

Spain



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

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

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

ASSOCIATION ACTIVITIES DURING 2021 AND TO DATE

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

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

A new special issue of the Journal of Public Works (ROP) on Tunnels and Underground Works was presented, in a continuation of the collaboration that the Spanish Association of Tunnels and Underground Works (AETOS) and the Journal of Public Works (ROP), has been developing since 2009 to disseminate experiences related to performances in tunnels and underground works.

September 22nd - General Assembly of AETOS, including:

- Medal of honour awarded to the past president, Mr. Manuel Arnáiz Ronda.
- Conference given titled "Singularities of Underground Works in Colombia, Case of Study: El túnel de la Línea, 8.6km" by Mr. German Pardo Albarracín, President of the Colombian Society of Engineers

Participation in the 2nd World Conference on Sustainable Transport, promoted by the United Nations, Beijing (China) from 13th to 16th October 2021. As part of this conference, the International Tunnels and Underground Spaces Association (ITA-AITES) organised a session on the 13th October to present the benefits of efficient networks as a transport solution for large cities. In this session, AETOS, was invited to participate and present the achievements of the Calle-30 underground and urban development on "Madrid Río", inaugurated in 2011, as a success story, both in the use of underground space for transport and the recovery of the surface for other uses.

The 2021 annual meeting of the European Tunnelling and Underground Forum (EUTF) took place in Madrid. November 4th to 5th, 2021.

The EUTF meeting in Madrid was

enthusiastically attended by representatives of the "Young European Tunnel Specialists" led by Daniel Jaén (Spain) and Jasmine Amberg (Switzerland).

As a culmination of the meeting in addition to the technical visits to the recently renovated Metro de Madrid stations, and to the refurb works of Plaza de España and the Bailén - Ferraz Tunnel a technical conference was held on 5th November in the Agustín de Betancourt Room of the CICCOP on the theme:

'Tunnelling integrating Heritage: refurbishment and new projects', which included the presentation of several relevant works that have been or are being executed in Spain in the field of underground works.'

CURRENT TUNNELLING ACTIVITIES

Throughout 2021, the design, construction, maintenance, and modernization of tunnels in Spain will continue:

Railway Tunnels

Completion and commissioning, at the end of 2021, of the high-speed access lines to the Northwest of Spain (Galicia).

The section inaugurated in December 2021 is called Pedralba de la Pradería - Ourense (more than 119km), has some 30 tunnels and another 30 viaducts which account for this most complex section on the Madrid - Galicia Line.

Some of these high-speed rail tunnels and among the longest in Europe:

- Zamora - Ourense Line - 40 tunnels (131km)
- Zamora - Pedralba de la Pradería Line: Nine tunnel (131km)
- Pedralba de la Pradería - Ourense Line: 31 tunnels

Burying the railway in Murcia

This undergrounding of two contiguous projects has a length of more than 5km in cut and cover tunnel, 10.20m wide, that houses a double high-speed track (one mixed gauge track and one standard gauge track), which in its final kilometre widens into the future Murcia del Carmen underground station, with an excavated section of up to 60m wide with four standard gauge tracks and three mixed gauge tracks.

The project includes the construction of almost 200,000m² of diaphragm walls, the pouring of more than 380,000m³ of HA-30 and the placement of more than 52,000 tons of B500SD steel. There is also the

EUTF-Meeting





work carried out by the Canary Islands Government, including the longest tunnel in the Archipelago, namely the “Túnel de Erjos”, at 5.1km long, which will link the north and the south of Tenerife Island

The project is a twin-tube tunnel with 35m between tubes. The tunnel length includes approx. 120m of artificial tunnels each side.

A total of 19 cross passages will connect the tubes, one every 250m, alternating between pedestrian tunnels and vehicles and pedestrian tunnels. The connecting galleries for vehicles and pedestrians have a gauge of 5m x 5m, while the exclusively pedestrian ones will have a width of 1.8m and a height of 2.2m.

The tunnel will be bored using the NATM, mainly through volcanic geology made up of basalt lavas and massive phonolite formations with some tephra and/or volcanic scoria insertions. A few stretches of tuff will be also excavated.

Tunnel construction is set to begin in October and continue until mid-2022.

Tunnels on the El Risco-Agaete highway, Gran Canaria - Section length: 8km

Eight tunnels, mostly executed at full section and divided into sections of three lanes and two lanes.

Urban Tunnels

Plaza de España refurbishment: Tunnel under archaeological remains (Madrid)

The refurbishment of the Plaza de España, in Madrid’s Royal Palace, includes a new cut and cover tunnel linking Bailén and Ferraz streets. The archaeological survey identified the remains of the basements of a historical palace. The tunnel design and construction method was modified so the tunnel could be bored under the ruins’ length.

This 50m long sector has a cover of 1.5m under the basement’s load bearing wall foundations. The ground profile consists of Miocene hard cohesive soils, above the local water level. To tackle the challenge of excavating a tunnel in soil, with a shallow cover under historical remains, a robust excavation and support method was required to minimize ground lost. The tunnel portals were supported by piled wall sections perpendicular to the main cut and cover ones. Two 30m long minipile umbrellas were drilled from both portals. Traditional hand mining excavation was used, developed from the early 20th Century Madrid underground tunnels and still used in specific cases. The general horizontal sequence consists of top heading, bench, and invert. The top heading is hand excavated with successive timber supported

construction of a new station, located on the covering slab of the false tunnel with an area of about 4,400m², which will replace the current historic building, which will be kept on the same site and used for other purposes.

The project also includes the construction of emergency exits in the underground section every 1,000m.

Metro Tunnels

In 2021, the Andalusian Regional Government’s Public Works Agency carried out the following underground works/actions as developer:

Málaga Metro Lines 1 and 2.

Renfe - Guadalmedina Section:

The section is 713m long and runs entirely underground at three levels, with a single station called Guadalmedina where the two metro lines intersect.

The top-down, cut-and-cover method was used to complete the excavation and place all of the concrete slabs (intermediate, floor and counter-vaults) and other structural elements accessed via purpose-built ramps.

The tunnel has three levels. The first level houses the future main concourse of Guadalmedina Station, whilst levels 2 and 3 accommodate the track superstructure of Lines 1 and 2, two tracks per level.

Guadalmedina – Hospital civil Section:

The first phase foresees a station at the hospital that includes the Civil Hospital and the Maternity and Children Hospital. This section is 1,920m long and runs entirely underground on two levels. It includes three stations: Hilera, La Trinidad and Hospital Civil.

The method envisaged for excavation and placement of all concrete slabs (intermediate, floor and counter-vaults) is top-down cut-and-cover.

The cross-section of the tunnel at the bench is 8.3m, increasing to between 15m - 19m at the station, depending on the station. The average depth of the walls is around 26m.

Road Tunnels

In compliance with the European Directive on minimum safety requirements, for the adaptation of road tunnels of the RGE to R.D. 635/2006: 65 tunnels have been put out to tender, with a cumulative length of over 32km.

Erjos tunnel, on the motorway ring road project - Section el Tanque - Santiago del Teide, Tenerife

Currently, the completion of western section of the island’s motorway Ring Road between El Tanque and Santiago del Teide is being executed. It is the largest

man size galleries. When a 1m to 1.5m step of the vault is completed, a variable thickness (70cm at the crown to 140cm at the foot) mass concrete lining is pumped into place. In this way, the lining is always behind the tunnel face. Once the vault is finished, the bench is excavated in 2m to 3m steps and a vertical 90cm lining concreted. Finally, a 50cm invert is excavated and concreted

Detailed tunnel convergences and ruins settlement monitoring was carried out during the tunnelling. Settlements were in the order of 2mm to 4mm. The objective of not disturbing the ruins was fulfilled.

FUTURE ASSOCIATION ACTIVITIES

- Junta de Andalucía- AETOS, 17th March 2022, Sevilla: Seminar Andalusian Metros: A sustainable solution for city transport.
- April 6th and 7th, 2022, the Technical Conference “AVE Tunnels of the northwest corridor Madrid-Galicia” will take place at the Barrié Foundation, A Coruña, organized by ADIF and AETOS.
- AETOS 5th session: Geotechnics of tunnels, XI National Symposium of Geotechnical Engineering 24th, 25th, 26th and 27th May 2022 – Mieres – Asturias.
- 2022 AETOS Seminar on the Bilbao Tunnels of the Basque Railway Network, Donosti Metro, Vergara Triangle (November/pending on scheduling).
- Sep 2022 General Assembly & Annual Conference AETOS.
- 2nd International Conference on Road Tunnel Operations and Safety & VIII Spanish Symposium PIARC 25th - 28th October 2022 (Granada).

Technical meetings and WG activities are on-going

STATISTICS

1. List of tunnels completed:

High Speed Railway tunnels:

Status	Number of tunnels	Cumulative length (km)
Panning	29	45.8
In the beginning phase of construction	10	28.1
In construction	27	96.4
On service	274	511.6
Total	340	681.9

EDUCATION ON TUNNELLING IN THE COUNTRY

Tunnelling Master and Degree courses in several Universities:

UPM Polytechnic University in Madrid, UPC Cataluña, UPV Valencia, Univ. Cantabria, Univ. La Coruña, Univ. Castilla la Mancha, Univ. Granada and Univ. Sevilla. All courses with a Discipline of Civil Eng ECTS (European Credit System, according to the European Higher Education Area).

XVII Edition “Master in Tunnels and Underground Works”. The Master’s degree is currently a Post-Graduate Master Course from the National University of Distance Education (UNED), with an equivalence of 60 ECTS and is training recognized by the ITACET (International Tunnelling Association).

The teaching cycle, which includes 1500 teaching (contact) hours and a Master’s thesis (plus individual study, design practices, etc.), has allowed us to train numerous specialists in the fields of Design, Construction and Maintenance of Tunnels and Underground Works over 16 years, and many of our students have successfully carried out tunnelling works in the Public and Private sectors.

To offer the highest quality of teaching, since 2014, AETOS has collaborated with the Spanish National Distance University (UNED) and with the Spanish Professional Association of Civil Engineers (Colegio de Ingenieros de Caminos), to (i) reach a wider audience, (ii) to maintain and update the contents, and (iii) to incorporate new technological advances and experiences into our Educational Program. This has allowed us to develop a state-of-the-art online teaching Program and enrol more than 350 students from 18 different nationalities.



Malaga