

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 321; (234 individual members, 59 corporate members, and 28 young members)

ASSOCIATION ACTIVITIES DURING 2020 AND TO DATE

Due to the COVID-19 pandemic, many of the activities initially planned have been postponed and others have been held by teleconference. Among others, the following are worth mentioning:

- New Board Appointment AETOS, Current President: Juan Pablo Villanueva Beltramini, from 25th Nov 2020
- AETOS General Assembly, 25th Nov 2020 Jornada Técnica y Acto Homenaje: “Túnel de Valls -Montblanc” and a tribute to Miguel Fernández-Bollo”, Past-Vice President
- International Seminar CTES-MOP Estándares en túneles viales - Santiago



de Chile, Chile, 1st -28th Oct 2020.

Participation with presentations and stands at a virtual exhibition

- 9º congreso Lationamericano de túneles - Tunnel Mining. Participation with the paper: “Criterios de diseño de túneles en España”, 1st - 4th Dec 2020, Lima. Perú

- XV Seminario Andino de Túneles y Obras Subterráneas. Participation with the paper: “Estándares internacionales en túneles viales y aplicación en proyectos”, Bogotá, Colombia, 26th - 28th Nov 2020
- 4th Expert Network meeting on the design of underground structures, 12th – 13th Nov. 2020
- Meeting of AETOS and CPT with the Grupo Lationamericano de túneles, 26th Jan 2021
- Regular meetings in the European Underground and Tunnel Forum EUFT
- Regular Technical Meetings of FAT (AETOS Technical Forum) with national working Groups
- Organization of the XVI Master Universitario en Túneles y Obras Subterráneas AETOS (Endorsed by ITA-AITES)
- Collaboration with DAUB in translating German-BIM in Tunnelling to Spanish (Feb 2020 draft version)
- 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



Martorell tunnel

the Journal of Public Works (ROP) has been developing since 2009, to publish monographs disseminating the experiences related to tunnels and underground works.

CURRENT TUNNELLING ACTIVITIES

High speed network tunnels

The tunnel network on the high-speed railway lines currently includes a total of 1,229 tunnels, with a total length of 497km. In 2020 and 2021, work will continue on the following tunnels:

Mediterranean corridor:

Castellbilbal-Martorell:

- Castellbilbal 872m
- Costablanca: 810m
- Martorell: 1,025m

Murcia-Almería

- Chinchilla
- Alcantarilla
- Viator

Sant Feliu Burying 1,565m

Emergency exits for the Sant-Sagrera

Barcelona

Extremadura corridor:

Malpartida de Plasencia tunnel: 1,500m

Galicia corridor:

Rante tunnel: 3,410m

Montealegre tunnel: 3,495m

León-Asturias corridor:

Pajares tunnel (Emergency exits):

88+204+295m

León burying: 1,790m

The Pajares New Line is part of the León-Asturias Line, on the High-Speed North-Northwest Corridor. It is located between La Robla (León) and Pola de Lena (Asturias), on the central hub of this line between the

León - La Robla and Pola de Lena - Oviedo sections. It is 49.7km long and, in addition to the construction of the two main Pajares tunnels between Pola de Gordón (León) and Telleo (Asturias), it includes the outer stretches towards La Robla and Pola de Lena.

The Pajares Tunnels, approximately 25km in length, will be the sixth longest in Europe and the seventh in the world. Another important tunnel on-going is the Pontones, at 6km long.

The final construction of these tunnels (expected in 2025) will allow the Puerto de Pajares mountainous massif to be crossed, while ensuring a high-speed connection between Madrid, Castile-León and Asturias.

“Y” Vasca and Navarra

- Udalaiz West tunnel: 7023m
- Udalaiz East tunnel: 6910m
- Kortazar tunnel: 3684m
- Karraskain tunnels, twin single track 543m Western/448m Eastern.

The tunnels initially run through a zone of alternations of limestones, marlstones, carbonate siltstones and limestone breccias and a second zone of dark siltstones. The main characteristic of the limestone section is the karstification which is the main geological risk for the excavation of the tunnels.

Minimizing the impact on the aquifer and the control of possible water inflows into the tunnels will be two of the determining factors during their execution.

The method of excavation is the NATM (New Austrian Method) by drilling and blasting as a full section in the limestone and dividing the section into top heading and bench in the siltstones. Excavation will be carried out occasionally using mechanical methods.

The types of design supports are based on shotcrete, bolts and steel ribs. A 0.60cm thick invert of HA-30 concrete will be built along the entire length of the tunnels.

To avoid affecting “the Udalaiz karst system”, a waterproofing and secondary lining system has been designed.

Hydraulic Tunnels

Mularroya tunnel

The tunnel will transfer water from the Jalon River to the new Mularroya reservoir. The underground tunnel of 12.6km has an i.d. of 2.9m and an o.d. of 3.35m, and will cross the municipalities of Calatayud, Paracuellos de la Ribera, El Frasno and Morata de Jalón, with a capacity to transfer 8 cubic metres of water per second.

Road Tunnels

N-260 Roadway. Section Cogosto-Campo (Huesca)

Tunnel 1,265m

Tunnel 2,540m - it includes the construction of an emergency gallery parallel to the tunnel with a length of 263m.

The tunnels have a free section of 68m². Both tunnels will be excavated in calcareous lithologies of limestones, breccias and shales. The method of excavation is NATM (New Austrian Method) by drilling and blasting the full section. The primary support consists of shotcrete, bolts and steel ribs. In addition, the tunnels will be waterproofed with a PVC sheet membrane protected by a geotextile and a final lining of 30cm of cast-in-place concrete.

Las Glorias Square lot 3 - (Barcelona)

This complex works consist of constructing a tunnel between two shafts, previously built, built under an existing railway tunnel. The reinforcement of the upper railway tunnel was carried out before the excavation of the tunnel. The construction procedure consisted of driving pipes both on top and laterally to create a protective enclosure for the tunnel. The top pipes are 24-30m long and 1100mm diameter, and the side pipes are 508mm diameter. All steel pipes were backfilled and connected by a tie beam.

M30 - Urban Roadway (Madrid)

Operations have been carried out throughout the year to maintain the M-30 tunnel's conditions for the thousands of users who travel through them every day. These include everything from cleaning and repainting to sealing, injections and treatment of metal structures, among others. One of the most extraordinary

operations is cleaning the vitrified steel panels that cover the walls. These get rid of the so-called “black hole” effect, act as a visual guide for users and increase the luminosity inside the tunnel.

This year, the corresponding Tunnel Condition Inspections have also been carried out, covering 6,500m of roadways and 50 enclosures, including emergency exits, technical rooms and ventilation shafts. The condition of the 21,500 support systems that bear the weight of the by-pass roadway slab and surfacing was also checked.

Furthermore, Special Spot Inspections, accompanied by auscultation campaigns, have been carried out, using unique methods, such as geophysical ground reconnaissance using the Continuous Surface Wave Recorder (CSW) method, to verify the ground stiffness.

Seberetxe tunnel

South Metropolitan Bypass in Bilbao, Stretch: 9B and 9B-2. Tunnel alignment 1 has a length of 520.6m (excavated) and 67.1m of artificial tunnel. Tunnel alignment 2 has a length of 528.5m (excavated) and 68.3m (artificial tunnel).

Plaza de España Tunnel (Madrid)

The Plaza de España Tunnel (1km) is being built adjacent to the Royal Palace of Madrid, one of the largest palaces in the world, which dates back to the 18th century. The tunnel will allow traffic (two lanes in each direction) to run underground, leaving the entire surface for pedestrians and landscaped areas. One of the main characteristics of this tunnel is that its construction has been adapted to the numerous archaeological remains of XVIII Century buildings and “palace exterior works” found in the area. The longitudinal profile of the tunnel, and the construction method have been modified to suit the position of the archaeological remains in different parts of the route. In areas where the remains were found in the middle of the tunnel cross section, they have been dismantled and reconstructed on the surface, in landscaped areas adjacent to the tunnel.

Subway Tunnels

Metro de Málaga: Lines 1 and 2

Section: Guadalmedina- Atarazanas

Length: 300m

Section: RENFE – Guadalmedina. Length:

713m.

Works of the Málaga Metro are ongoing in the Renfe-Guadalmedina section, which runs 100% underground between el



Málaga Metro Lines 1-2



Metro Madrid refurbishment

Perchel-María Zambrano Station. Lines 1 and 2 of the Malaga Metro to El Perchel-María Zambrano, in commercial service since July 2014, consist of 12km and 17 stops and stations. Currently, the Ministry of Development, Infrastructure and Land Management is advancing the execution of the works of the Renfe-Guadalmedina and Guadalmedina-Atarazanas sections, which cross the center of the capital and which include the two additional stations of Guadalmedina and Atarazanas, in the Paseo de la Alameda of Malaga.

Tribunal station-Madrid subway

Refurbishment of shafts and galleries for the modernization of the Tribunal Subway station

- Main Shaft 36m depth
- 150m of connecting galleries.

The geology of this area is made up of a succession of sand, silty sand, sandy silt and clayey silt.

Bilbao Station, Madrid Subway

Work includes 50m of galleries and 32m of Shafts. The objective is the installation of seven elevators to improve the station accessibility. The station is very shallow,

being a century-old station, and the works were carried out when the station was open to public transport.

The works were carried out from the level 3 distributor corridor and consist of a 55m gallery using the traditional Madrid method, 400m³ of earth excavation, and a modernization of the station, which has allowed for waterproofing such a shallow station.

Other works carried out included the restoration of two murals, as well as a new layout of the main concourse level, which has facilitated passenger traffic.

FUTURE TUNNELLING ACTIVITIES

Sub-river twin tunnels for the Multimodal riverbank connection in the Bilbao estuary

The study phase for the project (“the Lamiako tunnel”), currently underway, began at the end of 2020. It encompasses the design of a road connection between riverbanks to solve the lack of capacity, congestion and vulnerability challenges on the road network of the Bilbao metropolitan area. The feasibility analysis of the addition of a railway connection, and its design, if viable, are also comprised in the project study, with the aim of providing a multimodal solution. The road connection consists of two 3.2km long twin tunnels under Bilbao estuary with two 3.5m wide lanes, plus shoulders in each tube. Connection galleries are planned with a spacing of 225m. The tunnels will be bored mainly through limestone, marl, siltstone and igneous rocks, crossing a complex stretch lying under saturated soils. The addition of the railway connection, if viable, will condition the design. Apart from the tunnelling works, challenging road junctions at both ends are included in the Project, resulting in a total length

of 4km between ends. The study phase is scheduled to finish in 2023. Presently geological investigations, construction method choice, traffic analysis, and layout design tasks, among others are being undertaken. Currently there is only one road connection between the riverbanks in the metropolitan area along the 10km of the estuary.

Detailed design of refurbishment works for several highway tunnels on the road network are ongoing to national tunnel regulation RD 635/2006.

- La Canda and Padornelo tunnels (N-525) (Zamora)
- El Carmen, LLovio, Tezangos, El Fabar, Arena De Morís y Duesos. (Asturias)
- Somosierra. A-1 (Madrid)
- Jarrio and Rellón A-8 (Asturias)
- San Juan (Alicante)
- San Simón (Huesca)
- Lladó, Colladetes, Fogá and Juan Carlos I (Vietha). N-230 (Lleida)

Erjos Tunnel:

The project consists of the construction of the road section to close the Tenerife Island Ring Road (Canary Islands). The total length is 5,100m of twin-tube tunnel with two lanes of traffic running under the Teno Massif.



- 2021 AETOS Seminar Metro in Sevilla (“Solución sostenible para el transporte en la ciudad” (pending on schedule due to COVID conditions)
- 2021 AETOS Seminar in Bilbao “Lamiako tunnel” 3km highway tunnel under the Nervión River (pending on scheduling due to COVID conditions)
- Jun 2021 Annual Conference AETOS
- European & Underground tunnel forum (EUFT) Board Meeting and Technical seminar, Madrid 4th-5th Nov 2021
- 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

EDUCATION ON TUNNELLING IN THE COUNTRY

Tunnelling Master and Degree course 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 with a Discipline of Civil Eng ECTS (European Credit System, according to the European Higher Education Area).

XVI Edition “Master in Tunnels and Underground Works”. The Master’s degree is currently a degree from the National University of Distance Education (UNED), with an equivalence of 60 ECTS and is training recognized by the ITACET (International Tunnelling Association). This Master Course has an important international projection through collaboration with the ITA Member Associations, especially those with a development in Spanish-speaking countries, such as: ACTOS, AMITOS, APTOS, etc. with which AETOS maintains collaboration agreements. In the last edition of this Master, 10 of 22 students graduated.