Italy

Name: Società Italiana Gallerie (Italian Tunnelling Society)

Type of Structure: Non-profit, open association

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

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

ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

Congress:

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

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

Technical Visits:

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

Courses and Seminars:

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

Others:

SIG is a Sponsor of the Level II Masters in Tunnelling and Underground Constructions, in Italy at the Politecnico di Torino and at the Politecnico di Milano, and of the Level II Masters in Geotechnical Design at the Sapienza University in Rome and at the Federico II University in Naples. These collaborations aim to bridge the gap between Universities and Industry, in order to support the growth of future industry leaders.

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

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

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

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

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

Volume 1: Concept – Basic Principles of Design

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

Volume 3: Case Histories and Best Practices

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

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

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

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

CURRENT TUNNELLING ACTIVITIES

Railway Projects

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

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

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

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

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

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

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

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

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

Metro Projects

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

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

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

FUTURE TUNNELLING ACTIVITIES

Railway Projects

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

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

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

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

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

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

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

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

STATISTICS

1. Length of tunnels excavated during 2021

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

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

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

3. List of tunnels completed in 2021:

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

EDUCATION ON TUNNELLING IN THE COUNTRY

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

Master Degree Level

All the major Italian Universities, among the others in:

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

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

Metro Projects

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

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

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

Hydraulic Projects

Peschiera acqueduct (Rome): A new 27km

long tunnel with an i.d of 3.6m is going to be built parallel to the existing aqueduct, in an area with significant challenges such as seismicity, landslides, sinkholes, interferences with regional groundwater, and an impervious morphology. The new tunnel will allow inspection and maintenance of the existing one, which is about 80 years old and has been in operation without interruptions. Also, the project will increase the resilience of water supply to Rome (3M people), as any damage to the existing aqueduct from an earthquake or a landslide could cause disruption to the service for at least 6 months.

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

SMAT sewer (Turin): A new 14.4km long sewer tunnel, with a 3.2m i.d, will be built parallel to the old one built 40 years ago, from south of the city to the Castiglione Torinese treatment plant. The new tunnel will collect rain and wastewater, increasing the capacity of the existing network and the resilience against climate change to prevent flooding events. Given the urban environment (including underpassing Lingotto railway station), a TBM with 4.1m excavation diameter will be employed, with 20m deep and 25m wide shafts built along the alignment. An automatic rail system will be used to move the segments within a 9km long tunnel to minimise the interferences with traffic on the surface.