydro Project:** Civil works include 27km of TBM tunnels.

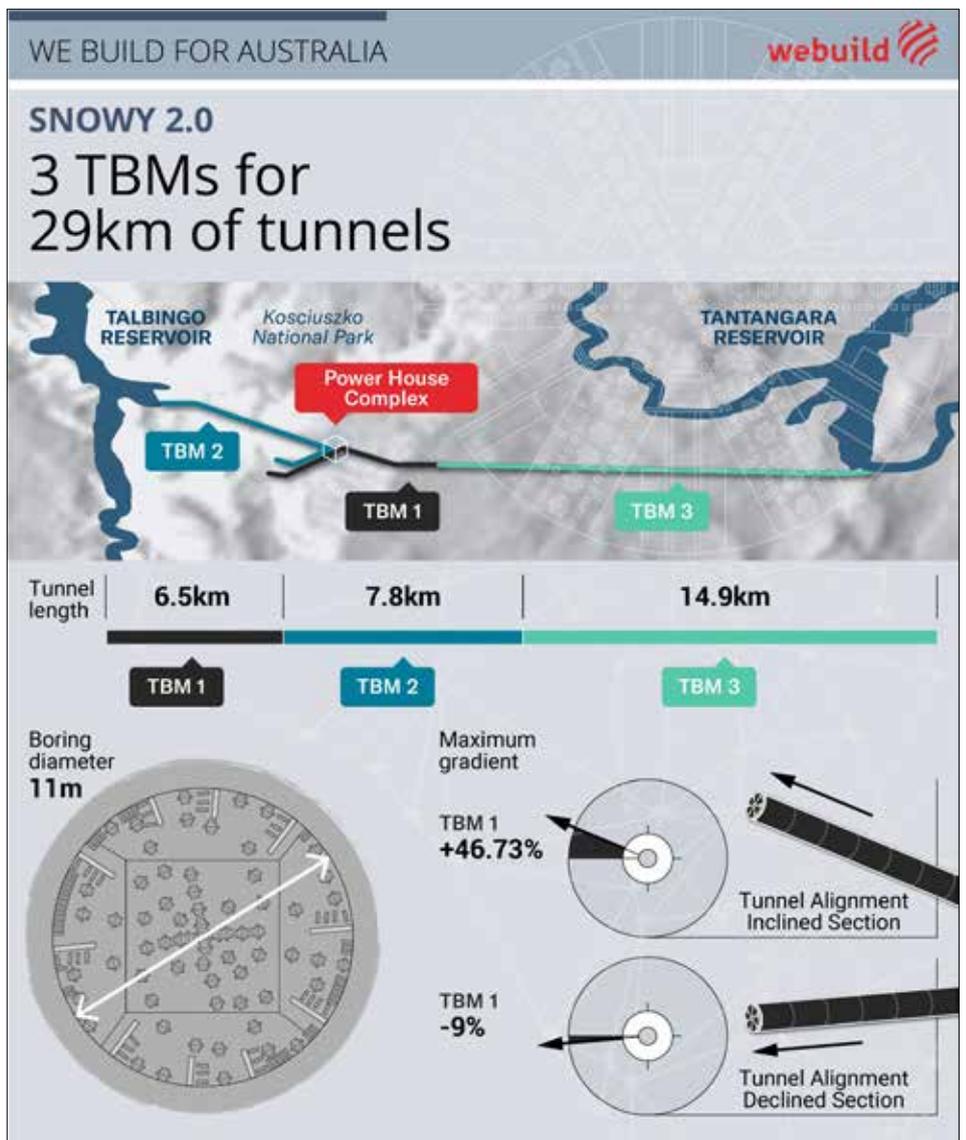
**M6 Stage 1 (formerly known as F6 Stage1):** 4km of motorway tunnel from new M5 to Presidents Ave Kogarah.

**Western Harbour Tunnel:** Road tunnel linking WestConnex with North Sydney.

**Sydney Metro City & Southwest Tunnel and Stations Excavation:** Underground rail Link from Chatswood to Sydenham via Central Station which includes twin 15km long tunnels excavated by TBM.

**Victoria**

**Melbourne Metro:** Twin 9km tunnels,



and construction is underway on 5 new stations and testing of the new High Capacity Signalling system that will enable turn-up-and-go services.

**West Gate Tunnel:** Twin Road tunnels (2km – 4km long) and elevated road structures linking the Westgate Freeway at Williamstown Road with City Link.

**Suburban Rail Loop (SRLE):** 26km twin rail tunnels, 6 new underground stations.

**Northeast link:** 6.5km twin three lane TBM road tunnels.

**Western Australia**

**Forrestfield – Airport Link Project:** A 7.1km twin-bored, concrete lined and 6.2m internal diameter tunnels extending from Guildford Road to Dundas Road in Forrestfield. Three stations will be located underground close to the current Domestic Airport precinct. Due to be completed 2021.

**South Australia**

**0.5km Torrens to Darlington (T2D) Project:** Final piece of the North – South Corridor. Southern Tunnel is 4.8km twin three lanes, Northern Tunnel is 2.2km twin three lanes.

**Queensland**

**Cross River Rail**

New north – south tunnel(s) with connections running from Dutton Park in the south to Victoria Park in the north and new underground stations.



# *Driving Progress Forward*

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Working with technology partners, we are developing products and solutions which deliver real-time data to help you monitor performance of your products and inventory, helping improve productivity.

The AT – Pipe Umbrella VR Simulator increases occupational safety through industry-led virtual training before commencement in construction. We reinforce progress — for our customers, and for the world.

**Brisbane Metro**

A 21km service connecting 18 stations along dedicated busways with easy links between Metro, bus and train services. This project includes a new underground bus station. Early utility diversions commenced.

**FUTURE TUNNELLING ACTIVITIES**

**Great Western Highway – New South Wales**

11km of twin tunnels between Katoomba and Lithgow, forming the longest road tunnel in Australia. Expected to start in 2022, taking 8 – 10 years.

**Beaches Link – New South Wales**

Road tunnel connecting Warringah Freeway with the Northern Beaches.

**Coffs Harbour Bypass – New South Wales**

A road project including three tunnels with a combined length of 1km.

**Inland Rail Project – Kagaru to Gowrie PPP package – Queensland**

A 126km rail link which includes three tunnels totalling 8.5km in length.

**Maribyrnong River Main Sewer Augmentation – Victoria**

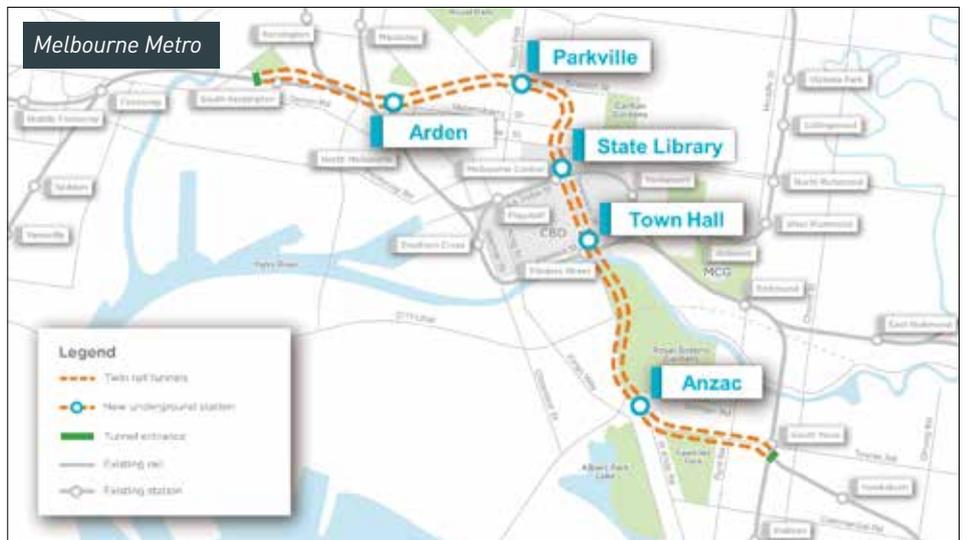
Augmentation of the existing sewer with a 1.3km pipeline which includes 800m of DN1400 pipejacking.

**Hobson Bay May Sewer – Victoria**

Upgrade of existing Hobson Bay Main Sewer crossing of the Yarra River.

**EDUCATION ON TUNNELLING IN THE COUNTRY**

Post-graduate (Master of Engineering) subject courses were held at the University of NSW, The University of Queensland, Royal Melbourne Institute of Technology, and the University of Wollongong.



# Belarus



**Name:** Belarusian Tunneling Association  
**Type of Structure:** Non-profit, open association  
**Number of Members:** 7 organisations

**CURRENT TUNNELLING ACTIVITIES**

In 2021, construction of the 1st section of the 3rd line continued. The length of the section is 4.2km, with three stations (from “Kovalskaya Sloboda” station to “Slutsky gostinets” station). The contractor has completed 1,434m of distillation tunnels with a diameter of 6m using a reinforced concrete waterproof high-precision lining. The three stations are being built as open cuts with sheet piles or bored piles.

**FUTURE TUNNELLING ACTIVITIES**

JSC “Minskmetroproject” has completed the development of the “Architectural project” of the 2nd section of the 3rd line of the Minsk Metro from the Yubileynaya station to the Peoples Friendship Park station: the length of the section is 4.4km with four stations.

**STATISTICS**

1. Length or volume excavated - % mechanized/% conventional during 2021  
 TPMK has built 1,434m of tunnel with a diameter of 6m.  
 Non-mechanized shields built 385m of tunnels with a diameter of 5.5m.

**EDUCATION ON TUNNELLING IN THE COUNTRY**

Belarusian National Technical University, Department of Bridges and Tunnels.  
 275 students, two Doctors of Technical Sciences, two candidates of technical sciences.



# 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:** 18 individual members, 50 corporate members

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

In 2021 the Belgian Tunnelling Association continued to promote underground solutions to resolve congestion problems, and the crossing of waterways and sensitive areas. Unfortunately, only one site visit could be organized due to the Covid pandemic. Nevertheless, digital activities were organized instead. The Webinar on European Research in Underground Techniques and Urbanism was a successful event on the 30th of March. Our scientific prize was awarded during the webinar. In cooperation with the Flemish engineering association ie-net, we organised a second webinar on the 4th May on the Grand Paris Express. On the occasion of the World Tunnel Day on the 3rd December, the works of the new Tangent Tunnel in Mechelen were visited. We strengthened our cooperation within the EUTF regarding the interests of the European Tunnel Community with knowledge sharing objectives. We continued our close cooperation with the French Tunneling Society AFTES, with whom we share the same magazine T&ES. Our activities are visible on <https://www.abtus-bvots.com/>

## CURRENT TUNNELLING ACTIVITIES

- The renovation of the metrostation Lemonnier and the start of the new Toots Thielemans Subway station (MIVB/STIB). Construction work on the 233m long Toots Thielemans subway station, formerly known as 'Constitution', started in 2020 to be completed by 2025. The renovation and expansion of the Lemonnier tram station will follow between 2025 and 2028.
- Several mechanized tunnels:
  1. Inauguration of a new storm water basin in Woluwe-Saint-Pierre - Storm basin Avenue Grandchamp (Vivaqua), tunnel i.d. 5.2m, length 370m
  2. Installation of pipelines by pipe jacking DN1800 and 1270m long, as part of the second phase of the stormwater drainage project from Cubber & Stockis

3. Lot 2 at the airport of Liège (Sowaer)
3. Wastewater networks Vliegtuiglaan (Farys), carried out by microTBM AVN2500 at a mud pressure length of 350m
4. Luxemburg Airport, technical gallery, made by MicroTBM AVN1800 with a mud pressure length of 260m under the landing strip.



*The Scheldt tunnel - this 1.8km long immersed tunnel will have two tubes for motorway traffic and a separate tube for cyclists and pedestrians.*

- In Brussels the rehabilitation of the road tunnels for the city's inner ring started. These old tunnels are being completely refurbished and will get an up-to-date control system. The most important is the Leopold II Tunnel (which is finished now).
- Renovation of the Kennedy railway Tunnel with new control and safety systems (which is almost finished).
- Start of the construction dock in Zeebrugge for the tunnel elements for the Scheldt tunnel on the Oosterweel connection (this 1.8km long immersed tunnel will have two tubes for motorway traffic and a separate tube for cyclists and pedestrians). See for the project on <https://www.lantis.be/>

## FUTURE TUNNELLING ACTIVITIES

- On the 29th of March 2022, annual seminar held on the topic 'Seminar on

Underground and Environment'.

- In May/June, a seminar on "The Fehmarnbelt Link" will be organized (in cooperation with the Flemish engineering association ie-net).
- In Brussels, the existing metro line will be adapted at the south station, so that the whole line can be upgraded into a fully automated subway system. The works have started. The tender for the extension of the metro from the north station towards the new NATO-building will begin.
- In Antwerp the works for the Oosterweel Connection (closing of the northern motorway ring) have started with the adaptation of the interchange at the left bank of the Scheldt river. The preparation works for the immersed tunnel under the Scheldt river started (works 2020-2027). The tendering for

the cut-and-cover tunnels under the Straatsburg dock will begin.

- The road tunnels for Brussel's inner ring will be further rehabilitated and will become safer.
- In the future, a second railway track from Antwerp's main shunting station towards the hinterland will be required. This will be delivered by two single track, 16km long tunnels that will underpass the Albert canal and several motorways to avoid interference with the dense urban areas on the surface.
- In Brussels the existing north-south railway link with its six tracks has reached saturation point. The link needs to be extended by four extra tracks (each in a separate tunnel some 10km long) that will be bored by TBM under the existing ones. The need is there but the funding will determine when the project starts.

# Bhutan



**Name:** Member Nation represented by Druk Green Power Corporation Limited

**Type of Structure:** Public Organization

**Number of Members:** All relevant agencies in the country such as DGPC, DHPS and Hydropower Construction Companies

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

No events could be organized due to COVID 19 pandemic.

## CURRENT TUNNELLING ACTIVITIES Punatsangchhu – II Hydropower Project (1020MW)

Excavation of the Downstream Surge Gallery (North) is currently in progress. The project was delayed due to geological challenges during the construction of the underground powerhouse is now expected to be commissioned towards the end of 2023. The construction of the concrete gravity dam and the headrace tunnel is

in an advanced stage of completion. The completion of underground powerhouse with the downstream surge system is on the critical path of the project.

## Nikachhu Hydropower Project (118MW)

The project is scheduled to be commissioned in 2023. While the construction of all other components such as concrete gravity dam, underground powerhouse, surge shaft and inclined pressure shaft are making good progress, the construction of the headrace tunnel from one of the adit is encountering geological challenges.

## Kholongchhu Hydropower Project (600MW)

The work for construction of the headrace tunnel was awarded to contractors in 2021. Site development and initiation of adit portal works have commenced.

## FUTURE TUNNELLING ACTIVITIES

Construction of three Small Hydropower Projects with a capacity ranging from 18MW to 54MW is expected to commence by mid 2022.

## STATISTICS

- 1,049m of additional surge tunnel excavation and 5,262m<sup>3</sup> of transformer hall and downstream surge gallery completed using the conventional method.
- A contract value of US\$58M for the construction of a headrace tunnel on the 600MW Kholongchhu hydroelectric project was awarded in 2021.
- List of tunnels completed: Headrace tunnel of the 1020MW Punatsangchhu-II hydroelectric project completed.

# 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:** 217 Individual Affiliate Members and 10 Corporate Affiliate Members.

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

### January

- 20th - Webinar CBT – “Safety on tunnel design” – Roberto Kochen”
- 28th – Webinar CBT – “Predicting tool wear in soils and planning the cutter head intervention strategy - Marc Comulada e Ulrich Maidl,
- 29th – Online tunnelers chat – chat regarding Morro Alto Tunnels

### February

- 11th – Invisible construction that protects a city: Lisbon: PGDL - Gonçalo Mendes Diniz Vieira
- 26th – Online tunnelers chat

### March

- 11th - “Perspectives on Underground Space: Past, Present, Future” – Antonia Cornaro
- 17th - webinar with the Portuguese geotechnical society about Jet Grouting Solutions. – Akira Koshima
- 25th – round table about woman in underground excavation.
- 26th - Online tunnelers chat

### April

- 8th webinar CBT – Operational safety in underground construction. – Ricardo Miranda
- 22th webinar CBT – TBM operation follow up - Lars Badendererde and Gustavo Aguiar



30th - Online tunnelers chat

### May

- 6th – webinar CBT – Emerald geomodelling - André Araujo Silva
- 27th – webinar CBT - Digital transformation and the application of Building Information Modeling in tunneling” - Janosch Stascheit e Felix Hegemann
- 28th - Online tunnelers chat

### June

- 17th - Webinar CBT – “small diameter tunnels in Calgary, Canadá” - Heinrich K. Heinz
- 25th - Online tunnelers chat

**July**

15th - "Evolution in products and services in blasting - José Silvio Corsini  
 30th - Online tunnelers chat

**August**

27th - Online tunnelers chat

**September**

24th - Online tunnelers chat

**October**

29th - Online tunnelers chat

**December**

01st - 04th - 5 Brazillian Tunnelling and Underground Structures Congress and Latin American Tunnelling 2021.

Online tunnelers chat: is an online meeting to bring together the Brazilian tunnel community, the idea is to connect seniors professionals and students in an informal chat.

**Publication**

**Journal:** Soils & Rocks (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. The following volumes were published in 202:

- Volume 44, N. 1, January-March 2021 - Nine articles, five technical notes, one case study -
- Volume 44, N. 2, April - June 2021 - Nine articles, four technical notes, two case study, one discussion, one lecture and one editorial.
- Volume 44, N. 3, July -September 2021 - Eight articles, two technical note, two review article, one discussion, one lecture and one editorial.
- Volume 44, N. 4, October-December 2021 - Nine articles, one technical note, one case study, 1one lecture.

**Press and social media**

Articles on the CBT website; mailing on CBT@News; and posts on Facebook, Instagram and LinkedIn.

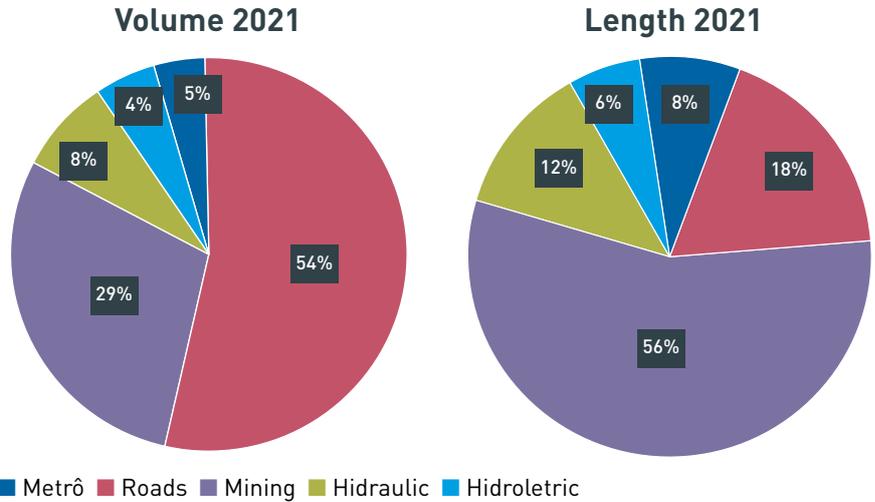
**FUTURE TUNNELLING ACTIVITIES**

New concessions around the country will bring previsions for new tunnels in SP, RJ, RS, but probably after 2022.

In Sao Paulo, Metro Line 2 will start TBM excavation in 2023.

**CURRENT TUNNELLING ACTIVITIES**

The estimated total volume of tunnels excavated in Brazil is 819.000m³ in 21.3km of tunnels. This includes roads, railways, hydroelectric facilities, mining and hydraulic. The distribution, in percentage is:



**STATISTICS**

1. Length or volume excavated 21.4km - 5% mechanized/95% conventional during 2021
2. Amount (USD or EUR) of tunnelling/underground space facilities awarded in 2021 - US\$180M
3. List of tunnels completed: Tamoios Road, PCH Alto Farias
4. List of tunnels under construction: Contorno de Florianópolis Road, Contorno de Caraguatatuba Road, Line 6 Sao Paulo Metro, Line 2 Sao Paulo Metro, Fortaleza Line 2 Metro.

**EDUCATION ON TUNNELLING IN THE COUNTRY**

There are no courses in Brazil yet that focus on tunnelling. Some universities have one or two disciplines related to underground construction, like Makenzie (São Paulo-SP), USP (São Paulo-SP), UnB (Brasília-DF), Iesplan (Brasília-DF). On post-graduate courses our references in Brazil are Brasilia Federal University (UnB) and São Paulo University (USP), São Carlos school.

# Canada



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

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

**Number of Members (2021):** 386 (266 full, 68 corporate, 15 retired, 37 student)

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

The COVID-19 pandemic curtailed the ability to hold in-person meetings for most of the year, so TAC's Ontario and BC Chapters and Young Members Group continued to offer online webinars. These included:

- **01/28/2021** – Risk and Risk Management in Underground Projects
- **02/25/2021** – Current and Future Tunnel Projects in Ontario
- **03/04/2021** – 2020 TAC Undergraduate & Dan Eisenstein Memorial Scholarship Presentations
- **04/29/2021** – Ashbridges Bay Treatment Plant Outfall Tunnel Update
- **05/27/2021** – Rockmass Technologies – Axis Mapper
- **06/17/2021** – Eglinton Crosstown LRT
- **07/22/2021** – Twinning of the West Trunk Sewer
- **08/12/2021** – Emerging Safety Technologies for North American Tunnelling
- **09/22/2021** – Grouting Comparison of Two Segmentally Lined Rock Tunnels
- **11/18/2021** – Site C Clean Energy Project Underground Works

TAC was able to hold its postponed 2020 conference in October 2021. Over 350 tunnelling professionals and guests, 29 sponsors and 33 exhibitors met October 19-21 in Toronto, Ontario under the theme Vision Underground for TAC's most successful conference ever. Keynotes and sessions included:

- Global Tunnelling Update and ITA (Canada)'s Role: Today and Tomorrow
- Canadian Tunnelling – What Can the Mining Industry Bring to The Table?
- Transit Development and Expansion Growing Below the Ground
- 2020 and 2021 Canadian Project of the Year Presentations
- Current & Future Canadian Projects
- Transit Tunnels: Design & Construction
- TBM Tunnelling
- Case Histories and Challenging Projects
- SEM and Caverns

- Future Projects & Costing
- Research and Innovation
- Trenchless and Rehabilitation
- Safety and Risk Management



The conference featured the return of TAC's annual Achievement Awards Dinner.

The 2021 award recipients included:

- Lifetime Achievement Award – Frank Policicchio
- Young Tunneller of the Year Award – Michael Mains
- Canadian Innovation Initiative Award – Robbins, Hatch, Southland Holdings, Astaldi and the City of Toronto for the "Ashbridges Bay Treatment Plant Outfall Tunnel Project"
- Canadian Project of the Year (Up to \$100M CAD) – AECOM, Volker Stevin, Innovative Pipeline Crossings and the City of Calgary for the "Rangeview Sanitary Trunk Phase 1 Project"
- Canadian Project of the Year (Over \$100M CAD) – Hatch, Technicore and the Region of Peel for the "Burnhamthorpe Water Project, Contract 1/2"
- Photo of the Year Award – Hatch for "Kemano T2 Project TBM Cutterhead Inspection"
- TAC Outstanding Service Award – Steve Skelhorn

- Dan Eisenstein Memorial Scholarship – Simone Markus
- TAC Undergraduate Scholarship – Claire Thurston

Full 2021 TAC Achievement Award details and videos are posted on the TAC website at [https://www.tunnelcanada.ca/awards\\_2021.php](https://www.tunnelcanada.ca/awards_2021.php).

The 2021 conference also featured the release of TAC's new commemorative book Canadian Tunnelling: Memories and Achievements, which showcases prominent Canadian tunnelling projects undertaken since the founding of Canada. The book charts the progress of Canada's tunnelling industry and includes high quality photos in large format that capture both historical and recent tunnelling projects. This six-year project undertaken by TAC Directors will be a valuable means to promote the tunnelling industry to educators, government, and industry decision makers, as well as the public at large.

2021 also saw the launch of TAC's semi-annual magazine Canadian Tunnelling, issued in conjunction with Tunnelling Journal as part of its February and September issues. Content for the periodical (see <https://tunnellingjournal.com/archive/tunnelling-journal-september-2021/>) is generated primarily by TAC Directors and features industry news, TAC news and feature articles from across Canada.

The brief window of relaxed COVID-19 in-person event regulations in the fall enabled TAC's Ontario Chapter to run its St. Barbara's Day year-end social on December 2 that saw 100 members attend.

## CANADIAN TUNNELLING ACTIVITIES

Key Western Canada projects currently under construction or completed in 2021 include:

- North Shore Wastewater Conveyance (North Vancouver, BC): 520m intake tunnel.
- Second Narrows Water Supply Tunnel (Vancouver, BC): 5.4m diameter, 1.2km long TBM excavated water conveyance tunnel.
- Annacis Island Wastewater Treatment Plant Outfall (Vancouver, BC): 1.2km long TBM excavated tunnel between two 40m deep shafts.
- Broadway Subway Project (Vancouver, BC): 6km TBM bored subway extension to the existing Millennium Line Skytrain with 6 new stations.
- Trans Mountain Pipeline Burnaby

Mountain Tunnel (Burnaby, BC): 2.6 km long, 4m diameter TBM tunnel to relocate existing 24-inch delivery pipeline and replace with three 30-inch pipelines.

- Valley Line LRT (Edmonton, AB): 27km LRT extension includes construction of two 500m long soft ground NATM tunnels.
- Duggan Tunnel Replacement (Edmonton, AB): 3km of 2.1m diameter truck sewer with 18 shafts and open cut work.
- Inglewood Sanitary Trunk Project (Calgary, AB): 2.4m diameter, 4km microtunnelling project.
- Combined Sewer Overflow Relief Project (Winnipeg, MB): Multiple ongoing projects.

Examples of key Eastern Canada projects currently in progress or completed in 2021 include:

- Hwy 401 Rail Tunnel (Greater Toronto and Hamilton Area, ON): Two tunnels excavated less than 3m underneath two busy highways.
- Coxwell Bypass (Toronto, ON): 6.3m diameter and 10.5km long TBM-excavated tunnel.
- Ashbridges Bay Outfall (Toronto, ON): 7m diameter, 3.5km long TBM-excavated outfall tunnel underneath Lake Ontario.
- Scarborough Subway Extension (Toronto, ON): 10.7m single bore 8km tunnel with three stations and eight emergency exit buildings.
- Metrolinx Stations (Toronto, ON): Various Projects
- Ontario Line (formerly Downtown Relief Line, Toronto, ON): Advance works have commenced. 16km of 6m diameter TBM tunnels with eight new underground stations.
- East to West Diversion Tunnel (Peel Region, ON): 11km, 2.4m earth-pressure balance TBM



Annacis Outfall Tunnel

- Ottawa LRT Stage 2 (Ottawa, ON)
- Bassin Lavigne (Montréal, QC): 1.9km of tunnelling to provide supply and connecting tunnels to a 42m diameter, 25m deep retention basin for reducing wastewater overflow.
- Lafontaine Tunnel (Montréal, QC): Renovation of the 53-year-old, 1.5km long, double tube immersed, Louis-Hippolyte-Lafontaine tunnel.
- Réseau Électrique Métropolitain, REM (Montréal, QC): Two major tunnels including a 3km long TBM excavated tunnel to be driven underneath the Montreal Airport runways.
- Blue Line Extension (Montréal, QC): 5.8km of tunnel with five stations

- Côte Vertu Storage/Maintenance Facility (Montréal, QC): 3 tunnels totalling 1.5km in length

**FUTURE MAJOR CANADIAN TUNNELLING PROJECTS (PLANNED OR PROSPECTIVE)**

A sampling of planned projects across Canada includes:

- Stanley Park Water Supply (Vancouver, BC): 1.4km long, 4m diameter, SEM tunnel in rock, with shafts in excess of 30m deep.
- Coquitlam No 4 Watermain (Coquitlam, BC): 2km long, 5m diameter, TBM tunnel in soil, with access shafts in excess of 40m deep.
- Annacis Water Supply Tunnel (New Westminster, BC): 2.3km long, 3.8m EPB single pipe tunnel.
- Cambie Richmond Water Supply Tunnel (Vancouver and Richmond, BC):
- Fortis BC Eagle Mountain (Squamish, BC): 9km long, 4m diameter TBM tunnel, driven in both rock and soil, with dedicated hard rock and soft ground TBMs.
- Green Line LRT (Calgary, AB): 46km extension to the existing LRT includes over 3km of tunnel in the City's downtown area.
- Eglinton Crosstown (West) Phase 2 (Toronto, ON): 9.2km LRT extension, predominantly tunnelled

Prospective Canadian projects include:

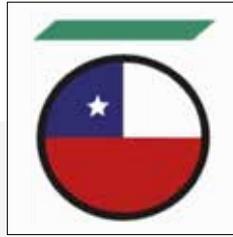
- Coquitlam Second Intake Project (British Columbia)
- Yonge Street Subway Extension (Greater Toronto Area, Ontario)
- Inner Harbour West Tunnel (Ontario)
- Taylor Massey Creek (Ontario)
- Québec-Lévis Tunnel (Quebec)
- Halifax Red Line Tunnel (Nova Scotia)
- Newfoundland to Labrador Crossing (Newfoundland)

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# Chile



**Name:** Committee of Tunnels and Underground Spaces (CTES)

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

**Number of Members:** 73 Members (55 are companies from the industry)  
Corporate Members: 1 premium category, 15 Category Gold, 39 Category Associated and 18 Individual members.

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

### Seminars and conferences

11 technical webinars held throughout the year, with more than 1,156 attendees.

- **(April)** El Teniente mining underground megaproject.
- **(April)** Megaproject Vvision: International tunnel.
- **(May)** Gaps, challenges and initiatives for underground development
- **(June)** "Underground blasting: Optimization of production at the Panamericana Silver Mine"
- **(July)** "Automation of underground mining equipment"
- **(August)** "Automation and digitization for mining and tunnel development"
- **(August)** "Underground infrastructure: urban and social integration"
- **(September)** "Double Shield TBM experience at Los Condores Hydroelectric Power Plant"
- **(October)** "Paso Las Le as international tunnel: feasibility study result"
- **(November)** International seminar "Development of underground works in LATAM"
- **(November)** "A structural challenge: use of metallic fibres on line 16 of the Grand Paris metro"

International seminar on the development of underground works in Latin America, co-organized with the Mexico Underground

Association and ACTOS of Colombia.

### Other

Visits to a GMTC plant (Geobruigg Mining Technology Centre) and its new production plant in Rancagua, Chile (November). In addition, a visit to the Tobaraba Urban Market, MUT, underground works under construction (October).

A technical working group on "Seismic effects (or induced) in underground works".

**Documents:** Work is being done to update the Directory and upload 200 documents on the CTES site. The CTES website is being updated, promoting news for members and technical documents, as well as disseminating national and international events, with more than 9,500 visits.

**YouTube channel:** A new channel is being developed for technical webinars, podcasts and corporate videos promoted by CTES Chile. It currently has 15 webinars available, seven from 2020 and six from 2021.

**10 newsletters:** Outstanding news, opinion columns, agendas, and events.

**Podcasts:** The first podcast has been developed that allows a technical communication channel for the community, beginning with the topic - advances in digitization.

**Registry of underground spaces in the country:** 180 underground projects are identified in Chile.

Celebration of 10 years of the CTES Chile.

## FUTURE TUNNELLING ACTIVITIES

- **Webinar 1:** Operation and emergency management in mega-road tunnels in Europe.
- **Webinar 2:** Design and construction of caves
- **Webinar 3:** BIM technologies and innovations in underground works projects (Mining/Infrastructures/Roadworks).
- **Webinar 4:** Equipment and evolution accessories and explosives used underground.
- **Webinar 5:** Rockburst experiences.
- **Webinar 6:** Design and construction of underground works with raise bore and blind hole.
- **Webinar 7:** Advances underground mega projects - 7 Line Advance.
- **Webinar 8:** Activity table for the underground space.
- **Webinar 9:** Drilling steels and umbrella bolts; Innovations and their importance in tunnel development.
- **Webinar 10:** Advances of the working group seismic effects in underground works
- **International Mission:** Norway (April 2022)

## STATISTICS

### List of tunnels under construction:

Three new underground subway lines will be built; Line 7 (26km), Line 8 (19km) and Line 9 (17km).

**AVO II:** Urban Road concession of 5.2km length, made up of two express

## EDUCATION ON TUNNELLING IN THE COUNTRY

1. Postgraduate Diploma in Tunnels and Underground Spaces; Universidad de Chile
2. Diploma in Modern Tunnel Excavation Techniques; Universidad de Santiago de Chile
3. Undergraduate Programs in Civil Engineering Mining (University of Chile, University of La Serena, University of Santiago of Chile, Universidad Adolfo Ibañez and others)



# China



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

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

**Number of Members:** Total number: 45,407, number of corporate members: 1,355

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

The 2021 China (Shanghai) International Tunnel Engineering Seminar was hosted by the Tunnel and Underground Works Branch of the China Society of Civil Engineering from April 18th to 19th in 2021. With the theme "Challenges and Innovations of Tunnel Engineering in Complex Urban Environment", the two-day event included one theme forum and six sub-forums. Nearly 100 academic papers were presented. Six Chinese academicians and top experts from China, Japan, Italy, Austria, and Brazil attended the seminar, which gathered more than 600 participants through both online and offline platforms. There were more than 2 million live-stream viewers, and the event was widely reported in the media.

"The Third International Symposium on Detection and Monitoring for Tunnels and Underground Works and the Seventh Construction Management and Technology Youth Forum of the Tunnel and Underground Works Branch of CCES" was hosted by the Central South University in Changsha, China from October 15th to 17th, 2021. The theme was "Safety Risks and Intelligent Monitoring of Tunnel and Underground Engineering". Top experts and young graduate students from China, Japan, the United States and France were invited to present papers, including 11 keynotes and 55 presentations for five sessions. The event was held both online and offline, and attracted more than 350 experts, tunnellers, and graduate students from universities, research institutions and companies.

### Publication

"Modern Tunnelling Technology", 3,000 copies in print

"Proceedings of The 3rd International Symposium on Detection and Monitoring for Tunnels and Underground Works and the 7th Construction Management and Technology Youth Forum of the Tunnel and Underground Works Branch of CCES"

"Proceedings of the 20th Waterproofing and Drainage Technology Forum of the



*The Gaoligongshan Tunnel*



*The Shenzhen-Zhongshan Channel*



*Oujiang River North Estuary Tunnel*

Tunnel and Underground Works Branch of CCES"

"Proceedings of the 12th National Tunnel and Underground Space Forum for Safe Operation, Energy Saving and Environmental Protection and the 3rd Traffic Tunnel Fire Prevention and Emergency Rescue Technology Forum by the Tunnel and Underground Works Branch of CCES

## CURRENT TUNNELLING ACTIVITIES

In 2021, there were 743 railway tunnels (length: 1,425km), 2,132 road tunnels (length: 2,199km), and 971.93km of subway tunnels newly built and put into operation in China. Major tunnel projects still under

construction include the Gaoligongshan Mountain Tunnel of the Darui Railway, Shenzhen-Zhongshan Tunnel, Shenzhen Chunfeng Road Tunnel, etc. Major tunnel projects completed in 2021 include the Oujiang River Tunnel in Wenzhou City, etc. some are shown below:

### The Gaoligongshan Tunnel, is 34,538m long and has a maximum depth of 1,155m

The unfavorable geological conditions encountered in the tunnel are characterized by "three highs" (high geotherm, high geo-stress and high earthquake intensity), and "four actives" (active neotectonic movement, active geothermal water environment, active external dynamic geological conditions, and an active bank slope superficial transformation process), which makes construction extremely difficult.

### The Shenzhen-Zhongshan Channel

A cross-sea link integrating tunnels, artificial islands, bridges and underwater interconnections. The project is about 30km from the Humen Bridge in the north and about 38km from Hong Kong's Zhuhai Macao Bridge to the south. The length of the link is about 24km. The main structures of the project include: a suspension bridge for the Lingding channel with a main span of 1,666m, a cable-stayed bridge for the Hengmen East Waterway with a main span of 580m, a 6,845m long undersea tunnel (5,035m long steel shell immersed tube), and East artificial island (930m long), a West artificial island (625m long), etc. The initial project started in December of 2016 and is planned to be completed and opened to traffic in 2024.

### Oujiang River North Estuary Tunnel

On June 6th, Wenzhou's first cross-river shield tunnel project – the Oujiang North Estuary Tunnel of Wenzhou Rail Transit S2 Line Phase I Project SG5 Section - bored through smoothly. This is the first shield tunnel with a super-large diameter composite lining in China, and also the first tunnel constructed by shield tunnelling in Wenzhou. The Jiangbei Shield receiving shaft is the deepest rectangular foundation pit in Zhejiang Province. The Oujiang North Estuary Cross-River Tunnel is 4.8km long, with the shield tunnel section 2,664m long. The underwater section has a maximum buried depth of 60m. It is designed with a single tube and two lanes and has been constructed using a TBM with a diameter of 14.93m. Oujiang River North Estuary Tunnel has been awarded "Three-first Records", i.e. Wenzhou's first shield tunnel,

the province's first super-deep foundation pit (52m), and the country's first municipal railway super-large diameter shield.

### FUTURE TUNNELLING ACTIVITIES

In 2022, the major tunnel projects planned and constructed in China include the Shenhai Expressway Jihe Section Reconstruction and Expansion Project (41.43km), the Yongsheng Tunnel for the Dali (Lijiang)-Pan-zhihua Railway (18.085km), the Jiuliwan Tunnel on the Chongqing-Guiyang High-speed Railway (19.54km), and the Nanwashan Tunnel for the Changzhi-Handan-Liaocheng Railway (22.11km), etc. Some are shown below:

#### He'ao Tunnel

With a length of about 41.43km, the Shenhai Expressway Jihe Section Reconstruction and Expansion Project is located in the centre of Shenzhen City and is the east-west traffic axis of the Guangdong-Hong Kong-Macao Greater Bay Area. The completion of the project will promote the construction of the Guangdong-Hong Kong-Macao Greater Bay Area, accelerate the development of the Shenzhen-Dongguan-Huizhou metropolitan area, and speed up the integration of the Pearl River Delta which plays an important role in implementing Shenzhen's development plan of "connecting the east and the west".

The He'ao Tunnel starts from the east of the He'ao Interchange and ends at the Longkou Reservoir. Complying with the standard of expressway construction, it has a design speed of 100km per hour and is a dual carriageway with eight lanes. It has been proposed as a shield tunnel, passing under the Longgang New City, an existing water source protection zone, and existing buildings, subways, expressways, underground structures, etc. There are many sensitive factors and risks to be tackled, and the geological conditions are complex. To ensure construction safety, a single-tube double-layer shield tunnel has been proposed, which is a first for expressway construction in China. The outer diameter of the shield tunnel segments is 17.5m, and the outer diameter of the TBM 18.1m. After its completion, it will be the largest diameter shield tunnel in the world, beyond the Tuen Mun Tunnel in Hong Kong.

#### Qinling Mabaishan Tunnel

The new Xi'an-Shiyan High-speed Railway starts from the Xi'an hub - Xi'an East Station, and ends at the existing Shiyan East Station. With a length of 256.7km, the main line has seven stations, including

six newly built ones. The construction of the Shaanxi section of Xi Shi High-speed Railway is scheduled to commence on December 20th, 2021 and to be completed on June 30th, 2026, with a construction period of 4 and half years. The length of new bridges is about 40.9km, accounting

for 15.99% of the whole line, while the length of the 41 new tunnels is 201.6km, accounting for 78.83%. The proportion of bridges and tunnels will be 94.82%. Among these new tunnels, the longest one is the 22.9km long Mabaishan Tunnel in Qinling.

## STATISTICS

By the end of 2021, there were 17,532 railway tunnels in operation in mainland China, with a total length of 21,055km. In 2021, 734 railway tunnels were newly built and put into operation, with a new mileage of 1,425km. The length of railway tunnels under construction is about 6,414km, and 15,266km in the planning stage.

By the end of 2020, the number of highway tunnels in China reached 21,316, with a length of 21,999km in total. Among them, the number of super long tunnels increased rapidly. In 2020, the number of super long highway tunnels in China was 1,394, with a year-on-year increase of 219, and the length was 6,236km, with a year-on-year increase of 19.5%.

By the end of 2021, a total of 50 cities in mainland China had put 9,192.62km of urban rail transit lines into operation, including 7,253.73km of subways, accounting for 78.9%. In 2021, Luoyang, Jiaying, Shaoxing, Wenshan Prefecture and Wuhu were classified as the five new urban rail transit operation cities.

## EDUCATION ON TUNNELLING IN THE COUNTRY

### Graduate courses

- "Tunnel Engineering", Central South University
- "Introduction to Underground Works, Mountain Tunnels, Metros, Underwater Tunnels, Design Principles for Underground Structures, Utilization of Underground Space", School of Civil Engineering, Southwest Jiaotong University

### Post graduate courses

- "Shield Tunnel Engineering", Central South University
- "Tunnel Mechanics, Vibration Reduction of Tunnels and Underground Structures, Construction
- Methods of Tunnelling and Underground Engineering, Similarity Theory and Model Test", School of Civil Engineering, Southwest Jiaotong University
- School of civil engineering, Tongji University

### Doctoral program:

Advanced underground structure, Tunnel Mechanics and engineering, advanced rock mechanics, underground structure test and testing technology, geotechnical plastic mechanics, underground structure calculation theory, special theory of underground space utilization, risk and safety of civil engineering, dynamic feedback and control of underground engineering, underground engineering construction technology, optimization method of underground structure, unsaturated soil mechanics, probability analysis of civil engineering Earthquake resistance of underground structure, deep foundation pit engineering, Soil Mechanics II, its technology and application of tunnel and underground engineering, disaster science of underground engineering, intelligent underground structure, etc.

### Master Program:

Civil engineering discipline progress and research methods, underground structure test and testing technology, advanced rock mechanics, geotechnical plastic mechanics, underground structure calculation theory, Tunnel Mechanics and engineering, underground engineering construction technology, underground structure optimization method, underground structure earthquake resistance, tunnel and underground engineering IT technology and application, introduction to underground space utilization, underground engineering disaster Tunnel and underground space operation safety and disaster prevention, advanced underground concrete structure theory, intelligent underground structure, etc.

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# Colombia



**Name:** The Colombian Tunneling Committee

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

**Number of Members:** 10 members that represent more than 2500 engineers in the country

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

The Committee continues to participate with the Colombian Society of Engineers as part of the revision team for the Colombian Tunnel Design Manual developed by the National Roads Institute (INVIAS). The Colombian Tunnel Committee (CCT) was working on the following:

Completion of the in-situ stress measurement – ITA working group Bulletin No. 12 - Camilo Marulanda, with historical cases.

As the 2021 congress was rescheduled to 2022, the Colombian tunnel committee has been working on the following two technical publications:

1. Design and Construction Considerations for Two Shallow Highway Tunnels in Soft Ground: C. Marulanda and R. Gutierrez, Ingetec, Bogotá. Colombia.
2. Analysis of the Squeezing Phenomenon and Rehabilitation of La Línea Roadway Tunnel: C. Marulanda (1) and R. Gutiérrez (2) - (1) Technical Manager, (2) Head of Tunneling Department - Geotechnical Division, Ingetec SA, Bogotá, Colombia.

The committee will organize the 2022 Tunneling Symposium, in which all Working Groups will participate. The committee will work on an academic

article on tunnelling based on the local Working Group's research. The committee will organize more short talks by invited experts, which will be open to all interested members of the community.

Participation in the WORLD ROAD TUNNEL SEMINAR: implementation of technologies in tunnel operation, with the two topics:

1. Environment and Sustainability (Design

- and construction of two shallow road tunnels in soft ground)
2. Construction and operation during the useful life of the tunnel (Analysis of the performance and rehabilitation of the La Línea Tunnel).

Participate in the World Tunnel Congress - WTC 2022, Denmark, 2nd - 8th September 2022.

## CURRENT TUNNELLING ACTIVITIES

Colombia has an abundance of low strength rocks and due to the tectonic mountain building history of the region there is a huge variability in geological conditions and rock stresses, which give rise to excessive decompressions during underground works, thus generating a significant challenge to the industry.

To mitigate the often-long trips from ports to production centers and vice versa,

## EDUCATION ON TUNNELLING IN THE COUNTRY

Postgraduate course applied to tunnel engineering/University: Universidad Javeriana/ Bogotá, Colombia.

Postgraduate course applied to mining engineering/University: Universidad Javeriana/ Bogotá, Colombia.

Postgraduate course in Road Tunnels: Design, Construction and Management/ University: Universidad de Los Andes/Bogotá, Colombia.

Postgraduate course in rock embankments and tunnel design/University: Universidad de Los Andes/Bogotá, Colombia.

Postgraduate course in underground construction /University: Universidad Militar Nueva Granada/Bogotá, Colombia.

Postgraduate course in geotechnical tunnel design/University: Universidad EAFIT/ Medellín, Colombia.

Postgraduate course in road tunnels/University: Universidad Javeriana/Bogotá, Colombia.

Course in bridges/viaducts, tunnels, embankment stability, complex excavations, hydroelectrics, ports, docks and cargo terminals/Escuela Colombiana de Ingeniería Julio Garavito/Bogotá, Colombia.

Andean Seminar about tunnels and underground works/Sociedad Colombiana de Ingenieros/Bogotá, Colombia.

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the design and construction of highway tunnels has increased in recent years.

The Colombian government has committed significant investments through the fourth generation 4G concession plan, which will include the construction of tunnels with varying characteristics.

The construction of tunnels has become a fundamental pillar in the national road network with almost 15km finished in 2021 and more than 36km of tunnels currently being built. The Guillermo Gaviria Echeverry Tunnel (Túnel del Toyo) is 9.73km long as is currently under construction and when complete will be the longest tunnel in Latin America. The entire "Cruce de la Cordillera Central" project is now in operation, after its inauguration in November 2021. It is composed of:

- 31 Bridges (5km)
- 3 Road interchanges
- 25 Tunnels (22km)

The most important tunnel - Túnel de La Línea - was opened in 2020, with a length of 8.65km. This is an important milestone in Colombian history. This project will improve commerce between Buenaventura port and Bogotá, where 42% of merchandise traded enters and leaves the country.

### FUTURE TUNNELLING ACTIVITIES

At present, several road tunnel projects are being developed, within which the following stand out:

- 4 Tunnels on the Autopista al Llano Highway (8.25km)
- 1 Tunnel on the Autopista al Mar 1 Highway (4.6km)
- 1 Tunnel on the Autopista al Mar 2 Highway (2.2km)
- 2 Tunnels on the BBY Highway (5.4km)
- 2 Tunnels on the Pacífico 1 Highway (5km)
- 1 Tunnel on the Pacífico 2 Highway (2.5km)
- 1 Tunnel on the Pacífico 3 Highway (3.5km)
- 3 Tunnels on the Pamplona-Cúcuta Highway (2.87km)
- 1 Tunnel on the Vías del Nus Highway (4.1km)

The construction of these tunnels will improve the travel times for vehicles and heavy traffic, reduce the accident rate and will connect the main productive centers of the country with the main Colombian ports.

At present, Line 2 of the Bogota subway is under study, which consists of a 12.6km long main tunnel with a diameter of 10.80m to be built by EPBM through Sabana formation clays. Two entrance and exit shafts 20m wide and 25m deep will be constructed.

## STATISTICS

### 1. Length or volume excavated - % mechanized / % conventional during 2021

100% of the length of the tunnels completed in 2021 were built using the conventional method.

### 2. List of tunnels completed:

Project	Tunnel	Length (km)
Cruce de la cordillera central	Túnel Los Ocelotes	0.30
Cruce de la cordillera central	Túnel Búho de anteojos	0.14
Cruce de la cordillera central	Túnel Mono aullador	0.23
Cruce de la cordillera central	Túnel Las Mariposas	0.10
Cruce de la cordillera central	Túnel Condor de Los Andes	0.10
Cruce de la cordillera central	Túnel Oso de anteojos	0.34
Cruce de la cordillera central	Túnel Los colibríes	0.90
Cruce de la cordillera central	Túnel Los barranqueros	0.63
Cruce de la cordillera central	Túnel de La Línea	8.60
Cruce de la cordillera central	Túnel Piloto	8.5
Cruce de la cordillera central	Túnel Loro orejiamarillo	0.27
Cruce de la cordillera central	Túnel Tapir Andino	0.16
Cruce de la cordillera central	Túnel Los tucanes	0.06
Cruce de la cordillera central	Túnel Tigrillo lanudo	0.20
Cruce de la cordillera central	Túnel Los trogones	0.40
Cruce de la cordillera central	Túnel Los perezosos	0.11
Cruce de la cordillera central	Túnel León de montaña	0.22
Cruce de la cordillera central	Túnel Los azulejos	0.06
Cruce de la cordillera central	Túnel Carpintero real	0.13
Cruce de la cordillera central	Túnel Las tangaras	0.13
Cruce de la cordillera central	Túnel Los venados	0.19
Cruce de la cordillera central	Túnel Los guatines	0.12
Cruce de la cordillera central	Túnel Las zarigüeyas	0.08
Cruce de la cordillera central	Túnel Los armadillos	0.02
Cruce de la cordillera central	Túnel Las guaguas	0.09
Pacífico 3	Túnel de Tesalia	3.5
Pacífico 2	Túnel de Mulatos	2.5
Pacífico 1	Túnel de Sinifaná	1.4
Vías del Nus	Túnel de La Quiebra	4.1
Conexión Mar 1 y Mar 2	Túnel del Toyo	9.73
Autopista al Mar 1	Túnel de Occidente	4.6
Pacífico 1	Túnel de Amagá	3.6
Pamplona-Cúcuta	Túnel de Pamplona	1.4
Pamplona-Cúcuta	Túnel de Pamplonita	1.07
Pamplona-Cúcuta	Túnel de La Honda	0.4
BBY	Túnel de La Paz	3.2
BBY	Túnel La Sorda	2.2
Autopista al Llano	Túnel Buenavista II	4.6
Autopista al Llano	Túnel 2	0.55
Autopista al Llano	Túnel 3	1.45
Autopista al Llano	Túnel 5	1.65
Autopista al Mar 2	Túnel de Fuemia	2.2

# Costa Rica



**Name:** ACROS - Asociación Costarricense de Obras Subterráneas  
**Type of Structure:** Non profit, open association  
**Number of Members:** 21 individual members, 3 corporate members

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

- Short Course on Design and Construction of Tunnels, May 2021
- Participation in the GA of the ITA-AITES, June 2021

## CURRENT TUNNELLING ACTIVITIES

Tunnelling activities in 2021 concentrated on the pipe jacked micro tunnelling for residual water treatment on the Project for Ambiental Improvement of the San Jose Metropolitan Area.

In the north sector of San Jose, 713m of pipe jack micro tunnels of 600mm diameter, and 37 shafts of 2.9m - 3.2m diameter and an average depth of 8m were constructed.

In the south sector, 3460m of pipe jack micro tunnels of 1200mm diameter, and

18 shafts of 4.5m – 5.5m diameter and an average depth of 10m were built.

In addition, a new underground pass of 790m under the Guadalupe roundabout was built with another underground pass of 900m under construction at the Bandera roundabout had reached 70% completion in December 2021.



Bandera underground pass

## FUTURE TUNNELLING ACTIVITIES

- Three Three tunnels for the fifth stage of the potable water supply project for the Metropolitan Area of San José, with a total length of 11.8km and 3.9m diameter.
- Two tunnels for storm sewage in the Metropolitan Area of San Jose, 1300m length and 3m diameter each.
- New underground pass of 60m under the national route No. 2 at the La Galera intersection

## STATISTICS

### 1. Length or volume excavated - % mechanized/% conventional during 2021

Micro tunnelling 100% mechanized, underground passes 100% conventional

## 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)

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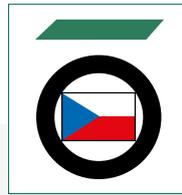
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# Czech Republic



**Name:** Czech Tunnelling Association

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

**Number of Members:** total number: 92, number of corporate members 44

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

The publishing of the "Tunel" journal – four issues per year.

Organising "Tunnelling afternoons" – public lectures for those involved in the underground. The lectures were held on the following topics:

- Mezno and Deboreč tunnels
- Foreign Tunnel Projects IV
- Prepared Underground Structures in the Czech Republic

Preparation began for the 15th International Conference Underground Construction, Prague.

## CURRENT ASSOCIATION ACTIVITIES

In 2022 the Czech Tunnelling Association (CzTA) will continue the following activities:

Publishing the "Tunel" journal – four issues per year.

Organising the public lectures - "Tunnelling afternoons" – with the topics:

- Cut and Cover Tunnels
- Reconstruction of Railway Tunnels
- Metro D – New Line of Prague Metro
- Preparation of the Completion of the Prague City Ring Road

Continue with preparations for the 15th International Conference Underground Construction, Prague, to be held in May 2023.

## FUTURE ASSOCIATION ACTIVITIES

The Czech Tunnelling Association ITA-AITES cordially invites you to 15th International Conference entitled "Under-ground Construction Prague 2023", which will be held in Prague, the capital of the Czech Republic, 29–31 May 2023.

This international conference is one of a series of conferences "Underground Construction Prague", held every three years. Due to the pandemic, this year's event has been postponed by a year. The conferences have been attended by distinguished international experts in the field and we look forward to prominent guests in 2023. "Underground Construction Prague" can be considered one of the key events in 2023 in the discipline of underground construction. The conference is endorsed by the International Tunnelling and Underground Space Association (ITA). We are looking forward to your active participation and exchanges of new information and experiences.

## STATISTICS

### 1. Length or volume excavated - % mechanized / % conventional during 2021

- 658m 100% conventional.

### 2. List of tunnels completed:

- Mezno Tunnel and Deboreč Tunnel on Railway Corridor IV

### 2. List of tunnels under construction

- Geotechnical Survey for the Metro D Project
- Zvěrotice Rail Tunnel
- Žabovřeská Tunnel
- Blansko Single-track Tunnel No. 8/2

## 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

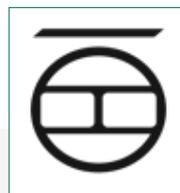
### 2. Brno University of Technology, Faculty of Civil Engineering

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 and Underground Engineering

# Denmark



**Name:** Danish Tunnelling Society

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

**Number of Members:** 34 corporate members, 230 individual participants

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

A large part of 2021 was still affected by the COVID-10 pandemic. However, since the re-opening of the Danish Society in the summer of 2021, the first member meetings since 2019 were successfully held.

Through 2021 the Danish Tunnelling Society has been working hard on

organizing the World Tunnel Congress 2022 in Copenhagen. These activities are progressing according to plan, and we look forward to inviting the entire tunnelling community to Copenhagen in September 2022.

## CURRENT TUNNELLING ACTIVITIES

### The Fehmarnbelt Fixed Link

An 18km long immersed tunnel connecting

the island of Fehmarn in Germany with the island of Lolland in Denmark. The tunnel will comprise a four-lane motorway and dual track railway.

The fixed link will close a gap in the rail network between Scandinavia and central Europe and will be supported by the EU as one of the Community's prioritised railway corridors in Europe.

Construction is ongoing on the main civil works contracts, where reclamation works and erection of casting facilities for the immersed tunnel elements in ongoing on the Danish coast. The MEP contract was tendered in 2021.

### The Nordhavn Tunnel

A 1.4km road tunnel connecting the existing Nordhavnsvej tunnel with the urban development area in Nordhavn

(Northern Harbour), Copenhagen. Once finished the road will form a 3km tunnel connection with the Elsinore motorway and the road network north of Copenhagen. The project will connect with a new Ring Road going east of Copenhagen. The Nordhavn Tunnel will be constructed as a cut & cover structure through an existing leisure boat harbour. The harbour area will be backfilled to construct a temporary dam, through which the tunnel will be excavated and cast. After construction of the tunnel the harbour will be re-established. In 2021 the tender was sent to the market.

### Copenhagen Metro Extension Southern Harbour

Extension of the Copenhagen Metro line M4 by 8km TBM tunnels and five underground stations to bring the southern harbour residential area into the Copenhagen metro network. Construction works started in 2018 and the line is due to open in 2024. Two EBPMs completed tunnelling in 2021.

### Strandboulevarden Storm Water Tunnel

In Northern Copenhagen the Strandboulevarden Storm Water Tunnel consisting of 900m of 2m diameter TBM bored tunnel and 220m of 2.5m diameter TBM tunnel including four shafts was completed in 2021.

### The Kalvebod Brygge Storm Water Tunnel

A 1.5km long pipe jacked tunnel with ID of 2-3m and three shafts, one includes a outlet pump structure. The construction works started in 2021 and are expected to be completed by 2027. The tunnels will cross under existing railway tracks and in very close proximity to the Metro Circle line.

### Underground development of the Copenhagen South Station

Includes a concourse area connecting the metro, regional trains station, S-train station and the Øresund railway.

### FUTURE TUNNELLING ACTIVITIES

Tunnelling activity in the coming years will increase with many new projects coming up. Some of the major projects that will start construction within the next 5 years are:

#### Svanemøllen Storm Water Tunnel

Consisting of 10km bored tunnels, of which 2.5km is a segmental lined tunnel with i.d. of 4.9m and the remaining 7.5km is pipe jacked tunnels with 1.6 – 3.2m i.d. The shafts are circular and vary in



The Fehmarnbelt Fixed Link

diameter from 15m to 20m and from 15m to 30m depth. The Environmental Impact Assessment and design is under preparation and the project is planned to be tendered for construction in 2023. Construction cost is DKK2bn.

#### The Marselis Boulevard tunnel

A project connecting the harbour to the major road network. The tunnel is planned as a cut & cover structure. An update of the EIA study that was performed in 2010 will be tendered in 2022. Construction work is planned for 2025 -2 029 with a total cost of DKK2.7bn.

#### A study for a new eastern by-pass in Copenhagen

Designed to close the existing gap and reduce traffic in the City Centre, was completed in 2020. Two corridors have been investigated covering nine different alignments. Cut & cover tunnels, TBM bored tunnels and immersed tunnels have been investigated. The recommended alignment will run through a tunnel from Nordhavn via Lynetteholmen and Refshaleøen and continue as an immersed tunnel along the east coast of Amager Island before joining the motorway network by the airport. The road will be designed for four lanes and a design speed of 80km/hour. The construction cost is estimated to be between €2.6 and €4.1bn (2019) depending on which alignment is selected.

#### A 3rd connection over Limfjord in Northern Denmark

A 23km new road including an immersed tunnel to the island of Egholm has been added to the government's infrastructure investment plan. Construction cost is estimated at €1bn (2019).

#### H-H Link

Further studies for a road and a rail tunnel between the Danish city Helsingør and the Swedish city of Helsingborg have been performed. Separate alignments are being investigated for the road and rail connection. Both connections include a subsea tunnel below the Øresund sea connecting Helsingborg in Sweden with Helsingør in Denmark.

#### Copenhagen-Malmö Metrolink

An 18km subsea metro line connecting Malmö in Sweden with Copenhagen in Denmark. The connection will provide a second link between the two cities and reduce travel time from 40 minutes to 20 minutes with departures every two minutes. This will free capacity on the Øresund Railway connection which will be required when the Femern Belt link is put into operation. The fourth phase of the feasibility study was completed in spring 2021.

#### Copenhagen Metro extension line M5

A study of new metro lines connecting to Lynetteholm Island, a proposed new development area for new housing, was issued in 2020. Three different alignments are being proposed comprising between nine and 11 stations. Construction cost is estimate at €3bn (2019).

#### The Kattegat Fixed Link

A project connecting Zealand with Jutland passing the island of Samsø for rail and road - several alignments combining bridges, bored and immersed tunnels are being considered. The feasibility report will be published by the Danish Road Administration in 2022.

# Finland



**Name:** Finnish Tunnelling Association – MTR - FTA Space Association (AFTES)

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

**Number of Members:** 182 Individual Associate Members, 26 Corporate Affiliate Members

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

- Annual Meeting on 15th April 2021
- Nomination of Finnish Young Tunneller 2021-2022
- Panel discussion with politicians on underground projects in Finland
- ACUUS 2020 Virtual Conference on 3rd – 4th February 2021 in co-operation with the Finnish Association of Civil Engineers RIL and Finnish Association of Architects SAFA
- Participating into work of the FISE Qualification of Professionals in Building, HVAC and Real Estate Sector in Finland

## NEWLY COMPLETED PROJECTS

### Blominmäki Underground Wastewater Treatment Plant (testing phase)

- 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

### Helsinki Metro Western Extension to Espoo (testing phase)

- The Helsinki metro will be extended to the west in two phases: eight + five new stations.
- The first phase was ready in autumn 2017.
- The metro will operate for 21km 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. An underground metro depot will be located in Sammalvuori with a total excavation volume of 240,000m<sup>3</sup>.

### Cavern Heat Storage Facility

- The caverns located underground in Mustikkamaa have previously been used for storing heavy fuel oil. The oil stores were emptied and decommissioned in 1999. Two of the connected caverns will now be converted into a heat storage facility.
- It will no longer be necessary to use

and produce all heat at the same time. With the facility, it will be possible, for example, to avoid starting up separate oil or gas-fired heating plants in the winter

- The volume of the heat storage facility is 260,000 cubic metres. The amount of energy stored is 11.6GWh. Its charging and discharging capacity is 120MW, which enables discharge or charge for about four days when the accumulator is full or empty.
- The budget is €15M, construction works 2019-2021

## CURRENT TUNNELLING ACTIVITIES

### Jokeri Light Rail (under construction)

- The Jokeri Light Rail line will be built between Itäkeskus in Helsinki and Keilaniemi in Espoo and is one of the key projects for orbital cross-region public transport in the capital area
- Construction works of the line started in 2019, to be ready in 2024.
- The length of the line is approximately 25km, with 33 stops.
- A 400m long tunnel was excavated in 2021

## Tampere Region Central Wastewater Treatment Plant “Sulkavuori” (under construction)

The treatment plant will process wastewater of up to 429,000 residents (2040)

- With a budget of €300M, this is the largest single environmental investment in the Tampere region
- The project started in 2018

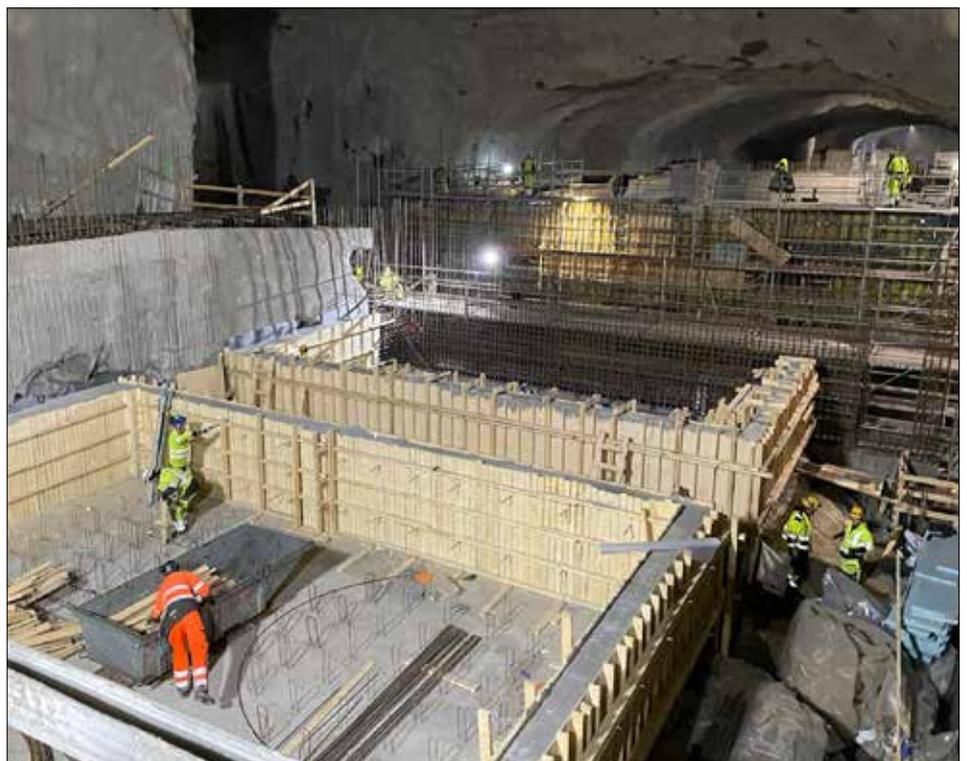
## Final Disposal Facility ONKALO (under construction)

The final disposal facility consists of two sections:

- 1) The above ground encapsulation plant where spent nuclear fuel is received, dried and packed into final disposal canisters
  - 2) The repository located deep inside the bedrock, the most important section being the tunnels where the encapsulated spent nuclear fuel is disposed of.
- The volume of rock to be excavated for the repository is approximately 1.5M cubic metres.
  - The number of final disposal tunnels required is 137 with a total length of tunnel of 50km, located within an area extending over 2 - 3 square km.
  - Final disposal starts in the mid 2020's.

## Art Cave Saimaa Retretti (under construction)

- Reconstruction and additional spaces
- The new Centre of Art and Culture will be built during 2021-25.



### Savilahti Underground Sport and Event Center, Kuopio (under construction)

- Re-use of an old underground military depot built 80 years ago
- A new, modern facility to serve as an event center for 4,000 people and as an air-raid shelter for 7,500 people
- The construction period is 2021-2023

### FUTURE TUNNELLING ACTIVITIES

#### Seasonal Heat Storage, Vantaa

- VECTES (Vantaa Energy Cavern Thermal Energy Storage) is a seasonal energy storage project, which harnesses the warmth of summer for the cold winter days. The facility will be the world's largest cavern thermal energy storage at 1,000,000m<sup>3</sup>. It will have a storage capacity of 90GWh of energy – the annual heat consumption of a medium-sized town. Completion is expected in 2026

#### Underground Parking Hall in Keilaniemi, Espoo

- Excavation volume of 250,000m<sup>3</sup>
- Underground parking for 1 600 cars
- Construction 2022-

#### Teollisuuskatu Waste Water Tunnel, Helsinki

- To improve the wastewater service in Helsinki
- Length 0.2km
- Construction 2022-

#### Underground Parking Hall in Hakaniemi, Helsinki

- Construction 2022-

#### Underground Parking Hall for Laakso hospital, Helsinki

- Construction 2022-

#### Garden Helsinki

- Event arena providing sports and culture events, shopping facilities, apartments
- Private funding
- Excavation volume of 800,000m<sup>3</sup>
- Construction 2023-

#### Underground Parking Hall, Maria 01, Helsinki

- Excavation volume of 60,000m<sup>3</sup>
- Underground parking for 350 cars
- Construction schedule remains open

#### Traffic Tunnel in Sörnäinen, Helsinki (planning)

- Two parallel tunnels with a length of 800m and excavation volume of 270,000m<sup>3</sup>
- Estimated cost of €160M
- Currently in the general planning phase

- Construction estimated from 2026 - 2030

#### Jätkäsaari Harbour Tunnel, Helsinki

- Estimated cost of €180M
- The city council of Helsinki made a positive in-principle decision in Feb 2021
- Construction schedule remains open

#### Esplanadi Waste Water Tunnel, Helsinki (planning, waiting for a decision on construction)

- Improve the wastewater service in central Helsinki
- Length 1km
- Estimated cost of €5M

#### Espoo – Salo High-speed Railway (planning)

- 95km of new high-speed railway between Espoo and Salo
- Multiple tunnels with a total length of over 14km
- The general planning phase was completed in 2020, the next planning phase is on-going

#### Salo – Hajala High-speed Railway (planning)

- 55km of new high-speed railway between Salo and Hajala
- Two new railway tunnels for parallel track, with a total length of about 700m

#### Lahdenperä – Jämsä - railway (planning)

- 18km of new railway between Lahdenperä and Jämsä
- 5km of railway tunnel
- Environmental Impact Assessment and General planning started in 2021

#### Pyhäsalmi Pumped Hydro Energy Storage

- 75-150MW
- Construction 2023-

#### Subsea Tunnel in Åland (feasibility study)

- Subsea road tunnel to link the island of Föglö and the Åland main island where city of Mariehamn is located
- The tunnel length is 10.5km
- Requires further works for investigation, studies and design

#### City Rail Loop Pissararata, Helsinki (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 construction has yet to be verified.

### FinEst Link & Finest Bay Area (feasibility study)

- A 85-100km subsea railway tunnel linking Helsinki (Finland) and Tallin (Estonia)
- FinEst Link is an initiative established by Finnish and Estonian authorities
- Finest Bay Area is an initiative established by private organization

### STATISTICS

#### Underground (UG) Spaces in Helsinki with Rock Surface:

- Area 2,145,081m<sup>2</sup> = 2,145km<sup>2</sup>
- Volume 13,100,000m<sup>3</sup>
  - UG spaces altogether 336
  - 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 294km
  - 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:

Engineering Geology; Rock Excavation; Rock Mechanics; Rock Construction; Seminar in Geoengineering; Project Course in Geoengineering

#### Tampere University:

Introduction to Rock Engineering; Design of Rock Engineering Structures; Construction of Rock Engineering Structures

#### 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:** French Tunnelling and Underground Space Association (AFTES)

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

**Number of Members:** 1049 members (including 127 corporate members and 138 young members and students)

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

### Tunnels and Underground Space Magazine

Four quarterly issues and a special issue on Grand Paris projects:

- Surface and subsurface land rights
- Operating equipment
- Special issue on Grand Paris projects
- Small diameter tunnels
- Maintenance and auscultation

### Technical Committee

17 active Working Groups. Four recommendations published:

- GT3: Vibrations generated by mine fires: guide for the determination of vibration limits during pre-project studies (French version).
- GT30: Radial rock bolting in tunnels – Design and sizing guide.
- GT4: State of the art concerning developments in the tunnelling machines and their capacities from 2000 to 2019 (French version).
- GT24: Geological, hydrogeological and geotechnical reconnaissance required for underground design (French version).

### News

- Launch of new Working Group on numerical modelling
- Organization of webinars for the presentation of the latest technical recommendations

### Materials, Equipment and Products Committee

Actions for the promotion of manufacturers and innovative products

- Consolidation of the committee steering board.
- Creation of a technical showcase for manufacturers and suppliers.
- Preparation of a collective booth at WTC 2022 in Copenhagen

**Preparation of two technical days in Chambéry in October 2022 (Conferences and Exhibition): Lyon-Turin: Major Underground Projects & Innovation**

### 'Materials, Equipment, Products'. UNDERGROUND SPACE COMMITTEE.

- Organization of a special session during the 2021 AFTES congress.
- National research project Ville10D; Synthesis of the various contributions.
- Consolidation of the committee with the involvement of young architects/ engineers.

### Education Committee

- Master's degree in Tunnels and Underground Works - TOS - Class 10 (October 2021 - September 2022) - 16 students.
- Joint continuing education sessions at the TOS Specialist Master's degree.
- Creation of a sustainable animation group able to define and carry out a programme of actions around the themes of training and research in the field of underground.

### Youth Members Committee

- Visit of the LHC – CERN project

- Organization of a training session during the 2021 AFTES congress
- Involvement in the international young professionals' network (ITAYm, EUTFym).

### Congress AFTES 2021 Paris

- Organization of the international AFTES congress «Underground, a space for innovation» from 6 to 8 September 2021: 3061 registered participants, 26 countries represented, 165 exhibitors, 180 articles, 72 oral communications, 108 e-posters.

### EUTF – European Underground and Tunnel Forum

- Consolidation of the new EUTF Forum and discussions around the common issues
- Joint contributions to the ITA issues (international strategy, organization of the WTC, working groups,..)
- Specific actions regarding BIM, refurbishment, and standardization
- Contribution to the AFTES congress in Paris and to the AETOS congress in Madrid (November)

### Involvement in AITES/ITA

- Participation of AFTES members in ITA Working Groups and Committees.
- Participation in governance (GA, specific meetings, etc.) as well as events (ITA Week, ITA Awards, etc.).
- Participation in the organization of ITACET training programs.
- Organization with ITACET of a training session during 2021 AFTES congress.

## CURRENT AND FUTURE TUNNELLING ACTIVITIES Grans Paris Express and Line 14



**Grans Paris Express and Line 14**

Since the beginning of the underground works, 24 tunnel boring machines have been launched. At the beginning of 2022, six of them were still active on Lines 16, 17 and 18 and a tunnel boring machine is being built for Line 16.

Lines	Sections	Horizon
Line 14 nord	Mairie de Saint-Ouen à Saint-Denis Pleyel	2024
Line 14 sud	Olympiades à Aéroport d'Orly	2024
Line 15 sud	Pont de Sèvres à Noisy - Champs	2025
Line 15 ouest	Pont de Sèvres à Saint-Denis Pleyel	2030
Line 15 est	Saint-Denis Pleyel à Champigny Centre	2030
Line 16	Saint-Denis Pleyel à Clichy - Montfermeil	2nd Semestre 2026
Line 16	Clichy - Montfermeil à Noisy - Champs	2028
Line 17	Saint-Denis Pleyel au Bourget - Aéroport	2nd Semestre 2026
Line 17	Le Bourget - Aéroport au Triangle de Gonesse	2028
Line 17	Triangle de Gonesse au Mesnil-Amelot	2030
Line 18	Massy-Palaiseau à CEA Saint-Aubin	2026
Line 18	Aéroport d'Orly à Massy-Palaiseau	2027
Line 18	CEA Saint-Aubin à Versailles-Chantiers	2030
Line 18	Versailles-Chantiers à Nanterre-La Folie	After 2030

**CRER line EOLE - Paris**

Metro line E Eole: TBM 'Virginie' continued excavation of the 8km stretch between la Défense and Gare Saint-Lazare. The

crossing of the Porte Maillot station was one of the major challenges in 2021. Arrival at Saint Lazare station occurred in February 2022. The work continues for a project

commissioning before the Olympic Games in 2024.

**Lyon**

Metro line B: TBM 'Coline' travelled 2.4km, laid 1,250 rings and excavated approximately 400,000 tonnes of materials, including approximately 30,000 tonnes recycled directly on site. The stations are currently being built. In this very complex geotechnical setting, mixshield TBM technology has proved its usefulness .

**Toulouse**

3rd Metro Line: 27km long with 21 stations – the design process for this new metro line is on course with the objective of a tender phase in 2022

**TELT**

Tunnel Euralpin Lyon Turin  
In 2021, the tender phase for the construction of the main international tunnel (57km, two tubes) led to the selection of the contractors for the French stretch of the tunnel. Nearly €3bn of work were awarded in July 2021. Another €1bn will be awarded in 2022 for the Italian stretch

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# 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 2021 AND TO DATE

### Activities

- STUVA Conference '21, Separate Segments on "Tunnelling" and "Tunnel Operation", attended by more than 1500 participants and approx. 190 exhibitors, 24th – 26th November 2021, Karlsruhe
- DACH-meeting (German, Austrian, Swiss Tunnelling Committees) in Germany (technical seminar and site visit)
- Meetings of the European Underground and Tunnel Forum (EUTF, consisting of Austria, Belgium, France, Germany, Italy, Netherlands, Portugal, Spain and Switzerland)
- Regular Meetings of Tunnel Committee and Working Groups
- Several Meetings with workshops of Young Engineering Professionals "STUVA-YEP"
- Webinar on "BIM in Tunnelling" (in co-operation with EUTF)
- Due to the Covid-19-pandemics, the meetings were partly held via video conferences

### Working Groups

- 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 Tunnel Boring Machines (TBM)
- Planning and implementation of occupational health and safety concept on underground worksites
- Standardization needs for the design of underground structures
- Emergency management for accident, fire and special risks
- Measures to reduce hazardous substances in the air
- Working in compressed air
- Risk management in tunnelling
- Recycling/disposal of excavated material

### Publications (recently finished)

- Recommendation BIM in Tunnelling (Spanish version)
- Recommendation for the Selection of Tunnel Boring Machines (TBM)
- Status report: Renewal of traffic tunnels under operation (only in German)

### 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 website ([www.daub-ita.de](http://www.daub-ita.de), [www.stuva.de](http://www.stuva.de)); the majority is bi-lingual (German/English)

### Future Activities

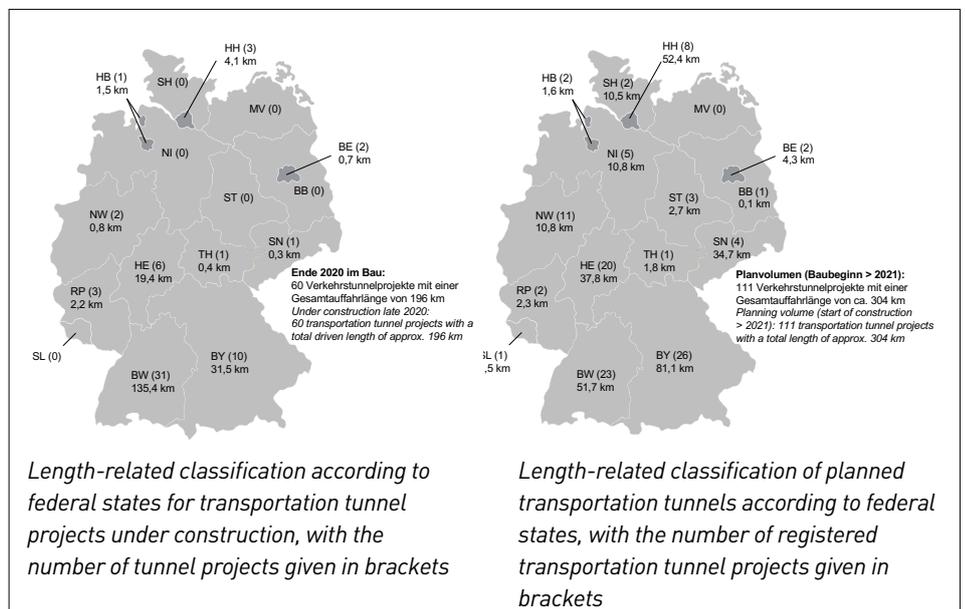
- Regular meetings with Austrian, Swiss and EUTF colleagues

- Munich Tunnel Symposium, 8th July 2022
- InnoTrans, Tunnel Forum, 20th – 23rd September 2022, Leading int. trade fair for transport technology
- Sealing of buildings by injections; Information on afterwards sealing of concrete structures, geotechnical sealing injections, 2nd – 3rd November 2022
- STUVA-Conference 2023, Separate Segments on "Tunnelling" and "Tunnel Operation", 8th – 10th November 2023, Munich

### CURRENT TUNNELLING ACTIVITIES

About 196km of traffic tunnels are under construction in Germany in 2021.

This year, the main activities relating to inner-urban rail tunnelling once again are taking place in Munich, where some 15.3km of urban and underground tunnels are under construction at the turn of the year 2020/21. It should be noted that preparatory construction work is still in progress on Munich Second Trunk Light Rail Line and that the tunnelling work had yet to begin at the time of the survey. This is followed by Stuttgart (5.4km) and Karlsruhe (4.7km). Further tunnel projects, each less than 3km long, are under construction in Hamburg, Nuremberg, Frankfurt/Main and Düsseldorf. The length-related proportion of underground construction methods with regard to inner-urban rail tunnel construction amounted to 21.9km at the



end of 2020, accounting for about 67% of the total national construction volume for underground, urban and rapid transit rail systems (79% the previous year). Of this total, a good 19% was accounted for by shotcreting methods (20% the previous year) and roughly 48% by shield driving (60% the previous year).

The main-line rail tunnels largely relate to DB Netz AG (German Rail) tunnelling works in and around Stuttgart. Of the tunnelling projects currently being implemented (a total of 116km), almost 51km are accounted for by the major "Stuttgart 21 rail hub" project and some 57km by the new Wendlingen–Ulm rail route. A further 8km of main-line tunnels are being constructed in conjunction with the upgraded/new Karlsruhe–Basle section. Currently, 32% of main-line tunnels are built by the conventional method, whereas tunnel boring machines (TBMs) are applied for 63% of the driven volume.

The drive-up length in road tunnel construction in 2021 was approx. 47km throughout Germany. Almost 50% of the driven length was accounted for by the two southern federal states of Baden-Württemberg and Bavaria. About two thirds of all road tunnels are built by

underground methods. The shotcrete method predominates in the majority of those tunnelling projects.

**FUTURE TUNNELLING ACTIVITIES**

About 304km of traffic tunnels are projected but not yet started in 2021.

A slight increase of the already high-level planning volume can be observed for light rail and metro tunnels in Germany (104km). Among the listed projects, Hamburg takes the lead with a good 44km of planned tunnelling, ahead of Munich with 42km. Leipzig is engaged in pre-planning 7km and Frankfurt/Main is planning around 6km of tunnel for regional transport. Further tunnelling activities involving less than 3km are foreseen in the cities of Berlin, Dortmund and Stuttgart.

The planned volume of main-line rail tunnels (91km) has also increased compared to the previous year. Approx. 30% of the volume is accounted for by the newly included new/upgraded Leipzig–Prague rail line (approx. 27km). A further 23km is accounted for by tunnels already approved as part of the new/upgraded Karlsruhe–Basel rail line. Further tunnels are planned in the course of the new Rhine/Main–Rhine/Neckar line (18km), the Nuremberg–Fürth

rail line (8km), the new/upgraded line Nuremberg–Marktreditz (6km) and the railway line Siegen–Hagen.

The planned volume of projected road tunnels (110km) has decreased moderately again – on account of the German state’s revamped planning requirements, the scheduled volume had dipped considerably in previous years.

**STATISTICS**

For detailed analysis, figures and tunnel lists visit:

<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 people (see e.g. MSc "Geotechnics and Tunneling", 4 Semester Mastercourse in German language at the Ruhr University Bochum, BSc Civil Engineering required)

**Reliable overload protection for TBM cutter head drives!**

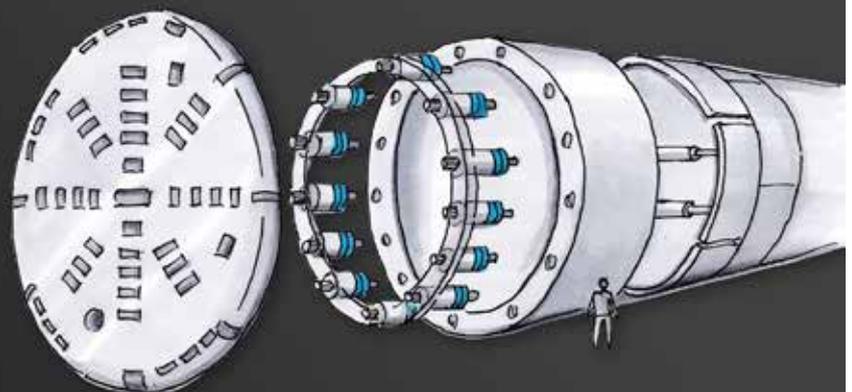


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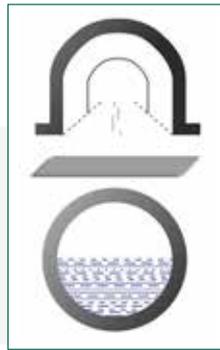


# Greece

**Name:** Greek Tunnelling Society (GTS)

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

**Number of Members:** 250 members, 16 corporate members



## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

In 2021 the Greek Tunnelling Society (GTS), during the pandemic, continued working to promote the environmental, social, technical and economic advantages of the design, construction and operation of tunnels and underground space. The Council Board executed numerous meetings, most of them virtual, for running GTS activities.

Last year was an exceptional landmark for the Greek Tunnelling Society when on 12/2/2021 at the ITA General Assembly, the member nations voted to award the organization of the World Tunnel Congress 2023 and the 49th ITA General Assembly to GTS in Athens. The GTS Board and members have been working hard since then to accomplish the task in line with the ITA "WTC Planning Guide". We are in continuous contact with ITA and have already presented the WTC Backup Plan and 1st Progress Report. We have set up the Organizing Committee (OC), as well as various committees, each assigned to work on organizing WTC 2023. After long negotiations, GTS signed a contract with an experienced PCO company as our partner to deliver a successful WTC in Athens. Since then, GTS, OC and PCO are in close cooperation. The Congress will be hybrid and include the Scientific Sessions, the Technical Exhibition, the ITA General Assembly and other ITA activities (<https://wtc2023.gr/>).

Following elections on 1/7/2021, which were postponed in 2020 due to pandemic, our members elected a new GTS Council Board consisting of seven board members.

The Chairman of the WTC2023's OC participated in the virtual ITA ExCo meetings representing the host member nation.

GTS published regular issues of its electronic magazine for informing our members about our activities, recent news, new underground projects in Greece and globally, and interesting technical publications etc. The Young Members

Group emphasized its work on promoting webinars on interesting tunnelling issues, research results, work opportunities for young tunnellers etc via social networks (Facebook page).

Workshops/on-line webinars organized/co-organized by GTS:

- "Innovations and solutions in Tunnelling", Mr. A. Boscaro & Mr. S. Anzani, UTT MAPEI, 18/10/2021 joint organization GTS and GTSym
- "Safety of Road Tunnels based on data from ODOS Project", Prof. K. Kirittopoulos, NTUA -Mechanical Engineering Faculty, 9/12/2021, Joint Research Program of NTUA, NCSR Democritus, Ioannina University, TEKMON GEOMATICS

GTS was a sponsor of the "ITA Tunnelling Week", a virtual Congress held instead of WTC2021, and participated with a presentation about underground projects scheduled in Greece and an e-booth, 20-24/9/2021.

In collaboration with ITA-AITES and the Brazilian Tunnelling Society, in March 2021 GTS collected data for female Greek engineers active in underground works during the last 30 years.

## CURRENT TUNNELLING ACTIVITIES ATTIKO METRO (Athens METRO)

### Line 3 Extension to Piraeus

This year the "Line 3 Extension to Piraeus" project will become operational when it delivers the final three Stations (MANIATIKA - PIRAEUS - DIMOTIKO THEATRO) thereby concluding the whole 7.6km long section (6.5km of which was constructed by TBM). DIMOTIKO THEATRO Station will also become an open museum. The Metro Extension to Piraeus will serve approximately 132,000 passengers on a daily basis reducing private car traffic by 23,000 daily and CO2 emissions by 120 tons per day. PIRAEUS Station is to become a vital transport hub by connecting two Metro Lines (Line 1 and Line 3), the Port, the Suburban Railway

and a new Tram Line (5.4km long with 12 Stations) recently put into operation. Furthermore, the direct connection between the Port and the Athens International Airport "El. Venizelos" will promote the development of the economy of the Attica region and Greece as a whole.

### New Line 4 - Section A "Alsos Veikoy - Goudi"

On 22-06-2021, the contract for the new Athens Metro Line 4, first section (from Alsos Veikou to Goudi) was signed between the responsible authority and the project contractor. The Design and Built contract has an estimated cost of €1.5bn and a delivery time of 96 months for the 13km long, fully automated Metro Line with 15 stations in Athens. The project includes tunnel boring using two TBMs, underground stations, station fit-out, ventilation shafts, mechanical and electrical systems, rail infrastructure and systems, underground train maintenance and washing plant, rolling stock light maintenance facilities and a new central control building.

It is the biggest public Project currently being executed in Greece. It is foreseen that the Section A of Line 4 will serve at least 341,000 passengers on a daily basis in 2030.

Preparatory works have started and include archaeological investigations, utilities diversions, traffic deviations, and worksites occupation etc.

### Thessaloniki Metro

The first Metro Line for the second largest city in Greece, Thessaloniki, is under implementation. The project includes 18 underground stations, ~14.4km of tunnelling and a 50,000m<sup>2</sup> depot in the Pylea area. There will be 18 fully automatic driverless and air-conditioned trains, as well as automatic Platform Screen Doors in each Station for improved passenger service and safety. Excavation and final lining installation of the twin single-track tunnels has been completed using two EPBMs. Nearly all Stations are complete and equipped. According to the project owner ATTIKO METRO S.A. planning, the project is expected to be commissioned in 2023. The Metro line alignment was designed at significant depths to minimize the chances of archaeological finds, which were nevertheless encountered in the historical city centre. The Venizelos Station will now become an open museum that will display the ancient history of the city.

It is expected that upon completion of the Project, the daily ridership will rise

to 313,000 passengers. As a result of the project's operation, the number of circulating private vehicles will be reduced by 57,000 vehicles/day and the respecting CO2 emissions will be reduced by 212 tons per day.

### CURRENT TUNNELLING ACTIVITIES

#### Underground railway corridor between "Central Athens Station" and "Three Bridges" area

The €66M project involves the construction of a 2.36km long four-track rail corridor, 60% of which will be in a fully underground alignment. It is expected to become fully operational in 2023.

#### Central Greece Motorway (E65) – Lamia – Xyniada Section

The project concerns the construction of the south section of the Central Greece Motorway. It includes a 3km long twin tunnel. Excavation of the first tunnel was completed in 2021. Boring was difficult through geologically adverse ground conditions and took two years.

#### Halkidiki mining project

The northeastern side of Halkidiki, in northern Greece, has a long history of mining activity. Currently three exploitation areas exist namely Olympiada, Skouries and Stratonii areas. The overall development of Kassandra mines is considered as a mega-project with numerous challenging civil works (surface and underground) and earthworks. In underground infrastructure, the most notable works completed or currently under construction include Kokkinolakkas stream diversion tunnel, 1,140m long, Olympias main access tunnel, ~9km long, Skouries spiral decline, ~5.5km long and the Skouries access shaft, ~700m deep.

### FUTURE TUNNELLING ACTIVITIES

#### New Athens Metro Line 2 extension to Ilion

An extension of the existing Line 2 from Anthoupoli Station to the district of Ilion is being designed by ATTIKO METRO S.A. The double-track tunnel will be approx. 4km long, constructed by the conventional method, with three underground stations, six shafts and will include both civil and electromechanical works.

#### New Athens Metro Line 2 extension to Glyfada

A 4.5km long Extension of Line 2 from Elliniko Station to the district of Glyfada including three stations has been planned.

#### Underwater road link connecting Salamina - Perama in the Attica region ~ €400M.

A competitive dialogue process is underway between the preferred three interested parties. The project concerns the design, construction, financing, operation, maintenance and exploitation of an approximately 15km long highway which includes a 1.2km long immersed tunnel and two tunnels, 1.7km l and 600m long respectively. The Environmental Impact Assessment study of the project is at the approval phase and following that the tendering process will be finalized.

#### Road extension of the Kimis Highway to Athens-Thessaloniki Highway

The Project's tendering phase has started and includes 1.26km long double-tube Kimis Urban tunnel and a 1.16km long cut & cover tunnel that will connect Attiki Odos (highway) with Athens-Thessaloniki Highway. The budget is €434M and the estimated construction period is 4 years.

#### Underground section of coastal road at the Hellinikon area, Athens

The Project is at tender phase with a budget of approx. €80M. The existing coastal road (Poseidonos Street) will be taken underground in a 3km cut & cover tunnel with two traffic directions of three lanes each. This project is part of the "The Ellinikon", near the former Athens airport, and is Europe's greatest urban regeneration project.

#### Northern road axis for Crete Island (NRAC)

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 i.e. i) Souda-Kalyves section: an 1.22km long tunnel, ii) Kalyves – Agioi Pantes: an 230m long tunnel, iii) Vrises-Petres-Atsipopoulos: five tunnels of 4.59km total length, iv) Exantis-Fodele-Linoperamata: Five tunnels of a total length of 3.19 km, v) Hersonissos – Malia: a 375m long tunnel, vi) Malia – Neapoli: two tunnels of 4km long. The project is split into two separate tenders: i) a concession agreement for the section between Chania and Hersonissos, and ii) a PPP project for the Hersonissos-Neapolis section. The cost has 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.

#### Urban tunnels in the Metropolitan area of Athens

The implementation of the Athens Metropolitan Area Master Plan requires new road tunnels, which include: i) the 3km long Ilioupolis urban tunnel, and ii) a 2km long motorway tunnel that will connect Attiki Odos (highway) and Rafina port.

#### Klissouras road tunnel

A new road tunnel (Klissouras) 1.36km long on the highway connecting the towns of Castoria and Ptolemais in northern Greece is ready for the project tender to begin. The budget is €74M with EU funding, and a construction period estimated at 36 months.

#### Thessaloniki Metro line extension

The Thessaloniki Metro line extension to the north-west of the city will serve six municipalities including nine new underground stations and is currently in the first design phase.

## STATISTICS

**1. Length or volume excavated - % mechanized/% conventional during 2021** ~ 1000m - 0%/100%

**Amount (USD or EUR) of tunnelling / underground space facilities awarded in 2021** = €1.50bn

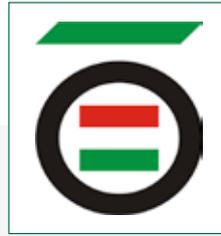
**3. List of tunnels completed:** Central Greece Motorway (E65) – Lamia-Xyniada Section, first of the twin tunnels with a total length of approximately 3km.

**4. List of tunnels under construction:** Athens Metro Line 4, Thessaloniki Metro, Othris mountain twin tunnels (E65 motorway), tunnels along the Rododafni-Patra new railway section, underground railway corridor in Athens area.

## 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/>)

# Hungary



**Name:** Hungarian Tunnelling Association

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

**Number of Members:** Total number: 73, number of corporate members: 18

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

2021 saw some events missed such as the Széchy Memorial Day, because of the pandemic. The Association held one big event only: Tunnelling and Civil Engineering Day Conference 2021. The invited keynote lecturer was Prof. Robert Galler from the Leoben University – Austria.

The Association Presidency held on-line meetings, only.

Saint Barbara Day was held in Sopron (Tunnel M85)

## CURRENT TUNNELLING ACTIVITIES

### The Expressway M85 Sopron Bypass tunnel is under construction

The development of the Hungarian expressway network continues, with its length increasing by an average of 100km of new road per year. With the completion of the 60km Csorna - Sopron section of M85 expressway at the end of 2020, the City of Sopron is now included in the national expressway network. Due to the location of the city, the M85 and the Austrian A3 motorway can only be connected via the Bécsi Hill requiring this section to be in tunnel. The current contract includes the construction drawings and realization of the 4km long 2x2 lane M85 expressway section from the Fertőrákos junction to Sopron including a 780m long twin-tunnel with a maximum ground cover of 40m under Bécsi hill. The contract started on 14th June 2019, with a contract duration of 60 months, taking into account the interpretative provisions of the contract, the contract runs to 30th June 2024. Bécsi hill faces NW-SE on the northern outskirts of Sopron, next to the N0 84 main road. Excavation work commenced from the work site set up at the eastern side, with parallel tunnelling. Based on core samples taken from geotechnical drilling, a geological model was constructed along the length of the tunnel. Based on the location and geological stratification conventional tunnelling methods were chosen for the soft ground environment, and in the more resistant, but relatively



soft rock environment. However, the progress of construction has been greatly hindered and is still affected by unexpected geological conditions. Nevertheless, the project is still on time when applying the built in reserves of the schedule. Based on anticipated progress, the excavation works in the left tunnel should be completed by summer this year and in the right tunnel by the end of autumn, with the final reinforced concrete structure commencing at the end of spring.

**The M3 metro-reconstruction also continued in 2021**

## FUTURE TUNNELLING ACTIVITIES

### Tunnel-chain on the M100 expressway

In addition to optimising the economic potential of the Esztergom region, the goal of the M100 expressway is to relieve the Zsámbéki basin residents from high levels

of truck traffic by developing new roads in surrounding hilly environment. Currently, the journey between the Esztergom area and the M1 motorway takes at least 50 minutes, but with the construction of M100 this time will be halved. The M100 expressway is a 32.3km long 2x2 lane expressway. Due to the complexity of the project and the topography of the site, bespoke technical solutions are required along the entire expressway. The hilly nature of the area ensures the complexity of the route, which includes three pairs of tunnels with a total length of 2 x 1km and five huge valley bridges with a total length of 2 x 2.3km and a new engineering plant for operating the expressway, all of which have contracts already signed. Starting with the design works, the project will be implemented under two separate contracts, the first phase with a lead time of 44 months, and the second phase with a lead time of 84 months, considering the time needed to prepare the construction design.

**Tunnel-chain on expressway M0**

**Under the Danube railway tunnelling will be in preliminary planning in 2022**

**M0 motorway Buda section tunnels planning from 2022**

A public procurement procedure for the design works has recently started. The tender for the design works of the 8km long section of the northern M0 ring road between No 10 and No 11 Main Roads, which will include a 5.2km long 2 x 3 lane twin tunnel in addition to several complex intersections and structures. Construction of this section of the M0 ring road could start in 2026 at the earliest.

Metro Line 5, 1st Stage Kalvin square underpass

## STATISTICS

### 1. Length or volume excavated

775m (ca. 93.000m<sup>3</sup>) 0 % mechanized/100% conventional during 2021

### 2. List of tunnels under construction:

M85 tunnel, M3 metro-tunnel

## EDUCATION ON TUNNELLING IN THE COUNTRY

**Budapest University of Technology and Economics**

# Iceland



**Name:** Icelandic Tunnelling Society

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

**Number of Members:** 56 members, 16 corporate members

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

Three board meetings and an annual meeting with invited speakers. Meetings via Teams due to Covid 19 pandemic.

## FUTURE TUNNELLING ACTIVITIES

### Fjardarheidi road tunnel (Point 1 on map)

A 13.5km long, 60m<sup>2</sup>, road tunnel in east Iceland. This road tunnel will replace a mountain road between Seydisfjord village on the fjord side

and the larger inland community of Egilsstadir. Presently the mountain road peaks at over 600m a.s.l. and can be dangerous to pass during winter due to ice and sudden snowstorms. The tunnel will not only ease travel for locals but also for the tourists coming to Iceland by ferry from Europe (Denmark and the Faroe Island). The pre-design is finished and the Environmental Impact Assessment ongoing. Tender design is ongoing with tendering planned for the fall of 2022 and start of 2023.

There are underground hydroelectric projects planned but construction is not foreseen in the near future (the next two years).



Location map of future road tunnel projects

## EDUCATION ON TUNNELLING IN THE COUNTRY

No special education on tunnelling except traditional engineering and geological courses (University of Iceland and University of Reykjavik).

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# India



**Name:** Tunnelling Association of India

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

**Number of Members:** 600

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

### Main activities

- Organization of Conferences, Seminars, Workshops and Training Programmes;

### TAI Awards Biennial

- Life Time Achievement Award; Tunnelling project of the year
- Technical innovation of the year; Environmental initiative of the year
- Young Tunneller of the year

### TAI Young Member Group - Launched

## CURRENT ASSOCIATION ACTIVITIES

### TAI Publication

- Guidelines for Design of Steel Fibre Reinforced Concrete Precast Segments in Tunnels.
- Guidelines for Geo-physical investigation for tunnels
- Directory of Tunnels: Under Preparation.

TAI Journals

January 2021 Issue

July 2021 Issue

List of Virtual Training Session organised by TAI & TALym: Virtual training sessions in view of the COVID-19 pandemic, India organized Virtual Training Sessions on different aspects of tunnelling and underground space development to educate tunnel professionals and young engineers.

### TAI Activities during 2021 and to date

Contract Models & Risk Assessment by Dr. Harald Wagner	April 22nd, 2021
Life Cycle Assessment by Dr. Harald Wagner	May 19th, 2021
Urban Space Use – Comparing Surface and Underground by Dr. Harald Wagner	July 21st, 2021
Expert Discussion Series by TAI & Informa on Tunnelling : A Prized Passage to Economic Upliftment	July 23rd, 2021
High Performance Steel & Composite Anchors in the Tunnelling Industry	July 27th, 2021
Expert Discussion Series by TAI & Informa on Modern Tunnelling Techniques	July 30th, 2021
Hydro Tunnel Specifics in Design and Construction by Dr. Harald Wagner	August 25th, 2021
“Automation in Tunnel Construction” by TAI	27th August, 2021
Norwegian tunnelling techniques by Dr Zeidler	28th August 2021
Hybrid Event World Tunnel Day organised by TAI& TALym	December 3rd, 2021
Transport Tunnel Specifics in Design and Construction by Dr. Harald Wagner	December 15th , 2021
One day Workshop on Innovation in Tunnelling Technology at Guwahati for NFR Officers	December 15th , 2021
Pune Metro-A Typical Underground Stations by Mr. J Kalyan Kumar, AECOM	December 21st , 2021
Design of NATM Tunnel Support System in Soft Ground Condition - A case study by Mr. Sharique Khan, Lead Specialist-Tunnels at COWI India	January 8th, 2022

## STATISTICS

Tunnelling Association of India has analysed 1,641 tunnels spanning a length of over 3,445km. These tunnels are spread across three stages of development – awarded, under construction and completed.

Of the total no. of tunnels analysed, 77.76% have been completed, 19.44% are under construction and the remaining 2.80% have been recently awarded.

Of the analysed tunnel length, 60.02% has been completed, construction work is going on 33.45% tunnel length and the remaining 6.43% has been recently awarded.

According to the data drill and blast method (DBM) is the most commonly used method of tunnelling. DBM is closely followed by mechanised/ advanced tunnelling techniques such as TBMs which has a share of 31.58%. New Austrian Tunnelling Method (NATM) has also gained prominence over the years. A significant amount of tunnel length in the railways and roads sectors has deployed more advanced NATM technique, in sharp contrast to DBM.

Another advanced method of tunnelling which is deployed in the construction of sewerage tunnels is micro-tunnelling.

The top 10 states account for 82% and 85% share in the upcoming tunnel length and number of tunnels respectively. Maharashtra accounts for the highest share in the total upcoming length at 978km. This is followed by Arunachal Pradesh at 430km and J&K at 369km. In terms of number of tunnels, Arunachal Pradesh accounts for the highest share with 245 tunnels, followed by J&K at 204 tunnels and Himachal Pradesh at 159 tunnels.

## EDUCATION ON TUNNELLING IN THE COUNTRY

1. M. Tech Tunnelling and Underground Space Technology in Indian Institute of Technology Indian School of Mines Dhanbad (Also known as: IIT DHANBAD)
2. M. Tech. in Tunnel Engineering at MIT WPU, Pune , Kothrud

**FUTURE ASSOCIATION ACTIVITIES**

Sl. No.	Topics	Scheduled Date
1	The UK Mega Infrastructure Project a Brief Introduction by Dr. Kurt Zeidler	25th March, 2022
2	Innovations in Mechanized Tunnelling by Dr. Harald Wagner	April 20th, 2022
3	Workshop on Concrete Technology	May 11th, 2022
4	Tunnel Shaft and Cross Passage Construction by Dr. Harald Wagner	May 20th, 2022
5	Workshop on Tunnel Design at New Delhi	June 29th & 30th, 2022
6	Session on TBM Partial Excavation Operation, Design and Burial challenges by Mr. Keivan Rafie	July 22nd, 2022
7	Conference on Tunnelling Asia 2022-Underground Space - the need of the day at Mumbai	June/July, 2022

Sl. No.	Topics	Scheduled Date
8	Best Practices in Cross Passages Construction	July 28th & 29th, 2022
9	Workshop on Modern approaches to Waterproofing	September, 2022
10	International Conference on Tunnelling for Infrastructure Projects for RVNL at Rishikesh	December, 2022
11	Conference on Tunnelling in North East Area: Challenges and Issues at Guwahati	February, 2023
12	Training Programme on Underground Works Contract Management by Dr. Harald Wagner	

**TRANSPORT TUNNELS UNDER CONSTRUCTION**

Project name	State	Total project length (km)	Tunnel length (km)	Promoter/Implementing agency	Actual/ Expected date of completion
Ahmedabad-Gandhinagar Metro Rail Project Phase I	Gujarat	18.87	-	Gujarat Metro Rail Corporation Limited (erstwhile Metro-Link Express for Gandhinagar and Ahmedabad Company Limited)	NA
Bhopal Metro Rail Project Phase I	Madhya Pradesh	14.99	1.79	Madhya Pradesh Metro Rail Corporation Limited	2023
Bhopal Metro Rail Project Phase I	Madhya Pradesh	12.88	-	Madhya Pradesh Metro Rail Corporation Limited	2023
Kanpur Metro Rail Project-Phase I	Uttar Pradesh	23.78	8.62	Uttar Pradesh Metro Rail Corporation (erstwhile Lucknow Metro Rail Corporation Limited)	2024
Indore Metro Rail Project (Phase I)	Madhya Pradesh	31.55	3.22	Madhya Pradesh Metro Rail Corporation Limited	August 2023
Bengaluru Metro Rail Project - Phase II	Karnataka	21.25	13.79	Bangalore Metro Rail Corporation Limited (BMRCL)	June 2024
Kolkata East-West Metro Project	West Bengal	3.60	3.60	Kolkata Metro Rail Corporation (KMRC)	2021-22
Kolkata East-West Metro Project	West Bengal	7.20	7.20	Kolkata Metro Rail Corporation (KMRC)	2021-22
Kolkata Metro Expansion Project	West Bengal	17.02	NA	Indian Railways (IR)	2024
Mumbai Metro Rail Project	Maharashtra	12.81	-	Mumbai Metropolitan Region Development Authority (MMRDA)	2024
Mumbai Metro Rail Project	Maharashtra	14.47	-	Delhi Metro Rail Corporation (DMRC)	2022
Mumbai Metro Rail Project	Maharashtra	23.64	-	Mumbai Metropolitan Region Development Authority (MMRDA)	2022
Mumbai Metro Rail Project	Maharashtra	32.32	-	Mumbai Metropolitan Region Development Authority (MMRDA)	2022
Mumbai Metro Rail Project	Maharashtra	2.68	-	Mumbai Metropolitan Region Development Authority (MMRDA)	2022
Mumbai Metro Rail Project	Maharashtra	10.48	-	Mumbai Metropolitan Region Development Authority (MMRDA)	2024
Delhi Metro Rail Project - Phase IV	Delhi	28.92	7.74	Delhi Metro Rail Corporation (DMRC)	2024
Delhi-Ghaziabad-Meerut Regional Rapid Transit System	Delhi, Uttar Pradesh	82.15	14.12	National Capital Region Transport Corporation (NCRTC)	2023 (priority stretch); 2025 (entire corridor)

# Iran



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

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

**Number of Members:** 799 (non-student) members, 445 student members, 190 corporate members

## Road tunnels

Work on the second section of the Tehran-Shomal Freeway continued over the last year. As reported previously, this sector consists of 59 tunnels (in two directions) with a total length of tunnel being approx. 37km (northbound, southbound, and service tunnels). Through last year, the progress was:

- Northbound: Heading 10.4km, bench 8.5km
- Southbound: Heading 12.1km, bench 8.1km

## FUTURE TUNNELLING ACTIVITIES

News have been announced by Iran’s Ministry of Roads and Urban Development that the construction of an undersea tunnel between Iran and Qatar is being considered for evaluation. The idea of constructing this tunnel has been put forward during an official meeting. A joint committee will evaluate the costs and benefits.

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

- Publishing the quarterly “Tunnel” Magazine
- Publishing the bi-annual “Tunnelling and Underground Space Engineering” Journal with Shahrood Technical University
- Holding six technical seminars

## CURRENT TUNNELLING ACTIVITIES

Construction of various metro lines in different cities in Iran continues. Progress in construction of Metro tunnels during 2021 includes: Advance of the Isfahan Metro Line 2 – the 600m western single tunnel with a diameter of 9m. Advance of the Isfahan Metro Line 2 – the eastern twin tunnels with a total 3500m length (1750m each) with a diameter of 6m (bored by EPBMs). Advance of the Mashhad Metro Line 3 – 120m long western single tunnel with a diameter of 6m. Advance of the Mashhad Metro Line 3 – 1,800m eastern single tunnel with a diameter of 6m (mechanised). Tehran metro Line 6 with a total length of 32km is in the completion stage with a total progress of almost 94%. Work of this project included the construction of 11km mechanized tunnelling and 21km of tunnelling using the NATM method. All tunnelling works have been completed. This line consists of 27 stations which are at almost 92% completion.

## EDUCATION ON TUNNELLING IN THE COUNTRY

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

- Amirkabir University of Technology
- Shahrood University of Technology
- Tarbiat Modares University
- Urmia University of Technology

Tunnelling is also taught to Bachelor level in the form of study modules in Mining and Civil Engineering fields. Other related courses in Geotechnical Engineering (Soil Mechanics, Rock Mechanics, Engineering Geology), Construction Management etc, are also offered at various universities.

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# Italy



**Name:** Società Italiana Gallerie (Italian Tunnelling Society)

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

SIG mainly promotes and coordinates studies and research in the field of tunnelling and underground construction works. SIG is a founding nation of the ITA and EUTF (European Underground & Tunnel Forum).

**Number of Members:** About 800 members (80 corporate and 250 young members).

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

### Congress:

The association, despite the Covid-19 pandemic has organized several technical events:

- 29-30/09/2021: SIG Conference at the Expo Ferroviaria in Milan - "Industrialization in the processes of construction and maintenance of underground infrastructures: design and use of innovative machines, equipment and materials;
- 3/12/2021: S. Barbara Conference for the World Tunnelling Day - Colombo Lecture - "Transport infrastructures for sustainable mobility" held by Ing. Renato Casale;
- 3-4/12/2021: ITA Young Members World Tunnelling Day 24h on-line event.

### Technical Visits:

- 19/11/2021: Alta Velocità Tratta Canello - Frasso Telesino project
- 22/10/2021: Cesaronica tunnel - ss 685 delle Tre Valli Umbre project
- 02/07/2021: Terzo Valico dei Giovi project
- 20/05/2021: Virtual visit to the Brenner Base Tunnel - Isarco River under-pass construction lot.

### Courses and Seminars:

- 25/03/2021: SIG Webinar - Safety in tunnelling during construction: data analysis and use of digital tools for prevention.

### Others:

SIG is a Sponsor of the Level II Masters in Tunnelling and Underground Constructions, in Italy at the Politecnico di Torino and at the Politecnico di Milano, and of the Level II Masters in Geotechnical Design 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.

Since 1976, the Journal "Tunnels and Major Underground Works" has been SIG's pride and joy. It is currently published once every three months and reached issue 141 in Feb 2022.

The periodical presents technical and scientific articles, as well as Editor's letters, news on construction works and tenders around the world, bulletins from the Italian tunnelling market, reports on technical visits, scheduled training courses and international congresses.

The association members regularly take part in the ITA-AITES working groups (WGs) and in the SIG working groups. Members proactively collaborate and exchange expertise and experience in underground works.

The SIG YM Group, as of December 2021 having 250 young members, actively supports SIG activities and connects young professionals from both university and industry. The group has also established a fruitful collaboration with the other ITA's Member Nations YM Groups.

Since late 2019, SIG has been writing a comprehensive, up-to-date scientific and technical book, called "Handbook on tunnels and underground works". The Italian Tunnelling Society is pleased and proud to be able to introduce this three-volume book to the international tunnelling community.

Volume 1: Concept - Basic Principles of Design

Volume 2: Construction - Methods, Equipment, Tools and Materials

Volume 3: Case Histories and Best Practices

The three sequential and integrated volumes offer the reader a valuable reference text regarding the design and the construction of tunnels and underground works, useful for both universities and post-graduate studies and in the professional field. As a handbook, it also aims to be a tool for use in everyday works for tunnelling specialists, engineers, geologists

and architects involved in underground planning, design and construction worldwide.

Professors from the most important and influential universities in Italy, professionals, specialists and technicians from large engineering companies and corporate infrastructure managers have actively participated in the drafting of the publication.

Volume 1 "Concept - Basic Principles of Design" has been published by Taylor & Francis in Feb 2022 and is now available.

Volume 2 "Construction - Methods, Equipment, Tools and Materials" and Volume 3 "Case Histories and Best Practices" will be published in June and December 2022.

## CURRENT TUNNELLING ACTIVITIES

### Railway Projects

**The third Giovi Pass, Genoa - Tortona Railway:** 37km of twin tunnels along the 53km section between Genoa and Tortona, part of the Rhine-Alpine TEN-T Corridor. The tunnels, excavated for 65% using conventional methods and for 35% by TBM, are located in the complex Apennines range between Piedmont and Liguria. The Valico tunnel (27km) is going to be the longest in Italy.

**Brenner Base Tunnel:** When completed in 2032, the tunnel will be 55km long between Tulfes/Innsbruck and Fortezza and, and when including the junction with the Innsbruck urban tunnel, it will have a max. underground length of 64km (the longest in the world). The works include the construction of two single track tunnels (9m dia.) with underground safety areas every 20km and a pilot/service tunnel (6m dia.). Two of the main sites are on the Italian side, the section Mules 2-3, and the section passing under the Isarco River (with artificial ground freezing beneath the river).

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

This is the main project on the entire Mediterranean TEN-T corridor, consisting of two 57.5km long twin-tubes (45km on the French side and 12km on the Italian side), with 170 cross-passages (every 333m), four intermediate adits for construction and emergencies, five ventilation plants and three underground safety areas. It will compete with the Brenner Base tunnel for the title of longest railway tunnel in the world.

**Brescia-Verona high speed railway:** With 6.6km of bored tunnels, together with

10.2km of cut & cover tunnels this project will allow the railway to twice underpass the A4 highway (Lonato and Sona) and also an urban centre near the Mincio river. This section is crucial for the completion of the Turin-Venice high-speed railway line connecting all the main cities in northern Italy, as well as the whole European corridor from Lisbon to Kiev (Mediterranean TEN-T corridor).

**Napoli Bari high Speed Railway:** The Napoli-Cancello section under construction is the first example in Italy of a cut & cover tunnel excavated under hyperbaric conditions to sustain the water table. The Cancello-Frasso Telesino section includes a 4km tunnel (Monte Aglio) with excavation almost complete. The Frasso Telesino-Telese and Telese-Vitulano sections include two tunnels, for a total length of 2km. Furthermore, works are beginning on the Apice-Hirpinia section, with the Rocchetta tunnel (6.5km), Melito tunnel (4.4km), Monte Aglio tunnel (4.1km) and Grottaminarda tunnel (2km).

**Florence High Speed Railway Junction:** The 8km long twin tunnels, excavated by EPBM (9.4m dia.) will underpass one of the most important cities for art in the world, whilst speeding up high-speed services along the Rome-Milan route and freeing up capacity on the surface for regional commuter trains. The excavated soil is being transported by train to the area of S. Barbara (about 50km from Florence) where it will be used to regenerate a disused mine.



**Messina-Palermo railway:** On the Fiumetorto-Castelbuono section, excavation of the 4.1km S. Ambrogio tunnel (single tube for a double track) is currently ongoing using conventional methods. In addition, a 10m diameter TBM will excavate the 6.7km long Cefalù tunnel (twin-tubes) through clayey sandstones, siltstones and quartz sandstones, with a max. depth of 300m and a max. hydraulic pressure of 5 bar. Also, an underground station will be built to serve the town of Cefalù. The 13km project

will increase capacity and cut travel times between Messina and Palermo.

**Genoa urban railway junction:** The project involves sextuplication of tracks along the Brignole-Principe section and quadrupling of the Voltri-Sanpierdarena sections, the busiest portions of the Genoa urban railway junction. The project will include with an extension of the existing Colombo tunnel and S. Tommaso tunnel. It will allow the separation of metropolitan/regional and long-haul services, remove bottlenecks and increase capacity on the junctions, including more freight services from and to the port of Genoa (which will be essential when the new Genoa-Tortona railway will be completed).

**Metro Projects**

**Naples Metro - Line 1:** A new metro line beneath one of the most densely populated cities in the country, often in sand below the water table, excavated with advanced technologies such as ground freezing and vertical shaft boring machine (SBM). A twin-bore TBM tunnel is currently under construction between Capodichino Airport station and Poggioreale station, over a 1km length, to close the Line 1 ring. One bore has already been completed with the other still under construction.



**Rome Metro - Line C:** One of the most complicated metro projects, in a poor geotechnical context, beneath millenary monuments and through archaeological finds unique in the world. The overall investment is about €3.8bn for a project extending from south-east to north-west, extending for about 25.5km (18km underground), with 30 new stations (20 underground). Currently the section between San Giovanni and Colosseo/Fori Imperiali is under construction, with works are commencing for the extension to Piazza Venezia.



**Milan Metro - M4:** 15km of twin tunnels from Linate to Lorenteggio, beneath the busy financial capital of Italy, through loose sand below the water table, and involving several interchanges with the three existing lines. Currently the central stretch passing through the historical centre of the city is under construction using two EPBs of 9.1m diameters, which allow the placement – within each tunnel – of one track plus station platform to minimize station excavation from the surface and disruption to the city. All underground works were completed in 2021.

**FUTURE TUNNELLING ACTIVITIES  
Railway Projects**

**Napoli Bari High Speed Railway:** The Hirpinia-Orsara (29km) and Orsara-Bovino (11km) sections were awarded in 2021. The Hirpinia Tunnel will be the 2nd longest in Italy (27km twin-bore) and just 500m divide it from the Orsara tunnel (10km twin-bore). These tunnels will cross the Southern Apennines within complex clay formations, the presence of methane gas, and a high level of tectonisation, within a highly seismic area. Swelling and squeezing is expected.

**Palermo-Catania railway:** This project will link the two main cities and metropolitan areas in Sicily and involves the excavation of more than 70km of tunnels through the central areas of Sicily, such as: Alia (20km), S. Catena (7.8km), Marianopoli (6.6km), Salso (3.9km), Trinacria (13.4km), Montestretto (2.3km), Sicani (5.3km), Dittaino (2.3km). The Alia tunnel will be the 3rd longest in Italy.

**Messina-Catania railway:** This project includes 37km of underground works over a 42km alignment between Fiumefreddo (nearby Catania) and Giampileri (nearby Messina), including an underground station in Taormina. The project is divided into two lots, both awarded in March 2021. The project will link the two main cities and metropolitan areas on the east coast of Sicily and will be part of the Salerno –

Reggio Calabria railway toward the south, linking Catania with Bari, Naples and Rome.

**Verona-Forzezza new railway line:** As part of the southern access to the Brenner Base Tunnel, 7 lots will be built, giving priority to the sections that currently give the highest limitations on the performances of the line. The Forzezza - Ponte Gardena section (23km) was awarded in 2020 and will be the first to be built. It includes the twin-bore tunnels Scaleres (15.4km), and Gardena (6.3km), with a maximum overburden of 800m within Granite and Quartz Phyllites, with fault zones. The other lots in future will include the Val d'Ega (10km), Trento (11.5km), and Zugna (16.7km) tunnels.

**Salerno - Reggio Calabria high speed railway:** After the Covid-19 pandemics, the Italian government decided to include this massive project in the strategic infrastructure plan for the country to revitalize the economy and promote the modernization of southern Italy. Crossing one of the most complex areas of the country in terms of morphology, geology, and seismicity, it would have 180km of twin tunnels over a 400km total length, with an estimated cost of €20bn. It will link the Calabria region - and eventually Sicily - to the wider high speed and freight railway network of the country.

**New Santomarcò tunnel:** A brand new 15.8km twin-bore tunnel (about 10m dia.) will replace the existing (old) Santomarcò tunnel, which is single track and has small cross section, linking the tyrrhenian coast line to the Cosenza valley. Four TBMs are anticipated for use (two on each side) to shorten construction times. The project will increase accessibility of Cosenza for passenger services and will boost freight transportation capacity between the ports of Calabria and Puglia and then - through the Adriatic line - towards the north of Italy.

**Catania urban railway junction:** A new double track line will underpass the city underground, replacing the existing single track, with the addition of three new underground stations. This will require 1.1km of bored tunnel and 2.3km of cut & cover tunnel in a densely populated area, below the water table, in a geological context ranging from loose soil to very hard volcanic rock. The project will allow a new metropolitan railway service through the entire urban area, which will integrate existing metro services. The project will also increase capacity and cut travel times along the Messina-Catania-Palermo route.

## STATISTICS

### 1. Length of tunnels excavated during 2021

Railway	Highway	Metro	
21.8	0	0.5	TBM
13.5	1.2	1.5	Conventional
35.3	1.2	2.0	Total

### 2. Amount (Eur) of tunnelling / underground space facilities awarded in 2021:

€10.5 bn including €5bn (Railway) €5bn (Highway) and €0.5bn (Metro).

### 3. List of tunnels completed in 2021:

Railway	Highway	Metro
Serravalle Tunnel (Terzo Valico dei Giovi)	-	Metro Turin - Line 1: "Collegno - Via De Amicis" tunnel
		Metro Rome - Line C: T3 section, "Fori Imperiali - Venezia" tunnel

## EDUCATION ON TUNNELLING IN THE COUNTRY

- Politecnico di Torino, Turin - Master in "Tunnelling and Tunnel Boring Machines"
- Politecnico di Milano, Milan - Master in "Tunnel Engineering"
- Università di Roma "Sapienza" - Master in "Geotechnical Design"
- Università di Napoli "Federico II" - Master in "Geotechnical Engineering for Infrastructures"
- Politecnico di Torino, Politecnico di Milano, Politecnico di Milano School of Management and Autostrade Group Master in "Integrated engineering and management of motorway networks"

### Master Degree Level

All the major Italian Universities, among the others in:

- Politecnico di Milano, Milan
- Politecnico di Torino, Turin
- Università di Roma "Sapienza"
- Università di Napoli "Federico II"
- Università di Bologna "Alma Mater Studiorum"
- Università Politecnica delle Marche

**Genoa - Ventimiglia railway:** There is a last section of this line, between Andora and Finale, which is still single track. A new 32km double track will be built, with six twin-bore tunnels of a total length of 25km, thus involving about 50km of tunnel excavation. The narrow coastline is very urbanised and squashed between the sea and the mountains. Moving the railway underground through the mountains will increase capacity and cut travel time while still preserving local towns and communities.

### Metro Projects

**Turin Metro - Line 2:** The route will be 27km long with 33 stations. The alignment will connect the south-west side of Turin city (Orbassano) with the north and north-east areas of San Mauro T.se and Rebaudengo, intersecting the metro line 1 at Porta Nuova railway station. The construction works of the line will start in 2022 and the completion is expected by 2038.

**Catania Metro:** An extension of the existing metro is planned for both ends of the current line, to reach the towns north-west of Catania (Misterbianco and Paternò) as well as the international airport of Catania Fontanarossa, including an interchange with the railway suburban services. The project will include more than 6km of new twin tunnels.

**Naples Metro - Line 10:** In 2020 the authorities of the Campania region presented the feasibility study of a new metro line linking the city centre (Cavour) and the existing metro network to the north-east area of the city. It would link the new high-speed railway hub of Napoli Afragola and the international airport of Capodichino. The alignment would be 12km long and run entirely underground.

### Hydraulic Projects

**Peschiera acqueduct (Rome):** A new 27km

long tunnel with an i.d of 3.6m is going to be built parallel to the existing aqueduct, in an area with significant challenges such as seismicity, landslides, sinkholes, interferences with regional groundwater, and an impervious morphology. The new tunnel will allow inspection and maintenance of the existing one, which is about 80 years old and has been in operation without interruptions. Also, the project will increase the resilience of water supply to Rome (3M people), as any damage to the existing aqueduct from an earthquake or a landslide could cause

disruption to the service for at least 6 months.

**Marcio Acqueduct (Rome):** Two new 20km long micro-tunnels (2.5m i.d) are planned to replace two 100 years old existing aqueducts which, besides the vulnerability to earthquakes and landslides, have a risk of contamination due to their minimal cover.

**SMAT sewer (Turin):** A new 14.4km long sewer tunnel, with a 3.2m i.d, will be built parallel to the old one built 40 years ago,

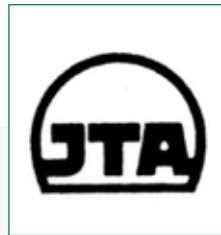
from south of the city to the Castiglione Torinese treatment plant. The new tunnel will collect rain and wastewater, increasing the capacity of the existing network and the resilience against climate change to prevent flooding events. Given the urban environment (including underpassing Lingotto railway station), a TBM with 4.1m excavation diameter will be employed, with 20m deep and 25m wide shafts built along the alignment. An automatic rail system will be used to move the segments within a 9km long tunnel to minimise the interferences with traffic on the surface.

# Japan

**Name:** Japan Tunnelling Association

**Type of Structure:** Non profit organization

**Number of Members:** Total number 1476, number of corporate members 201



## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

WGs: JTA consists of the following four committees, each committee has WGs and task forces.

Technology/International Communication/Events/Public Relations  
In each committee, the main activities are:

- Investigation, research and information transfer on general techniques and on subjects of specific projects.
- Meetings such as online lectures, online symposiums and online workshops and online training: "Two-days online seminars" and "Online lectures on topics of the year" (Organized by the Events committee)
- Publication of reports and documents: Monthly journal – "Tunnels and Underground" - and Biyearly journal – "Tunnelling Activities in Japan 2022"
- International cooperation
- Publicity activities

## CURRENT TUNNELLING ACTIVITIES

The Otonaka Tunnel (4,686m in length) on the Otoineppu Bypass of National Route 40 is set in a section of fragile serpentine rock and subjected to strong ground pressure rarely seen in tunnels, resulting in deformation near the face and large-scale heaving and subsequent destruction of the arch tunnel support (Fig. 1). At the time of the deformation, a closed-ring support

pattern with shotcrete  $t=45\text{cm}$  and steel support H-200 was adopted. The section where the deformation occurred was about 450m long, meaning large-scale re-excitation was unavoidable. During re-excitation of the deformed section, various surveys, measurements, and numerical analyses were conducted to determine the support structure and construction method. A round triple support structure (Fig. 2) was adopted to ensure the stability of the tunnel.

Re-excavating the deformed section confirmed that the displacement of the upper half-horizontal inner space remained in the range of  $-60\text{mm}$  to  $-80\text{mm}$  and showed a gradual convergence trend after the section was closed. The estimated earth pressures acting on the support structure was slightly lower during the re-excitation, but generally increased with the overburden height during both the initial excavation and re-excitation, with the maximum earth pressure estimated to be equivalent to about 140m of overburden.

## FUTURE TUNNELLING ACTIVITIES

A 920m long subway station extension/improvement project using the three-dimensional urban planning system at Sengakuji Station, Toei Asakusa Line:

The Sengakuji Station on the Toei Asakusa Line serves as a transport node giving access to Tokyo's subway

network and Tokyo International Airport. In the vicinity of the station, a new JR station has opened. Sengakuji Station is currently a box-shaped tunnel with two underground levels. The second underground level has two  $\times 5\text{m}$  wide island platforms with four tracks. The first underground level has separate concourses on the north and south sides. The station is chronically congested during rush hours and an increase in the number of station users is expected as large-scale developments progress in the surrounding area.

Therefore, there is a need to drastically improve the station, including the widening of platforms and improvement of elevator facilities. The platform width will therefore be widened to about 10m to meet the increase in passenger numbers and to minimize the scope of the renovation.

The station will have additional entrances and exits that will form a new pedestrian network and enhance passenger routes avoiding constraints nearby.

To further improve the station, the elevator facilities will be enhanced, and two barrier-free routes will be developed to allow passengers to move from the platforms to the ground level entrances by elevator.

Improving Sengakuji Station is a highly challenging construction project that will be carried out in a narrow space while the subway is in operation. Furthermore, it is directly under a very busy and congested main road.

This project will apply complex reinforcement methods to cope with any structural changes from the construction and removal of new structures, formulate a track switching plan to minimize the impact on railroad operations, and adopt a trenchless method under a national historic site.

## EDUCATION ON TUNNELLING IN THE COUNTRY

Hokkaido University, Muroran Institute of Technology, Kitami Institute of Technology Iwate University, Tohoku University, Akita University, Ibaraki University, Nagaoka University of Technology, Tokyo Institute of Technology, Yokohama National University, Niigata University, Kanazawa University, University of Yamanashi, Gifu University, Nagoya University, Nagoya Institute of Technology, Toyohashi University of Technology, School/Graduate School of Engineering, Osaka University, Tottory University, Ehime University Faculty of Engineering, Kumamoto University, Kagoshima University, University of The Ryukyus, Maebashi Institute of Technology, Osaka City University, Hokkai-Gakuen University, Tohoku Gakuin University, Tokyo University of Science, Nihon University, Hosei University, Tokyo City University, Ritsumeikan University, Setsunan University, Fukuoka University, Ashikaga University, Kindai University, Okayama University, Kyushu Institute of Technology, Nagasaki University,

University of Miyazaki, Kanazawa Institute of Technology, Meijo University, Aichi Institute of Technology, Osaka Institute of Technology, Osaka Sangyo University, Kanazawa University, Kansai University, Gunma University, Saitama University, Kyushu Sangyo University, Shibaura Institute of Technology, Chubu University, Tokyo Denki University, Tohoku Institute of Technology, Nagaoka University of Technology, Hachinohe Institute of Technology, Hiroshima University, University of

Fukui, Yamaguchi University, National Institute of Technology, Kagawa College, National Institute of Technology, Kochi College, National Institute of Technology, Toyota College, National Institute of Technology (Kosen), Kure College, The University of Tokyo, Tokyo Metropolitan University, Waseda University, Kokushikan University, Yokohama National University, Chiba Institute of Technology, Utsunomiya University, Osaka Institute of Technology, Kyoto University, Kobe University, Yamaguchi University

### STATISTICS

#### 1. Length of tunnels excavated during 2021

25.8%/58.3%

#### 2. List of tunnels under construction

	Road	Railway	Waterway	Overseas	Others	Total
Number of construction section	187	60	133	23	43	446
Total length(km)	268	214	242	116	114	954
Contract amount (US\$bn)	15	6.7	4.6	6.0	1.9	34

# Korea (South)



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

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

**Number of Members:** 3055 members, 73 corporate members

### ASSOCIATION ACTIVITIES DURING 2021 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, although 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 2021, KTA hosted the international conference (ICTUS, International conference on Tunnels and Underground Spaces): 2021. 08.24~26, Seoul ,
- In addition, KTA hosted several domestic conferences and forums:
  - 1) 2021 KTA General Assembly: 2021.04.22, Seoul (300 domestic participants),



2021 KTA General Assembly

- 2) 2021 KTA Tunnel Construction Policy Forum & Annual Conference: 2021.11.05, Seoul (200 domestic participants),
- 3) The KTA Technical Forum on TBM

- Tunnel: 2021.02.22 - 02.24, Seoul (58 domestic participants),
- KTA hosted eight continuing education and training courses last year, see: 'Education on Tunnelling in the Country'
- KTA-Annual WG Activity Reports: 11 WG activity reports, 6 WG technical reports

### Publications

- Domestic technical journal: "Journal of Korean Tunnelling and Underground Space Association" (six issues with 43 papers in 2021)
- Quarterly magazine: "Nature, Tunnel and Underground Space"

### CURRENT TUNNELLING ACTIVITIES 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 in the Han River)

### Kimpo-Paju 2nd Seoul outer-ring-road project (passing the Han River section)

- Connecting the 2nd Seoul outer-ring-road
- Total length of 25.3km (Han River section is 4km)

- Project cost will be about \$1.3bn

**FUTURE TUNNELLING ACTIVITIES**

**Youngdong Main Street Underground underground complex development project**

- Mega-underground space in Seoul Metropolitan
- Total underground space of 0.41Mm<sup>2</sup>
- Project cost will be about \$1.5bn

**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 the Seoul metropolitan area
- The 3rd connection after two long-span marine bridges

**Gangneung-Jejin single line railway construction project**

- Railway along the east coast of Korea
- Total length of 111.7km (Undersea section of 50.9km)
- Project cost will be about \$2.5bn

**EDUCATION ON TUNNELLING IN THE COUNTRY**

**KTA Continuing Education and Training Course**

*2021.03.04, Seoul (online courses)*  
 Environmental issues during Tunnel blasting  
 Low-cost windless pipe local ventilation system  
*2021.04.08, Seoul (online courses)*  
 EPM protection system  
 Technology for widening existing tunnels  
*2021.05.06, Seoul (online courses)*  
 Understanding design and construction for tunnel maintenance  
 Tunnel maintenance  
*2021.06.03, Seoul (online courses)*  
 Geotechnical survey theory and lab-test  
 Field geotechnical investigation test  
*2021.09.02, Seoul (online courses)*  
 Subsidence analysis practice due to lowering of groundwater during underground excavation  
 “Underground space development” new demands and paradigm for urban development  
*2021.10.07, Seoul (online courses)*  
 Shield TBM design and construction technology for utility tunnel construction

Stability evaluation technology of utility tunnel  
*2021.11.04, Seoul (online courses)*  
 Expressway tunnel method (ex-TM)  
 Contents  
 Revision of railway tunnel design standards  
*2021.12.02, Seoul (online courses)*  
 BIM application in tunnel design  
 Domestic and overseas application examples of underground space BIM design (GeoBIM)

**STATISTICS**

**1. List of tunnels completed**

Wonju-Gangneung High-speed Railway Tunnel  
 Jinhae-Guyjae Main Gas Pipe Line Tunnel  
 Gunjang Energy GE-3 PJT Subsea Tunnel

**2. List of tunnels under construction**

Yulchon Thermoelectric Power Plant Tunnel  
 Boryung-Taeon Subsea Road Tunnel  
 Daegok-Sosa Railway Tunnel  
 Kimpo-Paju 2nd Seoul Outer-ring-road Project

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# Lesotho



**Name:** Lesotho Tunnelling Association (LTA)  
**Type of Structure:** Non-profit, open association

## CURRENT TUNNELLING ACTIVITIES

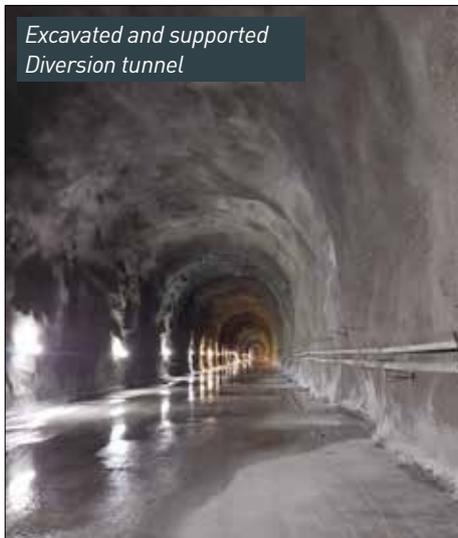
### Polihali Diversion Tunnels

- 7 and 9m dia. tunnels approx. 960m (each) in length. Two intake and outlet reinforced concrete structures.
- Method of excavation is drill and blast with sequential shotcrete rock support.
- Construction started in April 2019 and completed in November 2021.

## FUTURE TUNNELLING ACTIVITIES

### Polihali Transfer Tunnel

- 38km of 5m dia. TBM tunnel (with drill and blast access adits and two shafts)
- Still at the tender stage
- Construction anticipated to start Middle of 2022



Excavated and supported Diversion tunnel

## STATISTICS

### 1. Length of tunnels excavated during 2021

Two Polihali Diversion Tunnels (Drill and Blast) Approx. length is 1920m and Approx. Volume is 96,000m<sup>3</sup>

### 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2021

LSL520M at Tender (Polihali Diversion Tunnels)

### 3. List of tunnels completed

Lesotho Highlands Water Project (Phase II) - Polihali Diversion Tunnels

### 4. List of tunnels under construction

Lesotho Highlands Water Project (Phase II) - 38Km Polihali transfer tunnels under tender stage.

# Malaysia



**Name:** The Institution of Engineers, Malaysia  
**Type of Structure:** Non-profit, learned society  
**Number of Members:** Over 50,000 members inclusive of corporate members, graduates, associates, and students

## ASSOCIATION ACTIVITIES DURING 2020 AND TO DATE

In 2021, five successful digital events were organised for IEM members as well as non-members. Along with the IEM Malaysia event, two members of our committee presented at the Digital Symposium for Young Tunnellers of Asia (SYTA) on 7th August 2021. Another event was organized on the occasion of 20th Anniversary of the IEM Tunnelling and Underground Space Technical Division (IEM TUSTD) and World Tunnel Day. The celebration was organised by TUSTD and managed by the IEM Academy Sdn. Bhd. The two day event was held on the GoTo Webinar platform on 3rd – 4th December 2020 with the main objective of bringing attention to the advanced technology in tunnelling works carried out by Malaysia in the global arena. There were a total of 80 participants despite the Covid 19 pandemic. Six Webinar presentations

were organized and attended by about 100 participants each.

## CURRENT TUNNELLING ACTIVITIES

The current and future development and construction works looks less promising as the world is hit by the devastating effects of the Covid-19 pandemic. Malaysia has not been spared and is affected by a slowdown in business and tunnelling project development. Apart from some urban road/subway tunnels and underground construction works in the city areas, major tunnelling projects still on-going in Malaysia for the year 2020 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 of tunnels

the line connects 35 stations and will serve a corridor with a population of 2M people stretching from Sungai Buloh, to Serdang ending in Putrajaya. The first phase of the MRT Putrajaya Line stretches from Kwasa Damansara station to the Kampung Batu station for a total of 12 stations, with the former acting as the interchange between the Kajang Line and the Putrajaya Line. As of October, Phase One was 99.9% completed and it was announced that Phase One was expected to start service in the second quarter of 2022. The Putrajaya Line of the Klang Valley MRT project won the International Tunnelling and Underground Space on April 2021, the cabinet has given the go-ahead for the third MRT Line 3 which is also known as the Circle Line under the Budget for 2021. The minister also hopes that the project developer MRT Corp will kick-start the project in the second half of year 2021 with the plan to integrate several rail lines in the Klang Valley by 2025. The Circle Line will form a loop that encircles, but effectively by-passing Kuala Lumpur's central business district, while linking up most of the radial rail lines and serve the key major developments surrounding the Kuala Lumpur centre business district.

### East Coast Rail Link (ECRL)

As part of its overall transport development plan for the East Coast Economic Region, the Malaysian

Government has proposed connecting the East Coast to Kuala Lumpur and later to Port Klang, with a new electrified standard gauge railway. The railway line would cater to both passenger and freight trains. The ECRL alignment is on the east coast and central mountainous area. The terminal sits in the transition region between the central mountain belt and the western coastal zone. The relaunch of the ECRL project in July 2019 has kick-started the construction of the longest rail tunnel along the 223km main line between Dungun in Terengganu and Temerloh in Pahang, which is also known as Section B while the other sections of the improved 640km stretch include Kota Bharu to Dungun (Section A) and Temerloh to Port Klang (Section C). The 2.8km Kuantan Tunnel, located in Jabor, is the longest among the three tunnels of the ECRL in Section B, which includes the 1.1km Paka Tunnel and 871m Dungun Tunnel, both in Terengganu. In total, the 640km route will have approximately 40 tunnels with the longest tunnel measuring 7km, which will be built in the Jelebu-Semenyih area. In Jan 2022, the alignment for the East Coast Rail (ECRL) project was finalised, including the route in Selangor involving Section C2 from Gombak to Port Klang.

On the Genting Tunnel project, which will be the longest rail tunnel in the country, excavation of the 16.39km twin-tunnel will begin in March this year after the installation of two tunnel excavators, which are specially designed for hard rock use over the next three years. The Genting Tunnel which crosses the Titiwangsa Range, with most of the 10km located in Pahang, is the first ECRL tunnel to be excavated using the TBM method compared to the drill and blast method used previously.

**The LRT 3 - The Light Rail Transit Line 3 (LRT3)**

This envisages the connection of two million people between Bandar Utama and Klang by 2024. Developed in line with the Greater Kuala Lumpur/Klang Valley (GKL/KV) Land Public Transport Masterplan, LRT3 will be a key feature in extending rail connectivity to the Western Corridor of GKL/KV with the 2km tunnelling works that were completed in December 2021.

**FUTURE TUNNELLING ACTIVITIES**

A new RM250M road project is planned to link Kampung Baru and the Duta-Ulu Kelang Expressway (DUKE) as well as the Ampang-Kuala Lumpur Elevated Highway (AKLEH). The project, known as DUKE 2A

Lingkaran Kampung Baru or LINK, would commence in stages beginning this year and is expected to be completed by 2024. This [redevelopment plan] alignment will make Kampung Baru more open to an efficient traffic network system as it is relatively isolated and connected by small roads only. This project would allow direct access to Kampung Baru from AKLEH and also to create a smoother traffic flow.

**EDUCATION ON TUNNELLING IN THE COUNTRY**

- MMC-GAMUDA Tunnel Training Academy in Kota Kemuning, Selangor & MMC-GAMUDA TBM Refurbishing plant in Ipoh, Perak
- Talks, Courses, Seminar, Workshop and Conferences Organised by IEM Tunnelling and Underground Space (TUSTD), IEM Academy.
- TUSTD managed to publish the February 2021 IEM Bulletin Special issue
- In the next 2 years, TUSTD will plan to organise a Southeast Asian Conference and Exhibition in Tunnelling and Underground Space seminar (SEACETUS 2024)

**STATISTICS**

**1. Length or volume excavated - % mechanized / % conventional during 2020**

Briefly reported above.

**2. List of tunnels completed**

SMART (2007), Interstate water transfer tunnel (2011), KVMRTSBK (2016)

**3. List of tunnels under construction**

MRT2 (Expected completion 2020), East Coast Rail Link (ECRL), Bandar Malaysia Underground City, LRT 3

**4. Lists of tunnels under planning & Design:**

Circle Line (MRT3) & DUKE 2A road tunnel

**4. Lists of tunnels under planning & Design:**

Circle Line (MRT3) & DUKE 2A road tunnel 5. The soon to be iconic Merdeka 118 Tower in Kuala Lumpur when completed in 2022 will be the second tallest building in the world. The ingress and egress approach tunnels are currently under construction to the numerous levels of underground parking facilities at the tower.



# Mexico

**Name:** Name of Association: Asociacion Mexicana de Ingenieria de Túneles y Obras Subterráneas (amitos)

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

**Number of Members:** 60



## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

Quarterly Publication of the "Obras Subterráneas" Journal.

Migration from a conventional to a digital interactive production of the Obras Subterráneas Journal.

Virtual Training Courses:

- Emerald Book

- Calculation Methods for Tunnel Design by ITACET
- 6th International Symposium on Tunnels and Shafts in Soils and Rocks together with the Mexican Society of Geotechnical Engineering
- Joint Masters Degree with the National University of Mexico on Tunnels and Underground Construction

Project: Tunnel = 16.6km

- Sunkoshi-Marin Diversion Multipurpose Project: Tunnel = 1km

## 3. Road tunnel projects:

- 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:

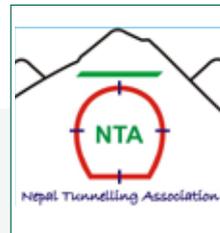
- Kathmandu Metro = 66.1km
- East West Electrified Railway Projects with 10 tunnels of total length 26.7km
- Rasuwagadi (China boarder) to Kathmandu to Lumbini via Pokhara

# Nepal

**Name:** Nepal Tunnelling Association

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

**Number of Members:** Life members: 124, Corporate members: 11



## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

Due to COVID-19 pandemic and restrictions imposed by the Government of Nepal against mass gathering, we were unable to conduct a program last year. We are planning to conduct a Nepal Tunnelling Conference 2022 during Nov or Dec, which will be confirmed within the next three months, and we will circulate the information accordingly.

## CURRENT TUNNELLING ACTIVITIES

So far, about 250km tunnel, mainly hydro, water supply, irrigation, mining, road, and sewerage have been excavated in Nepal.

The following current tunnelling activities are on-going:

- About 35 hydropower tunnels and caverns size ranging from 2.5m to 15m under construction by the drill and blast method
- A 26km long water supply tunnel excavated by the drill and blast and the semi-mechanized method is complete, but the project has suffered heavy losses due to last year's flooding (mainly at the dam/weir).
- A 12km long multipurpose tunnel of 5.2m diameter has been excavated by a double shield Robbins TBM with a segmental lining. The tunnel breakthrough was on 25th April 2019.



- 2.8km of road tunnel was excavated in 2021, this is half way through.

## 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

## STATISTICS

### 1. Length of tunnels excavated during 2021

11km completed using a TBM in Bheri Babai Diversion Multipurpose Project; and about 25km by conventional method.

### 2. Amount (USD or EUR) of tunnelling/ underground space facilities awarded in 2021

More than US\$100 M

## EDUCATION ON TUNNELLING IN THE COUNTRY

Currently two university have started educating in tunnelling in Nepal i.e., 1) Tribhuvan University, and 2) Kathmandu University

1. Master program in tunnelling at Pokhara under Tribhuvan University
2. Master program in tunnelling at Dhulikhel under Kathmandu University
3. Masters in Engineering Geology/ Geology/Mining Engineering:
  - Central Department of Geology, Kirtipur
  - Trichandra Multiple Campus, Kathmandu
4. Bachelor in Science (with Geology as major):
  - Trichandra Multiple Campus, Kathmandu, Nepal
  - Birendra Multiple Campus (BMC) Bharatpur, Chitwan Nepal and
  - Central Campus of Technology Hattisar, Dharan Koshi, Nepal
  - Prithvi Narayan Campus, Pokhara

# The Netherlands

**Name:** Department of tunnelling and underground works (TTOW) of the Royal Institute of Engineers KIVI

**Type of Structure:** Non profit

**Number of Members:** 529



## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

Due to Covid, limited activities were organised in 2021. The evening to celebrate the 50th year anniversary was postponed to 2022. What we did organise were:

- An on-line event on asset management in tunnelling
- The YM-department organised a site visit to the A16 tunnelling project
- The YM organised drinks and three lectures by Young Professionals on their experience in the tunnelling industry
- An annual meeting "ITA-avond", was organised as an on-line event

## CURRENT TUNNELLING ACTIVITIES

### Rijnlandroute (TBM)

In the Rijnlandroute project, a connection between the A4 with the A44 motorways is being established near Leiden. The twin-tube TBM tunnel is 2.5km in length, with each tunnel tube providing two traffic lanes. Fifteen years of management and maintenance is also included in the contract. The 2nd TBM-drive was finished in 2020. The reception procedure was problematic, which resulted in the deformation of the tunnel lining and problematic demobilization of the TBM. An extra internal lining was installed to stabilize the lining. The cross passages are complete. The tunnel technical installations are underway, and systems testing is progressing. Opening of the tunnel is expected in 2023.

### Zuidasdok Amsterdam (in-situ)

In 2020 the client reconsidered the project with it now cut into three independent projects, with the client responsible for the integral design of the total project. Procurement of the three individual projects started in 2021. In 2022 the procurement of the tunnel project will start.

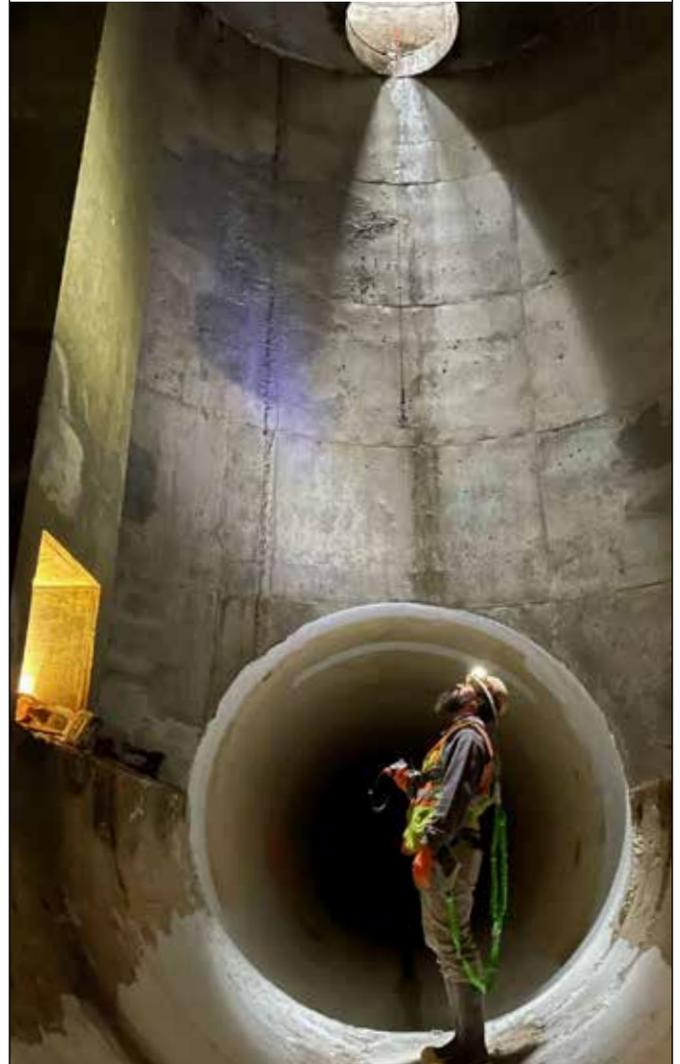
### Blankenburg connection: Maasdelta tunnel (immersed tube) & Hollandtunnel (in-situ)

The Blankenburg connection, the new A24 motorway, contains two tunnels: the Maasdelta tunnel, an immersed tube tunnel under the Scheur (Nieuwe Waterweg) waterway, and the primary access to the harbour of Rotterdam, and the Hollandtunnel, an in-situ tunnel through a natural habitat. Twenty years of maintenance are incorporated in DBFM project.

The Maasdelta tunnel will be about 945m in length and is characterised by its very deep ramps. The Holland tunnel is 510m long and is situated just below the surface. In 2018, construction started on the Maasdelta tunnel with the coffer dams, within which the deep ramps are to be constructed. The construction of the deep ramps was delayed in 2021 and will continue throughout 2022. The two tunnel elements are being prepared in the dry dock for float out in April 2022, See picture MDT. Immersion of the two tunnel elements in the waterway is planned for 2023. The foundation works on the Hollandtunnel are almost complete, with concrete works ongoing. The Blankenburg connection is scheduled for completion in 2024.

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PH: Vijay Shankar Jeyakrishnan; Pictured: James Franco, NRC, labor foreman

**A16 – Rottemerentunnel (in-situ)**

The A16 motorway from Terbregseplein traffic junction will be lengthened and connected to the A13 motorway near Rotterdam The Hague airport. On this connecting road a new tunnel is required - the Rottemeren tunnel. The Rottemeren tunnel is planned to be open in 2024 and will be 2235m in length. There will be two tubes with two lanes per tube and an emergency lane. The project has an energy-neutral design. The project is currently in the construction stage, with the first floor sections of the tunnel (reinforced underwater concrete) poured in May 2021.

**The Kiltunnel (1977) refurbishment**

In 2020, an E&C alliance contract was chosen to stimulate cooperation between the contractor and client, and flexible when unexpected conditions were found in this old tunnel.

Engineering activities are nearly finished and the tunnel refurbishment is ongoing.

**The Heinenoordtunnel (1969) refurbishment**

The project was awarded in October 2020 with the final contract close taking place in April 2021. The engineering of the renovation works are ongoing, with actual works to commence in 2023.

**The Roer and Swalmentunnel (2009) refurbishment tunnel systems**

In 2021 the MDCM-contract to renew several tunnel safety systems of these two tunnels was awarded, with the refurbishment works to commence in 2023. The contract is called; MDCM-contract, Maintain, Design, Construct and Maintain.

The municipality of Amsterdam is preparing a refurbishment scheme for the five tunnels they own (Piet Hein tunnel,

Arena tunnel, Spaarndammertunnel, Michiel de Ruijter tunnel, IJ-tunnel). Amsterdam is aiming to standardise the maintenance and operations procedures for this set of tunnels.

**FUTURE TUNNELLING ACTIVITIES**

**Future renovation projects (renovation mainly tunnel safety systems up to 2023):**

- Eerste and Tweede Beneluxtunnel
- Buitenvelderttunnel
- Noordtunnel
- Sijtwendetunnel
- Westerscheldetunnel
- Drechtunnel

**Future tunnel projects (Renovation - after 2023):**

- Botlektunnel
- Hubertustunnel
- Thomassentunnel
- Wijkertunnel
- Zeeburgertunnel

# New Zealand

**Name:** New Zealand Tunnelling Society

**Type of Structure:** Incorporated non-profit

**Number of Members:** 130 individuals and Corporate Sponsors Two Platinum Three Gold and Two Silver Corporate Sponsors



**ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE**

Despite COVID disruption the NZTS held several technical in person and virtual presentations from industry across 2021.

The NZTS is participating in an industry steering group for a five year programme of research at Auckland University sponsored by the NZ government that is studying the effects of dust and air quality, and in particular the mineral erionite that has

been identified in specific formations in the Auckland region.

The NZTS provided a virtual HUB to support the Australasian Tunnelling Conference in Melbourne. The Event was generally regarded as successful in switching between the two venues and providing broadcast quality links to enable live interaction between the two venues. The next Australasian conference will be held in Auckland in November 2023.

**CURRENT TUNNELLING ACTIVITIES**

Most tunnelling activities of note are located in the largest population centre, Auckland. In Auckland the two major tunnelling projects, the City Rail Link (metro) <https://www.cityraillink.co.nz/> and the Central Interceptor Project (wastewater) <https://www.watercare.co.nz/About-us/Central-interceptor> are progressing well despite disruption to the supply chain and resourcing from COVID.

In 2021 the City Rail Link TBM achieved two breakthroughs without major incident and is now being re-assembled for the second and final drive with major SEM works complete.

Central Interceptor is also progressing well with nine shaft sites active of 17 and has been launched and fully commissioned and is advancing well.

Watercare and Auckland Council continues with the smaller scale upgrades in water supply and water supply tunnels to suit Auckland's growth.

**FUTURE TUNNELLING ACTIVITIES**

In January 2022, the New Zealand Cabinet confirmed the recommendation by the Establishment Unit of an alignment for the Auckland Light Rail involve several kilometres of tunnel beneath the City Rail Link and across the Auckland Isthmus to Auckland Airport. The Establishment Unit was set up in March 2021 with an inclusive and collaborative governance structure with representatives from central government, (Ministry of Transport, Ministry of Housing



NZTS Young members Forum on site with Micro-TBM Domenica

and Urban Development, Treasury, Waka Kotahi NZ Transport Agency and Kōwhiri Ora), Auckland local government (Auckland Councillors, Auckland Local Boards, Auckland Council and Auckland Transport) and mana whenua. An ALR Board will drive the current detailed planning phase and transition the project through to a formal legal entity by the end of 2022. The Establishment Unit established a cost estimate of NZ\$14.6bn with advance works expected in 2023. <https://www.transport.govt.nz/assets/Uploads/OC210779-Auckland-Light-Rail-decision-to-progress-Cabinet-Paper.pdf>

Planning for the Auckland Additional Waitemata Harbour Crossing, a rail-based rapid transit connection for the North Shore (including across the Waitemata Harbour to the city centre), that would supplement and integrate an upgraded Northern Busway and the wider public transport



network to provide more public transport travel options is being considered in light of the ALR decision above. Construction is not anticipated to start until at least the 2030s.

Watercare has entered into a 10 year programme of work under an enterprise agreement an inherently collaborative procurement model [https://www.watercare.co.nz/About-us/News-media/Our-\\$2-4-billion-construction-partnership-with-Ful](https://www.watercare.co.nz/About-us/News-media/Our-$2-4-billion-construction-partnership-with-Ful)

With a renewed interest in the South Island hydro capability the NZ government is considering a Lake Onslow pumped storage scheme, anticipated to provide at least 5TWh of annual generation/storage. Estimated to have a construction and commissioning and lake-filling timeframe of 6-7 years, initial construction costs estimates are around NZ\$4B. The Lake Onslow option is located north-east of the Clutha River in Central Otago, South Island. To investigate the engineering, environmental planning and geotechnical feasibility investigations at Lake Onslow has been awarded These geotechnical, engineering and environmental studies will lead to a full feasibility-level decision by Ministers, currently planned for December 2022. <https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/low-emissions-economy/nz-battery/>

# 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:** 1,000 personal members and 100 corporate members (Including research institutes, academia, and public clients)

## ASSOCIATION ACTIVITIES DURING 2021 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 the Fjellsprengningsdagen, which gathers more than 700 rock blasting and TBM enthusiasts to share knowledge and latest news. In 2021, we managed to arrange the conference between two lockdowns (due to the pandemic). It was a great success, and it was obvious that our guests enjoyed meeting each other after too long a period dependent on digital meetings. The society is proud of the activity level we have managed to achieve in spite of the pandemic during most of 2021.

Also, Norway won one of the prestigious ITA Tunnelling Awards: The Lefdal Mine Data Centre in the category "Innovative and contributing underground spaces".

The Society publishes a handbooks and technical reports in Norwegian and one English publication every year. In 2021 we published a Norwegian handbook on rescue

chambers for underground use. The English publication was dedicated to the Follo Line Project.

The society also arranges a photo competition every year. Below you can see two of the finalists in 2021.

## CURRENT TUNNELLING ACTIVITIES

Tunnelling activity in Norway had a small volume decrease from last year, from

slightly above 4.3Mm<sup>3</sup> in 2020 to almost 4.2Mm<sup>3</sup> in 2021. The majority of activity is still concentrated around road and rail tunnels. In 2021 we had a significant excavation of storage caverns. The statistics also reflect the large water supply project that has just started in the Oslo area.

Very few tunnels opened to traffic in 2021, one though was the 1,230m long Blakset tunnel. The new tunnel replaces two older tunnels in Stryn in the western part of Norway. It is a typical road on the west coast of Norway, with steep hills and the risk of landslides. The tunnel greatly improves safety for users.

## FUTURE TUNNELLING ACTIVITIES

A high activity of infrastructure development will continue in the years to come.

Work has already started on a new railroad between Drammen and Kobbervikdalen. This project will complete



Left: From the Kobbervik tunnel - Photo Hans-Magnus Bjølgerud. Right: A photo moment in a tunnel not in use - Photo Kari Noer Lilli.

the double track railroad from Oslo to Tønsberg, opening in 2025. The project will include 6km of hard rock tunnelling, almost 300m soft ground tunnelling, and about 700m of cut-and-cover.

Another large project yet to start is a joint rail and road project, Ringerike Line and E16 Highway, it will include a 40km long tunnel for the railway in addition to some shorter tunnels both for rail and new highway between Sandvika and Hønefoss.

Road building will continue along E18 from Porsgrunn to Stavanger. These projects will include both tunnels and rock blasting over ground. The same goes for new E6 between Hamar and Vestnes. The new E6 both south and north of Trondheim includes both rehabilitation of old tunnels and excavation of new ones.

The Norwegian Public Road Administration has started the first contract for Rogfast. This project will include the longest and deepest subsea tunnel to date. In February it was decided which contractors will compete for one of the three largest contracts.

A new large scale new water supply has started for Oslo. The water will go through a long tunnel from the Holsfjord west of the city into the existing water pipe network. In addition, The Fornebu Line has started. This will be a metro tunnel that will connect Fornebu with the rest of the metro system in Oslo.

As a curiosity we also have to mention the Stad tunnel – the world’s first tunnel for ships? The construction of this 1.7km long tunnel is planned to start in 2026.

## STATISTICS

### 1. Length of tunnels excavated during 2021

47,286m in total, (included 4718m with TBM) - 4,177,386m<sup>3</sup> in total

### 2. List of tunnels completed in 2021:

The Blakset Tunnel

### 3. List of tunnels under construction

It is a list of more than 50 tunnels/caverns under construction at all times in Norway

## EDUCATION ON TUNNELLING IN THE COUNTRY

Norway has several universities giving both bachelor and master degrees with several aspects relating to 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.



The Blakset Tunnel

# Poland



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

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

**Number of Members:** 58 members, 5 corporate members

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

Representatives of Poland were present online at the ITA at special (digital) General Assembly on February 10th, 2021. Monika

Mitew-Czajewska (treasurer) is the member of the WG20, Anna Siemińska-Lewandowska (president) - WG15, Bartłomiej Dziuban and Dymitr Petrow-Ganew - WG14, Maciej Ochmański - WG2

and WG22, Jerzy Lejk - WG3, Bartłomiej Dziuban – ITA YM. Anna Siemińska-Lewandowska gave a lecture during the ITA Tunnelling Week on 22nd of September.

The Association organised two conferences – the 3rd Polish Tunnel Forum (live and digital) on 2nd of February 2021 and the 14th International Conference Underground Infrastructure of Urban Areas, Wrocław, 20-22.10.2021 (live and digital). Members of the ExCo (Olivier Vion, Arnold Dix, Lars Babendererde) took part in both events with special lectures.

## CURRENT TUNNELLING ACTIVITIES

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

- In the east-north direction (three stations, 8km) – Gülermak, due date 2023
- In west direction (five + one stations, 12km) – Gülermak, due date 2024

### Construction of the 3rd metro line in Warsaw

- Design works have begun, Construction method: EPBM + cut & cover



Road Tunnel in Warsaw – part of the south city ring

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

2,700m long tunnel, three lanes in each direction; construction method - cut and cover. In operation from December 2022

### Road Tunnel under the Świna river in winoujście – north Poland

The 1.44km long tunnel will connect Uznam and Wolin Islands. Construction method TBM – 13.46m diameter. Due date end of 2022. Design works are complete with the slurry TBM starting on 5th of March 2021, breakthrough scheduled for 19.09.2022

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

Length of the tunnel – 3km of double track tunnel, 4.5km of single track/tube tunnels, two underground stations. Construction method is TBM + cut & cover. Design works are complete. Two TBMs with a diameter of 13.04m and 8.76m are assembled. The start shaft is completed. The first TBM 8.76m started in July 2021, with the second in November 2021

### Road Tunnel under Luboń Mały – south Poland

Over 2 x 2km tunnel on the S7 motorway from Kraków to Zakopane (a Polish skiing resort). Construction works in progress, 2200m executed by the ADECO RS method. Due date 2023.

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

A 2.3km tunnel on the S3 motorway from Bolków to the state boarder. Design and build with construction in progress. The method of construction is NATM. The excavation works will be completed end of March 2022. Due date end of 2023.

### 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 in a design build contract. Tunnels will be constructed using NATM. Due date 2023/24

### Utility (storm water retention) tunnel along the Vistula River in Warasaw

Microtunneling – 3.2m diameter, total length approx. 9km. Due date: end of 2023

### Road Tunnels on the S19 motorway, Via Carpatia, Rzeszów - Babica

2,180m twin-tube TBM road tunnels on the S19 from Rzeszów to the state boarder.

The feasibility study is completed and tender awarded. Construction works will start at the end of 2022. (Fig. 7.1, Fig.7.2)

### FUTURE TUNNELLING ACTIVITIES

#### Three road Tunnels on the S19 motorway, Via Carpatia, section Rzeszów - Barwinek

Three road tunnels (1.75km, 1.6km, 1.2km) on the S19 from Rzeszów to the state boarder. The conceptual design is under progress with the construction period of 2022-2025.

#### Two Road Tunnels on the S7 motorway in Warsaw

Two road tunnels; two x three lines in each direction, preliminary design

#### Road Tunnel on the S6 motorway,

Road tunnel on the west city ring of Szczecin, under the Odra river - 5km in preliminary design

#### Eleven Rail Tunnels

12km length in total on the planned 58km long new rail route Podłęże-Piekietko in the south part of Poland. In addition, two Rail Tunnels – 5.8km length in total on the rail route Chabówka – Nowy-Sącz, will be modernized. The design works are in progress. Preparatory works and the design are to be completed by 2022. The construction and modernization is planned for 2022-2026

#### 2.5 km long railway tunnel in Łódź

On the railway line 85, a high speed train tunnel will connect the Central National Airport (under design) with Warsaw and Wrocław. In conceptual design.

### STATISTICS

#### 1. Length of tunnels excavated during 2021

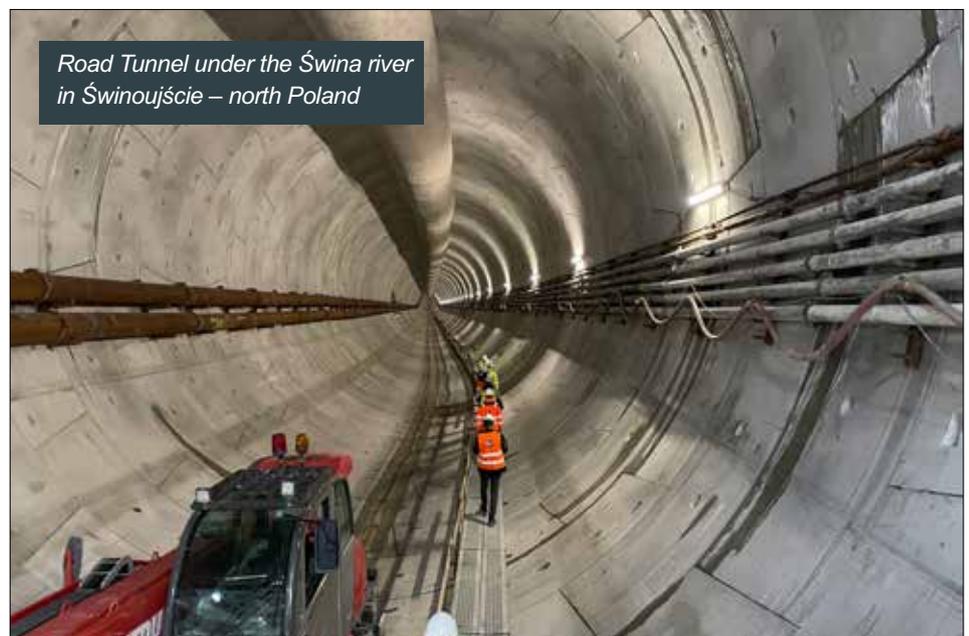
70% mechanized/30% conventional

#### 2. List of tunnels completed in 2021:

(two) road tunnel at South Warsaw Ring, tunnel under Świna (excavation completed)

### 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; 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.



Road Tunnel under the Świna river in Świnoujście – north Poland

# Portugal



**Name:** Comissão Portuguesa de Túneis e do Espaço Subterrâneo (CPT) – Portuguese Tunnelling Association and Underground Space

**Type of Structure:** A Committee of Portuguese Geotechnical Society (SPG), non-profit, open association

**Number of Members:** 70 individual members, 8 corporate members

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

In 2020 a new CPT Board was appointed for the period 2020-2024. The current president is Dr. Raul Pistone, former vice president. The former president Ing. João Bilé Serra integrates into the board as past president.

There are seven working groups in operation: GT1-Registry of Tunnels; GT2: Contractual Practices; GT3- Health and Safety; GT4-BIM and Information Management; GT5- Innovation and Life cycle Management; GT6: Construction Methodologies: Conventional and Mechanized Methods; YM: Young Members.

In 2021, CPT organized online events on Shotcrete in Underground Works, and Design of Complex Geotechnical Works.

GT2 worked with ITA-WG3 and published ITA Report #25: ITA Contractual Framework Checklist for Subsurface Construction Contracts (2nd Edition/2020), which is the revision of the 2011 checklist.

The GT3 worked on the preparation and editing of the technical guide - "Safety and Health in the phases of Project and Construction of Underground Works" (to be published in 2022).

CPT participated in the ITA's WG through meetings and paper contributions. During 2020 the CPT participated in the WTC20 in Kuala Lumpur and in the 2020 ITA General Assembly as well as the 2021 Extraordinary General Assembly.

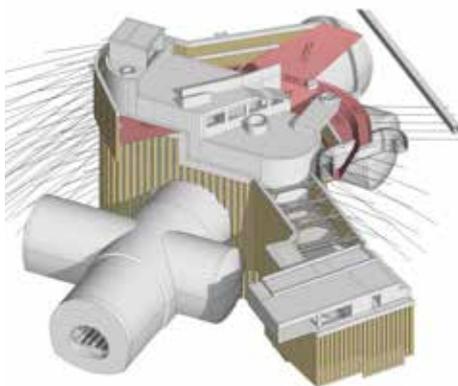
CPT also participated in the board of the European Forum EUTF and in the Iberoamerican Group on Underground Works.

## CURRENT TUNNELLING ACTIVITIES

### Lisbon Drainage Tunnels-Municipality of Lisbon

EPC contract for two drainage tunnels (4.5km and 1.3km long) with an i.d. of 5.5m, three shafts in urban areas of about 20m depth and 15m diameter.

### Reinforcement of the sewage and water system in Basin Q with Microtunneling



Santos Station 3D Model

Works concluded in March 2020. Lump Sum contract of one microtunneling pipeline with 1,6m diameter and 320m long, between two shafts (launch and reception) and several sewage box culverts.

### Lisbon Metro Extension (subway)

The new Metro extension (with a construction length of over 2000m) will connect the Yellow Line with the Green Line is expected to open in 2024. Launched in 2020, it was divided into four Design/ Construction EPC tenders, Lots 1 to 4. The works include two new stations at Estrela and Santos and two new ventilation shafts. Campo Grande and Cais do Sodré stations will also be rebuilt/adapted as part of the project, to become the new circular line "closing points". Once the extension is in service the Green Line will run as a circular route and will take over the section of the Yellow Line between Campo Grande and Rato, while the Yellow Line will run between Odivelas and Telheiras.

### Oporto Metro System - Pink Line

The construction contract was awarded in 2020 and notice to proceed was issued in March 2021. The new 3.1km Pink Line tunnel, constructed by the conventional method between Praça da Liberdade and Casa da Música, includes four Stations (Liberdade, Hospital de Santo António, Galiza and Boavista/Casa da Música) and

three ventilation shafts. The executions of the tunnels started during 2021. Piles for diaphragm walls are in progress at the new two stations.

### Oporto Metro System - Yellow Line

The construction contract was awarded in 2020 with notice to proceed issued in March 2021. The new 3km Yellow Line between Santo Ovídeo and Vila D'Este stations includes three stations (Manuel Leão, Hospital Santos Silva and Vila d'Este), a ventilation shaft, about 0.9km of tunnel between Manuel Leão and Hospital Santos Silva stations (bored by the conventional method), a viaduct and rollingstock maintenance, and parking installations. Construction of the tunnel and the shaft are in progress.

### Electrification and refurbishment of the Minho line ancient railway tunnels

### Rehabilitation of several others ancient rail tunnels

### Alto Tâmega Hydroelectric System - IBERDROLA.

The system comprises the following hydroelectric complexes:

#### Gouvães

- Dam height: 30m
- Installed power: 880MW
- Hydraulic circuit length: 7.6km
- Reservoir area and volume: 176 ha - 13.7hm<sup>3</sup>

#### Daivões

- Dam height: 77.5m
- Installed power: 118MW
- Hydraulic circuit length: 0.25km
- Reservoir area and volume: 340ha - 56.2hm<sup>3</sup>

#### Alto Tâmega

- Dam height: 106.5m
- Installed power: 160MW
- Hydraulic circuit length: Powerhouse at the dam foot
- Reservoir area and volume: 468ha - 132hm<sup>3</sup>

## STATISTICS

**1. Length or volume excavated - % mechanized / % conventional during 2020:** 3,000m, 100% Conventional

**2. Amount (USD or EUR) of tunnelling / underground space facilities awarded in 2020:** €400M

# Russia



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

**Type of Structure:** Non profit

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

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

- Scientific and technical conference "Application of advanced technologies in underground construction", Moscow, May 25th – 26th, 2021.
- International scientific and technical conference "Development of the underground space of megacities and transport tunnels" as part of the VIII International Forum and Exhibition "100+ TechnoBuild", Yekaterinburg, October 5th – 7th, 2021.
- Regular reporting and election for the Conference of the Tunnel Association of Russia, Moscow, November 25th, 2021.
- Competition S.N. Vlasov "Engineer of the Year of the Russian Tunnel Association 2021".
- Competition for scientific (diploma) works for university students.
- Competition "The best use of advanced technologies in the construction of tunnels and underground structures".
- The professional magazine "Metro and Tunnels" was published (four issues of the magazine were published).

## CURRENT TUNNELLING ACTIVITIES

### Moscow Metro development program

Despite the ongoing COVID-19 pandemic, in 2021, more than 23km of tunnels and 12 new metro stations were built and put into operation on the Big Circle Line (BCL) of the Moscow Metro.

The opening took place in two stages: in April, two metro stations were opened on a section of more than 2km, and then in December, 10 metro stations were simultaneously put into operation on a section of 21.2km (this is the longest section in the entire 86-year history of the Moscow Metro).

### Development of the railway infrastructure on the eastern range

In July 2021, construction was completed, and traffic was allowed along the new Baikal Tunnel, on the Baikal-Amur Railway.

Construction of a new Kerak double-track railway tunnel with a length of 926m has begun on the Trans-Siberian Railway in the Amur Region.

Member companies of the Tunneling Association of Russia continue to implement large-scale programs to increase the capacity of the Trans-Siberian Railway and the Baikal-Amur Railway.

### FUTURE TUNNELLING ACTIVITIES

#### Work continues on the development of the Moscow Metro:

By the end of 2022, construction is expected to be completed and preparations for the launch of one of the largest projects in domestic and global metro construction - the Big Circle Line of the Moscow Metro (BKL). It is planned to open the rest of the nine

## EDUCATION ON TUNNELLING IN THE COUNTRY

Main higher educational institutions, training and retraining specialists to work in the area of underground development:

- Moscow State University of Communication Lines (MIIT)
- Moscow State University of Civil Engineering (MGSU)
- Moscow State Mining University (MGGU) of National University of Science and Technology "MISIS"
- National Mineral Resources University "Gorny" (SPGU)
- Saint Petersburg University of Communications (PGUPS)
- Tula State University
- Ural State Mining University (UGGU)
- Siberian State University of Communications (SGUPS)

stations, including seven new stations and two after reconstruction. After the completion of the construction of the entire facility, the length of the Big Circle Line will be more than 70km and 31 stations.

By 2023, construction completion is planned for the Lyublinsko-Dmitrovskaya line on the Moscow Metro from Seligerskaya to the village of Severny, three metro stations will be located on this 5.8km section.

In 2022-2023 construction of the first stage of the Rublyovo-Arkhangelskaya line of the Moscow Metro will begin, where six stations will be located on a 12.6km section.

Work will continue on the development of metros in St. Petersburg, Nizhny Novgorod, Kazan, as well as the construction of metros in the cities of Krasnoyarsk and Chelyabinsk.

# Singapore



**Name:** Tunnelling & Underground Construction Society (Singapore)

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

**Number of Members:** 1329 members, 120 corporate members

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

In 2021, 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.

### Hulme Prize Award:

16th September 2021

#### Hulme Prize Paper Competition 2021

This annual competition is set up for young engineers or students (below 35) to submit best technical papers on any subject related to tunnelling and underground construction.

3 papers were shortlisted out of the 7 submitted papers by the TUCSS Committee as follows:

- Review of Investigation Methods to Determine Pile Lengths, Presented by Fu Jiajun, Land Transport Authority
- The Use of Classification Machine Learning for Cone Penetration Test Interpretation in a Singapore Context, Presented by Amelia Loo, Mott MacDonald
- Testing of a Muck Pumping System for EPB TBMs for Thomson-East Coast Line T307 Tunnelling Works, Vincent Zillianstretra, Land Transport Authority

The first prize was awarded to Mr Fu Jiajun, second prize to Mr Vincent Zillianstetra and the third prize to Ms Amelia Loo.

### Training Course & Conference:

20th to 21st April 2021

#### TUCSS Tunnel Course 2021

The two half-day course was attended by a total of 237 participants. The purpose of this course was to provide a comprehensive background to certain contemporary practices in design and construction of tunnels and underground structures.

23rd to 24th September 2021

#### Underground Singapore 2021

A total of 351 participants attended the hybrid conference. The purpose of the conference is to provide a forum to share and discuss issues relevant to the planning, design and construction of underground projects in Singapore and the region. Over 30 technical papers were accepted and presented during the 2-day conference.

## CURRENT TUNNELLING ACTIVITIES

The construction of subway, road and utility infrastructures form the bulk of current tunnelling activities in Singapore. In addition, with the limited land space available, Singapore has seen an increase in the adoption of pipe jacking as a method for the construction of underground linkways and pipelines. Some of the ongoing major tunnelling activities are as shown below:

### Circle Line 6 (CCL6)

Commenced in 2018, CCL6 comprises of a total of three stations and an extension to the existing Kim Chuan Depot and serves to connect the Central Business District with the rest of the Circle Line. Once completed, the 4km CCL6 will close the loop between the existing HarbourFront Station and Marina Bay Station and will bring the total number of Circle Line stations to 33, inclusive of 12 interchange stations. Three EPBMs have been used in CCL6 to support the bored tunnelling works, which have been now completed. In addition, CCL6 comprises of five underground linkways that will be constructed via pipe jacking, with 1.2m diameter slurry mTBMs supporting the works.

### North-South Corridor (NSC)

Commenced in 2018, NSC comprises of 21.5km of expressway, with a large portion underground and serves as Singapore's 11th expressway, connecting the northern towns in Singapore from Woodlands down to the city centre. Envisaged to be Singapore's first Integrated Transport Corridor, NSC comprises of dedicated, continuous bus lanes as well as cycling trunk routes and pedestrian paths, connected with the existing Park Connector Network. Construction of the road tunnels

Virtual Monthly Evening Seminars for members:		
21st January 2021	Challenges during Diaphragm wall construction	Mr. Michel Bock, COWI
24th February 2021	Baseline Approach to Manage Third-Party Risk in Underground Constructions	Dr. Logan Loganathan, WSP Australia Pty Limited
18th March 2021	Segmental Lining Design in Adverse Soft Ground Conditions	Dr. Benno Ring, Ring – Consultancy in Tunnelling
15th April 2021	An Automatic Back-analysis Methodology to Better Predict the Real Ground Behaviour	Dr. Cristian de Santos, SAALG Geomechanics
20th May 2021	Safety Challenges in Long Rail Tunnels	Mr. Bernd Hagenah, HNTB
17th June 2021	Precast Tunnel Segments reinforced by GFRP Reinforcements	Dr. Aniello A. Giamundo, ATP srl Italy
15th July 2021	40 km of TBM Tunnels excavated through Extremely Hard Rock and High Water Pressure - The Follo Line tunnels (Oslo, Norway)	Mr. Fernando Vara, ACCIONA
19th August 2021	Safety Practices in Tunnelling Industry	Mr. Michael Chin, Singapore Power
18th November 2021	Holistic approach for the construction monitoring of the Grand Paris Express metro network (France)	Mr. Vincent Lamour, SOCOTEC
<b>Virtual Annual Lecture:</b> 21st October 2021	Tunnelling Risk Management on the FAL Project, Perth	Mr. Eric Hudson-Smith, Perth Transport Authority

will be predominantly carried out via the cut and cover method and features extensive at-grade road and utility diversion works.

**Deep Tunnel Sewerage System (DTSS) Phase 2**

To meet Singapore’s long-term clean water needs, a used water conveyance system, the DTSS, is currently under construction. Some of the shafts were constructed using a vertical shaft boring machine which is a first in Singapore. The constructed link sewers will connect existing sewer lines with the deep tunnels via drop shafts, conveying used water via gravity to centralised water reclamation plants for further processing and treatment. With Phase 1 completed in 2008, DTSS Phase 2 comprises of 60km of link sewers (50km of which to be constructed via pipe jacking) and 40km of deep tunnels at depths between 35m to 55m, both underground and undercrossing the sea. A total of 19 TBMs, comprising of both EPBMs and

Slurry TBMs, are used to construct the deep tunnels with many already completed their drive.

**Changi East Airport Development**

To support the future airport infrastructure with the planned Terminal 5 (T5), Changi Airport Group (CAG) has awarded contracts for the construction of bored tunnel as well as for cut and cover tunnels; TBMs have been delivered and construction works are now in progress.

**FUTURE TUNNELLING ACTIVITIES**

**Cross Island Line (CRL)**

The CRL comprises of more than 50km of underground lines and is envisaged to increase connectivity between the western, eastern and north-eastern parts of Singapore. Construction of the CRL will be divided into three phases, with the first phase (CRL1) comprising of a total of 12 stations, inclusive of four interchange stations and spanning a total of 29km in

length. In addition to the conventional EPBMs and slurry TBMs, CRL1 features the use of two large-diameter TBMs, one EPB and one Slurry, for the construction of single tunnel to house both tracks. Passenger service for CRL1 is slated for 2030 and studies on the subsequent CRL phases are currently ongoing. The CRL also includes the 7.3km Punggol extension which will provide better rail connectivity and greater accessibility for those living in eastern areas. The Punggol extension will be fully underground and comprises four stations, and it will also feature the use of a large-diameter EPBM.

**EDUCATION ON TUNNELLING IN THE COUNTRY**

Certificate Course in Tunnel Engineering/ Singapore Institute of Technology Specialist Diploma in Underground Construction/BCA Academy

# Slovakia



**Name:** Slovenská tunelárska asociácia ITA/AITES  
**Type of Structure:** Non-profit organisation  
**Number of Members:** Total number 48, number of corporate members 42

**ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE**

In cooperation with the Slovak Technical University in Bratislava, members of the STA committee have given lectures on tunnelling and underground construction.

STA together with Czech tunnelling association continued to publish the quarterly journal *Tunel*.

The activities of STA were limited in year 2021 due to the pandemic in Slovakia.

**CURRENT TUNNELLING ACTIVITIES**  
**Ovčiarско and Žilina Tunnels**

The section of the D1 motorway - Hričovské Podhradie - Lietavská Lúčka - including the 2.7km long Ovčiarско Tunnel and the 0.7km long Žilina Tunnel was open to the public on 29.01.2021.

**Prešov Tunnel**

After more than four years of construction, the Prešov Tunnel on the D1 Prešov West - Prešov South motorway section was put into operation at the end of October 2021. It is the eleventh motorway tunnel

in Slovakia. The 2.2km long Prešov tunnel was conventionally excavated using NATM, in rock consisting mainly of alternating clay

and sandstone formations, with a maximum overburden of 80m.

**Milochov Tunnel**

At the end of December 2021, the 1861m long Milochov railway tunnel was put into operation as a single track structure. This is the third tunnel on the Bratislava - Žilina corridor to be put into operation after the Turecký Vrch and Diel tunnels. Full operation of the tunnel - along the second track - is dependent on the connection of the old line with the new line outside of the tunnel area, which is expected in spring 2022.



Prešov Tunnel

### Bikoš Tunnel

In 2021, work continued on the second phase of the Prešov bypass, which consists of a 4.3km long section of the R4 expressway. It includes the 1.1km long Bikoš tunnel. In January 2022, work is continuing with the concreting of the secondary lining in the right-hand tunnel tube. The secondary lining in the left tunnel tube is complete, as well as the supporting structures for the excavated tunnels at the southern portal. The goal is to complete the roadway in both tubes during the autumn months of 2022 and to start installing the tunnel process equipment in August.

### Čebrať Tunnel

Excavation works for both tubes of the 3.6km long Čebrať tunnel on the D1 motorway Hubová - Ivachnová continue from the eastern portal. In the southern tube, 3547.5m have been excavated leaving 77.5m. Approximately 25m more will be excavated from the east, with a widening of the profile of the tube end using a micropile umbrella.

### Višňové Tunnel

The twin tube Višňové tunnel has a total length of 7.5km and is being built on the D1 Lietavská Lúčka - Višňové - Dubná Skala motorway section, in the Malá Fatra Mountains. After a change of contractor, work in the tunnel continues with the construction of the secondary lining.

## STATISTICS

### 1. Length or volume excavated - % mechanized / % conventional during 2020

1400m, 100% conventional

### 2. List of tunnels completed in 2021:

Ovčiarско motorway tunnel, Žilina motorway tunnel, Prešov, motorway tunnel, Milochov railway tunnel

## EDUCATION ON TUNNELLING IN THE COUNTRY

- Slovak technical university in Bratislava, Faculty of civil engineering, Department of geotechnics
- University of Žilina, Faculty of civil engineering, Department of geotechnics
- Technical University of Košice, Faculty of Mining, Ecology, Process Control and Geotechnologies, Faculty of civil engineering



Ovčiarско Tunnel

# Slovenia



**Name:** Slovenian Society for Underground Structures

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

**Number of Members:** 100 members, 50 young members

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

### Events:

- 13th International Tunnelling and Underground Structures Conference (17th – 19th November 2021, Ljubljana, Slovenia).
- Excursion – tour of the construction site of the Karavanke tunnel (22nd September 2021)

### Publications:

Proceedings - 13th International Tunnelling and Underground Structures Conference.

## CURRENT TUNNELLING ACTIVITIES

### Karavanke Tunnel

The start of construction for upgrading the existing single bidirectional transalpine base tunnel with a second tube to form a twin highway tunnel tube system. The total tunnel length is 8km with more than 1000m of overburden. The tunnel passes through very heterogeneous rock materials from Permian, Carboniferous to Triassic formations, squeezing ground and difficult hydrogeological conditions. Construction of the tunnel started in the second half of the 2020. Currently the excavation is at around 1800m from the Slovenia side, with

around 1600m of the excavation left to the breakthrough.

### Second track of the Divača-Koper railway line

The start of construction for the upgrade of the existing single track railway between Divača and Koper with a second track. The new railway line passes through eight tunnels (T1-T8) with a total length of 38km. All of the tunnels are single-tube. 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 karstic features (sinkholes, cracks, caverns, tunnels, underground caves, chasms etc.).

### Pekel Tunnel

The start of construction of a 1.5km long double-track railway tunnel, as part of the upgrade of railway line on the Maribor – Šentilj – state border. The tunnel has a cross section of about 135m

and a maximum overburden 90m, which reduces to 10m when crossing highway H2. Construction of the tunnel started in the first half of the 2021 with 1200m currently excavated. The tunnel is being excavated from both sides (South and North). There is still around 300m to go to the final breakthrough.

### FUTURE TUNNELLING ACTIVITIES

#### Third Development Axis - North

The design for the Third Development Axis – North covers the execution of a new road link from the Koper – Šentilj motorway A1 near Šentrupert to Slovenj Gradec. The total length of the planned expressway amounts to 31.5km, and it will have four cut-and-covers over a total length of 1,840m and six tunnels for a total length of 3,700m.

#### Third Development Axis – South - Tunnel Gorjanci

The design for the Third Development Axis – South covers the execution of a new road link from the Ljubljana–Obrežje motorway

near Novo mesto to Maline. The total length of the planned expressway amounts to 17.9km, and it will have three bridges, four viaducts, two cut-and-covers tunnels, a 2,341m long tunnel under the Gorjanci hills, 10 overpasses, nine underpasses and two lay-bys.

#### Left track for the new Divača-Koper railway line

Preliminary design for the upgrade of the currently under construction railway line from Divača – Koper. The new left track has a total length of the planned tunnels of 17.05km.

### STATISTICS

#### 1. Length or volume excavated - % mechanized / % conventional during 2020

3500m (100% conventional)

#### 2. Amount (USD or EUR) of tunnelling/underground space facilities awarded in 2021

628.3M

#### 3. List of tunnels under construction

Second tube of Karavanke Tunnel; Pekel Tunnel; Second Track of the Divača-Koper railway line; Lokev Tunnel; Beka Tunnel; Stepni Tunnel; Tinjan Tunnel; Osp Tunnel; Mlinarji Tunnel; Škofije Tunnel

### EDUCATION ON TUNNELLING IN THE COUNTRY

Department of Geotechnology, Mining and Environment (OGRO)/Faculty of Natural Sciences and Engineering, University of Ljubljana

# South Africa



**Name:** South African National Committee on Tunnelling (SANCOT)

**Type of Structure:** SANCOT operates as a non profit, open association. It has operated as a tunnelling interest group under the umbrella of the South African Institute of Mining and Metallurgy (SAIMM) since 2003.

**Number of Members:** 300

### ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

- Held various SANCOT committee meetings, typically one meeting every second month.
- 2-Day Online Webinar, 20th – 21st October 2021- New approach to tunnelling and underground risk: Introduction to the FIDIC Emerald Book
- Held several organising committee meetings, for the SANCOT Symposium to be held in Cape Town/Western Cape in November 2022: Tunnel boring in civil engineering & mining
- Held several bid committee meetings to prepare Expression of Interest for hosting the World Tunnel Congress 2026 in Cape Town, in the Western Cape Province:
- Sustainable Development of Underground Space in an Urbanising World. Rising to the challenge: The role of underground space in shaping megacities of the future

### CURRENT TUNNELLING ACTIVITIES

#### Ongoing tunnelling work includes:

- Various micro tunnelling projects, mainly on the various metros.
- Underground development and decline access tunnelling on many mining projects.

#### New tunnelling work that commenced in 2021 includes:

- Buffalo City metropolitan municipality in the Eastern Cape: Construction of a sewer diversion tunnel using a TBM and associated civil works to allow for the diversion of effluent that flows from the existing Central Wastewater Treatment Works (CWWTW) to the new regional Reeston WWTW.
- Outfitting of the old second bore at the Huguenot Tunnel, on the N1 between Paarl and Rawsonville/Worcester in the Western Cape.

- Master Drilling's Mobile Tunnel Borer (MTB) commenced boring of a decline tunnel at Anglo American Platinum's Mogalakwena Mine

#### Major underground mine expansions completed/in progress/planned at:

- Venetia underground mine, Alldays/ Musina, Limpopo Province
- Finsch underground cave mining, Lime Acres, Northern Cape Province.
- Cullinan underground cave mining, Cullinan, Gauteng Province

### EDUCATION ON TUNNELLING IN THE COUNTRY

MSc (Eng) Rock Engineering, taught at the Mining Department at the University of the Witwatersrand, Johannesburg, Gauteng Province.

M Eng Mining Engineering/Rock Engineering & Numerical Modelling, taught at the Mining Department at the University of Pretoria, Pretoria, Gauteng Province.

Note: These are general post graduate programmes in rock engineering in mining, covering a wide range of subject material which also includes the design of mining tunnels and underground excavations in rock.

# Spain



**Name:** Asociación Española De Túneles Y Obras Subterráneas (Spanish Association Of Tunnels And Underground Works)

**Type of Structure:** Non profit, open association, founded in 1975

**Number of Members:** Total 329; (238 individual members, 59 corporate members, and 32 young members)

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

Due to the COVID-19 pandemic, many of the activities initially planned have been postponed and others have been held via teleconference:

Organization of XVII Master Universitario in Túneles y Obras Subterráneas AETOS (Endorsed by ITA-AITES).

A new special issue of the Journal of Public Works (ROP) on Tunnels and Underground Works was presented, in a continuation of the collaboration that the Spanish Association of Tunnels and Underground Works (AETOS) and the Journal of Public Works (ROP), has been developing since 2009 to disseminate experiences related to performances in tunnels and underground works.

September 22nd - General Assembly of AETOS, including:

- Medal of honour awarded to the past president, Mr. Manuel Arnáiz Ronda.
- Conference given titled "Singularities of Underground Works in Colombia, Case of Study: El túnel de la Línea, 8.6km" by Mr. German Pardo Albarracín, President of the Colombian Society of Engineers

Participation in the 2nd World Conference on Sustainable Transport, promoted by the United Nations, Beijing (China) from 13th to 16th October 2021. As part of this conference, the International Tunnels and Underground Spaces Association (ITA-AITES) organised a session on the 13th October to present the benefits of efficient networks as a transport solution for large cities. In this session, AETOS, was invited to participate and present the achievements of the Calle-30 underground and urban development on "Madrid Río", inaugurated in 2011, as a success story, both in the use of underground space for transport and the recovery of the surface for other uses.

The 2021 annual meeting of the European Tunnelling and Underground Forum (EUTF) took place in Madrid. November 4th to 5th, 2021.

The EUTF meeting in Madrid was

enthusiastically attended by representatives of the "Young European Tunnel Specialists" led by Daniel Jaén (Spain) and Jasmine Amberg (Switzerland).

As a culmination of the meeting in addition to the technical visits to the recently renovated Metro de Madrid stations, and to the refurb works of Plaza de España and the Bailén – Ferraz Tunnel a technical conference was held on 5th November in the Agustín de Betancourt Room of the CICCOP on the theme:

'Tunnelling integrating Heritage: refurbishment and new projects', which included the presentation of several relevant works that have been or are being executed in Spain in the field of underground works.'

## CURRENT TUNNELLING ACTIVITIES

Throughout 2021, the design, construction, maintenance, and modernization of tunnels in Spain will continue:

## Railway Tunnels

Completion and commissioning, at the end of 2021, of the high-speed access lines to the Northwest of Spain (Galicia).

The section inaugurated in December 2021 is called Pedralba de la Pradería – Ourense (more than 119km), has some 30 tunnels and another 30 viaducts which account for this most complex section on the Madrid – Galicia Line.

Some of these high-speed rail tunnels and among the longest in Europe:

- Zamora - Ourense Line – 40 tunnels (131km)
- Zamora – Pedralba de la Pradería Line: Nine tunnel (131km)
- Pedralba de la Pradería – Ourense Line: 31 tunnels

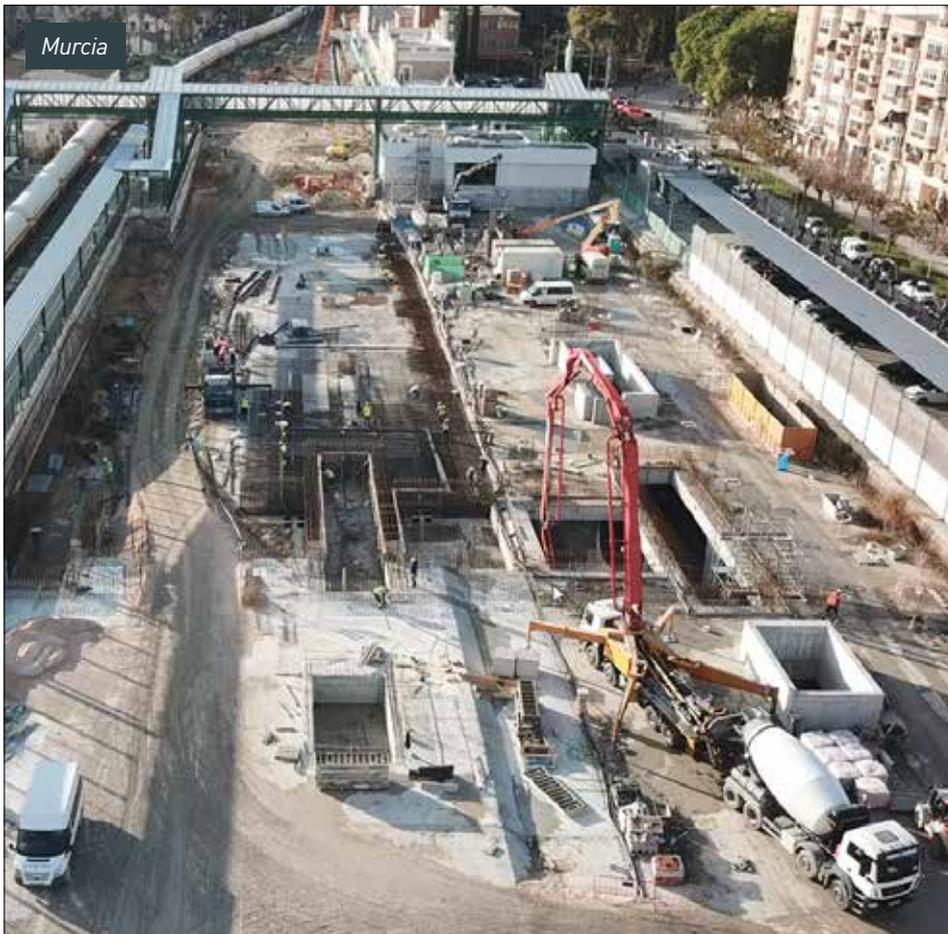
## Burying the railway in Murcia

This undergrounding of two contiguous projects has a length of more than 5km in cut and cover tunnel, 10.20m wide, that houses a double high-speed track (one mixed gauge track and one standard gauge track), which in its final kilometre widens into the future Murcia del Carmen underground station, with an excavated section of up to 60m wide with four standard gauge tracks and three mixed gauge tracks.

The project includes the construction of almost 200,000m<sup>2</sup> of diaphragm walls, the pouring of more than 380,000m<sup>3</sup> of HA-30 and the placement of more than 52,000 tons of B500SD steel. There is also the

EUTF-Meeting





work carried out by the Canary Islands Government, including the longest tunnel in the Archipelago, namely the “Túnel de Erjos”, at 5.1km long, which will link the north and the south of Tenerife Island

The project is a twin-tube tunnel with 35m between tubes. The tunnel length includes approx. 120m of artificial tunnels each side.

A total of 19 cross passages will connect the tubes, one every 250m, alternating between pedestrian tunnels and vehicles and pedestrian tunnels. The connecting galleries for vehicles and pedestrians have a gauge of 5m x 5m, while the exclusively pedestrian ones will have a width of 1.8m and a height of 2.2m.

The tunnel will be bored using the NATM, mainly through volcanic geology made up of basalt lavas and massive phonolite formations with some tephra and/or volcanic scoria insertions. A few stretches of tuff will be also excavated.

Tunnel construction is set to begin in October and continue until mid-2022.

#### *Tunnels on the El Risco-Agaete highway, Gran Canaria - Section length: 8km*

Eight tunnels, mostly executed at full section and divided into sections of three lanes and two lanes.

#### **Urban Tunnels**

##### *Plaza de España refurbishment: Tunnel under archaeological remains (Madrid)*

The refurbishment of the Plaza de España, in Madrid’s Royal Palace, includes a new cut and cover tunnel linking Bailén and Ferraz streets. The archaeological survey identified the remains of the basements of a historical palace. The tunnel design and construction method was modified so the tunnel could be bored under the ruins’ length.

This 50m long sector has a cover of 1.5m under the basement’s load bearing wall foundations. The ground profile consists of Miocene hard cohesive soils, above the local water level. To tackle the challenge of excavating a tunnel in soil, with a shallow cover under historical remains, a robust excavation and support method was required to minimize ground lost. The tunnel portals were supported by piled wall sections perpendicular to the main cut and cover ones. Two 30m long minipile umbrellas were drilled from both portals. Traditional hand mining excavation was used, developed from the early 20th Century Madrid underground tunnels and still used in specific cases. The general horizontal sequence consists of top heading, bench, and invert. The top heading is hand excavated with successive timber supported

construction of a new station, located on the covering slab of the false tunnel with an area of about 4,400m<sup>2</sup>, which will replace the current historic building, which will be kept on the same site and used for other purposes.

The project also includes the construction of emergency exits in the underground section every 1,000m.

#### **Metro Tunnels**

In 2021, the Andalusian Regional Government’s Public Works Agency carried out the following underground works/actions as developer:

##### *Málaga Metro Lines 1 and 2.*

##### *Renfe - Guadalmedina Section:*

The section is 713m long and runs entirely underground at three levels, with a single station called Guadalmedina where the two metro lines intersect.

The top-down, cut-and-cover method was used to complete the excavation and place all of the concrete slabs (intermediate, floor and counter-vaults) and other structural elements accessed via purpose-built ramps.

The tunnel has three levels. The first level houses the future main concourse of Guadalmedina Station, whilst levels 2 and 3 accommodate the track superstructure of Lines 1 and 2, two tracks per level.

##### *Guadalmedina – Hospital civil Section:*

The first phase foresees a station at the hospital that includes the Civil Hospital and the Maternity and Children Hospital. This section is 1,920m long and runs entirely underground on two levels. It includes three stations: Hilera, La Trinidad and Hospital Civil.

The method envisaged for excavation and placement of all concrete slabs (intermediate, floor and counter-vaults) is top-down cut-and-cover.

The cross-section of the tunnel at the bench is 8.3m, increasing to between 15m - 19m at the station, depending on the station. The average depth of the walls is around 26m.

#### **Road Tunnels**

In compliance with the European Directive on minimum safety requirements, for the adaptation of road tunnels of the RGE to R.D. 635/2006: 65 tunnels have been put out to tender, with a cumulative length of over 32km.

##### *Erjos tunnel, on the motorway ring road project - Section el Tanque - Santiago del Teide, Tenerife*

Currently, the completion of western section of the island’s motorway Ring Road between El Tanque and Santiago del Teide is being executed. It is the largest

man size galleries. When a 1m to 1.5m step of the vault is completed, a variable thickness (70cm at the crown to 140cm at the foot) mass concrete lining is pumped into place. In this way, the lining is always behind the tunnel face. Once the vault is finished, the bench is excavated in 2m to 3m steps and a vertical 90cm lining concreted. Finally, a 50cm invert is excavated and concreted

Detailed tunnel convergences and ruins settlement monitoring was carried out during the tunnelling. Settlements were in the order of 2mm to 4mm. The objective of not disturbing the ruins was fulfilled.

**FUTURE ASSOCIATION ACTIVITIES**

- Junta de Andalucía- AETOS, 17th March 2022, Sevilla: Seminar Andalusian Metros: A sustainable solution for city transport.
- April 6th and 7th, 2022, the Technical Conference “AVE Tunnels of the northwest corridor Madrid-Galicia” will take place at the Barrié Foundation, A Coruña, organized by ADIF and AETOS.
- AETOS 5th session: Geotechnics of tunnels, XI National Symposium of Geotechnical Engineering 24th, 25th, 26th and 27th May 2022 – Mieres – Asturias.
- 2022 AETOS Seminar on the Bilbao Tunnels of the Basque Railway Network, Donosti Metro, Vergara Triangle (November/pending on scheduling).
- Sep 2022 General Assembly & Annual Conference AETOS.
- 2nd International Conference on Road Tunnel Operations and Safety & VIII Spanish Symposium PIARC 25th - 28th October 2022 (Granada).

Technical meetings and WG activities are on-going

**STATISTICS**

**1. List of tunnels completed:**

High Speed Railway tunnels:

Status	Number of tunnels	Cumulative length (km)
Panning	29	45.8
In the beginning phase of construction	10	28.1
In construction	27	96.4
On service	274	511.6
<b>Total</b>	<b>340</b>	<b>681.9</b>

**EDUCATION ON TUNNELLING IN THE COUNTRY**

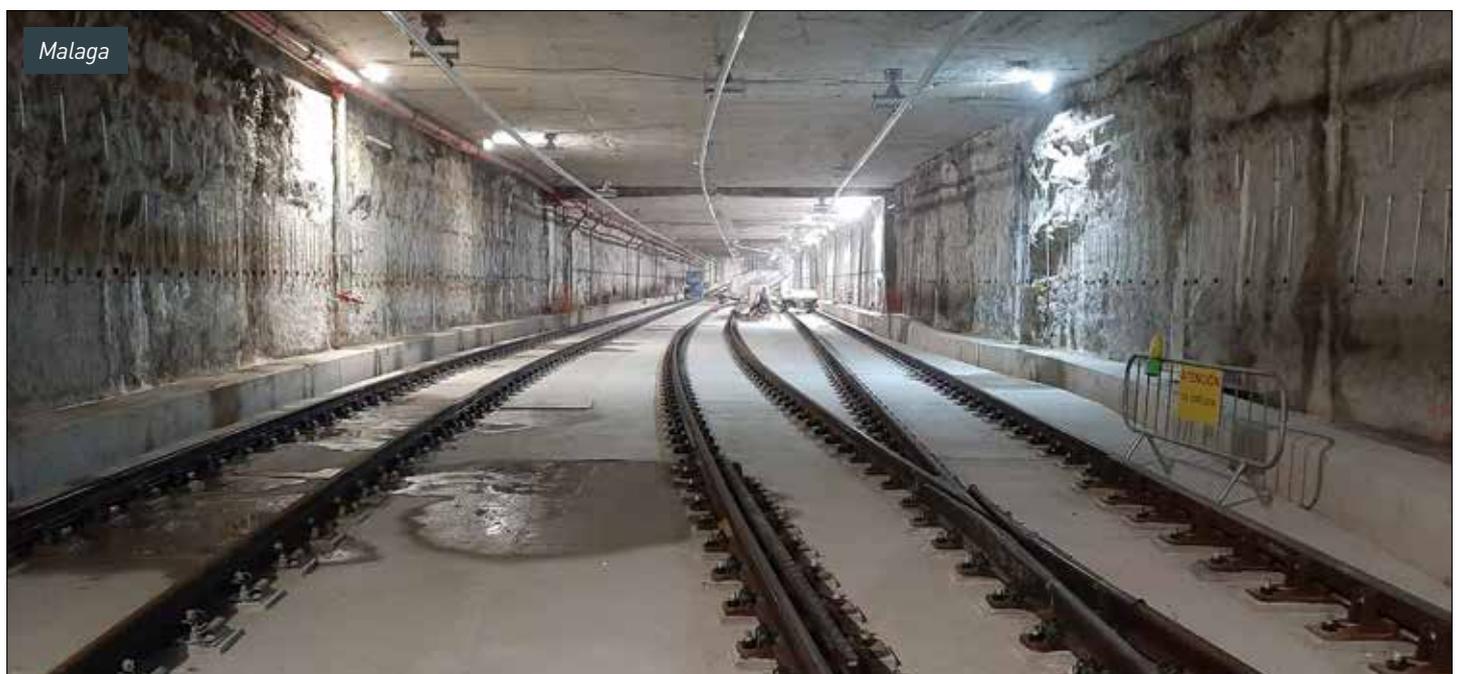
Tunnelling Master and Degree courses in several Universities:

UPM Polytechnic University in Madrid, UPC Cataluña, UPV Valencia, Univ. Cantabria, Univ. La Coruña, Univ. Castilla la Mancha, Univ. Granada and Univ. Sevilla. All courses with a Discipline of Civil Eng ECTS (European Credit System, according to the European Higher Education Area).

XVII Edition “Master in Tunnels and Underground Works”. The Master’s degree is currently a Post-Graduate Master Course from the National University of Distance Education (UNED), with an equivalence of 60 ECTS and is training recognized by the ITACET (International Tunnelling Association).

The teaching cycle, which includes 1500 teaching (contact) hours and a Master’s thesis (plus individual study, design practices, etc.), has allowed us to train numerous specialists in the fields of Design, Construction and Maintenance of Tunnels and Underground Works over 16 years, and many of our students have successfully carried out tunnelling works in the Public and Private sectors.

To offer the highest quality of teaching, since 2014, AETOS has collaborated with the Spanish National Distance University (UNED) and with the Spanish Professional Association of Civil Engineers (Colegio de Ingenieros de Caminos), to (i) reach a wider audience, (ii) to maintain and update the contents, and (iii) to incorporate new technological advances and experiences into our Educational Program. This has allowed us to develop a state-of-the-art online teaching Program and enrol more than 350 students from 18 different nationalities.



Malaga

# Sweden



**Name:** Swedish Rock Engineering Association

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

**Number of Members:** 100 corporate members from public and private clients, contractors, suppliers, mining companies, consulting firms, institutions and research organizations

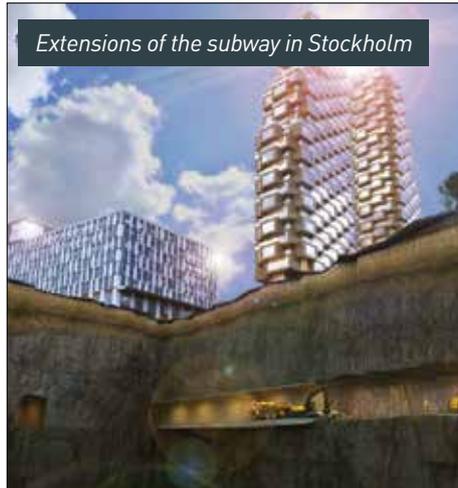
## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

Five committees constitute the backbone of the Swedish Rock Engineering Association (Svenska Bergteknikföreningen). These working groups are: Yearly Congress, Young Members, International, Competence Development and the national group of Rock mechanics. The association works towards the sustainable use and development of underground space. The main activity of the association is the annual Swedish congress where a significant part of the Swedish industry gathers. Due to the pandemic the physical event was cancelled. The Young Member's mentor program, DevelopYM, that was launched in 2018 continues. 'International' has been working towards an increased Swedish participation in ITA activities. We are now represented in all relevant Working Groups within the ITA. Competence Development (since 2020) is the group within the Swedish Rock Engineering Association that is responsible for accreditations of educators and certification of grout, bolt and shotcrete workers. During 2021 this was developed

to include shot fire licensees as well. The national group of Rock mechanics is the Swedish representative of the ISRM.

The association's proudest accomplishment of 2021 was the development of the Children's book "Vinnie and the Metro" (in Swedish "Bojan och Tunnelbanan"). The book has been distributed for free to more than 12,000 children between the ages of 3 and 6 years old where they learn how to build tunnels in hard rock. It is planned to be a giveaway at the WTC 2022

Extensions of the subway in Stockholm



## CURRENT TUNNELLING ACTIVITIES STOCKHOLM BY-PASS (E4 FÖRBIFARTEN, STOCKHOLM)

This project includes an 18km long road tunnel. When ready this tunnel will be one of the longest and most complex highway tunnels in the world.

### West Link - Korsvagen station (Västlänken, Gothenburg)

The West Link is a new double-track rail tunnel to strengthen the labour market in Gothenburg and West Sweden. Giving commuter and regional trains their own tracks in a tunnel beneath central Gothenburg will double the capacity of Gothenburg's Central Station. The expansion of the rail infrastructure in Gothenburg also enables future development of the city above ground. The Korsvagen section, is approximately 3.2km, and has a tunnel system of very complex geometries as well as tunnels with low rock overburden.

### Extensions of the subway in Stockholm

Building the new Hagastaden metro station is a large-scale and highly technical complex project below central Stockholm. It is surrounded by residential buildings, Karolinska university hospital and Gustaf Vasa Church. Traffic above and below ground will go on as usual. Hagastaden Station consists of four entrances, one in the hospital, two ticket halls and the metro tunnel with an accompanying service tunnel and connection with the existing metro system. A high requirement for health and safety and sustainability using the classification CEEQUAL is required.

### Reconstruction of Slussen Stockholm incl new underground bus terminal

Slussen is a central area of Stockholm, by the lock between Lake Mälaren and the Baltic Sea. This is an important hub in the city, and a large underground bus station is under construction in the area. The construction works were ongoing through 2021.

### City Link tunnel

This tunnel project has a length of 13.4km and a diameter of 5m and is sited approximately 50-100m below central Stockholm and began construction during 2020. The project will provide northern and southern parts of Stockholm with a new electricity supply. The project includes six ventilation shafts, elevator systems and the construction of technical buildings for electrical equipment. A 100m deep shaft was completed during 2020. From this

West Link - Korsvagen station



shaft a 250m long tunnel will run under the Stockholm's ström lake. The TBM tunnelling works started in 2020.

**HYBRIT: A unique hydrogen storage facility in Luleå**

The HYBRIT initiative was launched in 2016

by the three owners; SSAB, LKAB and Vattenfall. The pilot plant for the Hydrogen Storage facility will play a very important role in the overall value chain for fossil-free iron and steel production. Rock caverns and connecting tunnels have been constructed in the rock and a ventilation

shaft drilled from the top of the rock down to the upper part of the rock cavern. At the end of 2021, the compressor that will pressurise the hydrogen gas for storage was lifted into place.

**FUTURE TUNNELLING ACTIVITIES**

**Ostlänken, the East Link high speed rail**

The new high-speed rail system south of Stockholm. Design and planning is ongoing. The project includes 12 single rail tunnels and 15 double rail tunnels. The longest tunnel will be 6km and the shortest will be 100m long. Construction is planned to start in 2024.

**SKB Forsmark, final repository nuclear fuel**

Planning is continuing for Sweden's final repository for spent nuclear fuel. The process of obtaining the necessary permits is ongoing. The construction is ready to start as soon as permission is granted.

**Hydrogen storage in Gällivare**

This is a large, lined rock cavern project in northern Sweden, in the Gällivare municipality. It will be the world's largest facility for Hydrogen storage when completed.



HYBRIT: Hydrogen storage facility in Luleå

**EDUCATION ON TUNNELLING IN THE COUNTRY**

Civil Engineering 3 years (BSc) or 5 years (MSc) as well as PhD studies is offered at several technical Universities. Courses include engineering geology, site investigation, rock mechanics and hydrogeology.

Chalmers University of Technology (Gothenburg), KTH (Stockholm), Luleå University of Technology (Luleå), and Lund University (Lund).

At Uppsala University (Uppsala) courses focus on geology, engineering geology and geophysical investigations.

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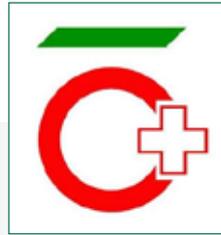
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# Switzerland

**Name:** Swiss Tunnelling Society (STS)

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

**Number of Members:** 507 members (thereof 85 young members), 90 corporate members



## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

- **August:** General Assembly in Aarau, Switzerland
- **September:** Swiss Tunnel Colloquium in Lucerne, Switzerland
- **November:** European Underground & Tunnel Forum (EUTF) annual meeting in Madrid, Spain  
Additionally, the STS young members (STSym) hosted the following events.
- **August:** Geological Hike, Leglerhütte Glarus, Switzerland
- **Nov/Dec:** STSym - Drinks in Lucerne, Lausanne and Zurich, Switzerland
- **December:** Part of the young member digital celebration of World Tunnel Day

## CURRENT TUNNELLING ACTIVITIES

### Construction of new safety gallery at Kerenzerberg Tunnel

Located in the canton of Glarus on the west-east axis of the motorway A3, the Kerenzerberg Tunnel plays an important role from both a local and trans-regional perspective. After 30 years of operation, Switzerland's fifth longest road tunnel is being refurbished and upgraded in terms of safety, with completion scheduled for 2026. A key component of the project for the Federal Roads Office (FEDRO/ASTRA) is the construction of a safety gallery. The new gallery is being built next to the road tunnel and will have a length of 5,504m. Approximately every 300m there will be a cross passage between the two tubes (emergency exits). In the upper section of the safety gallery, an exhaust duct will be provided to extract the fumes in the event of a fire in the road tunnel. The excavation work began in summer 2020 from both portal sides, largely by blasting. Since July 2021, the main section of the gallery has been excavated from the western portal using a TBM. The new safety gallery is expected to be completed in 2024.

### Second Gotthard Tunnel Tube

Located on the north-south axis of the A2 motorway, the Gotthard Tunnel connects the cantons of Ticino and Uri between Airolo and Göschenen. The existing two lane

motorway tunnel was opened in 1980. As part of the 'Gotthard conservation concept', efforts were made to identify and investigate different feasible options for conservation. The best option to ensure the vital north-south connection remains open during the renovation of the existing tunnel tube was the construction of a second tunnel. On 27th June 2012, the Swiss Federal Council decided in favour of this option. This solution significantly increases the level of safety in the Gotthard Tunnel. When the project is complete, both tubes will provide single-lane operation with one standard lane and one service lane in each direction.

The planned second tunnel tube through the Gotthard has a total length of 16,866m. It runs at a standard clearance of 70m from the existing tunnel and 40m from the service and infrastructure tunnel located east of the existing Gotthard Tunnel. After preparing works in 2020 for securing the installations sites from avalanches and other natural hazards the tunnelling construction works has in 2021 with the blasting of the new exits of the service and infrastructure tunnel. To reduce the risks and optimise the overall

construction programme, the northern and southern fault zones (approx. 570m) will be conventionally excavated in advance. Once this has taken place, two TBMs will be pushed through the areas. The fault zones will be reached from the north via separate access tunnels of approx. 4.4km, and from the south of approx. 5km. These also started construction in 2021. The tunnels will be excavated using TBMs with a diameter of approximately 7m. The tender for the two main lots using a 12.3m diameter TBM each for the excavation of around 7km tunnel is ongoing. Their adjudication is planned for spring 2022.

### Bypass road for the Evouettes

The Evouettes Tunnel is a bidirectional, single-tube, 657m long road tunnel under construction in Wallis, Switzerland. The commissioning is planned for 2024.

The ground conditions, comprising loose materials, are technically challenging in terms of de-sign and construction, with the presence of scree materials at the start of the excavation, followed by debris-flow cone formations and finally the local moraine.

The decision was taken to design and undertake a sub horizontal jet-grout umbrella. This technique also allows for a full-face excavation, thanks to the presence of 45 jet columns around the excavation perimeter and 13 in the face.

Lastly, the jet grouting has induced over-consolidation of the loose ground surrounding the tunnel. The project is currently in the processing stage to restart using a new pre-support solution of



umbrella vaults and GFRP anchors.

In 2021, the project achieved several milestones:

- 371m/657m of the tunnel has been excavated from the north
- 81m has been excavated from the south
- 50% of the safety tunnel with a cross section of 12m<sup>2</sup> has been built
- North and South cut & cover has been concreted
- Lining works in the tunnel has started

**Expansion of Bern RBS Station:**

The “Expansion of Bern RBS Station” (Switzerland) project involves building a new underground station as well as the railway line accessing it. The new RBS Station consists of two 200–210m long, 26m wide and 17m high station caverns, which lie 12m beneath the existing railway tracks of the Bern Central Station. The 1.5km access railway line has different cross sections and runs both underground and above ground (open cut).

In 2021, the project achieved several milestones:

- The access tunnel (Ø = 7m) to the station caverns, which underpasses several tracks west of Bern Central Station, was successfully completed.
- The main construction works for the two station caverns (200 m long, 26m wide and 17m high) started and progressed as scheduled.
- The main construction works for the access line started and is progressing as scheduled. The excavation works (heading and benching) for the double track tunnel (sections “Henkerbrünli” and “Bierhübeli”) celebrated break-through on April 30th.

**STATISTICS**

**1. Length of tunnels excavated during 2021**

5,000m/40% TBM

**2. Amount (USD or EUR) of tunnelling / underground space facilities awarded in 2021:**

€500M.

**3. List of tunnels completed**

Tunnel Neuhof (Kt. AG, 362m)

**4. List of tunnels under construction**

*Rail Tunnels:*

Albula Tunnel (RhB, 5,860m), RBS Bern Station Expansion (RBS, 1,200m), Ligerz Tunnel (SBB, 2,119m), Wylerfeld Tunnel (SBB, 300m), LEB Tunnel Lausanne (LEB, 1,700m)

*Road Tunnels:*

Second Gotthard Tunnel Tube (ASTRA, 16,918m), Safety Gallery Leissigen Tunnel (ASTRA, 2,200m), Safety Gallery Cholfirst Tunnel (ASTRA, 1,250m), Safety Gallery Kerenzberg Tunnel (ASTRA, 5,504m), Visp Tunnel 2nd Tube (Kt. VS, 2,600m), Rehabilitation Tunnel Belchen (ASTRA, 3,200m), Gubrist Tunnel 3rd Tube (ASTRA, 3,230m), Safety Gallery Crapteig Tunnel (ASTRA, 1,984m), Riedberg Tunnel (Kt. VS, S: 555m, N: 483m), Safety Gallery Rofla Tunnel (ASTRA, 1,018m), Tunnel de déviation des Evouettes (Kt. VS, 657m), Tunnel des Nations (Kt. GE, 870m), Gallery Schwamendingen and Schöneich Tunnel (ASTRA, 1,680m), Kaiserstuhl Tunnel (Kt. OW, 2,081m)

*Other Projects:*

Nant de Drance Pumped Storage Power Plant, Hydro Power Plant Ritom, CERN HILUMI LHC Project

**EDUCATION ON TUNNELLING IN THE COUNTRY**

ETH Zurich, Department of Civil, Environmental and Geomatic Engineering  
University of Applied Sciences, in various cities

- The excavation works (under cover) in the “Eilgut” sector (east of Bern Central Station) continues successfully.

**FUTURE TUNNELLING ACTIVITIES**

**Rail Tunnels**

Lötschberg Basetunnel II (BLS, 35,000m),

Stadelhofen Tunnel (SBB, 7,000m), Brüttener Tunnel (SBB, 11,000m), Zimmerberg Tunnel II (SBB, 11,000m), Crossrail – Lake Crossing Luzern (SBB, 5,500m), Geneve Station Expansion (SBB, 1,500m), Heitersberg Tunnel II (SBB, 5,000m), Grimsel Tunnel (SBB, 21,720m)

**Road Tunnels**

Morschacher/Sisikon Tunnel (Kt. SZ/UR, 8,037m), Vingelz Tunnel (Kt. BE, 2,300m), City Tunnel (Kt. BE, 700m), Port Tunnel (Kt. BE, 1,800m), Weidteile Tunnel (Kt. BE, 1,400m), Safety Gallery Fäsenstaub Tunnel (ASTRA, 1,460m), Bypass Luzern (ASTRA, 3,450m), Bypass Bern Ost (ASTRA, 4,000m), Rosenberg Tunnel 3rd Tube (ASTRA, 1,435m), Safety Gallery Tunnel Gei and Brusei (ASTRA, 485m), Twann Tunnel (ASTRA, 1,700m), Nischenberg Tunnel (ASTRA, 1,640m), Rhein Tunnel (ASTRA, 4,500m), Tunnel Melide-Grancia (ASTRA, 1,800m), Tunnel Cargo Station St. Gallen (ASTRA 2,400m)

**Other Projects:**

Cargo Sous Terrain Zurich – Haerkingen (CST, 70,000m)



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# Turkey



**Name:** Turkish Road Association

**Type of Structure:** TRA is an open association. Its function is to promote, coordinate and conduct studies and research in the fields of roads, highways, motorways, tunneling, and other underground works.

**Number of Members:** As of January 1st, 2022, TRA has 504 members of which 438 are individuals and 66 are corporate members.

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

A doctoral thesis, a master's thesis, and three papers/articles on Highway Engineering and Transportation were given awards in 2021, under the "TRA Award Regulation". International activity included a meeting held under the auspices of the Ministry of Transport and Infrastructure and the General Directorate of Highways, with the Turkish Road Association and the Turkish Asphalt Contractors Association. The 8th National Asphalt Symposium and Exhibition was held during the 8th and 9th December 2021 with the theme "Asphalt 4.0 for Digital Transformation and Mobility".

## CURRENT TUNNELLING ACTIVITIES

As of 2021, there are 465 tunnels on highways in Turkey with a total length of 650km. The longest tunnel on State Roads is the Ovit Tunnel has a length of 14,000m and is Turkey's 1st, Europe's 2nd, and the world's 4th longest double-tube tunnel. The widest tunnel with an opening of 21.9m is on the Kuzey Marmara Motorway which has a total of eight (2 x 4) tunnels. In 2021, construction works continued on

100 tunnels located on Turkey's highways. These tunnels have a combined length of 419km. Here is a summary of some of the major tunnels located on Turkey's major roads:

Highway tunnels on the Antalya-Mersin Highway: There are 34 tunnels with a combined length of 45,700m on the 440km long highway, 19 out of the 34 have been completed, amounting to a total length of 15,000m. The remaining 15 tunnels with a combined length of 30,700m are under construction.

There are three tunnels under construction on the Western Black Sea Coastal Road, T0 (2 x 236m) - T4 (2 x 4,607m) and T5 (2 x 3,090m) have a combined length of 7,833m.

Three out of the nine tunnels located along a mountainous area of the 149km long Karaman-Mut-Silifke Highway have been completed. These have a combined length of 2,176m.

30 tunnels with a total length of 31,207m have been designed along the Konya-Hadim-Alanya route, 13 with a combined length of 9,524m have been completed. Currently, there are ongoing works on three

tunnels, the Karapınar (697m), Kaplanhanı 3T (665m) and Kaplanpınar 2T (363m).

Karstic voids measuring 400m<sup>2</sup> were encountered during the excavation works of the 7,360m long double tube Alacabel Tunnel. This route connects the Central Anatolian region to the Mediterranean region. The tunnel passes at an elevation of 1,525m; 6.146m of the left tube and 5,905m of the right tube, i.e. 12.051m in total have been excavated, boasting a completion rate of 81.48%. Additionally, 56.78% of the concrete lining works have been completed.

The 5,000m long Demirkapı tunnel is located at an elevation of 835m along the Konya-Beyşehir-Serik-Antalya route. This particular route connects Central Anatolia to the Mediterranean Region. The excavation works for the Demirkapı Tunnel have been completed, along with 71,33% of the concrete works. There are ongoing constructions works on three other tunnels.

There are 13 tunnels (36,509m) along the 238km long Rize-Erzurum route which connects the Eastern Black Sea Region to Eastern Anatolia. Nine out of these with a combined length of 21,849m have been completed, while there are ongoing works for the Kırık, Dallıkavak and İkizdere tunnels that have a combined length of 13,466m.

The 4,700m long twin-tube Çirışli Tunnel is under construction on the Erzurum-Çat-Bingöl Highway. This tunnel is expected to be completed in 2023.

The 5,905m long twin-tube Eğribel Tunnel lies along the Sivas-Giresun route that connects Central Anatolia to the Black Sea Region. Excavation support, concrete lining, and asphalt works have been completed for the right tube. Ongoing works include electronic and lighting systems. This tunnel will be opened to traffic in 2022.

There are two double tube tunnels (2 x 5,710m) located along the Çanakkale-Ezine-Ayvacık-Küçükkuşu Highway (along the Kazdağ Ramps). Works completed include, concrete lining on the 1,693m long T1 Tunnel. Excavation support works for the 4,017m long T2 tunnel (left tube). Ongoing works include, concrete lining, right tube excavation works and other support works.

There are six tunnels with a combined length of 5,952m located along the Esenköy Pass which is a part of the Yalova-Çınarcık-Armutlu Highway. Excavation support works have been completed on the T1 (2,053m) tunnel where concrete lining works are ongoing. Excavation support works have been completed for the T2 (1,579m) tunnel. There are ongoing excavation support works on the T3 (862m), T4 (693m) and T5 (294m) tunnels. The exit portal works have commenced on the T6 (471m) tunnel.



Zigana tunnel

The 3,137m long Güzeldere twin-tube Tunnel is located along the Van-Başkale Highway, 3,400m of excavation and support works have been completed.

The 5,900m long twin-tube Ilgar Tunnel lies along the route that connects Ardahan, Posof and Türkgözü, 500m of excavation support works have been completed. The tunnel will be opened to traffic in 2023.

Ten tunnels with a combined length of 28,026m have been designed along the 173 km long route that connects the Eastern Black Sea Region to Eastern Anatolia. There are ongoing works on eight of these, namely, (Sünebeli 2. x 5,220m), Yakaköy (1,650m), Kemaliye (3,170m), Toybelen (1,539m), Kozlupınar (3,105m), Yeşilyurt (2,470m), Vali Recep Yazıcıoğlu (2,030m) and Dutluca (2,734m)

Construction works have been completed on 32 of the 36 tunnels located along the 278 km long Trabzon-Aşkale highway which connects the Central Black Sea Region to Inner and Eastern Anatolia. The combined length of these 32 tunnels is 29,805m. The remaining four tunnels, the Zigana, Vauk 1 & 2, and Kop with a combined length of 28,411m are under construction.

The 8,560m (2 x 4,280m) long Geminbeli Tunnel which lies along the Zara-Geminbeli-Suşehri Road has undergone 8.278m of excavation and support works, along with 5,585m of concrete lining works.

There are seven single tube tunnels totalling 16,608m in length along the Refahiye - Kuruçay - İliç - Kemaliye - Dutluca Road. A total of 2,198m of excavation support works have been performed on the T1 (Yakaköy) and T2 (Kemaliye) tunnels.

There are six double tube tunnels with a combined length of 9,492m on the first section of the Ordu Ring Road. The length of this section is 10.7km. The double tube tunnels, named Boztepe (2 x 3,311m) and Öceli (2 x 2,019m) have been completed. In regards to the other tunnels included in the scope of this Project, excavation works have been completed on the Terzili Tunnel (2 x 1,180m) with concrete lining works ongoing. Excavation works have started on the tunnels Akçatepe -1 (2 x 440m) and Akçatepe -2 (2 x 1,740m) whereas the Turnasuyu Tunnel (2 x 802m) is still in design.

While construction works continue on tunnels T1 and T2 located on the İstanbul - Şile - Ağva Road, there are seven double tube tunnels that have been completed (T3 - T4 - T5 - T6 - T7).

The Halkalı - Ispartakule double tube tunnel (2 x 5.978m) is being constructed by TBM as a part of the Halkalı - Kapıkule

Yusufeli Dam Relocation Road Tunnels



(İstanbul) Railroad Project.

There is a double-deck double tube tunnel being built for the Halkalı-Airport Metro line. The right tube measures 28,132m and the left 27,611m long. The metro line is under construction via TBM and NATM. 60% of the tunnel has been completed. The 31,500m route is expected to be opened in 2022.

Within the scope of the Gayrettepe-Kağıthane new airport subway line, TBM construction works have been completed on a section of 2 x 34,140m, and construction works are continuing with the NATM method at a section of 2 x 3,507m. It is planned to be put into service at the end of 2022.

The Başakşehir – Kayaşehir Subway Line is 6,187m long with an estimated travel time of 19 minutes through eight stations. A double-decker tube is being constructed by TBM and 72% of the excavation work has been completed.

The Sabiha Gokcen Rail Network is 14,536m long and designed for the NATM method. The rail systems have been installed and designed as a double-deck model. The construction works have been completed, whereas the construction works for the pedestrian crossing link are being carried out. The left tube is 810m long and the right 380m long, both being constructed by NATM.

The İstanbul Bakırköy – Bahcelievler –

Kirazli Subway Line will be 13,111m long. The line contains eight double-deck stations which have been constructed by TBM. There are also TBM works between the Bakırköy - Incirli stations. Excavation works have been completed on the 2 x 1.035m section using NATM. Construction works are being carried out via the TBM method on the 2 x 6,500m section.

Tunnel construction works are being carried out on the Kocaeli, Gebze - Darıca Coastal Metro line. The TBM method is being used on the 3,398m section of the left tube and the 3,376m section of the right tube. NATM is being used on the 10,721m section of the right tube and the 10,698m of the left tube.

On the Southeastern Anatolia Project, the Babakaya and Silvan Tunnels are being built to transport water from the Silvan Dam which is under construction. The Babakaya Tunnel is 5,320m long, with a 7m i.d. with two tubes. This tunnel will transport water from the dam into the Silvan Tunnel, which will carry 212m<sup>3</sup> of water per second. It is being constructed as a single tube with a length of 13.4km and a diameter of 10m. The water in the dam will be transferred to the 97.6km long canal through the Silvan and Babakaya Tunnels. 23% of the Project has been completed with 960m of excavation work completed by TBM. The project is expected to be completed within two years.

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## FUTURE TUNNELLING ACTIVITIES

### Subway Lines

- Üsküdar-Harem Line (İstanbul) (2,200m)
- Eyüp-Bayrampaşa Line (İstanbul) (3,200m)
- Sefaköy- Beylikdüzü-Tüyap Line (İstanbul) (19,050m)
- İTÜ-İstinye Funicular Line (İstanbul) (2,650m)
- Esenyurt Sadetdere Line (İstanbul) (4,600m)
- Sabiha Gökçen Airline-Kurtköy Line (İstanbul) (6,000m)
- Yenikapı-İncirli-Sefaköy Line (İstanbul) (14,620m)
- İncirli Gayrettepe-Söğütluçeşme Line (İstanbul) (31,000m)

### Highway

- Silifke-Mut T4 Tunnel (Mersin) (861m – 858m)
- Mazıkıran Tunnel (Sivas) (4,071m – 4,071m)
- Dokuzdolambaç Tunnel (Kayseri) (4,501m – 4,491m)
- Ziyaret Tunnel (Sivas) (640m - 640m)
- Berçin Tunnel (Kayseri) (6,542m – 6,542m)
- Salman Tunnel (Çorum) (380m – 380m)
- Turnasuyu Tunnel (Ordu) (788m – 816m)
- Turhal-Zile T1 Tunnel (Tokat) (1,227m – 1,193m)
- Çukurçayır Tunnel 2 (Trabzon) (159m – 280m)
- Gölçayır Tunnel 2 (Trabzon) (762m – 727m)
- Eskişehir-Seyitgazi-Kirka (Eskişehir-Seyitgazi) T1-T3 Tunnel (8,869m – 9,894m)
- Merzifon-Gürbulak Highway (Between Merzifon-Koyulhisar) T1 – T29 Tunnel (55,302m – 55,038m)
- Mardin Ring Road T4 Tunnel (Mardin) (1,105m – 1,175m)
- Merzifon - Gürbulak Highway (Erzurum) T1 – T10 Tunnel (29,897m – 29,627m)
- Bartın Ring Road Tunnel (Bartın) (2,570m – 2,570m)
- Sivas South Ring Road Tunnel (Sivas) (1,060m – 1,060m)
- Merzifon - Gurbulak Highways (Sivas-Erzincan) T1 – T28 Tunnel (67,293m – 68,145m)
- Seferihisar – Kuşadası (İzmir) Government Road T1 – T7 Tunnel (78m – 2,965m)
- Bodrum Ring Road T1 – T4 Tunnel (Muğla) (9,027m – 8,847m)
- Akşehir – Yalvaç – Şarkikaraağaç Road Cankurtaran Tunnel (Konya) (4,373m – 4,403m)
- Limankalesi Tunnel (Mersin) (850m – 850m)



Alacabel tunnel

- Bağcılar Tunnel (Mersin) (135m – 110m)
- Aydıncık Tunnel (Yozgat) (2,800m)
- Kabadüz Tunnel (Ordu) (305m)
- Palu-Beyhan-Gökdere Province Road (Elazığ-Bingöl) (1,890m)
- Şirnak - (Pervari - Narlı) Dist. Road T1 Tunnel (Şirnak) (2,844m)
- Bulancak - Kovanlık Province Road (Giresun) T2 –T4 Tunnel (2,924m)
- (Borçka - Artvin) Dist.- Murgul Province Road (Artvin) (290m)
- Yiğilca Tunnel (Düzce) (292m)
- Fatsa Çatalpınar T1 Tunnel (Ordu) (2,373m)

### Railway Tunnels

- Aksaray-Ulukışla-Yenice High Speed Rail (Niğde) (48,831m)
- Bandırma –Bursa – Yenişehir –Osmaneli – High Standart Railway (Bursa-Bilecik) (8,571m)
- Yerköy-Kayseri HSR Project (Yozgat-Kayseri) (12,991m)
- Ankara –İzmir High Speed Railway T 3-4 (Afyon) (1,140m)
- Ankara –İzmir High Speed Railway T 15-24 (Kütahya - Uşak) (6,599m)
- 3. Bridge-3.Airport Halkalı Railway Project (İstanbul) (37,900m)
- Yerköy-Kayseri Project (Yozgat-Kayseri) (13,100m)
- Konya Seydişehir Railway Project (Konya) (17,200m)
- Çorum-Merzifon Railway Project (Çorum-Amasya) (19,035m)
- Delice-Çorum Railway Project (Kırıkkale-Çorum) (19000m)
- Delice-Kırşehir Railway Project (Kırşehir) (9,229m)
- Ulukışla-Yenice Railway Project (Niğde-Adana-Mersin) (48,832m)
- Konya-Aksaray Railway Project (Konya-Aksaray) (4,590m)

- Seydişehir-Antalya Railway Project (Konya-Antalya) (81,530m)
- Çetinkaya Malatya Railway Project (Sivas-Malatya) (43,040m)
- Çerezköy-Ispartakule (Tekirdağ-İstanbul) (2,800m)
- Bursa-Gemlik Railway Project (Bursa) (10,090m)
- Sivas Erzincan Railway Project (Sivas-Erzincan) (169,820m)
- Burdur-Antalya Railway Project 8Burdur-Antalya) (92,440m)
- Erzurum-Kars Railway Project (Erzurum-Kars) (41,300m)
- Erzincan-Erzurum Railway Project (Erzincan-Erzurum) (54,520m)
- Siirt-Kurtalan Railway Project (Siirt) (16,380m)
- 3. Airport Müselles-Çatalca Railway Project (İstanbul) (7,385m)
- Malatya Elazığ Railway Project (Malatya-Elazığ) (28,450m)
- Elazığ-Diyarbakır Railway Project (Elazığ-Diyarbakır) (43,335m)
- Eskişehir Afyon Railway Project (Eskişehir-Afyon) (15,560m)
- Afyon Burdur Railway Project(Afyon-Burdur) (23,940m)
- Merzifon Samsun Railway Project (Amasya-Samsun) (50,611m)
- Aksaray-Kayseri Railway Project (Aksaray-Kayseri) (13,460m)
- Gaziantep Şanlıurfa Railway Project (Gaziantep-Şanlıurfa) (2,090m)
- Adıyaman –Gölbaşı Railway Project (Adıyaman) (28,440m)
- Nusaybin Cizre-Silopi-Habur Railway Project (Mardin-Şirnak) (9,500m)
- Malatya-Narlı Railway Project (Malatya) (24,182m)

\*There can be changes with the length of the roads during the project stage.

## STATISTICS

## 1. Length or volume excavated - % mechanized/% conventional during 2021

Total Excavation			
Length (m)		Length (m)	
35,594.9m		35,594.9m	
Mechanized (%)	Conventional (%)	Mechanized (%)	Conventional (%)
22.57	77.43	22.57	77.43

## 2. Amount (USD or EUR) of tunnelling/underground space facilities awarded in 2021

€3,501,942,200

## 3. List of tunnels under construction

## Subway Lines

- Tavşantepe - Tuzla Subway Line (İstanbul) (2,050m – 2,070m)
- Çekmeköy Sancaktepe – Sultanbeyli Subway Line (İstanbul) (3,350m – 3,355m)
- Dudullu-Bostancı Subway Line (İstanbul) (91.2m – 91.2m)
- Göztepe-Ataşehir-Ümraniye Subway Line (İstanbul) (6,220m – 6,233m)
- Halkalı New Airport (İstanbul) (28,132m – 28,132m)
- Gayrettepe – Kağıthane New Airport (İstanbul) (3,507m – 3,507m)
- Gebze Darıca Beach Line (Kocaeli) (14,119m – 14,074m)
- Bağcılar Kirazlı-Küçükçekmece Halkalı Subway Line (İstanbul) (52m)
- Kabataş-Beşiktaş-Mecidiyeköy-Mahmutbey Subway Line (İstanbul)
- Mahmutbey-Bahçeşehir-Esenyurt Subway Line (İstanbul)
- Ataköy Basın Express – İkitelli Subway Line (İstanbul)
- Boğaziçi U./Hisarüstü-Aşıyan Coastal Funicular Line (İstanbul)
- Tavşantepe Tuzla Line (İstanbul) (1,300m)
- Hastane-Sarıgazi-Çekmeköy-Taşdelen-Yenidoğan Line (İstanbul) (6,900m)
- Eminönü-Eyüpsultan-Alibeyköy Line (İstanbul) (1,100m)
- Bakırköy İDO – Bağcılar Kirazlı Line (İstanbul) (8,400m)
- Sabiha Gökçen Airline-Tavşantepe Line (İstanbul) (7,400m)
- Gayrettepe-Kemerburgaz-İstanbul Airline (İstanbul) (37,500m)
- Halkalı Arnavutköy - İstanbul Airline (İstanbul) (31,500m)
- Başakşehir –Kayaşehir Line Extension (İstanbul) (6,200m)
- Altunizade – Çamlıca (İstanbul) (4,000m)
- Sirkeci-Kazlıçeşme Line (İstanbul) (8,300m)

## Highway Tunnels

- Kırık Tunnel Highway Tunnel (Erzurum) (7,105m – 7,105m)
- Eğribel Tunnel Highway (Giresun) (5,905m – 5,905m)
- Erdemli – Silifke Tunnel (Mersin) (985m – 985m)
- Denizli-Acıpayam Tunnel (2,460m – 2,640m)
- Seydişehir Tunnel (Konya) (7,361m – 7,355m)
- Denizli Acıpayam Honoz Tunnel (2,640m – 2,640m)
- Alacabel Tunnel (Konya-Antalya) (7,361m – 7,355m)
- Sertavul Tunnel (Karaman-Mersin) (3,303m – 3,283m)
- Mazkırın Tunnel (Sivas) (4,071m – 4,071m)
- Dokuzdolambaç Tunnel (Kayseri) (4,501m – 4,491m)
- Ziyaret Tunnel (Sivas) (640m – 640m)
- Berçin Tunnel (Kayseri) (6,542m – 6,542m)
- Kırkdilim Pass T1 -T3 Tunnel (Çorum) (4,013m – 4,185m)

- Salman Tunnel (Çorum) (380m – 380m)
- Terzili Tunnel (Ordu) (1,180m – 1,180m)
- Akçatepe Tunnel 1-2 (Ordu) (2,180m – 2,180m)
- Turnasuyu Tunnel (Ordu) (788m – 816m)
- Erkenek On-Off Tunnel (Malatya) (721m – 721m)
- Akyazı Tunnel (Trabzon) (2,487m – 2,392m)
- Beşirli Tunnel (Trabzon) (1,028m – 1,012m)
- Bahçeçik Tunnel (Trabzon) (540m – 529m)
- Boztepe Tunnel (Trabzon) (700m – 647m)
- Çukurçayır Tunnel 1-2 (Trabzon) (495m – 622m)
- Gölçayır Tunnel 1-2 (Trabzon) (1,213m – 1,149m)
- Yeni Zığana Tunnel (Trabzon-Gümüşhane) (14,477m – 14,448m)
- Başar Tunnel (Trabzon – Gümüşhane) (2,534m – 2,356m)
- Dikkaya Tunnel (Trabzon – Gümüşhane) (290m – 301m)
- Of-Çaykara Dokap Tunnel (Trabzon) (3,880m – 3,336m)
- Pekün Tunnel (Gümüşhane) (6,350m – 6,350m)
- Yeniköy Tunnel (Gümüşhane) (620m - 560m)
- Pirahmet Tunnel (Gümüşhane) (400m – 480m)
- Hopa-Borçka T1 Tunnel (Artvin) (538m – 597m)
- Tatvan Bitlis Government Road T1 Tunnel (Bitlis) (1,950m – 1,950m)
- Buzlupınar T1 Tunnel (Bitlis) (237m - 229m)
- Şemdinli Province Road (Hakkari) (143m – 157m)
- Güzeldere Tunnel (Van) (3,107m – 3,116m)
- Dalıkavak Tunnel (Erzurum) (3,115m 3,095m)
- Çirişli Tunnel (Erzurum) (4,749m – 4,751m)
- Oba Tunnel (Antalya) (666m – 670m)
- Demirkapı Tunnel (Antalya) (5,000m – 5,000m)
- Gökçebelen Tunnel (Antalya) (11,001m – 11,089m)
- Phalesis Tunnel(Antalya) (1,306m – 1,277m)
- Dizlermezeci Tunnel (Bartın) (2,312m – 2,319m)
- Kastamonu İnebolu T1 – T5 (Kastamonu) (18,107m – 18,008m)
- Uzunkum Tunnel (Zonguldak) (240m – 233m)
- Geminbeli Tunnel (Sivas) (4,288m – 4,279m)
- Sünebeli Tunnel (Erzincan) (5,220m – 5,220m)
- Gelibolu-Ecebat Tunnel T3-T5 (Çanakkale) (3,853m)
- Kabadüz Tunnel (Ordu) (305m)
- Kiği-Yedisu Tunnel T1-T11 (Bingöl) (6,777m)
- Bağlı Tunnel (Şırnak) (1,955m)
- Eruh-Fındık Road (Siirt) (4,502m)
- Akyazı Tunnel (Trabzon) (441m)
- Kiremitli Yamaç Tunnel (Trabzon-Gümüşhane) (208m)
- Yağlıdere Tunnel (Giresun) (1,080m)
- Yusufeli Government Road (Artvin) (32,917m)
- Kuskunkıran Tunnel (Van/Bitlis) (2,306m)
- Sarıtaş Tunnel (Hakkari) (445m)
- Deliktaş Tunnel T2-T3 (Bitlis) (1,100m)
- Yaylapınar Uğuraçan Tunnel (Hakkari) (5,708m)
- Olur Ardanuç Tunnel (Erzurum) (3,490m)
- Pirinkayalar Tunnel (Erzurum) (2,272m)
- KAplanhanı-1 Tunnel (Antalya) (96m)
- Karapınar Tunnel (Antalya) (697m)
- Gemlik-Armutlu-Çınarcık-Yalova Road (Yalova) (7,950m)
- Yakaköy Tunnel (Erzincan) (1,650m)
- Kemaliye Tunnel (Erzincan) (3,170m)
- Sarıçiçek-1 Tunnel (Sivas) (2,700m)
- Türkgözü Road (Ardahan) (4,810m)
- Seferihisar – Kuşadası Government Road T3 Tunnel (İzmir) (455m)

## STATISTICS continued

- Fatsa – Aybasti – Reşadiye Province Road Fatsa Çatalpınar T1 Tunnel (Ordu) (2,373m)

**Railway Tunnels**

- Burdur- Antalya Project (27,935m – 27,935m)
- Erzurum – Kars Project (5,400m – 5.400m)
- Halkalı-İspartakule Railway Line (İstanbul) (5,987m – 5,987m)
- Yerköy- Kayseri Project (Yozgat) (13,100m)
- Konya –Seydişehir Project (Konya) (5,700m)
- Çorum – Merzifon Railway Project (Çorum) (19,035m)
- Delice-Çorum Project (Kırıkkale – Çorum) (19,000m)
- Bandırma –Bursa – Yenişehir- Osmaniye High Standard Speed Rail (Bilecik) (12,489m)
- Ankara –İzmir High Speed Railway T 8 – T13-14 (Kütahya) (7,160m)

**Drinking Water Tunnels**

- Afsar Bağlarbasi Hadimi Tunnel (Konya) (18,316m)
- Mersin Pamukluk Dam (Mersin) (4,618m)
- Yeni Yusufeli District (Artvin) (1,611m)
- Afsin Tunnel (Kahramanmaraş) (2,270m)
- Kahramanmaraş Tunnel (Kahramanmaraş) (1,824m)

**Irrigation Tunnels**

- Afsar Bağlarbasi Hadimi Tunnel (Konya) (18,316m)
- Kırıkkale-Kesikköprü Köprüköy Irrigation (Kırıkkale) (1,922m)

- Bolu Seben Taşlıyayla Project (Bolu) (1,155m)

**Mining Tunnels**

- Armutçuk I.and II.Block Floor Preparation (Zonguldak) (Single Tube – 110m)
- Armutçuk IV.Block Floor Preparation (Zonguldak) (Single Tube – 76.5m)
- Üzülmöz Asma Dilaver -320 Elevation Preparation of Mining Underground Structure (Zonguldak) (Single Tube-125m)

## EDUCATION ON TUNNELLING IN THE COUNTRY

Afyon Kocatepe University; Bilecik Seyh Edebali University; Bingöl University; Canakkale Onsekiz Mart University; Dicle University; Dokuz Eylül University; Düzce University; Eskişehir Technical University; Erzincan Binali Yıldırım University; Muğla Sıtkı Koçman University; Niğde Ömer Halisdemir University; Nisantasi University; Pamukkale University; Recep Tayyip Erdoğan University; Sivas Cumhuriyet University; Giresun University; İstanbul University – Cerrahpaşa; Karabük University; On Dokuz Mayıs University; Middle East Technical University; Sivas Cumhuriyet University; Şirnak University; Toros University; Zonguldak Bulent Ecevit University



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# Ukraine



**Name:** Ukrainian State Corporation on Construction of Underground and Tunnels

## CURRENT TUNNELLING ACTIVITIES

In spite of the escalation of the War in Ukraine, the construction of the Metro is on the up, with the government deciding to increase both the volume of work performed and the pace of construction.

Today, the metro is continuing its expansion in three Ukrainian cities, namely Kyiv, Dnipro and Kharkiv.

As of February 2022, two metro lines are

under construction in Kyiv.

Two station complexes (Mostytska and Prospekt Pravdy) and two tunnels are being built on the Syretsko-Pecherska line. The target date for commissioning is 2023.

Another milestone was achieved on the Syretsko-Pecherska line with the launch of a tender for the design work for the completion of the "Lvivska Brama" station.

Work on the construction of the fourth

metro line in Kyiv (three are currently in operation) has now been started.

Construction of metro stations continues in Dnipro city. The complex consists of three stations (Muzeina, Teatralna and Tsentralna stations). Work will be carried out with the use of loans from the European Bank for Reconstruction and Development. Work is currently being undertaken in eight tunnels using the drill and blast method. Overall completion is now over 35% of the total scope of work and the target with the commissioning date set for 2025.

The state authorities and Kharkiv city administration are also negotiating with the European Bank for Reconstruction and Development to continue the construction of two stations.

# 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:** 800+ members, 90+ corporate members at end 2020



## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

In 2021 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 despite the Covid 19 pandemic.

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 Mike King for his tireless work in the tunnelling industry and for the BTS for its 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
- The BTS Conference & Exhibition 2022, Oct 11th – 12th at the QEII Centre in Westminster, London

The BTS jointly with the Institution of Civil Engineers supports an All Party Parliamentary Group to engage with parliamentarians and promote tunnelling and the use of underground space as a sustainable form of infrastructure development.

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.

The BTS also continues to work with industry clients, contractors and consultants in an industry forum to review and improve health and safety cross the tunnelling industry. Transforming

Tunnelling Safety aims to transform the health and safety performance of UK tunnelling works and has embarked on a major project to increase openness, and to share best practice. This information is available to all through the BTS website <https://www.britishtunnelling.org.uk>

The BTS has begun a process for undertaking a further update of the Specification for tunnelling and this work continues.

2021 was the 50th anniversary of the BTS. This was a hugely significant milestone for the society. The BTS intends to publish a book celebrating 50 years of the BTS which will be available soon.

The BTS Young Members continues to deliver evening meetings, technical seminars, and social events for the development of young tunnellers. They recently held their young members conference for the first time since the beginning of the pandemic and this was a huge success.

## BTS Young Members

The young members continued to offer a wide range of activities including lectures, workshops, and socials. The BTSYM has close links with other ITA young member organisations and continue to develop relationships and co-host lectures and events.

A key part of their work in 2020 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.

# HEAVY-DUTY DEWATERING PUMPS FOR UNDERGROUND CONSTRUCTION WORKS



Tsurumi are Japanese manufacturers of electric submersible pumps and have been pumping groundwater in **mines, tunnels** and **shafts** since 1924.

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**CURRENT TUNNELLING ACTIVITIES**

**Thames Tideway Tunnel**

During 2021 and early 2022 tunnelling on the Thames Tideway contracts, comprising 25km of 7.2m diameter tunnel at depths up to 66mm under the River Thames connecting the previously constructed Lee Tunnel continued and has mostly completed.

**High Speed Two**

2021 has seen the continuation of the design and construction phase for the main works civils contracts for the proposed high speed rail line between London and Birmingham and the commencement of

construction. These contracts comprise 35km of twin bored tunnel. Tunnelling has now commenced on the project with further TBMs due to be launched later this year.

**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.

Hinkley Point Nuclear Power Station Work continues on the first new nuclear power station in the UK for many years. Main tunnelling works were completed earlier this year comprising around 9km in total. The first TBM commenced its journey in September 2019.



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**Bank Station Capacity Upgrade**

Construction work has continued on the upgrade to Bank station 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 platform for Northern Line. The recent closure of the Northern Line allowed the completion of the tunnelling works in early 2022.

**Silvertown Tunnel**

Late 2019 saw the contract award for the Silvertown project comprising twin bored tunnels under River Thames approximately

1.4km long and 12m diameter. The project is a PPP delivery model. This project will create another road crossing in East London adjacent to the exciting Blackwall tunnel. Tunnelling is due to commence in 2022.

**FUTURE TUNNELLING ACTIVITIES**

**Lower Thames Crossing**

A proposed new motorway on the M25 to include 14.5 miles of road. This will also comprise 4km of tunnel beneath the River Thames East of London with a tunnel diameter of around 15m. The project is currently in the planning and development phase with the procurement process now underway and the tenders have been issued. The road is due to be operational in 2027

**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 has recently been awarded by National Highways however the DCO has still to be granted therefore construction will not commence until 2023.

**Coire Glas hydroelectric scheme**

Scottish and Southern Energy continue with plans to develop a new hydroelectric scheme in Scotland. Planning has been approved for the scheme and the procurement for the projects commenced in 2021. The project will include extensive tunnelling and large span caverns.

**Haweswater Aqueduct Replacement Project**

United Utilities is planning to replace an existing aqueduct in the North West of England that provides drinking water for the city of Manchester. This replacement will comprise approximately 50km of 3m diameter tunnelling at depths of up to 300m. Procurement is due to commence in June 2022.

# United States



**Name:** Underground Construction Association (UCA of SME)

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

**Number of Members:** 1,463

## ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

- 2021 George Fox Conference. This one-day conference was not held in person, but a virtual session was used to educate the industry on some key developments in covid contracting as well as a feature presentation on the history of this conference and George Fox himself.
- The 2021 RETC (Rapid Excavation & Tunneling Conference) was held in-person in June in Las Vegas; notwithstanding that the attendance, at 820, was significantly below the usual average of 1400-1500, the conference was very successful from the organizers' and participants' viewpoints
  - A highlight was a session jointly held with the Dispute Resolution Board organization; it was well attended by high profile industry people with very positive feedback forthcoming
- 29 scholarships to attend RETC were awarded to students
  - Under the new Mentoring program, each recipient was introduced to a Mentor (min two, max three Mentees per Mentor) to facilitate them getting

the most from their experience by having a resource and a peer group with which to interact

- Anecdotal as well as survey feedback from the experience was very positive
- The 2021 Cutting Edge Conference was held in-person in Dallas, TX in November. It was the largest Cutting Edge in history with 286 attendees. Feedback on the single-track program addressing "Advances in Tunneling Technology" was excellent. Ten scholarships to attend the conference were awarded to students, and an introductory reception was held for the successful applicants.
- Women in Tunneling, Young Members, Down for That, and Teach the Professors were all organized under the new heading of Workforce Sustainability; in addition, a volunteer was appointed to represent UCE in the SME Inclusion and Diversity committee
- The Owner's Forum, a new program, was established, and a volunteer appointed to head it, under the

direction and support of the Vice-Chair; without owners, there are no tunnel projects, and we accordingly wanted to give this greater focus going forward

- US Working Groups developed momentum, establishing ongoing activity to support the ITA WGs
- Executive Committee meetings continued quarterly
- A "Tunnel Watch List", comprising 20 imminent projects and 20 needed projects, was published. The intent was to bring focus on what the industry is doing and what infrastructural needs we need to address via tunneling. This will become an annual event and has been moved under the supervision of the Owner's Group.
- As the UCA is the Member Nation representative for the USA to the ITA, and as elections for new members of the ITA's Executive Council will be held in 2022 (for a three-year term), we conducted a process to seek out candidates to run for this office. A successful process yielded the approved candidacy of Sanja Zlatanic. Documentation supporting Ms. Zlatanic's candidacy was accepted by the ITA and she is an official candidate for the upcoming General Assembly elections.



**Down for that.**

## A New Website for a New Generation of Underground Engineers

*Down for That* encourages engineering students to pursue a career in underground construction and tunneling by providing students and professors with introductory industry information including:

- Resource Library
- Tunnel Tours
- Industry Profiles
- Presentations
- Case Studies

*Together we'll grow the underground workforce.*

Share the excitement and reward of a career underground.  
[undergroundcareers.org](http://undergroundcareers.org)

**UCA** Underground Construction Association  
A Division of SME

**CURRENT TUNNELLING ACTIVITIES**

Project	Location	Tunnel Use	Length (ft)	Width (ft)	Type
LA Outfall	Los Angeles, CA	Sewer	36,960	18	DBB
Hampton Roads Bridge	Norfolk, VA	Road	15,000	46	DB
Alexandria River Renew	Alexandria, VA	CSO	10,500	20	DBB
Mountain	CA	Rehabilitation	58,080	10	DBB
Lower Olentangy	Columbus, OH	Sewer	17,000	12	DBB
Shoreline Storage	Cleveland, OH	CSO	16,100	21	DBB
Chimney Hollow	Loveland, CO	Water	1,920	25	DBB
NHCRWA	Houston, TX	Sewer	1,400	10	DBB
St. Louis Clean - Lower Meramec	St. Louis, MO	CSO	35,904	8	DBB
Sound Transit	Seattle, WA	Rehabilitation	n/a	n/a	DB
WMATA	Washington, DC	Rehabilitation	n/a	n/a	DB
Thimble Shoal	Chesapeake Bay, VA	Road	5,280	42	DBB
Narragansett Bay CSO - Pawtucket	Providence, RI	CSO	13,000	28	DB
MTA	New York, NY	Subway	n/a	n/a	DB
Ontario Airport	Ontario, CA	Subway	21,000	20	DB
Tarrant IPL - Section 19	Dallas, TX	Utility	10,944	12	DBB

**FUTURE TUNNELLING ACTIVITIES**

**Newly Published Project Watch List – Imminent Future**

No.	Project	City	State	Owner	Status	Tunnel Use
1	ALCOSAN CSO Tunnel Program	Pittsburgh	PA	ALLEGHENY COUNTY SANITARY AUTHORITY	Planning	CSO
2	Amtrak East River Tunnel Lines 1 and 2 Reconstruction	New York	NY	Amtrak	Design	Railroad
3	Amtrak North River Tunnel Reconstruction	New York	NJ-NY	Amtrak	Planning	Railroad
4	Austin Connect	Austin	TX	Metro/City of Austin	Planning	Subway
5	B&P Tunnel	Baltimore	MD	AMTRAK	Planning - EIS on going	
6	BART Silicon Valley Extension	Silicon Valley	CA	Santa Clara (VTA)	Design	Subway
7	Boston MWRA Metropolitan Redundancy Program	Boston	MA	MWRA	Design	Water
8	Brushy Creek Tunnel	Austin	TX	BCRUA	Design	Water
9	Central City Tunnel	Minneapolis	MN	City of Minneapolis	Design	Stormwater
10	DART D2	Dallas	TX	Dallas Area Rapid Transit	Design	Transit
11	DC Water Potomac Tunnel	Washington	DC	DC Water	Planning	CSO
12	Hudson River Tunnel	New York	NJ-NY	Gateway Program Development Corpora	Planning	Railroad
13	Joliet Alternative Water Source Program	Joliet	IL	City of Joliet	Planning	Water
14	New York Penn Station Expansion	New York	NY	Amtrak	Planning	Railroad
15	NYCDEP Newtown Creek	New York	NY	New York DEP	Planning	CSO
16	Project Clean Lake: Southerly Storage Tunnel Project	Cleveland	OH	NEORSO	Design	CSO
17	Project Clear: Lower Meramec Tunnel	St. Louis	MO	Metropolitan St. Louis Sewer District (MS	Design complete	CSO
18	San Francisco Bay crossing for the BART transit system	San Francisco	CA	BART	Design	Transit
19	Second Ave. Subway Phases 2-4	New York	NY	NYC MTA	Design	Subway
20	Storm Water Conveyance Tunnels	Houston	TX	Harris County Flood Control District	Planning	Flood control

**EDUCATION ON TUNNELLING IN THE COUNTRY**

Colorado School of Mines  
 Purdue University  
 University of Texas  
 University of Illinois – Champaign/Urbana

**2021 UCA Webinars**

- A Tribute to George Fox, January 26th
- Shotcrete for Underground Applications, October 6th
- Shotcrete Applications in Tunneling and Case Histories, October 27th

**UCA Young Members Tunnel Vision Webinar Series**

- Tunnel Vision – July 21st
- The Evolution of Digitalization in Tunneling, Aug 17th

- Predicting Soil Transition Locations using Geostatistics, September 22nd
- Challenges with Drilled Installation of Pipe Canopy Tubes in Gravelly Alluvium, Oct 27th

**STATISTICS**

**List of tunnels completed in 2021**

3RPORT – Ft. Wayne, IN  
 Northeast Boundary Tunnel – Washington, DC  
 Dugway Storage – Cleveland, OH  
 Westerley Storage – Cleveland, OH  
 Purple Line, Section 1 – Los Angeles, CA



# Delivering complex tunneling projects worldwide

We congratulate the successful breakthrough of the Hartford South Conveyance and Storage Tunnel on January 4, 2022.

**Pictured:**  
South Hartford Conveyance and Storage  
Tunnel, The Metropolitan District  
Contractor: Kenny Obayashi Joint Venture

**Contact:**  
Paul Nicholas  
Vice President, Tunneling Practice  
[paul.nicolas2@aecom.com](mailto:paul.nicolas2@aecom.com)

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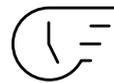
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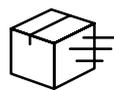
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Equipment &  
Critical Parts  
Supply Planning



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Equipment Service  
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