

# ITA Member Nation Activity Reports 2022



WEST GATE TUNNEL, AUSTRALIA

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More than 200,000 vehicles cross the Westgate Freeway each day. Two gigantic EPB Shields (Ø 15.5 m) are creating a new chapter for Melbourne as they excavate 6 km of tunnel to link the West Gate Freeway with the Port of Melbourne and CityLink. The new West Gate Tunnel will ease traffic for 5 million Melbourne citizens. TBM Vida finished its journey in February 2023, marking the completion of the first of two tunnels.

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**Contractors:**

- CPB Contractors
- John Holland JV

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Tunnelling Systems



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## Arnold Dix ITA President

The pace of global tunnelling and underground space development has continued to accelerate with an increase in all areas of underground development including flood diversion and drainage, sewerage, hydro, metro, highspeed rail, and road projects.

Activity in all major economies has intensified as underground infrastructure investment is embraced as part of a post COVID economic stimulus, economic efficiency programs, and as an adaptive response to the threats of climate change. China has continued construction at unparalleled levels, with countries such as the United States, Japan and India accelerating their domestic projects, and Japanese development banks heavily investing in Asian countries such as the Philippines.

The world is also seeing increased activity in areas such as nuclear waste storage and extreme physics experiments where the benefits of deep underground development are now being realised.

Activity in lower and middle income countries is also accelerating as development banks support essential projects in these areas of social, economic and environmental need [such as Colombia and the Philippines].

There remains a clear underinvestment in Africa. ITA has a number of projects aiming to remedy the deficiency of African projects.

A big thank you to all our Member Nations, the ITA secretariat, and Tunnelling Journal for their effort and contribution to this publication.



## Olivier Vion ITA Executive Director

After the two and half years of pandemic, 2022 has been the opportunity of the ITA Member nation to organize physical events attracting many people who were willing to meet each other. By reading the report you will be able to discover that many Member Nations have organized symposiums but also national, regional, or international congresses and conferences.

It seems that initial or continuous training in tunnel construction is developing in many countries, a sign that tunnels and the use of underground space are becoming an increasingly widespread subject. In terms of tunnel construction, the year 2022 shows sustained activity, despite the consequences of the pandemic and higher inflation in many countries. In any case, tunnel projects are developing, and the industry should continue to progress thanks to innovation and better consideration of the aspects of sustainable development. 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:** 46 affiliate members, 8 corporate members

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

October 26th and 27th saw the Tunnelling Congress held - "Tunnels for a Better Quality of Life" - with the participation of Latin American experts and those from the ITACET Foundation that developed a training lecture of the same theme as the Conference.

One online training course was developed for the Argentine Construction Chamber, dealing with "Waterproofing of Tunnels of Large Diameter".

## CURRENT TUNNELLING ACTIVITIES

### Tunnelling beneath the Sarmiento Railway Line – Buenos Aires

Replacement of the "Sarmiento" Railway Line that runs from Western Head Station in Buenos Aires to Station Castelar, over a distance of some 22km, with a double track tunnel, mainly excavated with a 12m diameter EPBM, and a short NATM section. Featured along this section are nine stations, seven mined and two in cut & cover. By mid 2019 the first 7km of running tunnel had been excavated using the EPBM with the machine recovered in an open pit for maintenance. As stated in previous reports, the works have been interrupted due to a lack of financing. The contract with the construction JV is yet to be resigned. Over the past year, nothing has changed and there is no official decision on when this project will resume.

### 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, comprising two sections: a 9.4km long upper section with a 3.2m i.d. excavated by EPBM, and a lower section of 5.1km with a 4.5m i.d. excavated using a slurry machine. The project features a treatment plant and an Emissary of 12km with 4.3m i.d. to be excavated into the La Plata River with an EPBM. Three contracts were awarded in 2015 (sewers, plant, emissary), which are all in construction. At the end of 2018 the construction of the treatment plant was stopped, due to the withdrawal of the contractor JV. This

work restarted at the end of 2019, after the appointment of a new contractor. At the end of 2019, excavation of the outfall tunnel was successfully completed. During 2020 the risers were built towards the riverbed. The EPBM excavated the entire 9,400m upper section, while the slurry machine also finished the 5.1km lower section. The 800mm and 1,100mm diameter secondary pipeline galleries were also completed, with a total excavated length of 14km. Both the sewerage and the outfall were completed in November 2022 and are in the period of acceptance of the works.

### 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, to the southern area of Buenos Aires, feeding a population of 2.5M people. It consists of a 23km long underground water line and two large pumping plants, tendered for construction in two contracts. A contractor has been selected for the first section (Lot 1) of 13.5km, 3.9m i.d and pumping plant No.1. The project has two EPBMs, ø 4.66m, with a universal segment ring 6+0, 1.4m wide, and 0.25m thick. The first TBM has finished excavation, leaving from the launching shaft in the vicinity of the Belgrano general plant, to the retrieval shaft at 7.9km, 55% of the total tunnel length. The second TBM machine will leave from an intermediate quad-lobed launch shaft in March of 2023, to complete the 5.6km tunnel to the pumping plant No. 1 in Lomas de Zamora. The first contract is scheduled to be completed in August 2024. The second part of the project, (Lot 2) is yet to be awarded, but has been tendered.

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

The project will bypass a road section aligned next to a creek that features beautiful gardens and weekend houses via the construction of two bidirectional road tunnels of 560m and 890m in length. The construction method is conventional tunnelling with a shotcrete primary lining

and a prefabricated inner lining. The excavation of the shorter tunnel was completed at the of 2020. Meanwhile, excavation of the second (longer) tunnel was initiated in early 2021 with the current progress of excavation at approximately 41% of its length. It is envisaged, that this project will be completed by the end of this year.

## Several sewer projects in Buenos Aires

Over the last few years, in the surrounding neighbourhoods of Buenos Aires, a large number of sewer projects were constructed for the Water Company AYSA and Buenos Aires Government. Some are in progress using mechanized construction, via different modes of TBM. In general, all of these projects are planned and executed using the pipe jacking method.

Opposite is a list of the projects.

## FUTURE TUNNELLING ACTIVITIES

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

A tender for the basic design of the first stage of the new Metro Line "F", a 5km long circumferential line which crosses many existing lines, was launched in 2019 and delayed. In 2022, the City Government finally decided to cancel the tender and instructed the Metro Authority (SBASE) to develop the tender design, which was initiated in mid 2022, and is expected to be finished by June of 2023. It is planned for the detail design tenders for several specific contracts to be called from mid to end of 2023.

During 2021 the tender design for the construction of the "Colector Baja Costanera", a sewer tunnel along the coast of the La Plata River, was developed. Again, for financing reasons, the process of tendering the construction has yet to be launched. Similarly, the construction of the third and last "rain water relief tunnel" for Buenos Aires, the "Medrano River", was not initiated last year. However, in November 2022 the tender for its design was launched and will commence in April 2023. Presently it is not known when construction of either project will begin.

### 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 launched in 2017, and a short list of companies was

No	Project	Owner	Status	Year of completion	TBM Type	Length (m)	Diameters (mm)	Material
1	Red Primaria Cloacal Colector Budge	AySA S.A.	Finalized 2022	2022	Slurry	1513	1100	Precast Concrete
2	Red Primaria Cloacal Colector Morón Resto	Ministerio de Infraestructura y Servicios Públicos - PBA	Finalized 2022	2022	Slurry	6593	1000	
3	Red Primaria Colector Fiorito-Lavallol (SC70256)	AySA	In execution	2023	EPB / Slurry	2980	1400 / 1500	
4	Red Primaria Cloacal Colector Banfield-Centenario (SC70267)	AySA	In execution	2023	Slurry	2308	600	
5	Colector Ezeiza Etapa 2	AySA	In execution	2024	Slurry	5041	1300	
6	Colector Las Catonas	AySA	In execution	2024	Slurry	5229	900 / 1000 / 2000	
7	Colector Martín Rodríguez Etapa 2	AySA	In execution	2024	Slurry	3333	600 / 700 / 900	
8	Cildañez-Vega 2022	Ministerio de Desarrollo Urbano - GCBA	In execution	2025	EPB / Slurry	6000	2200	
9	Cildañez-Vega 2022	Ministerio de Desarrollo Urbano - GCBA	In execution	2025	EPB / Slurry	4412	2400	
10	Ampliación de Colectores y Redes Cloacales - Santiago del Estero	Unidad Ejecutora del Programa (UEP) de la Unidad de Coordinación de Programas y Proyectos con Financiamiento Externo (UCPyPFE) del Ministerio del Interior, Obras Públicas y	In execution	2025	Slurry	17000	1200	

published in 2018, no further action for the tender process has been implemented, mainly due to Chile's reluctance to develop the project. At the end of 2021 the Chilean Ministry of Public Works launched a new study of alternative corridors, which aims to identify potential road tunnel options of a minimised length, overburden and overall cost, compared to the project developed by the Argentine Authorities. Sadly, this tender process was cancelled as no bidder showed interest but was launched again in 2022. In October 2022, two bidders did submit tenders. The Public Works Ministry is still evaluating them and is yet to award the new Feasibility Study.

Las Leñas Tunnel: This approx. 11km

long twin-tube road tunnel is officially recognized by both countries as the other relevant bi-national base tunnel. By the end of 2019 a new geological-engineering study was awarded by the Chilean Public Works Ministry to a consulting JV. Its aim was to develop a more detailed geological investigation, to create a better geological model, defining the final corridor for the tunnel, as well as its functional design. The study was finished at the end of 2021 and will be the basis for the next design step, scheduled to be a tender design. As a result of this study, the revised alignment of this 10.5km road tunnel will have two one-way tubes with longitudinal ventilation, connected with pedestrian and vehicular

cross passages.

Tunnel Cristo Redentor – second tube (widening of the tunnel Caracoles): With the support of the IDB in 2019 the design of the second tube of the existing Cristo Redentor road tunnel of approx. 3.1km length 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 Valparaíso which has been out of operation since 1978. The offers of the contractor JVs were delivered in 2019 for the construction of the Argentine part of the tunnel, with an award to the winning contractor JV at the end of 2021. Since then, this JV formed by the Portuguese company Mota Engil and the Argentine company Construction started in early 2022. By the end of last year the portal cut and support had been carried out, with mined excavation yet to be initiated. The construction of the Chilean section of this tunnel was tendered in 2022 but is yet to be awarded.

## 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 fifth year in 2022, 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:** 765 members, 64 Corporate Sponsors, 6 Platinum Sponsors

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

**Activities and Events:** With the ongoing pandemic in 2022, the Australian Tunnelling Society's activities moved into a hybrid space with online and in person events, where possible. The focus of 2022 was a celebration of 50 years of the ATS culminating in a national event that was streamed from

Sydney Melbourne and Brisbane with an address from National President Harry Asche, Arnold Dix and various other Australian Tunnelling entities. The Allen Neyland Achievement Award (50th Anniversary) was presented to Alan Robertson (retired).

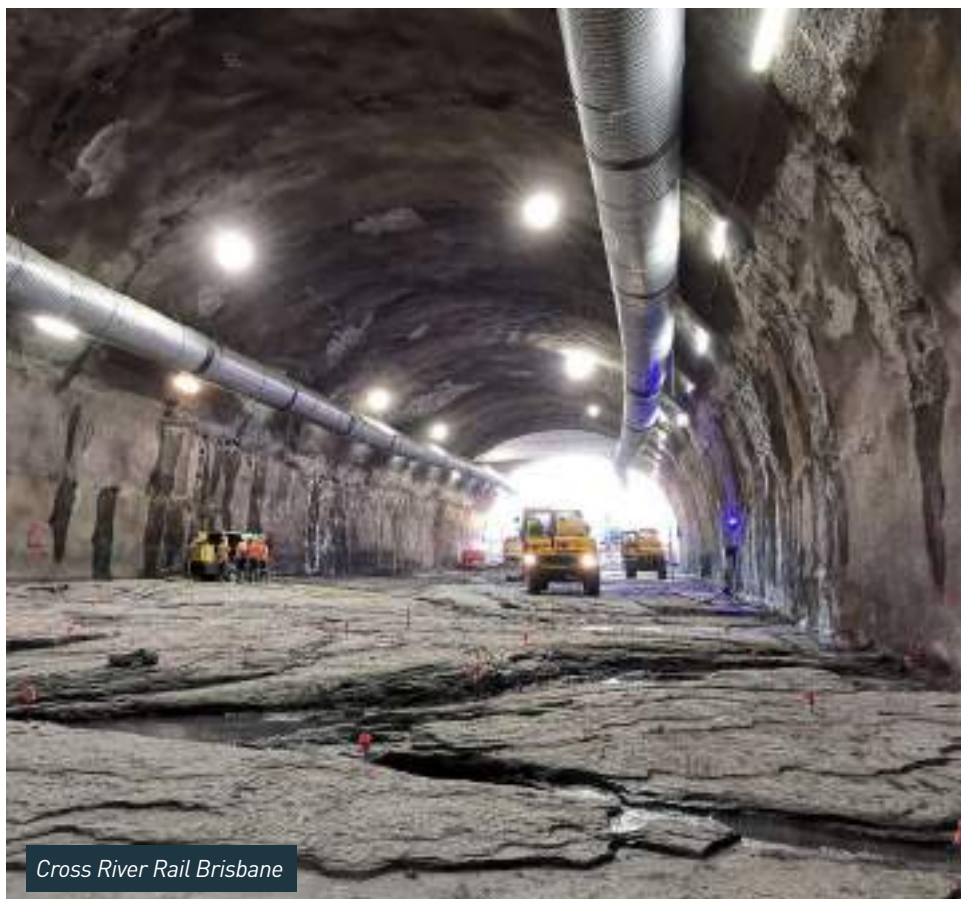
The annual David Sugden Technical writing award was presented to Ivan Haryono

(WSP/Golders).

Other events and technical sessions included:

- The Main Range Railway built 1865-1867  
3/02/2022
- Snowy 2.0 underground project overview and update  
8/03/2022
- WA Office Bearer (Volunteer) Induction  
10/03/2022
- Management and maintenance of sewer tunnels  
24/03/2022
- ATS Legends panel discussion - 50th Anniversary presentation  
28/04/2022
- Tunnel systems: three decades of Australian tunnel systems operation stall & axial fan parallel operation  
28/04/2022





Cross River Rail Brisbane



Forestfield Perth



Kidston Pumped Hydro

- ATS Tunnel Design Guideline  
23/05/2022
- Diversity in Tunnelling Launch - Sydney  
25/05/2022
- ATS Short Course - Sydney  
26 and 27th /05/2022
- Spaceproofing for Tunnels  
02/06/2022
- Challenges in creating caverns in urban areas – Melbourne Metro Tunnel  
09/06/2022
- Lessons learnt from past tunnelling project Experiences – 50th Anniversary presentation  
7/07/2022
- Sustainability in underground spaces  
4/08/2022
- Tunnel lighting functionality  
18/08/2022
- Suburban Rail Loop – Ground Conditions and Tunnelling Challenges  
14/09/2022
- ATS QLD One Day workshop – Major underground projects in Queensland  
06/10/22
- Innovation in mechanised tunnelling  
15/09/2022
- ATS 50th Anniversary National Celebration - Sydney, Melbourne, Brisbane and Perth  
13/10/2022
- St Barbara Day Dinner – Melbourne, Sydney, Brisbane  
01/12/2022

**Publications:** The ATS ANZ Journal was published twice in the last calendar year in conjunction with Tunnelling Journal. The second issue was a celebration of 50 years of the ATS in Australia showcasing major projects over the years, articles from Australian industry experts and other Australian tunnelling representatives. A highlight in the journal is a 10 page timeline which sets out the ATS's progress over the last 50 years and how it has important industry body for its members.

**Working Groups:** Diversity in Tunnelling sub-group (formerly Women in Tunnelling) is made up of representatives from the various ATS chapters interested in promoting and supporting diversity in tunnelling. Since launching in the second half of 2022 they have had a busy year. Lately they have just launched a Mentoring & Buddy Program which has been extremely well received. Collaboration with overseas organisation from Canada and Greece is currently being investigated.

#### CURRENT TUNNELLING ACTIVITIES

- West Gate Tunnel, Melbourne, VIC - 6000m
- Melbourne Metro Tunnels and Stations PPP, Melbourne, VIC - 18,000m
- WestConnex Stage 3B (Rozelle Interchange), Sydney, NSW - 19,000m
- Snowy 2.0, Cooma NSW - 27,000m

- WestConnex Stage 3 - M4-M5 Link, NSW, Sydney - 17,000m
- Cross River Rail Tunnels & Stations Development PPP - 10,000m
- Kidston Pumped Hydro, Regional QLD
- Brisbane Metro, Brisbane, QLD
- Western Harbour Tunnel Phase 1 - Sydney, NSW
- Sydney Metro West Central package CTP - Sydney, NSW - 22,000m
- Sydney Metro West Western package WTP - Sydney, NSW - 18,000m
- Suburban Rail Loop - Melbourne, VIC

#### FUTURE TUNNELLING ACTIVITIES

- Blue Mountains Road Tunnel, NSW
- Western Harbour Tunnel, Sydney NSW
- Coffs Harbour Bypass, Regional NSW
- Western Sydney Metro Eastern Package, Sydney NSW
- North-South Corridor, SA, Torrens to Darlington
- South West Rail Link Extension, NSW
- ARTC Inland Rail, QLD

#### 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.

# Promat

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# Azerbaijan



**Name:** Azerbaijan Tunnelling Association

**Type of Structure:** Non-profit

**Number of Members:** A nine-member management board and large membership

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

- Experts participated in the examination of the 1,700m long tunnel in the Dashkesan region and presented proposals for remediation.
- A 120-page methodology manual was prepared for those engaged in the construction of metro tunnels.
- The Union submitted its proposal for an exploration tunnel in the Balakan region of Azerbaijan

## EDUCATION ON TUNNELLING IN THE COUNTRY

Azerbaijan University of Construction and Architecture offers bachelor's, master's and postgraduate courses.

The future Toots Thielemans subway station:



Extension of the Metro Line 3 from Brussels North to Bordet



Several mechanized tunnels for stormwater drainage systems, energy and utilities



# 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:** 17 individual members, 53 corporate members

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

In 2022 the Belgian Tunnelling Association continued to promote underground solutions to resolve congestion problems, crossing of waterways and sensitive areas. Several site visits were organised, including a site visit on the Grand Paris Express Ligne 17, as well as our annual seminar with this year's topic 'Seminar on Underground and Environment' on the 29th of March. In cooperation with the Flemish engineering association ie-net, we organized on the 15th of June a seminar on the Fehmarnbelt Link (Denmark). On the occasion of the World Tunnel Day on the 2nd of December, a successful 1st Tunnel Asset Owners Day has been organized in Antwerp. We strengthened our close cooperation within the EUTF regarding the interests of the European Tunnel Community in general and with strong knowledge sharing objectives. We continued our close cooperation with the French Tunnelling Society AFTES, from who we share the same magazine T&ES.

Our activities are visible on <https://www.abtus-bvots.com/>

## CURRENT TUNNELLING ACTIVITIES

In 2022, the following activities were ongoing:

The renovation of the metro station Lemonnier and the start of the new Toots Thielemans Subway station (MIVB/STIB), as part of Metro Line 3. The construction works on the 233m-long Toots Thielemans subway station, formerly known as 'Constitution', started in 2020 and will be completed by 2025. The renovation and expansion of the Lemonnier tram station will follow between 2025 and 2028.



In Brussels, the rehabilitation of the road tunnels of the city's inner ring has continued. These quite old tunnels are completely refurbished and will get an up-to-date control system. In Liège, renovation of the Grosses Battes & Kinkempois tunnel has been finished



In Flanders, renovation of several tunnels with safety upgrades has continued, as f.e. the renovation of the Kennedy Road Tunnel with new control and safety systems. Start of the construction dock in Zeebrugge for the tunnel elements on the Scheldt tunnel of 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 30th March 2023, our annual seminar will be held with the topic

‘Seminar on Underground Storage of Nuclear Waste in Belgium’.

In Brussels, the existing metro line will be adapted at the south station and extended at the north station, so that the whole line can be changed to 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 has also started.

In Antwerp the works for the Oosterweel Connection (closing of the northern motorway ring) have been started with the adaptation of the interchanger at the left bank of the Scheldt River. The preparation works for the immersed tunnel under the Scheldt River have been started (works 2020-2027). The tendering for the cut-and-

cover tunnels has been done.

The road tunnels of Brussels inner ring will be further rehabilitated and will become safer.

In the future, the second railway track from Antwerp's main shunting station towards the hinterland will become necessary. This will involve the construction of two single track 16km long tunnels to underpass the Albert canal and several motorways and to avoid interference with the quite dense urban area on the surface.

In Flanders, several tunnel projects are in the stage of a pre-design or in the stage of a building permit, as f.e. the Ring of Ronse, North-South Link in Limburg, R4W0 Tunnelling Project Ghent (<https://r4wo.be/>)

# 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:** 218 Individual Affiliate Members and 18 Corporate Affiliate Members.



## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

### January

**18th** – Beginning of discussions for the creation of a Technical Standard of Tunnel Inspection for the Brazilian Technical Standards Association

### February

**17th** – Webinar CBT – “Geotechnologies applied to underground infrastructure works” – Vinicius Figueiredo  
**25th** – Online tunnellers chat

### March

**17th** – Lecture for undergraduate students in Engineering at UFRGS and La Salle universities in Porto Alegre. “Tunnels for a better life” – Eloi Palma Filho.  
**24th** – Webinar CBT – “Tunnel portal construction in humid tropical highlands” – Álvaro Rodrigues  
**25th** – Online tunnelers chat

### April

**6th** – Book release event – “Shotcrete Manual” – Paulo Fernando Araújo; with the special chapter: “Shotcrete in

tunnels”

**28th** – Webinar CBT – “Use of drilling fluids in shields” – Leonardo Silveira

### May

**17th** – Lecture organized by the Engineering Institute – “Tunnels in urban areas” – Tarcísio Barreto Celestino  
**26th** – Webinar CBT – “South Coast Tunnels - Florianópolis Bypass” – Thiago de Sa Lima  
**28th** – Lecture for the Portuguese Tunnelling Association (CPT), as part of a tunnel workshop, entitled “When to use a TBM - Types of machines and selecting the most suitable one” – Daniela Garroux G. de Oliveira

### July

**29th** – Webinar CBT – “Technologies for safe tunnelling and underground mining operations” – Marcelo Fernandes, Renato Almeida & Marcus Benassi

### August

**25th** – Webinar CBT – “Challenges experienced in tunnel boring machine construction - projects in Australia” – Viviana Braga

### September

**29th** – Webinar CBT – “Solutions for TBM technologies” – Rolando Justa

### October

**13th** – Webinar CBT – “Madrid Metro and its use of the Belgian Method” – Cláudio Dias  
**26th** – Lecture in the Argentinian Tunnelling Association (AATES, Asociación Argentina de Túneles y Espacios Subterráneos), in the event 12ª Jornadas de Túneles y Espacios Subterráneos – Hugo Rocha.

### November

**10th** – Webinar CBT – “Upcoming projects in Prague: route selection for a railway tunnel and new metro line” – Zdenek Zizka  
**27th** – Webinar CBT – WTC 2022 Echoes – Several presenters talking about their publications and experience during the ITA-AITES WTC 2022

### December

**2nd** – Tunnel Day Hybrid Event – Theme: “Production Challenges in Large Tunnel Excavation”; total of 120 live attendance, plus over 900 online

**14th** – Webinar in partnership with CBMR – Brazilian Rock Mechanics Committee – “Degradation of rock strength in tunnels” – Werner Bilfinger, 2022 ISRM Franklin Lecture award winner

**15th** – Webinar CBT Young Members – “Figueiredo Ferraz 2022 Award Winners” – Luiz Henrique Zago, Mariana Campos, Tom Fausel Koch

### Publications

Shotcrete Manual - Paulo Fernando Araújo; with the special chapter: “Shotcrete in tunnels”

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.

### Press and social media

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

### CURRENT TUNNELLING ACTIVITIES

During 2022, there were several tunnels under construction, some completed in 2022 and some major projects still ongoing. One completed is the “Rodovia dos Tamoios - SP-099”. The project was one of the ITA Awards finalists in the major works category (over €500M). With several constructive challenges, the project also focused on minimizing its environmental impact with its five main road tunnels totalling a length of 13.2km.

In 2022, two major metro projects began full speed excavation under one of the biggest cities in the world, São Paulo. Lines 2 and 6 are ongoing, with several stations and tunnels, using both conventional and mechanized methods.

Another road tunnel project at full speed is the Florianópolis Bypass, with four tunnels. This is the city to host one of the CBT activities at the beginning of 2023 - the Road Tunnels Seminar.

Regarding tunnels for hydroelectric power plants, there were a total of 3,255m of excavated tunnels in the south of Brazil.

Finally, for utility projects, a total of 8.4km of tunnels were excavated using pipe jacking.

### FUTURE TUNNELLING ACTIVITIES

For 2023, São Paulo’s metro projects will continue, with the TBM on Line 6 excavating from 2022 and the TBM on Line



2 starting in the middle of the year. Several conventional tunnels for both metro projects are currently being excavated and other connecting tunnels for both projects should start in 2023. Additionally, the extension to Line 2 should probably start by the end of 2023, connecting São Paulo to its neighbouring city, Guarulhos.

For São Paulo Metro, several viability and preliminary projects will start during

2023, such as Lines 16-Violet, 19-Sky Blue, 20-Pink and 22-Brown. Regarding road tunnels, the north connection tunnel project, as part of the São Paulo city ring, Rodoanel North, could resume soon.

In the South, the Florianópolis Bypass should be completed by late 2023.

Finally, the new government is promising to release a railway link, which could include tunnels.

### STATISTICS

#### 1. Length or volume excavated - % mechanized / % conventional during 2022

Total of 31.16km of tunnels, 30% TBM and 70% NATM

#### 2. List of tunnels completed

- 5 tunnels of the Tamoios Road
- 3.25km of hydroelectric power plant tunnels
- One NATM connection tunnel completed on Line 2 – São Paulo Metro

#### 3. List of tunnels under construction

- Line 2 Green Line – São Paulo
- Line 6 Orange Line – São Paulo
- Florianópolis Bypass

### EDUCATION ON TUNNELLING IN THE COUNTRY

Brazil has several universities providing education in tunnelling, including graduate and postgraduate courses, as well as research groups. Some to be mentioned are:

- UnB – Brasília University – Tunnel graduate course (60h course) and post graduate course (30h course), as well as a research group
- EPUSP - Polytechnic School of the University of São Paulo – Graduate course that includes tunnel execution (NATM and TBM) and post graduate course, focused on NATM excavation
- EESC – São Carlos Engineering School – part of the ITACET University Network, includes post graduate courses for a master, PhD and Post-Doc programs
- Presbiteriana Mackenzie University – a graduate course entitled “Tunnels and underground structures”



# Canada



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

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

**Number of Members (2022):** 450 individual members, 71 corporate members

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

2022 saw the return of in-person events across TAC's five regional chapters, the TAC National Conference in Vancouver, TAC's submission of a proposal to host the World Tunnel Congress in 2026 in Montréal, and the continuation of the TAC Young Members (TACym) webinars to connect members and large audiences across the country.

TACym was active in 2022, hosting three webinars, three site visits, and one social event. As well as the TACym events, 13 in-person events were hosted by the TAC Chapters in Vancouver, Toronto, Montreal and Quebec.

The TAC 2022 Conference was hosted in Vancouver, British Columbia from November 2nd – 4th, under the theme 'Tunnelling for the Future' and the sold-out event was attended and supported by 400 tunnelling professionals, 28 sponsors and 39 exhibitors. The conference featured five keynote speakers, short courses, two technical tours and 70 technical sessions with 115 speakers.

As part of the conference, the annual TAC Achievement Awards were presented at the Gala dinner held on November 3, 2022. The 2022 recipients included:

- Lifetime Achievement Award – Patrick McNally
- Young Tunneller of the Year Award – Dani Delaloye
- Tunneller of the Year Award – Paul Cott
- Canadian Innovation Initiative Award – Novamera Inc. for Mechanized Boring for Surgical Mining
- Canadian Project of the Year Award (Up to \$100M CAD) – Hatch, REM, NouvLR and CIMA+ for the Mount Royal Tunnel
- Canadian Project of the Year Award (Over \$100M CAD) – Metrolinx, Toronto Tunnel Partners (Ellisdon & Strabag), WSP and Jensen Hughes for the Go Expansion
- Photo of the Year Award – Bertin Caron-Boulé for Mount Royal Tunnel
- TAC Outstanding Service Award – Wayne Gibson
- Dan Eisenstein Memorial Scholarship – Caitlin Fischer



TAC 2022 Conference at the Fairmont Hotel Vancouver

- TAC Undergraduate Scholarship – Jay Modi

Full 2022 TAC Achievement Award details and videos are posted on the TAC website ([https://www.tunnelcanada.ca/awards\\_2022.php](https://www.tunnelcanada.ca/awards_2022.php)).

TAC looks forward to its next annual conference from September 24th to 26th, 2023 in Toronto, Ontario.

TAC has submitted a proposal to host the 2026 World Tunnel Congress and 52nd ITA General Assembly in Montréal. The proposed theme of the conference is "Connecting Communities through Underground Infrastructure". A copy of the proposal can be accessed online ([https://congresmtl.com/Communications/Bids/WTC2026/WTC2026\\_Montreal.pdf](https://congresmtl.com/Communications/Bids/WTC2026/WTC2026_Montreal.pdf)).

TAC communicates with its members and the general public through a number of forums:

- "Canadian Tunnelling" magazine - in partnership with Tunnelling Journal, this twice-yearly publication focuses on Canadian tunnelling activity and TAC events. Canadian Tunnelling was published in February and September 2022, with issues mailed to the TAC membership.
- TAC and TACym maintain a full Social Media presence, including an active LinkedIn page (<https://www.linkedin.com/company/tunnelling-association-of-canada/>).
- TAC also implemented a bi-monthly newsletter which was published with 5 issues in 2022.



TAC has implemented a series of Special Projects over the years as a means to promote the Association and the tunneling industry in Canada in general. In 2022, TAC carried out the following initiatives,

- Development of the French version of the 2021 book "Canadian Tunnelling – Memories and Achievements", which highlights historical Canadian Tunnelling projects.
- Development of the "Canadian Tunnelling Projects Dashboard" – a GIS-enabled database that will provide TAC members with an overview of upcoming projects across Canada.

TAC launched an EDI taskforce in 2022 with a mission to identify and address issues of diversity and address issues of diversity, equity, and inclusion to improve the experience of working in the tunnel industry in Canada and invest in the participation and promotion of underrepresented groups, while supporting the tunnelling industry to achieve their diversity and inclusion goals.

## CURRENT TUNNELLING ACTIVITIES

The tunnelling industry in Canada continues to be very active with tunnelling projects underway in all five Canadian Chapters. The following are some of the key projects currently underway:

Key Western Canada projects currently in progress or completed in 2022 include:

- Second Narrows Water Supply Tunnel - This 6.5m diameter slurry TBM driven tunnel under the Burrard Inlet between North Vancouver and Burnaby houses three critical water mains (1.5m dia. and 2x2.4m dia.). Tunnelling is complete and final pipe installation is underway.
- Annacis Water Supply Tunnel - This new

water supply tunnel between Surrey and New Westminster commenced construction in 2022. The project includes a 4.5m diameter EPBM to construct the 2.3km long tunnel below the Fraser River, which connect into two deep shafts (50 and 60m in depth).

- **Broadway Subway Transit Project** - Construction of the 5.7km extension to Vancouver's transit system is underway. Tunnelling of the 5km of twin TBM-bored tunnels commenced in 2022, as well as excavation of the six new underground stations.
- **Trans Mountain Pipeline – Burnaby Mountain Tunnel** - As part of the Trans Mountain Expansion Project with excavation of a 2.6 km long, 4m diameter tunnel using an EPBM under Burnaby Mountain. The new tunnel will contain three 0.76m crude oil delivery pipelines. Tunnel excavation was completed in mid 2022, with the overall project expected to be fully operational in 2024.
- **Kemano T2** - a second tunnel has been commissioned to convey water into the Kemano Powerhouse in British Columbia, marking the end of the Kemano T2 hydropower project. The new, 16km tunnel was filled up with water and produced its first megawatt of electricity in July 2022 after its construction was completed in May 2022. Both T1 and T2 are now operating together, ensuring the long-term reliability of the power supply for the BC Works aluminium smelter in Kitimat and neighbouring communities.

Key Eastern Canada projects currently in progress or completed in 2022 include:

- **Eglinton Crosstown West Extension** - This 9.2km extension to Eglinton Crosstown LRT which includes 6.4km of 5.75m (ID) twin bored tunnels. Rexy and Renny, the two TBMs started tunnelling on 11th April 2022 and are well advanced, achieving record excavation rates.
- **Scarborough Subway Extension** - This project will feature the largest diameter transit tunnel in Canada, 11.9m ID. The project consists of 7.8km of single bore tunnel, 500m cut & cover box structure between Kennedy Station and end of tunnel and three stations. The TBM arrived at the job site in Toronto in 2022.
- **Ashbridges Bay Outfall Tunnel** - The ABTP Outfall project has reached an important milestone: tunnel completing and TBM removal. To final completion there are a couple of raisers to be installed followed by tunnel connection and the rest of the marine work



*Rehabilitation of the Mount Royal Tunnel for the REM Project, Montreal.*

including riser connection and diffusers installation.

- **REM Transit Line** - TBM "Alice" finished excavation on July 7th, 2022 of the 2.5km long 7.4m diameter single track tunnel that runs underneath an airport runway and taxiway with very negligible settlement. Conversion of the 5km long, 100 year old Mt Royal tunnel, from a commuter rail operation to a high frequency light rail operation is underway (see photo below).

### FUTURE TUNNELLING ACTIVITIES

Canada has more than 50 major tunnelling projects planned for the next 10 years valued at more than \$50bn. A summary of some of these projects is provided below.

- **Eagle Mountain Gas Pipeline Tunnel Project, BC** - 9km tunnel to house a 24" gas pipeline
- **Stanley Park Water Supply Tunnel, Vancouver** - Metro Vancouver project will feature a 1.4km tunnel under Stanley Park constructed by roadheader
- **Coquitlam 4 Water Supply Tunnel** - new 5.5m diameter, 2km long water supply tunnel in the greater Vancouver suburb of Coquitlam
- **Cambie Richmond Water Supply Tunnel, Vancouver** - new water supply tunnel under the Fraser River between Vancouver and Richmond
- **Haney Water Supply Tunnel** - Pitt River Crossing, Vancouver - 1.2km long tunnel under the Pitt River between Port Coquitlam and Maple Ridge to house a 2.4m diameter steel water main
- **Green Line LRT, Calgary** - Extension to the existing LRT, which includes 3km of tunnel and four underground stations

in the city's downtown. Award of the DB project is expected in 2023.

- **Ontario Line, Toronto** - The Project will be the largest transit project in Canada including 15.6km of subway line with 15-stops running from Exhibition Place, through the heart of downtown, and all the way to the Ontario Science Centre. The D/B project is expected to be awarded by the end of 2022.
- **Yonge Extension, Toronto** - The Yonge North Subway Extension (YNSE) will extend the TTC's Line 1 subway service 8km from the existing terminus at Finch Station into the City of Richmond Hill. It will include a 6.1km underground tunnel segment. The RFP is expected in 2023.
- **Inner Harbour West, Toronto** - The project is stormwater storage for Wet Weather Flows (WWF) and water quality improvement. The project includes 5.5km of tunnels (6.3m ID), three shafts (up to 30m dia.), nine connections and eight drop structures.
- **Taylor Massey-Creek Tunnel, Toronto** - Represents the last phase of the Toronto and includes approximately 6km tunnel, wet weather flow storage shafts and connection points to the tunnels for stormwater and combined sewer overflow
- **Blue Line Extension, Montreal** - 3km Metro line extension, with five stations. Conventional BB contract. Request for proposals for is expected shortly.
- **REM East Extension** - Work is proceeding in the 5km long 100-year-old Mont-Royal Tunnel that is being converted from a commuter rail operation to a high frequency light rail operation.



- Québec City-Lévis Road Tunnel, Montreal - The provincial government has selected a twin tunnel configuration with two lanes in each direction as opposed to previously announced one bore with three lanes in each direction.

- Preliminary Design is expected to end in 2025
- Québec City Tramway Tunnel - 1.8km Tunnel with two tracks and two UG Stations. Tender Design is progressing for the Quebec Tramway with two packages:

the rolling stock and the infrastructure packages that are being tendered in sequence. Each package has received two proponents team. Bids are due in Fall 2022 for rolling stock and in Spring 2023 for the infrastructure package.

# Chile



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

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

**Number of Members:** 76 Members (57 are companies from the industry)  
Corporate Members: 1 Category Premium 17 Category Gold, 39 Category Associated and 19 Individual members.

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

**(January 13th, 2022)** 10 Years CTES Fellowship Meeting / face-to-face activity / 52 assistants

**(January 11th, 2022)** Webinar "Operation and emergency management in highway mega-tunnels in Europe" / online activity / 81 attendants

**(March 17th, 2022)** NTN Meeting - Norwegian Talk/online activity / 55 attendants

**(March 29th, 2022)** Webinar "Rectangular tunnel in rock - A new way forward" / online activity / 102 attendants

**(April 26th, 2022)** Webinar "Evaluation of the behavior of shotcrete in fibers and meshes in underground holdings" / online activity / 100 attendants

**(May 25th, 2022)** Webinar: "TBM Crossover Experience in the Condors' Project" / online activity / 103 attendants

**(June 29th, 2022)** Webinar "Large national projects - Future lines of the Santiago Metro" / online activity / 244 attendants

**(June 13th, 2022)** ROCKBURST SUMMIT: underground experiences in bursting rocks in Chile and abroad. /Hybrid Activity / 93 attendants

**(August - September 2022)** Technology Mission Norway - Sweden / face-to-face activity / 19 attendants

**(September 2022)** Visit ACTOS Colombia / Visit to El Teniente Mine and CIO Rancagua

**(October 27th)** Summit National and International Experience in Microtunneling / Hybrid Activity / 84 attendants

**(November 17th, 2022)** Webinar "Measurement of early strength in

Shotcrete" / online activity / 173 attendants

**(November 24th, 2022)** Webinar AVO II "Presentation of the AVO II Project" / online activity / 205 attendants

**(December 6th, 2022)** Webinar "Underground Megaprojects - Line 7 Progress" / online activity / 126 attendants

## FUTURE ASSOCIATION ACTIVITIES

**Seminar** - "Mechanized Excavation in Civil Works and Mining" (Organized by HK - CO ORGANIZA CTES)

**National and International Summit** - "Experiences, challenges and opportunities in vertical developments in Mining and Civil Works"

**Summit** - "Drilling steel importance in costs and productivity in tunnel development"

**Summit** - "Automation and digitization in tunneling" Sandvik

**Summit** - "Cavern design and construction"

**Summit** - Underground geotechnical exploration

## Technological Mission

**Summit** - "Safety in mines, tunnels and underground works. Unoptimized: Fire System - Lighting - Signage

**Latin American Congress of Tunnel and Underground Space Committees** - Santiago 2023: 12 entities will participate in the Congress.

- Argentina - Aates
- Bolivia - Abotúnel
- Brasil - Cbt
- Chile - Ctes
- Colombia - Actos
- Costa Rica - Acros
- Ecuador - Aime
- España - Aetos
- Mexico - Amitos
- Mexico - Mexico Subterráneo
- Perú - Aptos
- Portugal - Cpt

CTES CAMARADERIE MEETING - Closing 2023

## STATISTICS

### 1. List of tunnels complete

Second stretch of El melon tunnel  
Highway Vespucci Orient I

### 2. List of tunnels under construction

Extension Line 2, Extension Line 3, Line 7, East Vespucci Highway 2, The Condors Hydroelectric Plant

In Chile, underground mining provides a great demand for the construction of tunnels and shafts for exploitation, with a level of activity approximating:

Tunnels 80,000 to 100,000m/year

Pikes 8,000 to 10,000m/year

## EDUCATION ON TUNNELLING IN THE COUNTRY

Postgraduate Diploma in Tunnels and Underground Spaces; Universidad de Chile  
Diploma in Modern Tunnel Excavation Techniques; Universidad de Santiago de Chile  
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

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

### Academic activities

1. The 20th Academic and Technical Conference on Tunnel and Underground Engineering across Strait was successfully held on November 2nd – 3rd, 2022, in both physical and virtual forms, with the main venue in Taipei, Taiwan. It was organized by the Tunnel Association (China Taiwan) and co-organized by the Tunnel and Underground Engineering Branch of the Civil Engineering Society together with Underground Engineering Branch of the Rock Mechanics and Engineering Society from China mainland. The theme of the conference was “Energy Conservation and Carbon Reduction, Sustainable Tunnel”. More than 170 representatives and scholars from both sides of the Straits attended the Conference physically and virtually.

2. On December 15th, 2022, The “Tunnel and Underground Engineering Science and Technology Innovation Forum (5th Session)” was successfully held online, which was jointly organized by the Tunnel and Underground Engineering Branch of China Civil Engineering Society and China Railway Tunnel Group Co., Ltd., China Railway Tunnel Survey and Design Research Institute Co., LTD., Guangdong Provincial Key Laboratory of Intelligent Monitoring and Maintenance of Tunnel Structure, and Tunnel Construction Journal (Chinese and English). Due to the epidemic, the forum was held on online, attracting a total of 300 experts (due to the platform limitation on the number of participants), with more than 800 online video viewers.

3. On 2nd September 2022, the 48th ITA General Assembly and World Tunneling Congress, with the theme “Underground Solutions for a Changing World”, was successfully held in Copenhagen, Denmark. At the Conference, Liu Jialiang, deputy project manager of the Organizing committee of the 2024 World Tunnel Congress, introduced preparations for the WTC2024. The theme of the WTC2024 is “Tunnels Make Life Better!”. At present, the sponsorship and exhibition of the WTC2024 have been launched, the official congress website has been set up, the registration system has been debugged, the paper

submission system is under testing, and all related works are progressing.

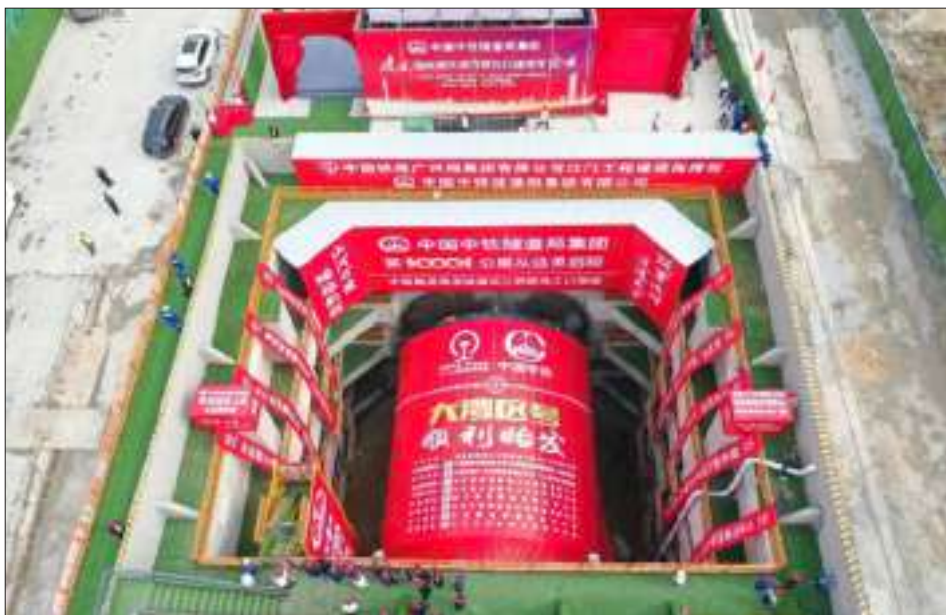
4. On Dec. 5th, 2022, some of our delegates participated in the World Tunnel Day Marathon 2022.

### Publications

Modern Tunnel Technology printed and released 3000 copies. The following proceedings are also published, including:

- The 3rd International Conference on Tunnel and Underground Engineering Inspection and Monitoring and the Seventh China Civil Engineering Society Tunnel and Underground Engineering Branch Construction Management and Youth Work Science and Technology Forum Report Summary
- Proceedings of the 20th Academic Exchange of Waterproofing and Drainage Technology Forum of Tunnel and Underground Engineering Branch of China Civil Engineering Society
- Proceedings of the 12th National Operating Safety, Energy Saving and Environmental Protection Tunnel and Underground Space Forum and the Third Traffic Tunnel Engineering Fire Control and Emergency Rescue Technology Forum, Tunnel and Underground Engineering Branch of China Civil Engineering Society

## CURRENT TUNNELLING ACTIVITIES



### Shenzhen-Zhongshan Immersed Tube Tunnel:

The underwater interchange integrating a bridge, tunnel and island constructed in shallow and deep silt. The total length of the Shenzhen-Zhongshan Channel Project is 24km, including the east artificial island, the west artificial island, an 17,129m bridge, a 6,845m immersed tube tunnel, and an airport hub interchange (the underground on-ramp part), etc. The design speed is 100km/h and the service life is 100 years. The immersed tube tunnel on the project is a two-way eight-lane steel shell concrete structure, comprising a single standard pipe section of 165m length, 46m in width and 10.6m in height. It has a self-weight of about 80,000 tons and a long floating distance of about 50km. The floating installation needs to cross several busy channels. The precision of underwater docking should be within  $\pm 5\text{cm}$ . The submerged tube adopts the new structure of “steel shell and concrete”, which has large bearing capacity and a better waterproof performance, with significant social, economic and ecological value. The project commenced in April 2018 and plans to open to traffic in June 2024.

### Pearl River Estuary Tunnel Project of Shenzhen - Jiangmen Railway

The project has a total length of 13.69km, in a single-tube, double line tunnel, with a design speed of 200km/h. It adopts the combined construction methods of TBM (6.52km, 13.32m diameter TBM), New Austrian Tunneling Method (5.52km) and open excavation (1.65km). The Shenjiang No. 1 shield tunnelling machine advances 3.590km from Humen, Dongguan, and the “Da Wan District shield tunnelling machine” drove 2.93km from Wanqingsha,



Guangzhou. The Project is implemented in complex geological conditions, with a large tunnel depth, high water pressure and long distance TBM tunnelling. The deepest part of the tunnel is 115m underwater. The construction of the Project commenced in July 2020 and will be completed in December 2025.

#### **Pearl Bay Underwater Channel Project (by the immersed tube method)**

This cross-river Channel runs from north to south from Huigu Wan City Road, passing Chiaomen Waterway, Lingshan Island Tip (Tuntin Road), Shang Hengli Road, Hengli Island Tip (Sing Can Road), Xia Hengli Road, and then connects to Pearl River East Cluster (Po Shing Wai Road) in the south. The main line of the tunnel is graded as a main trunk road, with a two-way six-lane design speed of 50km/h, and open to traffic of all kinds. The main line of the tunnel is 5.667km in length, the land section is implemented by the open excavation method with a total length of 4.262km, and the underwater section is implemented by the immersed tube method with a total length of 1.405km. Among them, the total length of the tunnel in the first phase of the project is 4.915km, the total length of the open-cut section is 3.935km, and the total length of the immersed section is 0.98km. The construction commenced in November 2022 and will be completed in September 2026.

#### **Guangzhou-Dongguan-Shenzhen Intercity TBM Section Project**

The largest diameter tunnel under construction in Shenzhen for rail transit Located in the middle of the Pearl River Delta, the Guangzhou-Dongguan-Shenzhen Intercity Line is the main line of the Pearl River Delta Intercity network.

The Qianhai to Huanggang port section is a further extension of the Suiguanshen Intercity Line. The line runs through the Qianhai Cooperation Zone, Nanshan District and Futian District, with a total length of 21.142km and a design speed of 160km/h. Qianhuang Section 1 (open-cut section) ~ Huanggang Port Station section is a single-tube, double-line tunnel with an outer diameter of 12.8m, constructed by a 13.27m diameter shield machine. The total length of the tunnel is 3.511km, with a minimum curve radius of 1300m, a maximum longitudinal slope of 29.6‰, and a tunnel roof depth of 10.7m ~ 32.9m. The project is located in the core of Shenzhen, and is the largest diameter tunnel under construction by Shenzhen rail transit. It has the characteristics of complex geological conditions, sensitive environments along the route. The construction commenced in 2021 and will be completed in 2026.

#### **Shenzhen Qianhai Comprehensive Transportation Hub**

A large-scale underground comprehensive transportation hub Qianhai comprehensive transportation Hub is a rare large-scale all-underground hub TOD project in China. The project includes three subway lines (Line 1, 5 and 11) and two intercity railways (Guangzhou-Dongguan-Shenzhen Intercity Line and Hong Kong-Shenzhen Western Railway). The total land area is 20 hectares, including the underground hub and the upper property, the total construction area is about 2,159,000 square meters. From east to west are: the subway stations on Line 1, 5 and 11; a transfer Hall and property development in the underground space; the Guangzhou-Dongguan-Shenzhen intercity

Line station; the stations of the Hong Kong-Shenzhen Western Railway and port space. It contains multiple functions, such as traffic distribution and underground commerce, and maximizes the intensive use of land resources.

The underground section of the project is a large deep foundation development near the sea, with a total length of 830m, the depth of the standard section of the basement is about 30m, and the deepest foundation in the tower and core tube is about 37m. In order to protect the safety of subway operation, eight foundation pit are excavated in sequence. The adjacent foundation pit of the Guangzhou-Dongguan-Shenzhen Intercity Line, 32m in depth, is constructed synchronously. The Project commenced in 2011 and will be completed in 2027.

#### **FUTURE TUNNELLING ACTIVITIES**

By the end of 2022, 5,376 railway tunnels with a total length of 13,221km had been planned.

#### **Beilun to Jintang Submarine high-speed Railway Tunnel**

The newly built Beilun to Jintang undersea high-speed rail tunnel (as part of the Ningbo-Zhoushan Railway), has a total length of 16.2km, with an undersea TBM section of 10.87km length, and will be the longest undersea tunnel in China, as well as the longest designed underwater high-speed rail TBM tunnel with the highest pressure (up to 1.0MPa) in China.

#### **Wanghai Road Passage: Constructed by slurry TBM with a diameter of 16.28m**

The total length of the Wanghai Road Passage is about 8.25km, including a 5.295km TBM tunnel, constructed by two slurry TBM with a diameter of 16.28m. The minimum curve radius of the TBM section is 520m. The geological conditions are complex and the surrounding environment is sensitive. The main strata is fully weathered, moderately weathered, breezed granite, clay and stone filling, and a uniaxial compressive strength of rock up to 138.9Mpa. The tunnel segment has an outer diameter of 15.7m, an inner diameter of 14.4m and a ring width of 1.8m. It is designed to be a double-layer bidirectional six-lane tunnel with a design speed of 60km/h.

#### **Qiongzhou Strait Cross-Sea Channel**

The average water depth of the Qiongzhou Strait is 44m, with a maximum depth of 114m, and a maximum water pressure of



nearly 1.5MPa. The length of the cross-sea tunnel on the Qiongzhou Strait is about 28km. The project is to be constructed by TBM with an excavation diameter of about 16m. The one-way tunnelling length is more than 11km. Construction of the channel will face challenges such as deep water, rapids, complex geology, frequent seismic activities, busy shipping, and many environment sensitive effects, etc.

### 3rd Symposium for Young Tunnellers in Asia (SYTA), April 21-23, 2023

SYTA is an annual symposium for young professionals working in the tunnelling industry in Asia. The theme of the 3rd SYTA is 'Low-carbon Construction and Sustainable Development of Tunnel Engineering'. The main goal of this symposium is to provide a forum for young professionals and researchers to engage in transnational collaboration, discuss recent advances and future challenges in the design, construction, and safety maintenance of tunnels and underground engineering toward low-carbon technologies and sustainable development. The 3rd SYTA was postponed from 2022 to 2023 due to the pandemic and it will be held in Changsha, Hunan on April 21st – 23rd, 2023. Conference Website: <https://www.syta2022.com/>



### STATISTICS

By the end of 2022, there were 17,873 railway tunnels in operation with a total length of 21,978km.

(1) New operation: In 2022, 341 new railway tunnels with a total length of 923km were put into operation, including 25 extra-long tunnels of more than 10km with a total length of 362km.

(2) Under construction: 3,025 railway tunnels with a total length of 7,704km are under construction.

By the end of 2021, there were 23,268 highway tunnels covering 24,698.9km. Compared with 2021, this is an increase of 1,952 tunnels covering 2,699.6km in 2022.

By December 31st, 2022, 55 cities on the Chinese mainland has built urban rail transit lines, reaching 10,291.95km accumulatively. In the 10,291.95km of urban rail transit lines, there are a total of Nine systems, among which subway totals 8012.85km, some 77.85%. In 2022, urban rail transit is operated for the first time in another five cities: Nanping, Jinhua, Nantong, Taizhou and Huangshi.



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## EDUCATION ON TUNNELLING IN THE COUNTRY

Postgraduate Program		Representative institutions in tunnel and underground engineering disciplines (and major associated disciplines)		
Nature of the Program	Course title	Serial no.	Province	School
Professional degree course (professional core courses)	Testing and testing techniques for underground structures	1	Anhui	Anhui University of Science & Technology
	Advanced rock mechanics	2	Anhui	Hefei University of Technology
	Geotechnical plastic mechanics	3	Beijing	Beijing Jiaotong University
	Theory of calculation of underground structures	4	Beijing	Beijing University of Technology
	Tunnel mechanics and engineering	5	Beijing	University of Science and Technology Beijing
Specialized non-degree courses	Advanced theory of underground concrete structures	6	Beijing	Tsinghua University
	Intelligent underground structures	7	Beijing	China University of Mining and Technology
	Case study of geotechnical engineering and underground structure	8	Beijing	China University of Geosciences (Beijing)
	major engineering	9	Beijing	China Academy of Railway Sciences Group Co.
	Construction technology of underground engineering	10	Beijing	General Institute of Coal Scientific
	Methods of underground structure optimization	11	Chongqing	Chongqing University
	Seismic resistance of Underground structures	12	Chongqing	Chongqing Jiaotong University
	Deep foundation pit engineering	13	Gansu	Lanzhou Jiaotong University
	Tunnel and underground engineering IT technology and application	14	Gansu	Lanzhou University of Technology
	Introduction to Underground space utilization	15	Guangdong	Guangzhou University
	Disaster science of underground engineering	16	Hebei	Shijiazhuang Tiedao University
	Tunnel and underground space operation safety and disaster prevention	17	Henan	Zhengzhou University
	Probabilistic analysis of civil engineering	18	Heilongjiang	Harbin Institute of Technology
	Structural repair and reinforcement of buildings	19	Heilongjiang	Institute of Engineering Mechanics, China
		20	Hubei	University of Chinese Academy of Sciences
		21	Hubei	Wuhan University
		22	Hunan	Central South University
		23	Hunan	Changsha University of Science and
		24	Ji Lin	Jilin University
Submitted graduate courses		25	Jiangsu	Southeast University
Course number	Course name	26	Jiangsu	Hohai University
	Professional degree courses	27	Jiangsu	China University of Mining and Technology
1020245	Higher underground structure	28	Jiangsu	Nanjing Tech University
2020418	Elastoplastic mechanics	29	Jiangsu	Army Engineering University
2020317	Advanced rock mechanics	30	Liaoning	Dalian University of Technology
2020533	Tunnel Mechanics and Engineering	31	Liaoning	Shenyang Jianzhu University
2020563	Research Advances and research methods in Civil engineering	32	Liaoning	Northeastern University
	Non-major degree courses	33	Liaoning	Liaoning Technical University
1020234	Fracture Mechanics and fatigue	34	Shandong	Shandong University
1020248	Special Discussion on Underground space utilization	35	Shandong	Shandong University of Science and
1020249	Risk and Safety in Civil engineering	36	Shaanxi	Chang 'an University
		37	Shaanxi	Xi 'an University of Architecture and
		38	Shaanxi	Xi 'an University of Science and Technology
		39	Shaanxi	Xi 'an University of Technology
		40	Shanxi	Taiyuan University of Technology
		41	Shanghai	Tongji University
		42	Sichuan	Southwest Jiaotong University
		43	Sichuan	Chengdu University of Technology
		44	Sichuan	Sichuan University
		45	Tianjin	Tianjin University
		46	Zhejiang	Zhejiang University
Note: This table is sorted by the pinyin order of the region in which the institution or research institution is located.				

# 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

ITEM	DEPARTMENT	QUANTITY	ITEM	DEPARTMENT	QUANTITY
1	CUNDINAMARCA	27	9	SANTANDER	4
2	TOLIMA	18	10	CALDAS	4
3	VALLE DEL CAUCA	18	11	NORTE DE SANTANDER	3
4	BOYACÁ	17	12	NARIÑO	3
5	ANTIOQUIA	16	13	RISARALDA	1
6	META	13	15	MANIZALES	1
7	QUINDÍO	9	16	CAUCA	1
8	CAQUETÁ	4			

## STATISTICS

**1. 100% of the length of the tunnels completed in 2021 were built using the conventional method.**

**2. US\$2.7bn of tunnelling / underground space facilities awarded in 2021**

**3. List of tunnels completed:**

1 Toyo Tunnel	9 Chirajara-Fundadores Tunnel 5
2 Occidente Tunnel	10 Road Bogotá – Villavicencio Tunnel 3
3 La Quiebra Tunnel	11 Pamplona Tunnel
4 Amagá Tunnel	12 Road Bogotá – Villavicencio Tunnel 6
5 La Paz Tunnel	13 Road Bogotá – Villavicencio Tunnel 2
6 La Sorda Tunnel	14 La Honda Tunnel
7 Fuemia Tunnel	15 Los Curos Tunnel
8 Road Bogotá – Villavicencio Tunnel 5	16 Pamplonita Tunnel

## 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 road tunnels / University: Universidad Javeriana / Bogotá, Colombia.

Master's Degree in Road Infrastructure / University: Universidad Santo Tomás

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

Geotechnical risk assessment and management / INGETEC / Bogotá, Colombia

Specialization in geotechnical engineering / University: Universidad del valle

## ASSOCIATION ACTIVITIES DURING 2022 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). Activities for the year 2022 included the following:

- The committee will organize more short talks with invited experts, which will be open to all interested members of the community
- WORLD ROAD TUNNEL SEMINAR: implementation of technologies in tunnel operation
- WORLD TUNNEL CONGRESS - WTC 2022

## CURRENT TUNNELLING ACTIVITIES

In recent years, the Colombian government has made investments through the fourth and fifth generation concession plans (4G-5G) that include the construction of tunnels for different uses (vehicles, public transportation, hydraulic).

In 2022, several underground works were carried out in Colombia related to the construction of subway works such as subway lines, highway tunnels and hydraulic structures, for example the Toyo tunnel was completed with a length of 10km and an estimated cost of US\$222M, as well as the development of the Buenaventura - Loboguerrero highway, vital for the communication of one of the most important international seaports.

## FUTURE ASSOCIATION ACTIVITIES

The committee will work on an academic article about tunnelling based on the local Working Groups research.

The committee will organize short talks with invited experts, which will be open to all interested members of the community.

World Tunnel Congress 2023

During 2022, the construction of 14 road tunnels was completed, putting into operation a total of some 36km.

We currently have 13 tunnels of different diameters and uses under construction in the country, about 36km of underground works.

Construction of two 1.4km tunnels and replacement of electromechanical equipment in the 17 existing tunnels on the 5G Buenaventura-Loboguerrero road.



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# Costa Rica



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

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

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

- Participation in the FEMCIC-CICCR Forum (Mexican Federation of Civil Engineers Colleges – Costa Rican College of Civil Engineers Forum)
- Organization of the False Tunnels for Costa Rican Mountain Roads Colloquium
- Organization of the CCROS 2023 Costa Rican Congress of Underground Works which will be held between March 9th and March 11th as an ITA endorsed event.
- Participation in the radio and TV program “Synergia” of the Colegio Federado de Ingenieros y Arquitectos de Costa Rica to talk about “Myths around the underground works and the importance of the underground space.”

## CURRENT TUNNELLING ACTIVITIES

- The pipe jacked micro tunnelling for the residual water treatment for the Ambiental improvement project in the San Jose Metropolitan Area reports the following progress: In the southern sector of San José, 2,999m of pipe jack micro tunnels of 1200mm diameter have been constructed, as well as 3,739m of micro tunnels of 1,500mm diameter and eight shafts of 4.5m to 5.5m diameter with an average depth of 12m.
- The project for mobility improvement on the Circumvallation Highway of San José has reported completion of the new underground pass of 790m under the Guadalupe roundabout and a new underground pass of 900m at the Bandera roundabout.
- The 510m long underground pass at the

La Uruca intersection has advanced to 70% completion.

- The underground pass of 1,200m at the Calle Blancos intersection has advanced to 55% completion.
- The pipe jacked micro tunnel of 1,200mm diameter and 900m length is completed.

## FUTURE TUNNELLING ACTIVITIES

- A new underpass of 60m on the national route No. 2 at the La Galera intersection is now under construction.
- 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 the storm sewage of the Metropolitan Area of San Jose, 1,300m length and 3m diameter each.

## 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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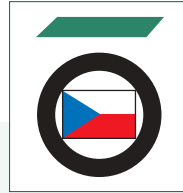
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# Czech Republic



**Name:** Czech Tunnelling Association

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

**Number of Members:** 94, including 45 corporate members

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

- 1) The publishing of "Tunel" journal – four issues per year.
- 2) Organising the "Tunnelling afternoons" – public lectures for those involved in the underground. Lectures were held on these topics:

- D Metro Line in Prague – Design Preparation and Supplementary Geological Survey.
- Reconstruction of Railway Tunnels.
- Historical Underground Constructions.

- 3) We continued preparation for the 15th International Conference UC Prague 2023.

## FUTURE ASSOCIATION ACTIVITIES

In 2023 the Czech Tunnelling Association (CzTA) will continue with the following activities:

- 1) The publishing of "Tunel" journal – four issues per year.
- 2) Organising of public lectures "Tunnelling afternoons", the topics:
  - Metro D – New Line of Prague Metro.
  - Preparation of the Completion of the Prague City Ring Road.
- 3) On 29th – 31st May, 2023 we will be hosting the conference - UC Prague 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, 29th – 31st May, 2023.

This international conference is one of a series of conferences "Underground Construction Prague", held regularly every three years. Due to the pandemic, this year has been postponed by a year. Participants of past conferences enjoyed the

scientific programme, venue and social programme. 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 as one of the key events of 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 exchange of new information and experience.

## STATISTICS

### 1. Length or volume excavated - % mechanized / % conventional during 2022

1,060m conventional

### 2. List of tunnels under construction

Metro D

## 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

# Finland



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

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

**Number of Members:** 202 Individual Associate Members, 23 Corporate Affiliate Members

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

## ASSOCIATION ACTIVITIES DURING 2022

- Annual Meeting on 12th April 2022
- Nomination of Finnish Young Tunneller 2021-2022
- Seminar on underground solutions in green transition energy projects
- Four scholarships for students active in

studies, working life and position of trust

- Activities of the Young Member Group
- Participating in the FISE Qualification of Professionals in Building, HVAC and Real Estate Sector in Finland

## NEWLY COMPLETED PROJECTS

**Blominmäki Underground Wastewater**

## Treatment Plant

- The project was completed at the end of 2022.
- The treatment plant processes the wastewater of 400,000 residents (2022).
- By 2040: 150,000m<sup>3</sup> of wastewater will flow through the new treatment plant daily.
- More info: <https://www.youtube.com/watch?v=D9PwTx4rQ0>

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

- The Helsinki metro is extending to the west in two phases: 8 + 5 new stations.
- The first phase was completed in autumn 2017 and the second was opened December 3rd, 2022.
- The metro route is 21km underground through twin parallel tunnels.
- In addition to the stations, a total



Savilahti Underground Sport and Event Centre (Photo credit: Vicente Serra)

of 23 shafts were built for pressure equalization, ventilation and smoke extraction. The shafts are also used as emergency exits. An underground metro depot is located in Sammalvuori with a total excavation volume of 240,000m<sup>3</sup>.

- More info: <https://www.lansimetro.fi/en/home/>

#### Jokeri Light Rail

- 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 on the line started in 2019.
- The length of the line is approximately 25km and will have 33 stops.
- 400m of tunnel was excavated during 2021.
- More info: <https://raidejokeri.info/in-english/>

#### Cavern Heat Storage Facility

- The caverns located underground in Mustikkamaa were 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 of the heat at the same time. With the facility, it will be possible to avoid having to start 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 120 megawatts, which enables discharge or charge for about four days when the accumulator is full or empty.

- Budget €15M, with construction works from 2019-2021.
- More info: <https://www.helen.fi/en/news/2018/gigantic-cavern-heat-storage-facility-to-be-implemented-in-mustikkamaa>

#### CURRENT TUNNELLING ACTIVITIES

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

- The underground treatment plant will process wastewater for up to 420,000 residents (2040).
- With a budget of €346M, it is the largest single environmental investment in the Tampere region.
- The project started in 2018 and it will be operational in 2025/2026.
- More info: <https://www.keskuspuhdistamo.fi/>

##### Final Disposal Facility ONKALO (under construction)

- The final disposal facility consists of two sections:
  - The above ground encapsulation plant where spent nuclear fuel is received, dried and packed into final disposal canisters.
  - The repository located deep inside the bedrock. Vital are the tunnels where the encapsulated spent nuclear fuel is disposed of.
- The volume of rock to be excavated for the repository, is approximately 1.5

million cubic metres.

- The number of final disposal tunnels required is 137. The total length of the tunnels is 50km, located within an area extending over two to three square kilometres.
- Final disposal starts in the mid 2020's.
- More info: Posiva - Front page

##### Art Cave Saimaa Retretti (under construction)

- Reconstruction and additional spaces.
- The new Centre of Art and Culture will be built from 2021-25.
- More info: <https://www.saimaantaideluola.fi/about-3-2>

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

- Re-use of an old underground military depot built 80 years ago.
- A new facility to serve as an event center for 2,500 people and also as an air-raid shelter for 7,000 people.
- Construction period 2021-2024.

##### Underground Parking Hall in Keilaniemi, Espoo (under construction)

- Excavation volume of 280,000m<sup>3</sup>.
- Underground parking for 1,600 cars.
- Construction 2022-2026.

##### Underground Parking Hall for Laakso hospital, Helsinki (under construction)

- Underground parking for 550 cars .
- Construction 2023.

##### Underground swimming pool in Lempäälä

- Construction 3/2023-07/2024.



### Eiranranta heat pump plant (Helen, Helsinki)

- The size of the heat pump plant is about 50,000m<sup>3</sup>.
- For the production of carbon-neutral district heating (93MW) and district cooling (60MW).
- Construction 1/2023-11/2025.

### FUTURE TUNNELLING ACTIVITIES

#### Seawater Heat Recovery Project, Helsinki

- The owner of the project is Helen Oy.
- The project is a Heat Pump Plant that uses seawater as a heat source.
  - Located in Salmisaari.
  - Underground space with a total volume of excavation of 300,000m<sup>3</sup>.
- The seawater system includes.
  - An intake tunnel, 17km long, excavated by TBM.
  - A discharge tunnel, 9km long, excavated by Drill & Blast.
  - Total volume of excavation 1,300,000m<sup>3</sup>

#### 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 for thermal energy storage with a 1,000,000m<sup>3</sup> size. It will have a storage capacity of 90GWh of energy – the annual heat consumption of a medium-sized town.

- More info: <https://www.vantaanenergia.fi/en/fossil-free-2026/worlds-largest-cavern-thermal-energy-storage-to-be-built-in-vantaa/>

#### Toellisuuskatu Waste Water Tunnel, Helsinki

- To improve wastewater and storm water handling in Helsinki.
- Length 0.5km.
- Construction estimated 2023-2025.

#### Garden Helsinki

- An event arena providing sports and culture events, shopping facilities, apartments, underground parking etc.
- Private funding.
- Excavation volume of 800,000m<sup>3</sup>.
- Schedule open.
- More info: <http://www.gardenhelsinki.fi/en/>

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

- Excavation volume of 60,000m<sup>3</sup>.
- Underground parking for 350 cars.
- Construction schedule remains open.
- More info: <https://www.yit.fi/en/mariasarea>

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

- Two parallel tunnels with length of 800m and an excavation volume of 270,000m<sup>3</sup>.
- Estimated cost of €160M.
- Construction estimated between 2028-2032.

#### West Harbour Tunnel, Helsinki (planning)

- Estimated cost of €260M.
- The city council of Helsinki made a positive in-principle decision in Feb 2021.
- Currently in the general planning phase.
- Construction schedule remains open.

#### Esplanadi Waste Water Tunnel, Helsinki (planning, waiting for decision of construction):

- Improve wastewater and storm water handling in the city centre of Helsinki.
- Length 1km.
- Estimated cost of €5M.
- Construction estimated from 2025-2027.

#### 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
- More info: <https://vayla.fi/kaikki-hankkeet/espoo-salo-oikorata>

#### Salu – Hajala -High-speed Railway (planning):

- 55km of new high-speed railway between Salo and Hajala.
- Two new railway tunnels with a total length about 700m.
- More info: <https://vayla.fi/helsinki-turku-nopea-ratayhteys>

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

- 18km of new railway between Lahdenperä and Jämsä.
- 5km length of railway tunnel.
- More info: <https://vayla.fi/kaikki-hankkeet/tampere-jyvaskyla>

#### Pyhäsalmi Mine Pumped Hydro Energy Storage

- Mine depth 1450m.
- Power 75MW, capacity 530MWh.

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

- Subsea road tunnel to link the island of Föglö and the Åland island where the city of Mariehamn is located.
- Tunnel length 10.5km.
- Requires further work for investigations, studies and design.

### City Rail Loop Pissararata, Helsinki (waiting for decision):

- The City Rail Loop is a planned urban railway line for commuter trains beneath Helsinki city centre.
- The city plan has been approved but the decision on the construction has yet to be verified.
- More info: <https://vayla.fi/pisara#WgrnfU32SM8>

### 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 110 young members and students)

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

### Tunnels and Underground Space Magazine (TES)

- TES 279: Maintenance works
- TES 280: Hydraulic works (hydro-electric galleries)
- TES 281: Technical progress in building wide, deep tunnels – Design and construction of 4km of pressured line with micro-tunnelling boring machine – Grand Paris Express: Feedback on technical risk management.
- TES 282: Interpretation of the behaviour of distributed anchor bolts – Test bench to characterise ventilation equipment to train piston effect – Design & built of an ultra-low-carbon concrete microtunnel – Excavation of a technical gallery involving multiple constraints.

### Technical Committee

22 working groups (WGs) in operation. Five recommendations finalized and approved in 2022:

- WG 12: Underground construction site traffic.
- WG 18: Reinforced concrete voussoirs.
- WG 6: Prescribed shotcrete.
- WG 9: Extrametered seals and drainage.
- WG 27: Mechanical ventilation for underground structures during construction and rehabilitation
- Two recommendations being finalized: WG 28: Shallow Wells. WG 14: Tools for diagnosing visible underground structures.
- Two technical evenings dedicated to final shotcrete and TBMs.

### Materials, Equipment and Products Committee

- Regular technical committee meetings and visits.
- Advancement of a technical showcase for manufacturers.
- Representation of AFTES in Copenhagen in 2022.
- Realization of two technical days in Chambéry on October 26th and 27th, 2022 (Conferences and Exhibition): Lyon-Turin:

Major Underground Projects & Innovation 'Materials, Equipment, Products - 500 delegates, 37 stands, 23 presentations and 50 years of the AFTES.

- Preparation of a collective stand at WTC 2023 in Athens.

### Underground Space Committee

- Redesign the committee to provide a broader role for the AFTES think tank that is dedicated to the contribution of underground space as a sustainable development resource.
- Preparation of the Underground Space Session to be held during the 2023 AFTES Congress.
- Valuation of the synthesis of the national research project Ville 10D.

### Education Committee

- Creation of a steering group (with owners, representatives of the engineering companies, the contractors and the university) to support the actions of the committee around the themes of training and research in the field of the underground.

- Master's degree in Tunnels and Underground Works - TOS - Class 10 (October 2021 - September 2022) - 16 students.
- Continuing education sessions at the TOS Specialist Master's degree.

### Youth Members Committee

- Events throughout the year, including three technical evenings.
- In 2023, the youth committee will participate in the preparation of the congress and particularly in the training day co-organized with ITACET.

### Congress AFTES 2021 Paris

- Preparation of the 2023 congress in Paris from 2nd to 4th October, 2023 at the "Palais des Congrès de la Porte Maillot": The underground at the heart of transitions (<https://aftes2023.com/en/>).

### EUTF – European Underground and Tunnel Forum

- EUTF Forum meetings held in Copenhagen (September 2022) and Bologna (October 2022).
- BIM and the rehabilitation of underground infrastructure heritage.
- Perspectives 2023: Eric Leca, President of the Forum for three years.

### Involvement in AITES/ITA

- Participation of AFTES members in ITA Working Groups and Committees.
- Participation in the organization of ITACET training programs.
- Organization with ITACET of a training session during 2023 AFTES congress.

## CURRENT AND FUTURE TUNNELLING ACTIVITIES

### Grands Paris Express and Line 14







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15 - 17 May 2023  
Athens, Greece.

**Grans Paris Express and Line 14**

Since the start of the underground works, 24 TBMs have been launched. In early 2022, six of them were active on Lines 16, 17 and 18 with a tunnelling machine under construction 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

**Toulouse: 3rd metro line**

27km - 21 stations – Tender phase in 2022.  
22km underground – five TBM will be in operation. Commissioning in 2028-2029.

**TELT (Tunnel Euralpin Lyon Turin)**

Cross-border section, with a 2 x 57km base tunnel and two international open-air stations at the tunnel ends, all under

TELT project management.

Access on the France side is under study by SNCF Réseau, and access on the Italy side is under study by RFI.

Cross-border section divided geographically into 12 “operational sites”, with approximately 45 works contracts and 36 engineering contracts; the main tunnel construction lots have already been awarded. A total of 164km of tunnels will be excavated, 30% of which were excavated by the end of August 2022.

**News**

**Paris:** <https://www.societedugrandparis.fr/gpe/actualites>

**Lyon-Turin:** [https://www.telt-sas.com/fr/category/news\\_fr/](https://www.telt-sas.com/fr/category/news_fr/)

**Lyon:** [https://www.sytral.fr/TPL\\_CODE/TPL\\_ACTUALITE/](https://www.sytral.fr/TPL_CODE/TPL_ACTUALITE/)

**Toulouse:** <https://tisseo-collectivites.fr/actualites>

**Name:** Michel DEFFAYET - President of AFTES

**Email:** [aftes@aftes.fr](mailto:aftes@aftes.fr)



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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 2022 AND TO DATE

### Activities

- Munich Tunnel Symposium, 8th July, 2022.
- DACH-meeting (German, Austrian, Swiss Tunnelling Committees) in Austria (technical seminar and site visit).
- InnoTrans, Tunnel Forum, 20th – 23rd September, 2022. Leading international trade fair for transport technology.
- Sealing of buildings by injections; Information on the after sealing of concrete structures, geotechnical sealing injections, 2nd – 3rd November 2022.
- Meetings of the European Underground and Tunnel Forum (EUTF, consisting of Austria, Belgium, France, Germany, Italy, Netherlands, Portugal, Spain and Switzerland).
- Regular meetings of the Tunnel Committee and Working Groups.
- Several meetings and workshops of the Young Engineering Professionals "STUVA-YEP".

### 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.
- Digitalization and Building Information Modelling (BIM) in tunnelling.
- 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.
- Sustainability in Tunnelling.

### Publications (recently finished)

- Recommendation BIM in Tunnelling, Model requirements Part 2 "Information

management".

- Recommendation BIM in Tunnelling, Model requirements Part 3 "Ground model".
- Recommendation BIM in Tunnelling, Model requirements Part 4 "Derivation of model-based Bill of Quantities".
- Recommendation BIM in Tunnelling, Model requirements Part 5 "Allowance of tolerances and superelevation".
- Guideline for occupational health and safety on underground worksites (only in German).
- Recommendations for Project Risk Management in Underground Construction.

### 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).

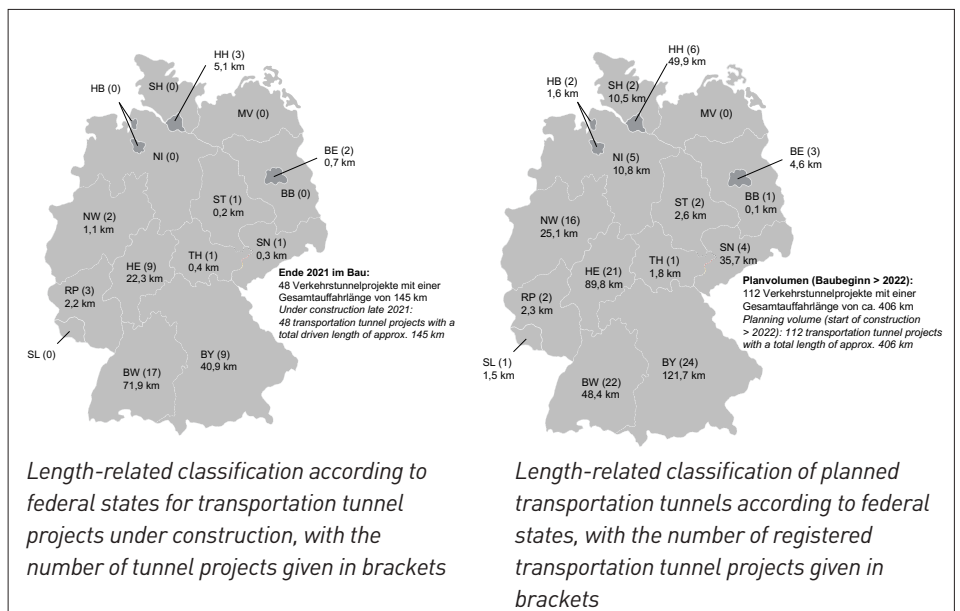
### Future Activities

- Regular meetings with Austrian, Swiss and EUTF colleagues.
- STUVA-Conference 2023, Separate Segments on "Tunnelling" and "Tunnel Operation", 8th – 10th November 2023, Munich.

## CURRENT TUNNELLING ACTIVITIES

About 145km of traffic tunnels were under construction in Germany in 2022.

- This year, activities relating to inner-urban rail tunnelling have increased to a total of 38km, mostly in Munich, where some 26km of urban and underground tunnels were under construction at the turn of the year 2021/22. It should be noted that preparatory construction work is still in progress on the Munich Second Trunk Light Rail Line and that the main tunnelling works had yet to begin at the time of the survey. Munich is followed by Stuttgart (4.8km) and Hamburg (2.6km). Further tunnel projects, each less than 2.5km long, are under construction in Nuremberg, Frankfurt am Main and Düsseldorf. The length-related proportion of underground construction methods



with regard to inner-urban rail tunnel construction amounted to 29.3km by the end of 2021, accounting for about 76% of the total national construction volume for inner-urban rail tunnelling (67% the previous year). Of this total, 12% was accounted for by shotcreting methods (19% the previous year) and roughly 64% shield driven (48% 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 59km), almost 51km are accounted for by the "Stuttgart 21 rail hub". Tunnelling for the new Wendlingen–Ulm rail line has been completed in the meantime. A further 8km of main-line tunnels are being constructed in conjunction with the upgraded/new Karlsruhe–Basle section. Currently, 25% of mainline tunnels are being built by the conventional method, whereas TBMs are applied for 67% of the driven volume.
- The length of road tunnel construction in 2021/22 was approx. 48km throughout Germany. 85% of road tunnel construction volume takes place in three of 16 federal states: Bavaria, Baden-Württemberg and Hesse. The shotcrete method predominates in the majority of those tunnelling projects.

## FUTURE TUNNELLING ACTIVITIES

About 406km of traffic tunnels are projected but yet to start in 2022.

- A slight decrease in the planning volume compared to the previous year can be observed for underground, urban and rapid transit tunnels due to contract award effects. Among the listed projects, Hamburg takes the lead with a good 44km of planned tunnels, ahead of Munich with a about 30km. Leipzig is engaged in pre-planning for 7km and Frankfurt am Main is planning around 6km of tunnel for regional transport. Further tunnelling activities involving less than 3km are foreseen in Cologne, Dortmund and Stuttgart.
- The planned volume of main-line rail tunnels increases significantly in comparison to the previous year. Approx. 30% of the planning volume totalling approx. 209km is accounted for by the newly planned upgraded Line 36 (Northern Brenner Junction). A further 27% of the volume is accounted for by the new/upgraded Fulda–Gerstungen Line. For the new/upgraded Leipzig–Prague Line with approx. 27km (Germany's share), the share of the total planned volume is about 13%. A further 23km are accounted for by tunnels already approved as part of the new/upgraded Karlsruhe–Basel Line. On further new/

upgraded main lines, tunnelling is planned for a total of approx. 5km. A further 10km of tunnelling is planned in the course of the expansion of the regional rail networks.

- Compared to the previous year, the planned volume of projected road tunnels (103km) has decreased moderately again – on account of the German state's revamped planning requirements, the scheduled volume had already dipped considerably in previous years.

## STATISTICS

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

# Greece

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

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

**Number of Members:** 250 members, 15 corporate members



## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

The Council Board executed numerous meetings – most of them virtual – for running GTS activities.

Preparations for the World Tunnel Congress 2023 and the 49th ITA Gen. Assembly in Athens, 12th – 18th May 2023, have been in full progress. The Congress Organizing Committee (OC) coordinated the various sub-committees working on the different aspects of the Congress, i.e. sponsorship, exhibition, marketing, advertising, technical visits, social events etc. The Scientific Committee (SC) examined all abstracts submitted

and, afterwards, reviewed the full papers, provided comments where needed, which authors had to consider before resubmitting their work for either oral or e-poster presentation. All the above tasks were executed in collaboration with our PCO company and always in line with the ITA "WTC Planning Guide".

We have been in continuous contact with ITA, presented the WTC Backup Plan and Progress Reports. The Congress will be hybrid and include the Scientific Sessions, the Technical Exhibition, the ITA Gen. Assembly and other ITA activities. Well known professionals in the field of tunnelling and underground works, both

local and international, have been handling the various challenges. (<https://wtc2023.gr/>).

The Chairman of the WTC2023's OC has participated in all ITA ExCo meetings, both virtual and physical, representing the host member nation.

GTS participated in the WTC 2022 held in Copenhagen, Denmark, in 5th – 8th September. In order to promote WTC2023, we rented an exhibition booth run by our PCO and six members of our Council Board (CB) and associated with exhibitors and foreign colleagues. Our Chairman took part in the two sessions of the 48th ITA General Assembly. At the closing of the Assembly, GTS were handed the official ITA flag for the upcoming WTC 2023 in Athens.

We were also present in the British Tunnelling Society 2022 Congress with a booth in London, October 2022. Three members of GTS ran a booth and promoted WTC 2023 to delegates. Our G. Doulikas, GTS Young Members secretary, was elected President of the respective BTS Young Members.

The WTC2023 SC's co-chair Prof. V. Marinos, National Technical University



Athens, was elected new President of the International Association of Engineering Geology and the Environment (IAEG) for the period 2023-2026.

GTS's CB member Prof. C. Paraskevopoulou, Leeds University, was honoured with the 2021 Science Award, A' Class, of the Academy of Athens for her research work in Mining Engineering.

On World Tunnel Day, 5-12-2022 - within the context of Saint Barbara's Day - we took part in the daily marathon broadcast presenting the work of young Greek academics and engineers on the underground works research field as well as on tunnelling projects.

GTS published regular issues of its electronic magazine informing our members about our activities, recent news, new underground projects in Greece and globally, 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.

## CURRENT TUNNELLING ACTIVITIES

### Athens METRO

#### Line 3 Extension to Piraeus

In October 2022 the last three Stations (Maniatika - Piraeus - Dimotiko Theatro) of the Project were put into operation concluding the 7.6km long (6.5km of which was constructed by TBM) Metro line section. It serves approximately 132,000 passengers daily reducing private car traffic by 23,000 and CO2 emissions by 120 tons per day. Dimotiko Theatro Station is an open museum with antiquities on display. Piraeus Station is a vital transport hub connecting Metro Lines 1 & 3, the Port, the Suburban Railway and a new Tram Line (5.4km long with 12 Stations). Furthermore, the direct connection between the Port and Athens International Airport "El. Venizelos" benefits the economy of the Attica region and Greece as a whole.

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

Works for the new Athens Metro Line 4, first section, are continuing. The €1.5bn, 96 month duration Design & Build contract for the 13km long, fully automated Metro Line with 15 stations was signed in 2021. The Project includes tunnelling works by 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 this Metro section will serve 341,000 passengers on a daily basis in 2030. Preparatory works are in full progress at all worksites including archaeological investigation, utilities diversions, traffic deviations etc.

The open cut excavated shaft to accommodate the first TBM is completed. The TBM's parts are being delivered to the site for its operation to start around April 2023. The second TBM start shaft in Veikou is also being constructed while excavation and retaining system installation has begun at other sites.

### Thessaloniki Metro

The first Metro Line for the second largest city in Greece, Thessaloniki, is close to commencing operation in 2023. The project includes 18 underground stations, ~14.4km of tunnelling and a 50,000m2 depot area. There will be 18 fully automatic driverless and air-conditioned trains of the latest technology, as well as automatic Platform Screen Doors in each Station for improved passenger service and safety. Civil, trackwork and E/M works of the twin single-track tunnels are completed. All but one of the stations are complete and equipped. Only Venizelou Station is currently under construction as it was delayed due to serious archaeological findings.

It is expected that the daily ridership will rise to 313,000 passengers. As a result of the Metro operation, street traffic will be reduced by 57,000 vehicles/day and CO2 emissions by 212 tons/day. Venizelos Station will become an open museum that will display the ancient history of the city.

An international tender was announced in 2022 for the operation and maintenance of the Thessaloniki Metro System on a public-private-partnership (PPP) basis.

#### **Underground section of coastal road in the Hellinikon area, Athens**

The Project budget is approx. €80M. The existing coastal road (Poseidonos Street) will be placed underground for a length of 3km by a cut & cover to host two traffic directions of three lanes each. This is part of the "The Ellinikon", near the former Athens airport, which is Europe's greatest urban regeneration project. Construction works are underway with excavation ongoing while concreting of the bottom slab follows. Completion is scheduled for the end of 2024.

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

The project covers the construction of the south section of the Central Greece Motorway. It includes a twin tunnel with a total length of approximately 3km. Civil works for the tunnel were completed in 2022 and E/M installations are underway. Boring of the tunnel was challenging within geologically adverse ground conditions and lasted for more than two years.

### **FUTURE TUNNELLING ACTIVITIES**

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

The first phase of the Tender process (Call for Interest) was released for potential bidders to submit their financial and legal documents. This extension of the existing Line 2, from Anthoupoli Station to the district of Ilion, is being designed in-house by the Metro Project authority. The double-track tunnel will be approx. 4km long with three underground stations, six shafts and will include both civil and electromechanical works. The estimated cost is €550M and a construction time of five years.

#### **Kimis Road extension to Athens–Thessaloniki National Highway**

The Project was assigned last year but due to judicial conflict, no contract has been signed yet. It includes a 1.26km long double tube urban tunnel and a 1.16km long cut & cover tunnel that will connect



Attiki Odos (highway) with Athens–Thessaloniki National Highway. The cost will be approx. €350M and the estimated construction period of four years.

#### **Underwater road linking Salamina – Perama in Attica region**

Three consortia filed bids for this Project that concerns the design, construction, financing, operation, maintenance of an approx. 15km long highway which includes a 1.2km long immersed tunnel and two tunnels 1.7km long and 600m respectively. The Environmental Impact Assessment study of the project is at the phase of approval and following that the tendering process is expected to be finalized. The cost will be approx. €500M and the estimated construction period is 4 years.

#### **Northern Road axis for Crete island**

A concession project concerning the design, construction, financing, operation, maintenance of an approx. 200km long motorway which includes a significant number of tunnels i.e. i) Souda-Kalyves section: a 1.22km long tunnel, ii) Kalyves – Agioi Pantes: a 230m long tunnel, iii) Vrises-Petres-Atsipopoulou: five tunnels of 4.59km total length, iv) Exantis-Fodele-Linoperamata: Five tunnels of a total length of 319km, v) Hersonissos – Malia: a 375m long tunnel, vi) Malia – Neapoli: two tunnels of 4km total length. 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 €360M for the PPP project.

#### **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 in the highway connecting the towns of Castoria and Ptolemais in north Greece is at the final phase before contract signing. The cost will be approx. €71M with EU funding while the construction period is estimated at 36 months.

#### **Underwater road link to connect Lefkada island to mainland**

To connect Lefkada island to the mainland national highways, 3.11km roads are currently being designed of which 1.2km will be an underwater tunnel crossing the existing sea strait.

#### **Thessaloniki Metro line extension**

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

### **STATISTICS**

#### **1. Length or volume excavated - % mechanized/% conventional during 2021 ~ 1500m - 0% / 100%**

**Amount (USD or EUR) of tunnelling / underground space facilities awarded in 2021 = €900M**

**3. List of tunnels completed:** Central Greece Motorway (E65) – Lamia - Xyniada Section, 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:** 53 individual and 19 corporate members

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

Two afternoon professional meetings have been organized by the Association and two day site visits and excursion at the M85 motorway tunnel construction site (near Sopron, Hungary) and at the Zentrum am Berg (ZaB, Austria). Thanks for the help of the Austrian Tunnelling Association especially Prof. Robert Galler.

The association board had four meetings. At the end of the year the social evening (St. Barbara evening) was organized with the Medallion for Tunnelling given to Mr. Janos Schulek.

## CURRENT TUNNELLING ACTIVITIES

- Expressway M85 Sopron bypass: 790m long twin tunnel under Bécsi hill. Both tunnel's primary support has been completed and the sealing works, secondary lining is in progress. Construction started in 2020.

- Reconstruction of five stations of the M3 metro line. For the most part the reconstruction is complete.

### Tunnels in different planning phases:

- Connection of the Csepel and Ráckeve HÉV (suburban railway) to Kálvin tér (downtown). The permit plans for the underground section (Közvágóhíd – Kálvin tér) was submitted by a consortium to the authorities. The railway authority permit is still pending.
- The connection of the Szentendre HÉV (suburban railway to Csepel and Ráckeve HÉV) detailed feasibility study is complete.
- The under Danube tunnel connecting Déli and Nyugati railway stations detailed feasibility study has been completed.
- Detailed design of the northern sector of the M0 motorway, including a 2km and a 3.2km pair of tunnels is expected to start in 2023.

## FUTURE TUNNELLING ACTIVITIES

- The Expressway M85, Sopron bypass tunnel under Bécsi hill will complete construction works by the first half of 2024.
- Reconstruction of the Várhegy hill tunnel, Budapest. The 160 years-old brick vault tunnel is planned to have new sealing and reinforced concrete lining. The length of the tunnel is around 350m, with a cross-section of 75.5 – 93.7m<sup>2</sup>.
- The M0 motorway, north section, twin road tunnel with 2 x 2 lanes will start this year. The cross-sectional area of each tunnel is around 98 – 106m<sup>2</sup>. The length of tunnels is 2030m and 3345m. Construction start is dependent on the financial resources available.

## STATISTICS

### 1. List of tunnels completed

Ventilation cross-passage for the M4 metro line 20m long conventional.1

### 2. List of tunnels under construction

Expressway M85 Sopron bypass, twin-tunnel under the Bécsi hill (2 x 780m).

## EDUCATION ON TUNNELLING IN THE COUNTRY

- Budapest University of Technology and Economics, Faculty of Civil Engineering
- University of Győr, Faculty of Civil Engineering

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# 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 2022 AND TO DATE

- Three board meetings were held.
- An annual general assembly took place in November with invited speakers.
- A joint autumn meeting with various presentations was held on 18th November. The meeting was held together with the Geological Society, Icelandic Geotechnical Society, ISCOLD, Icelandic Concrete Society, and JGFI.

## FUTURE TUNNELLING ACTIVITIES

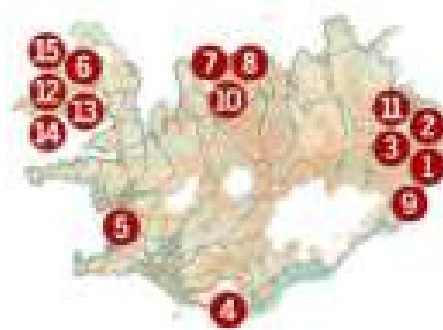
### Fjardarheidi road tunnel

(Point 1 on map) a 13.5km long, 67m<sup>2</sup>, road tunnel in east Iceland. This road tunnel will replace a mountain road between Seydisfjord village on the fjord side to the larger inland community Egilsstadir. The present 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 tourists coming to Iceland by ferry from Europe (Denmark and Faroe Island). Pre-design is finished and Environmental Impact assessment is ongoing. The tender design is ongoing with tendering planned for fall 2023 to start in 2024.

The Icelandic Road administration is looking at three tunnelling projects in the Reykjavik area. These are the Sæbraut tunnel (a 1km long cut and cover tunnel), the Miklabraut tunnel (1.3km concrete tunnel or 2.4km long hard rock tunnel) and the Setbergshamar tunnel.

More road tunnels are in the planning phases. The Icelandic government is preparing a plan for the construction of new road tunnels where 12+ new tunnels are to be built over the next 30 years. The National Power Company is preparing tender documents for the excavation of a 1km long tailrace tunnel, cross-section >160m<sup>2</sup>, at the Hvammur Hydropower Plant planned to start in late 2024.



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

### Conferences:

- Tunnelling in Infrastructure development: Issues and Challenges at Guwahati

### Workshops:

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

### Publication:

- TAI Journal : Half Yearly

### Training Programme for Young engineers:

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

## CURRENT TUNNELLING ACTIVITIES

- Large-scale infrastructure projects in India have created significant opportunities in the tunnelling segment. India will invest Rs. 700 billion on infrastructure development, which will provide a boost to the country's tunnelling industry as well. There has been a sharp increase in the budgetary outlay for the road (by Rs. 140 billion) and railway (by Rs. 100.5 billion) sectors. Over Rs. 82 billion has been allocated for metro rail projects in the country. There is also a focus on infrastructure development in the north-eastern region, a prime market for the tunnelling industry.
- In the past few years, the Indian industry has developed several landmark and strategic tunnel projects. The country's longest rail tunnel, the 11 km Pir Panjal Tunnel, and longest road tunnel, the 9.8 km Chenani-Nashri Tunnel were operationalized in Jammu & Kashmir. The 8.8 km Rohtang Tunnel is the world's longest road tunnel being built at an altitude of 10,000 feet.
- The world's longest tunnel boring machine (TBM)-driven tunnel without intermediate access – the 43.5 km AMR

Water Tunnel – is being built in Andhra Pradesh. India's first underwater metro rail tunnel is also being constructed as part of the Kolkata Metro project. Mumbai is building India's biggest urban water tunnel.

- Tunnelling methods have also evolved in recent times. TBMs were successfully used for the Hydropower Projects in Jammu & Kashmir for the construction of a 14.6 km long tunnel with an impressive monthly tunnelling progress of 816 metres. DMRC is using the NATM technology for the first time to construct a metro tunnel under the ongoing Phase III of the Delhi metro project.
- Few projects have faced delays due to long-standing issues. These pertain to geological surprises, weak risk identification and assessment, contractual disputes, old contracting practices, outdated tunnel design practices and construction methods, and inadequate safety mechanisms.
- Contractors start using advanced technologies and methodologies to enhance productivity and ensure timely delivery of projects. In addition, deployment of modern systems for monitoring, lighting, ventilation, safety and security are also being explored.

### North East Frontier Railway

- North East Frontier Railway (Construction) is executing number of new line projects to connect the capitals of North Eastern states. Apart from projects for connecting state capital, several projects such as gauge conversion and doubling have been undertaken to improve the connectivity and mobility in this area. Since alignment of these connectivity projects mostly pass through difficult terrain having deep gorges and high hills, construction of these railway lines involve construction of large number of tunnels.
- North-east region is geologically one of the most complex formations. The major rock formation consists of sand; silty clay and shale with limestone. The

formation in this part is mostly immature and there are several thrust and faults.

- Out of 188.6 km tunneling identified in various sanctioned projects, 12.60 km tunnels have since been commissioned for train operation and another 42 km tunneling has been completed where track linking is planned shortly.

### Jiribam-Tupul – Imphal New Line Project

(110.62 km): Out of total 59.5 km tunneling involved, 42.0 km tunneling has been completed. Construction is in full swing to complete the balance 17.05 km. The longest tunnel is between Tupul - Imphal, which is 11.55km.

### Bhairabi – Sairang New Line Project

(52.35 km) in Mizoram: There are 23 tunnels with total length of 9.26 km. Longest tunnel is 1.76 km. Out of above, underground excavation and primary support in 5.20 km has since been completed and final lining is in progress.

### Dimapur – Kohima New Line Project

(88.00 km): About 30.00 km tunneling is involved in this project.

### Barnihat- Shillong New Line Project

(108.00 km): There are 31 tunnels with total length of 39.06 km. Longest tunnel is 4.11 km.

**Sevok-Rangpo New Line Project:** About 38.55 km tunneling is involved in this project.

### Salonia – Khumtai New Line Project:

(99.00 km): About 17.65 km of tunneling is involved in this project.

**Delhi Metro Phase- IV Project :** The 6 new lines will have a total length of 103.94 kilometres, with addition of 28 new stations to the DMRC network. The Delhi Metro Rail Corporation (DMRC) is making significant progress on Phase-IV of the metro network. This phase comprises a total of 65 km, of which 28 km will be underground. The DMRC has already constructed a 10.0 km tunnel while work is ongoing on the 4.00 km tunnel on the Aerocity-Tughlakabad corridor.

### Chennai Metro Rail Project Phase I:

- Length of twin tunnels in alignment: 18km.
- Tunnel drive completed; partially commissioned
- Number of underground stations: 19
- Construction in progress; 7 stations in operation
- Number of cross passages: 59
- Construction in progress; partialt commissioned

### Chennai Metro Rail Project Phase I Extension

- Length of twin tunnels in alignment: 18km.
- Tunnel drive completed





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## MUMBAI'S AMAR MAHAL TUNNEL PROJECT

Two of TERRATEC's 3.2m diameter hard rock open gripper TBMs are currently being deployed by contractors Soma Enterprise Ltd. and Patel Engineering on Amar Mahal I & II water transfer tunnel contracts that will meet increased demand and ensure reliable water supply.

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### Water transfer tunnels

Construction of various water tunnels in different cities in Iran is continuing. Progress in the construction of Water tunnels during 2022 includes:

- The Gelass (Kani-Sib) water tunnel is being constructed to transfer 650Mm<sup>3</sup> of water from the Gelass River to Urmiah Lake. The total length of the tunnel is 35.7km which has been completed using two EPB-Hard Rock (Dual Mode) TBMs.
- Excavation of the first phase of the Lar-Kalan water tunnel with a 7000m length was completed last year.
- The Kerman water tunnel with a total length of 38km is under construction.
- The alternative drinking water transfer system of the Alborz and Tehran provinces from Taleghan dam; 65km long water conveyance tunnels (in 4 lots: Western lot (17km) + Middle lot (19km) + Eastern lot (16km) + Alborz lot (13km) is under detailed studies. Excavation of the Eastern tunnel will start at the beginning of 2023.
- Advance in the surface water collection tunnel of District 21 of Tehran's municipality – 1000m with a diameter of 4.4m (using an EPBM).
- Excavation of the Western Tehran Wastewater Tunnel with 10000m length was completed last year with a diameter of 4m (using an EPBM).

### Road & Railway tunnels

Construction of various road & railway tunnels in different cities in Iran is continuing. Progress in construction of Road & Railway tunnels during 2022 includes:

- Work on the second sector of the Tehran-Shomal Freeway has continued over the last year. As reported previously, this sector consists of 59 tunnels (bi-directional) with a total length of approx. 37km (northbound, southbound, and service tunnels).
- Advance of the Emamzadeh Hashem Road Tunnel No.2 – 500m
- Advance of the Pataveh-Dehdasht Road Tunnels – 8200m
- Advance of the Kabirkooch Road Tunnel – 4750m
- Advance of the Zahedan-Chabahar Railway Tunnels – 10000m
- Advance of the Bardsir-Sirjan-Kerman

Railway Tunnels –1000m

- Advance of the Rasht-Astara Railway Tunnel –500m
- Advance of the Shahrekord-Sefiddasht Railway Tunnels –1500m

### FUTURE TUNNELLING ACTIVITIES

- The development and extension of Metro tunnels; such as Tehran's Metro Line 4 and the extension of Shiraz's Metro Line 2.
- Water desalination and transferring purified water from the Sea of Oman to the east of Iran and from Persian Gulf to the Central Plateau of Iran is one of the biggest schemes defined to replenish Iran's eastern and central water deficit. It has been implemented since last year and will continue into the future. There are several tunnels designed for water conveying in these projects.

### 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

**Number of Members:** About 800 members (80 corporate and 160 young members).

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

### Congress:

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

- 23/06/2022 SIG Conference "Rivestimenti in anelli di conci prefabbricati di gallerie realizzate co TBM" Brescia
- 19 – 22/10/2022 Piazza Tunnelling in Bologna during the SAIE exhibition
- 20 – 21/10/ 2022 YMs SIG Conference "The role of underground infrastructure for the achievement of the U.N. Sustainable Development Goals" in Bologna during the SAIE exhibition
- 2/12/2022 S. Barbara Conference for the World Tunnelling Day - Colombo Lecture - held by Prof.Ing. Daniele Peila in Milan

### Technical Visits:

The association, has also organized technical site visits to relevant underground construction sites:

- 18/03/2022 – "Picchiarella" and Casacastalda tunnels ss318 Valfabbrica
- 07/04/2022 – The Brenner Base Tunnel – Isarco River under-pass construction
- 13/05/2022 – Linea C Fori Imperiali Station in Rome
- 27/09/2022 – Linea M4 in Milan
- 18/11/2022 – Cefalù Tunnel.

### Courses and Seminars:

- 25/03/2022 SIG Webinar – SIG Handbook Presentation "handbook on tunnels and underground work"

### Others:

The Italian tunnelling Society is a sponsor of the Master in Tunnelling: design, construction and management (Politecnico di Torino and Politecnico di Milano), Master in "Geotechnical Design" (Università di Roma "Sapienza"), Master in "Geotechnical Engineering for Infrastructures" (Università di Napoli "Federico II"), Master in "Integrated engineering and management of motorway networks" (Politecnico di Torino, Politecnico di Milano and Politecnico di Milano School of Management) and Master in "Sustainable

design of geotechnical works and tunnels" (Politecnico di Torino). These collaborations aim to bridge the gap between universities and industry to support the growth of future industry leaders.

Since 1976, the Journal "Tunnels and Major Underground Works" has been SIG's pride and glory. It is currently published once every three months and reached issue 144 in 2023. The periodical presents technical and scientific articles, as well as Editor's letters, news about

construction works and tenders around the world, bulletins from the Italian tunnelling market, reports on technical visits, scheduled training courses and international congresses.

In 2022, with the coordination of prof. Daniela Boldini and prof. Carlo Callari, ing. Remo Grandori, prof. Salvatore Miliziano, prof. Daniele Peila and ing. Andrea Pigorini a special issue of the Journal was published to share and discuss the most recent scientific and technological developments in the field.

The association members regularly take part in the ITA-AITES working group (WGs) and in the SIG working groups. Members proactively collaborate with national and international colleagues to exchange expertise and experience, and to divulge technical, scientific and business know how on underground construction.

The SIG YMs Group, of 160 young tunnellers, actively support SIG activities and connects young professionals from both university and industry. The group appointed, in 2021, a board expanding the number of YMs actively involved in the organization of events and activities. The group has also established a fruitful collaboration with the others ITA Member Nations YM Groups.

SIG is engaged in the drafting of an "Handbook on tunnels and underground works" which will be published in 3 volumes, including the theoretical and construction aspects of the design, construction, monitoring and maintenance of tunnels and underground works.

Volume 1 "Concept-base principles of design" was published in Feb 2022. Volume 2

"Construction – Methods, Equipment, Tools and Materials" was published in Aug 2022 and 3 "Case Histories and Best Practices" will be available soon.

## CURRENT TUNNELLING ACTIVITIES

### Railway Projects

*The third Giovi Pass, Genoa – Tortona*

**Railway:** 37km of twin tunnels along the 53km section between Genoa and Tortona, as part of the Rhine-Alpine TEN-T Corridor. The tunnels, excavated for 65% through conventional methods and for 35% by EPBM (about 10m dia.), are located in the complex Apennines range between Piedmont and Liguria. The Valico tunnel (27km) is going to be the longest in Italy. In July 2022, 80% of the tunnelling activities were completed.

**Brenner Base Tunnel:** when completed in 2032, will be 55km long between Tulfes/ Innsbruck and Fortezza and, considering the junction within the Innsbruck urban tunnel, 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 are the main sites on the Italian side, the section Mules 2-3, and the Section under passing the Isarco river (with artificial ground freezing underneath then river).

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

the main project of the 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 emergency, five ventilation plants and three underground safety areas.

**Brescia-Verona high speed railway:** With 6.6km of bored tunnels, together with 10.2km of cut&cover tunnels will allow the railway to underpass the A4 highway twice (Lonato and Sona) and an urban centre nearby the Mincio river. In 2022, the first bore of the Lonato tunnel (twin bore) was completed with the second is due to be excavated in 2023.

**Napoli Bari high Speed Railway:** the Napoli-Cancello section is under construction with the first example in Italy of a cut & cover tunnel excavated in hyperbaric conditions below the water table. The Cancello - Frasso Telesino section includes a 4km tunnel (Monte Aglio), with the excavation completed in June 2022.

Works have started on the Apice-Hirpinia section, with the construction of the portals for the tunnels Rocchetta (6.5km), Melito (4.4km), and Grottaminarda (2km).

**Florence High Speed Railway Junction:** The km long twin tunnels, excavated by EPBM (9.4m dia.) will speed up the services along the Rome-Milan route and free up capacity on surface for regional commuter trains. The tunnelling contract was awarded in 2022, and construction is going to start in 2023.



**Messina-Palermo railway:** On the Fiumetorto-Castelbuono section, excavation by the conventional method of the 4.1km S. Ambrogio tunnel (single tube, double track) was completed in 2022. A 10m diameter TBM was launched in 2022 to excavate the 6.7km long Cefalù tunnel (twin tube) 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:** sextuplication of tracks along the Brignole-Principe section and quadrupling of the Voltri-Sanpiero sections which are the busiest portions of the Genoa urban railway junction. The project will include with the extension of the existing Colombo tunnel and S. Tommaso tunnel.

### Metro Projects

**Naples Metro - Line 1:** a new metro line often in sand below water table, excavated with use of 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, of 1km length, to close the Line 1 ring. One bore has been completed while the second one is still under construction.



**Rome Metro - Line C:** One of the most complicated metro projects, in a poor geotechnical context, underneath millenary monuments and through archaeological finds unique in the world. The 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 commencing for the extension to Piazza Venezia.



**Milan Metro - M4:** 15km of twin tunnels from Linate to Lorenteggio through loose sand below the water table and several interchanges with the three existing lines. Currently the central stretch passing through the historical centre of the city is under construction with two EPBMs of 9.1m diameter which allow one track plus a station platform per bore to minimize station excavation from surface and disruption to the city. A first section of the line started service in 2022, with completion expected in 2024.

### FUTURE TUNNELLING ACTIVITIES Railway Projects

**Napoli Bari High Speed Railway:** The construction of the Hirpinia-Orsara (29km) and Orsara-Bovino (11km) sections started in 2022 with the tunnel portals. The Hirpinia Tunnel will be the second longest

in Italy (27km twin bored) and just 500m divide it from the Orsara tunnel (10km twin bored). These tunnels will cross the Southern Apennines with complex clay formations, presence of methane gas, within a highly seismic area. A critical mechanical behavior is expected due to swelling and squeezing. Six TBMs were ordered in 2022 to start excavation in 2023.

**Palermo-Catania railway:** The 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 third longest in Italy. All the contracts were tendered in 2022 and will be awarded in 2023.

**Messina-Catania railway:** 37km underground over a 42km alignment between Fiumefreddo (nearby Catania) and Giampilieri (nearby Messina), including an underground station in Taormina. The project will link the two main cities on the east coast of Sicily and part of the Salerno – Reggio Calabria railway toward the south, to link Catania with Bari, Naples and Rome. Construction started in 2022, with TBMs starting the excavation in 2023.

**Verona-Fortezza new railway line:** As part of the Southern Access to the Brenner Base Tunnel, seven lots will be built. The Trento by-pass (with the Trento tunnel, 11.5km) and the Fortezza - Ponte Gardena section (23km, with the tunnels, Scaleres, 15.4km, and Gardena, 6.3km) will be the first two being built, with construction starting in 2023, with maximum overburden of 800m within Granite and Quartz Phyllites, as well as fault zones. The other lots in future will include the tunnels Val d'Ega (10km), and Zugna (16.7km).

**Salerno – Reggio Calabria high speed railway:** After the Covid-19 pandemic, the Italian government decided to include this massive project in the strategic infrastructure plan of the country. 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. The first section [Battipaglia-Romagnano] was tendered in December 2022 and will be awarded in 2023.

**New Santomaro tunnel:** A brand new 15.8km twin bore tunnel (about 10m dia.) will replace the existing Santomaro tunnel, which is single track and has a small cross section, linking the tyrrhenian coast line to the Cosenza valley. Four TBMs are anticipated to be used (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. The contract is going to be tendered in 2023.

**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.

**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 involving about 50km of tunnel excavation.

### Metro Projects

**Turin Metro – Line 2:** The route will be 27km long with 33 planned stations and will run entirely through twin bore tunnels (8m dia. TBM). Construction works are expected to start in 2023.

**Catania Metro:** An extension of the existing metro has been financed and partially awarded at both ends of the current line. The project will include more than 6km of new twin tunnels (10.5m dia.). By 2022, all the contracts were awarded, except the section between Misterbianco and Paternò, which is still on tender phase.

**Naples Metro – Line 10:** In 2022 the authorities of Campania region received funds for this brand new metro line linking the city centre (Cavour) and the existing metro network to the north-east area of the city. The alignment would be 12km long and run entirely underground. Trains and stations will be short (about

## STATISTICS

### 1. Length of tunnels excavated during 2022

Railway	Highway	Metro	
7	-	-	TBM
7	-	-	Conventional
14	-	-	Total

### 2. Amount (Eur) of tunnelling / underground space facilities awarded in 2022

Railway	Highway	Metro
1.6	-	-

### 3. List of tunnels completed

Railway	Highway	Metro
Nuova San Tomaso	-	-
Nuova Colombo	-	-
Bretella di Voltri	-	-
Monte Aglio	-	-
Lonato (BP)	-	-
Sant'Ambrogio	-	-

## EDUCATION ON TUNNELLING IN THE COUNTRY

### II Level Master (after a Master Degree)

- Politecnico di Torino and Politecnico di Milano –Master in “Tunnelling: design, construction and management” developed in English, endorsed by SIG and by ITA-CET. <https://www.mastertunnelling.polimi.it/>
- Università di Roma “Sapienza” – Master in “Geotechnical Design” <https://web.uniroma1.it/masterprogeo/en>
- Università di Napoli “Federico II” – Master in “Geotechnical Engineering for Infrastructures” [https://www.unina.it/-/15391805-ma\\_icea\\_geotecnica-per-le-infrastrutture](https://www.unina.it/-/15391805-ma_icea_geotecnica-per-le-infrastrutture)
- Politecnico di Torino, Politecnico di Milano and Politecnico di Milano School of Management. Supported by Autostrade per l'Italia (Italian Autostrade Group). Master in “Integrated engineering and management of motorway networks” <https://www.masterinfrastruttureautostrade.it/>
- Politecnico di Torino – Master in “Sustainable design of geotechnical works and tunnels” [https://didattica.polito.it/master/progettazione\\_opere\\_gallerie/2021/home](https://didattica.polito.it/master/progettazione_opere_gallerie/2021/home)

### MSc courses (after a bachelor's degree)

- Politecnico di Milano, Milan
- Politecnico di Torino, Turin
- Università di Roma “Sapienza”
- Università di Roma Tor Vergata
- Università di Napoli “Federico II”
- Università di Bologna “Alma Mater Studiorum”
- Università Politecnica delle Marche
- Università di Trento
- Università degli Studi del Molise
- Università di Parma

50m) to minimise the extension of station boxes and hence the risk of delays due to archaeological findings or unexpected utilities diversion.

**Milan Metro – Line 5 extension:** in 2022 local authorities confirmed the completion of the scheme design for the extension to Monza and the tendering process in 2023,

with construction starting in 2024 and completion expected in 2030. The extension will include 12 new stations over 11km of new underground alignment.

### Highway Projects

**Gronda di Genova:** The project, called “Gronda di Ponente”, is going to involve the construction of a new highway, the widening



of the existing A10 highway in the section which crosses the municipality of Genoa. It will include more than 70km of new road, 54km of which will be underground, within 23 tunnels.

### Hydraulic Projects

**Peschiera aqueduct (Rome):** A new 27km long tunnel with an internal diameter of 3.6m is going to be built parallel to the existing aqueduct. The new tunnel will allow inspection and maintenance of the existing one, which is about 80 years old and has

been in operation without interruption. Also, the project will increase the resilience of water supply to Rome (3 million people). The contract is going to be tendered in 2023.

**"Marcio" Acqueduct (Rome):** two new 20km long micro-tunnels (2.5m internal dia.) are planned to replace two 100 years old existing aqueducts. The contract was tendered in 2022.

**SMAT sewer (Turin):** a new 14.4km long sewer tunnel, with a 3.2m internal

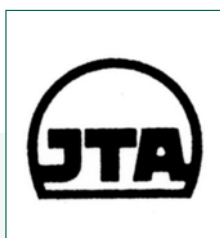
diameter, will be built parallel to the old one built 40 years ago, from south of the city to the Castiglione Torinese treatment plant. Given the urban environment (including underpassing of Lingotto railway station), a TBM with 4.1m excavation diameter will be employed, with 20m deep and 25m wide shafts 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 surface.

# Japan

**Name:** Japan Tunnelling Association

**Type of Structure:** Non profit organization

**Number of Members:** Total number 1446, number of corporate members 203



## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

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

Technology/International Communication/Events/Public Relation

In each committee, the main activities are:

- Investigation, research and information interchange on general techniques and on subjects from 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"
- International cooperation

## CURRENT TUNNELLING ACTIVITIES

The Ikejima section of the Aokuzuretogeto pilot tunnel on the San-Ennanshin Expressway is a tunnel with a standard excavation cross section of 5.7m in diameter, a section length of 1,168m (total length: 5,014m), and a maximum overburden of 625m. The location of the tunnel is close to the Median Tectonic Line, which is one of the world's largest faults and runs through Japan for about 1,000km from eastern Kyushu to the Kanto region (with a separation of about

500m), and has a complex geology that is difficult to predict in advance. In addition, the tunnel is subject to deformation due to the fragile ground consisting mainly of gouge (fault clay) and fault gravel caused by the intense fault movement of the Median Tectonic Line and the large overburden.

In order to collect three-dimensional information, three types of three-dimensional frontal surveys, namely seismic prospecting reflection survey, electromagnetic resistivity survey, and borehole logging, were carried out in addition to conducting advanced boring surveys to understand the location of the fault zone in front of the face, geological structure and water retention. Based on the results of these investigations, 3D FEM analysis was carried out to investigate the support structure. From the results of the three-dimensional frontal survey, it was estimated that there was a fault crush zone where the ground strength was further reduced in the section with the maximum overburden. Therefore, it was feared that the designed support structure would not ensure the stability of the tunnel, and it was decided to consider the use of a double support structure. A 3D FEM analysis was carried out to reflect the detailed three-dimensional geological data obtained from the exploration results, the displacement of shotcrete and the stress generated in the main support structure,

and the double support structure was constructed after the test construction.

The geological conditions along the Median Tectonic Line are far more complex and fragile than assumed at the time of design. For such rapidly changing and difficult-to-predict ground conditions, 3D computerized construction, in which the state and distribution of fault crush zones and fragile layers are realised by multiple 3D frontal surveys and the support structure is studied by three-dimensional numerical analysis, was an effective means of advanced preparation. We were able to excavate the crush zone section with the maximum overburden without deformation or excess displacement of the support structure.

## FUTURE TUNNELLING ACTIVITIES

The Sotetsu-Tokyu Direct Line is a 10km long line that connects the Sagami Railway, mainly in the Kanagawa Prefecture, with the Tokyu Railway, which operates in southwestern Tokyo, and is under construction for completion in the second half of FY 2022. The Shin-tsunashima Station to be built in Yokohama City will be an underground station with an island platform at a depth of about 35m, over four levels. The majority of the station will be constructed using open-cut construction, but the 34.5m long Tokyo side of the station, which is 240m long in entirety, will be constructed using trenchless methods because of the presence of buildings, including a hospital, above ground.

To construct the trenchless section of the station, we adopted an advanced construction method for the outer shell considering the geology and its impact above ground. Shafts in Japanese rail stations are set up on the departure and arrival sides, and the propulsion machines used to build the outer shell

are recovered and reused in the shafts on the arrival side. However, in this construction area, it was impossible to install a shaft on the arrival side due to the ground condition, so machine recovery presented an issue. To address this, we developed a self-propelled truck to retrieve the propulsion system, which enabled us to reuse the propulsion system without a shaft.

In addition, the square element propulsion method, which is new technology, was adopted to achieve a horseshoe cross-section with a longer construction length and larger cross-section than the conventional method. A square element is a box-shaped cross-

section (1000mm x 1000mm) of steel plates welded together to form a single element, with concave and convex joints connected.

In the construction of a square element, the propulsion machine is driven into the ground by extending the pressing jacks in the launching shaft, and the subsequent elements are connected one after another. For rectangular element propulsions, the position of the propulsion machine becomes the position of the main structure, so strict excavation accuracy is required. In this construction section, the excavation length was long, and each element had a different angle in a horseshoe shape, so it was important to

ensure the excavation accuracy. Therefore, to secure the digging accuracy, a new hydraulic correction jack was added to the propulsion system to control and manage not only the vertical and horizontal displacement, but also any rolling.

As a result, the 42 square elements were constructed within the control values. Internal excavation after the construction of the elements was also completed, there was little leakage into the interior and the impact on the ground surface was minimal. We believe that this will help expand the applicability of the trenchless method in the construction of large cross-sectional underground spaces.

## 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, Tottori 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, School of Science and Technology Graduate School of Science and Technology 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, University, Kobe University

## STATISTICS

### 1. Length of tunnels excavated

23.8% mechanized /58% conventional during 2021

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

About US\$32bn



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# Korea (South)



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

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

**Number of Members:** 3357 members, 74 corporate members

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

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

KTA held a president election on March 23rd, 2022. Dr. Nag Young Kim was inaugurated as a 15th President until April 2024.

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

- 2022 KTA General Assembly and Annual Spring Conference, 2022.04.14, Seoul (290 domestic participants)
- 2022 KTA Tunnel Construction Policy Forum & Seminar on Underground Safety, 2022.11.09, Seoul (130 domestic participants)
- The KTA Short Course on tunnelling with Tunnel Boring Machines, 2022.02.22~02.24, Seoul (58 domestic participants)

- Tunnel Face Mapping Short Course on NATM tunnelling for Korea National Railway, 2022.08.29~08.31, Seoul (310 domestic participants)
- The KTA 30th Anniversary Ceremony, 2022.11.25, Seoul (180 domestic participants)

KTA hosted 12 education and training courses during the last year

- See 'Education on Tunnelling in the Country'

There are a total of 18 Working Groups in KTA

- KTA-Annual WG Activity Reports: 18 WG activity reports, 7 WG technical reports

### Publications

- 30th Anniversary KTA History White Paper
- 2021~2022 KTA Continuing Education and

Training Course Book

- Domestic technical journal "Journal of Korean Tunnelling and Underground Space Association" (6 issues with 46 papers in 2022)
- 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

## STATISTICS

### 1. List of tunnels completed

Boryung-Taeon Subsea Road Tunnel  
Daegok-Sosa Railway Tunnel  
Yulchon Thermoelectric Power Plant Tunnel

### 2. List of tunnels under construction

Kimpo-Paju 2nd Seoul Outer-ring-road Project  
GTX A (Ilsan - Dongtan) Project  
GTX B (Songdo - Cheongnyangni) Project  
GTX C (Uiyeongbu - Geumjeong) Project  
Pyeongtaek-Osong four-tracked railway Project  
Gangneung-Jejin single-tracked railway Project  
Gimcheon-Geoje single-tracked railway Project  
ChunCheon-SokCho single-tracked railway Project

## EDUCATION ON TUNNELLING IN THE COUNTRY

### KTA Continuing Education and Training Course

**2022.06.09, Seoul:** The optimal TBM equipment and main design consideration for utility tunnel in the composite ground conditions - Air Lock operating technology and safety measures in the utility tunnel - TBM disc cutter monitoring technology in utility tunnel

**2022.06.28, Seoul:** Strategies for the underground complex development

**2022.07.08, Seoul:** Steel materials for construction in KS standards

**2022.08.19, Seoul:** Revisions of Korean design standards and Korean construction specifications related with Tunnelling Works

**2022.09.01, Seoul:** Latest technology trends in excavation and supports in NATM - Improvement of large diameter vertical shaft construction method - Connection of pipe umbrella support

**2022.09.15, Pusan:** Development of underground buried exploration technology using non-destructive exploration technique (GPR, electric field interpretation)

**2022.09.30, Sejong:** Development of road tunnel disaster prevention and ventilation facility installation and management guidelines

**2022.10.07, Seoul:** Overseas rock bolt technology/market trend - Technical innovation, performance evaluation, green technology certification case history for tunnel support materials

**2022.10.12, Seoul:** Smart construction on supply chain, processes and logistics : Ground settlement prediction during TBM excavation using the Two Phases LSTM model

**2022.10.21, Seoul:** Technical changes in the shield tunnel and excavation technology (focused on branch shields) : Disk cutter wear measurement technology to secure the safety of power equipment operators

**2022.10.28, Seoul:** Field trip to the Kimpo-Paju 2nd Seoul outer-ring-road project

**2022.12.09, Chuncheon:** TBM R&D status - Latest technologies related with TBM - Large-sized TBM preparation before launching

**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

**Great Train eXpress higher-speed commuter rail network Project**

- In the densely-populated Seoul capital region
- GTX-A 83.1km with 11 stations, GTX-B, GTX-C, GTX-D will be continued.
- Speeds of up to 180km/h in tunnels built 40m below ground, bypassing existing infrastructure, and reducing commute times significantly
- Project cost will be about \$61bn

# Nepal

**Name:** Nepal Tunnelling Association

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

**Number of Members:** Life members: Total number 147, number of corporate members 11



## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

**10th Annual General Meeting**

The Nepal Tunnelling Association (NTA) conducted the 10th Annual General Meeting on 11th March 2022 in Kathmandu, Nepal. During the event, a paper was presented by the Vice President Mr. Ram Hari Sharma on, "Soft ground tunnelling and its construction methodology".

**CURRENT TUNNELLING ACTIVITIES****Three day training on the design and construction of road tunnels**

Sponsored by the Ministry of Physical Infrastructure and Transport, the training course was jointly organized for 3 days (22nd – 24th May 2022) by NTA, the Society of Consulting Architectural and Engineering Firms (SCAEF) and the Federation of Contractor's Association (FCAN). Ten NTA experts delivered lectures during the training.

**Talk on mechanized excavation**

A talk on "Mechanized Excavation" was organized by NTA in the Hotel Akama on 10th June 2022. In the program, EPIROC technical official/experts presented technical information on the EPIROC equipment used in drilling and excavating tunnels and underground constructions. About 50 NTA members attended the program.

NTA contribution to the MSc course in Rock and Tunnel Engineering, IoE. Lectures were given by the following NTA members throughout the year on various subjects: Dr. Gyanendra Lal Shrestha, Mr. Ram Hari

Sharma, Dr. Pawan Kumar Shrestha, Dr. Chhatra Bahadur Basnet.

A workshop was organized for the R&T Masters Course on 7th July, 2022 in IoE Pulchok. GLS and PKS focused on "Rock Foundation Design". Similarly, CBB focused on "Numerical Modelling".

Project work and Masters degree thesis were also supervised by NTA members.

**Nepal Tunnelling Conference 2022**

The Nepal Tunnelling Association (NTA) organized the Nepal Tunnelling Conference 2022, on 22nd – 23rd December in Kathmandu, Nepal with theme "Design and Construction of Underground Structures for Infrastructure Development". On the first day training was conducted by the EC members of the NTA and the second day was allocated for paper presentations. The conference was sponsored by various industries and supported by IPPAN, NHA and NSRM. In total, 212 participants from Nepal, India and China attended the Conference.

## FUTURE TUNNELLING ACTIVITIES

SN	Project	Type	Headrace Tunnel Length (km)
1	Upper Karnali HEP (900MW)	Hydro	2.4
2	Khare Khola HEP (14MW)	Hydro	4.8
4	Kulekhani Bhainse Road tunnel	Road	3.2
5	Kaligandaki Koban HEP (150MW)	Hydro	6.2
6	Tamakoshi 3 (650MW)	Hydro	17
7	Upper Marsyangdi HEP (600MW)	Hydro	9.2
8	Nalsinggad storage (390MW)	Hydro	9.2
9	Upper Modi-A (42MW)	Hydro	4.8
10	Upper Modi (18.2MW)	Hydro	3
11	Budhi Gandaki Storage (1200MW)	Hydro	2
12	West Seti Multipurpose (750MW)	Hydro	6.7
13	Upper Marsyangdi-2 (570MW)	Hydro	10
14	Lower Arun (400MW)	Hydro	15
15	Upper Tamor (415MW)	Hydro	8.7
16	Kali Gandaki Gorge (275MW)	Hydro	6.1
17	Solu Khola Small (40MW)	Hydro	4.1
18	Madi I (26.5MW)	Hydro	4.44
19	Upper Marsyangdi (14MW)	Hydro	5.15
20	Upper Arun (1061MW)	Hydro	7.1
21	Dudh Koshi storage (650MW)	Hydro	5.6
22	Tamor Storage (762MW)	Hydro	2.5



## FUTURE TUNNELLING ACTIVITIES CONTINUED

23	Budhigandaki Ka HEP (130MW)	Hydro	3.447
24	Budhigandaki Kha HEP (260MW)	Hydro	6.925
25	East West Railway Project	Rail	45
26	Karnali chisapani Multi purpose (10,050MW)	Multi	
27	Karnali Betan HEP (450MW)	Hydro	2
28	Karnali Phukot HEP (450MW)	Hydro	4
29	Arun Kimanthanka HEP (600MW)	Hydro	4
30	Jagadulla HEP (110MW)	Hydro	7
31	Bajhang Upper Seti (140MW)	Hydro	8.5
32	Uttar Ganga Storage (828MW)	Hydro	6
33	Tamakoshi V (95MW)	Hydro	8.1
34	Andhi khola storage (180MW)	Hydro	2
35	Chainpur Seti (210MW)	Hydro	7
36	Begnas Rupa Pump Storage(150MW)	Hydro	2
37	Siddhababa Road Tunnel	Road	1.2
38	Simbuwa HEP	Hydro	4.5
39	Ghunsa HEP	Hydro	4.2

## STATISTICS

## 1. Length or volume excavated

20% mechanized / 80% conventional during 2022

## 2. List of tunnels completed

Projects in-construction in 2022 - 26 (21 HEP, 5 Road Tunnel)

Projects with break-through - 7 (HEP - 6, Road Tun - 1)

Total tunnel excavated - 39.13km (HEP - 34,167 Road Tun - 4,963)

## EDUCATION ON TUNNELLING IN THE COUNTRY

MSc in Rock and Tunnel Engineering, IoE, Tribhuvan University, Nepal, since 2020.

# The Netherlands

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

**Type of Structure:** Non-profit. The Royal Dutch Engineering Society for tunnelling and underground works is an association of individual members who are also member of the various departments of the association. The Department of Tunnelling and Underground Works is one of the larger departments within the association.

**Number of Members:** 506 (2022) & ca. 50 Young Members



## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

Our department has celebrated its 50-year anniversary with a party themed "Connection generations though Tunneling!" This year the department also hosted the following events:

- A workshop themed: How to develop an Interface design to an integral design.
- Annual meeting "ITA-avond".
- A double site visit "project marathon" on the A16 and A24 tunnelling project sites.
- The YM-department organised a site visit to the A16 tunnelling Project.
- The YM department organised a site visit to the Baak Blankenburg (immersed tube) tunnelling project.

## CURRENT TUNNELLING ACTIVITIES Rijnlandroute (TBM)

The Rijnlandroute project has been

underway for a few years now. The twin tube tunnel between the A4 with the A44 motorways near Leiden is 2.5km in length. The TBM-driven tunnels were finalised in 2020 with as opening expected by 2023. The opening was delayed due to a fire in the storage facility where all of the tunnel's technical installations were stored. The tunnel technical installations are now underway and testing of all systems is progressing.

### Zuidasdok Amsterdam (in-situ)

In 2020 the client reconsidered this major project for Amsterdam. The tunnel project is split 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 2023 the procurement of the tunnel project will commence.

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

The Blankenburg connection, the new A24 motorway, contains two tunnels: the Maasdelta tunnel, which is an immersed tube tunnel under the Scheur (which is the primary access towards the harbour of Rotterdam); and the Holland tunnel, an in-situ tunnel through a natural habitat, (see picture 1). Twenty years of maintenance is incorporated in the design, build, finance and maintain project contract. The Blankenburg connection is scheduled for completion in 2024.

The Maasdelta tunnel will be about 945m in length and is characterised by its very deep ramps (photo). In 2018, execution started for the Maasdelta tunnel with the deep ramps now finished and covered. The two tunnel elements are constructed in a dry dock and are stored in a harbour basin, waiting for immersion which is planned for April 2023 (See picture 2 and 3). The closed ramps are finished and tunnel technical installations are being placed.

The civil structure of the Holland tunnel is almost complete, tunnel technical installations are being installed and integration testing is planned to be completed in 2023.

### A16 – Rottemerentunnel (in-situ)

The A16 motorway from junction Terbregse plein will be lengthened and



Holland tunnel

Maasdelta tunnel  
embankments/entrances

connected to the A13 motorway near Rotterdam, The Hague airport. In this connecting road, a new tunnel is required; the Rottemeren tunnel. The Rottemeren tunnel will have a length of 2235m. There will be two tubes with two lanes per tube and an emergency lane. The project has an energy-neutral design with optimal integration of the new road in its environment. While most concrete works on the tunnel are finished, the installation of the technical systems is underway and opening is scheduled for 2024.

#### Renovation project and challenge:

A lot of tunnels in the west of the Netherlands were constructed during the second half of the last century. To keep tunnels open and safe for future access they need to be renovated and brought up to date in terms of fire safety and operational control. In the district South Holland over the coming years seven tunnels will systematically being

renovated in a uniform and standardized protocol for efficient and safe future use. This starts with the Heinenoord tunnel:

#### The Heinenoordtunnel (1969) refurbishment

The project was awarded in October 2020. The final contract close took place in April 2021. The engineering of the renovation works is ongoing, with the works commencing in 2023 with the first scheduled nightly traffic closures to renovate the segment joints and renew the fire resistant coverings.

#### The Roer and Swalmentunnel (2009) refurbishment

In 2021 the MDCM-contract to renew several tunnel safety systems of these two tunnels was awarded. During 2022 the engineering of the renovation works started. The refurbishment works will commence in 2023. The contract is called an MDCM-contract, Maintain, Design,

Construct and Maintain. In the 1st maintenance period the contractor can get acquainted with the tunnel systems and operational software to prepare and design the renewal of the different tunnel safety systems.

Also the municipality of Amsterdam has prepared a refurbishment scheme for five tunnels. (Piet Hein tunnel, Arena tunnel, Spaarndammertunnel, Michiel de Ruijter tunnel, and the IJ-tunnel). Amsterdam is aiming to standardise the maintenance and operations procedures for this set of tunnels. The first two tunnels have been renovated and are open for traffic, the Piet Heintunnel and the Michiel de Ruytertunnel:

#### The Piet Hein tunnel (1993) refurbishment

After 25 years of active duty for the Municipality of Amsterdam the tunnel was closed to traffic for two years. Only tram line 26 was allowed through during the refurbishment works. The replacement and renovation project consisted of the renewal of new systems for ventilation, lightings, and fire safety systems but also the installation of new fire resistant covers, water and sewage system and emergency escape system. The tunnel was also outfitted with a new tunnel control system. The Piet Hein was successfully reopened at the end of 2022.

### FUTURE TUNNELLING ACTIVITIES

#### Future tunnel projects:

- Zuidasdok
- Extension of the North South Line Metro from Amsterdam to Schiphol Airport is under investigation.

#### Tunnel Renovation projects (mainly tunnel safety systems up to 2024):

- Eerste and Tweede Benelux tunnel
- Buitenvelderttunnel
- Noordtunnel
- Sijtwendetunnel
- Westerscheldetunnel
- Drechttunnel

#### Future tunnel projects (Renovation - after 2024):

- Botlektunnel
- Hubertustunnel
- Thomassentunnel
- Wijkertunnel
- Zeeburgertunnel
- Arenatunnel
- IJ-tunnel



# New Zealand

**Name:** New Zealand Tunnelling Society

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

**Number of Members:** 129 individual members,  
9 sponsors



## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

During 2022 the NZTS held a number of evening presentations from industry, including joint events with other NZ societies such as the NZGS and SESOC who we continue to work closely with.

We also held a one day short course focussing on state of the art tunnelling practices which was well attended.

A new President for the society was appointed (Matt Mules) along with a new member of the board and a new committee.

A significant amount of effort (together with our Australian colleagues) has been dedicated to the planning of the Australasian Tunnelling Conference 23' which is to be held in Auckland. We are confident that this will be an excellent event.

We continue to strengthen our ties with other tunnelling societies within our wider region and also to strengthen our influence within the NZ underground industry, including with Worksafe NZ.

## CURRENT TUNNELLING ACTIVITIES

Works on the two major tunnelling projects within Auckland were progressed significantly through 2022. Tunnel excavation on the City Rail Link was completed, with the TBM - Dame Whina Cooper - breaking through into the Te Waihorotiu (Aotea) Station in September to complete the twin 1.6km long running tunnels and the station cavern excavation at Karanga a Hape Station was also completed. By the end of 2022, the waterproofing and secondary lining in the station caverns was well advanced and laying of track and rail services was underway.

The Central Interceptor project saw a number of milestones. The main tunnel TBM - Hiwa i Te Rangi - passed safely under the Manukau Harbour and arrived at the PS23 shaft on the Northern shore. The 2.1m internal diameter HDPE lined Link Sewer C was completed and the EPB microtunnel machine - Domenica - upskinned to commence the larger diameter Link Sewer B. There were also a number of shafts which were excavated including the drilling and lining of a 3.5m internal diameter 78.5m

deep GRP lined shaft at Keith Hay Park - the first of this scale in New Zealand.

A number of significant microtunnelling projects were progressed across the country throughout the year. These include the Clinker Place SW upgrade (550m of 1.2m, 3 shafts), Barber Grove to Seaview WW Plant (600m of 1.05m, 4 shafts), Ports of Auckland Outfall (280m of 2.5m, 2 shafts), Corbans Reserve SW Upgrade (684m of 2.1m, 3 shafts), Auckland Hospital Service Trench (240m of 10m deep, 6m wide cut and cover) and Milldale Subdivision (380m of 1.05m, 5 shafts)

2022 also saw the completion of the Hunua 4 watermain - Auckland's biggest-ever water project - after more than a decade of construction. The 31km watermain which ranges in diameter from 1.6 to 1.9m included a 3.0m diameter microtunnelled drive of 1296m - a new Southern Hemisphere record.

## FUTURE TUNNELLING ACTIVITIES

The New Zealand Government has endorsed a partially tunnelled light rail system in Auckland with an estimated price tag of \$14.6bn. The 24km Auckland Light Rail (ALR) project will run from the city centre to Mngere and the airport, with up to 18 stations. The detailed business case and preconstruction planning phase for the ALR is now underway and detailed site investigation has commenced.

Also in Auckland, Waka Kotahi NZ Transport Agency, Auckland Transport and Auckland Council are working in partnership to progress the next phase of planning work on the Additional Waitemat Harbour Connections project. A design alliance has been formed to work towards a preferred option for the second harbour crossing, and a significant public consultation programme is being carried out.

As part of the "Lets Get Wellington Moving" programme the Government is moving ahead with a second Mt Victoria tunnel for Wellington as its "preferred choice". The proposed second tunnel will be roughly 14m wide, 650m long, and located about 25m to the immediate north (towards the harbour) of the existing tunnel. The

tunnel will cater for two eastbound (towards the Airport) traffic lanes with the existing tunnel upgraded for city-bound traffic use only

A 230m long road tunnel is to be constructed with road headers and sprayed concrete as part of the Mt Messenger bypass in Taranaki. Physical works are due to commence in the second half of 2023.

The NZ Battery project commissioned by the NZ Government is exploring options for pumped hydro and other potential energy storage projects. One of the main potential schemes being considered is the Lake Onslow Pumped Hydro project, located north-east of the Clutha River, which would comprise a pumped hydro storage project with up to five terrawatt hours of storage capacity and the potential for more than 20km of tunnels. A significant ground investigation campaign has now been carried out and the detailed business case is planned to commence in 2023.

## STATISTICS

### 1. Length or volume excavated - % mechanized / % conventional during 2022

10.9km (95% mechanised, 5% conventional)

### 2. Amount (USD or EUR) of tunnelling / underground space facilities awarded in 2022 - €151M

### 3. List of tunnels completed

- City Rail Link
- Clinker Place
- Hunua 4 water pipeline
- Snells Beach Outfall
- Milldale Subdivision
- Corbans Reserve SW Upgrade

### 3. List of tunnels completed

- Central Interceptor
- Mt Messenger Bypass
- Barber Grove to Seaview Pipe Duplication
- Auckland Hospital Service Trench
- Ports of Auckland Outfall
- Snells to Warkworth WW Pipeline
- Stanmore to Fife SW Upgrade

## EDUCATION ON TUNNELLING IN THE COUNTRY

- Three universities in New Zealand offer Civil Engineering Degrees with Geotechnical specialisation - University of Canterbury, University of Auckland and University of Waikato.
- A Tunnelling Short course focussing on Tunnelling in NZ was held by the NZTS in 2022.

Sometimes the best  
way from point A to point B  
is underground.

# DELVE underground

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Founded in 1954 as Jacobs Associates, Delve Underground is an employee-owned firm with 21 offices delivering state-of-the-art, sustainable heavy civil infrastructure throughout the United States, Canada, Australia, and New Zealand.





# 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 2022 AND TO DATE

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

The society publishes handbooks and technical reports in Norwegian and one English publication every year. The title of the English publication in 2022 was "Sustainability in Norwegian Tunnelling". Together with other industry partners we also make films. The film in 2022 was about blasting, neighbours and vibrations. The film is in Norwegian and is available on YouTube.

The society also arrange a photo competition every year. Below you can see two of the finalists in 2022.

## CURRENT TUNNELLING ACTIVITIES

The tunnelling activity in Norway had an increase of almost 1Mfm<sup>3</sup> from last year, from almost 4.2Mfm<sup>3</sup> in 2021 to more than 5.1Mfm<sup>3</sup> in 2022. The statistics show a large increase of road and water supply projects, a small increase in hydro power projects, and decrease in railway and cavern projects. tunnel greatly improves safety for users.

E39 Svegatjørn – Rådal opened for traffic in October 2022. The facility consists of 18km of new four-lane road, with a total of four new twin tunnels. This means that eight new roadways with a total length of 28.7km have been completed.

In August 2022 Nordøyvegen opened for traffic. The project connected several islands to mainland via bridge constructions and three subsea tunnels.

The much discussed Follo Line opened to traffic in December 2022. It was forced to close shortly after due to electrical complications. After a period of extensive testing it re-opened to traffic on the 5th March 2023.

In addition, several hydropower plants opened, supplying Europe with clean renewable energy.

## FUTURE TUNNELLING ACTIVITIES

Work has already started on a new railroad between Drammen and Kobbervikdalen. This project will complete a double track railroad from Oslo to Tønsberg which opens in 2025. The project will include 6km of hard rock tunnelling, almost 300m of soft ground tunnelling and about 700m of cut-and-cover.

Another large project we are waiting for is the joint rail and road project, Ringerike Line and E16 Highway, which will include a 40km long tunnel for the railway and some shorter tunnels both for rail and highway between Sandvika and Hønefoss. Due to delayed financing, it is difficult to estimate the construction start and traffic opening.

Nye veier will also continue road building along E18 from Porsgrunn to Stavanger. These projects will include both tunnels and rock blasting above ground. The same goes for the new E6 between Hamar and Vestnes. The new E6 both south and north of Trondheim includes both rehabilitation of

old tunnels and the excavation of new ones.

The Norwegian Public Road Administration continues the construction of Rogfast. This project will include Norway's longest and deepest subsea tunnel. The large contract including the 18.5km subsea tunnel from the north was signed in December 2022 and the other large contract including 18.5km subsea tunnel from the south was signed in January 2023.

The new water supply system to Oslo continues. The water will go through a long tunnel from the Holsfjord to the west of the city into the existing network of water pipes. The TBM going westward towards the Holsfjord will start excavation in February/ March 2023. In addition, The Fornebu Line continues. This will be a metro tunnel that will connect Fornebu with the rest of the metro system in Oslo. Several of the tunnelling contracts are running. The project will open for traffic in 2029.

As a curiosity we also have to mention the Stad tunnel – the world's first tunnel for ships? The request for tenders for this project is planned for the third quarter of this year. Construction work could start in autumn 2024, with preparatory work starting earlier.

## STATISTICS

**Length of tunnels excavated during 2021**  
68,710m in total, included 3,205m by TBM  
5,127,384fm<sup>3</sup> in total

## EDUCATION ON TUNNELLING IN THE COUNTRY

Norway has several universities awarding both bachelor and master degrees containing several aspects of tunnelling. The major ones are NTNU in Trondheim and the University of Oslo. In addition to the higher degrees of education, Norway can offer a set of schools a four-year program for the certification for rock blasters.



Lepsøybrua (Photo Øystein Løvoll, Skanska)



# Pakistan



**Name:** Pakistan Tunneling and Trenchless Society (PTTS)

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

**Number of Members:** 102 including 6 corporate members

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

### Four Workshops

- Workshop #1: 28-03-2022 (Smart Scaffolding Solutions, by Mr. Tarc Feorlic, Meva, Germany)
- Workshop #2: 26-11-2022 (Introduction to Building Information Modeling, by Dr. Sohail Malik, Associate Prof. NUST Islamabad, Mr. Naqeeb Ullah & Syed Rafay Bukhari, Tunnelling Institute of Pakistan)
- Workshop #3 : 27-12-2022 (Introduction to Construction Management Productivity Tools, by Dr. Zia ud Din, Associate Prof. Huston University)
- Workshop #4: 03-02-2023 (Concrete Mix Design & Sand Analysis through Sika App, by Dr. Oscar Marazzini & Kashif Gardazi, Sika Pak)

### Tunnel Talk Series

- Tunnel Talk #1: 14-03-2022 (Shotcrete Technology & TBM Aids, by Dr. Oscar Marazzini)
- Tunnel Talk #2: 08-12-2022 (Underground Solutions for a Better World, by Prof. Arnold Dix)
- Tunnel Talk #3: 02-02-2023 (Soft Ground Tunnelling, by Dr Oscar Marazzini, Asif Riaz (FWO), Ashraf Hussain (TIP))

### Site Visits

- Site Visit #1: 17-08-2022 (969MW Neelum Jehlum Hydropower Project)
- Site Visit #2: 29-09-2022 (48MW Jagran-II Hydropower Project)

### Publications

- Publication#1: Impacts and challenge faced during deep excavation 1125.3m, rock encountered its effects on support and solution: A case study review from Suki Kinari Hydropower Project 870 MW Pakistan, Authors: Asif Riaz, Haris Waheed, Ashraf Hussain, Dr. Abdul Qudoos Khan, WTC-23
- Publication #2: Mixed use potential of existing road tunnels for conveying water for hydropower generation: A case study of motorway tunnels in swat Pakistan, Authors: Asif Riaz, Ashraf



Hussain, Ajdar Nawaz, Dr Zia ud din, WTC-23

- WGs : Think Big - Innovative UG use in the country

## CURRENT TUNNELLING ACTIVITIES

### Ongoing Tunnelling & Hydropower Projects:

Diamer Basha Dam & Hydropower Project

- Location: Gilgit Baltistan
- Total Length of Tunnels : 17km
- Tunnelling Method: Drill & Blast
- Design Capacity: 4500MW

Dasu Hydropower Project

- Location: KPK Province

- Total Length of Tunnels: 26km
- Tunnelling Method: Drill & Blast
- Design Capacity: 4320MW

Suki Kinari Hydropower Project

- Location: KPK Province
- Total Length of Tunnels: 40km
- Tunnelling Method: Drill & Blast
- Design Capacity: 880MW

Jagran-II Hydropower Project

- Location: AJ&K
- Total Length of Tunnels: 8km
- Tunnelling Method: Drill & Blast
- Design Capacity: 48MW

Kurram Tangi Dam & Hydropower Project

- Location: KPK Province
- Total Length of Tunnels: 3km
- Tunnelling Method: Drill & Blast
- Design Capacity: 83.4MW

Mohmand Dam & Hydropower Project

- Location: KPK Province
- Total Length of Tunnels: 8km
- Tunnelling Method: Drill & Blast
- Design Capacity: 800MW

## FUTURE TUNNELLING ACTIVITIES

Lahore Water & Wastewater Management Project (LWWMP)

- Project Contracting Mode - Design and Built
- About 28km of microtunnelling
  - Main Sewer Line 1(15~16km): Internal Dia - 2.44m
  - Main Sewer Line 2 (13~14km): Internal Dia - 1.52m
- Project Owner -Lahore Water & Sanitation Agency (LWASA)
- Financier -AIB funded project: US\$533.3M
- Project Timeline -5 Years

## STATISTICS

### 1. List of tunnels completed

- River Diversion Tunnel for the Dasu hydropower project
- River Diversion Tunnel on the Mohmand dam hydropower project
- Tunnelling components of Jthe aggran-II hydropower project

### 2. List of tunnels under construction

- Adits and headrace tunnels on the Dasu, Mohmand, Suki Kinari, Kurram Tangi hydropower projects

## EDUCATION ON TUNNELLING IN THE COUNTRY

- Tunnel Talk Series and Training Workshops initiated by the joint efforts of the Pakistan Tunneling and Trenchless Society (PTTS) and Tunnelling Institute of Pakistan(TIP)
- Diploma Course at the Tunnelling Institute of Pakistan (Second Batch)
- MSc Tunnelling at UET Lahore, Pakistan (First Batch)

# Poland



**Name:** Subcommittee of Underground Construction of Polish Committee on Geotechnics (Polish Tunneling Association)

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

**Number of Members:** 64 members, 5 corporate members

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

Representatives from Poland were present at ITA General Assembly on September 4th 2022 and September 7th in Copenhagen. Monika Mitew-Czajewska was elected as a Member of the Executive Council of ITA for 2022 – 2025. Anna Siemińska-Lewandowska was a Member of Scientific Committee WTC2022 and chaired one of the technical sessions. Monika Mitew-Czajewska (treasurer) is a member of WG20, Anna Siemińska-Lewandowska (president) - WG15, Bartłomiej Dziuban and Dymitr Petrow-Ganew – WG14, Maciej Ochmański – WG2 and WG22, Jerzy Lejk – WG3, Bartłomiej Dziuban – ITAYM.

The Association organised two conferences – the 4th Polish Tunnel Forum (live and digital) on 30th June 2022 in Wrocław and Geotechnics and Underground Structures, Cracow, 20th – 22nd June 2022 (live and digital). During the 4th Polish Tunnel Forum the Members of the ExCo presented lectures: Tarcisio Celestino “Carbon footprint in tunnel construction” and Olivier Vion “World trends in tunnel construction”.

## CURRENT TUNNELLING ACTIVITIES

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

- In a east-north direction three stations and 8km of twin single track tunnels were put into operation on September 22nd, 2022
- In a westerly direction two stations and 4km of tunnels were put into operation from June 2022

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

- Geological investigation along the route of TBM tunnels, construction method: EPBM + cut & cover.

### Road tunnel under the Świna river in Świnoujście – north Poland

The 1.44km long tunnel will connect the islands of Uznam and Wolin. The



*Road tunnel under the Świna river in Świnoujście*

construction method is via a 13.46m diameter TBM with a completion date end of 2023. Slurry TBM boring works were completed in 2021. Two of the four emergency exits were constructed using ground freezing. Other finishing works (construction of ventilation ducts, technical ducts, emergency exits under the road slab) are in progress

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

The length of the tunnel is 3km of twin track tunnel and 4.5km of single track/tube tunnels with two underground stations. The construction method TBM + cut & cover. Two TBMs – of diameters 13.04m and 8.76m started in 2021. Two stations are under construction, with 1000m of double track tunnel and 900m of single track tunnels are completed. Due date for completion is at the end of 2024.

### Road Tunnel under Luboń Mały – south Poland

Over 2 x 2km of tunnel on the S7 motorway from Kraków to Zakopane (Polish skiing resort) has been in operation since December 2022.

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

2.3km of tunnel on the S3 motorway from Bolków to the state border. Design and build using the NATM method. The excavation works were completed in February 2022. Finishing works are in progress with a completion due date of 2024.

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

Two road tunnels (830m and 980m) on the S1 motorway to the south state boarder. The contractor will construct the tunnel via a design and build contract using NATM. Due date is in 2025.

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

A Microtunnelling project of 3.2m diameter and total length approx. 9km, with a completion date at the end of 2023.

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

The project involves constructing 2,180m long twin tube TBM bored road tunnel on the S19 from Rzeszów to the state border. Construction works started at the beginning of 2023. Transportation of 15.4m diameter cutterhead and the rest of the TBM parts from Szczecin harbour by the Oder river to Opole and afterwards by road to the assembly site near Rzeszów posed a big challenge

### Road tunnels on the north city ring of Cracow

The 12km long north city ring of Cracow S52 has three road tunnels (496m, 653m, 100m long), created by the cut & cover method, with one of the tunnels crossing under the river Prądnik, Due date for completion is at the end of 2024.

## 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 - Babica to the state border. The conceptual design is underway. Construction period - 2023-2026.

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

Two road tunnels; 2 x 3 lines in each direction, currently in preliminary design.

### Road Tunnel on the S6 motorway

A road tunnel on the Szczecin west city ring, under the Odra river, 5km long, with a construction method using a 14m Slurry TBM. The separate tenders for the building permit design and construction will be open in April 2023.

### Eleven (11) rail tunnels – 12km in length on the rail route Podłęże-Piekiełko in south Poland

The environmental permit has been obtained and the design works are underway. Preparatory works and the design were completed in 2022. The construction and modernization is planned for 2023-2026.

### 2.5km 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. Building permit design.

## STATISTICS

### 1. Length of tunnels excavated

80% mechanized / 20% conventional during 2022

### 2. List of tunnels completed

II metro line east and west extensions, Warsaw. Road tunnel under Lubo Mały 2.3km, South of Poland. 2.1km long road tunnel Łagiewnicki – Cracow.

### 3. List of tunnels under construction

**Roads tunnels:** S3 under the Świna river, S3 Bolków-Kamienna Góra, S1 Węgierska Górka, S19 Via Carpathia, S52 North city ring for Cracow.

**Railway tunnels:** single track and double track Łódź.

**Utility tunnels:** storm water retention tunnel along the Vistula river, Warsaw.

## 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 Civil Engineering. Faculty of Civil Engineering, 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.

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# Russia



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

**Type of Structure:** Non profit

**Number of Members:** Total number - 68

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

- Round table "Presentation of the innovative material "Waterproofing GLEN", Moscow, March 3rd, 2022
- Scientific and technical conference "Application of advanced technologies in underground construction", Moscow, May 25th, 2022 (<https://disk.yandex.ru/d/Zqtg5lrCbega9w>)
- International Sino-Russian forum "Young scientists in the field of geotechnics and underground construction", Online form, September 14th – 15th, 2022 (<https://disk.yandex.ru/i/kjszgjB39jGo7A>)
- Scientific and technical conference "Development of the underground space of megacities and transport tunnels", Moscow, November 9th, 2022 (<https://disk.yandex.ru/d/Ph8nu-ElOYPLZw>)
- Specialists of the Tunnel Association of Russia took a direct part in the approval and development of the set of rules SP 120.13330.2012 "SNiP 32-02-2003 METRO".
- Competition S.N. Vlasov "Engineer of the Year of the Russian Tunnel Association 2022" (<https://disk.yandex.ru/d/JkCaalnLWEvyoA>)
- Competition of scientific (thesis) works for university students.
- Competition "The best application of technologies in the construction of tunnels and underground structures - 2022" (<https://disk.yandex.ru/d/afjuXG6uz9SBbA>)

The professional magazine "Metro and Tunnels" was published (four issues of the magazine were published). Two bulletins were issued during the year (in the first and second half of 2022).

## CURRENT TUNNELLING ACTIVITIES

### Moscow Metro development program

In 2022, as part of the Moscow Metro development program, the construction of the Big Circle Line (BCL) was completed. The full launch of the line is planned for 1st March 2023. The remaining nine stations will be opened, including seven new stations and two after reconstruction. The length of the BCL is more than 70km

and 31 stations. It is currently the largest circular metro line in the world. (<https://disk.yandex.ru/i/FAIkjT5NV2srBw>)

The construction of the Rublvo-Arkhangelskaya line of the Moscow Metro continues. As part of the first stage, the construction of a 12.6km long section is underway. It will run from the Shelepihka station on the Big Circle Metro Line to the Lipovaya Roscha. The site will house six stations. (<https://disk.yandex.ru/i/rktCLaKeJK3Gqw>)

A new radial metro line, Troitskaya, is being built in Moscow. It will have 17 stations. It will pass from the ZIL station and reach New Moscow. The construction of the Troitskaya line is being carried out in two stages. At the moment, construction is underway on the first section, which is planned to be launched by 2025 from the ZIL station to Kommunarka. There will be 11 stations here. (<https://disk.yandex.ru/i/D2krv6FWxkxUQg>)

The Biryulyovskaya metro line is currently at the design stage, a promising radial branch for the Moscow Metro that will serve areas in the south of the capital. There will be 10 stations on the 22.2km section.

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

The Kerak Tunnel has been completed - a double-track railway tunnel on the Ulruchi-Kovaly section with a length of about 926m. Currently, work is underway at the facility to create the lining and install the necessary equipment. For now, 2023 is planned for the full opening and launch of the tunnel as part of the Trans-Baikal Railway. ([https://disk.yandex.ru/d/vKo7GL\\_iWrxewg](https://disk.yandex.ru/d/vKo7GL_iWrxewg))

The construction of a new Dusse-Alinsky railway tunnel continues at the Novy Urgal-Postyshevo section of the Far Eastern Railway in the Khabarovsk Territory. The length of the new tunnel will be 1824m. Completion of construction and a full launch is planned for 2025.

In Primorsky Krai, between the settlements of Shkotovo and Smolyaninovo, the construction of two new railway tunnels with a length of 1420m and 1450m

is ongoing. These two tunnels will bypass the existing Shkotovsky Pass and eliminate the need for additional traction on this section of the Far Eastern Railway.

Member companies of the Tunneling Association of Russia continue to take part in the implementation of 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 mid-2023, it is planned to complete the construction and put into operation the section of the Lyublinsko-Dmitrovskaya line of the Moscow Metro from Seligerskaya to the village of Severny. Three metro stations will be located on this 5.8km section.

(<https://disk.yandex.ru/i/AaCHTWllw5GZ4A>)

Also in 2023, it is planned to complete construction and launch a section of the Kalinin metro line to Vnukovo airport, where two metro stations will be located. The final station - Vnukovo Airport will be the first station in the immediate vicinity of the airport anywhere in Russia. A metro bridge is being built on this section behind the Pykhtino station above the bed of the Likova River. (<https://disk.yandex.ru/i/F4kiGEk0tpQyng>)

The completion of construction and the opening of the Yuzhnoye electric depot in Moscow is scheduled for 2023. This is the country's largest complex for the operation and repair of metro trains and is being built in Brateevo. (<https://disk.yandex.ru/i/5BTae0ASWjqYZw>)

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

## EDUCATION ON TUNNELLING IN THE COUNTRY

- 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 "Gornyy" (SPGU);
- Saint Petersburg University of Communications (PGUPS);
- Tula State University;
- Ural State Mining University (UGGU);
- Siberian State University of Communications (SGUPS).

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# 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 2022 AND TO DATE

In 2022, TUCSS continued to promote tunnelling and underground construction and share knowledge by organising monthly evening seminars, training courses, conference & site visits. These activities were well attended and helped the dissemination of tunnelling & underground related information and best practices from around the world. In addition the society held social networking events to bring together the practitioners from the different sectors of the industry. TUCSS also continued to support the accreditation of tunnelling resident site supervisory staff during the year.

### Annual Lecture

TUCSS Annual Lecture was held on Thursday, 20th October 2022 at SMU Ngee Ann Kongsi Auditorium. The topic was "Development and Use of Steel Fibre Reinforced Concrete in Singapore" by Prof Tan Kiang Kwee, National University of Singapore. The Annual Lecture was attended by 182 TUCSS members.

### Hulme Prize Award:

This annual competition is set up for young engineers or students (below 35) to submit and present technical papers on subjects related to tunnelling and underground construction. Three papers were shorted by the TUCSS Committee as follows:

- Parametric Design Study of Hybrid Steel Fibre Reinforced Concrete (SFRC) in Singapore Cut-and-Cover MRT Structures. Presented by Ang Wei Jian, Land Transport Authority
- Evaluation of Over-Excavation for Earth Pressure Balance (EPB) Shield through Data Analytics. Presented by Caroline Teo, Land Transport Authority
- Underpinning and Tunnelling Undercrossing Keppel Viaduct using specialised cutter tools to cut the piles. Presented by Bryan Chng, Land Transport Authority

The first prize was awarded to Ang Wei

Jian, second prize to Caroline Teo and the third prize to Bryan Chng.

### Training Courses

TUCSS held the "TUCSS Tunnelling Course 2022" on 19th to 20th April 2022. The two half-day course was attended by 250 participants. The purpose of the course was to provide a comprehensive background to certain contemporary practices in design and construction of tunnels and underground structures.

### Conferences

TUCSS held "Symposium on Innovations & Challenges in Asian Tunnelling 2022" on 21st & 22nd September 2022 at Parkroyal on Beach Road Hotel. The symposium was organised together with industry partners from China, Japan and Korea. Its objective is to share valuable experiences gained from recent underground

infrastructure projects across the four countries. In all 16 presentations was delivered by prominent experts and 280 participants attended the symposium.

### Annual Dinner

TUCSS celebrated its 25th Anniversary Dinner on 4th October 2022 at Raffles City Convention Centre. The event was attended by 800 members and guests.

### Golf Friendly

TUCSS organised its Golf Friendly on 12th August 2022 at Sentosa Golf Club.

### Project of the Year Award

TUCSS organised the 2nd edition of the Project of the Year Award. This award is an initiative to recognise best practices and enhance the professional standards of tunnelling & underground construction works in Singapore.

The winner of the 2022 edition was "T228 Construction of Gardens by the Bay Station & Tunnels for Thomson – East Coast Line".

There were also 2 merit awards presented to the following projects:

- Contract T211 – Design and Construction of Bright Hill station and Construction of Tunnels for Thomson – East Coast Line.
- T305 – Construction of Katong Park Station and Tunnels for Thomson – East Coast Line.

### Virtual Monthly Evening Seminars for members:

20th January 2022	The New Bern RBS Underground Station and Expansion of Bern SBB Station public facilities: Design and execution challenges (Bern, Switzerland)	Mr. Martin Schafer, Basler & Hofmann AG
17th February 2022	East Side Access – transforming Manhattan	Mr. Andy Thompson, Mott MacDonald
17th March 2022	City Rail Link – Delivery of the first underground railway project in New Zealand (Auckland, New Zealand)	Mr. Francois Dudouit, Link Alliance
21st April 2022	Thomson East Coast Line E1003 – Design Challenges & Solutions	Dr. Nicholas Mace, Mott MacDonald
19th May 2022	Design and construction challenges with tunnelling at speed: TBM tunnels for Brisbane Airport Link	Dr. Anthony Harding, Jacobs International Consultants
16th June 2022	Completing the full Circle Line – Tunnelling Challenges in CCL6 (Singapore)	Mr. Poh Chee Keong, Land Transport Authority
21st July 2022	Underground Infrastructure under extreme threats - How to cope with fire and explosion in a changing societal environment?	Dr. -Ing Goetz Vollmann, Ruhr University Bochum
18th August 2022	Role of Reinforcement in Tunnel Linings	Dr. Ralf Winterberg, Barchip Inc.
17th November 2022	Pawtucket CSO Tunnel – Cleaning Up Narragansett Bay R.I.	Mr. Bob Frew, AECOM Singapore



**CURRENT TUNNELLING ACTIVITIES**

**1)** Tunnel boring works for Thomson East Coast Line and Circle Line 6 were completed using a total 57 pressure balance Tunnel Boring Machines including 2 Rectangular Machines, while the track and other works are in progress. The tunnelling was done in an urban environment and included the undercrossing of residential and heritage buildings and tunnelling in close proximity to the foundations of commercial buildings.

- 2)** The first stage of tunnelling for the Thomson Line extension within Changi Airport have completed
- 3)** Construction of North South Corridor, a 22.5km long expressway with a 12.5km underground section, is now in progress.
- 4)** Cross Island construction contracts involving large diameter (>12m) TBMs are being progressively awarded.
- 5)** DTSS Phase 2 tunnel construction is nearing completion.
- 6)** Changi Airport tunnel boring works for

large and smaller tunnels were completed in 2022 and fit out works are in progress.

**7)** Singapore Powergrid is building South East Asia's largest underground substation

**FUTURE TUNNELLING ACTIVITIES**

- 1)** Construction works for new MRT lines is expected to continue well into the 2030s
- 2)** Changi Airport Terminal 5 project consists of large cut and cover tunnels and deep basements.

# Slovakia

**Name:** Slovenská tunelárska asociácia ITA/AITES

**Type of Structure:** Non-profit organisation

**Number of Members:** Total number 45, number of corporate members 39

**ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE**

- In cooperation with Slovak Technical University in Bratislava, members of the STA committee have given a lectures on the topic of tunnels and underground construction.
- Lecture have also been given members of the STA committee in cooperation with the Technical University in Žilina.
- STA and the Czech Tunnelling Association continued to publish the quarterly journal Tunel.

**CURRENT TUNNELLING ACTIVITIES****Bikoš Tunnelfirst**

In 2022, works continued on the second stretch of the Prešov bypass which consists of a 4.3km long section of the R4 expressway and includes the 1.1km long Bikoš tunnel. The works for the construction of the Bikoš tunnel were almost finished by the start of 2023. The landscaping of the portals and the operational and technical facilities are still being completed. Work is continuing on equipping the tunnel, including installation of lighting, laying of cables and power supply equipment. The opening of R4 expressway with the Bikoš Tunnel is expected in August 2023.

**Čebrať Tunnel**

The construction of the 3.6km long Čebrať tunnel on the Hubová - Ivachnová D1 motorway continued through 2022. The southern tunnel tube broke through on the 15th November 2022, and to date

tunnelling is complete. The breakthrough of the northern tube followed in January 2023. Works on the secondary lining are underway in both tunnel tubes.

**Višňové Tunnel**

The 7.5km long Višňové twin-tube tunnel is being built on the D1 Lietavská Lúčka - Višňové - Dubná Skala motorway

section. It is located in the Malá Fatra Mountains. The secondary lining of the north and south tunnel tubes, including the 18 emergency bays are complete. The construction of all 10 connections to the drainage tunnel from the cross-connections are also complete. In the drainage tunnel itself, reinforcement of the lining and the recesses for lifting drainage water into the central trough are being implemented.

**FUTURE TUNNELLING ACTIVITIES****Okruhliak tunnel**

The second section of the R4 Expressway Prešov bypass which includes the 2km long Okruhliak Tunnel is still in the tender phase. If the public procurement is successful, the works on the tunnel could start at the end of 2023.



Visnové tunnel

**STATISTICS**

**1. Length or volume excavated - % mechanized / % conventional during 2020**  
600m, 100% conventional

**2. List of tunnels completed in 2021:**  
Tunnel Bikoš, Tunnel Čebrať, Tunnel Višňové

**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

# 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 318 (216 individual members, 66 corporate members, and 36 young members)

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

During 2022, many of the activities that had initially been postponed due to the pandemic took place in both hybrid face-to-face and virtual modes. These include, among others, the following:

- XVIII Máster Universitario in Túneles y Obras Subterráneas AETOS (Endorsed by ITA-AITES).
- Participation in the JRC expert committee on the adaptation of the Eurocodes (2nd gen.) for tunnels and underground structures.
- Activities in Working Groups coordinated by AETOS Tunnel Forum (FAT)
- Meetings of EUFT and GIT and other counterpart Associations.
- Monography issue of tunnels in the ROP (Journal of Public Works) A new special issue of the ROP on Tunnels and Underground Works is presented, as 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 publish monographs, which disseminate experiences in tunnels and underground works.
- The fulfilment of the objective of AETOS to promote the study and research of underground works, facilitating contact between professionals and collaboration with related organizations is ongoing with, among others, the yearly publication of this monograph.

Other technical conferences and seminars:

- “Andalusian metros: Sustainable solution for city transportation” - Seville, 17th March 2022.
- Northwest corridor tunnels, Madrid-Galicia. Barrié Foundation. A Coruña, 6th and 7th April 2022.
- XI National Symposium on Geotechnical Engineering, organised by SEMSIG in collaboration with the University of Oviedo, SEMR, IGS-Spain, AETOS, SPG, and with the organisational support of

the University of Oviedo Foundation, and in parallel with the Seventh Spanish--Portuguese Geotechnical Engineering Symposium. Mieres - Oviedo. 24th – 27th May 2022.

- Participation as a EUTF member in the SIG Conference: “The role of underground infrastructures in the achievement of the EU sustainable developments goals”. Bologna (Italy). 19th – 21st Oct 2022.
- Spanish presence at the WTC and 48th ITA-GA. Copenhagen 2nd – 8th September
- September 22nd, General Assembly of AETOS, including:
  - Medal of honor award to past AETOS Secretary Pedro Sola Casado, and Alfonso Navarro Lérda as a young member.
  - Conference: “The Brennero-Fortezza Base tunnel” by David Marini, and y Gisuseppe Venditti, managers of engineering and construction.
- 2nd “International conference on road tunnel operations and safety & VIII Spanish Tunnelling Symposium - PIARC. Exhibition centre - Granada, 25th – 28th October 2022.

## FUTURE ASSOCIATION ACTIVITIES

- Technical conference “Tunnel in Gipuzkoa and other unique tunnels”, Donostia, 14th – 15th February.

Forecast events during 2023 (pending on confirming scheduling):

- Innovations and digitalization in tunnelling, EC-2nd Gen - JRC (June)
- AETOS General Assembly including Annual Conference (September)
- Madrid Metro extensions (October)
- Technical meetings and WG activities on going.

## CURRENT TUNNELLING ACTIVITIES

### Railway Tunnels

- Progress on the underground works at the Bergara Junction (Kortazar and Udalaitz tunnels) on the Vitoria-Bilbao-San Sebastián High-Speed Line.
- The Castellbisbal Tunnel in the Mediterranean Corridor.
- Underground works for the commissioning of the LAV to Murcia and works in the underground station at Carmen.
- Rail access to the Outer Port of A Coruña in Punta Langosteira.
- Underground works associated with the future La Sagrera Station (Barcelona).
- New rail access to T1 for the Josep Tarradellas Barcelona-El Prat airport.
- The Rincón tunnel in Pulpí (Almería).
- Commissioning of the LAV tunnel between Puerta de Atocha and Madrid Chamartín-Clara Campoamor (Madrid).
- The Zumelegi tunnel on the Elorrio-Elorrio section of the Vitoria-Bilbao-San Sebastián High-Speed Line.
- Access routes to northwest Spain (Galicia) have been commissioned and put into service, including more than 80 new tunnels. Over 40 new tunnels for high-speed lines are already planned for the coming years and are in the design or construction phase.

### Metro Tunnels

The Madrid Metro expansion project has been launched, which includes the



construction of 40.5km of new tracks and seven more stations, by 2028. Specifically, the Community of Madrid has launched in 2022:

- Line 3 - Villaverde Alto-El Casar, with a length of 2.5km and an investment of over €75M.
- Line 11 - Plaza Elíptica to Conde de Casal, with a 7km length and investment of over €550M
- Line 11 - Conde de Casa to Mar de Cristal, with an 18.6km length and investment of over €556M

The Madrid Metro today includes 302 stations and 294km of tracks, the fifth largest network in the world behind London, New York, Shanghai and Paris. If the schedule is followed in detail, within seven years it will have 309 stations and 334km of tracks.

In total, the three on-going projects will add up to more than 17km of Metro surface area and two brand new stops near the Hospital at Enfermera Isabel Zendal: Ciudad de la Justicia and Valdebebas Norte, which will also be an interchange. The new layout will also pass through the existing Madrid underground station at T4, at the end of Line 8, facilitating a new, more direct connection between the Adolfo Suárez Madrid Barajas Airport and Atocha.

### 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.

Within this set of activities, the following project for road tunnels are ongoing:

- San Juan Tunnel. (Alicante).
- Aguadulce, Bayyana, La Parra and La Garrofa tunnels (Almería).
- Adaptation of various tunnels in the province of Barcelona.
- Llado, Collaguets, Fogá and Juan Carlos I tunnels (Lérida).
- Montefurado, Piedrafita San Pedro, Doncos, Cereixal and Neira tunnels (Lugo).
- Villafranca, Trabadelo and La Escrita (León).
- Capistrano, Tablazo, Frigiliana, Lagos, Torrox, Churriana and San Pedro tunnels (Málaga).
- El Carmen, Llovio, Tezangos, El Fabar, Arenal de Morís, Ángel Uriel, El Padrún and Duesos tunnels. (Asturias).
- Gedo, Somaconcha, Lantueno, Las Caldas, Riocorvo and Pedredo, Caviedes, Hoz, Torrelavega, Gibaja, Astillero,

## 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 are available in several universities, the most relevant being: 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 include the Discipline of Civil Eng. ECTS (European Credit System, according to the European Higher Education Area).

XVIII 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 recognized by ITACET (International Tunnelling Association).

The teaching cycle, which includes 1250 teaching 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 gained employment in tunnelling works in different areas of the Public and Private sectors.

To offer the highest quality of teaching, since 2014, AETOS has been collaborating with the National University of Distance Education (UNED) (through its Permanent Training program) and with the College of Civil Engineers (CICCP), to offer distance learning possibilities, to access a greater number of students.



La Marga, Maliaño, La Albericia, La Morcilla and Limpias tunnels. (Cantabria).

- La Canda, Padornelo, Padornelo N-525 and La Canda N-525 tunnels. (Zamora).

Several road tunnels are currently under construction. Among these is the El Risco-Agaete motorway on the island of Gran Canaria, comprises eight tunnels along 8.5km of dual carriageway with three lanes in each direction and a total budget of €153M.

### Hydraulic Tunnels

The €52M, 13km long Mularroya tunnel, for the transfer of water between the Jalón and Grío river basins, has completed by September 2022 a total of 8.2km.

The tunnel has an internal diameter of 2.9m and an external diameter of 3.3m, and will cross the municipalities of Calatayud, Paracuellos de la Ribera, El Frasno and Morata de Jalón, with the capacity to transfer 8 cubic meters of water per second.



# 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 2022 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, Professional Certification, and the national group of Rock Mechanics. The main activity of the association is the annual Swedish congress where a significant part of the Swedish industry gathers. This physical event was held in September 2022. 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 represented in all of the Sweden-relevant Working Groups within the ITA. Professional Certification is, since 2020, 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 ISRM.

One of our proudest accomplishments is the development of the Children's book "Vinnie and the Metro". 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 available as an e-book at the WTC 2023

## CURRENT TUNNELLING ACTIVITIES STOCKHOLM BY-PASS (E4 FÖRBIFARTEN, STOCKHOLM)

This project includes an 18km long road tunnel. When complete 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 labor

market in Gothenburg and West Sweden. Giving commuter and regional trains their own tracks in a tunnel beneath central Gothenburg will double capacity at Gothenburg's Central Station. The expansion of the rail infrastructure in Gothenburg also enables future development of the city above ground. The section Korsvagen, is approximately 3.2km, and has a tunnel system featuring very complex geometries as well as tunnels with low rock overburden.

## Extensions of the subway in Stockholm

Building the new metro station at Hagastaden is large-scale and of high technical complexity below central Stockholm, which is surrounded by residential buildings, Karolinska University Hospital and Gustaf Vasa Church. Traffic above as well as below ground will go on as usual. Station Hagastaden consists of four ingresses, one in the hospital, two ticket halls and of course the metro tunnel with an accompanying service tunnel and connection to the existing metro system. High requirements are on health and safety and sustainability as the

sustainability classification CEEQUAL is being applied.

## Reconstruction of Slussen Stockholm incl new underground bus terminal

Slussen is a central area by the lock between lake Mälaren and the Baltic Sea. This is an important hub in Stockholm and a large underground bus station is under construction in the area. The construction works were ongoing during 2022.

## City Link tunnel

This tunnel project with a length of 13.4km and a diameter of 5m approximately 50-100m below central parts of Stockholm started in 2020. The purpose of the project is to connect 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 finished during 2020. From this shaft



Extensions of the subway in Stockholm



West Link - Korsvagen station

a 250m long tunnel will run under the Stockholms ström lake. The tunnelling works using a TBM started 2020.

#### **HYBRIT: A unique hydrogen storage facility in Luleå**

The HYBRIT initiative was launched in 2016 by 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 has been drilled from the top of the rock down to the upper part of the rock cavern. In 2022 the facility was set into operation and the world's first fossil free steel has been produced.

#### **FUTURE TUNNELLING ACTIVITIES Ostlänken, the East Link high speed rail**

This new high-speed rail south of Stockholm is at the ongoing design and planning stage. 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 regarding Sweden's final repository for spent nuclear fuel. Process of getting 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. This is a full scale Hydrogen Storage facility for fossil-free iron and steel production. It will be the world's largest facility for Hydrogen storage when completed.

#### **Host of the WTC 2025 in Stockholm**

At the WTC 2022 in Copenhagen, Sweden was chosen to host the WTC 2025 and the 51st General Assembly. This will take place on the 12th - 18th May in 2025.

### **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.

# Switzerland



**Name:** Swiss Tunneling Society (STS)

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

**Number of Members:** 541 members (thereof 120 young members), 88 corporate members

#### **ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE**

- **April:** STS General Assembly in Zug, Switzerland
- **June:** Swiss Tunnel Congress and Colloquium in Lucerne, Switzerland
- **October:** European Underground & Tunnel Forum (EUTF) annual meeting in Bologna, Italy

Additionally, the STS young members (STSym) hosted the following events:

- **April:** Excursion to the tunnel sites "Vispताल/Riedberg", Valais, Switzerland
- **June:** STSym event at the Swiss Tunnel Congress in Lucerne, Switzerland
- **August:** Geological excursion tunnel "Les Evouettes, Valais, Switzerland
- **September:** Excursion to the "Second Gotthard Tunnel Tube", Uri/Ticino, Switzerland
- **Nov/Dec:** STSym Drinks in Lausanne and Zurich, Switzerland
- **December:** Part of the young member digital celebration of World Tunnel Day

#### **CURRENT TUNNELLING ACTIVITIES Belchen rehabilitation tunnel**

The 3.3km-long Belchen rehabilitation tunnel opened to traffic on July 1st, 2022. Preliminary construction work began in 2014. In 2016, the largest TBM ever used in Switzerland at that time – weighing approximately 2,000 metric tons – began tunnelling through the largely heave-prone Jura rock. The breakthrough took place on June 21st, 2017. Before the rehabilitation tunnel could be commissioned, further construction works were required, which included building the roadway and the portal control centers as well as installing and testing operating and safety equipment such as lighting and ventilation.

The third Belchen tunnel will enable the two existing tunnels to be renovated without affecting the accessibility of the A2 highway, which is one of Switzerland's major trunk routes. In the central tunnel, which is inaccessible to traffic, the connector shafts leading to the rehabilitation tunnel are currently being completed, and preparations are

being made for the next phase of the rehabilitation.

#### **Second Gotthard Tunnel Tube**

The project for the second tube of the Gotthard Road Tunnel includes the construction of a new two-lane tunnel with a length of 17km which runs parallel to the existing Gotthard Road Tunnel, 67 new cross-passages to the existing service gallery, five new underground ventilation caverns linked to the existing ventilation shafts of the existing tube, two new technical buildings in the portal areas Göschenen and Airolo and several comprehensive preparatory works, such as two access adits of 5km length each, and two new sections of the service and emergency gallery.

In 2022 the project achieved several milestones:

- The civil works on the southern service gallery (lot 342) were successfully completed. The new gallery and the new ventilation building were handed over to the equipment's contractor, who will equip and lead the commissioning of the new service gallery.
- In the northern area, lot 243 completed the excavation of several logistic galleries and caverns. These excavations were performed by D&B and includes a cavern with an excavation section of 260m<sup>2</sup> and a length of 148m. This cavern will house the future concrete production plant for the main north lot.



- The two TBMs for the northern and the southern access adit were successfully launched in summer 2022. The excavation of the northern access adit, with a length of 4km, is being performed using an open Gripper TBM, with an excavation diameter of 7.03m. In the southern access adit a closed shield TBM, with an excavation diameter of 7.46m, is being used to excavate the 5km long access adit.
- The works on the three main lots were successfully awarded and launched. The main lot north (lot 241) was awarded for US\$520M (including VAT), the main lot south (lot 341) was awarded for US\$556M (including VAT) and the lot responsible for the material management and logistics of the whole project (lot 111) was awarded for US\$268M (including VAT).

### New Road Tunnel in Geneva

The Tunnel of Nations in Geneva is a part of the new axis from Le Gd-Saconnex (Geneva Airport) to the United Nations district. The entire new construction has a length of 1.2km, the tunnel itself is 500m long, a bidirectional single tube.

The construction works started in 2017 with opening to the traffic foreseen for December 2023.

The tunnel is entirely excavated underneath the city and through a very uneven geology and groundwater. The first action before excavation works could start consisted of lowering the groundwater using several pumping wells. Once the groundwater was lowered, two pilot galleries were excavated over the whole length. In each gallery a concrete foundation was built as a support before the excavation of the main section. The main section was planned as a heading and bench from both sides simultaneously. The heading section was excavated under a steel pipe umbrella with GFRP anchors in the front. The bench was excavated afterwards from one side. The inner lining is composed of a fully waterproofing injectable double layer and a concrete ring.

### Nant de Drance

The Nant de Drance pumped storage power station project, where work began in September 2008, was inaugurated on 9th September 2022 after 14 years of construction in the western Swiss Alps. During construction, hundreds of workers from all over Europe and even from Asia worked under difficult conditions to complete the project. Up



to 650 people worked and lived on site at the height of the project. The gigantic machine cavern, 194m long, 52m high and 32m wide, is located 600m underground. 1.5Mm<sup>3</sup> of rock were extracted from the mountain to drill the eight caverns and 16km of tunnels that now make up the hydroelectric scheme. No serious accidents were reported, which is remarkable for such a large-scale project. The six pump-turbines, each with a capacity of 150MW are state-of-the-art. They were installed on site, in the heart of the mountain, and tested for months to ensure their optimal operation. The plant started operation on 1st July 2022 and is characterized by the availability of its machines enabling it to react very quickly to fluctuations in the electricity grid.

### Celebration for the completion of the HL-LHC Civil Engineering works at Points 1 and 5

The Large Hadron Collider (LHC) is the most recent and powerful accelerator constructed on the CERN site. The LHC consists of a 27km circular tunnel, about 100m underground, with eight sites positioned around the tunnel circumference. The data collected by this unique instrument has allowed CERN experiments ATLAS and CMS to discover the Higgs boson in 2012. High-Luminosity

LHC (HL-LHC) is a new project aiming to upgrade the LHC, at Point 1 (ATLAS in Switzerland) & Point 5 (CMS in France), will maintain scientific progress and exploit its full capacity with new underground and surface structures. It will be operational in 2026.

The project required new technical infrastructures near each of the two main detectors (ATLAS at Point 1, CMS at Point 5): an additional shaft and cavern, approximately 500m of tunnels connected to the LHC tunnel, and additional technical buildings at the surface.

The HL-LHC design has been developed in Point 1 and Point 5. Two supply contracts have been dedicated to the construction of both the underground and surface structures at Point 1 and Point 5.

The construction works started in April 2018 and in January 2023 a ceremony was held to mark the completion of civil engineering works at Points 1 and 5.

### 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), Geneva Station Expansion (SBB, 1,500m), Heitersberg Tunnel II (SBB,



5,000m), Grimsel Tunnel (SBB, 21,720m)

### Road Tunnels

Morschacher/Sisikoner Tunnel (Kt. SZ/UR, 8,037m), Vingelz Tunnel (Kt. BE, 2,300m), City Tunnel (Kt. BE, 700m), Port Tunnel (Kt. BE, 1,800m), 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)

## EDUCATION ON TUNNELLING IN THE COUNTRY

ETH Zurich, Department of Civil, Environmental and Geomatic Engineering  
University of Applied Sciences, in various cities

## STATISTICS

### 1. Length of tunnels excavated during 2022

6,000m / 45% TBM

### 2. Amount (USD or EUR) of tunnelling / underground space facilities awarded in 2022

€600M.

### 3. List of tunnels completed

Rehabilitation Tunnel Belchen (ASTRA, 3,200m), LEB Tunnel Lausanne (LEB, 1,700m), Safety Gallery Leissigen Tunnel (ASTRA, 2,200m), Safety Gallery Crapteig Tunnel (ASTRA, 1,984m), Nant de Drance Pumped Storage Power Plant

### 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)

#### Road Tunnels:


Second Gotthard Tunnel Tube (ASTRA, 16,918m), Safety Gallery Cholfirst Tunnel (ASTRA, 1,250m), Safety Gallery Kerenzerberg Tunnel (ASTRA, 5,504m), Visp Tunnel 2nd Tube (Kt. VS, 2,600m), Gubrist Tunnel 3rd Tube (ASTRA, 3,230m), 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), Tunnel Melide-Grancia (ASTRA, 1,800m)

#### Other Projects:





Hydro Power Plant Ritom, CERN HILUMI LHC Project




# TPC



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Rafael Losada Velon, PM Civil Engineer at PACADAR




[www.optimas.com/tunnel](http://www.optimas.com/tunnel)
[tunnel@optimas.com](mailto:tunnel@optimas.com)

# Thailand



**Name:** Thailand Underground and Tunnelling Group (TUTG), The Engineering Institute of Thailand under H.M. The King's Patronage

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

**Number of Members:** 60 members

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

The Thailand Underground and Tunnelling Group (TUTG) organized the Tea-Talk Seminar on "Dusit Central Park Project – Impact of Underground Construction to the Existing MRT Tunnel" on 25th July 2022.

## CURRENT TUNNELLING ACTIVITIES

- Flood Drainage Tunnel – Klong Nong Bon to Chao Pha Ya River, Bangkok – 5.7m diameter EPB shield tunnel, 9.4km in length (Bangkok Metropolitan Administration – US\$144M)
- Bangkok MRT Orange Line - East Section – 20km long bored twin-tube EPB shield tunnels and Stations (Mass Rapid Transit Authority of Thailand – US\$2,310M)
- Mae Tang – Mae Ngud – Mae Kuang Water Diversion Tunnel, Chiangmai, Northern Thailand– 48km tunnel in length, three Double shield TBMs and drill and blast excavation, four contracts, (Royal Irrigation Department – US\$268M)
- Railway Track Doubling Project, North-Eastern Line – Mab Kabao – Thanon Chira Junction – three twin-tube tunnels, total length 7.9km (State Railways of Thailand (SRT) – US\$268M)
- Klong Prem Prachakorn Flood Drain Tunnel, Bangkok – Khlong Bang Bua to Chao Pha Ya River – 5.7m diameter EPB shield tunnel 13.5km in length (Bangkok Metropolitan Administration – US\$240M)
- Klong Taweewattana- Bottle Neck Flood Drain Tunnel, Bangkok, 3.7m diameter EPB shield tunnel, 2km in length (Bangkok Metropolitan Administration – US\$65M)
- Power Cable Tunnel Projects (Metropolitan Electricity Authority -Bangkok)
  - Work plan to change the electrical cable system to an underground power line "The City of ASEAN": 127.3km tunnel length - US\$1,420M
  - Conversion of overhead lines to an underground system, Rama III Project:

10.9km tunnel - US\$164M

- Chong Nonsri Project: 8.3km tunnel in length – US\$84.5M
- Ratchadapisek – Asoke Project: 8.2km tunnel length – US\$132.8M
- Ratchadapisek – Rama 9 Project: 14.3km tunnel length – US\$126.7M
- South Bangkok – Chao Phraya River Crossing Project: 3.6m diameter, 950m EPB Shield Tunnel - US\$10.6M
- Eastern Line - High-Speed Rail Linked 3 Airport Project – one tunnel of 0.3km length at Khao Chi Chan, Pattaya (The Eastern Economic Corridor Office of Thailand, EECO)
- North-eastern Line High Speed Rail Tunnel (Thai-China Cooperation) – 1st Section - Bangkok to Nakorn Ratsima, three single tube double-track D&B tunnels, with a combined length of 12.2km (State Railway of Thailand - US\$123M)
- The 9th Bangkok Water Supply Improvement Project – Water Transmission tunnel - 44km in length and 3m - 3.2m diameter EPB Shield Tunnels, (Metropolitan Waterworks Authority – US\$496M)
- Bangkok MRT Purple Line South – 25.4km long twin-tube EPB shield

tunnels and Stations (Mass Rapid Transit Authority of Thailand – US\$3,616M)

- Denchai-Chiang Rai-Chiang Khong Railway Project, new railway line in Northern Thailand – 323km in length, consists of four twin tube tunnels, - 1.18km, 6.24km, 2.7km, and 3.4km tunnel in length (State railways of Thailand(SRT) – US\$2,126M)

## FUTURE TUNNELLING ACTIVITIES

- Bangkok Orange Line - West Section – 20.4km tunnel (Mass Rapid Transit Authority of Thailand –US\$2,800M). To start in 2023
- Klong San Saeb Flood Drain Tunnel, Bangkok – from Khlong Lad Praow to Soi Lad Praow 130 – 3.7m diameter and 3.8km tunnel length (Bangkok Metropolitan Administration - US\$50M)
- Klong Samsen to Existing Bang Sue Flood Drain Tunnel, Bangkok - 3m diameter and 3.3km tunnel length (Bangkok Metropolitan Administration - US\$28M)
- Klong Bang Nam Jued Flood Drain Tunnel, Samut Sakorn, - West of Bangkok - 6m diameter EPB Shield Tunnel, 11.71km in length, with four shafts (Royal Irrigation Department - US\$154M)
- Klong Likit Flood Drain Tunnel, Nakorn Pathom&Samutsakorn - West of Bangkok - 4m diameter, EPB shield tunnel, 7.3km in length (Royal Irrigation Department - US\$71M - tunnel cost only)
- Power Cable Tunnel ((Bangkok) Metropolitan Electricity Authority)
  - Outgoing Cable Tunnel at Bang Phli Terminal Station – 2.6m diameter EPB Shield Tunnel, 1.2km in length
  - Outgoing Cable Tunnel at Bang Sue



Track Doubling North-Eastern Line - Mab Kabao - Thanon Chira Junction (SRT)

Terminal Station – 2.6m diameter EPB Shield Tunnel and 2.6km in length

- Outgoing Cable Tunnel at Lad Phraw Terminal Station – 2.6m diameter EPB Shield Tunnel, 1.6km in length
- Outgoing Cable Tunnel at Erawan Terminal Station – 3.6m diameter EPB Shield Tunnel, 5.5km in length
- Bhumipol Water Diversion Tunnel, From Western to Central Thailand, 62 km in length, 10m in diameter, TBM tunnelling + D&B adits (Royal Irrigation Department of Thailand - US\$2,682M -

PPP project)

- Tak-Mae Sod Railway line - single track twin tube D&B rail tunnels, 15.1km, 1.43km, 0.74km and 11.9km in length = 29.1km in total with two access adits (State Railways of Thailand - US\$880M)
- Phuket: Kratu-Patong Toll Road Tunnel - twin tube road tunnel, 1.2km in length (Expressway Authority of Thailand) PPP Project
- Phuket Airport-Patong Link: Khoh Kaew - Kratu Expressway - twin tube tunnel, 1.1km in length - (Expressway Authority

of Thailand). Under detailed design

- Krabi City By-pass roadway, three parallel tunnels of 1.3km in length. Detailed design completed under a Cooperation with Japan International Cooperation Agency (JICA)
- Tak-Mae Sod Motorway – three twin tunnels of 10.35km, 3.78km and 15.19km (Department of Highway)
- Railway Track Doubling Project, Denchai – Chiang Mai, eight double track single tunnels with a total length of 16km approx. (State Railways of Thailand).

# Türkiye



**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:** 538 members of which 471 are individuals and 67 are corporate members that represent Universities, Consultants, Contractors, Manufacturers, and other Governmental Organizations.

## ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE

A doctoral thesis, a master's thesis, and three papers/articles on Highway Engineering and Transportation were given awards in 2022, under the conditions specified in the "TRA AWARD REGULATION". In 2022, the "2nd Concrete Roads Congress and Exhibition" was organised by the Turkish General Directorate of Highways (KGM), Turkish Cement Manufacturers' Association (TÜRKÇİMENTO), and The Turkish Road Association (TRA), with technical support from EUPAVE (European Concrete Paving Association), under the auspices of the Ministry of Transport and Infrastructure of Turkey. In addition, the 32nd Ordinary General Assembly of TRA was held with the participation of the General Manager of Highways and President of TRA, Mr. Abdulkadir URALOĞLU.

## CURRENT TUNNELLING ACTIVITIES

As of 2022, there are 471 tunnels on intercity highways in Turkey with a total length of 665km. The longest tunnel on State Roads is the Ovit Tunnel, with a length of 14,000m. It 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 located along the Kuzey Marmara Motorway which has a total of eight (2x4) lanes. In

2022, construction works continued on 106 tunnels located on Turkey's intercity highways. These tunnels have a combined length of 471.81km. 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 33 tunnels with a combined length of 51,190m on the 440km long highway. Twenty out of the above-mentioned 33 tunnels have been completed, amounting to a total length of 15,935m. The remaining 12 tunnels with a combined length of 35,005m are under construction and the remaining one tunnel will be tendered.

There are 12 tunnels under construction on the Western Black Sea Coastal Road (İstanbul – Sinop Road). These tunnels have a combined length of 22,999m.

Four out of the nine tunnels (T1/B – T 3 – T 5 – T 6) located along a mountainous area of the 149km long Karaman-Mut-Silifke Highway have been completed however electromechanic works are still on work. These four tunnels have a combined length of 2,589m.

30 tunnels with a total length of 31,207m have been designed along the Konya-Hadim-Alanya route. Thirteen of the 30 tunnels with a combined length of 9,524m have been completed. Currently, there are ongoing works on three tunnels, namely, Karapınar (1 x 697m), Kaplanhanı 3 (1 x

665m) and Kaplanhanı 2 (1 x 363m).

Karst voids measuring 400m<sup>2</sup> were encountered during the excavation works of the 7,360m long double tube Alacabel Tunnel. This particular route connects the Central Anatolian region to the Mediterranean region. The route along which the Alacabel Tunnel is built lies on the Konya-Seydişehir-Manavgat axis, this tunnel passes through the route at an elevation of 1,525m, boasting an excavation completion rate of 95.46%. Additionally, 57.98% 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 and concrete works have been completed on the Demirkapı Tunnel.

There are 13 tunnels (36,509m) along the 238km long Rize-Erzurum route which connects the Eastern Black Sea Region to Eastern Anatolia. Nine of these 13 tunnels with a combined length of 21,849m have been completed, while the works on four of the tunnels is still ongoing work.

The 2 x 4,700m long double tube Çirili Tunnel is under construction on the Erzurum-Çat-Bingöl Highway. This tunnel is expected to be completed in 2023. To reduce the risks and costs associated with the threat of avalanches on the current route, a new road will be used to ensure traffic safety and reduce maintenance costs.

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 (1 x 2,053m) tunnel where concrete lining works are ongoing. Excavation support works have been completed for the T2 (1 x 1,579m) tunnel. There are ongoing excavation support works on the T3 (1 x 862m), T4 (1 x 693m)





Zigana Tunnel Exit

and T5 (1 x 294m) tunnels. The exit portal works have sustained on the T6 (1 x 471m) tunnel.

Nine tunnels with a combined length of 28,122m have been designed along the 173km long route that connects the Eastern Black Sea Region to Eastern Anatolia (Refahiye - Kuruçay - İliç - Kemaliye - Dutluca Road). There are ongoing works on seven of these tunnels, namely, (Sünebeli 2 x 5,220m), Yakaköy T 1 (1,650m), T 2 Kemaliye (3,170m), Toybelen (1,539m), Kozlupınar (3,324m), Vali Recep Yazıcıoğlu (4,315m) and Dutluca (2,735m). The remaining two tunnels (Arpayazı 2 x 4,615m, Gümüşakar 2 x 1,583m) will be tendered.

Construction works have been completed on 32 of the 36 tunnels located along the 278km 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, namely, Zigana, Vauk 1 & 2, and Kop with a combined length of 28.411 m 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 six double tube tunnels with a combined length of 9,492m on the

first section of the Ordu Ring Road. The length of both sections is 21.4km. The double tube tunnels named Boztepe (2 x 3,311m) and Öceli (2 x 2,019m) have been sustained. In regards to the other tunnels included in the scope of this Ordu Ring Road 2. Section, excavation works have been completed on the Terzili Tunnel (2 x 1,180m) with concrete lining works ongoing. Excavation works have started on tunnels Akçatepe -1 (2 x 440m) and Akçatepe -2 (2 x 1,740m) whereas the Turnasuyu Tunnel (2 x 802m) is still being designed.

The Halkalı - Ispartakule double tube tunnel (2 x 6,180m) is being constructed via a TBM as a part of the Halkalı - Kapıkule (İstanbul) Railroad Project.

Within the scope of the Gayrettepe-Kağıthane new airport subway line, TBM construction works have been completed at a section measuring 2 x 34,140m and it is planned to be put into service at the end of 2023.

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 via a TBM and it is planned to be put into service at the end of 2023.

The Istanbul Bakırköy - Bahçelievler - Kirazlı Subway Line will be 13,111m long. The journey will take 13.5 minutes from Bakırköy to Kirazlı. The line contains eight double-deck stations which have been

constructed by TBM.

There are TBM Tunnel construction works between the Bakırköy - Incirli stations. Excavation works have been completed on the 2 x 1,035m section using the NATM method. 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. Whereas the NATM method is being used on the 10,721m section of the right tube and the 10,698m section of the left tube.

Within the scope of 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 5,278m long, with a 7m inner diameter and two tubes. This tunnel will transport the 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 main canal through the Silvan and Babakaya

Tunnels - 35% of the Project has been completed and it is expected to be finished within the next two years.

## 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-Söğütözü Line (İstanbul) (31,000m)

### Highway

- Sahilyolu Tunnel (Trabzon) (1.865m – 1.865m)

- Trabzon Province Crossing Government Road T 2 (Trabzon) (159.50m – 279.90m)
- Trabzon Province Crossing Government Road Gölçayır T 2 (Trabzon) (762.41m – 726.80m)
- Sivas North Ring Road (Sivas) (1,245m – 1,245m)
- Turnasuyu Tunnel (Ordu) (802m – 802m)
- Borçka - Artvin Province Road T 2 - 3 Tunnel (Artvin) (1,080m)
- Zara – Beypınarı T 1 – 2 Tunnel (Sivas) (2,800m)

### Railway Tunnels

- Erzurum – Kars Railway Project (Erzurum – Kars) (41,080m)
- Erzincan – Erzurum Railway Project (Erzincan – Erzurum) (54,520m)
- Siirt – Kurtalan Railway Project (Siirt) (16,380m)
- Malatya – Elazığ Railway Project

- (Malatya – Elazığ) (28,450m)
- Elazığ – Diyarbakır Railway Project (Elazığ – Diyarbakır) (43,335m)
- Aksaray – Kayseri Railway Project (Aksaray – Kayseri) (11,000m)
- Afyon – Burdur Railway Project (Afyon – Burdur) (23,940m)
- Gaziantep – Şanlıurfa Railway Project (Gaziantep – Şanlıurfa) (2,090m)
- Adıyaman – Gölbaşı Railway Project (Adıyaman) (28,440m)
- Malatya – Narlı Railway Project (Malatya) (24,182m)

### Irrigation Tunnels

- Bilecik Osmaneli Göynük Dam Irrigation Tunnel (Bilecik) (872m)
- Eğirdir Tepeli Pond (Isparta) (406m)
- Köyünü Pond Derivation Tunnel (Afyonkarahisar) (1,349m)

## STATISTICS

### 1. Length or volume excavated - % mechanized/% conventional during 2022

Total Excavation			
Length (m)		Length (m)	
137,000m		11.654,923m	
Mechanized (%)	Conventional (%)	Mechanized (%)	Conventional (%)
0	100	0	100

### 2. Amount (USD or EUR) of tunnelling/underground space facilities awarded in 2022

€429.104.976,70

### 3. List of tunnels under construction

#### Subway Lines

- Halkalı New Airport (İstanbul) (28,132m – 27,611m)
- Gayrettepe – Kağıthane New Airport (İstanbul) (34,140m – 34,140m)
- Gayrettepe – Kağıthane New Airport (İstanbul) (3,507m – 3,507m)
- Sabiha Gökçen Railway System (İstanbul) (7,309m – 7,227m)
- Sabiha Gökçen Railway System (İstanbul) (810m – 380m)
- Bakırköy-Bahçelievler-Kirazlı (İstanbul) (6,523m – 6,588m)
- Bakırköy-Bahçelievler-Kirazlı (İstanbul) (1,034m – 1,029m)
- Başakşehir – Kayaşehir Subway Line (İstanbul) (1,600m – 1,645m)
- Başakşehir – Kayaşehir Subway Line (İstanbul) (3,134m – 3,053m)
- Başakşehir – Kayaşehir Subway Line (İstanbul) (486m)
- AKM – Kizilay Subway Line (Ankara) (2,928m + 3,203m)
- AKM – Kizilay Subway Line (Ankara) (39m + 419m)
- Gebze Darıca Beach Line (Kocaeli) (14,119m – 14,074m)

#### Highway Tunnels

- Kırık Tunnel Highway (Erzurum) (7,091m – 7,091m)
- Eğribel Tunnel Highway (Giresun) (5,905m – 5,905m)

- Salarha Tunnel Highway (Rize) (2,945m – 2,945m)
- Şile - Ağva Yolu Construction Work T 1 – T 2 (İstanbul) (750m – 766m)
- Şile - Ağva Yolu Construction Work T 1 – T 2 (Kocaeli) (2,338m – 2,338m)
- Karaman 5. Region Government Road Sertavul Tunnel (Karaman) (3,308m – 3,292m)
- Seydişehir-13 Government Road Alacabel Tunnel (Antalya – Konya) (7,355m – 7,361m)
- Mersin-Tarsus Highway Bağcılar Tunnel (Mersin) (328m – 364m)
- Erdemli-Silifke Taşucu Limankale Tunnel (Mersin) (851m – 851m)
- Erdemli - Silifke - Taşucu Tunnel T 1 – 8 (Mersin) (14,693m – 14,550m)
- Silifke - Mut T 1 – T 6 Tunnel (Mersin) (10,590m – 10,588m)
- Ordu Ring Road Terzili tunnel (Ordu) (1,180m – 1,180m)
- Ordu Ring Road Akçatepe Tunnel T 1 – 2 (Ordu) (2,180m – 2,180m)
- Çorum Laçın Province Road T 1 – 3 (Çorum) (4,182.50m – 4,016.80m)
- Hopa – Borçka Government Road T – 1 (Artvin) (597m – 538m)
- Değirmendere Tunnel (Trabzon) (1,961.50m – 1,977.40m)
- Trabzon Province Crossed Government Road Bahçecik Tunnel (Trabzon) (540.47m – 529.03m)
- Trabzon Province Crossed Government Road Boztepe Tunnel (Trabzon) (700.23m – 647.08m)
- Trabzon Province Government Road Çukurçayır Tunnel (336.06m – 341.59m)
- Trabzon Province Crossed Government Road Gölçayır 1 Tunnel (Trabzon) (451.25m – 422.15m)
- Trabzon – Aşkale Road Zigana Tunnel (Trabzon – Gümüşhane) (14,477m – 14,448m trabzın)
- Of – Çaykara Road T 4 – 6 Tunnel (Trabzon) (2,750m – 2,577m)
- Gümüşhane – Bayburt Kelkit Şiran Road Pekün Tunnel (Gümüşhane) (6,350m – 6,350m)



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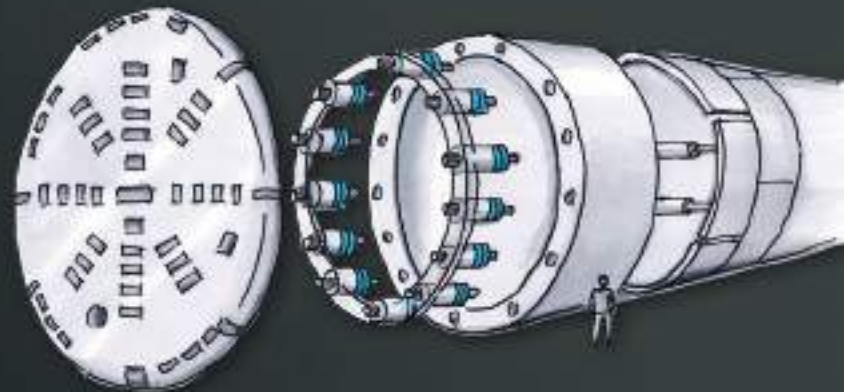
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## STATISTICS continued

- Gümüşhane – Bayburt Kelkit Şiran Road Yeniköy Tunnel (Gümüşhane) (620m – 560m)
- Gümüşhane – Bayburt Kelkit Şiran Road Pirahmet Tunnel (Gümüşhane) (400m – 480m)
- Trabzon – Aşkale (DAP) Vauk Tunnel T 1 – 2 (Bayburt) (7,489m – 7,470m)
- Yeniköprü – Yüksekova T 1 – 2 Tunnel (Hakkari) (8,529m – 8,531m)
- Tatvan Ring Road T 1 – 2 Tunnel (Bitlis) (2,582m – 2,431m)
- Van (Hakkari – Yüksekova) Güzeldere Tunnel (Van) (3,150m – 3,150m)
- Çukurca – Dağlıca Road T 1 – 2 Tunnel (Hakkari) (3,523m – 4,235m)
- KOP Mountain Tunnel Pass (Erzurum – Bayburt) (6,526m – 6,533m)
- Dallıkavak Tunnel (Erzurum) (3,105m – 3,105m)
- Çirışli Tunnel (Erzurum) (4,750m – 4,750m)
- Kırık Tunnel (Erzurum) (7,080.40m – 7,101.80m)
- Korkuteli – Çavdar – Fethiye Govrnment Road Karabel Tunnel (Muğla) (3,343m – 3,383m)
- Gazipaşa 5. Region Border Road Gökçebelen Tunnel (Antalya) (11,088m – 11,000m)
- (Antalya - Manavgat) – (Taşağıl – İbradı) Demirkapı Tunnel (Antalya) (5,000m – 5,000m)
- Alanya – Gazipaşa Road Oba Tunnel (Antalya) (668m – 668m)
- Bartın – Kurucuşile – Cide Road T 4 – 5 (Bartın) (7,677m – 7,717m)
- Kastamonu – Çankırı Road (Kastamonu) (5,333m – 5,321m)
- Kastamonu – İnebolu Road T 1 – 5 (Kastamonu) (18,107m – 18,008m)
- Çaycuma – Bartın – Hisarönü Zonguldak T 1 (Zonguldak) (2,660m – 2,660m)
- Çaycuma – Bartın – Hisarönü Zonguldak T 2 (Zonguldak) (360m – 360m)
- Çaycuma – Bartın – Hisarönü Zonguldak T 3 - 7 (Zonguldak) (9,569m – 9,520m)
- Zara -Geminbeli-Suşehri Government Road Geminbeli Tunnel (Sivas) (4,283m – 4,283m)
- Sivas – Kovalı Kangal Government Road Yağdonduran Taunnel (Sivas) (1,567m – 1,567m)
- Refahiye – Kuruçay – İliç Province Road Sünebeli Tunnel (Erzincan) (5,220m – 5,220m)
- Refahiye – Kuruçay – İliç Province Road Gümüşakar Tunnel (Erzincan) (1,580m – 1,580m)
- Çamlıbel Tunnel and Connected Roads (Tokat - Sivas) (4,705m – 4,705m)
- Silvan-Malabadi-Haydarköprü (Demirışık (Open / Close) (Siirt) (396m – 396m)
- Refahiye – Kuruçay -İliç Government Road Arpayazı Tunnel (Erzincan) (4,615m – 4,615m)
- İmranlı (Refahiye – Suşehri) Government Road Kızıldağ Tunnel (Erzincan – Sivas) (6,440m – 6,440m)
- Sakaltutan Tunnel (Erzincan) (8,780m – 8,780m)
- Ahmediye Tunnel (Erzincan) (6,315m – 6,315m)
- Zara – Geminbeli – Suşehri Government Road Bozkır Tunnel (Sivas) (2,545m – 2,545m)
- Şebinkarahisar Province Pass T 1 – (Giresun) (4,440m – 4,440m)
- Posof – Türkgözü Road Ilgar Tunnel (Ardahan) (4,810m – 4,972m)
- Çıldır Aktaş Road Aşık Şenlik Tunnel (Ardahan) (2,304m – 2,312m)
- Pirinkayalar Tunnel (Erzurum) (2,252m)
- Gelibolu-Eceabat Constructon Work T 4 – T 5 (Çanakkale) (3,061m)
- Adana-Kozan T 1 - 2 (Adana) (855m)
- Kiğı – Yedisu Road T 1 – 11 (Bingöl) (7,314m)
- Eruh - Fındık Road T1 Tunnel (Siirt) (4,119m)
- Şırnak - (Pervarî-Narlı) Road T1 Tunnel (Şırnak) (2,845m)
- Şırnak – Ortabağ Çıgılı Road 2 (Şırnak) (1,965m)
- Borçka – Artvin T-1 – T 4 (Artvin) (418m)
- Of – Çaykara Road T 3 Tunnel (Trabzon) (665m)
- Yağlıdere – (Şebinkarahisar – Alucra) T 1 – 4 (Giresun) (1,180.53m)
- Şemdinli – Alan Province Road Alan Tunnel (Hakkari) (550m)
- Dağlıca – Oramar Hill Aktütün Tunnel (Hakkari) (5,700m)
- Olur – Ardanuç Tunnel (Erzurum) (3,490m)
- (Alanya – Gazipaşa) – (Taşkent – Başyayla) Kaplanhanı Tunnel 2 – 3 (Antalya) (968.20m)
- (Alanya – Gazipaşa) – (Taşkent – Başyayla) Karapınar Tunnel (Antalya) (697.32m)
- Gemlik – Armutlu – Çınarcık – Yalova Road T 1 – 5 Tunnel (Yalova) (5,465m)
- Bursa – Keleş Orhanlı Province Road Doğancı Tunnel (Bursa) (1,998.80m)
- Kemaliye – Dutluca 8. Region Board Government Road T 1 Yakaköy Tunnel (Erzincan) (1,650m)
- Kemaliye – Dutluca 8. Region Board Government Road T 2 Kemaliye Tunnel (Erzincan) (3,170m)
- Kemaliye – Dutluca 8. Region Board Government Road T 3 Toybelen Tunnel (Erzincan) (1,510m)
- Kemaliye – Dutluca 8. Region Board Government Road T 4 Kozlupınar Tunnel (Erzincan) (3,324m)
- Kemaliye – Dutluca 8. Region Board Government Road T 6 Vali R. Yazıcıoğlu Tunnel (Erzincan) (4,315m)
- Kemaliye – Dutluca 8. Region Board Government Road T 7 Dutluca Tunnel (Erzincan) (2,735m)
- Keban – Arapgir – Divriği 8. Region Board Government Road Sarıççek T 1 – 2 (Sivas) (2,931m)
- (Akıncılar – Refahiye) Gölova 10. Region Board Province Road T 1 – 2 (Giresun – Sivas) (992m)
- Üçdam 8. Region Board Province Road T 1 (Tunceli) (3,841m)
- Sincan T 1 Tunnel (Sivas – Erzincan) (3,715m)
- Erzincan – Kemah – İliç Province Road T 1 – 3 Tunnel (Erzincan) (5,656m)
- Şebinkarahisar 10. Region Board Government Road Şaplıca Tunnel (Giresun) (1,613m)
- Erzincan Alpköy Province Road T 1 – 6 (Erzincan) (5,305m)

**Irrigation Tunnels**

- Silvan Project 1. – 2. Part (Diyarbakır) (15,488.10m – 15,488.10m)
- Eskişehir Irrigation Tunnel (Eskişehir) ( 885m)
- Afşar Bağbaşı Hadimi Tunnel (Konya) (18,136m)
- Bolu Seben Taşlıyayla Pond (Bolu) (1,155m)
- Kırıkkale Kesikköprü Köprüköy (Kırıkkale) (1,922.50m)
- Reyhanlı Dam T 1 – 2 (Hatay) (3,408m)
- Aşağı Çekerek Project Ponds Irrigation (Tokat) (1,563m)

## STATISTICS continued

- Samsun Salı Bazaar (Samsun) (289.35m)
- Samsun 19 Mayıs Dam (Samsun) (470m)
- Geldingen Pond (Amasya) (311.10m)
- Erzurum Pasinler Söylemez Dam (Erzurum) (5,625m)
- Erzurum Pasinler Söylemez Dam T 1 (Erzurum) (2,848.99m)
- Erzurum Elmalı Tunnel (Erzurum) (9,000m)
- Ağrı Pond Derivation Tunnel (Ağrı) (3,889.90m)
- Erzurum – Hınıs Başköy Dam (Erzurum) (3,315.69m)
- Malatya Yoncalı Irrigation Tunnel (Malatya) (9,038.60m)
- Silvan Tunnel (Diyarbakır) (18,400m)
- Çemik Kale Project (Diyarbakır) (9,505m)
- Kalaba – Seyfe Irrigation Tunnel T 1 – 2 (Kayseri) (4,010m)
- Hilvan Siverek Project (Şanlıurfa) (14,400m)
- Eğirdir Çayköy Dam (Isparta) (372m)
- Atabey Akçay Dam (Isparta) (341m)
- Sinanpaşa Kayadibi Pond (Afyonkarahisar) (116m)
- Merkez Karakent Pond (Burdur) (555m)
- Çavdır Büyükalan Pond (Burdur) (269m)
- Koçali Irrigation (Adıyaman) (5,200m)
- Adıyaman Büyükçay Irrigation Tunnel (Adıyaman) (9,269.35m)
- Gömükan Dam and Balyan Tunnel (Adıyaman) (2,422m)
- Göksu Araban Project T 1 – 2 (Adıyaman) (8,480m)
- Adıyaman Çelikhan (Adıyaman) (801.90m)
- Gaziantep Araban Yavuzeli Tunnel (Gaziantep) (2,336m)
- Gökbel Dam Derivation Tunnel (Aydın) (425.73m)
- Tavas Nostar Pond (Denizli) (1,510m)
- Menteşe Pond (Muğla) (359.59m)

**Potable Tunnels**

- New Yusufeli District Potable Water Transmission Line Supply (Artvin) (1,605m)

**Railway Tunnels**

- 3. Bridge – Airport Halkalı Railway Project (İstanbul) (10,850m – 10,850m)
- Burdur – Antalya Railway (Burdur – Antalya) (27,935m – 27,935m)
- Bahçe -Nurdağ Electrification Work (Osmaniye -Gaziantep) (9,954m – 9,954m)
- Nurdağ – Başpınar Railway T 1 – 6 (Gaziantep) (17,220m – 17,249m)
- 3. Bridge – Airport Halkalı Railway (İstanbul) (16,200m)
- Çorum – Merzifon Railway (Çorum – Amasya) (19,035m)
- Delice – Kırşehir Railway (Kırşehir) (9,229m)
- Çetinkaya – Malatya Railway (Sivas – Malatya) (43,040m)
- Burdur – Antalya Railway (Burdur – Antalya) (36,570m)
- Eskişehir – Afyon Railway (Eskişehir – Afyon) (15,560m)
- Merzifon – Samsun Railway (Amasya – Samsun) (50,611m)
- Between Toprakkale – Bahçe Stations Tunnel Construction Work (Osmaniye) (13,467m)
- Ankara – İzmir H.T.P. High Speed Railway Bayat 1 – 2 (Afyonkarahisar) (1,240m)
- Nusaybin – Cizre – Silpi – Habur Railway (Mardin -Şırnak) (9,500m)
- Ankara – İzmir H.T.P. High Speed Railway T 6 – 7 – 8 (Afyonkarahisar) (5,160m)
- Bursa – Gölbaşı North High Speed Railway T 11 – 12 (Bursa) (7,436.50m)
- Bursa – Gölbaşı North High Speed Railway T 12 - GT 1 - 3

- (Bursa) (2,473.52m)
- Ankara – İzmir H.T.P. High Speed Railway T 4 – 9 (Afyonkarahisar) (4,317m)
- Kayaş – Kırıkkale Security Tunnel T 15 - GT 1 – 3 (Kırıkkale) (2,969.43m)
- Kayaş – Kırıkkale Security Tunnel T 7 - 8 (Afyonkarahisar) (5,051.53m)
- Ankara – İzmir High Speed Railway T 4 (Uşak) (2,365.45m)
- Ankara – İzmir High Speed Railway T 6 (Manisa) (1,910m)
- Ankara – İzmir High Speed Railway T 8 – 23 (Manisa) (12,459.47m)
- Ankara – İstanbul High Speed Railway GT 1 - 4 (Bilecik) (2,931.84m)
- Ankara – İstanbul High Speed Railway T 26 (Bilecik) (5,589.43m)
- Ankara – İstanbul High Speed Railway T 14 – GT 1 - 2 (268.50m)
- Ankara – İstanbul High Speed Railway T 15 – GT 1 - 2 (1,199.05m)
- Ankara – İstanbul High Speed Railway T 19 – GT 1 (817.30m)
- Ankara – İstanbul High Speed Railway T 24 – GT 1 (1,262.32m)
- Ankara – İstanbul High Speed Railway T 34 – GT 2 – 3 (786.67m)
- Ankara – İstanbul High Speed Railway T 35 – GT 1 – 3 (728.67m)
- Ankara – İstanbul High Speed Railway T 36 – GT 1 – 2 (1,566.92m)
- Sapanca – Geyve High Speed Railway T 1 – 2 (Sakarya) (7,552m)
- Sapanca – Geyve High Speed Railway GT 1 – 6 (Sakarya) (3,439.76m)
- Girme Dam (Muğla) (304m)
- Yukarı Esen Project (Muğla) (408.16m)
- Fethiye Eşen Irrigation Canal (Muğla) (8,077.81m)
- Obrucak Irrigation (Kastamonu) (1472m)
- Manyas Pond (Balıkesir) (2,847.40m)

**Mining Tunnels**

- The Omerler Underground Coal Mine (Kütahya) (Single Tube – 115m)

## EDUCATION ON TUNNELLING IN THE COUNTRY

The Tunnelling courses in Türkiye are both graduate and undergraduate programs. These universities are: Adana Science and Technology University; Afyon Kocatepe University; Ataturk University; Baskent University; Bilecik Şeyh Edebali University; Bingöl University; Bulent Ecevit University; Çanakkale Onsekiz Mart University; Cankiri Karatekin University; Dicle University; Dokuz Eylul University; Duzce University; Eskişehir Technical University; Erzincan Binali Yıldırım University; Muğla Sıtkı Koçman University; Nigde Omer Halisdemir University; Nisantasi University; Pamukkale University; Recep Tayyip Erdogan University; Sivas Cumhuriyet University; Giresun University; İstanbul University – Cerrahpaşa; Karabuk University; at Dokuz Mayıs University; Middle East Technical University; Sivas Cumhuriyet University; Sınak University; Toros University; Zonguldak Bulent Ecevit University.



**ASSOCIATION ACTIVITIES DURING 2022 AND TO DATE****2022 George Fox Conference – New York City, NY**

**Theme:** “Tunneling: Responding to the Needs of a Modern Society”

**Attendance:** 403

The conference set a record attendance and reinforced that the industry was back to getting together in-person, post-Covid. The keynote speaker was the Administrator for the Federal Transportation Administration, and Ms. Nurya Fernandez’s presentation was very well received, signalling the large investments in underground infrastructure to come.

**2022 North American Tunneling Conference (NAT) – Philadelphia, PA**

The NAT is the premier biennial tunnelling event for North America, bringing together the brightest, most resourceful and innovative minds in the tunnelling and underground construction industry. The four-day conference focused on the information, advances and projects in North America, along with the victories and challenges of working in diverse environments

**Attendance:** 1,058

# United States



**Name:** Underground Construction Association (UCA of SME)

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

**Number of Members:** 1,737 (1,667 Individual / 60 Corporate & Sustaining)



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- Ground improvement



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The conference returned to in-person in 2022, with attendance levels about 95% of pre-Covid expectations. Everyone was glad to be able to get back together and benefit from congregating. A highlight was the presentation of the UCA Awards, recognizing excellence in individual and team achievement in the industry. The Awards were broadened in 2022 to better reflect the breadth of contributions made by and within the industry. The “Teach the Professors” program was revived in conjunction with NAT, and 12 university/college educators were informed and provided tools on why the industry is a great opportunity for their students.

### 2022 Cutting Edge Conference – Long Beach, CA

**Theme:** “Underground Innovation Benefiting Climate Change, Social Change and Sustainability”

**Attendance:** 300

Another record attendance number was set for this conference, as well. The single track session encourages attendees to look at cutting edge innovation being adopted and contemplated for the industry.

The UCA created the new Government and Public Affairs Committee (GPAC), designed to take a more focused and intensive view to fulfilling our strategic

objective of Stakeholder Awareness, and ensuring that decision makers are aware of the benefits of underground infrastructure investment.

The UCA's nominated candidate for ITA ExCO, Ms. Sanja Zlatanovic, was elected during the GA at WTC 2022.

## STATISTICS

### List of tunnels completed

Mill Creek Storage project  
Westside Purple Line 2  
Sister Grove  
Lower Pogues Run

## CURRENT TUNNELLING ACTIVITIES

Project	Location	Tunnel Use	Length (ft)	Width (ft)
LA Outfall	Los Angeles, CA	Sewer	36,960	18
Hampton Roads Bridge	Norfolk, VA	Road	15,000	46
Lower Olentangy	Columbus, OH	Sewer	17,000	12
Shoreline Storage	Cleveland, OH	CSO	16,100	21
St. Louis Clean - Lower Meramec	St. Louis, MO	CSO	35,904	8
Thimble Shoal	Chesapeake Bay, VA	Road	5,280	42
Narragansett Bay CSO - Pawtucket	Providence, RI	CSO	13,000	28
Tarrant IPL - Section 19	Dallas, TX	Utility	10,944	12
Howard Street	Baltimore, MD	Rehabilitation	4,700	25
Brushy Creek Phase II	Austin, TX	Water	8,780	12
Ellicott City North	Ellicott City, MD	CSO	5,800	15
Big Walnut	Columbus, OH	Sewer	12,350	10
Ontario Airport	Ontario, CA	Subway	22,000	24
Potomac River CSO	Washington, DC	CSO	24,000	18
Bay Park Conveyance	New York, NY	CSO	18,500	8
Sumner Rehabilitation	Boston, MA	Road	5,700	22
Enbridge Line 5	Traverse City, MI	Oil	23,760	12

## FUTURE TUNNELLING ACTIVITIES

- Gateway Tunnel Project, NE Corridor, NY/NJ
- US 64 Corridor K Tunnel, Polk County, TN
- Delta Conveyance, Sacramento, CA
- Sepulveda Pass, Los Angeles, CA
- West Seattle Project, Seattle, WA
- Silver Line Extension, Boston, MA
- Continental Rail Gateway (Detroit-Windsor Tunnel), Detroit, MI
- LA Westside Purple Line Extension - Phase 4, Los Angeles, CA
- Red Line Blue Line Connector, Boston, MA
- Ontario International Airport and Cucamonga Station Tunnel, San Bernardino, CA
- Horizon Lateral Project, Las Vegas, NV
- Connector Conveyance Tunnel, Ph IIIC, Providence, RI
- CSO Control Parallel Interceptor, Newark, NJ
- Gordon Butte Pumped Storage Hydro Project, Martinsdale, MT
- Lowell Creek Flood Diversion, Seward, AK
- Banks Lake Pumped Storage Project, Grand Coulee, WA
- Harlem River Drive Ramp, New York, NY
- Steel Bridge Replacement Tunnel, Portland, OR
- Vermont Transit Corridor, Los Angeles, CA

## EDUCATION ON TUNNELLING IN THE COUNTRY

Colorado School of Mines  
Purdue University  
University of Texas  
University of Illinois – Champaign/ Urbana

### 2021 UCA Webinars

- 3/23/2022 - Discreet Event Simulation Model for Predicting Tunnel Boring Machine Utilization
- 7/27/2022 - East Don Roadway Microtunnel in the City of Toronto
- 10/4/2022 - Modern Leak Remediation of Existing Structures
- 11/16/2022 - Long Baseline Neutrino Facility (LBNF): Design Overview and Validation through Field Observations and Instrumentation and Monitoring (I&M)

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