EDITION | 2024

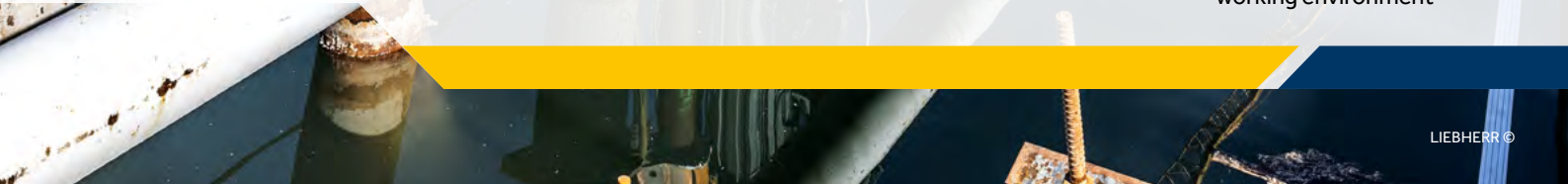
KELLER INSIGHT

CARBON CALCULATOR –
Calculation of CO_2 emissions for special foundation works

WELCOME TO SEN –
Keller's nothernmost branch worldwide is located in Luleå, Sweden

KELLER WOMEN IN CONSTRUCTION (KWIC) –
Our contribution to creating a diverse and inclusive working environment

KELLER



LIEBHERR ©

Dear colleagues and business partners,

As another year comes to an end, it is time to once again present you our Keller Insight magazine and look back on what we have achieved. This year has been a challenge for all of us, but thanks to your and our tireless efforts and enthusiasm, we have achieved great things together.

First and foremost, I would like to thank our site staff. Your hard work, your commitment and your willingness to always give your best, even under difficult conditions, are the cornerstone of our success. Without your daily efforts and commitment on site, our projects would not be possible. You are the heart of our company and I am proud of each and every one of you.

But I would also like to thank our workshop and yard staff, as well as all the office staff. Your support, precision and ability to maintain an overview even in hectic times are indispensable. You ensure that our processes run smoothly and that our projects can be completed on time. Your contribution is invaluable and I greatly appreciate your work.

Last but not least, I would like to thank our business partners. Your trust and cooperation have enabled us to be successful even in a difficult year, which was characterised by the recession, at least in Austria. Your support and your belief in our abilities are of great importance to us. Together we have overcome challenges and broken new ground.

Let us use this moment to be proud of what we have achieved and look to the future with confidence. I am convinced that we will also be successful together in the coming year.

Many thanks to all of you!

Yours, Andreas Körbler

04

AREAS AND DEPARTMENTS

MASTHEAD

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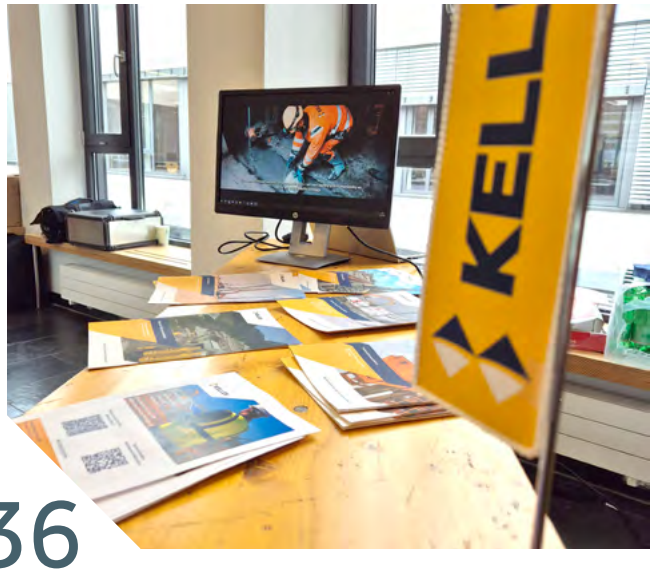
WHAT WE DID IN AUSTRIA

WHAT WE DID IN EUROPE



WHAT WE DID FOR US

INTERNATIONAL

Sustainable solutions **for Jet Grouting**

Keller is constantly working on ways to reduce the carbon footprint of its products. For our jet grouting (Soilcrete) technique, we already started some initiatives and can present some of these findings.

Christian Sigmund – Keller SEN

1 | Switch from combustion engines to electric drives

The use of electrically powered equipment has already been implemented: both the high-pressure pump and the drilling rig are already fully electric and therefore carbon neutral, given the right conditions.

The drilling rig – KB0-electric:
This is an in-house development by the Keller Geräte Service (KGS), which was developed in close cooperation with the users.

The device has successfully been used on construction sites in Austria and abroad for around a year.

In addition to the 75kW main engine, the device also has a small auxiliary motor with only 7.5kW for unloading or maintenance work when there is not yet a sufficient power connection.

The rig comes with a 50m cable as standard, which can be extended to 100m if required. The device is connected via a 200 Ampere plug to ensure a maximum torque of 400Nm.

Compared to a conventional drive, the device has other advantages (no vibrations, lower noise level, higher torque and lower maintenance requirements) in addition to more environmentally friendly operation.

The high-pressure pump – TW800-electric:
As with the drill, Keller also wanted to take a new environmentally friendly approach with the second main consumer of diesel on site. Converting from a combustion engine to an electric motor is relatively simple, but requires significantly higher power.

A 570kW connection is no longer possible via a plug, but via a direct connection to a required transformer.

THE DRILLING RIG – KB0-ELECTRIC

THE HIGH PRESSURE PUMP – TW800-ELECTRIC

Since mid-2023, this unit has been running continuously and successfully on construction sites in the Nordics, where the switch to renewable energy has also received a great deal of support from the clients.

As with the drilling rig, the advantages are lower maintenance costs, a lower noise level and, of course, no local emissions on the construction site.

2 | Use of low-carbon and cement-free binders

It is generally known that by far the most emissions caused by the construction industry come from the raw materials used. It is therefore a very clear and essential step to concentrate on reducing these. The development of alternative binders, such as cement-free binders or low carbon cements, has been the focus of research at Keller's global Jet Grouting team over the past three years.

Low Carbon Cement:
Keller already executed their first project partly with the cement type CEM II **C**-M 42.5N and partly with a well-known, common CEM II **B**-M 42.5N. This enabled us to compare the materials in the laboratory – direct with uniaxial compressive strength tests and indirect with calorimetric tests. Both tests showed a similar ratio between the two types of cement, with Type B performing approximately 10% better.

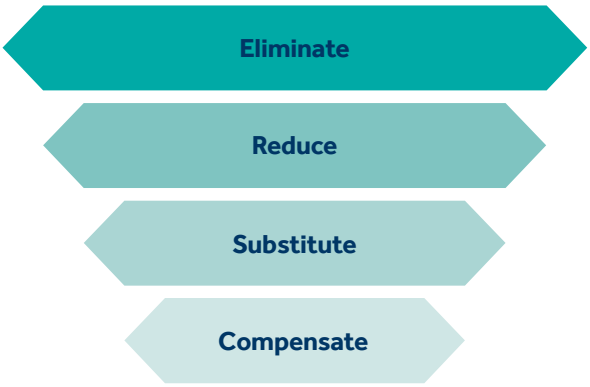
Considering the lower performance, we still can save 20% CO_2, using a Type C cement, even with adding more cement for the same Jet Grouting quality.

Cement-free binders:
The much greater challenge is the development of a completely cement-free binder. However, with the great advantage of a possible savings potential of 80% CO_2 equivalent. The idea is to mix a hydraulic active, low carbon material with an activator (lye solution). In the first step, we tried to find out which materials are suitable and which dosage of the activator is required.

Takeaways:

- Not all materials lead to the same results and locality has a major influence – firstly we need to check if a proper material is available for every single project in the volume we need.
- The price of the activator is crucial, even if the dosage is very low. Major action is to find an inexpensive activator and clients who are willing to pay for a sustainable solution.
- And finally we also saw, that a cement-free binder is much more sensitive to shrinkage cracks. This needs to be considered for every single project.

RELATIVE SIZE OF OUR EMISSIONS (APPROXIMATE)



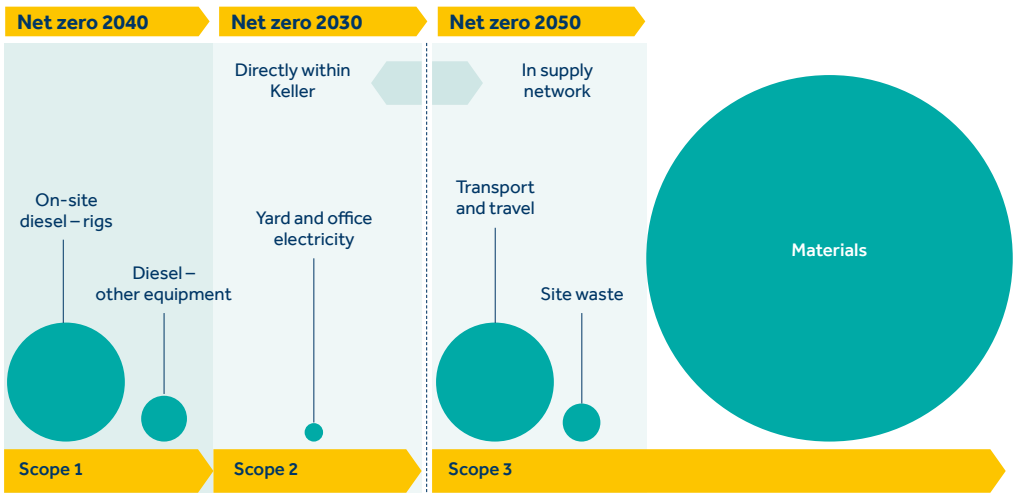
Eliminate emissions completely
eg Teams instead of travel, eliminate concrete, cement and steel

Reduce emissions
eg reduce number of piles and pile diameter, improve the efficiency of our processes

Substitute emission sources
eg low-carbon cements, recycled steel/aggregate, offices powered by renewable power

Compensate
eg carbon-negative solutions, carbon offsetting ('carbon credits')

THE CARBON HIERARCHY



Calculation of CO_2 emissions **for special foundation works**

A joint working group made up of members of the European Federation of Foundation Contractors (EFFC) and the Deep Foundations Institute (DFI) developed the first version of the EFFC-DFI Carbon Calculator over ten years ago. This tool was the first calculation tool for determining the CO_2 emissions of construction projects that was specially optimised for special foundation techniques. The cross-company and cross-national working group was able to create a uniform calculation standard for the special foundations sector. The Carbon Calculator is freely accessible, free of charge and can be downloaded by any user from the EFFC homepage. The aim of this is to achieve the widest possible use, enabling the results of CO_2 calculations from different companies or institutions to be quickly compared with each other. A comprehensive manual (Methodological Guide) is also available on the EFFC homepage, in which all calculation principles are explained.

Alexander Zöhrer – Keller SEN

The methodology for calculating CO_2 emissions is basically the same for all calculation programmes. All emission sources that occur, such as m³ of concrete, are multiplied by an associated emission factor and then added up to the total CO_2 load (see Figure 1). The result is output in kg or tonnes as a CO_2 equivalent (CO_2e). In this way, not only the direct carbon dioxide emissions but also all other greenhouse gases can be taken into account (e.g. N_2O, CH_4).

In the course of development, the most common standards, in particular the GHG Protocol, ISO 14067 and PAS 2050, were used as the basis for the calculation logic. In addition to compliance with these standards, user-friendliness and transparency were the most important requirements. In order to enable an efficient calculation, all emission sources were divided into primary and secondary sources based on the analysis of many case studies. Fig. 2 shows the corresponding process-specific distribution of emission sources for each product group. The red frame indicates the primary sources, which account for more than 90% of total emissions and must therefore be recorded in as much detail as possible. Secondary emissions can be taken into account in a simplified manner as a percentage of total emissions using process-specific factors. The tool also gives the user the option of calculating secondary emissions based on actual data. This is always useful if the project differs significantly from typical projects in certain aspects, e.g. if personnel have to travel to the construction site by plane due to long distances.

Fig. 3 shows the calculation framework for determining emissions. The project-based approach thus takes into account all emissions that occur along the supply chain, starting with the production of the construction materials and equipment, their transport to and from the construction site and the actual production on the construction site. The EFFC-DFI Carbon Calculator contains its own database with emission factors specially selected for special foundation works, which have been taken from various databases. The user also has the option of using additional emission factors or other values for existing factors. In order to ensure transparent compa-

rability of the results, such changes are listed on the results sheets.

Data is entered into the Excel-based tool on separate input sheets for each construction method. In this way, several products can be summarised into an overall project, which can then be compared with other projects. In this way, the advantages and disadvantages of different methods in terms of CO_2 emissions can be quickly recognised and evaluated. In many cases, it makes sense to relate the calculated absolute values to project-specific parameters. In addition to the order volume in euros, two functional units can therefore be freely defined. Typical examples of such functional units for foundation projects are 'kN of load transferred' or 'm² of foundation area', while 'm² of elevation area' or 'linear metres of excavation support' are well suited for retaining structures.

In addition to the information in the manual, the Association of Austrian Drilling, Well Construction and Special Foundation Companies (VÖBU) organises training courses on the use of the Carbon Calculator. A separate working group, consisting of members of the EFFC Sustainability Working Group and the American DFI, is currently working on the development of a new, modern application to replace the existing Excel calculation tool. This should be available from autumn 2025.

FIG. 1: PRINCIPLE OF CALCULATION

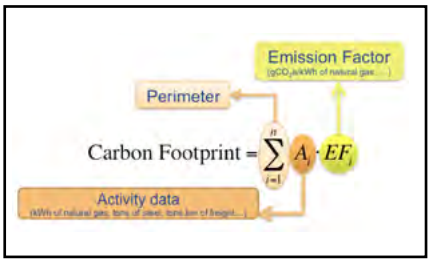


FIG. 2: INCLUDED TECHNIQUES WITH THE ASSOCIATED EMISSION SHARES

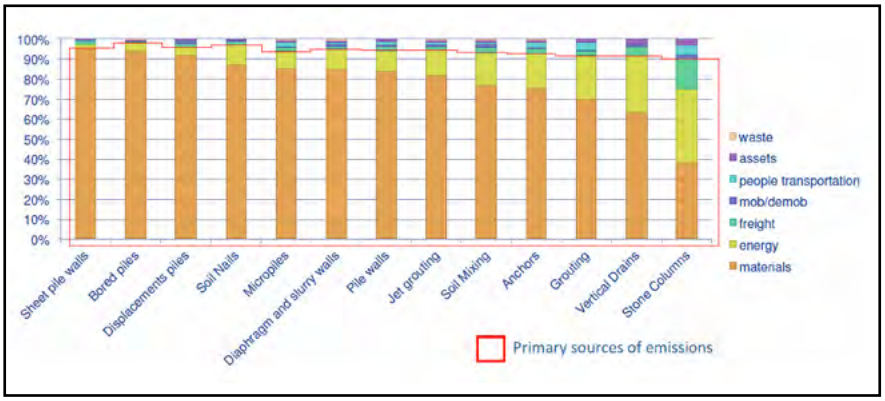
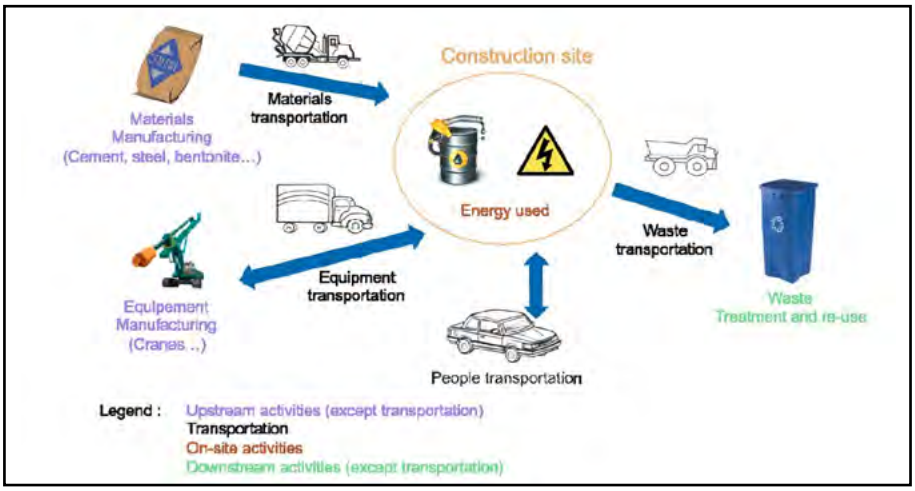


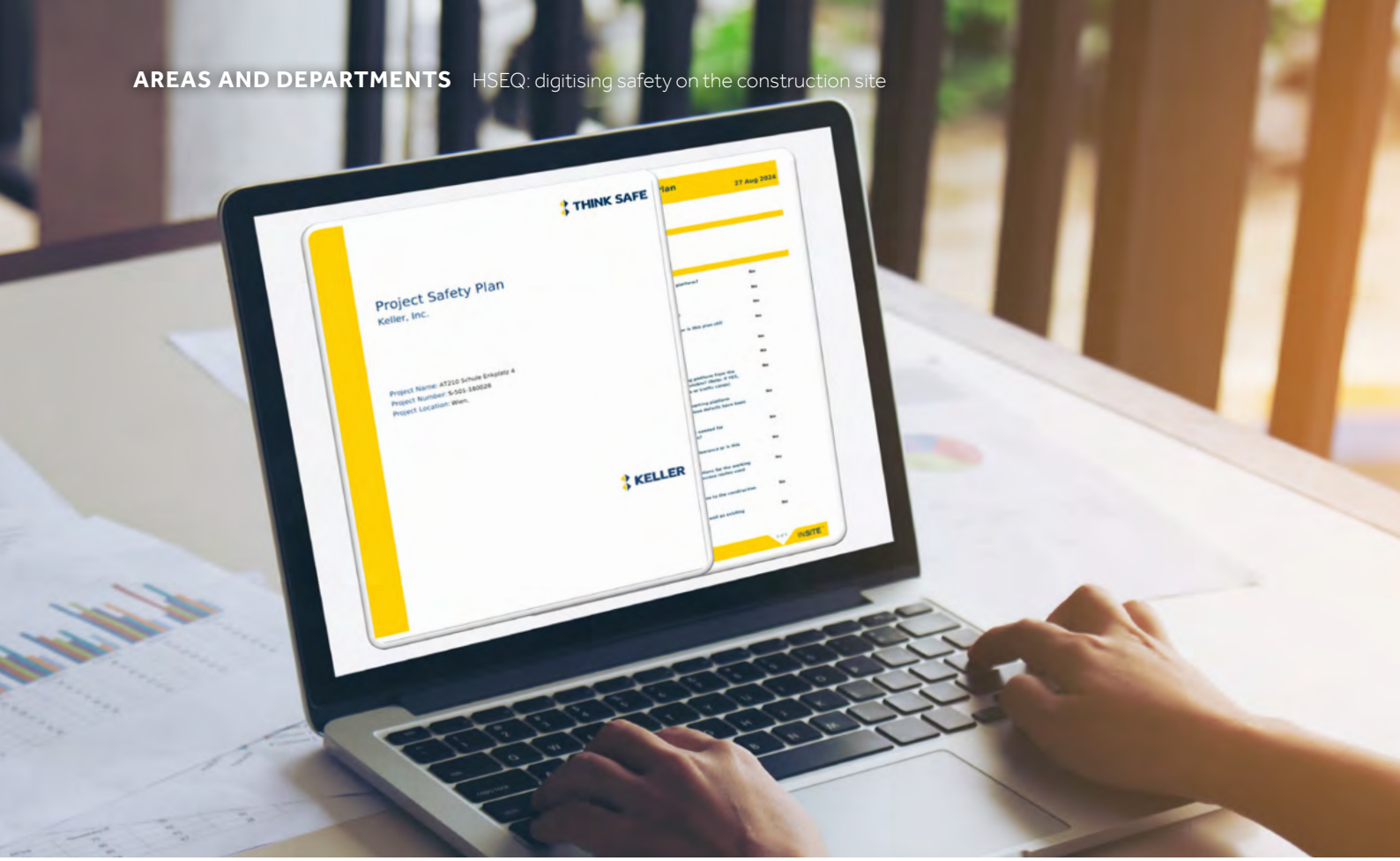
FIG. 3: CALCULATION FRAMEWORK



Further information on the topic of sustainability can be found on the VÖBU and EFFC websites, in particular the Carbon Reduction Guide and the Circular Economy Guide.

voebu.at

effc.org



HSEQ: there can be no improvement without digitisation

Digitisation is now revolutionising safety on construction sites and making a significant contribution to reducing accidents and risks. We at Keller are also following this trend and are using a solution called InSite, which is tailored for the Keller world.

Elke Legenstein / Martina Rückenbaum – Keller SEN

What InSite does for and with us:

The system utilises the required project data from our Keller project management tools and primarily ensures the communication and documentation of all necessary safety-relevant activities of daily construction site management between the office/site management and the construction site/construction site employee.

Furthermore, it helps to identify potential hazards and risks at an early stage, which leads to better safety awareness and improved decision-making, which in turn contributes to minimising or avoiding accidents.

> ***The equipment required for this on the construction site is limited to a tablet or laptop.***

During the preparation and set-up of the construction site (1st day), the hazard evaluation is prepared by the site manager/foreman and the corresponding project safety plan (PSP) is generated as a result.

The tool then requests the daily safety meetings on the construction site, which are held by the foremen with the construction site employees. After the meeting, each employee confirms the instruction on the tablet or laptop by signing and the foreman generates the corresponding report from it, which is thus always available digitally.

Safety warnings and/or Tool Box Talks are updated on a daily basis and thus become part of the daily meeting.

Using the integrated dashboard function, this gives us an optimal overview of all these interactions and their results.

Conclusion:
- Minimises errors caused by delays or loss of information
- Improves communication between all parties involved (office ⟷ construction site)
- Reduction of misunderstandings and coordination errors
- Increased security awareness
- Complete documentation
- Accident reduction/avoidance

DASHBOARD

Due to our ongoing efforts to increase safety on our construction sites, digitisation is also being used in other areas – to live the holistic aspect of HSEQ.

Another Keller-wide tool called **EcoOnline** helps us with this.

This unifies the results from InSite through further significant interactions that broaden the perspective on everything related to HSEQ.

In EcoOnline, for example, leadership interactions, HSEQ site inspections and 5S audits are carried out and documented. In addition, the tool is also used to report near misses and safety-related incidents and to evaluate them.

Conclusion:
- Documented verification for our IMS (Integrated Management System)
- Measures are tracked and assigned to the responsible persons
- Key figures can be generated and monitored out of it
- Involvement of all management levels

PROJECT INFORMATION

Investor:
BE Energy GmbH

Client:
ENERCON

Geotechnical consultant:
IGP GEO ZT GmbH

Structural design:
Fröhling & Rathjen GmbH & Co.KG

Techniques:
Vibro replacement (stone columns)

Duration:
June–July 2024

Wind park Neusiedl-Weiden

Development of renewable energy

The existing wind turbines at the Neusiedl-Weiden wind park are being replaced by new, modern ones. This will increase the output and more green energy can be generated. For the new construction, soil improvement using vibro replacement was executed in some areas.

Christoph Nagl – Keller Grundbau, Vienna

The existing wind park Neusiedl-Weiden, north of the Lake Neusiedl, will be 'repowered'. This means that some of the existing turbines will be dismantled and replaced by new, more modern and higher ones. As a consequence, more renewable wind electricity will be generated

Due to the remarkable height of approx. 140m, measured without blades, strong winds evoke high forces on the wind turbines, which must be safely transferred into the ground. Weak soil therefore made it necessary to execute ground improvement. Vibro techniques are very suitable for this, as the soil is improved in such a way that a shallow foundation is possible. Due to the weak cohesive soil in this area, vibro replacement (stone columns) was chosen as the most beneficial method, and we were awarded the job.

The required number of stone columns is determined by several parameters, such as wind turbine and foundation size and loads evoking. All this is calculated by our inhouse engineering and design department.

The vibro replacement method uses a depth vibrator, which feeds coarse granular material to the tip of the vibrator (nozzle) with the aid of pressurised air, creating stone columns in the ground. The depth of the stone columns depends on the load-bearing capacity of the soil and is continuously checked by measuring the current consumption of the vibrator and the vertical pressure. This ensures that each column is embedded in the load-bearing soil.

Compared to other special foundation techniques, vibro replacement is very cost-effective and fits perfectly to the expansion of renewable energies. As neither cement nor steel are used, it is really a low CO_2 foundation method. Gravel required is sourced from nearby gravel pits, which significantly reduces the number of transport kilometres.

A modern rig was used, which, in addition to its high compaction performance, is also characterised by fast assembly and disassembly when moving between the wind turbines. This means that the stone column work could be completed quickly and handed over to the client for further construction.

Power station Tauernbach – **Soilcrete between Austria's highest mountains**

The energy transition is one of the greatest challenges and at the same time one of the most important tasks of our time. In view of advancing climate change and the limited availability of fossil fuels, there is a growing need to switch our energy supply to sustainable and eco-friendly sources. In this context, hydropower is once again back in the spotlight.

Johannes Dolzer – Keller Grundbau, Innsbruck

PROJECT INFORMATION

Investor:
Tiroler Wasserkraft AG

Client:
Ing. Hans Bodner
Baugesellschaft m.b.H.&CoKG

Geotechnical consultant:
Amt der Tiroler Landesregierung

Structural design:
BAUCON

Quantities:
approx. 4,000 m jet grouting (Soilcrete)

Duration:
July – winter 2024

TIWAG is building the Tauernbach-Gruben hydropower plant in East Tyrol. The Tauernbach will be utilised for energy production between the Schildalmen and the Gruben pumping station of the transalpine pipeline. Most of the headrace will be constructed as an underground pipeline. Due to topographical reasons, a gallery construction is planned on the right bank of the Tauernbach (approx. 2.5km) along the section from Schildalmen to the mouth of the Landeggbach. The water intake and desander will be located on the right bank of the Tauernbach, south of the Schildalmen.

In the area of the water intake, a double-row sealing umbrella was constructed using Soilcrete. This serves to control the underground water flow and prevents erosion by groundwater. This is particularly important to ensure the stability of the structure and to protect the surrounding soil structures.

Along the orographic right-hand side of the stream, the bank protection and sealing measures were executed using Soilcrete to minimise dewatering measures for the subsequent work.

SWACRIT systems – **Nassereith production facility**

To expand its production capacities, SWACRIT systems – a company belonging to Dr. Christoph Swarovski's group of companies – is building a third production facility in Nassereith with an area of 8,000m². This facility will be used to manufacture highly sophisticated and complex system tools for the vacuum technology/semiconductor industry. Due to the inhomogeneous soil conditions, soil improvement was planned and ultimately constructed using vibro replacement (stone columns).

Tobias Molitor – Keller Grundbau, Innsbruck

PROJECT INFORMATION

Investor:
SWACRIT systems GmbH

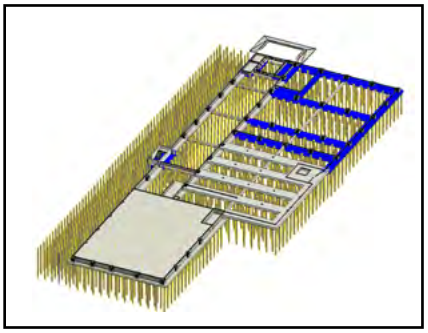
Client:
LOREA Immobilienverwaltung GmbH & Co KG

Geotechnical consultant:
GTC Geotechnik Tirol Consult

Structural design:
ATP Innsbruck Planungs GmbH

Techniques:
Vibro replacement (stone columns)

GRAPHIC:
Cross-departmental 3D design



Soil conditions consisting of alternating layers of sandy gravel and silty fine sand foundation pattern and loads were almost predestined for large-scale soil improvement and homogenisation using the vibro replacement method. This soil improvement method is characterised by penetrating the soil with a deep vibration using compressed air. Coarse-grained material is then fed through the vibrator to the nozzle tip and then compacted from bottom to top in alternating steps. On the one hand, this creates stone columns and, on the other hand, the surrounding soil (if non-cohesive components are existing) is also compacted, increasing the overall load-bearing capacity of the soil and thus, reducing the expected settlements.

Thanks to BIM, it was possible to carry out the design in 3D, which made it much easier to visually check the different foundation heights.

Due to the risk of flood waters from the nearby Gurglbach stream, the working platform was backfilled between 0.5 and 2.5m, to prevent the building against flooding. The column length was adapted to the depth of the load-bearing layer based on the penetration resistance, resulting in column lengths between five and eleven metres.

Over a period of five weeks, a total of 9,470 metres of stone columns were executed simultaneously with two rigs, so the site could be handed over for further construction on schedule.

PROJECT INFORMATION

Investor:
Wuppermann Metalltechnik GmbH

Client:
Unger Stahlbau GesmbH

Geotechnical consultant:
Geotechnik Tauchmann GmbH

Structural design:
PETER MANDL ZT GMBH

Techniques:
CFA piles and shotcrete
Stone columns
Vibro concrete columns

Duration:
May–July 2024

Wuppermann production hall Altmünster

Challenging work at the base of the Traunstein mountain

In Altmünster am Traunsee, Wuppermann Metalltechnik GmbH is building a new production hall including a coil warehouse. In order to optimise the available space, Keller was awarded to secure the adjacent property by executing a permanent, free-standing bored pile wall. In addition, soil improvement was necessary in some areas of the new coil storage facility.

Manuel Senoner – Keller Grundbau, Linz

Due to expected inhomogeneity of the soil, complementary ground investigation was carried out in addition to the existing dynamic probing using a heavy DPH dynamic probe.

The major outcome of this complementary showed two important aspects, firstly a drop of the underlying moraine from 0.3m to 9m and secondly extended areas with low load bearing capacity.

As a consequence the initial planned ground improvement method using stone columns had to be adapted to a hybrid foundation system designing CFA piles and vibro concrete columns with the speciality of 'gravel heads' to ensure elastic load transfer.

This solution allowed the high loading capacities to be transferred into the ground moraine with settlements within the design requirements.

BORED PILE WALL
Permanent, free-standing bored pile wall with shotcrete infill

CONSTRUCTION OF THE TEMPORARY ANCHORS

Messendorf underpass – a lot of news on the ÖBB major project in Raaba-Grambach

An infrastructure project that has been planned for many years is now underway. The construction of a new underpass will relieve traffic congestion in the area of the crossing on Josef-Kaiser street (L370) and the construction of entire local traffic junction will lead to enormous additional benefit for the municipality of Raaba-Grambach.

Peter Schicker – Keller Grundbau, Söding

In the district of Messendorf, in the municipality of Raaba-Grambach, south-east of Graz, Austria, the Messendorf railway station is being rebuilt, the Raaba stop adapted, parking areas built, the entire track system renewed or extended over a length of approximately 2km. In addition, due to the traffic situation, an approximately 250m long underpass is built below the L370 at the junction with the ÖBB railway line Graz main station to Fehring.

The preparation work started already in 2023 with the relocation of lines and the construction of a provisional relief route.

The main work started in January 2024.

An essential part of this is the construction of the L370 underpass as a watertight trough structure, which requires extensive special foundation works. Due to the groundwater level being almost at ground level, the design requires an excavation pit with almost 700 bored piles with temporary anchoring. As rail operations must be maintained during the entire construction phase, a temporary bridge founded on micropiles had to be executed as well.

In January 2024, the general contractor, Kostmann GesmbH, awarded Keller with the special foundation work (bored piles, anchors, micropiles and gravel piles).

After a preparation period of just under four weeks, the construction of the bored piles for the underpass started in mid-February. Due to the requirement that excavation work in the trough structure may only begin after pile execution has been completed, it was necessary to complete the piles as quickly as possible. Therefore, up to three bored pile rigs were parallel

on site – a BG20, a BG28 and a BG30. In just ten weeks, the 700 (approx. 7,500 metres) DN90 cased piles were executed using the Kelly system. Due to the impermeability requirements, all piles were executed with an overlap. The individual lengths of the piles were between 6.2 and 17.0m. The Easter week proved to be a particular challenge for pile construction. In a planned track closure, in the area of the existing track, almost 480m of piles had to be installed in just three shifts, using two machines in very confined space. Around 300 tons of reinforcement and 4,800m³ of pile concrete were installed for the entire excavation pit.

After completion of the bored piles and excavation by our client, the execution of the 129 temporary strand anchors with individual lengths of 16 and 20m and a total length of approximately 2,350 metres began at the end of May. Due to the high groundwater level, some of the anchors were constructed below the ground water table and all these anchor heads had to be sealed accordingly.

Before the walls of the tank structure walls will be concreted, all anchors must be detensioned and the head structures dismantled.

Although our work has not yet been fully completed* (the gravel piles are still outstanding), we can say that despite the tight schedule and the demanding nature of the work, all our services were carried out to the complete satisfaction of everyone involved in the project.

CONSTRUCTIO OF THE APPROX. 700 PILES
in just ten weeks with three machines

PROJECT INFORMATION

Investor:
ÖBB – Infrastruktur AG
(Austrian Federal Railway)

Client:
Kostmann GesmbH

Geotechnical consultant:
BGG Consult

Structural design:
Constructiv ZT GmbH

Quantities:
7,500m bored piles,
2,350m strand anchors,
185m micropiles,
180m ductile piles,
90m gravel piles

Duration:
February – autumn 2024

Editorial deadline: August 2024

Salzburg Museum
Neue Residenz / "Belvedere Salzburg"

The Neue Residenz, home to the Salzburg Museum, is being extensively renovated and expanded. The Austrian Belvedere Gallery in cooperation with the "Belvedere Salzburg" develop a unique project between two museums at one location in Austria. The project includes the underpinning of the existing buildings with jet grouting and anchors for the construction of the new underground levels in the inner courtyard.

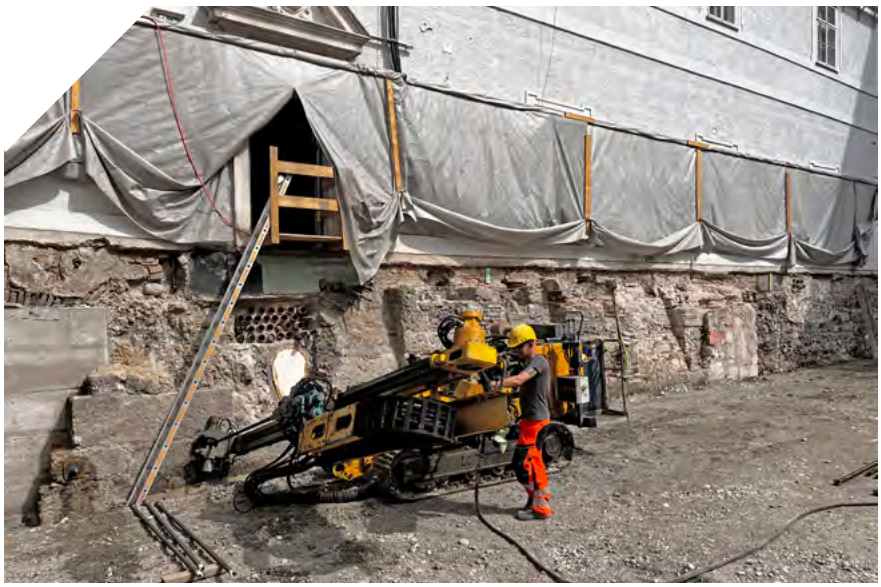
Kevin Fauland – Keller Grundbau, Salzburg

Major challenges already arose during the preparation for the underpinning works. An archaeologists team and monument protection officers were on site and documented every step. Several ancient Roman findings came to light, which were carefully uncovered and comprehensively documented.

The construction work was executed in two main areas: the inner area with its staircases and the connecting corridors, and the outer area 'inner Courtyard 2'. A flexible selection of equipment was crucial to ensure a smooth and efficient construction process, especially in the very narrow inner spaces.

In order to prepare the historic building for the underpinning and for the subsequent excavation work down to approxima-

INNER COURTYARD AREA WITH ARCHAEOLOGICAL PLACE OF FINDINGS



CONSTRUCTION OF THE GROUND ANCHORS IN THE OUTSIDE AREA

PROJECT INFORMATION

Investor and client:
Land Salzburg

Geotechnical consultant and structural engineer:
Geo² ZT GmbH, Hallein

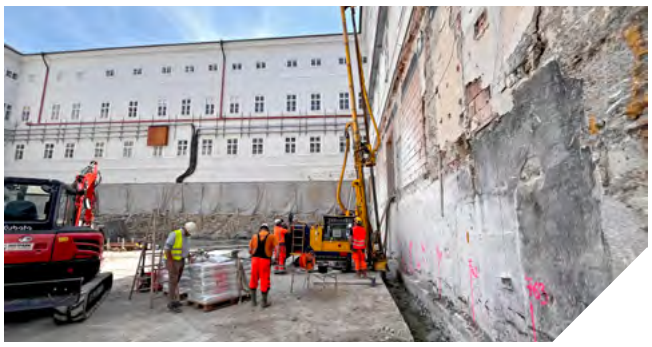
Quantities:

approx. 1,400m ground anchors

approx. 5,000m³ jet grouting

Duration:
May–December 2024

CONSTRUCTION OF JET GROUTING COLUMNS IN THE OUTER AREA



CONSTRUCTION OF JET GROUTING COLUMNS IN THE INNER AREA

ENVIRONMENTAL PROTECTION THROUGH BACKFLOW TREATMENT

tely 9m below the existing surface, the foundation walls were secured with ground anchors in advance. Due to the high building loads, multiple rows of jet grouting underpinning were necessary. Thanks to a carefully selected construction sequence, the jet grouting work was completed in August 2024, nearly without any settlements.

Particular attention was paid to carrying out our work in an environmentally friendly manner. Our innovative backflow treatment system was used, which enabled a significant reduction of material to be disposed. This led to a considerable reduction in disposal transports and thus to a significant reduction in CO_2 emissions.

After further excavation to approximately -6m below the existing surface, a second layer of prestressed anchors will be executed. Only then, the excavation work will be continued to the final depth.

This project impressively shows how technical expertise, care for the historic building fabric and sustainable construction methods can be successfully combined.

SITE INSTALLATION AREA
at the Residenzplatz in Salzburg, Austria

D3 Green bridge Svrčinovec – **special foundation works**

The construction of the highway "D3 Svrčinovec – Skalité", together with the adjacent Svrčinovec junction, narrowed and restricted the natural bio corridor for wildlife, located in the vicinity of the village Svrčinovec. In order to preserve this bio corridor, the project "Green bridge D3 Svrčinovec" was established. To create a natural direct passage for wildlife, with a width of at least 80m, three bridge structures have been designed over road and railway communications, which will be filled with earth.

Daniela Piliarová / Erik Valašik – Keller špeciálne zakladanie, Bratislava

The individual bridge structures were designed to be founded on foundation strips with depth foundations, which, due to the geological composition of the soil and slope deformations, will both transfer the loads from the proposed structures to the load-bearing layer and stabilise the soil in the section of the area. For the bridge construction over the railway line, the special foundation works consisted of large-diameter bored piles and temporary securing of the excavation. Bored piles with a diameter of 1,200mm were executed from two levels. Under the foundation, located within the slope above the railway track, 88 bored piles were designed, with a length of approx. 14m, and for the foundation below the railway, 88 bored piles, each 18m long. Due to the length of the proposed piles and the limited access to the site, the reinforcement cages were delivered in two parts and subsequently welded together on-site according to the design specifications. Due to the location of the lower foundation of the bridge within the slope, and the location of the catenary, it was not possible to execute a temporary slope stabilisation. A ditch, approximately 1.5 to 2m deep, had to be temporarily secured. A retaining wall, made of IPE200 steel profiles, with a length of approx. 5.50m and a spacing of one metre, was executed and the infill between the steel profiles was secured by wooden struts. The excavation to the

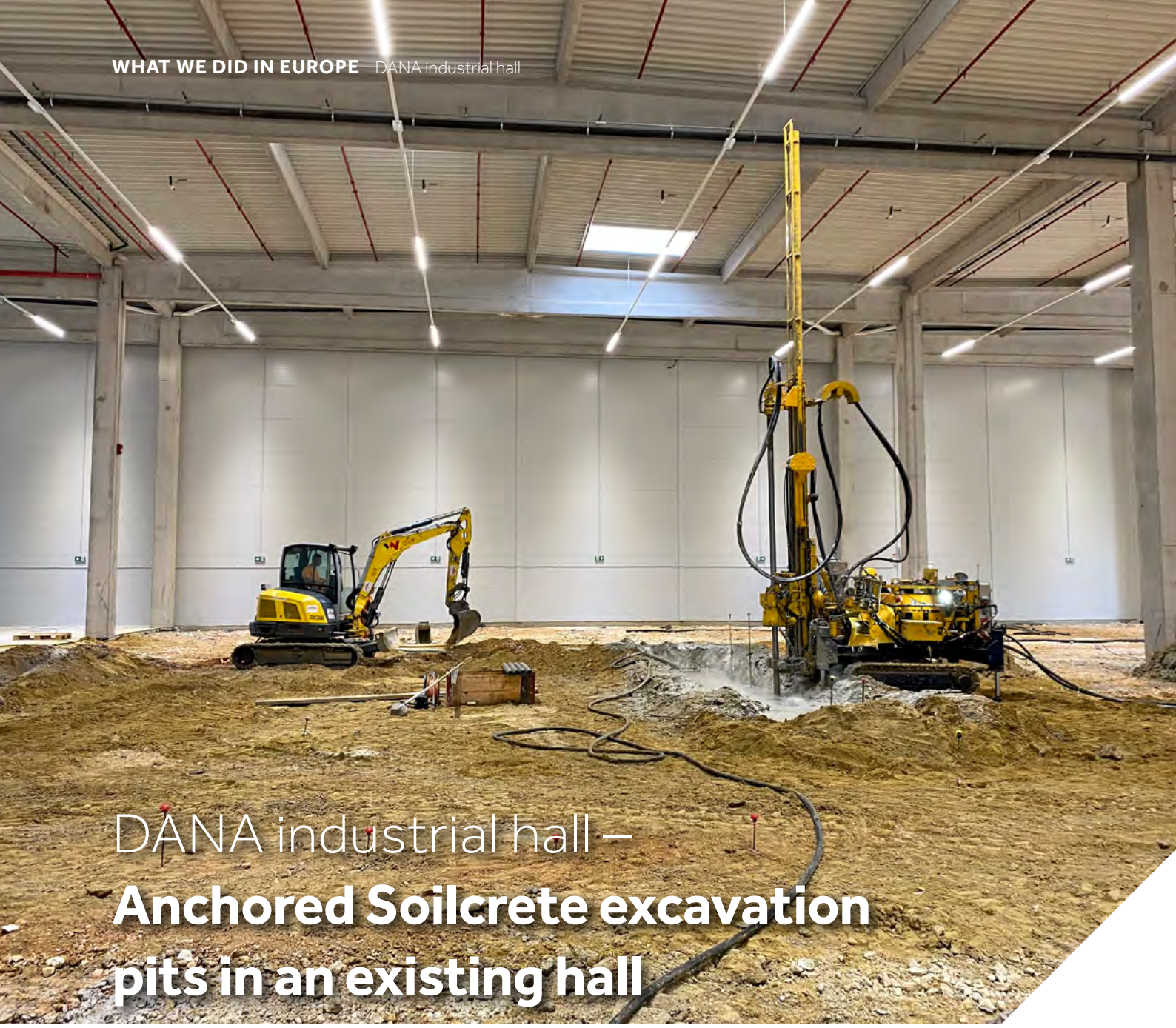
required piling level was carried out step by step. The piles were implemented in close proximity to the trench stabilisation and tied-in to the bearing bedrock, consisting of sound claystone or sandstones (R4-R2).

On the basis of the engineering/geological survey, jet grouting was chosen for the deep foundation of the construction object over the Šlahor stream. In total, 156 columns with a diameter of 1.50m and a length of approx. 2.0 to 3.0m were executed with the columns reaching to the sufficiently load-bearing rock surface. Under one foundation strip, the columns were arranged in two rows. The inner row, was inclined at a 15° angle towards the stream to be able to transfer the horizontal forces.

The same system was chosen for the structure above the road. 160 columns with lengths of approximately 3.0 to 7.5m had to be constructed. One of the proposed footings was located at the foot of the slope but only a small part of the slope could be excavated to create a working platform. The proposed jet grouting columns had to be implemented as 'sunk' with dead drilling and then drilled down to bedrock. Again, the inner row (closer to the I/11 road) was inclined by 15° towards the road.

During the execution of the temporary securing works in the section above the road, which in the original project designed as temporary slope and nailing of the slope, cracks were observed in the soil and at the level of the working platform. The geological conditions mentioned above, place the area in a zone with a potential landslide. As monitoring was carried out during the works, it was possible to react immediately to this critical situation and a permanent stabilisation was designed. In a first step, backfilling was put in place to stabilise the zone and to be able to create the necessary working platform. In a second step, piles of 900mm diameter, in two rows, were designed and executed in such a way not to collide with the executed nails in the lower levels. An additional concrete beam was then placed on top of the piles.

Once the piles and the concrete beam were completed, permanent strand anchors, approximately 19.0m in long, were drilled through and pre-stressed to the required anchorage forces.



DANA industrial hall – **Anchored Soilcrete excavation pits in an existing hall**

This project involved the construction of two excavation pits in an existing hall. Our company developed a solution using the Soilcrete technique and was awarded the contract for the design and execution of the structures. Quality control was very crucial and a key factor to construct the watertight construction pits.

Péter Nagy – Keller SEN
Gábor Gajó – Keller Mélyépítő, Budapest

Keller was awarded by CTP Management Hungary Kft. to construct two excavation pits for machine foundations in an existing industrial hall of DANA Hungary Kft. Keller was also responsible for the earthworks and reinforced concrete work, which was then carried out by subcontractors.

The groundwater level in the project area is at a depth of around 2.50m below ground level, which meant that a water tight construction pit support was necessary. The excavation pit also had to be sealed from below, as it was not possible to embed the walls in a less permeable soil layer. Due to the limited room height in the hall and the high requirements for vibration emissions due to a highly sensitive production processes in the neighbouring hall, only the Soilcrete technique was considered as a possible method for the construction pit. Both the excavation pit walls and the high-lying sealing slab were executed using this technology. Due to the excavation depth, the Soilcrete wall had to be anchored with a row of prestressed strand anchors.

THE EXPOSED SOILCRETE WALL

PROJECT INFORMATION

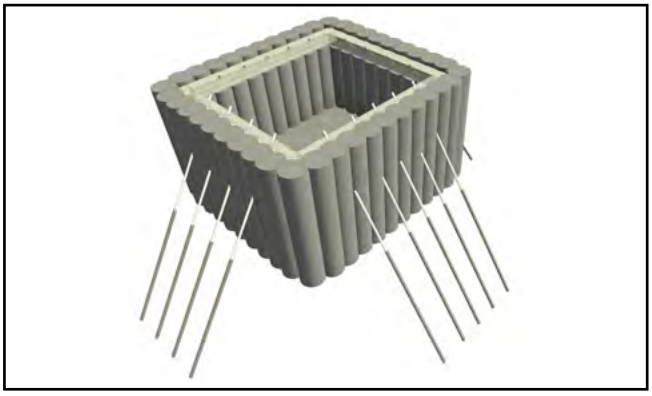
Investor:
DANA Hungary Kft.

Client:
CTPark Arrabona Kft.

Structural engineer:
Mérnök-Mátrix Zrt. /
Keller Grundbau

Techniques:
Soilcrete
Anchors

Duration:
Summer 2024



3D REVIT MODEL OF THE CONSTRUCTION PIT

The jet grouting work was carried out in soil layers characterised by a high percentage of sand and gravel, which is really very favourable for jet grouting. However, the water level difference of six metres and working in the immediate vicinity of the existing foundations caused particular challenges. Furthermore, wood debris was to be expected in the soil. This may lead to jet shadows and subsequently to leakage in the Soilcrete walls and in the slab. A leaking excavation pit is high risk in that special case, as a leakage would not only lead to flooding the excavation pit, but also to wash out the soil under the existing foundations. For this reason, double-row Soilcrete bodies were constructed in the areas of the walls and a thick, high-lying Soilcrete slab was designed. In addition, the existing hall foundations near the pits were underpinned using the jet grouting technique.

The excavation pit was planned by our internal design department. As part of the execution planning, a three-dimensional model for the two pits was implemented using the Revit software package, which is ideally suited for component-oriented building modelling. Three-dimensional modelling has enormous advantages. All existing structures and those to be constructed can be modelled. In this project, potential collisions and leakages in the Soilcrete wall resulting from the designed arrangement of the columns were recognised at an early stage and eliminated during the design and execution phase.

Quality assurance played a central role in this project, especially in the jet grouting work. The production parameters of the columns of various diameters were determined using ACI tests before work began. The production sequence was carefully planned and, if necessary, adjusted on site to minimise production-related gaps. All Soilcrete columns were measured using an inclinometer and visualised in the three-dimensional excavation Revit model. This procedure enabled a continuous comparison of the target and actual position of the jet grouting elements. As a result, potential leaks could be recognised in good time and sealed with additional columns.
This procedure during quality assurance is now state of the art at Keller and has also demonstrated its enormous advantages. The excavation pit was watertight and could be excavated without any problems. The work carried out by Keller had a very marginal impact on the existing structure; apart from the production-related deformations during the Soilcrete work, no deformations occurred.

THE FINISHED CONSTRUCTION PIT

Reconstruction and extension **of the Faculty of Arts buildings of Charles University in Prague**

In late 2023 and early 2024, Keller had the exciting opportunity to contribute to the reconstruction and extension project concerning the buildings of the Faculty of Arts at Charles University in Prague. This included providing a design and build solution to secure the construction pit with jet grouting for a two-story underground extension in the courtyard in a busy area of central Prague.

Radek Sedláček – KELLER-speciální zakládání, Prague

With an almost 700-year history, Charles University is one of the oldest universities in the world in continuous operation, and its faculties are spread out throughout the inner districts of Prague. This specific project consisted of two neighbouring street-facing and one courtyard building located on Opletalova street in central Prague. With our extensive experience in central Prague, managing the logistics of this exciting project was an easy task for Keller.

The project included the construction of a new two-story underground object underneath the courtyard, for which Keller was tasked with designing and securing the construction pit. Other parts of Keller's scope included the securing of the construction pits for the new elevator in the stairwell, for the transformer station, as well as for the rainwater retention.

The geological profile on site included anthropogenic deposits (3-7m) with sandy clay to clayey sand with construction debris, in particular the foundations of existing buildings, followed by medium-grained silty sands which form the foundation subsoil of the existing buildings (1-3m), medium-grained gravel layers (6m) and bedrock, located approximately 13.5m below the ground level. The groundwater level was sufficiently deep below the level of the final excavation in all sections.

The technology chosen for securing the perimeter of the construction pit of courtyard building was an anchored (spaced) jet grouting wall. The jet grouting fulfils a dual role in this context: first, to act as the foundation structure for the retained perimeter wall of the courtyard building, and second, to retain and support the construction pit. The jet grouting wall consisted of either two rows of 160cm-diameter jet grouting columns, or one row of 160cm-diameter jet grouting columns reinforced with HEB 140 or Tr 108/16 steel profiles. The part of the jet grouting columns protruding into the new structures was scrapped and subsequently coated with a layer of shotcrete.

The part of the existing courtyard structure extending into the future construction pit was secured by 36 micropiles 108/12 of 12,5m in length. The micropiles were connected to steel

PROJECT INFORMATION

Investor:
Charles University – Faculty of Arts

Client:
AVERS s.r.o.

Geotechnical consultant:
Chemcomex

Structural engineer:
KELLER – speciální zakládání s.r.o.

Quantities:

156 jet grouting columns (Ø 1.0 to 1.6m, total length of 614m)

20 beams HEB 140 (total length of 150m)

12 temporary strand anchors (total length of 116m)

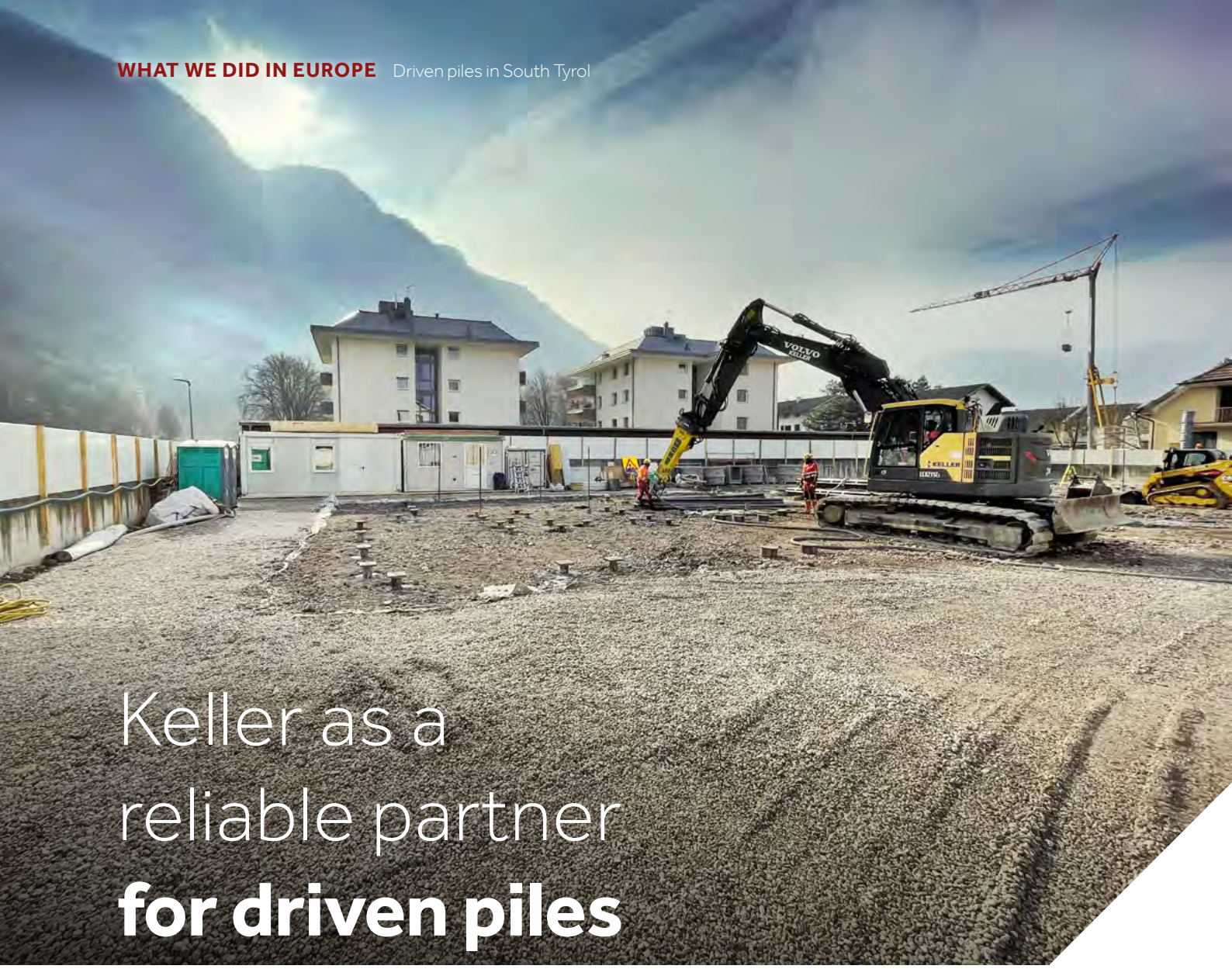
48 micropiles 108/12 and 108/16 (total length of 522m)

48 tonnes of steel strut and bracing structure

Duration:
November 2023–April 2024

supports erected during excavation, and connected to the building's bearing walls. Once the courtyard building is supported by the underground structure, these steel supports will be removed.

The technical solution chosen and implemented was found to be elegant, efficient and reliable, and the comprehensive design and build concept provides an important contribution to Keller's experience and reputation as a leading specialist in the Czech market.



Keller as a reliable partner **for driven piles**

Variable ground conditions are a daily practice for many of our projects. Different geological ground conditions influence the type of the foundation, but now we are able to offer two options for driven piles to overcome these challenges. Keller has been intensively involved with this type of foundation in South Tyrol in recent years and can offer to customers driven piles made of ductile cast iron or steel. Our goal is always to optimise our solution to the customer's specific requirements. As a result, we recently executed different driven piles for two different projects, but with the same client.

Stefan Nitz / Matthäus Plaikner – Keller Fondazioni, Brixen

Social housing built on driven steel piles

The Institute for Social Housing of the Province of South Tyrol is building twelve new flats in Neumarkt. One of the challenges of this project was the design and execution of a deep foundation solution, as the geological conditions on site were very challenging.

Based on previous positive experience, the project developer chose a deep foundation solution with driven piles. Due to our experience of already executed projects in the same area, we knew that the soil conditions were relatively homogeneous and that the load-bearing layers were not to be expected higher than approx. 20.0m below ground level. As the designing phase was carried out with sufficient lead time, the existing soil was soft and cohesive and the foun-

dation depth was very homogeneous across the construction site, we decided to choose our driven steel pile system.

The new social housing units are therefore founded on 137 driven steel piles (115/6.3/300) and a length of approx. 25.0 metres. The required load-bearing capacity was successfully verified after completion of the work with static load tests.

The driven steel piles have technical and economic advantages in certain situations. Looking ahead, these steel piles can be made from fossil-free steel from 2026 on and therefore have no CO_2 footprint. This means that no CO_2 emissions will be produced during the manufacture of this product in the future, which is also becoming increasingly important for our clients.

Social housing built on ductile driven piles

No piles were originally planned for this project in Latsch. However, further geological investigations during the excavation work showed that the existing soil was unable to transfer the loads of the new houses.

As the construction site was already underway, it was necessary to act quickly. As a result, Keller was already involved in the design phase of additional measures. We were able to contribute with our experience from several projects in that area and then could convince the customer with a technically and economically optimised solution.

In order to prevent further delays, it was of utmost importance to start with the work asap. Additionally, we knew that we would have to adapt our piles very flexibly to the soil conditions met during the execution phase. This was one of the reasons, why we chose our ductile driven piles. The piles are available at short notice and are ideal for adapting to variable ground conditions.

This project is solidly founded with 146 ductile driven piles (118/7.5/220). The lengths of the individual piles vary between 5.0 and 10.0 metres. Thanks to the early involvement in the construction project, Keller was able to plan the realisation efficiently, execute it successfully and complete it on schedule.

Driven pile systems have been installed and executed by Keller for many years in South Tyrol. The projects shown are examples for the numerous projects realised with ductile driven piles or driven piles made of steel. We, as Keller, are proud to be known as a reliable and competent partner for designing and executing in time!

INSTALLATION OF DRIVEN PILES

STATIC TEST LOAD AS PROOF
of load-bearing capacity

DETAIL – STATIC TEST LOAD

Cimitero S. Agostino – **Mitigation of liquefaction risk under historic cemetery buildings**

Work carried out quickly and in tight spaces while minimising the impact on existing structures.

Francesco Frassinella – Keller Fondazioni, Verona

The project involves the refurbishment and renovation of the monumental cemetery of St. Augustine, which was damaged by the earthquake in Emilia-Romagna in 2012.

The challenge is to mitigate the risk of potential liquefaction below the existing masonry structures, while minimising the impact on them.

PROJECT INFORMATION

Investor:
Municipality of Terre del Reno (FE)

Client:
ABeP costruzioni – Quarto (NA)

Quantities:
400 compaction grouting points

Duration:
December 2023 – March 2024

The solution was the realization of 400 points of compaction grouting, with various inclinations, carried out below the historic buildings. The columns, with a diameter of approximately 70cm, consolidated the loose sandy bank present between -5m and -10m from ground level.

A new logistics centre **built with our newest generation of vibro rigs**

The project site of the new logistics centre is located on an old gravel pit that had been backfilled with excavated material until 2004. The heterogeneous soil conditions were predestined for an ecological alternative using vibro replacement (stone columns).

Gramos Muja – Keller-MTS, Regensdorf

Keller-MTS AG was awarded the contract to carry out the post-investigation work, the planning and designing as well as the execution of the soil improvement by means of vibro replacement.

Additional soil investigation using electrical cone penetration tests and dynamic probing formed the basis for a better characterisation of the landfill body. The investment in a refined soil model and our many years of experience in the dimensioning of the stone columns led to an economic optimisation of the foundation measure.

The different layer thicknesses, especially the hard lime intermediate layers, caused particular challenges for the construction site teams. In some areas, it was only possible to penetrate through these hardened layers after pre-drilling.

The ambitious construction schedule required special attention to be paid to coordination between the contractors involved. Parallel to the excavation work and the backfilling of the working level, the new access road to the new industrial estate was constructed.

With the alternative, proposed by Keller-MTS, it was possible to achieve ecological homogenisation of the landfill body. A total of almost 12,000 tonnes of natural aggregate were used to execute vibro stone columns. Furthermore, by using electric vibrators, the construction project, which is located in an groundwater protection zone, could be realised without endangering the groundwater.

The point loads from the hall's own weight were transferred to the improved ground by shallow foundations with strip and single foundations. Under the storage and logistics areas, the arrangement of a regular grid of vibro stone columns results in an evenly bedded floor slab.

A major advantage of soil improvement is the flexible adaptation of the system to the existing soil. The total of almost 1,900 stone columns were executed in lengths of up to 11.50m, depending on the existing load-bearing layers. Two vibro rigs of the latest generation were used in this project. The special equipment, manufactured by Keller's machine factory, especially for the vibro replacement technique, was a decisive factor in the short production time of just under eight weeks.

KELLER'S VIBRO RIG TR05-2
The newest generation of Keller's vibro rig TR05-2

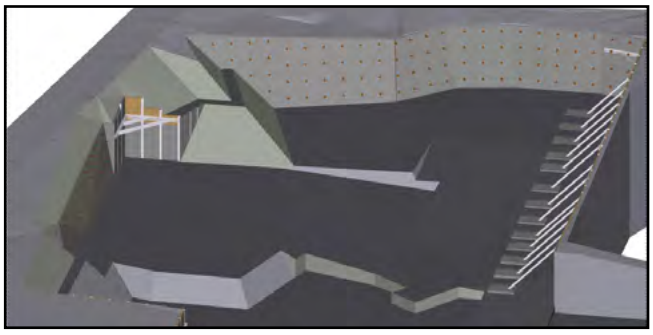
Despite parallel construction work and difficult ground conditions, the project was realised efficiently and on schedule thanks to careful planning and innovative solutions.

Le Domaine – **Apartment complex project in Vétroz**

Keller-MTS AG was awarded the design and build of the excavation pit support for the project of apartment buildings in the heart of Vétroz with an integrated medical centre and a bank.

Clément Boehler / Ahmad Wehbe – Keller-MTS, Vétroz

3D EXECUTION PLAN



Vétroz, a small village in the Swiss Alps in the canton of Valais, has experienced impressive demographic growth in recent decades. This has led to major allocations of additional building land to allow the region to develop further. The new 'Le Domaine' development is located close to the main road in the town centre and offers ideal access to the nearby nature and recreation areas.

Thanks to Keller-MTS's many years of experience in the field of special foundation, it was possible to optimise the design of the excavation support proposed by the client. As a result, it was possible to find solutions which led to significant reductions in material and costs. That allowed us to finish works in time.

Immediately after signing the contract, Keller-MTS was able to provide the required detailed structural analysis and the necessary implementation plans to ensure smooth execution. The central location of the site, located next to existing neighbouring buildings and roads, required various safety measures for the five to six metre deep excavation pit. The project posed considerable challenges for our team, particularly in minimising potential deformations of the adjacent building structures and the important main road with various service lines. Furthermo-

VERTICAL DRILLING – KING POST SOLDIER WALL

PROJECT INFORMATION

Quantities:

approx. 6m Vertical excavation pit with a depth and **670m²** shotcrete area

approx. 550m soldier pile wall: drilling diameter 323mm with steel girder HEB 160-200

approx. 900m soil nails up to 13m long
Injections: Cement consumption approx. 29 tonnes

15 pieces inclined bracing

re, access to the construction site was only possible to a very limited extent, as various road renovations were underway at the same time as the construction work.

In the south-eastern section, a soldier pile wall with inclined bracings was designed to minimise the settlement of the two adjacent, older and not well-founded buildings. The position of struts was adjusted so that they were located higher than the planned ceiling of the underground car park. Once the ceiling had been completed, it was therefore possible to remove these bracing elements and transfer the forces to the concrete structure. Furthermore, it was possible to increase the usable area compared to the design, which was very much welcomed by the client.

The customer also wanted a space-saving solution in the north-western section. By using deadman anchors, the construction pit corner, which was sensitive to settlement, could be optimally secured and a perfect solution was found. As an additional benefit, a large number of drill holes in the neighbouring property could be avoided.

In the area of the access road to a neighbouring vineyard, the excavation pit was secured using a nail wall, as little deformations of the excavation pit shoring were acceptable. A soldier pile wall with additional corner struts was constructed in the area of the excavation corner, which was very close to the road and a sewage pipe. This minimised the risk of damage to the road surface and infrastructure.

The 3D model of the project, created in-house, identified any conflicts with other constraints at an early stage, improved communication between the parties involved and optimised project planning through precise visualisation. These points were particularly helpful for the team on site, as the construction time was very short and parts of the work had to start before the entire design was finalised.

The work was completed on schedule and took around 13 weeks, with planned interruptions to construction, from October 2023 to February 2024.

HORIZONTAL DRILLING – DEADMAN ANCHORS

Hard work pays off: **Jet grouting – always a good solution**

You know the feeling when you know you can do so much more with a technique, than what it is usually used for? You 'just' need to convince those who haven't understood the full potential of the method.

In Sweden, we have worked hard to present the possibilities with jet grouting and now (in the end) it has paid off.

Fredrik Brauer – Keller Grundläggning, Stockholm

The most common use for jet grouting in Sweden is to seal the gap between the sheet pile foot and the rock, to get a technical watertight pit. In general, as some of you know, we use it for so much more, such as soil improvement, remedial works and underpinning of foundations.

We have worked very hard in Sweden to get designers and clients to see what other areas jet grouting can be used for and how to manage it. We have had knowledge sharing days and Teams meetings to inform and train consultants, customers and designers.

At the end of 2022, we received our first request for tender, to use jet grouting as an underpinning technique to stop the settlement of an old building (Postmuseum) in the Old Town of Stockholm.

A new part in our offer was that we would work as a general contractor. Something we have seen as an important step in our future projects. Furthermore, our scope of work included the demolition of concrete floors, excavation measurements, core drilling, filling and reinforcement and concreting.

Finally, we signed the contract in the beginning of July 2023 and started immediately the preparation works for the start-up beginning in August. We began our work to secure and demolish certain parts of the basement and with the installed surveying system on the entire property we could measure any movements throughout the project.

The demolition work went smoothly and during production, we were awarded a bigger part of work at this project. After a few weeks of preparatory work, we carried out the mobilisation of the jet grouting equipment that we transported down to the

basement. Machine, staff and most of the equipment came from Austria and that support has been of great help to us on site.

We started by performing three test columns and then moved on to the production columns. Some typical challenges we encountered were getting them in a good position under the foundation wall using core drilling.

After the demolition works, the detailed layout needed to be adjusted based on the actual geometry of the foundations etc. Keller suggested a flow chart to enable a sufficient production. This included also steps like changed diameter close the foundation to limit the eccentricity, a so-called "crown" was executed with a diameter of 1.8m and a length of 1.8m. Together with the client's team we discussed and agreed on the best solution for the progress of the project. In addition, further test columns were performed in other parts of the basement.

A major known challenge, to be handled from the tender phase until the last column was executed, was to manage the backflow. The Old Town is an area with narrow spaces and restrictions on transport in both weight and length. We rented land from the City of Stockholm and put containers and a water treatment plant there. However, during the production phase, we had to handle less water and more liquid backflow than expected. As a consequence, we had to remove the water treatment plant and replaced it by more containers. The amount of solid backflow that could be transported by containers was only about one third; the rest was transported with suction trucks to the deposit areas. Another challenge we had

PROJECT INFORMATION

Investor and client:
Fastighetsaktiebolaget Penelope

Geotechnical consultant:
Geomind

Design:
Kvarteret kontruktörer

Quantities:

Jet grouting: **approx. 1,490** columns ø1,2m (approx. 1,080m total length),

Backflow treatment: **approx. 3,400ton**

Demolition works concrete: **207m²**

Excavation material: **65m³**

Core drilling: **approx. 260m**

Backfilling: **22m³**

Reinforcement and concretework: **5ton** and **approx. 57m³**

Duration:
July 2023–July 2024

with the backflow was significantly more wood than we expected. We had to load this by hand and transport it out with bullet cutters to a separate container outside.

To sum up, jet grouting is a good solution for underpinning buildings, especially in tight and small areas. The client was satisfied with the result. We would like to say a big THANK YOU to the team that executed the project! A big THANK YOU to who made this possible. Now we hope for a new project in the near future.

The design was done by the client. The owner of this building is Fastighetsaktiebolaget Penelope with the representant Mattias Lindmark. They used the company Qognito Managment for the construction management and named Ann Hoang as project manager. The geotechnical design was made by Geomind KB and the consultant Victor Enbom. The design is by Kvarteret konstruktörer AB with Dan Kazen and Pontus Wedin as the designers. Geomind is one of the companies for which we held a knowledge sharing day.

Tangenvika Bridge – **Drilled and Driven Piles for longest railway bridge in Norway**

Increased requirements for rail transport north of Oslo have forced Norwegian Authorities to invest in the development of a double-track rail to decrease traveling time and increase the frequency of the rail service. Part of this development is Tangenvika Bridge which is built on the largest lake and drinking water reservoir in Norway.

Wojciech Szczepinski – Keller Geoteknikk, Oslo

Bane NOR, the state-owned company responsible for Norway's national railway infrastructure, continues to upgrade the existing railway infrastructure by building the double railway track between Oslo and Hamar. A part of this development is the Tangenvika Bridge. The railway bridge will be a 1,022m concrete prestressed bridge which, once completed, will be the longest railway bridge in Norway and will allow trains to pass at the speed of up to 250km/h. Prior to start of the project, Keller Geoteknikk performed ground investigation to verify soil parameters. Using a sonic rig located on a floating barge, we have performed coring, CPTs and rock probing with the water depth of up to 52m. The ground conditions have been confirmed to have typical parameters for this area which is sensitive silts directly present at the lakebed level, underlined by layer of sand, moraine and bedrock (granite). This allowed designers to go ahead with a concept, presented during the tender stage, which allowed Keller to start the process of the steel procurement. Due to the size and the specification of the steel, as well as global transport constraints in the 2nd half of 2022, decision was made to deliver all the 7,100 tonnes of steel at once. The chosen supplier from China managed to manufacture the required steel in six months from contract signing and had another three months to deliver it in full from Shanghai area directly to the site in Tangen. The casings were delivered on site in 20m length sections (total of 347 sections). To eliminate the risk of not meeting the design requirements (all welding in accordance with EXC 3 as per NS-EN 1090), the project team made the decision to perform all the welding of the casings on land in a controlled environment. For that purpose, a concrete slab was poured to a total length of 135m and all-year insulated tent was established on site. All circumferential structural welds were performed by a welding robot while the casings were supported and levelled on roller tables to meet the verticality requirement. All welds were later 100% tested for visual test (VT), ultrasonic test (UT) and magnetic test (MT). All of these were necessary to ensure that piles of up to 85m long will be welded in accordance to the applicable standards. Piles were later placed on the transport pontoons and hauled to the barges with a tug boat. Piles were installed from floating container pontoons instead of jack-up barges due to the significant depth of the water (up to 55m). Close to shores, due to the local presence of sensitive soils and the risk of underwater landslides, a total of 78 drilled piles (1016x28 and 1016x40mm) were executed using the reverse circulation method (RC). All piles were drilled 2m into bedrock using a fully integrated ring bit system.

All drilled piles were installed using an LRB 355 drill rig in DTH mode with a 24 inch hammer. In the deepest parts of the lake, a total of 60 driven piles (1430x34mm) were installed using 350kJ hydro hammers. To ensure the position, inclination and azimuth of the piles, Keller used a modified Clough Leader which was installed on a travelling frame, allowing to install five piles with different azimuths without a single repositioning of the barge. The bottom parts of the piles were finished with a closed-ended pile tip, which is the most popular driven pile tip in Norway. All drilled and driven piles were installed in single lengths of up to 85m and net weight of 102 tonnes at 1:5 inclination. The lifting process of the piles on the water presented significant challenges for which a combination of a 400 tonnes crane, two transfer pontoons, and a tugboat were used to provide a safe execution method. Following project requirements, the site team had to provide EPD certificates (Environmental Product Declaration) for each material delivered on site. Based on that, the project team could accurately calculate the CO_2 emissions of the foundation works. These emissions include direct emissions from on-site activities, indirect emissions from the production of materials and energy, and other indirect emissions from transportation and waste disposal (Scope 1 + 2 + 3). Total carbon footprint calculated for Tangenvika Bridge was 29,000 tonnes of CO_2 and Scope 3 alone is over 92% of that amount.

Tangenvika Bridge was without a doubt a complex project that had to take into account several external factors, such as ground conditions, including sensitive soils, environmental factors and water depth which eliminated the possibility of working on jack-up barges.

PROJECT INFORMATION

Investor:
BaneNOR

Client:
Implenia AS

Structural design:
Norconsult AS

Quantities:
2,580m Drilled piles
3,570m Driven piles

Duration:
July 2022–September 2025

Keller Group
youtube.com/c/KellerGroup

Review of March 2024 – Tangenvika Bridge

The first driven pile of the Tangenvika project

Liebherr
.youtube.com/@LiebherrGroup

Norway's longest railroad bridge – Tangenvika

> ***As a result, the project team was able to install drilled and driven piles of up to 85m long and weight of 102 tonnes in a single piece, which will provide long-standing support for the yet-to-be the longest railway bridge in Norway.***

Denya Forest V – **Apartment complex, which consists of six buildings**

This residential project has been developed over the last years in several phases. By now, four out of six phases have been executed. Keller was appointed as a design-and-build contractor after the first phase due to high settlements of the building.

The height regime for each building is similar – ten stories plus one underground that serves as a parking area. Considering the soil conditions, which consist of soft clay in the upper part, and the loads of the 12-stories-building, a soil improvement solution was designed by Keller Romania.

Stefan Guran – Keller Geotehnica, Bucharest

Danya Cebus Properties is building an apartment complex which consists of six buildings, ten stories each, in the northern part of Timisoara. At the moment, four phases out of six have been executed.

The existing soil on site can be described as silty clay with medium consistency (soft in some areas) down to 8m of depth, then down to 11m the clay layer is medium to firm. Under this clay a medium dense sand layer down to the bottom of the boreholes is found, followed by a hard clay layer. The underground water level at is at approx. -4.00m below the surface, related to the natural terrain level. Due the fact that the ground at the foundation level was not suitable to transfer the loads of the new building within the required design settlements of 4 to 6cm, it was necessary to design a ground improvement solution in this area.

The chosen solution involved the execution of full displacement piles (FDP) with a diameter of 52cm and an average length of 10m, down to the sand layer. The piles were reinforced, but not connected to the raft foundation. This solution is called Controlled Stiffness Columns (CSC).

Currently, the entire infrastructure is done for this building, and superstructure is under construction.

The measurements for the other three buildings, for which ground improvement was carried out too, do not show relevant deviations from the expected design values.

2026 AUSTRIA VIENNA
WHERE IT ALL BEGAN
21st ICSMGE

21st International Conference on Soil Mechanics and Geotechnical Engineering

Vienna, Austria, 14–19 June 2026

The Austrian Geotechnical Society and the Austrian Society for Geomechanics are proud to host the *21st International Conference on Soil Mechanics and Geotechnical Engineering (ICSMGE)* in Vienna in June 2026.

Prof. Helmut F. Schweiger
Chair ICSMGE 2026

It marks the 100th anniversary of a milestone in geotechnical engineering, namely the publication „Erdbaumechanik auf bodenphysikalischer Grundlage" by Karl Terzaghi. Leading experts in the field have agreed to deliver state-of-the art lectures and, very important, for the first time in this series of conferences a plenary session will be organized by the European Federation of Foundation Contractors (EFFC), providing the industry with the opportunity to present their efforts in battling climate change and reducing CO2-footprint of construction industry. It can be expected that this session will make significant contributions to the conference fully incorporating the theme of the conference **Geotechnical Challenges in a Changing Environment**. It will be an in-person event because personal communication and networking is a key component of such an international event.

The venue is the Austria Center Vienna providing ample space for exhibitors and it is expected that all major players in geotechnical engineering: contractors, consultants, authorities, research institutes and universities will be presenting their services and latest technologies. A special session will be dedicated to the younger generation of geotechnical engineers.

If you are interested in submitting a paper or being part of the exhibition visit www.icsmge2026.org

Northern Sweden: **Keller's new place to be**

Northern Sweden is rapidly emerging as a hotspot for industrial development, making it an exciting new area for Keller to establish its northernmost office in the world. Over €100 billion is expected to be invested in this region in the near future.

Per Vedin – Keller Grundläggning, Luleå

The industrial growth in Northern Sweden is driven by massive investments in the region's infrastructure and industries. One of the most significant developments is the state-owned company SSAB's plan to replace its current steel plant in Luleå with a new fossil-free facility. Tens of billions of euros are being invested in this project, which is expected to revolutionize the steel industry and place Northern Sweden at the forefront of sustainable industrial practices. Additionally, in a neighbouring municipality, a new steel plant is being constructed by private investors, further contributing to the region's industrial boom.

> ***"It is incredibly exciting to be part of establishing a new area for Keller, an area that many of our competitors and partners are also looking towards. With our techniques and methods, we can help lay the foundation for a sustainable future"***

In addition to steel, Northern Sweden is expanding its port facilities, with Luleå's harbour undergoing a significant upgrade to accommodate increased shipping demands. This expansion is critical as the region's industries grow and require more efficient logistics solutions. The total investment in the harbour infrastructure is estimated at around €1 billion, making it a vital link for Northern Sweden's industrial future.

Moreover, the ongoing development of the North Bothnia Line project, a new railway line connecting the northernmost parts of Sweden with the rest of the country, is another crucial project. With a budget of approximately €4 billion, this railway will enhance the region's connectivity, facilitating the transport of goods and personnel across Sweden and into Europe.

A key factor behind Northern Sweden's green transformation is the region's extensive hydropower resources. The abundant supply of renewable energy is not only driving the green transition but also represents significant potential projects for Keller, especially in stabilising the large dams associated with hydro-

KELLER'S NORTHERNMOST BRANCH WORLDWIDE
is located in Luleå, Sweden

power plants. Similarly, the region is home to numerous mines that, like the hydropower plants, present challenges related to dam stabilization – another area where Keller's expertise will be essential.

Northern Sweden's potential is clear. With these massive investments and developments, Keller is well-positioned to play a crucial role in the region's transformation, leveraging our expertise in foundation engineering to support this burgeoning industrial landscape. As Keller's northernmost office, we are proud to contribute to this exciting new chapter in Northern Sweden's history.

ILLUSTRATION OF THE LAYOUT OF FUTURE CIRCULAR INDUSTRIAL PARK
for production of critical minerals and phosphorus in Luleå

Shared values and guidelines **are the basis and standards for our daily work**

The topic of leadership and communication within a company is and always will be a 'work in progress' situation. Keller SEN is no exception.

Andreas Kolenc – Keller SEN

This topic was one of the results of an employee survey during the pandemic. In order to comply with this result and the will of the employees, an internal project group was formed. Based on the three worldwide Keller values, integrity, collaboration and excellence, this group was asked to jointly create Keller leadership values and guiding principles and to find a way to operationalise these values. This group, under the direction of our regional manager from southern Austria, in cooperation with our Finance Director, the Operations Director, the Head of Engineering, the regional manager from our eastern Austrian region, as well as the former regional manager for the Nordics (now Chairman of the Board in Sweden), the Head of HR and an external Consultant, created drafts of these values in two 1½-day workshops. These were followed by three World Cafés (three hours each), with a total of around 40 participants from Austria, the Czech Republic, Slovakia, Italy, Hungary, Norway and Sweden. These groups consisted of employees and managers and all participants were asked to give input on the draft values that were prepared before. Based on this input, the leadership values and guiding principles were finalised in 2023. The five leadership values represent the core for realistic and pragmatic leadership behaviour and working together. The guiding principles are intended to provide more specific guidance for day-to-day work in leadership and cooperation.

These five leadership values are (in any order):
Contribution to the whole – Coaching – Openness & Diversity – Sustainability & Innovation – Respect & Appreciation.

The responsible BU Managers, Andreas Körbler and Michael Flor, together with HR, presented these values to the employees in the Business Unit in the course of 2024. In order to keep them omnipresent, they are displayed in all meeting rooms at Keller SEN as table stands or as 1.70m high towers on the respective language of the country.

> ***It is now up to all Keller SEN managers and employees to live and share these values.***

Safety first – **also to support our external partners**

End of July 2024 we welcomed once again a major fire drill at our yard in Söding, Austria. The seven neighbouring volunteer fire brigades were called in to assist with this exercise.

Paul Rott – Keller SEN

Several scenarios were prepared for this purpose. Firstly, a fire in the warehouse was simulated with several injured persons in the smoky inner space. Secondly, an overturned car that came to rest on its side, trapped between a wheel loader and an excavator. In addition, the car came into contact with a building site main cabinet, which was in operation. To make matters worse, the gearing mechanism of the training car was in the rear, which made it extremely difficult for the fire brigade to rescue the two injured people. The third task was a dummy, which hang from a mast of a rig and had to be rescued.

The injured persons, all of them young firefighters with an excellent make-up (open leg fractures, burns, broken spine), were first treated by the Red Cross and an emergency doctor and taken from the area by blue lights. But the end of the line was in front of the office building, where the fictitious hospital was located.

In total, almost one hundred firefighters were involved in the operation, with 16 vehicles, four Red Cross emergency vehicles and an emergency doctor team, but without a real emergency doctor. Of course, a real doctor cannot be provided for such an exercise.

At the end, there was a barbecue with cold drinks in a small restaurant in Söding.

Section training of section 3 in Söding (in German)

ff-soeding.at

Career fairs at Austrian **Higher Technical Education Institutes**

From April to May this year, Keller Grundbau was once again represented at various career fairs in Austria. Similar to a trade fair, the companies presented themselves via an 'exhibition stand' in order to establish contacts with future graduates.

We used this opportunity to draw the attention of potential new employees to us and introduce them to Keller Grundbau. At the same time, there was the opportunity to exchange ideas with other companies and find out about the current applicant situation.

In addition to the classic goodies and presentations, we were also able to inform the students with printed designs and pictures, as well as background information on the challenges of construction sites and everyday office life.

The students' interest was consistently very high at all locations, which was reflected in the many questions asked and the recognition value from previous years. It was clear to the company representatives that the majority of graduates would like to work straight after graduation.

HTL Pinkafeld Engineering

HTL 1 Linz
Engineering & Design

HTL Saalfelden
Engineering

Secondary school Stallhofen

In addition to the various technical colleges, we also like to participate in the same concept of secondary schools. Paul Rott (Head of Equipment and Machinery Department) and Bianca Langmann (HR Assistant) visited the secondary school in Stallhofen on 17 April 2024.

These information days give the pupils an insight into Keller Grundbau and the apprenticeships that are offered in Söding.

The aim of the visit is to prepare the pupils for the vocational experience day, which takes place annually for two schools in Söding.

We received consistently positive feedback at all events and are already looking forward to more career days next year!

We would like to take this opportunity to once again say a big thank you to all those involved, who always take the time to meet potential new colleagues despite their heavy workload!

SKI CUP 2024

Team spirit and collaboration: **the highlights of our 2024 events**

In addition to our numerous projects, 2024 was also characterised by various activities. These are made up of sporting events, training sessions and celebrations. As our employees are our greatest asset, we always try to create a healthy mix of these events.

The Keller Ski Cup in Altenmarkt-Zauchensee 2024

At the beginning of March, around 130 colleagues from nine countries in our division came together again for the 21st Keller Ski Cup in Altenmarkt-Zauchensee, Austria. The weather conditions were fantastic and everyone was highly motivated, which is the best prerequisite for organising an accident-free event. The teams from SEN were able to beat the teams from the other countries and so the beautiful challenge cup remained in Vienna. The teams from the Söding and Brno branches took second and third place respectively.

Who will take home the popular trophy in 2025 will be decided on 1 March 2025 at the 22nd Keller Ski Cup.

From skiing to playing football

In June, the EME (Europe & Middle East) division continued its sporting endeavours. While Germany prepared itself for the European Championships, Keller was already playing football in Warsaw, Poland. 21 men's and women's teams – around 260 participants – were either on the pitch or cheering on their teams at the event. Our Business Unit was represented by two 'international' teams from Slovakia and the Czech Republic and from Austria, Hungary and Switzerland.

Under the watchful eye of world-renowned referee Szymon Marciniak, the Slovakia-Czech Republic team took second place in the men's tournament. They were defeated by the team from Keller Germany.

We are already very excited and look forward to taking part in the 2025 tournament and

Being ambitious at work helps too

Sporting activities were not the only thing on the programme this year. There were once again numerous opportunities for professional development and to gain information from the global Keller world. After the successful start of the HSEQ days last year, these took place right at the beginning of the year. Our blue-collar workers from Austria were again trained in the areas of work safety and we presented Keller Group's new standards as well.

Our site managers and designers were not neglected in 2024 when it came to passing on our expertise. Our two-week Keller Academy in Söding took place again in March. This time with a highly motivated English-speaking group.

Our annual site manager conference followed in September. Over three days, our colleagues in two groups (English and German-speaking) were given an insight into the Keller world through general presentations from the management, finance

FOOTBALL CUP 2024

FOOTBALL CUP 2024

SITE MANAGER CONFERENCE 2024

KELLER ACADEMY 2024

or marketing, but above all it was about their day-to-day work on the construction site. There were various tasks that they had to solve in small groups and then present to the other participants.

In order to strengthen the team spirit – after all, we always want to be able to rely on each other – a scavenger hunt was organised in various teams through the town and then their skills were tested in crate lifting and stand-up paddling. Many a talent was discovered in the process – it seems that our colleagues not only have special foundation engineering in their blood.

Our company is constantly growing and we always welcome new employees. This year, we would like to give you an overview of some colleagues that are living the Keller spirit, although some of them are with us not more than a couple of months.

I am Matteo Meloni. I joined Keller in May 2022 and I've been the Regional Manager for Italy since October 2023.

Why did you want to join Keller in the first place?
Keller is the market leader in special foundations – that's a fact. I have crossed Keller's job sites many times all around the world, and I understand the value of the Keller brand well.

What was your first impression of the company?
I can assure you that the company's global strength and experience, combined with its local focus, are the hallmarks of a truly successful business and organisational model. The company's rules and procedures are completely adapted to the different regional needs, and all are always involved in the regional strategy. However, many of the initiatives that drive success originate from the local staff.

What is your approach to continuous improvement and learning?
It is essential for every career to stay curious at any age and in any domain of construction. Soft skills are much more difficult to improve than technical ones. Only a good work environment can facilitate that personal growth. I also recognise one important step in every working life: the step where you feel confident enough to share your knowledge with the younger staff. When we look at our professional backgrounds, we are going to recognise that the knowledge we got from experienced colleagues was much more effective than courses or academies for many of us.

Tell us something about you that most people wouldn't expect. How do you spend your free time?
The only time I spend away from my family is when I'm riding my dirt motorbike (Husqvarna) far away from the tarmac in the Tuscan countryside. Stopping in some remote local restaurant is part of the enjoyment!

My name is Per Vedin. I have been the Area Manager for Northern Sweden at Keller Grundläggning since March 2024.

Why did you want to join Keller in the first place?
I chose to join Keller because I knew it was a company that would allow me to focus on techniques, methods and a curiosity to constantly develop and improve. I was drawn to the challenge of establishing Keller in a new area with high competition.

What have you learned about the company that has surprised you the most?
Despite being aware that I was joining a company with a large engineering team, I was still impressed by the level of expertise. It's fantastic to be part of such a competent organisation.

How do you motivate yourself and ensure high performance?
I never say something is bad. I don't use the term 'bad'. I use the term 'less good' The truth is, every experience is valuable. The outcome of an action may be less good, but the experience itself is always beneficial.

How do you manage stress and maintain productivity under tight deadlines?
I am interested in personal efficiency. I always know what I am doing and what I need to do, and I also know what I am not doing. I believe this is the key to avoiding stress. Having control over the big picture, both at work and in my personal life, is crucial.

How do you spend your free time?
I like to stay busy. When I'm free, I enjoy getting involved in non-profit organisations or local politics where I live. I like to gather experiences, and I do that by participating in different kinds of activities and meeting various types of people.

My name is Peter Škoda. I have been working for Keller since 2007 and started as a site manager. I've been Regional Manager for Slovakia since the beginning of 2024, but I'm still a site manager at heart.

How do you motivate yourself and ensure high performance?
I keep asking myself this question, and I think the answer is that all of us who work here, see Keller as our own company. What motivates me at the moment is the support and feedback from my team.

What do you do to create a positive and inclusive working environment?
I try to treat people at least the way my managers have treated me in the past, and I'm glad I can do that now. We have always worked on a friendly basis and that is the cornerstone of our success.

Can you give us an example of a creative/innovative solution that you have applied to a project?
I am proud to say that I cannot choose one of the many innovative solutions that we implement. On the one hand, there is the almost standard design of oval jet grouting columns for deep excavations below the groundwater table, but on the other hand there are also 19-strand permanent anchors for stabilising a rock face below a castle. In addition, there are numerous other solutions that we offer and execute every day.

How do you ensure that 'lessons learnt' from past projects are transferred to future projects?
It is easier in Slovakia than in other countries because we are a very small team that works very closely together. As a result, we communicate constantly and can also exchange information at meetings that are called at short notice.

How do you spend your free time?
I try to spend as much time as possible with my family (I volunteered as a football coach for my younger son's club), but when I have time I cycle and go fishing.

My name is Marko Zechner and I have been working as Health & Safety Manager for Austria since the end of August 2023.

Why did you want to join Keller in the first place? What was your motivation?
The company and the products really appealed to me. I also enjoy travelling to construction sites and being able to make them 'safer' step by step for and with the employees – making a difference together and creating added value. Work safety, and many other things that go with it, is added value in my view. Not just going home safely, but also reducing hazards and risks.

What was your first impression of the company?
Everyone is very friendly and open. When I started on my first day, my workplace was already prepared, including laptop, mobile phone, etc. That's not a given and unfortunately, I know it to be different from other companies. I'm also constantly surrounded by interesting people and characters who work here. A lot of knowledge and experience comes together.

What have you learned about the company that has surprised you the most?
How big the company actually is. Which products are executed and the expertise behind them. This then inevitably leads to the good reputation that the company has.

How do you manage stress and maintain productivity under tight deadlines?
For me personally, I try to create the necessary balance by running, for example. In my day-to-day work, I try to prioritise; to focus on the points that are important first and then work through them one by one. But that always sounds easier than it actually is.

How do you spend your free time?
I spend a lot of time with my children and going for a run. I'm fascinated by people, which is why I enjoy talking to and meeting inspiring people. I spend a lot of time studying global economics, as I am very interested in this topic, also in relation to my work in an international company.

KELLER WOMEN IN CONSTRUCTION

Did you know that as part of Keller's commitment to fostering a diverse and inclusive work environment, our company actively supports the creation of employee-led networks?

One such network is Keller Women in Construction aka 'KWIC'.

KWIC is an employee-led committee which offers all of our colleagues opportunities to share thoughts, resources, and ideas to promote women's professional development within the organisation and construction industry. Although it remains a challenging environment for women, affinity groups like KWIC promoting diversity not only support people within the company but also make it much more attractive to outside talent.

Our mission

Our goals are to inspire, support and develop women at Keller, as well as attract the very best women in the industry to join our great company.

Attract

Helping to make Keller an employer of choice for women, by finding out what would attract them to the company and, more importantly, stay with us to forge strong careers.

Inspire

Share case studies on inspiring colleagues, from a range of roles and backgrounds, who make great ambassadors for our division and company.

Support

Provide environments where women and allies can talk and be listened to, while offering tools and resources to boost skills, confidence and wellbeing.

Develop

Raising awareness of career paths and development opportunities for women at Keller, through spotlighting role models, and championing (reverse) mentoring, coaching, and training.

How can we achieve it?

We do this through running webinars on professional and personal development; sharing key resources and guidance; spotlighting inspirational employee success stories; as well as supporting Keller's overall commitment to diversity, equity and inclusion, and approach to employee wellbeing.

We spotlight the work and careers of brilliant female colleagues from across EME; help to foster an environment where women feel supported to succeed, be happy, and progress at Keller. KWIC EME is part of a global network, sitting alongside committees in our AMEA and North America divisions.

What have we achieved?

We are collaborating with HR and HSEQ and by doing so, we achieved eg inclusive PPE standards. Keller is looking to better support the growing number of women working on our sites. For that, a pan-global PPE project team, including representatives from KWIC committees, had been set up to make sure personal protective equipment (PPE) is suitable for everyone. Besides that, we want to ensure everyone feels safe, welcome and respected, so Keller developed guidance on how to build an inclusive site, embedding the topic into inductions and site orientations, and sharing real-life examples.

For more information about our DEI commitment (diversity, equity, inclusion), visit our keller.com website

We are Keller

Nejla Yildiz Helvacioglu (Design & Estimation Engineer at Keller Grundläggning in Sweden) gives us an insight into her Keller life.

Hi Nejla. Can you tell us how you got into engineering?
I grew up in Turkey in a family that was involved in construction and engineering, so that was the main spark for my early interest. Then, when I was at high school, subjects like math and science added to my interest. From there, I studied civil engineering at Middle East Technical University, one of the best universities in the country, followed by a master's in geotechnical engineering.

Why did you choose geotechnical engineering specifically?
One of my professors played a significant role in my decision. She was a role model and inspired me through her passion and expertise in the field. I thoroughly enjoyed her geotechnical courses and I was motivated to follow in her footsteps.

What do you like about working for Keller?
I've been with Keller Sweden for over two years now and enjoy working with a diverse team of professionals from all over the world. I also feel supported all the time in terms of my education and training; I'm continuously learning new techniques and have an open career path.

What's the best part about being an engineer?
Each project is unique, requiring innovative solutions tailored to specific site conditions. Additionally, I find great satisfaction in knowing that my work contributes to creating safe and sustainable infrastructure that benefits communities. It's amazing to go over a bridge you were involved in the construction of.

Have you got a favourite project that you've worked on?
I would like to say it's the Södertälje canal and lock project, which is one of the biggest and most prestigious projects in Scandinavia. Keller is completing the foundation works for the major reconstruction of the lock, which is located around 30km south west of Stockholm City. It's being totally rebuilt, with the existing bridge replaced by a new moveable one and the canal enlarged. I got involved in October 2023 and I'm still involved. There have been a lot of challenges but we have a great team on it.

What would you say is the most challenging part of your job?
The lack of female representation and mentorship within the industry. It can sometimes feel isolating to be one of the few women in a room. However, this has also driven me to seek out and build strong networks and support systems with other women in engineering, both within my organisation and through professional societies.

What do you hope to see for women in engineering in the future?
I hope to see a more inclusive and supportive environment. This includes increasing the representation of women at all levels, from entry-level positions to leadership roles.

Who inspires you in your career and personal life?
As a Turkish woman, my answer is Mustafa Kemal Atatürk, the founder of the Turkish Republic. Atatürk is not only a pivotal historical figure but also a profound role model for me. His efforts to reform education and promote equal opportunities for all citizens, regardless of gender, have paved the way for many, including myself, to pursue careers in fields traditionally dominated by men.

But Nejla is just one of several women who work for and with us.

This QR code will take you to our **YouTube Channel** and to an interview with Cristina Peslari (site manager at Keller Geoteknikk in Norway)

World's largest monopile factory **takes shape**

Construction of the world's largest offshore wind turbine base factory is well underway, thanks to the efforts of three UK Keller companies. Despite multiple challenges, including frequent design changes and complex ground conditions, thousands of piles have been successfully installed on this high-profile project to boost British manufacturing.

England's north-east has a proud industrial heritage that saw coal mines, steelworks and ship yards once dominate the landscape. In recent years, the region has been undergoing huge regeneration and reinvention, attracting new industries and manufacturers to the area.

One of these is South Korean firm SeAH Wind, which is building a 100,000m2, 40m-high facility to produce over a hundred wind turbine monopiles every year. Monopiles are the enormous steel bases on which the turbines are mounted and can be up to 120m high. The £400 million factory will employ 750 people and support many more jobs in the supply chain, as well as boosting the UK's shift to greener energy production.

Ready to go

Once it had secured approval for the factory, SeAH moved quickly, appointing K2 Consultancy as the main contractor and, for the foundations, a joint venture team of Keller and Bauer.

> ***"We have a long, successful relationship of working with Bauer on large projects and with our complementing areas of expertise, this was the perfect project for us to team up again," says Andy Miller, Estimating Manager, North.***

"The initial design called for two techniques: continuous flight auger (CFA) piles and bored rotary piles. With most Keller projects using the former and Bauer the latter, the scope was neatly divided along those lines."

Keller based its CFA scope on the initial designs from client. But once on site, these plans would go through several iterations, with increasing pile sizes and changing pile locations and sequencing.

This meant the crew had to be flexible and ensure a close partnership approach, adapting to meet SeAH's needs, while also managing expectations over the impact the changes would have.

Ground of steel

Adding to the complexity of the project were the ground conditions, as Project Manager George Martin explains: "The site is a former steelworks and so the top 10m was full of waste material we couldn't drill through without damaging our CFA rigs.

"The top 2m was stripped and crushed and then for the rest of that top layer we decided to 'core' every pile position using rotary rigs. These holes were then backfilled with stone and the piles installed. Sometimes this was made more difficult because in between coring and installation, the design would change and so would the pile location."

To maintain high levels of production, up to seven coring rigs were in operation, along with three to four CFA rigs.

"It's a huge site, but once you have all those rigs, plus Bauer's machines and other trades there, it's surprising how quickly the space shrinks," he adds. "That meant we had to sequence everything carefully so we didn't get in each other's way or slow things down."

Helping Keller with this, was sister company GEO-Instruments. A team of expert engineers were responsible for setting out 7,646 pile positions for Bauer and Keller rigs as well as producing as-built drawings, and coordinating the multitude of changes to ensure smooth progress.

Meanwhile a third Keller company, Phi, was also involved. Phi is the UK's largest retaining structures contractor and used its expertise to supply and install 6,500m3 of welded mesh gabion cages for the site's access road.

A big success

By the time the project wrapped up at the end of 2023, Keller had been on site for more than 70 weeks, installing over 5,700 piles with diameters of 600mm, 750mm and 950mm to an average depth of 24.5m.

> ***"This was one of Keller UK's largest jobs of recent times, and certainly the largest piling job I've ever been involved in," says George.***

"It's been hugely successful, we've maintained production in excess of what we initially promised and we've shown our adaptability to react to demands and challenges. Both K2 and SeAH are very pleased with the quality of our work and we're proud to have been involved in what is an important project for the region."

Leading by example in building sustainably:

HPQ Office in Frankfurt am Main, Germany – Optimising CO_2 emissions

Keller Grundbau Germany executed a 13m deep construction pit in cooperation with the company Kern, based in Langen. The ground plan area of this construction pit is about 9,400m² and in striking distance to the river Main. Besides the 'normal' work including the pit support, the foundation work, the excavation and the demolition of the bored pile wall built in 2019 from the adjacent area "South", special attention had to be paid on the carbon footprint. We were contractually bound to reduce CO_2 emissions as much as possible. By optimising the design and transportation routes, the initially calculated CO_2e emissions could be reduced by 54% to approx. 4,100to.

Stephan Buddenberg, Keller Grundbau – Offenbach am Main
Eva Reiners, Keller Grundbau – Köln

For the HPQ Offices project, located in Frankfurt am Main, Germany, the client asked already during the tender phase for a CO_2 optimised construction method for the building pit. This was one of the main criteria for being able to win the tender. Keller Grundbau Germany supported this goal right from the beginning and checked various optimisation methods together with the company Kern, as its JV partner. We examined the transportation and travel routes, the quantities and properties of all materials, the energy consumption of the equipment used during execution. The emissions could be reduced from approx. 8,200to CO_2e to approx. 5,000to CO_2e presumed in the tender phase. The biggest reduction was achieved by the optimisation of transportation routes for the excavated material (from 2,000to CO_2e to 390to CO_2e) as well as the use of cement with a low percentage of clinker brick for all concrete products. The shortfall of one anchor layer during the optimisation process of the design led to further reduction of the emissions. During production, special attention was led on further optimisation of all quantities, routes and fuel consumption. As a result it was possible to lower the emissions for the construction of the building pit and the deep foundation step by step to 4,100to CO_2e. One major step was achieved by further design optimisation of the combined pile raft foundation, the use of fly ash for the concrete mix design, and the use of HVO instead of Diesel. HVO is produced from vegetable waste and is chemically very similar to Diesel, so it can be used in the most engines. The total amount of HVO emission is likely to be more than 80% less than for Diesel. The profiling of the excavation pit and the dismantling of the constructed elements at the end of their life were also taken into consideration, resulting in an increased amount compared to the alternative analysis during the tender phase. The achieved savings of approx. 4,100to CO_2e compared to the initial alternative correspond to the approximately annual CO_2e emissions of electricity consumption of 3,300 households . The client will compensate the remaining emissions in other regional projects.

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