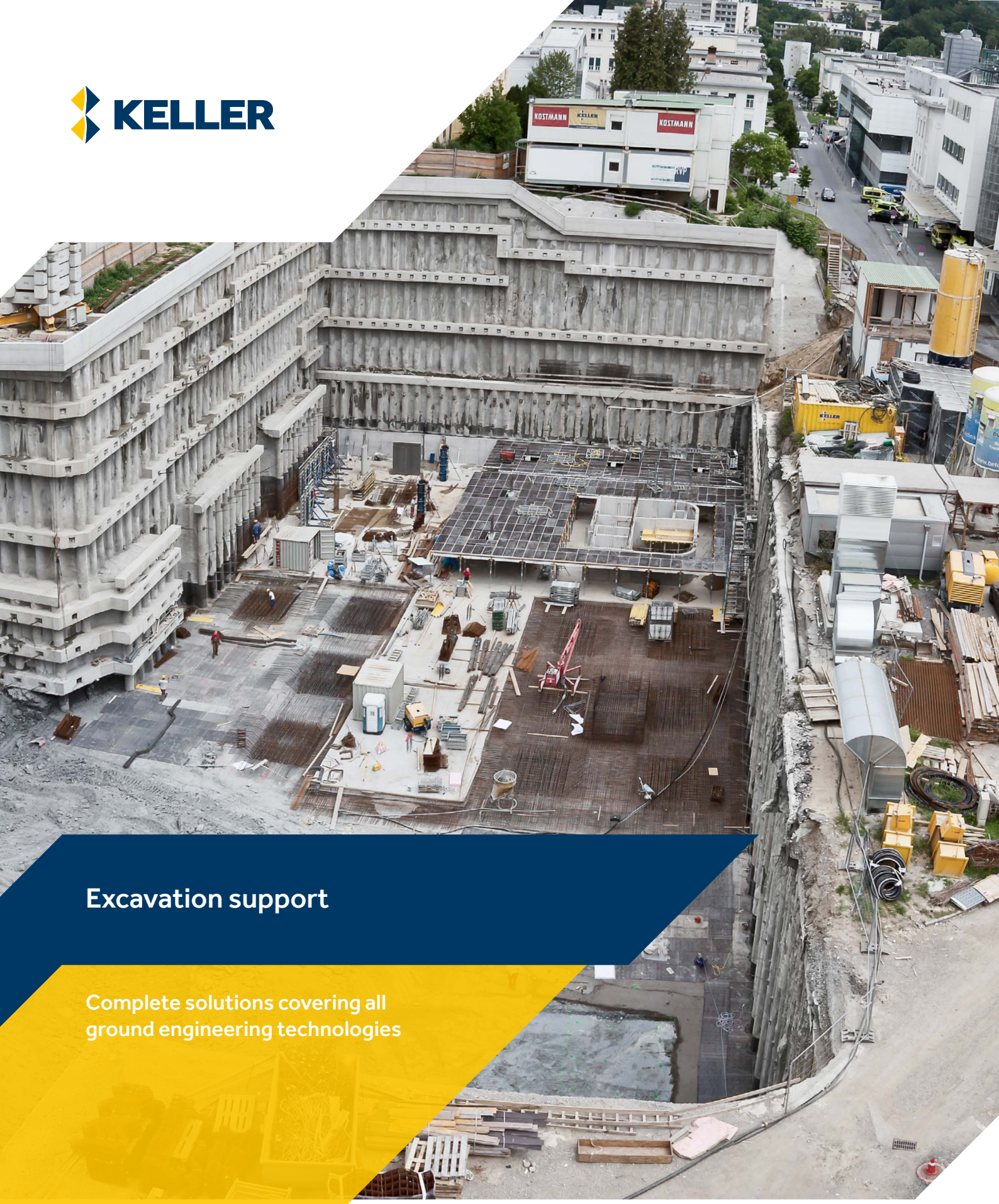
KELLER



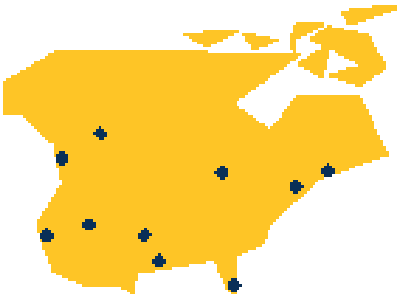
Excavation support

Complete solutions covering all ground engineering technologies

Geotechnical solutions for the construction industry

Keller Group plc - Who we are

Every day, people around the world live and work on ground prepared by Keller, the world's largest geotechnical specialist contractor.



North America

Bencor
Case Foundation
Hayward Baker
HJ Foundation
Keller Canada
McKinney Drilling
Moretrench Industrial
Suncoast

EMEA

Central Europe
North-East Europe
North-West Europe
South-East Europe
Brazil
Franki Africa
Middle East
Iberia and Latin America
French Speaking Countries

Asia-Pacific

ASEAN
India
Keller Australia
Waterway Constructions
Austral Construction

Solutions specialist

Used individually or in combination, our technologies solve a wide range of challenges across the entire construction sector – from industrial, commercial and housing projects to infrastructure construction.

Global strength and local focus

Global strength and local focus are what makes us unique. Our knowledge of local markets and ground conditions means we're ideally placed to understand and respond to a particular local engineering challenge. Our global knowledge base then allows us to tap into a wealth of experience, and the best minds in the industry, to find the optimum solution. With 10,000 employees and operations in more than 40 countries, we have the people, expertise, experience and financial stability to respond quickly, get the job done and see it through safely.

By connecting global resources and local knowledge, we can tackle some of the largest and most demanding projects around the world but the everyday work we do is just as important and, in total, we handle an unrivalled 7,000 projects every year.

Keller at a glance

1860 established

10k employees

40 countries

7k projects pa

We are
the world's largest geotechnical specialist contractor

Helping create infrastructure that improves the world's communities

- Ground improvement
- Grouting
- Deep foundations
- Earth retention
- Instrumentation and monitoring

KELLER

Overview

The unique character of each project and the underlying site conditions mean that customised solutions in the planning and construction of excavation support are essential. As a full-service provider, Keller is able to offer solutions perfectly tailored to the requirements of any project.

Keller can provide suitable solutions for many soil conditions and technical requirements in connection with excavation support. Our extensive geotechnical expertise accumulated over the years enables us to provide cost-efficient solutions, especially on complex shoring systems.

The variety of systems we are able to offer allows us to respond flexibly to a variety of boundary conditions. We are committed to maintaining the highest quality and environmental standards, which are deeply rooted in our company philosophy.

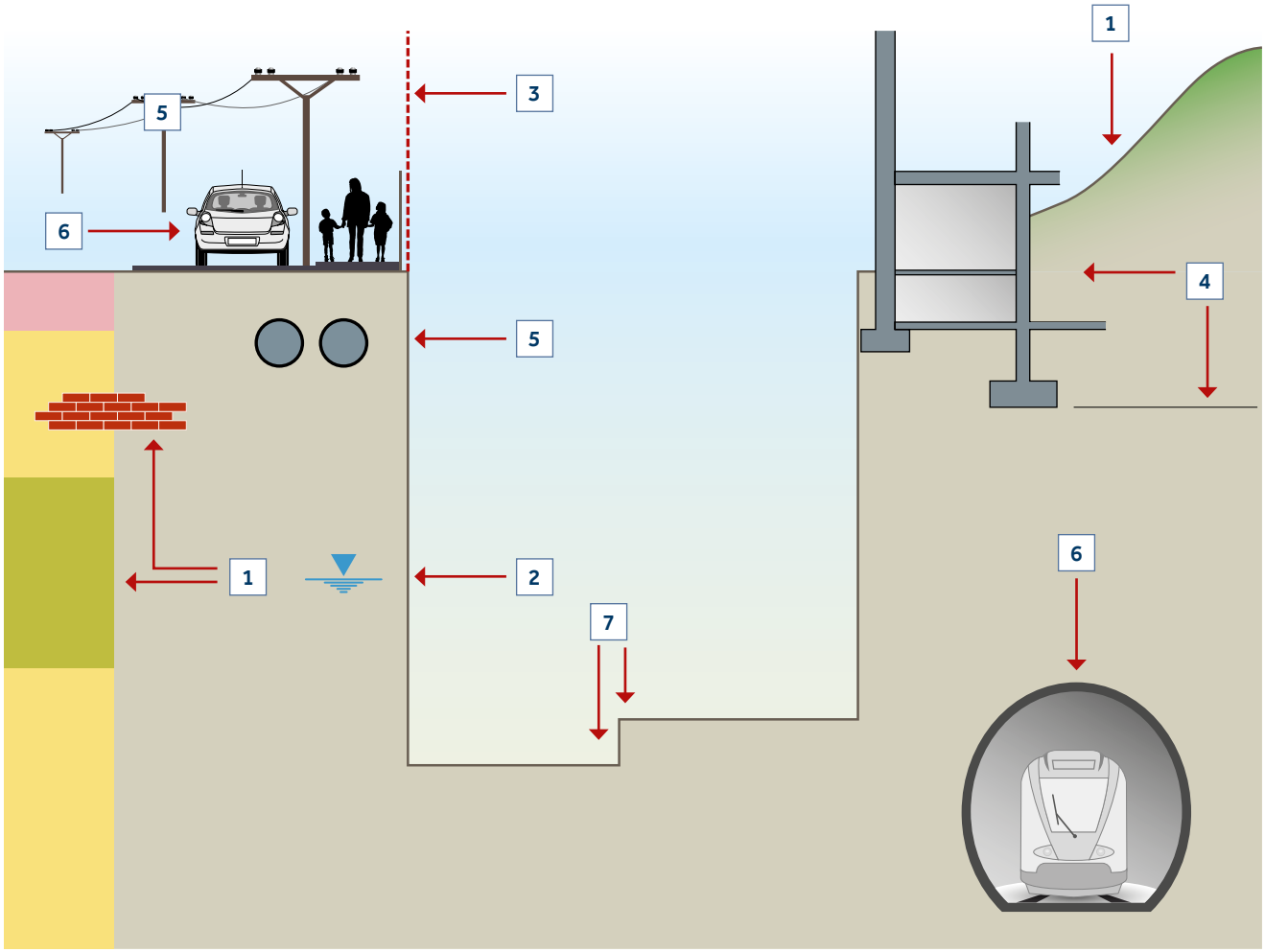
Our engineers are constantly pushing the boundaries of our high-performance products, and we make extensive use of the most advanced software to ensure our designs are the best they can be to suit your project.

Health and safety

Health and safety is a priority for Keller and we have a proven track record of one of the lowest accident frequency rates in our industry. The commitment of leaders and employees to our Think Safe programme has earned us awards and recognition from industry bodies as well as our clients.

We believe no one should be harmed as a result of any work we do and our ultimate goal is zero incidents.

When designing and constructing excavation support, we work to complex boundary conditions and performance requirements, whilst considering how to make the best use of the land available.

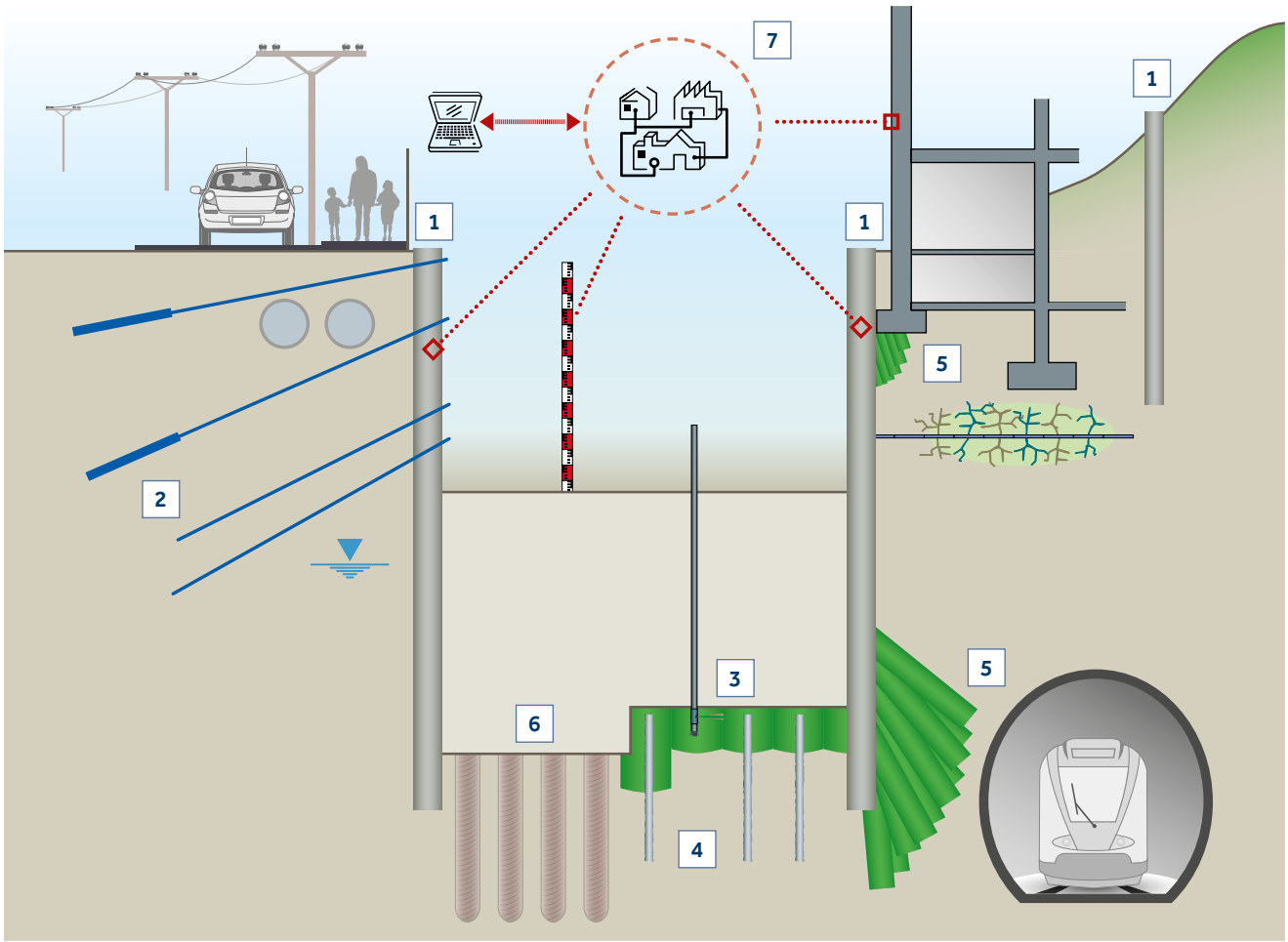


Requirements

- Minimum impact on existing building structures
- No disturbance to day-to-day operations
- Optimum use of plot space and facilities
- Integration of foundation system into the overall structure
- Minimum deflection even for deep excavation support
- Compliance with environmental standards, noise, dust- and vibration regulations
- Efficient use of natural resources
- Extensive monitoring and verification through measurement, with detailed records
- Close cooperation between owner, designer and foundation specialist

1. **Soil conditions**
   Difficult soil conditions (stratigraphy, obstructions, existing slopes etc) require careful design and planning to select an appropriate solution.
2. **Groundwater**
   Protection of groundwater against pollution and prevention of water ingress into the excavation pits.
3. **Plot boundaries**
   Plots and existing rights of way require particular care when planning the building site and during construction.
4. **Existing buildings**
   Damage to adjacent buildings as a result of the work being conducted must be avoided. In particular, the serviceability of the existing building foundations must not be compromised. This often requires additional support and underpinning to secure them.
5. **Underground services**
   Underground services such as sewage and water pipes, power lines and communication cables must remain in service, especially in densely populated areas such as city centres.
6. **Traffic**
   Traffic flow should be impeded as little as possible and existing traffic infrastructure needs to be protected against damage.
7. **Varying excavation depths**
   Some projects require excavation depths to vary across the site, for which a range of tailored solutions may be required.

Keller offers flexible solutions and specialist techniques to solve even highly complex excavation support problems. Working to industry leading quality and environmental standards is an integral part of our philosophy.



Solutions

- Complete package: A full range of methods for the construction of excavation support to suit your job
- Custom-made solutions designed in our in-house Engineering Centre
- Low-vibration and ecologically sustainable construction
- Use of environmentally compatible materials
- Continuous monitoring
- Flexible response to unexpected problems
- Direct communication between client and Keller
- Extensive knowledge from more than 150 years' experience in ground engineering

1. Pit walls
- Bored pile walls
- Diaphragm walls
- Sheet pile walls
- Berlin type pit lining
- Shotcrete
- Soil mixing method (DSM)
- Jet grouting method (including Soilcrete® wall/ underpinning)
- Combined solutions (eg bored piles and Soilcrete®)

2. Groundwater
- Anchors
- Soil nails
- Steel and concrete reinforcements

3. Base slabs
- Jet grouting method (Soilcrete®)
- Soft-gel chemical grout
- Underwater concrete

4. Uplift control
- Micropiles

5. Base slabs
- Jet grouting method (Soilcrete®)
- Soilfrac® curtain

6. Foundations
- Bored pile walls
- Piles
- Diaphragm wall barrettes
- Full range of soil improvement methods
- Jet grouting method (Soilcrete®)
- Deep soil mixing method (DSM)

7. Measurement
- Monitoring
- Control
- Documentation

Glücksteinquartier Mannheim, Germany

In a major development project for the city of Mannheim, Keller Grundbau constructed the 'No. 1 Excavation Pit' in the southern part of the inner city. The site covered an area of around 6,000m² with an average depth of 5.50m. Keller constructed a pedestrian ramp (interpile sheeting with shotcrete infill) and excavation pit shoring with bored pile walls and anchors, as well as completing earth excavation and demolition work and soil improvement.

Project examples

Schultheiss-Quartier Berlin, Germany

Centered around the historic Schultheiss Brewery, a new shopping and service centre was built in the Berlin district of Moabit. Together with Bauer Spezialtiefbau, Keller Grundbau constructed the complete excavation pit.

Our services included the demolition of ten building complexes including removal of demolition material and excavation of pits covering 4,600m² and 7,100m². Additionally, implementing a shoring system: 7,000m2 of mixed-in-place walls, 2,650m² of Soilcrete® walls, 700mm² of bored pile walls, uplift tension and shoring anchors. We installed a 11,600m² silicate gel sealing barrier, managed the excavation of 95,000m³ earth and dealt with groundwater drainage through gravity wells and groundwater cleaning systems.

Discovery Basement

Sandton, Johannesburg, South Africa

Keller company Franki Africa carried out a mammoth 550,000m^3 excavation and 15,540m^2 lateral support basement for Discovery's new head office. Geotechnical investigations of the site revealed a very complex diabase dyke along most of one of the boundaries and a deeper weathering of the granite bedrock in the area surrounding the intrusion. This resulted in the provision of additional anchor force, and reduction in the rock excavation and blasting requirements. The biggest challenge was the doubling of the anchor forces required to provide satisfactory stability to the excavation face, and limiting the movements of the sites surrounding the excavated area.

Project examples

Four Ashes manufacturing facility

Wolverhampton, United Kingdom

Keller UK installed more than half a kilometre of CFA piled wall to allow the construction of three Press Pits for a new manufacturing facility at Four Ashes near Wolverhampton.

More than 900No 600mm diameter hard and soft piles were installed to depths of 12m and reinforced full length to provide a high retention capacity.

Keller's CFA pile technology was the preferred solution due to the unstable glacial and glaciofluvial soil deposits present. Using two state-of-the-art rigs, the conditions were easily overcome producing high quality piles and impressive rates of production. This ensured the project was successfully delivered within the tight 10-week programme.

Neuer Kanzlerplatz Bonn, Germany

Located in the heart of Bonn, the 'Neue Kanzlerplatz' is an attractive urban quarter consisting of modern office buildings and a hotel. The project comprised three pentagonal buildings including a 100m-tall high-rise structure and a three-storey underground car park.

Keller Grundbau constructed the complete excavation pit covering an area of 20,000m², with a depth of up to 12m. Our services included 6,000m² of diaphragm walls; 2,000m² of secant bored pile walls; 7,000m of anchors; steel reinforcements and 130,000m³ of excavated material.

Project examples

Warburgstraße Hamburg, Germany

In a high-class residential area in Hamburg, Keller Grundbau constructed a complete excavation pit for a new eight-storey residential building with three underground floors. The position of the building site in a cul-de-sac immediately adjacent to the American consulate presented a major challenge from a logistics point of view. Our services included the preservation of the historic facade dating back to 1872; explosive ordnance exploration; excavation confinement with bored pile walls (2,900m²); steel reinforcement; 8,000m³ of excavation; water management with expansion boreholes, as well as residual and day water containment under geologically challenging ground conditions.

Shopping centre, Tamaraceite

Canary Islands, Spain

Keller Cimentaciones was awarded excavation and retaining structure design and construction work for a large shopping centre. The cohesion-less soil and close proximity of a road, meant that a 180m-long pile wall braced with ground anchors was required.

Project examples

Benjamin Street, London, United Kingdom

Keller were employed to install a combination of 600m diameter hard and soft piles to an average length of 24.5m for the basement of a residential building

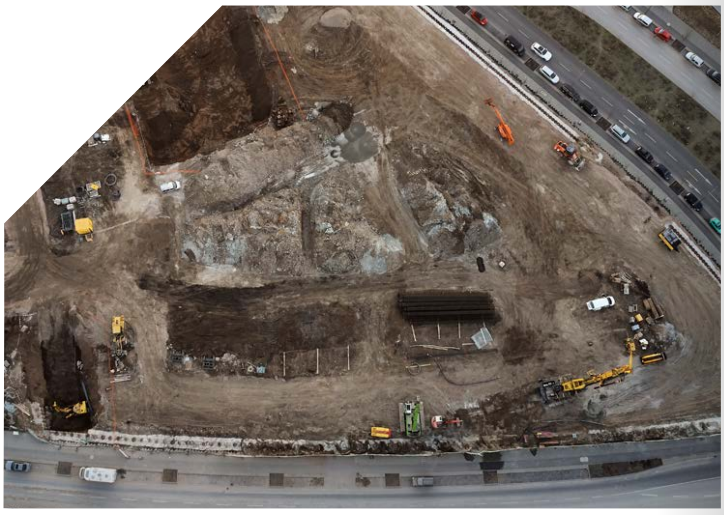
A total of 170 linear metres of secant wall were completed in combination with 70No bearing piles.

The greatest risk identified and managed at tender was the restricted working area. Close collaboration with the client and the nominated groundworker was developed to ensure programme security. This allowed all party wall and approval in principle issues to be addressed.

Hafenparkquartier Frankfurt, Germany

The 'Hafenparkquartier' project is under development in Frankfurt within close vicinity of the river Main, besides the European Central Bank.

Keller Grundbau was awarded the contract to construct the 10m-deep excavation pit on an area of 15,000m² – including related earthworks and dewatering system. The scope of works comprises the construction of an 18m-deep secant bored pile wall with two rows of retaining anchors. In part of the area, permanent micropiles are installed to prevent flotation. Foundation piles with a diameter of 1.5m will be constructed beneath the high-rise buildings.



Project examples

141 Harley Street London, United Kingdom

Design and construction of restricted access mini piles to form a 73 linear metre secant pile wall, a 35 linear metre contiguous pile wall and load bearing piles in low headroom conditions to allow the excavation of a three-storey basement in central London to accommodate a new proton beam therapy facility.

Amongst the challenges overcome by Keller UK were strict noise restrictions, materials transport times, reduced headroom under the temporary props, close vicinity of the pile foundation to neighbouring buildings and tight tolerances in position and verticality.

Works performed: 117 hard piles up to 22m-deep 508/450mm using case and auger methods and 117 7m-deep soft piles using SFA methods sealed into London clay.

Muharraq Sewage Treatment Plant (STP), Bahrain

The Muharraq STP involved the construction of gravity sewer and network connections comprising 47 shafts, one intermediate lifting station (ILS) and one terminal lifting station (TLS). Keller's scope includedeight shafts and one ILS varying in diameter and depths. Keller constructed 0.9m diameter secant piles to a maximum depth of 22.5m to allow the deep shaft excavation works to proceed in dry conditions. Double walled steel casings were used to case the entire length of the secant piles ensuring the required verticality that subsequently produced adequate secant between adjacent piles that is essential to prevent water seepage.

Project examples

LKH – Universitätsklinikum Graz, Austria

Keller Grundbau's scope of work for this prestigious project in the Steiermark state of Austria was divided into two phases:

The slope protection for the emergency access constructed with a continuous flight auger (CFA) pile wall (630mm diameter/8m average length) using 20cm-thick shotcrete infill.

And the 25m-deep excavation pit support executed in two sequences via a lower and upper pile wall. The upper wall installed two-three metres from the lower, using the same piling method as for the emergency access works but with CFA piles up to 20m deep.

The Royal Castle Warsaw, Poland

The construction of the double-floor machine chamber 10m below the courtyard of the 18th-century palace was highly restricted by the presence of historic structures in the subsoil, giving the excavation pit a complex layout. The design and build of the excavation support system was done by Keller Polska and was successful in protecting adjacent buildings. Lateral displacement of the palace wall not exceeding 4mm.

The palace is built on ground with two-eight metre-thick uncontrolled deposits underlain by fine sands and Pliocene clay, with a groundwater level to depths of two-six metres.

A temporary retaining wall was built using a row of deep soil mixing columns, each 0.7m in diameter and 14.5m long, spaced at 0.55m. A steel beam was installed in every second column to provide the required wall strength. The wall was anchored with two - three rows of pre-stressed anchors each 18m long.

Project examples

Maraton
Poznań, Poland

Maraton is a mixed-use building in the heart of the city, surrounded by both business and commercial venues and historical and cultural landmarks.

Keller Polska constructed a perimeter excavation support using 3,900m^2 of d-wall which also limited the groundwater inflow. In addition, horizontal steel strutting has been installed with a total weight of 305 tons.

Trémie du Port Autonome de Strasbourg, France

The extension of the Strasbourg tramway line D needed to pass under an existing railway line, so an underground passage was constructed below the groundwater table.

Keller Fondations Spéciales installed 620mm-diameter secant piles and a 1,200m2 injected slab (1,000mm thick, cement grout and silica mix) as temporary cut-off during civil works.

Project examples

Secant Box Test Pit

Montrose, United Kingdom

During the construction of a Centre of Excellence for Baker Hughes Gas and Oil, there was a need to construct foundations to support a new shed facility and its underground testing pit.

The secant box methodology was a new technique to Keller UK but one which has been successfully utilised in other business units across the world. Due to the challenging ground conditions of dense, saturated sandy strata, a hybrid solution was devised.

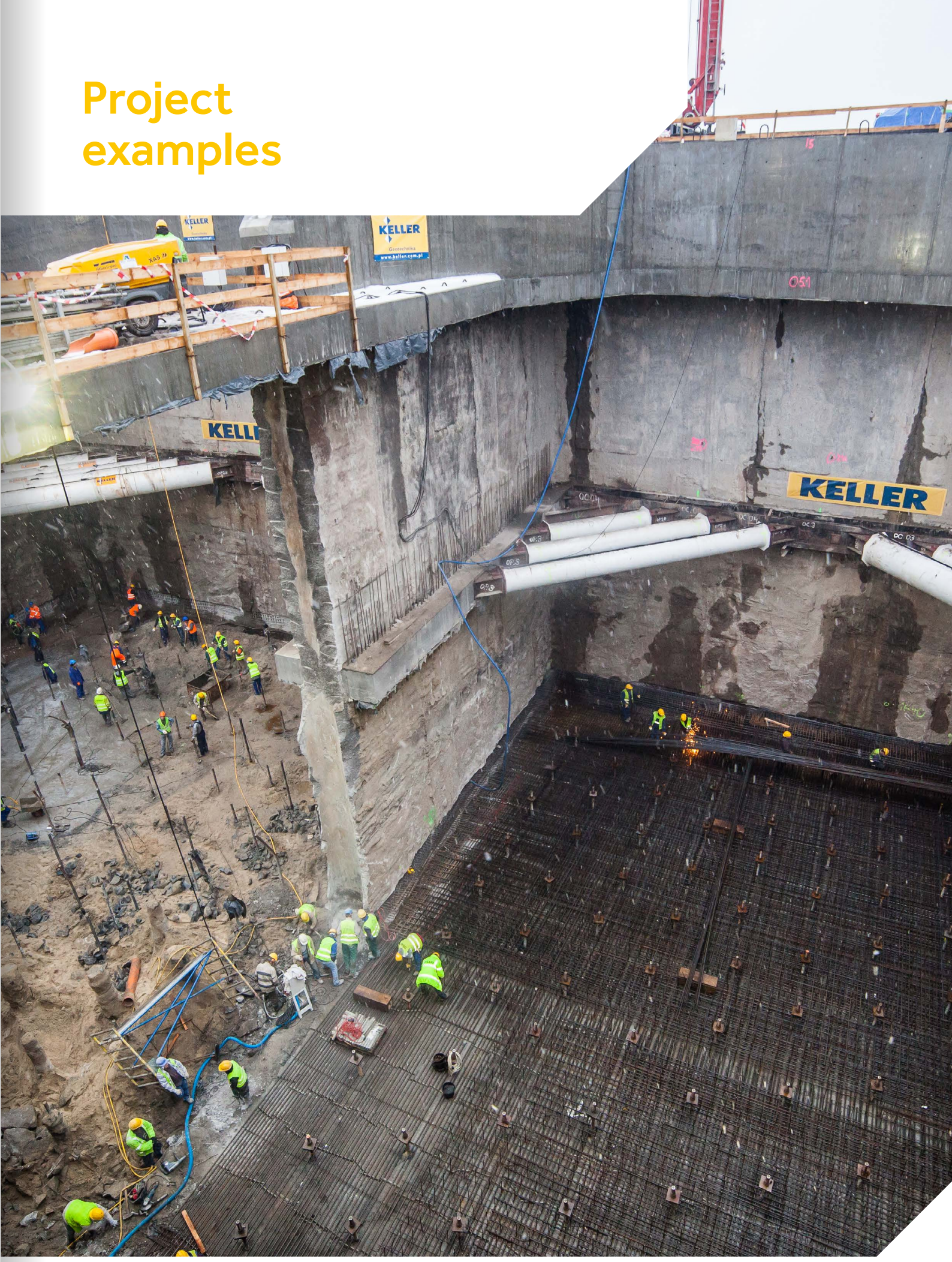
The 900mm diameter CFA piles were installed first with jet grouted columns being sized to seal between the piles and construct the watertight wall. A further 88No plug columns were then installed, up to a diameter of 2.2m to create the base of the box. There were two levels of grouting, the 2m deep plug 12m below ground level to resist hydrostatic uplift and another at 7.5m below ground level to act as a dry working platform to construct the permanent slab.

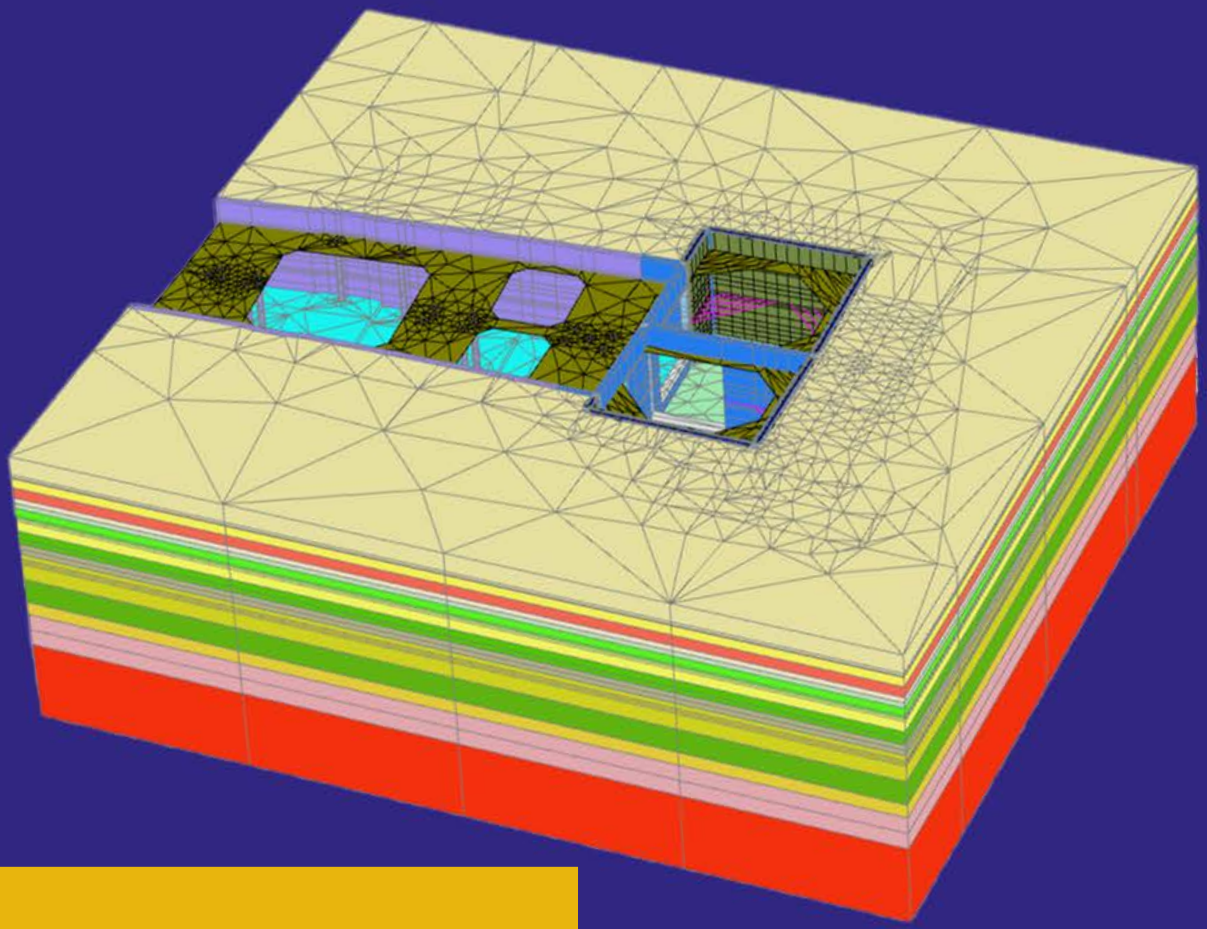
Tunnel under The Dead Vistula, Gdańsk, Poland

The project involved construction of of (up to) 22m-deep and 1,090m-long excavation pits for tunnel ramps and two Tunnel Boring Machines chambers. The team worked with high groundwater levels and challenging ground conditions at the Vistula River estuary, characterised by an alternating presence of sands and soft organic silt. The client adopted Keller's design proposal to move from working underwater to a dry operation to cut construction time and reduce costs. Anchored soilcrete plugs were used in TBM chambers to ensure structural stability and water-tightness - a unique approach.

The scope of work included 66,400m^2 d-walls, 42,000m^3 jet grouting, 60,000m micropiles, 1,500m^3 reinforced concrete, and the installation of 3,000 tons steel structures.

Project examples





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