

Kennedy Tunnel | Santiago Centro Oriente 2 Program | Chile | COSTANERA NORTE



Subterra



Alto Maipo Hydroelectric Project | Chile | HOCHTIEF-CMC

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Las Cruces Mine | Spain | COBRE LAS CRUCES



Americo Vespucio Oriente. AVO 1 | Chile | CVO



Americo Vespucio Oriente. AVO 2 | Chile | COSTANERA NORTE

1. Introduction

SUBTERRA is an independent private corporate group, unconnected to construction companies, suppliers of equipment or services and financial companies. Their projects are based exclusively on the rigorous analysis of each case, in order to develop technical solutions optimizing the construction costs with the maximum safe and environmental conditions, as well as compromise with the community

SUBTERRA is certified in ISO 9001:2015, ISO 14001:2015, ISO 45001:2018, ISO 37001:2016 y UNE 166002:2014.

Since its creation **SUBTERRA** has offer services both in the design stage and during construction. As design engineering, its services include field data collection and interpretation, sophisticated support and lining calculations, functional design and security installations; and applied to all phases of feasibility, basic engineering, and detailed engineering value. In the construction phase, its services extend to the geotechnical monitoring and monitoring of slopes, tunnels and underground spaces.

SUBTERRA group actually is constituted by the following companies:

- **SUBTERRA Ingeniería Ltda in Chile,**
- **SUBTERRA Ingeniería SAS in Colombia,**
- **SUBTERRA Ingeniería SL in Spain,**
- **SUBTERRA Engineering Pvt. Ltd India, and**
- **SUBTERRA Ingeniería SAC in Peru;**

that functionally act as a unique company organizing its staff and facilities to offer the best services accordingly to the specific characteristics of each project.

SUBTERRA has permanent offices in Delhi, Lima, Madrid, Medellin and Santiago, as well as several site offices; developing also projects during 2020 in fifteen countries. All of them are fully equipped with specific software tools such as FLAC 2D y 3D, UDEC, PFC, EXAMINE 2D y 3D, FAGUS, STEPS, SOLVENT, SAP2000, among others.

SUBTERRA employs, with nine countries's technicians, is constituted for a multidisciplinary staff , from which 81 % has University degree, with more than 30 years of expericiencie.

SUBTERRA has consolidated worldwide as one of the leading engineering companies specialized in the fi eld of underground works.

2. Mission, vision, values

Mission

To provide geotechnical, tunnelling and underground space engineering services based on a rigorous analysis of each case, in order to develop technical solutions optimizing the construction costs with the maximum safe and environmental conditions, as well as compromise with the community.

Vision

To be a benchmark in the Iberoamerican and India geotechnical, tunnelling and underground space engineering.

Values

- Excellence
- Innovation
- Social Commitment
- Motivation
- Integrity



Interoceanic South. Ollachea Tunnel | Peru | INTERSUR

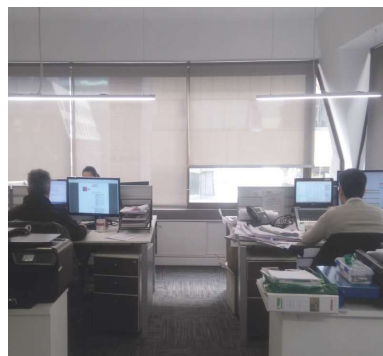
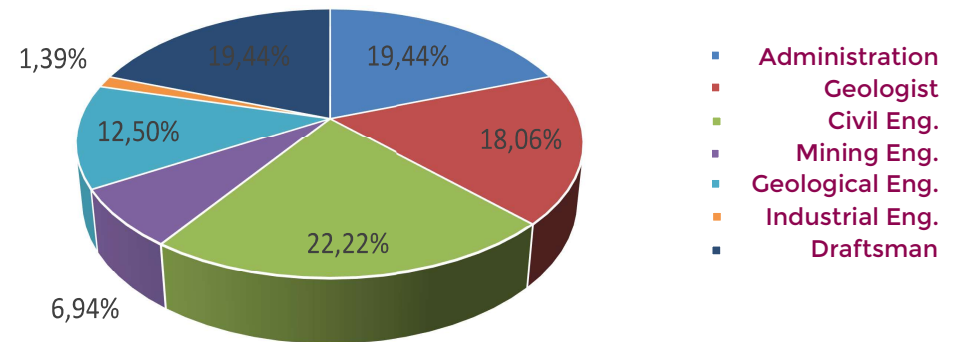
3. Staff



SUBTERRA has an agile structure that allow us to offer our clients a top quality services. Our multidisciplinary staff is composed by qualified people of nine countries (Argentina, Bolivia, Chile, Colombia, Guatemala, Spain, India, Peru and Venezuela).

Continuous learning is a major issue for **SUBTERRA**, which is why different external and internal training programs have been implemented. We also provide our staff with innovative state of the art technical tools, so that they can achieve a complete professional engagement with our clients.

In **SUBTERRA** we fully support the principle of gender equality thus 40% of our staff is composed by high qualified women.



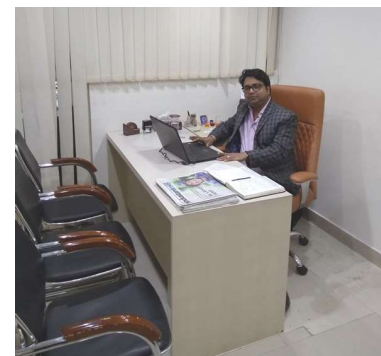
Santiago | Chile



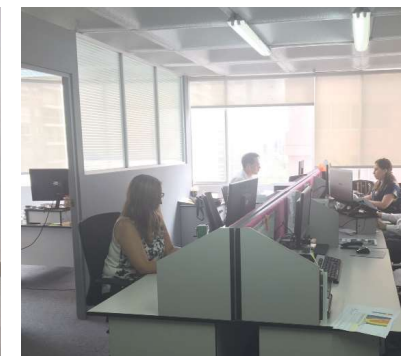
Medellín | Colombia



Madrid | Spain



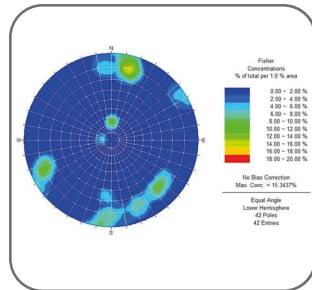
Delhi | India



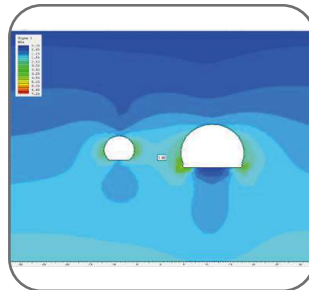
Lima | Peru

4. Software tools and facilities

We have permanent offices in Santiago (Chile), Madrid (Spain), Medellin (Colombia), Delhi (India) and Lima (Peru), all of them are fully equipped and with the advanced technical.



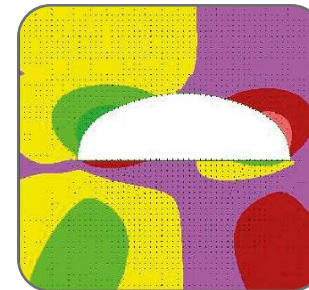
DIPS V.5.1



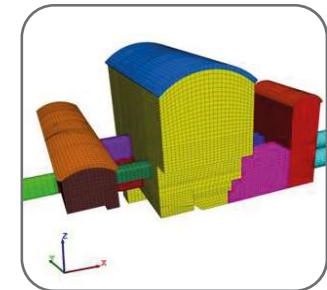
EXAMINE 2D V.7.0



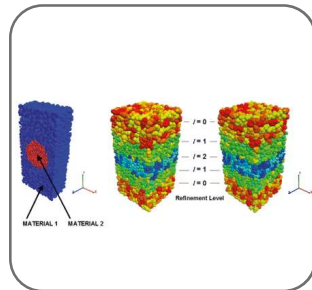
EXAMINE 3D V.4.0



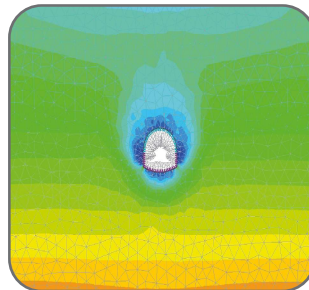
FLAC V.6.0



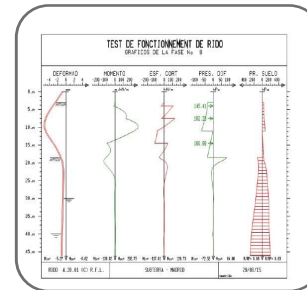
FLAC 3D V.5.0



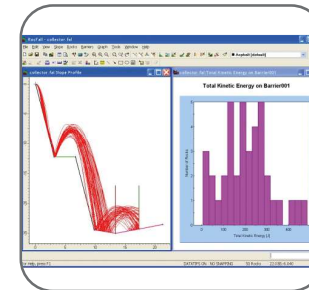
PFC2D V.4.0



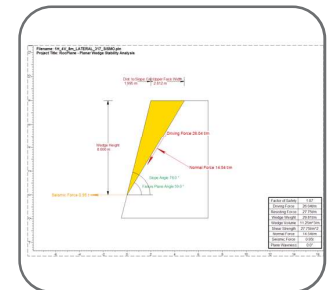
PHASE 2 V.8.0



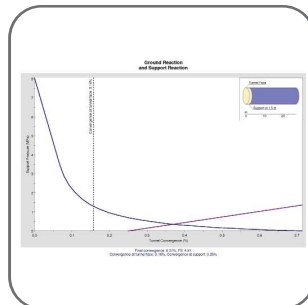
RIDO V.4.20.01



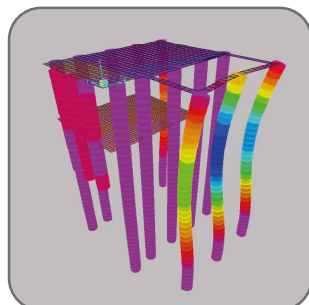
ROCFALL V.4.0



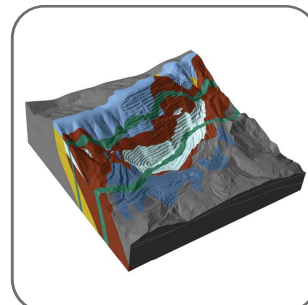
ROCPANE V.6.0



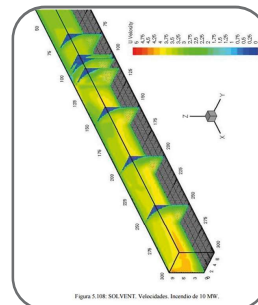
ROCSUPPORT V.3.0



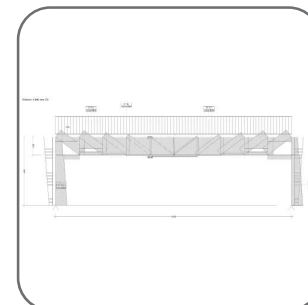
SAP2000



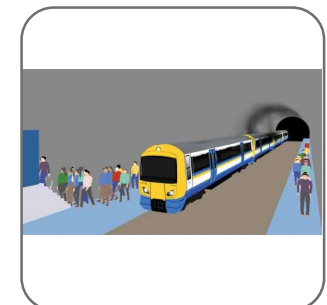
SLIDE 3D V.3.0



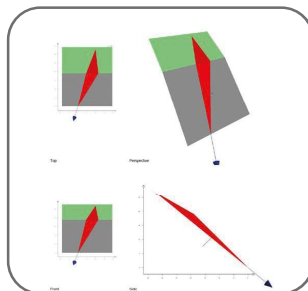
SOLVENT V.IV



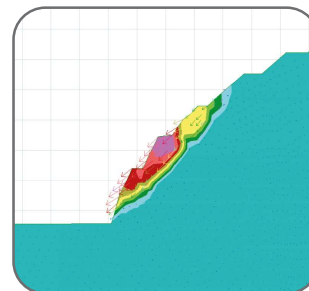
STATIK V.6.0



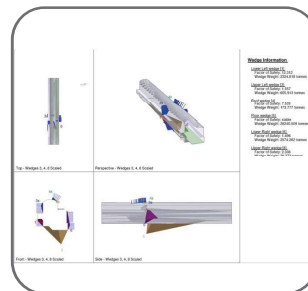
STEPS V.5.3



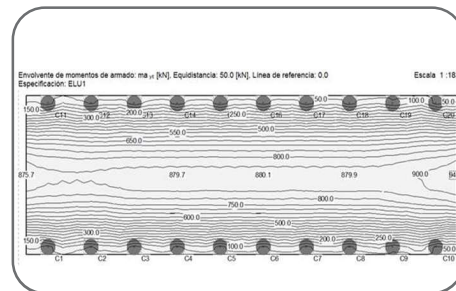
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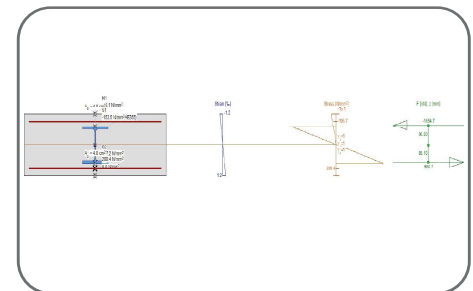
UDECD V.5.0



UNWEDGE V.3.0



CEDRUS V.6.0



FAGUS V.6.0

5. Quality, environment, security and health, R+D+i systems

SUBTERRA is Certified in ISO 9001:2015, ISO 14001:2015, ISO 45001:2018, ISO 37001:2016 and UNE 166002:2014.

This intention reflects the strong commitment with our clients in order to offer them the highest **QUALITY** in our projects/works, promoting in our team respect and responsibility to the **ENVIRONMENT**.

We express our commitment to develop our work in optimal conditions of **HEALTH** and **SAFETY**.

Finally, we have an **R+D+i** project management system, which is so important for us.



False Tunnel Almendral | Spain | OSSA-TAPUSA



6. Presence in organizations

SUBTERRA belongs to the following associations:

- AETOS** (Asociación Española de Túneles y Obras Subterráneas)
- AIC** (Asociación de Empresas Consultoras de Ingeniería de Chile A.G.)
- AMINER** (Asociación de Empresas Investigadoras, Extractoras, Transformadoras Minero-Metalúrgicas, Auxiliares y de Servicios)
- CTES** (Comité de Túneles y Espacios Subterráneos de Chile)
- SEMR** (Sociedad Española de Mécanica de Rocas)
- APTOS** (Asociación Peruana de Túneles y Obras Subterráneas)
- ACTOS** (Asociación Colombiana de Túneles y Obras Subterráneas)
- PTTP** (Plataforma Tecnológica de Túneles)
- EURACOAL** (European Association for Coal and Lignite)
- TECNIBERIA** (Asociación Española de Empresas de Ingeniería, Consultoría y Servicios Tecnológicos)
- PTES** (Plataforma Tecnológica Española de Construcción)

At the same time its members belong, or have belonged to the following organizations:

- AENOR:** Comité CTN 103 “Geotecnia”.
- COMITÉ EUROPEO DE NORMALIZACIÓN CETN TC 341 WG5:** Geotecnia.
- ASTM:** Comité D18.02.07. Ensayos de presiometría y dilatometría.
- COMISIÓN EUROPEA:** Coal Advisory Group (TGC1-DGXII)
- CORDIS (Comm. Research and Development Information Services):** FP7.

SUBTERRA has personnel affiliated to the following Professional Associations:

- **CHILE:** Colegio de Ingenieros de Chile A.G.
- **COLOMBIA:** Consejo Profesional Nacional de Ingeniería
Sociedad Antioqueña de Ingenieros y Arquitectos
Sociedad Colombiana de Ingenieros
- **SPAIN:** Colegio Oficial de Ingenieros de Minas
Colegio de Ingenieros de Caminos, Canales y Puertos
Colegio Oficial de Geólogos
- **PERU:** Colegio de Ingenieros del Perú



Hydroelectric power station Belesar II |
Spain | GNF Engineering

La Quebra Tunnel. Concesión Vial del Nus | COLOMBIA | MINCIVIL



Company activities

- 7. Professional capabilities
- 8. R+D+i activities
- 9. Safety installations
- 10. Diagnosis and rehabilitation of tunnels

Leaders of the tunnel consultancy sector in Latin America



7. Professional capabilities

Underground excavations

- Tunnel Design
- Excavation Method Analysis
- Tunnel Boring Machines (TBM)
- Support and Lining Design
- Subsidence Evaluation
- Portals
- False tunnels
- Caverns and Shafts
- Geotechnical Assessment during Construction
- Monitoring
- Diagnosis and Rehabilitation of Tunnels
- Safety Installations (Ventilation, Illumination, etc)

Mining

- 3D Geological Modeling
- Resources and Reserves Assessment
- Mine Feasibility Studies
- Open Pit Designs
- Underground Mining Designs
- Mine Decommissioning and Closure
- Dumps and Tailings Studies
- Underground Mine Infrastructure Design (Tunnels, Shafts & Caverns)

Geotechnical

- Risk Assessment
- Hidrogeology Studies
- Soil & Rock Mechanics
- Slopes & Earth Structures
- Excavation Assesment
- Aggregates and Quarries

8. R+D+i activities

The applied research give us the opportunity to off er our clients the latest ground engineering techniques, improving our designs, enabling them to solve these complexes and challenging problems.

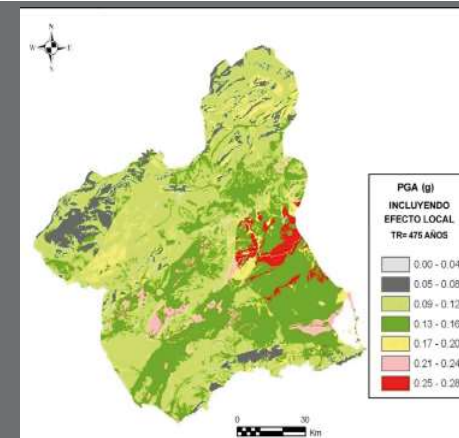
As we said before, we have a UNE 166002 system for the Research and Development projects. We were registered as an innovative PYME.

In the past we collaborated in the following projects of R+D+i:

- Avanced tool for the standardization in the Naturals Risks's evaluation and management based in Quantitative Cartograph. (**MODELISK**). INNPACTO SUBPROGRAM 2010-2014. Ministerio de Ciencia e Innovación.
- Underground Coal Gasification in operating mine and areas of high vulnerability (**COGAR**). RFC-PR-12005 - (2013-2016). European Comission. DG XII.
- Smarter Lignite Open Pit Engineering Solutions (**SLOPES**). RFCR-CT-2015-00001 - (2015-2018). European Comission. DG XII.
- Investigation for the competitive improvement of the perforation cycle and blasting in mining and underground works through the defi nition of news techniques of engineering, explosives, prototypes and advanced tools. (**TUÑEL**). 2015-2018. Centro para el Desarrollo Tecnológico Industrial (CDTI).
- Avanced methodology based in seismic zoning for evaluating and using the seismicity in underground works. (**SYOS**). 2017-2019. CONCYTEC.
- Advanced prediction for the behavior of the mass-tunnel complex, through the management and interpretation of geotechnical geological information of underground projects (**KNOWTUNNEL**). 2017 - 2019. CDTI.

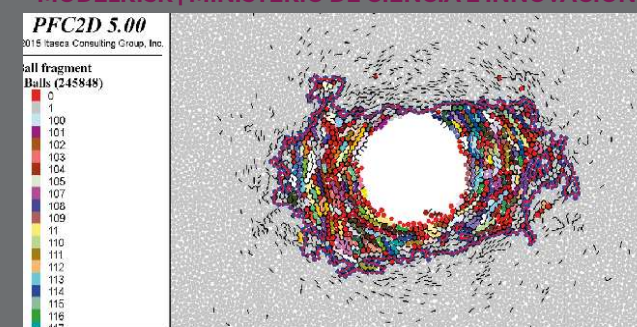
Currently we have the following projects:

- Risk Assessment of Final pits during Flooding (**RAFF**). 2019 - 2022. RFCS. European Comission. DG XII,
- The impact of EXtreme weather events on MINing operations (**TEXMIN**). 2019 - 2022. RFCS. European Comission DG XII,
- From Mining Waste to Valuable Resource: New Concepts for a Circular Economy (**MINERESCUE**). RFCS. 2020-2023. European Comission DG XII,
- A human-centred internet of things platform for the sustainable mine of the future (**Dig_IT**). 2020-2024 European Comission H2020.



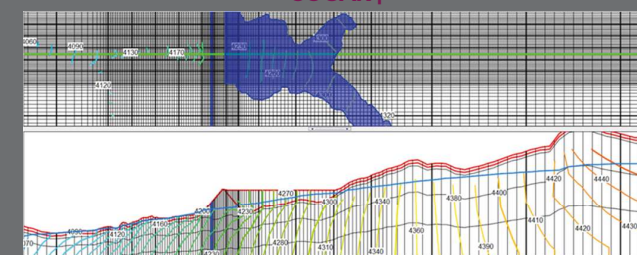
Map of seismic accelerations

MODELISK | MINISTERIO DE CIENCIA E INNOVACIÓN



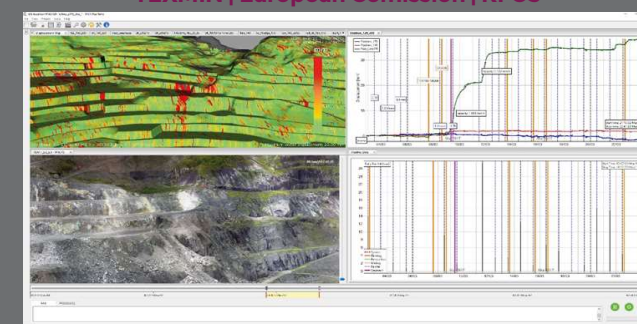
Thermal effect in a gasifi cation's borehole

COGAR |



Hydrogeological modeling

TEXMIN | European Comission | RFCS



Remote geotechnical monitoring systems

DIG_IT | European Comission H2020



9. Safety installations

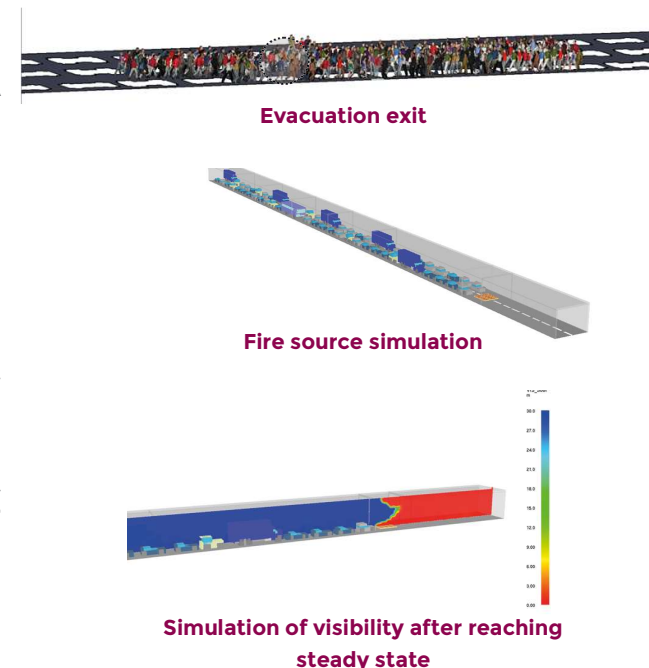
The engineering of tunnels and underground spaces requires having modern installation systems that enable their functionality in the maximum security conditions.

Because of them, the international normative and the different national normative of the tunnel's safety systems, including the tunnel's exploitation in normal conditions like in case of fire, are increasingly demanding. It's necessary to have the following:

- Safety concept.
- Ventilation system.
- Detection and fire detection system.
- Illumination.
- Electromechanical systems.

This requirement is attended by SUBTERRA with the following services:

- **Safety installations project:** including ventilation, illumination and all electromechanical systems necessities.
- **Exploitation manual,** of the tunnels attending its functionality, including operational normally plan, emergency plan and maintenance plan.
- **Analysis of risks,** versus different scenarios typified in the regulations for cases of accident and fire.



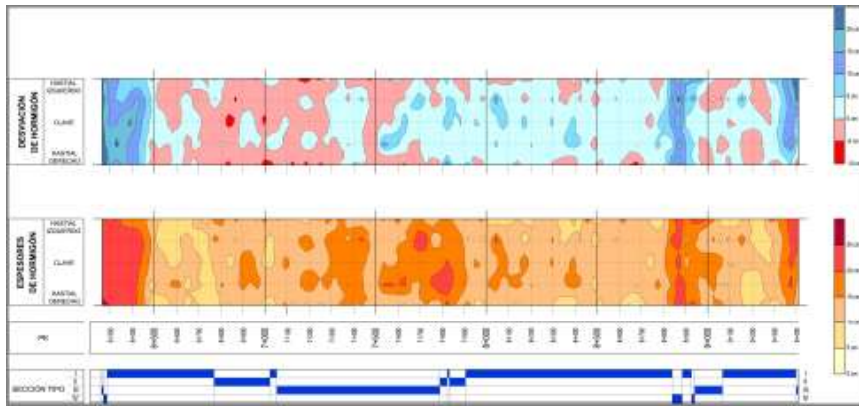
Main references of security installations projects

Project	Country	Function	Typology		Traffic	Length (m)	Level of study	Year
Americo Vespucio Oriente. El Salto-Príncipe de Gales (AVO 1)	Chile	Road	Single bore	3 pistas	Single way	8.360	Final design	2014-16
Americo Vespucio Oriente. Príncipe de Gales-Los Presidentes (AVO 2)	Chile	Road	Double bore	3 pistas	Single way	2x5.200	Final design	2018-19
Guayaquil Airport Tunnel	Ecuador	Road	Double bore	2 pistas	Single way	2x3.140	Final design	2016
Galicia High Speed Line. Cerdedo-Barro. Os Campos Tunnel	Spain	Railway	Single bore	2 vías	Double way	2.795	Final design	2011
Galicia High Speed Line. Cerdedo-Barro. O Galo Tunnel	Spain	Railway	Single bore	2 vías	Double way	4.705	Final design	2011
Galicia High Speed Line. Cerdedo-Barro. Barro Tunnel	Spain	Railway	Single bore	2 vías	Double way	7.792	Final design	2011
Tunnel 1 of the Agaete-La Aldea Highway	Spain	Road	Double bore	2 pistas	Single way	2x3.100	Operating manual	2017
Section 4 Railway Gran Canaria	Spain	Railway	Single bore	2 vías	Double way	6.430	Final design	2018
Amazoc-Veracruz Highway. Xalpetec tunnel	México	Road	Single bore	4 pistas	Double way	302	Final design	2009-10
Interoceanic South. Ollachea Tunnel	Perú	Road	Single bore	2 pistas	Double way	1.025	Final design	2017-18

10. Diagnosis and rehabilitation of tunnels

SUBTERRA offers a tunnel's inspection services, diagnosis and rehabilitation, based in its experience in the interaction's analysis between the ground, governed by its mechanical parameters and the characteristics of the support applied to the tunnel.

- Inspection of Tunnels
- Structural Rehabilitation Tunnels Projects
- Maintenance Programs of Tunnels

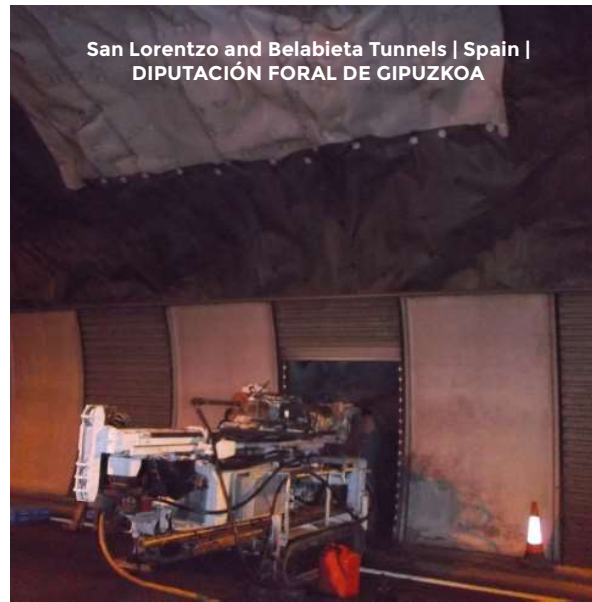


Thickness isolines of shotcrete.

La Aldea Tunnel | Spain | UTE LA ALDEA (OHL-TITO-FCC)



Rehabilitation PH La Confluencia | Chile |
HOCHTIEF-TECSA



San Lorentzo and Belabieta Tunnels | Spain |
DIPUTACIÓN FORAL DE GIPUZKOA



Quellaveco Mine | Peru | COSAPI-MAS ERRÁZURIZ

Main references

- Inspection and expert report of the underground warehouses. Navalcarnero (Spain) 2020
- Terminal tunnel maintenance. Colca-Sigüas System (Peru) 2018
- Inspection and verification, transport tunnel and By Pass tunnel. Antamina (Peru) 2017
- Astigarraga-Irún tunnels (Spain) 2017
- Inspection and verification. Hydroelectric power, Pangal tunnel (Chile) 2017
- Inspection tunnel. Quellaveco Mine (Peru) 2016-17
- Definition of stabilization solutions. San Lorentzo and Belabieta A-15 tunnels (Spain) 2016
- Tunnel 1 highway Agaete-La Aldea. Tunnel lining and drainage analysis (Spain) 2015
- Inspection and rehabilitation project of the adduction tunnel of Pizarras HP (Peru) 2013-14
- Inspection of the railway tunnels of Forcadiña, Sierra Pequena and El Molino (Spain) 2013
- Rehabilitation railway tunnels Llanes Bypass. Altares and El Bolao Tunnels (Spain) 2012
- Inspection and advice. Portillo CH La Confluencia Tunnel. VI Region (Chile) 2011-12
- Inspection of the tunnels of the Jabarella Canal (Spain) 2010

San Francisco Mines Hydroelectric Project | Ecuador | GNF ENGINEERING



References

- 11. Motorways and road projects
- 12. Railway and metro projects
- 13. Hydraulic projects
- 14. Hydroelectrical projects
- 15. Mining projects

Cavern, Cheves Hydroelectric Project | PERU | HOCHTIEF-TECSA

Americo Vespucio Oriente. El Salto-Príncipe de Gales, Chile

AVO 1 project has been divided into two sectors:

Sector 1: Avenida El Salto - Puente Centenario, between DM 0.000 and 3.368. It contemplates the execution of two separate platforms for each direction of traffic, which each house three tracks. In the North-South direction, the execution of a viaduct is projected that starts from the surroundings of the junction of the Business City and then continues through a three-lane tunnel under the San Cristóbal hill (La Pirámide tunnel) and under the Mapocho river. After the passage under the Mapocho there is a section in a simple covered trench, which begins to transform into a two-level trench. This two-level trench continues under Vespucio's tray until it connects with Sector 2.

Sector 2: Centennial Bridge - Prince of Wales Avenue, between DM 3,368 and 8,278. Both directions of circulation run inside a common underground structure with two levels of circulation, with 3 lanes each plus their corresponding additional lanes on the entrance and exit ramps. The South-North direction of circulation runs along level -1 of the covered trench, having as a starting point the access to the entrance hatch that is at the height of Carlos Alvarado street. The north-south direction of circulation runs through level -2, which has as its end point or exit the hatch that is at the height of Las Luciérnagas street. On the other hand, Sector 2 has as singular points the pass under Kennedy and under Apoquindo, in which there is a section that is built as a tunnel in mine projected according to the construction philosophy of the German Method.



Tunnel and geotechnical. Santiago Centro Oriente 2 Program, Chile

Costanera Norte has been appointed by MOP (Ministerio de Obras Públicas of Chile) to develop the new traffic system East-West in Santiago de Chile. Detailed design and technical adduce will be came out by **SUBTERRA**.

Costanera Norte-Costanera Sur tunnel, 292 m long, 10 meters wide, will house two lanes of road traffic, it will be excavated in the Gravas del Mapocho, and in a rocky massif composed of shales and andesites.

Kennedy Tunnel, constitutes the most singular work of the involved in the Project, runs along its 1,150 meters in length parallel to Kennedy Avenue, on the north side of the Golf Club and between the current roundabout Perez Zujovic to the west of the intersection of the Avenues Kennedy and Américo Vespucio. The tunnel section will house a four-lane traffic platform which entails widths of excavation of around 20 meters and excavation sections of 200 m². The The excavation will be developed following the NATM and by dividing the section into different phases.

Lo Saldes Tunnel, 65 m long and 14 meters wide, excavation.



Project	Section (m²)	Length (m)	Year	Country	Design engineering	Assistance
Carretera Maitenes-Confluencia. Túneles T1, T2 y T3	75	447+989+3.361	2012-15	Chile	x	x
Programa Santiago Centro Oriente 1. Túnel Vivaceta	92	580	2013-14	Chile		x
Costanera Norte. Túnel AVO bajo Kennedy	284	42	2013	Chile	x	
Programa Santiago Centro Oriente 2. Túneles: Costanera Norte-Costanera Sur, Kennedy y Lo Saldes	80	292	2013-17	Chile	x	x
	200	1.150	2013-17	Chile	x	x
	90	65	2013-17	Chile		x
Américo Vespucio Oriente. El Salto-Príncipe de Gales (AVO 1)	148	8.360	2014-21	Chile	x	x
Autopista Radial Nororiente. Túnel Chamisero 2	80	2x1.590	2015-17	Chile	x	x
Eje Los Maitenes. Parque Negocios Enea	85	282	2016	Chile	x	
Américo Vespucio Oriente. Príncipe de Gales-Los Presidentes (AVO 2)	120	2x5.200	2018-24	Chile	x	x
Concesión Vial del Nus. Túneles de La Quiebra	90	2x4.200	2018-19	Colombia		x
Corredor vial Pamplona-Cúcuta. Túnel de Pamplona y Pamplonita	93/120	1.390	2019	Colombia		x
Redacción proyecto ejecución Soterramiento A-5-Paseo de Extremadura	-	3.800	2021-22	Spain	x	
El Tranque-Santiago del Teide. Variante C-820.Cierre del anillo insular. Túnel de Erjos	-	2x5.100	2020	Spain		x
Eix Diagonal. C15/C37. Túnel de Montconill	90	615	2010	Spain		x
Autopista Arequipa-La Joya. Túnel de La Joya	90	2x740	2014	Peru	x	
Accesos puerto de Chancay. Túnel de Chancay	75	2.300	2014-22	Peru	x	x
Carretera Central. Túnel de Yanango	100	1.062	2014-16	Peru		x
Estudio de viabilidad y definitivo variante Emp. PE-022 km. 101 + 379 (Río Blanco) - Emp. PE-3S km. 21 + 918 (Huari), 70,480 km de vía y tres túneles proyectados	83,18	274	2019-21	Peru	x	
	83,18	207				
	91,25	3.213				
Tramo 2 de IIRSA: Pte Ricardo Palma - La Oroya. Túnel Chacahuaró II	-	360	2016	Peru	x	
Interoceánica Sur. Túnel de Ollachea	80,55	1.025+891	2017-22	Peru	x	x
Estudio de factibilidad carretera Santa - Huallanca	-	2.007	2018-21	Peru	x	
Estudio definitivo proyecto de construcción de la vía de evitamiento La Oroya	113	1.200	2019-20	Peru	x	
Autopista Tharthri-Kilhotran. Túnel de Kahaljugasar	79	2x4.000	2018-21	India	x	
Carretera Monteagudo -Ipati. Túnel de Incahuasi	72	1.230	2010-11	Bolivia	x	
Rodoanel Trecho Norte. Túnel 501	180	2x1.100	2014-16	Brasil		x
Autopista Guayaquil - Santa Elena. Túnel de Santa Elena	92	2x3.000	2014	Ecuador	x	
Túnel del Aeropuerto de Guayaquil	110	2x3.140	2016	Ecuador	x	
Carretera Amazoc-Veracruz. Túnel de Xalpetec	145	302	2009-10	Mexico	x	
Libramiento Acapulco. Túnel María Bonita	210	495	2015	Mexico	x	
Autopista Jala-Las Varas. Túneles de Las Truchas y Paso del Jaguar	190	240+235+120	2017-18	Mexico		x
Autopista Atizapán-Atlacomulco. Túneles de Los Gallos y Cahuacán	215	210+115	2018-19	Mexico		x
Autopista Jala-Las Varas. Túnel Guamúchil	144	1.080	2019-20	Mexico		x

El Corno tunnel. Lubián-Orense High Speed Line, Spain

El Corno tunnel, designed on the Cerdedeló-Porto Lubián - Ourense High Speed Line section, is a twin tube tunnel which has a length of 8.5 km.

The tunnel alignment crosses at several points the current route of the railway line, which is an important milestone to consider when analyzing the stability of the tunnel.

It is designed to an Adit of nearly 800 m in order to carry out the excavation of the tunnel Corno from four different faces.

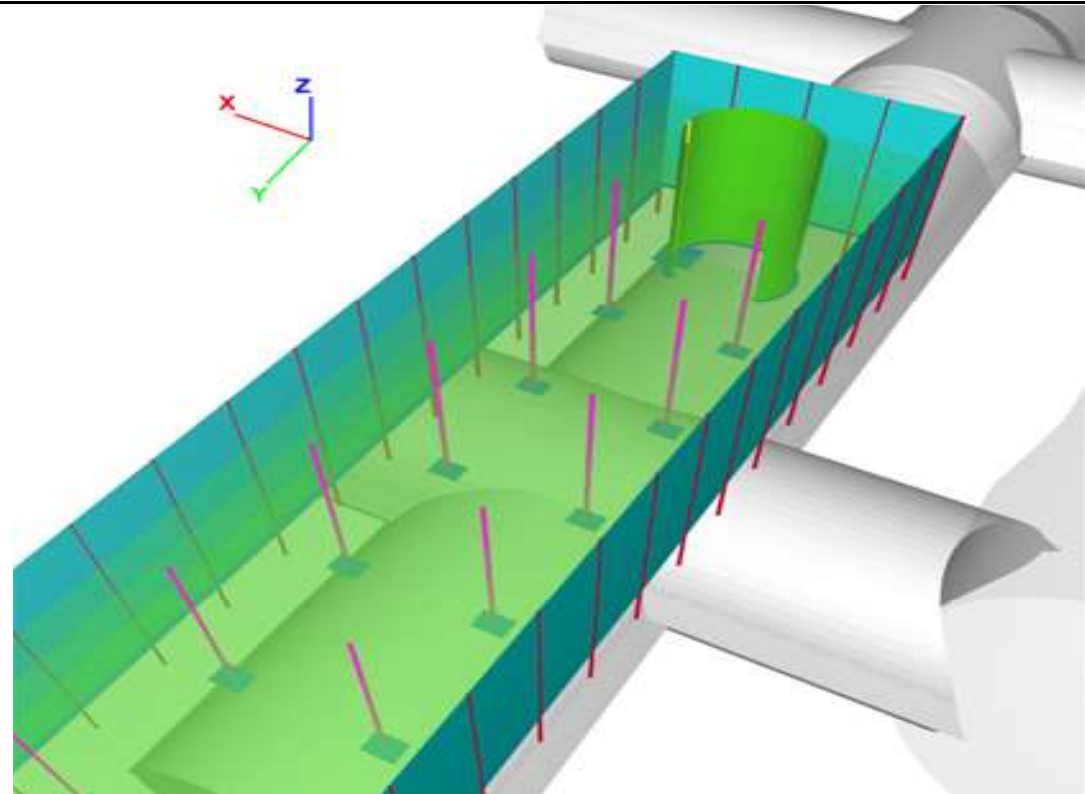
In addition it is designed the junction between the tunnel and the Adit in an area where the water infiltration to the excavation is high.



Line 7 of the Santiago Metro. Section B, Chile

Detailed Engineering of the Shafts, both for Stations and for Construction, Galleries and **Tunnels of Line 7**, for section B, whose western limit is constituted by the eastern tympanum of Walter Martínez Station, and PK 18 to the east +100, covering an approximate length of 10,400 km, including in said section: six stations (Matucana, Cumming, Cal y Canto, Baquedano, Pedro de Valdivia and Isidora Goyenechea), eight Construction Shafts and three Ventilations.

It also includes the Detailed Engineering of the extension of the Line 6 Interstation Tunnel, from the current maneuvering queue to the PC-13 shaft, including the Station Tunnel of the future Isidora Goyenechea Station of that Line.



Project	Section (m²)	Length (m)	Year	Country	Design engineering	Assistance
TBM on Metro Line 7	-	7.500	2019-22	Chile		x
Santiago de Chile Metro. Section B. Line 7	-	10.400 (km)	2019-20	Chile		x
Northern section of line 3 of the Seville Metro	9-7,35	7,55 (km)	2020-21	Spain	x	
Rail Access to Port of Ferrol. Brión Tunnel	70,69	5.640	2017-21	Spain	x	x
Burgos-Vitoria High Speed Line. Burgos-Prádanos de Bureba. Fresno de Rodilla Tunnel	77	5.250	2009-10	Spain	x	
South Train. San Miguel-Arona. Tunnel 6	115	2.283	2010	Spain	x	
High Speed Atlantic Axis. Section: Vigo-O Porriño	115/77	10.000	2010	Spain	x	
Manacor-Artá Railway. Son Servera-Artá section. Son Sureda Tunnel	40	80	2010	Spain	x	
Bobadilla-Granada High Speed Line. Archidona-A. de la Negra. Archidona tunnel	138	1.053	2010	Spain		x
Gran Canaria train. The Goro-Airport. El Goro tunnel	105	2.000-4.300	2011-12	Spain	x	
Gran Canaria train. Maspalomas Tunnel	100	3.000	2011	Spain	x	
Galicia High Speed Line. Galicia. O Carballiño-O Irixo. Tunnels 1, 2 and 3	78	2.400	2011	Spain	x	
	110	2.271			x	
	110	2.278			x	
Galicia High Speed Line. Cerdedo-Barro. Os Campos, O Galo and Barro Tunnels	110	2.795	2011	Spain	x	
	110	4.705			x	
	71	7.792			x	
Asturias High Speed Line. Pola de Lena-Oviedo. Pola de Lena tunnel	118	11.380	2012	Spain	x	
Madrid-Galicia High Speed Line. Prado-Porto. Prado tunnel	72	7.606	2012	Spain	x	
Madrid-Galicia High Speed Line. Cerdedelo-Prado. Corno Tunnel	72	8.510	2011-16	Spain	x	x
San Sebastián Metro. La Concha Station	150	190	2016	Spain	x	
APD section 2. 1, 1A2 y 2 tunnels	75	600+800	2013	Argelia	x	
	75	18.900	2013-15	Argelia	x	
	52	3.680	2013-15	Argelia	x	
Obulavaripalle-Venkatachalam. Chennai tunnel	52	980+6.780	2010	India	x	
Dublin Metro	-	2.339.23+8909	2019-21	Irlanda	x	
Guadalajara Metro Line 3	120	4.500	2015-17	Mexico	x	x
Ho Chi Minh City Urban Mass Rapid Transit Line 2	-	9.100	2018	Vietnam	x	

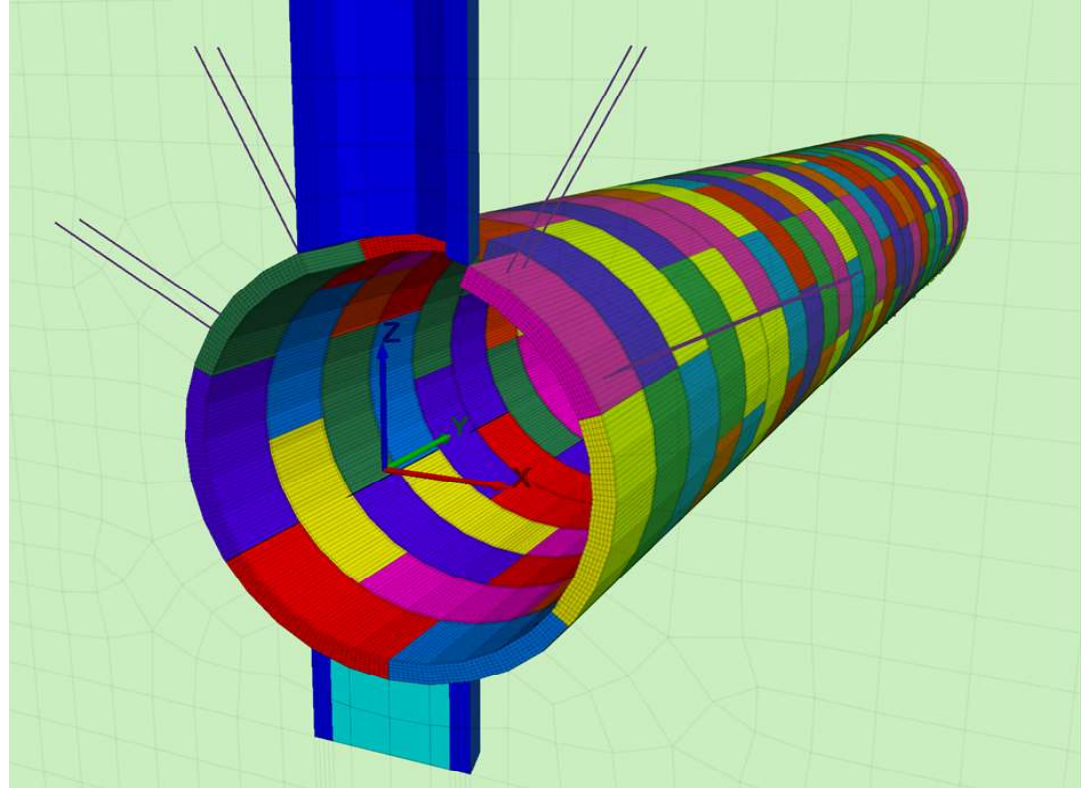
Detailed engineering of the drainage system in Pozuelo de Alarcón, Spain

In order to be carried the rainwater to the new urban areas, the Pozuelo de Alarcón's sewer has been designed underground. For it **SUBTERRA** proposed the construction of a **tunnel of 4,543 m length**.

It was realized a detailed analysis of the stability of the front of the excavation by TBM and the link of the precast concrete segments.

In addition, it was designed a unique connection between the sewer, the Adit, and the ventilation duct.

The lithologies affected by the Pozuelo's sewer belong to the so-called "Material detrítico de Madrid" (clays and sands).



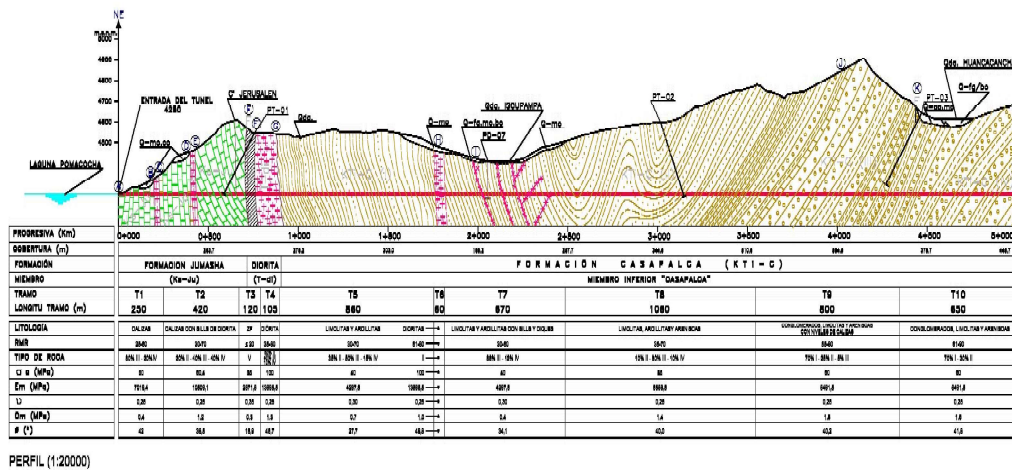
Desalination plant for the Atacama Region, Copiapó, Caldera, Chañaral and Tierra Amarilla, Chile

ECONSSA S.A. is developing the Project "Desalination Plant for the Atacama Region", for the supply of drinking water to the towns of Copiapó, Caldera, Chañaral and Tierra Amarilla.

The complete project consists of obtaining seawater by means of an open capture in depth and its sending to the desalination plant for desalination, the production of water suitable for human consumption in the desalination plant, its storage in a product water pond and the distribution of the water drinkable through impulses and lifting stations, to the different points of supply of the population for the localities of Caldera, Chañaral and Recinto de Piedra Colgada, the latter for supply the towns of Copiapó and Tierra Amarilla. In addition, it includes the discharge of the brine to the sea and the electrical supply to the different points of consumption. Among the works to be carried out, the construction of the following underground works is planned: Pique Inmisario / Pique Emisario.



Project	Section (m ²)	Length (m)	Year	Country	Design engineering	Assistance
Chironta Reservoir	70	473	2018-19	Chile		x
Desalination plant Atacama Region, Copiapó, Caldera, Chañaral and Tierra Amarilla	14	25	2017-20	Chile	x	x
New adduction line residual water treatment plant Cali river	9	1.630	2019-20	Colombia		x
Construction of the residual water treatment plant, Sinova (Soria)	11	4.960	2020-22	Spain		x
Pozuelo de Alarcón's sewer	6,5	4.572	2010	Spain	x	
Transfer Majes - Sigüas. Transandino and Pucara Tunnels	25	11.410+6.450	2011	Peru	x	x
Llucila-Siguas diversion. Tunnels 1, 2 and 3	25	4.600	2012-14	Peru	x	
		2.500				
		3.100				
Drinking water supply works to Lima. Header tunnel	15	9.898	2014-15	Peru	x	



Basic engineering. Drinking water supply works to Lima | PERU |
PROINVERSIÓN



New adduction line residual water treatment plant Cali river | COLOMBIA | OHL

Alto Maipo hydroelectric project, Chile

Alto Maipo Hydroelectric Project (PHAM) is located in the commune of San José de Maipo, Cordillera Province, Santiago Metropolitan Region, Chile.

The underground works included in the PHAM are:

6,250 m long **“Alfalfal II”** tunnel, of which the initial 3,250 m will be built with D + B in a box section of 4.75 x 4.90 m (20.8 m²), and the rest with TBM of about 4.10 m in diameter (13.2 m²),

1,020 m long **“Suelo”** tunnel to be fully excavated using conventional methods, with a 4.0 x 4.0 m trunk section (13 m²),

“El Volcán” tunnel, 14,100 m long, of which 7,100 m will be built with D + B in a trunk section of 3.80 x 4.90 (4.60) m (17/16 m²), and the rest with 4.10 m diameter TBM (13.2 m²).

Also it is included the geotechnical monitoring of all underground works of the hydroelectric project.



Cheves hydroelectric project, Peru

Cheves hydroelectric project is located located on the Huaura River, between the towns of Sayán and Churín (Peru). This The hydroelectric plant will capture water from the Huaura and Checra rivers about 2 km upstream from their confluence at an altitude of 2,170 meters above sea level and It will return to the Huaura River through the discharge tunnel located about 1.5 km downstream, at an altitude of 1,548 meters above sea level.

This project is carried out in order to take advantage of the water resources of the Huaura river basin, for the generation of energy electricity with an installed power of 168 MW divided into two Pelton turbines using a head of 599 m and a design flow of 33 m³/s. The construction of the following tunnels has been planned:

Transfer tunnel:	2,580 meters
Headrace tunnel:	9,915 m.
Powerhouse cavern:	31.5 x 15.5 x 62.7 m (high*width*length)
Tailrace tunnel:	3,700 m.
Access tunnel to the cavern:	960 m.
Adit tunnel tunnel 1:	860 m.
Surge tunnel:	697 m.



Project	Section (m²)	Length (m)	Year	Country	Design engineering	Assistance
La Confluencia Hydroelectric Power Plant. Portillo and Tinguiririca tunnels.	20/35.5	9.040	2009-10	Chile		x
El Paso Hydroelectric Power Plant. Conduction tunnel	28	4.500	2011	Chile	x	
La Confluencia Hydroelectric Power Plant. Portillo tunnel lining	35.5	11.290	2011-12	Chile	x	x
Itata Hydroelectric Power Plant. Shaft and discharge tunnel	51	70	2013	Chile	x	x
Alto Maipo Hydroelectric Power Plant. El Volcán, Suelo and Alfalfal tunnels	13/21	22.000	2013-17	Chile	x	x
José María de Oriol II Hydroelectric Power Plant (Alcántara II)	8,4/6,80	860/765	2020-21	Spain	x	
Edrada-San Esteban Hydroelectric Power Plant	50	5.900	2010	Spain	x	
Belesar III Hydroelectric Power Plant. Tunnels, surge tunnel, shafts and caverns	45	1.650	2010-11	Spain	x	
Los Peares III Hydroelectric Power Plant. Tunnels and shafts	45	450	2010-11	Spain	x	
Salas-Conchas Hydroelectric Power Plant	50	6.100	2010-11	Spain	x	
Chira-Soria. Hydroelectric Power Plant. Powerhouse cavern and Transformer cavern	22	60	2012	Spain	x	
Chira-Soria. Hydroelectric Power Plant. Tunnels, shafts, and caverns	22	5.200	2015-16	Spain	x	
Cheves hydroelectric project. Powerhouse cavern and Transformer cavern	16/41	15.776	2010-14	Peru	x	x
La Virgen Hydroelectric Power Plant. Conduction tunnel	18	4.600	2011	Peru	x	
Colca Hydroelectric Power Plant. Conduction tunnel	10	545+1.945	2016	Peru	x	
Manta Hydroelectric Power Plant. Conduction tunnel	10	1.800	2016-19	Peru	x	x
Larreynaga Hydroelectric Power Plant. Conduction tunnel and chimney	17	2.500	2009-10	Nicaragua	x	
Torito Hydroelectric Power Plant. Transfer and conduction tunnel	40	3.700	2011	Costa Rica	x	x
Los Negros Hydroelectric Power Plant. Conduction tunnel	12	3.000	2016-17	Costa Rica		x
San Francisco Mines Hydroelectric Project. Tunnels, surge tunnel, shafts and caverns	50/90	1.270+350	2012-16	Ecuador	x	x
Renace 2 Hydroelectric Power Plant. Tunnel 1 and 2, and desander	21	8.200	2012-14	Guatemala	x	x
Renace 3 Hydroelectric Power Plant. Conduction tunnel and shaft	21	4.750	2014-15	Guatemala	x	x
El Recreo Hydroelectric Power Plant. Conduction tunnel	15	1.800	2014-15	Guatemala		x
PH-3 and Cuetzalín Hydroelectric project	10	1.180+1.280	2014	Mexico	x	
Tatatila Hydroelectric project	22	1.360	2014-15	Mexico	x	
Banda Azul Hydroelectric Power Plant	12/24	7.500+6.800	2015-16	Bolivia	x	
Miguillas Hydroelectric Power Plant. Palillada tunnel	18	9.000	2016	Bolivia	x	

Cobre Las Cruces open pit Mine, Spain

Cobre Las Cruces mine aims to exploit the secondary copper ore reserves from a mineralization of massive sulfides embedded in volcanic and sedimentary rocks of the Paleozoic, hidden under tertiary sediments.

Secondary copper ore reserves have been estimated at 17,625,000 tons of ore grading 6.22% copper, with a total of 1,096,275 tons of extractable copper and 978,504 tons of recoverable copper, and marketed in the form of copper cathodes.

The coating is made up of about 140 m of marl from the Tertiary, under which a layer of sandstones, calcarenites and conglomerates with a variable thickness of 5 to 10 m, which constitutes the Niebla-Posadas aquifer. The deposit is exploited using the open-pit method of cutting, which will allow the extraction of 97% of the copper metal contained in the reserves. The final cut will be oval in shape, 1,500 m long in an east-west direction, 900 m wide in a north-south direction and a maximum depth of 245 m.

SUBTERRA is responsible for the geotechnical monitoring of the exploitation from inception to date, including both the open pit mine and the dumps. This includes mapping, stability calculations, and geotechnical monitoring.

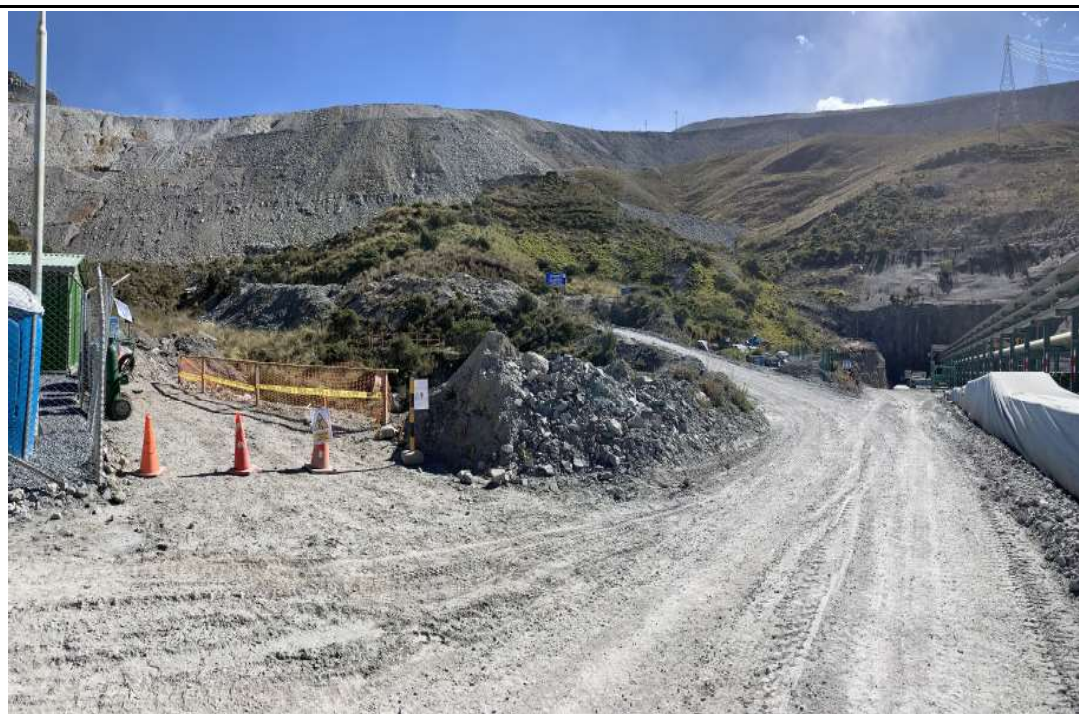


Antamina Mine. PCS and Waste Tunnels, Peru

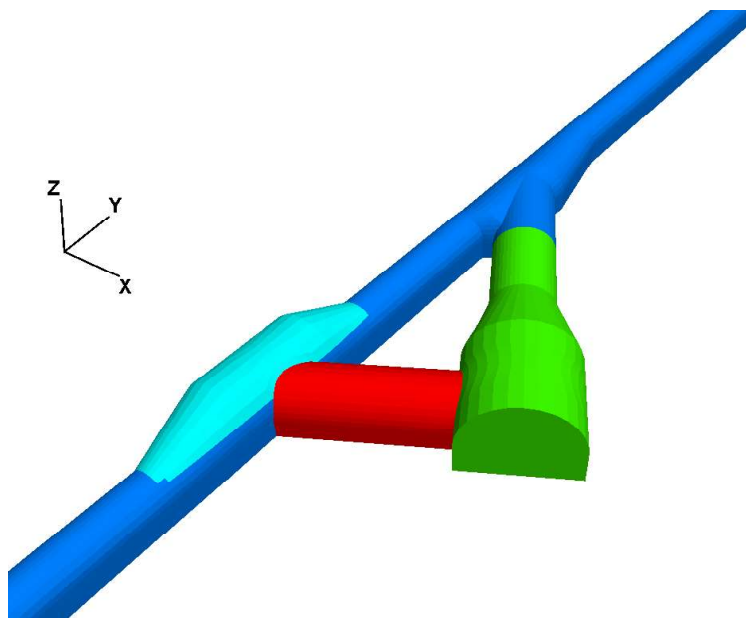
ANTAMINA is developing the Mineral and Dismantling Tunnels project, as part of the new Crushing and Transport system (CCS & DBN).

The length of the tunnels that run approximately parallel is about 3,600 m with a slope of 7.9%, having a section of about 35 m².

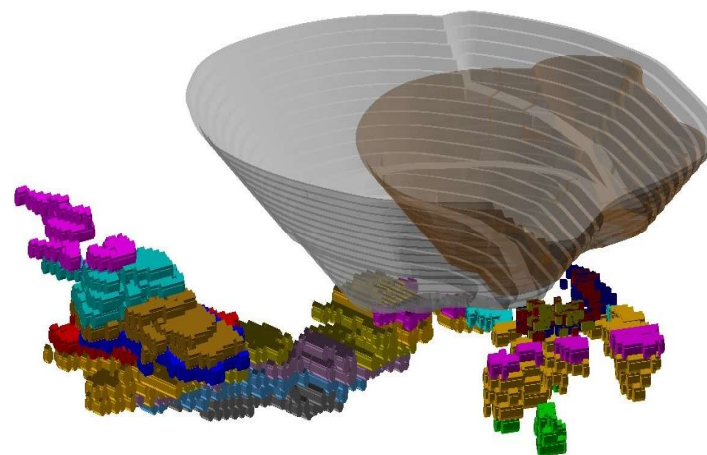
The project includes a 900 m construction window and several interconnection galleries between the two tunnels.



Project	Section (m²)	Length (m)	Year	Country	Design engineering	Assistance
Pit 2 ventilation PMCHS	8,40	918	2020	Chile	x	
Los Bronces Mine. South Tunnel	20	8.125	2010	Chile		x
Collahuasi Mine. Rosario Oeste Tunnel	16	1.150	2011	Chile		x
PM Chuquicamata Subterráneo. Access and Transport Tunnels	70	7.600+6.300	2013-17	Chile		x
Quebradona Mine. Infrastructure access tunnels	9	5.700	2019	Colombia	x	
Muga Mine. Access and Transport Ramps	24/34	685,71 / 346,56	2016	Spain	x	x
Muga Mine. Access and Transport Ramps	50	2x2.500	2015-22	Spain	x	
Cabanillas Mine. Ramp. VFN-CBN connection. Shafts	50	4.500	2015-20	Spain	x	x
Las Cruces Mine. Research ramp and gallery	35	1.200	2016-18	Spain	x	x
Toquepala Mine. Transport tunnels	32/25	2.027	2011-13	Peru	x	x
Quellaveco Mine. Asana River Diversion Tunnel	25	6.500	2016-17	Peru		x
Romina Mine. Romina Exploration Ramp 2	22	850	2016-17	Peru	x	
Antamina Mine. Transport Tunnel	30	2.600	2017	Peru		x
Coroccohuayco Mine. Transport Tunnel	25	7.500	2017	Peru	x	
Antamina Mine. Side-Hill tunnel and Decantation	17	940+320	2020-22	Peru		x
Antamina.Mine. Tunnels, PCS y Waste	4/5,5	2.600	2020-21	Peru		x
Parcoy Mine. Yuracyacu Tunnel	24	11.400	2018	Peru	x	
Final lining design of different chambers at Konrad Mine	-	800	2019	Alemania	x	



PM Chuquicamata Subterráneo | CHILE | CODELCO



Coroccohuayco Mine | PERU | COMPAÑÍA MINERA ANTAPACCAY (GLENCORE)



Los Gallos Tunnel. Atizapán-Atlacomulco | MEXICO | OSSA

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La Confluencia Hydroelectric Power Plant. VI Región | CHILE | HOCHTIEF

Subterra

SUBTERRA Ingeniería Ltda

Alfredo Barros Errázuriz 1960, Of. 901
C.P. 7500521 Providencia
Santiago. Chile
T./ +(56) 2 2797 6822

chile@subterra-ing.com

SUBTERRA Ingeniería SAS

Calle 5A # 43B-25 Of. 808. El Poblado
Medellin. Colombia
T./ +(57) 4 260 8018

colombia@subterra-ing.com

SUBTERRA Ingeniería SL

Vallehermoso, 18
28015 Madrid. Spain
T./ + (34) 91 534 05 30
F./ + (34) 91 533 14 75

spain@subterra-ing.com

SUBTERRA Engineering Pvt Ltd

18 LGF, NRI Complex
Greater Kailash IV
110019 New Delhi. India
T./ + (91) 981 865 7311

india@subterra-ing.com

SUBTERRA Ingeniería SAC

Ca. General Recavarren 103, of 901
Miraflores. Lima. Peru
T./ + (51) 1 242 3918
F./ + (51) 1 440 6656

peru@subterra-ing.com



www.subterra-ing.com