

We are Pini Group

DETAIL "D"
1st Phase: Excavation UR55 gallery
(1:20)



Considered deformation (Td)	8 cm
Excavation section (Vault)	44.60 m²
Excavation section (Invert)	2.73 m²
Vault development	18.03 m
Invert development	6.42 m

	Tunnel face area ≤ 5m		Rearward area	
	Supports	Quantity	Supports	Quantity
Vault	3a	24 m³/m		
	3b	22.5 m³/m		
	3e	100 m		
	3f	21 m³/m		
Vault	1a	0.90 m³/m	3f	0.87 m³/m
	1e	2.65 m³/m		
Invert			1a	0.34 m³/m
			1e	1.00 m³/m
			3f	0.34 m³/m
Excavation face	1c	2.97 m³/m		
Vault	2	first layer		
		second layer		

$\gamma_{xy} = \frac{\tau_{xy}}{G}$ $\gamma_{yz} = \frac{\tau_{yz}}{G}$ $\gamma_{zx} = \frac{\tau_{zx}}{G}$ $\epsilon_p = \frac{p'}{K}$

(3b) Spiling structurally/alternatively to the radial bolts selected the grouted bolts, Ftk2340 kN L=6.00m
 (3e) Supplementary rock bolts Ftk2340 kN L = 4.00m, Plate 150x150x8mm if necessary
 (3f) Radial fibre glass bolts L = 6.00m, with appropriate blocking system
 (4) Lattice girders type "Jörimann 3G-70/20/28" (or equivalent)

NOTES:

- For construction/deformation tolerances and materials see the following Documents:
 -Contractual Appendix H.2 - Annex A "Constructive Tolerances"
 -LHC-LOM1350030090 Underground Structures, General - Table of materials.
- Drawing shows typical rock support that may be adjusted to local conditions approved by the Engineer.
- The quantities indicated for the ribs do not include the values of the connections, plates and overlays.
- The invert shall be excavated in the rearward area, in principle at the end of excavation phase.
- At least six meters before and after the crossing zones, despite the encountered geological conditions, the heaviest support class shall be adopted.
- The drawings don't take into account the additional excavation allowance (d), see document LHC-LOM1350030090.
- The part of the rock support indicated as "A" shall be executed within 1 excavation round, the part indicated as "B" can be executed in the rearward area. (Detail "A")
- The dimensions less than one meter are given in centimeters.
- The contractor is responsible for the production of the shop drawings of steel ribs. The shop drawings shall include also the design of the connection between steel rib in the crown and in the invert, as represented in Detail "C"
- Radial deformation allowance "Td", already considered in the drawing

REFERENCE DOCUMENTS:

- LHC-LOM1350030090 - Table of Materials
- LHC-PSW135003010/11 - First Lining Segments Layout
- LHC-PSW135233101 - Excavation and rock support - Support class UR55.1
- LHC-PSW135233102 - Excavation and rock support - Support class UR55.2
- LHC-PSW135133101 - Excavation and rock support - First Part - Support class UA53.1
- LHC-PSW135133102 - Excavation and rock support - First Part - Support class UA53.2

UA53.2 First part

Considered deformation (Td)	8 cm
Excavation section (Vault)	48.45 m²
Excavation section (Invert)	1.84 m²
Vault development	18.46 m
Invert development	7.07 m

	Tunnel face area ≤ 5m		Rearward area	
	Supports	Quantity	Supports	Quantity
Vault	3a	31 m³/m		
	3b	35 m³/m		
	3e	100 m		
	3f	21 m³/m		
Vault	1a	0.90 m³/m	3f	0.89 m³/m
	1e	2.71 m³/m		
Invert			1a	0.37 m³/m
			1e	1.10 m³/m
			3f	0.37 m³/m
Excavation face	1c	3.23 m³/m		
Vault	2	first layer		
		second layer		



$$\begin{Bmatrix} \delta \epsilon_a \\ \delta \epsilon_r \end{Bmatrix} = \frac{1}{E'} \begin{bmatrix} 1 & -2\nu' \\ -\nu' & 1 \end{bmatrix} \begin{Bmatrix} \delta \sigma'_a \\ \delta \sigma'_r \end{Bmatrix}$$

Rev.	Date	Drawn by	Checked by	Approved by
F				
E				
D				
C	18.05.15	FERRARIO	GIANELLI	VERLINI
B	18.12.20	OLMO	GIANELLI	VERLINI
A	18.03.21	FERRARIO	GIANELLI	VERLINI
-	18.03.30	OLMO	GIANELLI	VERLINI

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Passion**

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multidisciplinary teams
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across
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- Urban & Cities
- Energy & Environment
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70 years of development



1950

Luigi Pini founds in Lugano Studio d'ingegneria Pini

1995

Pini Associati SA the firm becomes a public limited company with shareholders

2013

Development in Switzerland with the acquisition of KBM SA (Sion) and Straub AG (Chur-Baden). Rebranding into Pini Swiss Engineers SA

2014

Opening of the Zurich branch in Switzerland. Expansion outside national borders with the first branch in Austria (Innsbruck)

2015

Establishment of Pini Italia (Lomazzo)

2017

Establishment of Pini France (Paris)

2019

Establishment of Pini Israel (Modi'in)

2020

Opening of Lausanne branch in Switzerland

2021

Adoption new "Glocal" strategy.
Opening Rome, Fribourg, Roveredo branches.
Acquisition of Anastasi & Partners SA in Locarno

2022

Swiss companies merge into Pini Group SA.
Acquisition of JLCM in Lisbon (Portugal), EBEI in São Paulo (Brazil), SEPI in Trento (Italy), INEA in Latina (Italy) and ALP in Visp (Switzerland).
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Establishment of Pini Australia in Melbourne, Pini Norway in Oslo and Pini Group USA in Washington DC.
Acquisition Geodata

2023

Opening of Aarau branch.
New Business Unit Latin America.
New Business Unit Middle East & North Africa.
Opening of the new Headquarters in Grono, Switzerland.

2024

Opening of Basel, Milan, Cairo, Tunis and Abu Dhabi branches.



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is central to everything
we do**

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- Bolivia
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- Egypt
- Equador
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- India
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- Italy
- Nepal
- Norway
- Perù
- Portugal
- Saudi Arabia
- Switzerland
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- Türkiye
- United Arab Emirates
- USA

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for CompleXL projects



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Key numbers

More than

12000

employees

50

branch
offices

1126

CHF

mln
turnover

International
footprint
in over

50

countries

More than

50000

km
of tunnel

More than

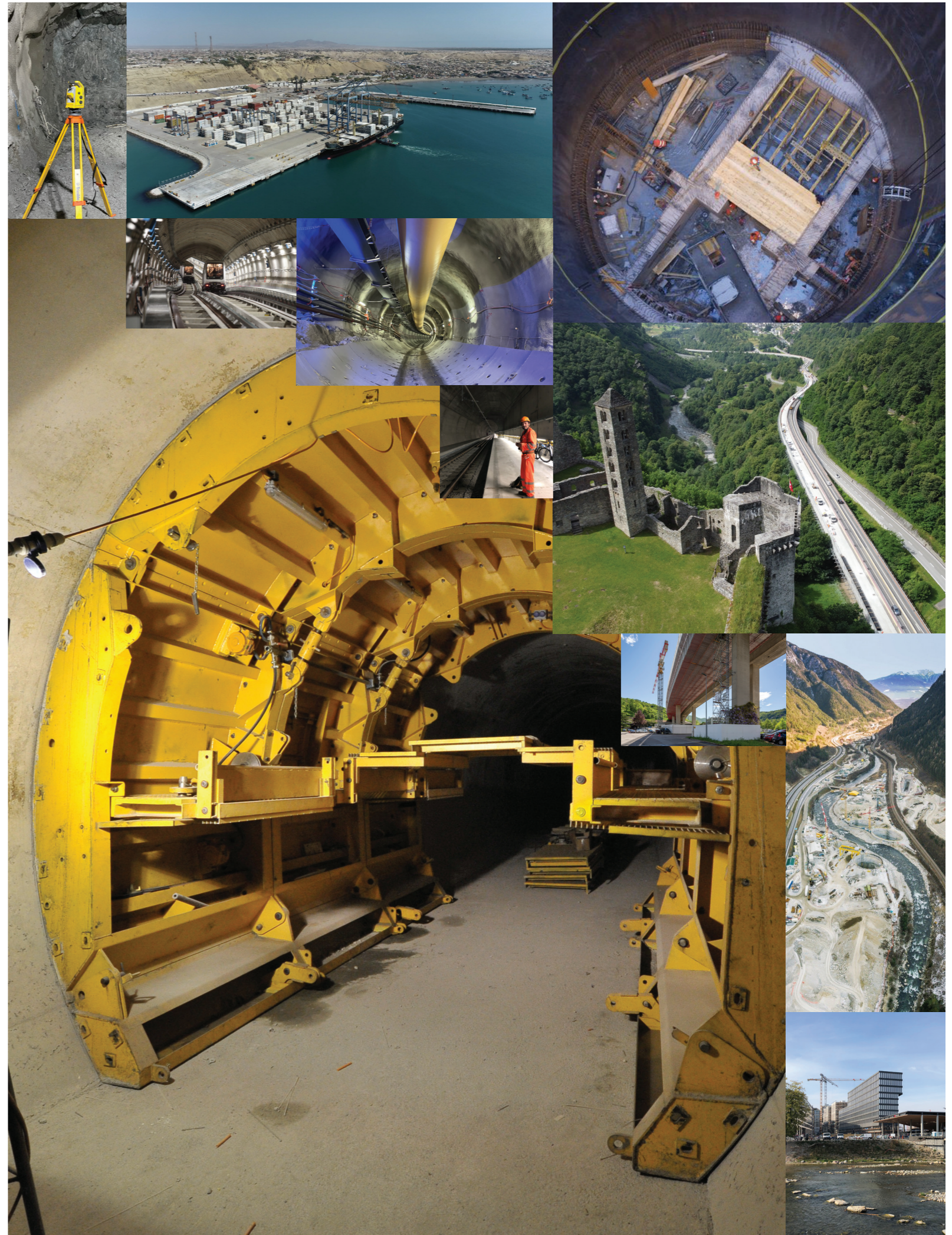
10000

current
projects

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360°
Throughout
the whole lifecycle
of a project

Project Management
Design for public and private clients
Independent checking engineer
Site & Construction Management
Claim and risk Management
Inspection & Assessment
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Our expertise connects people

In the image:
Ceneri Base Tunnel
Switzerland
Construction of two railway tunnels with a total length of approx. 32 km as part of the Alptransit project.

2006 – 2019
1'600'000'000 CHF

Our core business includes the largest infrastructure projects of our time, requiring cost efficient and sustainable solutions in the long terms as well as designs and constructions of all types of traffic routes at local, national, and international levels.

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- **Bus Rapid Transportation (BRT)**
- **Railways & Highspeed Rail (HSR)**
- **Metro**
- **Light Rail Transit (LRT)**

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In the image:
Europaallee Zurich
Switzerland

In a prominent location in the new Europaallee district of Zurich, the building is built of great architectural value and energetically outstanding.

2012 – 2018
80'000'000 CHF

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- Airports
- Ports
- Datacenters



From the feasibility study to implementation, we provide reliable support and advice. Generating, distributing, storing, and consuming energy is becoming increasingly complex. We are partners with our customers in analyzing these challenges and seeking solutions to ensure that their investments are sustainable and ageless.

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- Waterways & Water Management
- Natural Hazards Assessment & Solutions

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We empower ideas for a future of sustainable energy

In the image:
Slotted fishway in Champfèr, Switzerland
The existing fish pass will be decommissioned and replaced with a slotted pass on the opposite bank.

2016 – 2024
1'400'000 CHF

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- Metaverse Architecture
- Innovative Measurements & Drones
- Traffic Planning & Technology

#Pini4Innovation is our Corporate Venture Capital and Innovation Development Fund: the Pini Group's in-house tool that has the agility, expertise and autonomy to invest in innovative start-ups and SMEs in the ACE (Architecture, Construction & Engineering) sector and to support innovative projects.

In the image:
CERN, HiLumi, LHC Point 5
France/Switzerland
The Large Hadron Collider Project (LHC) consists of a 27 km circular system with eight sites positioned around the circumference of the tunnel.

2016 – 2024
65'000'000 € (Point Nr.5)

Worldwide experience



Gubrist Road Tunnel, Zurich
 SBB Europaallee Building, Zurich
 Interxion Datacenter ZUR 4, Zurich
 Campus HES Sion, Valais
 Hôpital du Valais, Valais
 Susten Road Tunnel N9, Valais
 Martigny High-Voltage Underground Link, Valais
 Highway Vennes-Chexbres TP3 + TP5, Vaud
 Limmern Pumped Storage Plant 1520 MW, Glarus
 Drinking Water Plant Riet, St. Gallen
 Switzerland

Sotra Link Road Tunnels, Norway
 Vestkorridoren E18 Road Tunnel, Norway
 Buildings Degnerstrasse, Germany
 Grand Paris Express, France
 Metro of Toulouse, France
 CERN HL-LHC, France/Switzerland
 Road Tunnel TSEE 4.0, France
 Airport Bâle-Mulhouse, France/Switzerland
 TELT Railway Base Tunnel, France/Italy

Ceneri Base Railway Tunnel, Ticino
 SBB Refurbishment Railway Tunnels, Ticino
 SBB Bellinzona Railway Station, Ticino
 Giornico Multi-Service Area and HGVC, Ticino
 Highway PoLuMe N2, Ticino
 Mendrisio Road Junction N2, Ticino
 Second Gotthard Road Tunnel, Ticino/Uri
 Switzerland

Bogdkhan Bypass Railway Tunnels, Mongolia
 Friendship Bridge, China
 HSR Zhengzhou-Zhoukou-Fuyang Railway (PMC), China
 HSR Beijing-Shenyang Railway (PMC), China
 HSR Shangqiu-Hefei-Hangzhou Railway (PMC), China
 Siddhababa Road Tunnel, Nepal
 HPP Bheri Babai Diversion Multipurpose 48MW, Nepal
 Metro of Bangalore, India
 Delhi Metro, Phase III, India
 Mumbai Metro, India
 North East Link, Australia
 Metro of Sydney, Australia
 Snowy 2.0 Hydro, Australia
 Forrestfield Airport Link, Australia
 Cross River Rail, Australia
 Northern Sydney Freight Corridor - Stations, Australia
 Eastern Region Line (ERL), Singapore
 New Mutwal and Torrington Storm Water Tunnels of Colombo Metro, Sri Lanka
 Metro Interchange node with Volzhskaya Metro Station & Ryazanskaya Transit Oriented Development, Russia
 SMART Tunnel - Kuala Lumpur, Malaysia
 Theun Hinboun Hydroelectric Project, Laos

Terminal Port XXI Sines, Sines
 Salgueiro Maia Bridge, Santarém
 Aveiro Port Feeder Line, Aveiro
 Red Line Metro, Lisbon
 Portugal

RFI Fortezza-Ponte Gardena, Alto Adige
 BBT Underpass Isarco river, Alto Adige
 CEPAV2 HSR Milano-Verona, Lombardy/Veneto
 Tram of Padova, Line 3, Veneto
 RFI HSR Napoli-Bari, Campania/Puglia
 RFI Giampitieri-Fiumefreddo, Sicily
 Turin Automatic Metro Line 1 & Depot (GOA4 Automatic Line), Piemonte
 Italy

South Hartford Conveyance and Storage Tunnel, Connecticut
 3RPORT, Indiana
 Lower Olentangy OARS Tunnel, Ohio
 Parallel Thimble Shoal Tunnel, Virginia
 LA Outfall Tunnel, California
 Suffolk County Outfall Replacement Project, New York
 Chemical and GTL complex project, Louisiana
 USA

Bridge over the Rio Grande, Costa Rica
 PSA Marine Terminal, Panama
 Via Ferrea, Bolivia
 Distribution Lines renovation, Paraguay
 Paíta Port, Peru
 Lima Metro Lines 2 and 4, Peru
 Offshore Port, Colombia
 Bogotá-Fucha-Tunjuelo Wastewater Interceptor and complementary works, Colombia
 E-ELT, Antofagasta, Chile
 Santiago-Batuco Railway Line, Chile
 HPP Alto Maipo 531MW, Chile
 Chuquicamata Mine Access Tunnel, Chile
 HPP Coca Codo 1500MW, Ecuador
 HPP Villadora & Chontal 365MW, Ecuador
 Matanza-Riachuelo basin Lot 1&3, Argentina
 Multi storey depo: Etileno XXI Project, Mexico
 Caracas Metro. El Valle-La Rinconada-Line 3, Venezuela

Monorail Line 17, São Paulo
 São Paulo Metro Extension of Line 5 and Depot, São Paulo
 BRT São Luiz, Maranhão
 Maringá Road, Paraná
 BRT Goiania, Goiás
 Salvador Airport, Bahia
 Fortaleza Airport, Ceará
 Manaus Port, Amazonase
 Brazil

BBT Railway Base Tunnel, Austria
 Sibiu-Pitesti Motorway, Romania
 North-South Corridor Highway, Armenia
 Road 60 Tunnels, Israel
 Shazar Road Caverns, Israel
 Purple Line LRT, Israel
 Green Line LRT, Israel
 Kokhav Hayraden Pumped Storage Power Plant 340MW, Israel
 Zarqa College Bridge, Jordan
 El-Grou Bridge, Algeria
 Rail Line Beni Mansour-Bejaia, Ghourzi-Tougourt, Algeria
 Rabigh PP2 Water Intake Structure, Saudi Arabia
 Tahliya Underpass and Flyover, Saudi Arabia
 Réunion Island Bridge, France (Overseas)
 Wharf Gorée Island, Senegal
 Dakar Airport, Senegal
 New Luanda Airport, Angola
 Istanbul Metro, different lines, Türkiye
 HPP Julius Nyerere 2100 MW, Tanzania
 Bar-Boliare Highway, Montenegro
 Main Eastern and Western Tubes of Alborz Tunnel, Iran
 Thessaloniki Submerged Tunnel, Greece
 Gibraltar strait crossing, Gibraltar

A team ready for the challenge

Group Management



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Head of Business Unit Latin America



Davide Merlini
Group Chief Technical Officer



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Head of Business Unit
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Roberto Schürch
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Switzerland & Austria	Italy	International	LATAM	MENAA
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Market Area East St. Moritz Chur Ilanz	Milan	Norway Bergen Oslo	Chile Las Condes Santiago	United Arab Emirates Abu Dhabi Dubai
Market Area South Lugano Roveredo Locarno Visp	Rome	France Chambéry Paris	Argentina Buenos Aires	Saudi Arabia Riyadh
Market Area West Sion Lausanne Fribourg	Trento	Israel Modi'in	Ecuador Quito	North Africa
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Austria Innsbruck	Latina	North America	Brazil São Paulo	Egypt Cairo
	Brescia	USA Washington DC		Asia
	Construction Management	Oceania		India New Delhi
		Australia Melbourne Sydney		Nepal Kathmandu
				Türkiye Ankara Istanbul

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Finance	Human Resources	Information Technology	Innovation	Marketing & Communication	Strategy & Business Development	Sales	Quality
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EXCAVATION PROFILE UR55 2
L = 6.00 m

	Project level
	Excavation level

$$G = \frac{E}{2(1+\nu)}$$

$$K = \frac{E}{3(1-2\nu)}$$

POSITION OF THE
LATTICE GIRDERS

$$\gamma_{xy} = \frac{\tau_{xy}}{G}$$

$$\gamma_{yz} = \frac{\tau_{yz}}{G}$$

$$\gamma_{zx} = \frac{\tau_{zx}}{G}$$

Effective excavation line
(including Td)

