



KELLER *insight*

Building on our strengths



2018



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EVERYTHING CHANGES AND NOTHING STANDS STILL.

This quotation from the Greek philosopher Heraclitus reflects today's standard of living more than ever. We live in a time when the market is constantly and steadily growing, innovation is becoming more and more important and is encouraged, and expectations are rising inside and outside a company.

Good and new ideas, good communication and, above all, good employees are the factors that enable a company to follow this ongoing change and to ensure a healthy future for a company. For this reason, this year I dedicate this magazine to all those who work every day in the office, on the construction sites, in the workshops and in the yards to ensure that all requirements are met.

As you browse through this magazine, you will see that in 2018 we have again completed many interesting projects, and have achieved

a lot in the area of innovations, but we can also build on the future by welcoming many new and young faces.

We hope you enjoy reading the Keller Insight magazine and that you will find yourselves in some projects and (why not) let yourself think back to your beginnings.

Best wishes

Andreas Körbler



Masthead:

"Keller Insight" is a magazine by Keller Grundbau Ges.mbH and affiliated companies.

Owned and published by:

Keller Grundbau Ges.mbH, Guglgasse 15 / BT 4a / 3.OG, 1110 Vienna

E-Mail: info@kellergrundbau.at

Editor: Vacali Marina

Design, layout and print: G.A. Service GmbH, Siesenheimer StraÙe 39, 5020 Salzburg
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HIGH PERFORMANCE ON AU STRIA'S HOLIDAY TRAFFIC AX IS

Renovation of the 21 m high anchor wall Egger on the Salz burg Tauernautobahn

The anchor wall Egger on the A10 Tauernautobahn at km 50.6–50.9 in the municipality of Hütttau was redeveloped in the course of the roadworks on the route to Salzburg. For us, drilling works at dizzy heights were part of the programme.

Immediately after the total blockade of the carriageway towards Salzburg, installation works on the construction site started at the end of March 2018, followed by the drilling works for the permanent strand anchors. The design, by the company 3G Gruppe Geotechnik Graz, shows vertical concrete pilaster strips, which secure the existing support structure by means of pre-stressed

permanent anchors with a length of up to 26 m. The construction plan was to move the strand anchors before concreting the pilaster strips. A particular challenge was the large starting height of the drilling points for the anchors to be produced. A special drilling platform for this project was used to successfully and safely handle the unusual work at great heights.

SEVERAL SPECIAL SOLUTIONS ON ONE CONSTRUCTION SITE

The lowest anchors were drilled from the ground with a specially adapted mounting carriage. All manipulations on the drilling points had to be done with lift trucks. Immediately after the production of the first anchors, the concreting of the reinforced concrete pilaster strips began, and the anchorages for fixing the drilling platform were installed at the same time.

The upper anchors, with a starting point height of up to 21 m above the roadway level, were carried out with the drilling platform hanging freely in the wall. The logistical challenge involved transferring the approximately seven-tonne platform from one drilling point to the next by means of a mobile crane. The forest road running along the wall head was used for the continuous supply of energy, compressed air and drilling equipment. As a result, the existing chronic shortage of space on the wall foot improved significantly, since the tight schedule required the renewal of the complete directional road including, the substructure at the same time. For the project team and the staff on the construction site, continuous co-ordinated work was essential to finally complete all work on time.



PROJECTS

Marko Schmolzer

Dominik Struber
Keller Grundbau
Salzburg

AUSTRIA
Hütttau

PROJECT INFORMATION

- Client:** ASFINAG Bau Management GmbH
- Customer:** Kostmann GmbH
- Designer:** 3G Gruppe Geotechnik Graz
- Quantities:**
 - » 5,722 m permanent strand anchors
 - » 400 m temporary anchors
- Execution period:** March – August 2018

TIME SAVINGS FOR FREE ROADS IN TOURISTIC TRAFFIC

Through a tireless effort, a small lead over the extremely ambitious time schedule could be worked out during the drilling works and so, the traffic assignment took place earlier than planned. The anchor tensioning works, which started parallel to the above mentioned works from the third week of execution, had also to be carried out by lift operators.

In order to execute the required performance tests in all heights and across the wall, another working platform was constructed, which joined the already used drilling platform. Thus, the several hours of tests were carried out under the highest safety standards and without the blocking of lifting equipment. Despite the strict construction schedule and the high logistical requirements of such a demanding construction site with complex boundary conditions, the assigned works were completed as planned and handed over to a satisfied client. The main wave of holiday traffic could pass the Tauernautobahn at this point as planned and continue unhindered to the south.



As part of the construction of the new bridge between Fußach and Hard, it was also necessary to adapt the sewer and water pipeline infrastructure in the area, as all lines until now have been routed across the Rhine along the "old" Rhine bridge. The cable routing over the new Rhine bridge will no longer be possible. For this reason, the new pipes will run at a depth of about 12 m below the New Rhine by means of culverting. To accomplish the forwarding of the waste water arising on the left side of the Rhine to the ARA Hard on the right side of the new Rhine, the construction of a sewage pumping station is necessary.




For the construction of the pumping station, a 9 m deep shaft was necessary. Due to the groundwater just below the surface, special attention had to be paid to the density. The initial design showed a 14 m diameter shaft made by means of overlapped bored piles. To seal the excavation pit, a 3 m thick jet grouting slab was planned, which is secured against buoyancy by previously constructed piles.




Keller offered a cost and time-efficient alternative and replaced the overlapped bored piles by spaced bored piles where the spacings had to be sealed with jet grouting columns, i.e. the unreinforced primary piles were exchanged with jet grouting columns.


After the contract was awarded to Keller, the geotechnical works started at the end of June. The continuous flight auger piles (CFA) were quickly constructed by a local sub-contractor, so that the jet grouting works started after a period of only two weeks. Due to the exceptional local geological conditions (inter alia peat layers), the first jet grouting columns encountered problems with the setting behaviour of the binder commonly used in this region. A quick sampling of the first Soilcrete® columns enabled immediate reaction to the inhibited setting behaviour. By the partial use of blast-furnace cement as well as pre-cutting the columns by means of thin binder suspension, the required strengths were achieved. In the area of the initially produced columns with limited setting behaviour,



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RHINE BRIDGE
PUMPING
STATION
FUßACH

PROJECT INFORMATION

Investor: Wasserverband Hofsteig/Gemeinde Fußach/ MG Hard/Vorarlberger Energienetz
Customer: i+R Bau GmbH
Geotechnical consultant: BGG Consult/Rudhardt Gasser Pfefferkorn Ziviltechniker
Quantities: 863 m CFA piles Ø 88 cm
 » 390 m Soilcrete® columns Ø110 cm,
 » 550 m³ Soilcrete® sealing slab
Execution period: June – August 2018

the problem was solved constructively, in which the head area of the Soilcrete® column was replaced by concrete between the CFA piles. In this way, the load capacity of the non-anchored and non-stiffened circular shaft, whose operation is based on the boiler formula, could be restored with relatively little effort. Due to these prior works, the excavation started as planned at the end of August.



Roman Weidacher
Keller Grundbau
Soding



AUSTRIA
Granitztal

TUNNEL GRANITZTAL
SECTION 50.4

During the excavation works on the two tunnel tubes (track 1 and 2) of the Koralmbahn for the client ÖBB (Austrian Federal Railways) Infrastructure, swellable tunnelling sections (occurrences of anhydrite) were found, which led to the need for bulkhead grouting.

In the wake of the tunnelling works, two grout curtains (SV / PM only in the slab and SV / PM revolving) were produced in the two tunnels (track 1 and track 2) at a distance of approximately 200 m. Keller Grundbau was awarded the contract for these works but all injection drillings as well as the entire grout material were provided on site (JV Tunnelkette Granitztal-Implenia / Hochtief).

The drilling and grouting works were subdivided into three primary grouting levels (A, B, C) and if required (grouting success) into two further grouting levels (D, E). In each of the approx. 2 m long grouting levels A, B (D), C, A free Portland cement suspension (using a single packer in one section, 0 – 2 m) was used for compensation close to the cavity. In the wake of the results from levels A and B, the intervening level C (E) was charged to a chemical injection with approx. 4 m long injection drillings (single packer in two sections, 2 – 4 m and 0 – 2 m). The chemical grouting material that was used, was an acrylate gel, which is a three-component, water-swellable acrylate or methacrylate-based hydrogel.

The biggest challenge of these works were the boundary conditions. On the one hand the injection rules, recording criteria and requirements of the grouting material and on the other hand, the preliminary tests of the mixtures.

To be able to check the grouting success, several core drillings were sunk and handed over to the responsible geologist for visual inspection.

INJECTION RULES PZ – SUSPENSION (OPTICENG52,5):

- » 0 – 5 bar (effective, measured at the borehole top) 6 bar max.
- » 0.5 – 10.0 lt. / min; 0.5 lt. / min at maximum pressure
- » Limit quantity 100 lt. / drilling hole
- » Gin concept: 200 bar*l / m – drilling hole
- » Stable mixture, sedimentation rate ≤ 5 %

INJECTION RULES – CHEMICAL INJECTION:

- » 5 – 25 bar (effective, measured at the borehole top) 30 bar max.
- » 0.2 – 5.0 lt. / min; 0.2 lt. / min at maximum pressure
- » Limit quantity 30 lt. / m drilling hole
- » Gin concept: 400 bar*l / m – drilling hole in the gradient 2 – 4 m
- » Gin concept: 100 bar*l / m – drilling hole in the gradient 0 – 2 m
- » Dynamic viscosity ≤ 2,5 mPa*s (at +20°C)
- » Working life (gel time): 4 – 5 minutes

DOCUMENTATION:

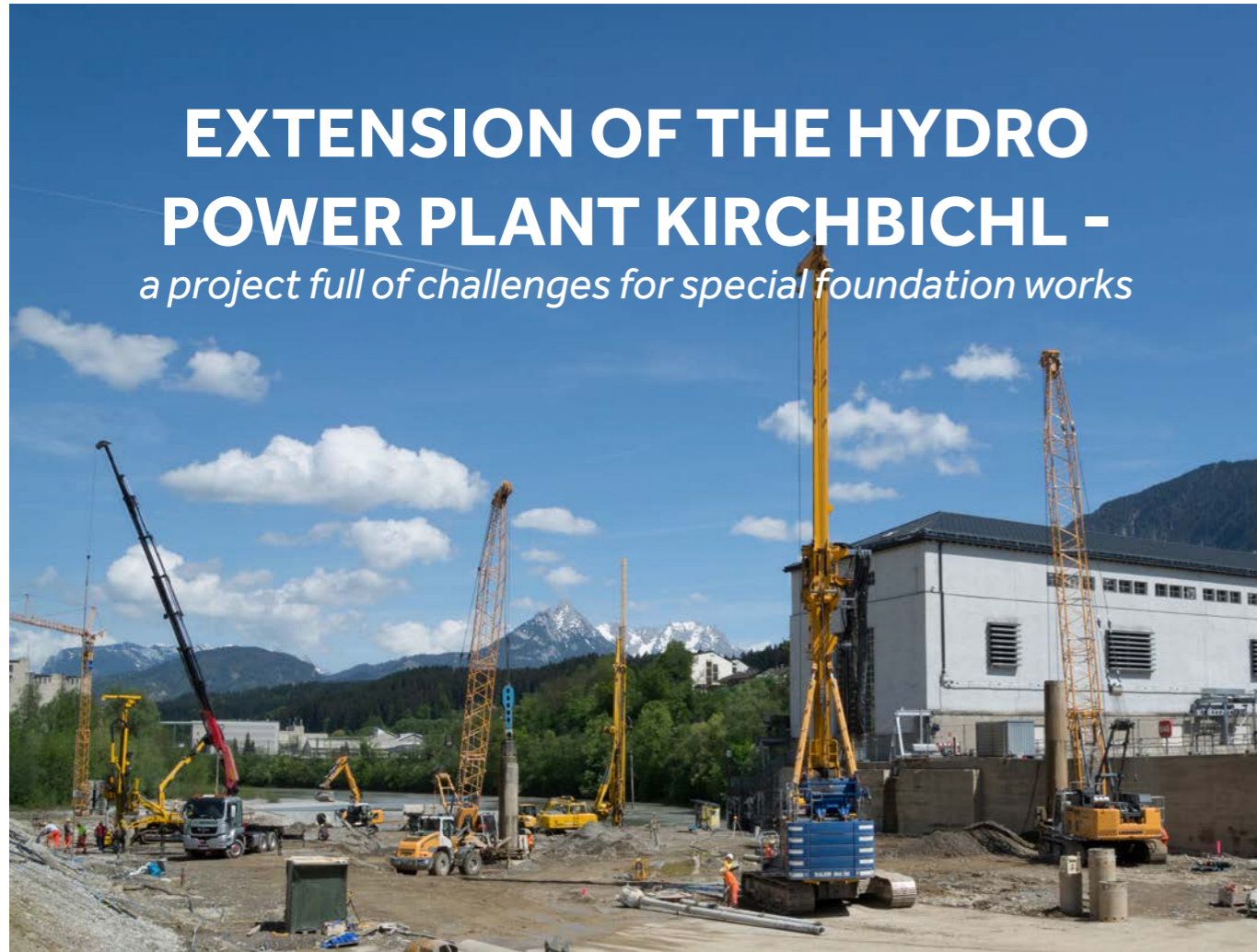
- » Grouting material and associated composition according to test book
- » Pump pressure, pump rate, time, depth of drilling holes
- » Gin value (Grouting Intensity Number according to Lombardi)

Due to the excellent cooperation of all participants, all grouting works (without the use of secondary levels D and E) were completed on time to the utmost satisfaction.



PROJECT INFORMATION

Investor: ÖBB INFRA
Customer: JV Tunnelkette Granitztal (Implenia / Hochtief)
Expert for grouting technique (customer): Dipl.-Ing. Andreas Walter; viglconsult
Quantities:
 » approx. 29 grouting days
 » approx. 1.000 m grouting
 » approx. 500 grouting sections
Execution period: January – March 2018 (8 weeks)



EXTENSION OF THE HYDRO POWER PLANT KIRCHBICHL –

a project full of challenges for special foundation works

TIWAG-Tiroler Wasserkraft AG intends to expand the existing run-of-river power plant in Kirchbichl to increase the efficiency of the plant, which was built around 1940. The works were also necessary to meet changed legal requirements, in particular the consistent fish passes and the cross-linking of habitats. The trial operation is planned for September 2020, the construction costs of this expansion amount to approx. € 40 million, with a total cost of around € 110 million.

The Tyrolean construction company Ing. Hans Bodner Bau Ges. M.b.H. & Co. KG, headquartered in Kufstein, has been awarded the contract for the overall construction project, the special foundation works is being carried out by Keller Grundbau.

After ten months of intensive project preparation, we started our works in October 2017. Four construction phases, with different challenges from the perspective of special foundation works, are designed for this project:

In sections II, III and IV, the focus is on the production of technically impermeable excavation pits with different geological and hydrological conditions, the knowledge of which plays an essential role in the success of the works. Already in the submission phase, intensive soil and laboratory investigations were carried out, which were part of the geotechnical report that was the basis for bidding and execution.

In autumn 2017, the first special foundation works in section I – temporary bridge – were carried out. Bored piles with a diameter of 1200 mm and a drilling length of 24 m were executed as a foundation for the temporary bridge above the Inn, which is part of the direct access road to the construction site from the A12 motorway.

With almost seamless transition, the next task awaited us, namely Phase II – fish ladder and dopant power plant – in striking distance

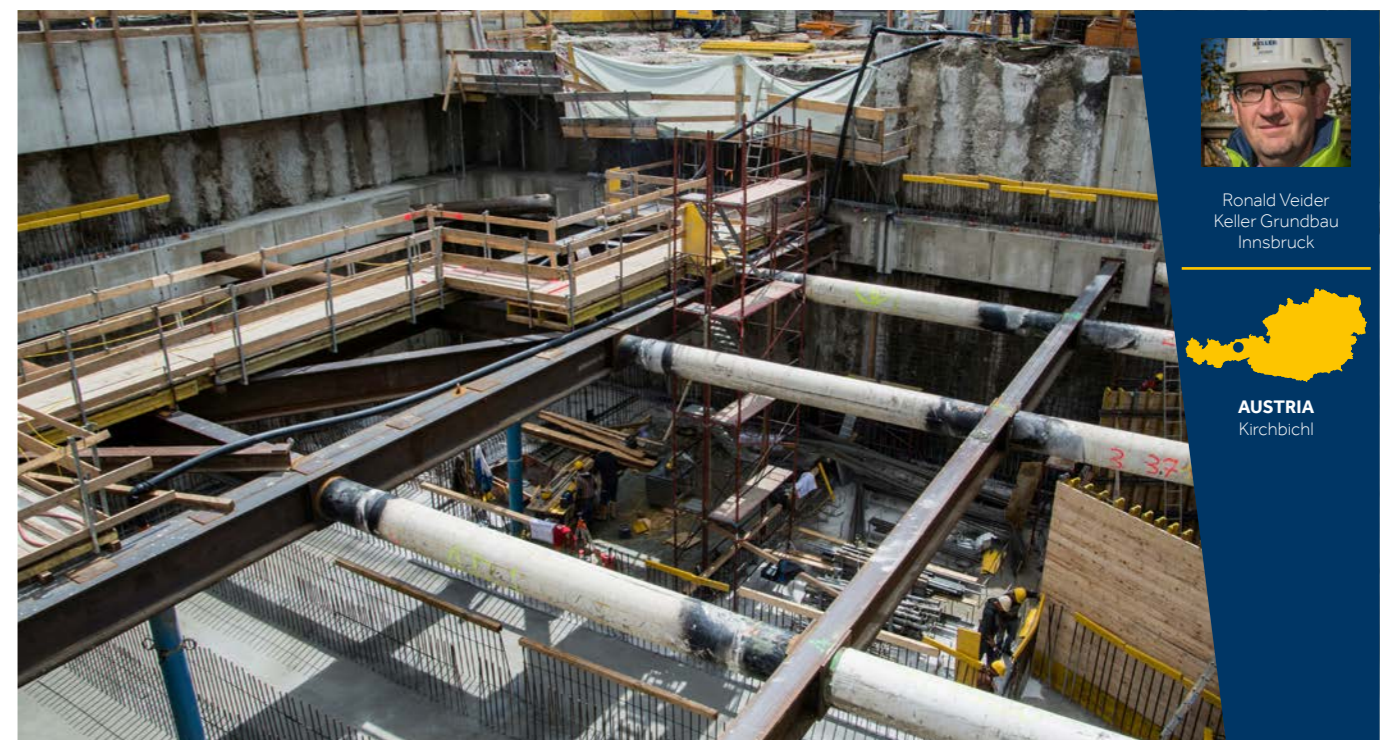
to the existing weir plant. The works that had to be carried out in this section lasted almost the complete winter – about five months. For the excavation pit with a ground area of approx. 550 m² and almost square dimensions, a spaced bored pile wall with gap sealing with jet grouting was executed. Additionally, statically required reinforcement was used. Due to the local groundwater conditions – a mirror difference of 12 m – a deep jet grouting slab was built as a horizontal sealing element.

A combination of bored piles and jet grouting columns was constructed as a vertical sealing element. The construction of the bored piles with a diameter of 1200 mm, a depth up to approx. 22 m and a horizontal distance of 1.5 m was done by two drilling rigs using the Kelly drilling method and drilling with bored pile grab.

Two bored wells were constructed for dewatering. The sinking inside the excavation pit was measured and recorded by two piezometers. The arising amount of residual water was below the admissible value. In the meantime, the building construction has progressed so far that both the dewatering has finished and the bracing has been dismantled.

While working in section II, we already had to face the next challenge. In section IV, which is certainly the most demanding one, three dense excavation pits with surface areas of up to 2.300 m² were planned. Keller drew a spaced bored pile wall with the spacing being sealed with jet grouting columns, a statically required anchoring and bracing and a jet grouting slab – high and low lying, partially with anchors.

In principle, a combination of bored piles and jet grouting columns was again used as a vertical sealing element. The bored piles had a diameter of 1200 mm and were constructed with up to three drilling rigs using the Kelly drilling method and drilling with bored pile grab into a depth of approx. 30 m and a horizontal distance of 1.60 m. Due to the contract specifications and the technical requirements, it was



PROJECT INFORMATION

Investor: TIWAG – Tiroler Wasserkraft AG, Innsbruck
Customer: Ing. Hans Bodner Bau Ges. m.b.H. & Co. KG, Kufstein

Quantities:

- » Bored piles: approx. 9,000 m
- » Jet grouting columns: approx. 9,650 m
- » Jet grouting slab: approx. 4,600 m²
- » Temporary strand anchors: approx. 3,000 m
- » GEWI-grouted piles: approx. 7,400 m

Execution period: October 2018 – ongoing

necessary to measure and evaluate the verticality of the pile elements before the concreting works.

The resulting data was then reflected in the arrangement of the jet grouting columns. Two decision criteria had to be taken into account to choose the correct jet grouting column diameter: the verticality of the bored piles and the one of the jet grouting columns. The evaluation and visualisation of the borehole courses, was carried out by the in-house developed KCI (Keller Column Inspector) program.

Different systems were used for the horizontal sealing. In the area of the structure with overflow, a low-lying jet grouting slab with a thickness of up to 2.50 m and in the excavation pit for the powerhouse, an anchored high-lying jet grouting slab with a thickness of 3.0 m.

The bored pile works began in January 2018 and were completed in the first half of the year. The production of the jet grouting slab in the area of the structure with overflow, the anchoring of the jet grouting slab inside the excavation pit of the powerhouse as well as the construction of the temporary anchors followed. Activities in section IV finished in November 2018.



Ronald Veider
 Keller Grundbau
 Innsbruck



AUSTRIA
 Kirchbichl



AGRANA WHEAT STARCH PLANT II, PISCHELSDORF

Foundation by means of vibro compaction, continuous flight auger (CFA) and micropiles

Agrana Stärke GmbH is expanding its location in the chemical park in Pischelsdorf near Tulln (Lower Austria) with an additional wheat starch factory. Agrana is thus able to use 100% of the raw materials delivered at this location, without waste products.

The construction company Granit Gesellschaft m.b.H. won the contract to build the wheat starch plant II and subcontracted the special foundation works to our company, Keller Grundbau Ges.mbH. For Keller Grundbau this is the fourth major construction site in the chemical park in Pischelsdorf, which is why much experience has already been gained with the inhomogeneous soil.

The layers consist of thin alluvial soils (fine-sandy silt and silty fine sands) and inorganic accumulations of sandy gravel down to the aquiclude (marl) in

about 10–12 m depth. The sandy gravel is found in very different densities from very loose to very dense and partly also grouted.

The wheat starch plant is being built on the one hand on a construction site next to the existing wheat starch plant and on the other hand in open areas within the existing plant, partly adjacent to existing buildings. Thus, depending on the boundary conditions – the inhomogeneous soil, the very different loads of the various buildings and the location of the buildings (directly on adjacent buildings or on remote open spaces) – different foundation systems were carried out on the construction field. While subordinate components

with low bearing loads on the existing subsoil or after a soil replacement of the unsustainable alluvial soils could be flatly founded, most buildings had to be founded with additional measures of special foundation.

In areas with intermediate bearing loads, away from existing buildings, ground improvement was carried out by means of vibro compaction. Thus, the upcoming, loosely laid, sandy gravel was improved to such an extent that the settlements and the differences in the uprising buildings could be minimised and the entire soil under these buildings could be homogenised.

The short construction period could be realised not least because Keller Grundbau has used from its range of in-house produced deep vibrators a heavy duty S-vibrator with increased impact force and vibration amplitude that is especially suitable for the needs of this special construction site. Thus, the execution grid on the open construction field and the layer performance could be optimised accordingly.

For buildings with very high bearing loads (silos, mill buildings) as well as for adjacency to existing buildings, due to the high loads and settlement requirements, CFA piles with a diameter of 88 cm and a pile length of 15 m were constructed. In the case of limited space and high bearing loads, micropiles were used for deep foundation. This system was also used, for example, for the foundation of raw bridge foundations between existing railway tracks in the existing plant.

Due to the large portfolio of special foundation techniques from Keller Grundbau, the entire special foundation works could be assigned to only one subcontractor by the client, which facilitated the handling and co-ordination on the construction site for the client and ensured a smooth construction process. Thus, the special foundation works were completed in a net construction period of 17 weeks to the full satisfaction of our customer and the client.



PROJECT INFORMATION

- Client:** Agrana Stärke GmbH
- Designer:** BHM-Ingenieure
- Geotechnical expert:** ARGE Dr. Fross u. Dr. Blovsky
- Customer:** Bauunternehmung Granit Gesellschaft m.b.H.
- Quantities:**
 - » Vibro compaction: approx. 1,160 pieces with approx. 11,000 m
 - » CFA piles: 264 pieces with approx. 3,960 m
 - » Micropiles: 65 pieces with 933 m
- Execution period:**
 - » Vibro compaction: 12 weeks
 - » CFA piles: 8 weeks in 2 stages
 - » Micropiles: 3 weeks



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AUSTRIA
Graz

PURPLE SOILCRETE®?! The 'Rittergasse' in Graz. A special site for various reasons.

THE GLACISSTRASSE IN GRAZ, OPPOSITE TO THE STADTPARK, IS ONE OF GRAZ'S FINEST ADDRESSES. WELL, IN PRINCIPLE, AT LEAST.

In the past, there have been chemical laundries which might, as it is often the case, have contaminated the subsoil. One such site is the 'ST25 Putzerei Plachy' situated on the crossing with the Rittergasse. There, Tetrachloroethylene was used between 1958 and 1973 and ended up in the subsoil, most probably because of leaks from tanks and sewage pipes.

The remediation concept proposed excavation and off-site treatment of the soil. In the planning phase, Keller was contacted to bid for the necessary excavation pit securing works. During the course of the detailed planning two topics crystallised as critical to the whole planned project:

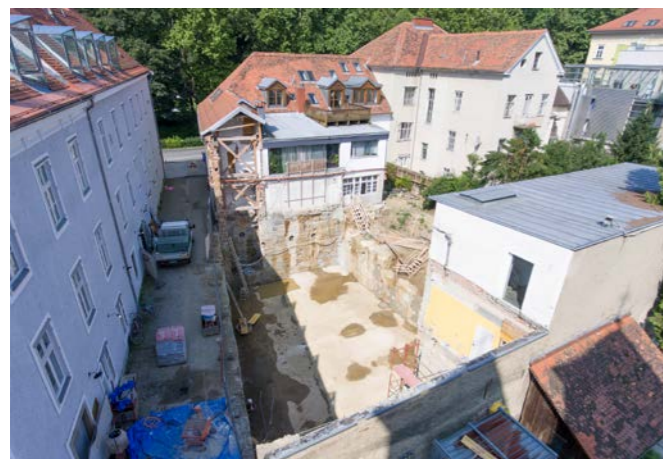
1. There was not enough space to execute the planned bored piles
2. It was not possible to excavate contaminated hot spots in a public area and below an existing building that had to be left in place

Soilcrete® and its extension HaloCrete® proved to be the best solution to both problems. For the latter the slurry recipe is altered in a way to contain chemical reactants that degrade the contaminant. In this case Potassium permanganate (KMnO₄) an oxidising agent that is often used in brownfield site remediation, was used. The challenge with such a remediation project is planning. An exact estimation of the boundaries of the contaminated zone as well as the contaminant inventory can only be achieved through extensive investigation measures and in

co-operation with experts which have specific expertise in this field. After resolving these questions, the work continues in the laboratory with the design of the slurry recipe. Here, factors regarding the local soil have to be taken into consideration. For example through the determination of the Natural Oxygen Demand (NOD) one has to make sure that not all oxidant is used up by the soil itself.

The actual execution proved problem-free. The permanganate was simply added into the mixing plant, the jet process itself was not different to a normal application. The only difference and complexity to the well-known Soilcrete® process, was the waste logistics, since two different backwashes were produced. A fact that was exacerbated in this project because of the existing shortage of space. Proof of success was delivered using cores drilled directly from the HaloCrete® columns which were chemically analysed in an accredited laboratory. The contaminant concentration was lowered calculative by a factor between 10⁴ and 10⁶!

Finally, all works were executed under difficult spatial conditions, in a complex soil, in bad weather and in the presence of a carcinogenic contamination on time, technically successful and, crucially, without accidents. In other words, a usual outcome for a Keller construction site.



A7 VÖEST BRIDGE - Construction of by-passes to calm traffic in the centre of Linz

As part of the planned restoration of the 45-year-old Vöest bridge in Linz (Upper Austria), which is part of the A7 Mühlkreis Highway, two additional bridges, so-called 'by-passes', are being built. In addition to increasing safety, these by-passes will also lead to fewer traffic jams for the approx. 100,000 vehicles that cross the bridge daily.

These by-passes are also bridges that ensure traffic is managed. The drivers, who only want to cross the capital of Upper Austria, will be navigated via the renovated main bridge and the newly built by-passes will serve the inner-city traffic. These will also feature with a walking and cycling path.

The by-pass bridges require the construction of four pillars placed in the Danube. These pillars are built in a sheet pile box for added safety and founded on bored piles. To seal the sheet pile box in the construction phase and to form a scour protection between the bored piles in the final state, it is necessary to compact the in-situ soil in the river bed via Soilcrete® works. Keller was awarded these special foundation works by the Joint Venture A7 Vöestbrücke (HBM Swietelsky – Granit) in June 2018. The Soilcrete®

equipment was assembled on work boats and then manoeuvred to the first sheet pile box, so that the works on the Danube could be started at the end of July.

Depending on the top edge of the marl, the sealing slabs have a thickness of 3 – 4.5 m. Keeping that in mind, drilling depths of up to 15 m had to be achieved. For quality assurance, diameter controls were performed on each pillar using the ACI® (Acoustic Column Inspector®) method. In addition, the borehole drills were measured and recorded in execution plans. The four sheet pile boxes were executed one after the other, with the construction being completed at the end of September.



Johannes Zauner
Keller Grundbau
Linz



AUSTRIA
Linz

PROJECT INFORMATION

Client: ASFINAG
Customer: ARGE A7 Vöest-Brücke HBM Swietelsky – Granit
Geotechnical consultant: Geoconsult
Design: Öhlinger + Partner
Quantities: 2,330 m³ jet grouting
Execution period: July – September 2018



© ASFINAG



RECONSTRUCTION OF A RAILWAY EMBANKMENT FOR THE CZECH STATE RAILWAYS DURING RUNNING SERVICE

As part of the optimization to increase the speed of the double-track Prague–Pilsen railroad line to 120 km/h, the curve radius at the railway embankment had to be increased. The embankment which is limited by bridges on both sides, has a length of 400 m and a height of 5–6 m. According to these parameters, the dam had to be upgraded with an additional fill in 2006, but it showed that there had been incompatible settlements—especially in the area of the tracks. To ensure a safe operation of the railway, regular rehabilitation of the track layers by means of packing under with ballast had to be made.

The geotechnical investigations of the railway embankment showed that the deformations were created especially in deeper layers and that the in-situ soil showed hardly any deformation. In addition, it was shown that the lateral dewatering of the railway embankment became inoperative due to the continuous track rehabilitation by means of packing under with ballast. Thus, the rainwater could penetrate into the railway embankment and in this way moisten the

partially fine-grained filling material so far that it was present only in soft consistency and was subsequently no longer sustainable. Since the redevelopment concept showed maintenance during the railway operation, an exchange of the complete embankment filling material was not possible. Furthermore, the stop of each track axle was only possible for a duration of 90 days and thus a quick special foundation technique had to be found for the complete

embankment rehabilitation. The working sequence was planned in a way that, on the one hand, the limited access to the dam crown was ensured and on the other hand only one track axle was closed. To get along with the limited time schedule of the track lock, we decided to use the vibro replacement technique for the rehabilitation of the embankment – a fast and efficient soil improvement method.

In the area of bridge abutments, however, this technique could not be used as geogrid layers were installed to stabilise the changeover from the railway embankment to the bridge abutments. In these areas, classic deep-foundation systems with piles had to be used.



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CZECH REPUBLIC
Brno

In order to be able to do this as quickly as possible during the track lock, we used the Keller Ductile Pile System (KDP).

To be able to carry out the special foundation works, a track, including the substructure, had to be removed, so that additional care was taken to ensure that the rail track under operation could not slide into the rehabilitation area. In addition, the equipment had to be arranged in a way that it did not protrude into the railway loading gauge of the track in service.

The securing was carried out by means of a soldier pile wall with HEB 140 profiles and after the removal of the track including the substructure, a working area of approx. 5.50 m width was created, which was bounded on one side by the soldier pile wall and on the other side by the embankment. This meant that the workflow had to be organised in a way that the rehabilitation works were completed in a precisely planned time window:

- » Construction of the gravel piles to a depth of approx. 15 m with a vibrocat TR04
- » associated pre-drilling of the gravel columns with a Soilmec SR45 rotary drilling rig
- » subsequent construction of the KDP in the bridge abutment area

It has to be noted that for security reasons, only one device was allowed to move on the limited working area. Afterwards, the substructure and the tracks were restored to their original geometry.

The gravel columns were designed with a diameter of approx. 700 mm in a triangular grid and a distance between them of 1,500 mm. To achieve a corresponding consolidation and dewatering effect of the dam material, the columns had to be constructed down to 15 m into the natural soil.

In total, 804 pieces of vibro columns with a total length of 11,300 linear meters were produced in 38 working days.

In the transition area near the bridge abutment, the KDP were also constructed in a triangular grid. During production it became apparent that no sufficient bearing soil was found to a depth of 12 m as designed and so the KDP had to be extended to 19.5 m. The extremely flexible KDP system made this work without problems. The pile heads were formed with specially prefabricated reinforced concrete slabs to ensure the best possible force transmission into the pile. Approximately 700 meters of coated KDP were produced in less than two days.

After completing the rehabilitation of track 1, the same procedure was repeated with track No. 2.

The rehabilitation works carried out would not have been possible in the required time without the use of modern methods of special foundation works – the co-operation between the designer and Keller thus proved its worth. The client could be offered a solution that gave all sides a positive and satisfactory result.



Davorin Lesnik
Keller Grundbau
Soding



SLOVENIA
Ljubljana

A-TOWER LJUBLJANA –

Pit support by means of overlapping Soilcrete® columns and temporary anchors

In the centre of the Slovenian capital Ljubljana, the well-known jeweller chain Zlatarna Celje d.o.o. has invested in the construction of another luxury hotel with a total building area of approx. 2,000 m².

The design includes four basement levels and the total height of the building is more than 80 m above ground level. Keller Grundbau was awarded the contract for the design and construction of a pit support, which was specially applicable to the present complex boundary conditions. SLP d.o.o. from Ljubljana carried out the geotechnical design based on our in-house calculation done by the design department. Before being approved by the client, it was also checked by the University of Ljubljana and additionally by the INSITU Geotechnik ZT GmbH from Graz.

The existing soil can be described mainly as sandy gravel with embedded conglomerate layers and partially embedded sand-silt formations. The region-wise extreme inhomogeneity or the strongly changing stratifications over the excavation depth are determined by the Sava River lying near the city.

The original design showed an excavation pit with large bored piles in combination with stiffening elements. Numerous optimisation steps back in 2012 by Keller Grundbau have proposed excavation support by means of overlapping Soilcrete® columns with nominal diameters of 160 cm as well as temporary pre-stressed strand anchors, which can considerably help the excavation works. The continuous development of the technologies in the company and further economic optimisation, ultimately led to Keller getting the job assignment. The Soilcrete® columns are executed with a diameter of 200 cm and a centre distance of 170 cm and up to a depth of 20 m from the working platform. These diameters require the use of special high-performance pumping and mixing systems. The anchoring works were carried out with temporary strand anchors with up to four strands with individual

lengths reaching a maximum of 20 m. To be able to guarantee the required or designed diameter and to be able to optimally match the manufacturing parameters to the existing soil, three diameter controls were carried out in advance with our Acoustic Column Inspector® (ACI®) system. In order to fulfil the required pit support works, approx. 2,000 m of Soilcrete® columns and approx. 4,400 m of temporary anchors have to be constructed.

The comprehensive quality assurance was carried out on site and by an external concrete laboratory by means of external monitoring. At the copy deadline, the Soilcrete® works were already in progress. The completion of all works by Keller Grundbau is scheduled for the end of March 2019.

PROJECT INFORMATION

- Investor and customer:** Zlatarna Celje d.o.o.
- Designer:** SLP d.o.o., Ljubljana
- Revision of the project:** University of Ljubljana and Insitu Geotechnik Graz GmbH
- Quantities:**
 - » Approx. 2,000 m Soilcrete® columns Ø 200 cm, double system
 - » Approx. 4,400 m 4-strand temporary anchors
- Execution period:** October 2018 – March 2019 (scheduled)



Timo Ackermann
Keller-MTS AG
Ennetbaden



Thomas Kimpritis
Keller-MTS AG
Ennetbaden



SWITZERLAND
Kilchberg

SWISS CHOCOLADE

on solid ground

The Lindt Chocolate Competence Foundation is building the new 'Lindt Home of Chocolate' at its headquarters in Kilchberg near Zurich. The new building should become 'the Swiss chocolate destination' for visitors from home and abroad and also serve as a research and upgrade training centre.

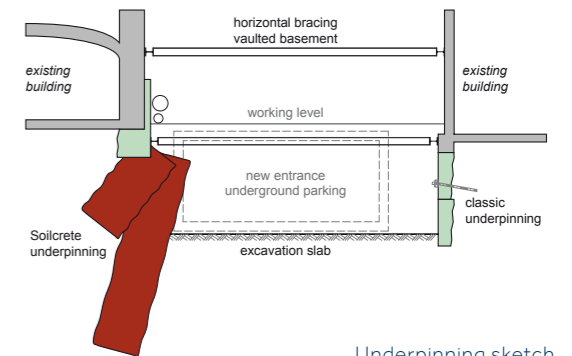
On the densely built company premises, directly on the shores of Lake Zurich, innumerable measures of pit support are required, to construct the new buildings. During the execution of a conventional step by step underpinning by means of anchored bored piles, large settlements occurred – on the one hand due to the process-related settlement rates and on the other hand due to unexpected local changes in the surrounding soil.

The affected building dates from an earlier construction period and is designed in the base area with quarry stone masonry with vaulted ceilings. Due to the soft and sensitive building substance, the risk assessment of the underpinning led to an increased risk of major damage to the structure. While looking for alternative solutions for underpinning the building, the engineering team contacted Keller-MTS for advice.

With the Soilcrete® method, Keller has the lowest settlement method available, which was considered as the best solution regarding the existing boundary conditions. With a short handling time, a customised alternative for the client was worked out. The underpinning had to be executed by means of double rowed Soilcrete® columns with diameters of 150 cm which was arranged



Underpinning works under limited space on site



Underpinning sketch

PROJECT INFORMATION

- Investor:** LINDT Chocolate Competence Foundation, Kilchberg
- Customer:** Priora AG Generalunternehmung, Kloten
- Design:** Bänziger Partner AG, Buchs und Conzett Bronzini Partner AG, Chur
- Structural analysis:** Keller-MTS AG / Bänziger Partner AG, Buchs
- Geotechnical consultant:** ABI Group Baugrund & Umwelt, Zürich
- Quantities:** 260 m Soilcrete® – columns for underpinning and foundation
- Execution period:** January 2018

with an inclined drilling axis underneath the existing building. In the predominantly silty, sandy soil, diameter control was measured via ACI® on a trial column before the main works started. On the basis of acoustic signals, it was possible to determine the layer-dependent production parameters for the jet grouting process.

Due to the local changes of the geology, a foundation of the new entrance into the underground car park was also necessary. Thus, parallel to the works of the underpinning, additional foundation columns had to be constructed using jet grouting. This made it possible to adjust the production intervals of the underpinning columns to the deformation behaviour of the building and to carry out the less sensitive works for the foundation in between.

The choice of the jet grouting process combined with years of experience in this specialised field led to no further damage to the building during construction and the deformations were reduced to a minimum of a few millimetres.

After almost three weeks of construction, our work was completed with great success and to the satisfaction of all parties involved.



GO-AHEAD FOR THE LES EVOUETT ES BYPASS BY MEANS OF A 650M LONG TUNNEL

After years of planning, Keller-MTS was contracted at the beginning of this year to carry out the special foundation works for the bypass of the village of Les Evouettes in the western part of Switzerland, near the French border.

The bypass is of great importance for the village of about 3,000 inhabitants in the canton of Valais, as there are currently about 15,000 vehicles passing through the it every day. In order to minimise traffic, a new road with a total length of approx. 1.5 km will be built. About 650 m of this route will be a tunnel, leading from the H144 road to the French border at Saint-Gingolph.

According to the designer, a jetting block for the tunnel entrance in combination with an excavation pit is to be constructed by means of anchored bored

piles. After a very short preparation time, both the bored piles and the jet grouting works started at the end of January 2018.

After a field trial, Keller-MTS was able to increase the given column diameter for construction. In addition, the given diameters and parameters required for horizontal jetting inside the tunnel were also verified. Furthermore, various types of cement were investigated regarding strength development and the reduction of environmentally harmful chromium VI. Due to the challenging soil conditions – large quantities of blocks were found – we had to pre-drill




Thierry Oechsl
Keller-MTS AG
Vétroz


SWITZERLAND
Les Evouettes

often during the execution of the bored pile works. Although this partly led to unexpected time losses, it was possible to start with the anchoring works including shotcrete in April 2018 as scheduled. The challenge in this area was that core drillings had to be done through the piles by a subcontractor for each anchor. The anchors that were placed afterwards were stressed to a tension force of 900 kN. Here, we have to mention that working areas in different levels had to be constructed by the earthwork company which was only possible due to a good communication between the various companies.

As with all projects, all quality assurance measures were taken. Thus, possible movements of the anchored bored piles and the blocks were measured regularly via inkline- and extensometer and geomonitring.

Even more attention was paid to environment issues. The complete untreated wastewater was collected on site, sedimented and neutralized. Furthermore, the entire site installation area of about 300m² was concreted to avoid possible infiltration into the soil.

Despite the sometimes difficult conditions on site, the first part of the works on the north portal of the tunnel was completed on time. Construction work on the south portal will start in the first half of 2019.



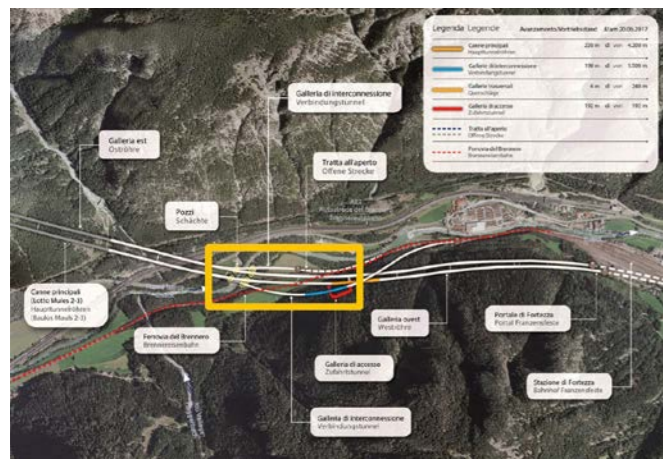


KELLER'S QUALITY MANAGEMENT PROCESS APPLIED TO THE BBT ISARCO RIVER UNDER PASSING SITE

Efficiency in terms of costs and timing, without any compromises about quality is our business creed. We are aware that our clients are committed to their own customers and stakeholders. When we put forward our ideas or projects, we are fully aware of our liabilities and we commit ourselves to satisfy their expectations and needs.

THE PROJECT

The Brenner Base Tunnel is the key element of the new Brenner railway that is going to connect the Munich-Verona axis. Once completed, at 64 km, it



will be the longest underground railway system in the world. The site named 'Isarco River Underpassing' is at the southern part of the Brenner Base Tunnel and is located near the Fortezza station (Bolzano). The site was contracted to Consorzio Isarco Scarl (Salini Impregilo - Strabag - Collini Spa - Consorzio Integra) and its objective is to develop the two main tubes of the line tunnels (about 4.5 km in total), the two cross tunnels that will be linked to the existing line (a further 1.6 km in total), in addition to other bypass tunnels (about 0.3 km). The works are particularly complex since both main tunnels and the cross tunnels will be running underneath the Isarco river, the A22 highway, the SS12 state road and the existing Verona-Brennero railway line.

GEOLOGICAL OVERVIEW

The project is located within the Isarco valley, at approximately 800 m above sea level. From a geological point of view, the Isarco River Underpass passes through the alluvial deposits of the valley bottom and through the dejection conoids of the tributary rivers. These loose deposits, heterogeneous both in composition and in granulometry, consists of gravel and rounded sand, with frequent boulders and some large granite blocks (the so-called 'Brixen Granite').

PROJECT DESCRIPTIONS AND DESIGN CHOICES

Some of the work involved ground consolidation, from ground level using jet grouting technology, preliminary consolidation before the excavation works for natural and artificial tunnels, as well two shafts with depths of approx. 33 m, which are needed for the ground freezing phase underneath the Isarco river. The tunnels reached depths between 22 and 25 m.

In addition to that, chemical grouting and micropiles were also executed. To comply with the very tight contractual timing of 400 consecutive calendar days, the works have been carried out by working 24/7. The two jet grouting rigs, type KB6 that were used were manufactured in-house by Keller Geräte und Service (KGS) in Renchen, Germany. At the moment, such rigs feature the most advanced standards, in terms of production, quality and safety, and are used worldwide for the most complex and challenging sites.

QUALITY MANAGEMENT PROCESS

For the first time on an Italian construction site, Keller operated in compliance with the entire portfolio of quality protocols, developed on the basis of experience on other complex construction sites throughout Europe.

Each piece of equipment featured a GNSS semi-automatic positioning system, to pinpoint position, height and orientation of each completed column (over 5.300 columns for this site). Orientation is extremely important for the verticality measurements. For the above reasons, before starting the works and for each WBS (Work Breakdown



Emanuele Nanni
Keller Fondazioni
Italy

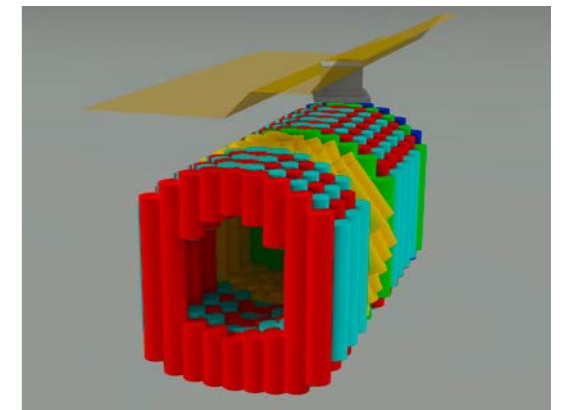


ITALY
Franzensfeste

Structure), a digital project was created and set up in a database for each column to be completed. Positioning was detected through the above-mentioned GNSS system and by using a base station installed at a fixed point within the site. Therefore, detailed documentation was created for each column, to include all the data required, such as:

- » Drilling and grouting parameters;
- » Grout pump protocol (water-cement ratio, thickness, viscosity, specific weight);
- » Pump capacity, total volume injected;
- » Measurement of drilling verticality by using a two-axis inclinometer inside the drill rods once the drilling were completed (Glötzl System).

All this data was stored in a special database named KSDM (Keller Site Data Manager) that was created especially for this kind of projects. Thanks to such a database, the protocol related to each completed column can be automatically retrieved, as well as a 3D model of all columns. To further test and check the works completed and evaluated through such methods, before starting the pit excavations some pumping and thermometric tests were also carried out. The tests confirmed the permeability values required according to the contract before starting with the challenging excavation operations.



PROJECT INFORMATION

Client: BBT SE
Customer: Isarco Scarl
Quantities: approx. 156,000 m³ jet grouting
Execution period: May 2017 – June 2018

ACKNOWLEDGEMENTS:

Many thanks to the management and all the staff of Consorzio Isarco Scarl, together with BBT, in the person of Mr Raffaele Zurlo, MScEng, (Managing Director, BBT, Italia) and Stefano Torresani (RUP) who authorized the publication of this article. Furthermore, we would like to thank our Project Manager Christoph Deporta and the Site Managers Devid Wolfsgruber and Stefano Motta.



Peter Kovacs
Keller Melyépítő
Budapest



Robert Holczer
Keller Melyépítő
Budapest

KELLER CONNECTS COUNTRIES

The new Danube bridge is being built between Komárom (Hungary) and Komarno (Slovakia)

HUNGARY
Komárom

The design of a cross-border bridge over the Danube between Komárom and Komarno started in 2006. The actual construction started in autumn 2017 and will finish by the end of 2019.

The bridge is planned for traffic with one lane per direction of travel. The total length is about 623 m. The bridge is being built by the consortium H-M Dunahíd (Hidépítő Zrt.–Mészáros és Mészáros Kft.). The cable-stayed bridge is founded on three pillars, one located in the middle of the Danube and the other two near the shore. For the foundation, water-proofed double-row sheet pile boxes were built and raised by about 1 m above water level, so that it was possible to build an adequate working platform for the heavy equipment that had to work in this area. The original design showed an underwater concrete slab. Keller developed an alternative solution with a Soilcrete® sealing slab and was awarded afterwards with the construction works. Before the execution of the Soilcrete® slab, piles with a diameter of 150 cm and a length of 15 m were constructed. The grid of the Soilcrete® works was adjusted to the effective position of the piles and the sheet piling.

After Kellers alternative was approved by both the Slovakian and Hungarian designers and inspection engineers, and work preparations were completed, the KB6 rig (42 tonne) could be transported to the

artificial islands via ship pontoon and ship crane. The Soilcrete® slab, with its 2m thickness on average, was constructed by columns with a diameter of 2 to 3.5 m and a drilling depth of about 25 m against buoyancy. To ensure the impermeability of the slab and the diameter of the columns, the parameters were aligned by several ACI® (Acoustic Column Inspector®) measurements. The drilling deviation of each single column was recorded by inclinometer measurements. Based on these drilling deviations, an as-built plan was created with all actual positions of the columns and wherever needed, additional columns were constructed.

Due to the high quality assurance level, the Soilcrete® slabs were executed technically impermeable. All three excavation pits could be handed over to the client in a proper state and all other works could be continued by the client without affecting the construction process.

We would like to thank all participants for their work.



HUNGARY IS AGAIN A PART OF KELLER SOUTHEAST EUROPE

After a three-year break in Hungary, we were able to reopen our office in Budapest in the summer of 2018.

As many of you know, after 19 years of having a presence in Hungary, we unfortunately had to close our office in Budapest in 2015 due to the prevailing economic situation and the associated low number of orders. Only one and a half years later, several new projects started so Keller was once again part of the geotechnical market in Hungary. The next logical step was therefore the re-establishment of the local company, the search for representative offices and good employees. This was completed this summer, so that now all projects there can be carried out by local Keller staff.

We wish the team all the best and are sure that after the positive start, they will carry out many more interesting projects



PROJECT INFORMATION

Quantities: approx. 5,800 m³ Soilcrete® slab
Execution period: approx. 3 months (partly in day and night shift)

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PIT SUPPORT

in Bratislava's city centre – Račianske múto

For a new construction of a multifunctional residential complex, an excavation pit with an average depth of approximately 14.5 m had to be built. The excavation with a trapezoidal ground plan of about 20 x 30 m is surrounded by three streets and a neighbouring building which has to be secured with as little deformation as possible.

On the shortlist of solutions was a diaphragm wall, which was quickly eliminated due to the limited dimensions of the construction site. In addition, an overlapped bored pile wall with a pile diameter of 90 cm and the executed pit support by means of Soilcrete® were considered. These two alternatives were designed as a temporary backup. One of the important arguments against the bored pile wall was the loss of net underground area by approximately 14 %. An essential advantage of the Soilcrete® solution was a flat wall after milling the Soilcrete® overbreaks, which is very well suited for the further works. The advantages are:

- » Easier installation of the insulations, sealing layers, etc.
- » No unnecessary additional concrete consumption when producing a constructive inner shell
- » Significant reduction in forced tension in the inner shell when used as a waterproof concrete tanking

Also for these reasons, the Soilcrete® alternative was selected.

GEOLOGY

The construction site is located in the "Staré Mesto" (Old Town) district of Bratislava. Quaternary sediments were found to a depth of 10 metres, which

were underlain by Neogene deposits. The Quaternary sediments consist of sandy gravels that have been deposited as Danube soil. The groundwater table is located in the Quaternary sediments at a depth of -7.9 m below ground. This means that the maximum groundwater difference to the lowest point of the excavation (16.1 m) is approx. 8.2 m. The Neogene consists of a removable storage of sandy and silty to clayey packages. A tense groundwater level in the sand lentils could not be eliminated.

EXECUTED SOLUTION

The challenge for executing the Soilcrete® works was the existing Neogen soil. Through the further development of the Soilcrete® process and decades of experience with the encountered soil, we believed a Soilcrete® solution was feasible with column diameters of 180 cm. This diameter was confirmed during execution by the Acoustic Column Inspector® (ACI®). For such a deep excavation pit, a double row arrangement of these columns was necessary.

The double row solution made it possible to execute a nearly dry excavation even with a groundwater difference of approximately 8.2 m. The horizontal load of the jet grouting wall (earth pressure and water pressure) was anchored



Ján Dobrovolský
Keller špeciálne zakladanie spol. s.r.o., Bratislava



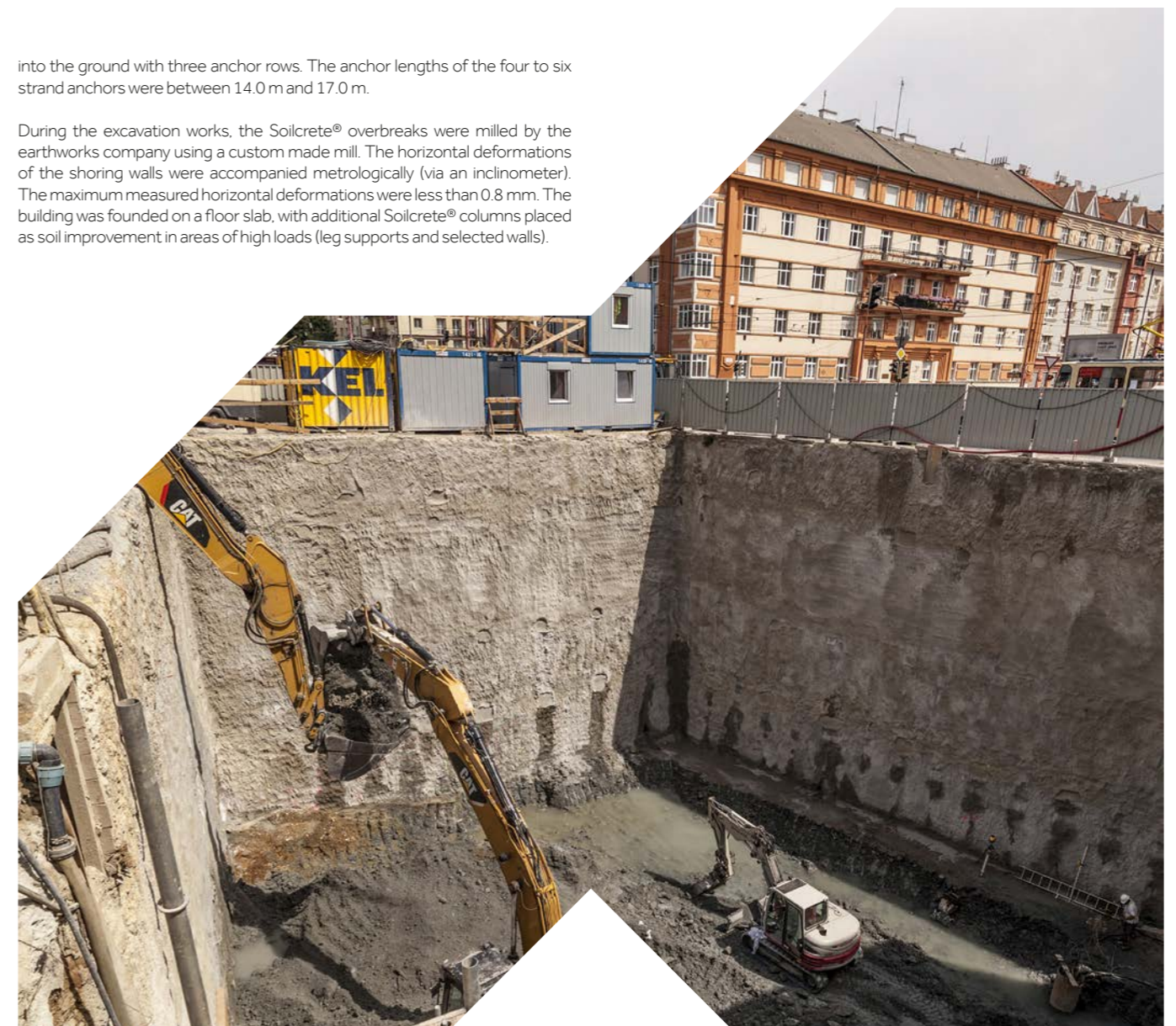
Peter Skoda
Keller špeciálne zakladanie spol. s.r.o., Bratislava



SLOVAKIA
Bratislava

into the ground with three anchor rows. The anchor lengths of the four to six strand anchors were between 14.0 m and 17.0 m.

During the excavation works, the Soilcrete® overbreaks were milled by the earthworks company using a custom made mill. The horizontal deformations of the shoring walls were accompanied metrologically (via an inclinometer). The maximum measured horizontal deformations were less than 0.8 mm. The building was founded on a floor slab, with additional Soilcrete® columns placed as soil improvement in areas of high loads (leg supports and selected walls).





Dominik Gächter
Keller Grundbau



ICELAND
Reykjavik

ICELAND 'FLIES' on Keller ductile piles

Fly Over Iceland is a virtual flight ride that takes guests on a breathtaking aerial journey over some of Iceland's most spectacular landscapes, using the latest in-flight ride technology. Guests sit suspended in specialised ride vehicles, with their legs dangling as they move in concert with the film. With the addition of special effects (scent, mist, wind), riders feel like they are actually flying.

The Fly Over Iceland project was the second foundation job for Keller in Reykjavik in 2018. The piling works started in May directly after the extensive piling of the automatic warehouse, presented in the last Keller Insight. The stable growth of tourism in Iceland is one of the reasons the Fly Over team brought this technology to Europe for the first time. As the construction site is located in a reclamation area next to the shore of Reykjavik, the soil conditions were expected to vary a lot. Due to missing information regarding the soil, Keller was contracted to execute test piles to investigate the bed rock depth and the bearing capacity of the piles. During the test piling, the piles were injected and grouted over the full length of the pile. The ground profile is characterized by a 3 m thick man-made fill followed by soft sandy clays before reaching the bedrock. Based on the results of the test piles that were executed directly on site, the design team reviewed the pile grid and issued the pile plan for execution.

The KDP (Keller ductile pile) was chosen for the execution of the compression and tension piles because of the high production rate compared to other piling products. All piles are grouted over the full length and installed until reaching the sound bedrock. The piles are executed with depths between 16 and 21 m depending on the bedrock surface. The execution time was a key factor for the owner and one of the reasons why Keller was contracted for the piling works. For the dynamic and horizontal forces coming from earthquakes and the high wind loads in the region of Reykjavik, inclined KDPs with internal bar anchors were installed. This solution ensures a safe and stable foundation for the future of the new landmark building in the centre of Iceland's capital. The logistics were the key to success to handover the foundation to the client in time, as the whole material needed to be imported and shipped to Iceland just in time with the installation. The team from Iceland would like to thank Maria-Magdalena Bischoff and Friedrich Lasnik from the Keller logistics department who ensured that every single pile was delivered on site without any delay. The project was mobilised and demobilised including the full execution of the piling works within less than 14 days.

Keller would like to thank all involved parties for the excellent co-operation during the planning and execution time of the foundation works, without which the smooth running of the works would not have been possible.

PROJECT INFORMATION

- Client:** Esja Attractions ehf, Iceland
- General Contractor:** Munck ehf, Iceland
- Geotechnical Designer:** Mannvit ehf, Iceland
- Structural Designer:** Mannvit ehf, Iceland
- Quantities:**
 - » approx. 2,400 m, 130 pcs Ductile Piles 170/9,0 mm
 - » 100 m bar anchors 63.5 mm
 - » 2,400 m grouting of piles
- Execution period:** May 2018



HAMBURG Construction of a complete pit support in the centre (Germany)

BN Warburgstraße GmbH & Co. KG is building a new residential and commercial building in the centre of Hamburg, with eight upper floors, a ground floor and up to three basement levels. For the construction of the basement floors, which are to be used as underground parking, the construction of a closed excavation was required. To this end, Keller Grundbau was awarded the contract for the production of a temporary, reinforced excavation pit support. In addition to the construction of the excavation pit, further services were provided as part of a complete solution for the client. These included, for example, the investigation of the construction site for explosive ordnance as well as the creation of a geotechnical measurement concept for on-site monitoring of the adjacent existing buildings during construction. In accordance with the execution plan set up by Keller Grundbau, the excavation pit was constructed by means of a secant bored pile wall. At an excavation level of up to 10 m depth, the surrounding drilling pits with a diameter of 88 cm and a length of up to 17 m were set down in the cohesive soil.

The construction was carried out despite very limited space and resulting logistical restrictions, within a short time.

We would like to thank all those involved in the project as well as the client for their trust and co-operation.

Keller Grundbau Central Europe

Since Keller is not only active in Southeast Europe, we would like to show you some interesting projects that our colleagues have carried out

WORLDWIDE.



BRAZIL Keller Tecnogeo executes 2147 piles in challenging time for GE/Alstom

Porto de Sergipe I Thermolectric Power Plant's (TPP) generating units will produce natural gas up to 1.5 gigawatts, making it the largest TPP in Latin America. This project, with an investment of about € 1.1 billion, is located in an industrial area on the seafloor, between an oil terminal and a large wind tower park, in the northeast of Brazil. The geotechnical solution applied by Keller Tecnogeo, in conjunction with the client's expert consultant, was a soil improvement system using CFA. Due to the geological parameters and to meet the strict requirements, it was necessary to execute 2,147 columns of 600 mm diameter, using high strength concrete and robust steel cages. For this technically sophisticated project, Keller Tecnogeo mobilised its best resources including teams with extensive experience in similar works. The work was a success. About 14,000 m of piles were installed in 2.5 months, including the static load tests and concrete integrity tests for all piles, as well as the earthwork necessary to reach cut off elevation.

Part of the contract was the trimming of the piles with an expected challenging performance of 100 piles per day. This was not only achieved, but also exceeded to the satisfaction of all. As a consequence of the first job, another contract for the same project was awarded to Keller Tecnogeo.

Keller Tecnogeo



SOUTH AFRICA
Old racecourse gets a new face

The Clairwood Logistics Park, located on the old Clairwood Racecourse in Durban, consists of various warehouse structures totalling 358,000 m². This 4 billion rand project will set a new standard in prime grade A logistics facilities in KwaZulu-Natal, South Africa. The site is underlain by soft clays extending to depths in excess of 35 m and posed significant challenges for the geotechnical and structural engineers. To meet the stringent differential settlement requirements, ground improvement using Controlled Stiffness Columns (rigid inclusions combined with gravel head) were used to support large warehouse structures. The technique was used for the first time in South Africa and provided significant saving on the foundation of the structure compared to conventional deep foundation solutions.

The viability of the solution was verified through a rigorous programme, including full scale preconstruction field tests as well as extensive monitoring of the structural performance during construction and operation. Current results indicate excellent performance which satisfies the stringent design requirements. The operation was equipment intensive and a dedicated site workshop and team provided quick turnaround during equipment maintenance or breakdown. A robust quality control programme was also developed to ensure safety and quality specifications were achieved. The combined effects of the engineering and operational teams resulted in an accelerated programme and early completion.

Franki Africa



BARCELONA
Keller breaks records

With its famous football team and history as an Olympic city, Barcelona is no stranger to breaking records. And the jet grouting project at Barcelona Airport, is just one more on the list for this unique centre of culture and sport. The project itself was ambitious. To connect the centre of the city of Barcelona and the newly constructed terminal 1 of the airport, the project involved a tunnel that to be excavated approaching the terminal building. This would enable a route under Terminal 2 just below the main building, which had yet to be built.

The tunnel has two parallel D-Walls and a jet grouting slab which needed to avoid water seeping during its excavation. We had to complete this slab the entire length of the 1 km tunnel and within the whole area of the underground train terminal. Competition was

tough and after a challenging dual with our competitors, work began in May 2016 and was completed in April 2018. During that time we drilled 279,000 m and jetted 89,000 m, deploying four rigs on double shifts six days per week, alongside four Tecniwell pumps and plants. By meeting the works' schedule in close collaboration with our client, the excavation of the tunnel has been a success for Keller as the water that needed to be pumped during that process was even less than anticipated during the project planning phase.

Because of its drilling and jetting lengths, and cement grout pumping, this jet grouting project is a record in Spain, and in fact, one of the largest ever performed by Keller.

Keller IberAm



FRANCE
Outstanding project design makes waves on French Atlantic coast

Keller recently worked with several key partners to complete a major public project in southwestern France, demonstrating their engineering expertise and global profile. To improve the management of effluents in the municipalities of Arcachon and La Teste de Buch, the local authority needed to set up safety basins with a capacity of 30,000 m³ in addition to the existing wastewater treatment plant. The project was further complicated by the fact that the operation was located near a natural area 'Natura 2000', which is a network of nature protection areas in the territory of the European Union. It was also in sandy ground with a high level of water and so it was essential to limit the dewatering of water tables during the works.

A consortium of partner companies consisting of Etchart (civil engineering), Keller (special foundations), SCE (prime contractor), Bruno Jacq (architect) and GCIS (design office) was set up to meet this challenge. The key project requirements consisted of building

two underground basins 8 m deep and 42 and 60 m respectively in diameter, connected by a pumping station. Our engineering team proposed a circular D-wall, working in tandem with an injected plug that would, on the one hand, support the earth and, on the other hand, guarantee the required residual flow in the basins during civil engineering work.

The diaphragm wall was 0.62 m thick and reached a depth up to 19 m. By using polymer mud as a drilling fluid, a clean construction site was prioritised, while clean sand was also more easily disposed.

Difficult projects are also always the most satisfying to successfully complete and Keller played a crucial role in the design and implementation of this complex solution and ensured this project became a great commercial and technical success.

Keller French Speaking Countries



ENGLAND
Just what the doctor ordered in Harley Street

Keller UK's specialist restricted access piling team worked on a challenging project in the heart of London's famous Harley Street early in 2018.

The area is world-renowned as a centre of medical excellence and when a new clinic needed a basement to site a proton beam therapy facility to treat cancer patients, main contractor Deconstruct called in Keller.

The UK team designed and constructed a 73 linear metre secant piled retaining wall and a 35 linear metre contiguous piled retaining wall using mini piles to allow for the construction of the three-storey basement 15 m below street level.

For the secant wall, 234 pieces of 450 mm piles were installed to a depth of up to 22 m. For the contiguous wall a rig was lifted over the building and into the basement at the rear to install 36 pieces of 600 mm piles up to 15 m deep and 12 pieces of 600 mm load bearing piles up to 20 m deep.

Despite facing limited space on site, reduced access and a complex design to carry heavy loads, the work was completed ahead of schedule and the clinic is due to open in 2019.

Keller Northwest Europe



SUCCESSFUL COMPLETION of a major project

As you may remember, in 2015 we reported on the start of our major project 'ÖBB BL 60.3' in St. Kanzian. Now, three years later, we are pleased to announce the completion of the works on the largest project ever executed by Keller in Austria.

These three years were long but, above all, interesting and instructive. At some points we faced difficult soil conditions that made the project even more demanding. But this did not stop us from completing the works to the fullest satisfaction of all parties involved and holding a small thank-you celebration in the summer.

After three years of construction, Keller Southeast Europe took the opportunity to celebrate the completion of the project. All project participants were invited to the forecourt of the local construction

supervision on 5 July. About 100 representatives of our customers (Kostmann GmbH and Baresel GmbH), the investor (ÖBB – Austrian Federal Railway), various universities, design offices and our own (construction site) staff met to reminisce about the last few years.

During the celebration there was a small review of the three years of the actual construction, but of course the planning for such a demanding project has started much earlier – in 2013 to be exact. In 2014, our product line manager for Soilcrete® flew to Japan to work with the local specialists to develop the latest technologies for the delivery of the tunnelling works.

In 2015, Keller was finally awarded the contract to carry out the complete set of foundation works after carrying out a few trial

fields. These trial fields were of great importance, since the present lacustrine clay could have made the work very difficult.

In March 2018, our construction team constructed the last Soilcrete® column, and the project could be handed over to the client. In total, approx. 55.000 m of bored piles and 75.000 m of Soilcrete® columns were constructed for the Srejach and Untersammelsdorf tunnels.

We used the celebration to thank all employees of all companies that have devoted themselves to this project over this long period of time. This good co-operation was the key to a successfully completed job. This was the only way to keep to the tight time schedule, avoid



accidents at work and keep everyone motivated. Despite a little cooling off on this hot day, we like to remember this celebration and again thank all persons involved – internally and externally – for their commitment during the whole execution time and look forward to working again in the future!



Petr Svoboda
KELLER –
speciální zakládání
Brünn



Lenka Turcanova
KELLER –
speciální zakládání
Brünn

KELLER – SPECIÁLNÍ ZAKLÁDÁNÍ

Part of the Keller family for 25 years

This year Keller celebrated its 25th anniversary in the Czech Republic. Such a jubilee not only had to be remembered, but also celebrated. We took this opportunity to meet near the Brno artificial lake in a small, but more than fine, circle of people.

In the midst of peaceful nature – surrounded by greenery – the employees of the local offices and representatives of the various branches of Keller Southeast Europe met in the four-star Hotel Maximus Resort in Brno on June 18, 2018. We were especially pleased that former employees of the company attended the celebration

because they are the ones who laid the foundation for the success of the business. We would also like to take this opportunity to thank our business partners who have accompanied and trusted us over the entire 25 years and have taken the time to recall the past.



HOW IT BEGAN ...

Petr Svoboda, managing director and 'veteran' of Keller Czech Republic took the opportunity to remember the leading personalities of the company since 1993 in Prague, such as Messrs Gryc, Saufnauer and Stockhammer, the first managing directors of the company.

... AND DEVELOPED

The positive entry into the Czech market led to further milestones in the company's history, such as the founding of the office in Brno in 2000 and the merger with BORETA and the resulting office in Zlín (2008). All these things have led to an increase in sales and in the number of employees over the years despite some ups and downs, so that more than 90 employees are now employed by Keller CZ and thus represent the largest subsidiary in Southeast Europe after Austria.



To summarise 25 years of company history is not easy, but Mr. Svoboda reminded us of some of the projects that shaped this time in a humorous way. This included, above all, the following:

- » Power plant Prunerov: The first construction site on which the vibro replacement technique was applied
- » Na Pankraci 26-28 in Prague: The first pit support that Keller executed in the Czech Republic
- » Petroleum tank Klobouky: The first Soilfrac® construction site in the Czech Republic
- » Ceska pojistovna in Prague: The construction site with the highest turnover in the history of the company

Also Mr. Andreas Körbler, Business Unit Manager of Southeast Europe, found himself involved in many of these projects, as he is a former Managing Director of the company. Therefore, he wanted to take the opportunity to thank Mr. Svoboda for the good co-operation between the two countries over all these years.

After the official business, the party was moved to the garden, where the cymbal band Cardas was already waiting for the guests. With classical Czech music in the background and the weather being kind to the guests, the party took its course. The evening was rounded off by a magician who walked among the guests as part of his act and delighted the audience with his tricks.

We all wish the company KELLER - speciální zakládání many more successful years!

THE NEW KELLER GENERATION!

Everyone talks about innovation, renewal, modernisation and similar topics. We too at Keller belong to this group, if you look at this year's issue – Innovations Conference, young talents and modernisation of our workshop and the yard by means of TPM and 5S. But the question is: How do we continue to do these things? For us, the simplest solution seems to be the best: through young, motivated employees.

Often we think about the people 'in the foreground' when talking about people in a construction company – site managers, supervisors, canvassers etc. But as important as them, are those who pull the strings in the background and without which none of our construction sites would run as smoothly as they do.

These people are the 45 members of the workshop team in Söding near Graz. This year is a special one for us, as we are training seven apprentices at once in the workshop for the first time – six construction machine technicians and one mechatronics engineer. This pleases our Equipment Manager, Paul Rott. "It's nice to see that young people are so excited about something," he said. When

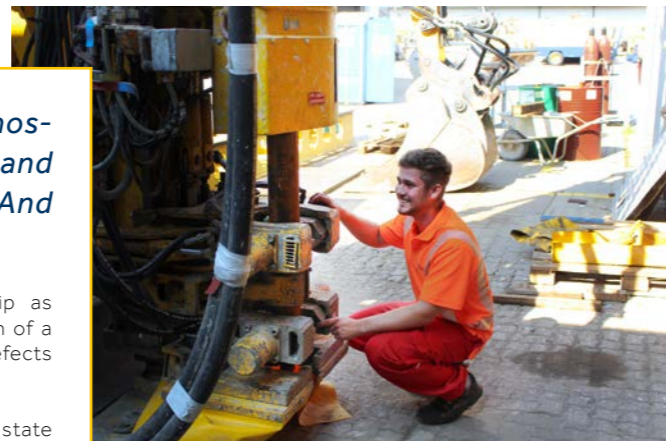
asked how to motivate the people in a company where sometimes the youngest ones in their first or second year of apprenticeship are under pressure, since the equipment has to be prepared and ready for the next site on time, Mr. Rott said: "We try to make them feel part of the team from the beginning, e.g. by various leisure activities such as the workshop hiking day that is organised twice a year and shows them that they are part of Keller even out of work".

We took the opportunity to ask what made these young people between the ages of 15 and 18, who are between the first and fourth year of apprenticeship, to choose Keller as their company training centre. For us the decision was clear after their respective 'trial days'. They are not afraid of big machines, they are very interested in technology and some of them have a very good education at forestry and agriculture schools. But knowledge is not everything, because that can be acquired with the right commitment. It was important for Paul Rott and his workshop managers Ewald Rupprechter and Karl Grabler that everyone is very nice, polite and communicative and thus fit perfectly into the existing team.

"I chose Keller because the working atmosphere is very good, you can learn a lot and everything is shown and explained to you. And the people are very nice."

Franz Grießer (18 year old – 4th year of apprenticeship as construction machine technician) during the initial inspection of a KB5 after returning from a construction site due to visible defects and leaks

It should be mentioned here that Franz took part in the state apprentice competition for construction machinery technicians at the Landesberufsschule (LBS) Mistelbach.



"Through my father, who is also a mechanic, I became aware of Keller. Because of my interest in technology, the decision to choose Keller was very easy."

Johannes Karlovits (16 years old – 2nd year of apprenticeship as construction machine technician) during the removal and repair of a cement conveyor screw of a horizontal silo.

"During my trial day I liked everything very much. The working atmosphere is great and the tasks are extensive and very interesting."

Sebastian Kormann (17 years old – 2nd year of apprenticeship as construction machine technician) during valve adjustment on a CAT C15 engine during a 1,000 hour service on a BG28H.



"The trial day showed me that I can learn a lot from older colleagues at Keller. Everyone is very nice and takes very good care of their young colleagues."

Matthias Schörgi (15 years old – 1st year of apprenticeship as a mechatronics engineer) during an LED exchange at a control panel of a BG28H.

"Friends alerted me to Keller. The tour of the workshop with Paul Rott, the equipment manager, impressed me a lot."

Matthias Spielhofer (18 years old – 2nd year of apprenticeship as construction machine technician) during a bearing adjustment on a transfer gearbox of a vibrocat.



To hear such statements from our young employees, gives us heart and we are pleased that the new Keller generation is in the starting blocks to take over from the 'old stagers'. We look forward to seeing what the future holds for us.

Note: Unfortunately, our two other apprentices, Philipp Kristöfl and Stefan Toswald, were not at the company on the day of the interview, but at vocational school. We welcome both of them and wish all seven newcomers all the best for their futures and we are happy having them with us.





Under the motto 'Innovation. Connected', the first Keller Innovation Conference took place in Mainz, Germany at the end of June. More than 120 Keller employees met to discuss current developments and to take a look into the technological future of the company.



The location chosen was the 'Alte Lokhalle Mainz' – a converted maintenance hall for locomotives. It was the perfect setting for this event, combining history and modernity.

Change, innovation, digitisation, automation – all concepts that we see every day. But what does that mean for our company? Where do the ideas come from and how are they implemented? The answers to these questions were presented at the two-day conference. It was nice to see that the participants came from all professional classes in the company – from board members to former site staff, who have come up with technological advancements through their great and, above all, simple ideas, and which are now used worldwide inside Keller.

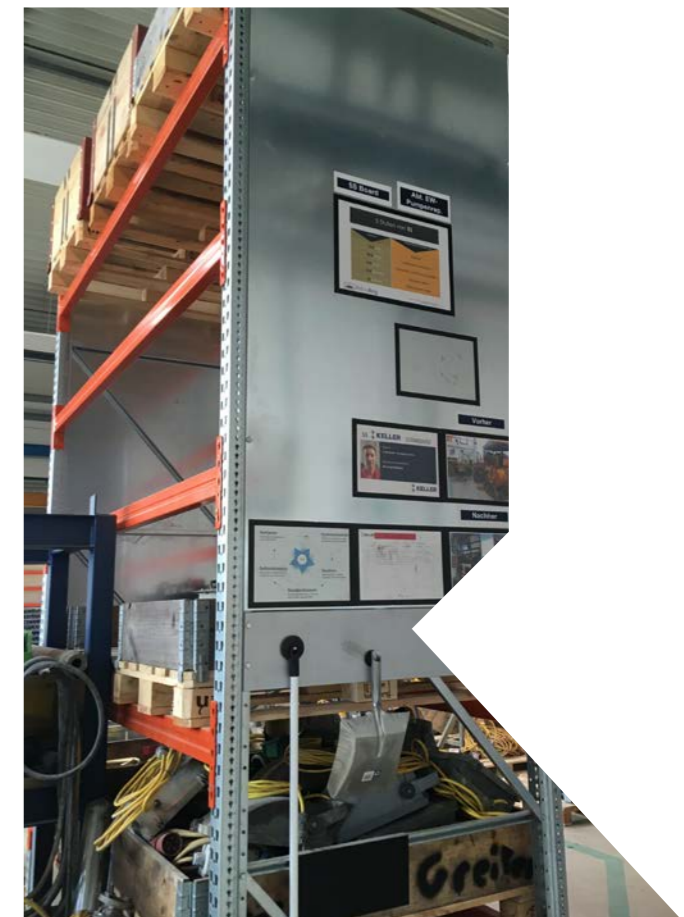
Keller Southeast Europe was represented with 15 participants, making it the largest group in the event. We are proud to say that many of the innovative projects presented have been (co-)developed by Keller SEE. These include the further development in the vibro technique, which will further optimize vibro compaction, fibre optic sensors for ground anchors that can determine distributed strain measurements along geotechnical elements such as piles, micropiles and anchors,

as well as horizontal drilling (HDD), in which the active, non-straight drilling holes are formed. Last but not least, we would like to mention the ACI® (Acoustic Column Inspector®), a patented online diameter control for jet elements where the diameter of the columns has to be measured.

Christian Sigmund and Jürgen Schaden, who had the idea, were awarded with the Keller Innovations Award for Technology. So, we would like to congratulate and thank them but also all other colleagues, from all other Business Units who come up with ideas which are used in our day-to-day working life.

We can only survive and grow with new ideas in this fast-paced business.

Thank you all!



WORKSHOP AND YARD SÖ DING

The modernisation continues

With over 900 construction sites a year in Southeast Europe, good planning and organisation is the key to success. All departments must work hand-in-hand to ensure a smooth workflow.

To simplify these operations, we have introduced the TPM and 5S system in SEE, which together increases the effectiveness and efficiency of the entire yard, including our workshop. The TPM ensures the longevity of tools and equipment by regular maintenance while the 5S takes care of the order, cleanliness and safety of the actual workstation.

"The implementation of these systems was associated with a great deal of additional work two years ago," explains Ewald Ruprecht, head of the workshop in Söding, "but in retrospect, the effort was worthwhile". Since then, the storage area has become much tidier and more organised, and all employees take responsibility for ensuring that this continues in the future.

Mr. Ruprecht, who has been with the company for 11 years and the head of the workshop for five, sees the future of the company in this model. Since the introduction of the two systems, he has an average of one to three equipment devices and machines per product line in his workshop, which are inspected for new construction sites. As a rule, due to this system, a well-maintained machine can stay away from the workshop for about two to three years. Minor repairs and maintenance works can be carried out directly on site. However, this can only continue in the future if this thinking is pursued further. Because only "who is organized, can organize his daily business".

These statements are also approved by the head of our electrical workshop, Karl Grabler. He and his team also benefit from the wheel of time and the further development of not only the equipment,

but above all the thinking of all employees. 10 to 15 years ago, when everything was antiquated, modernisation eased the work of everyone in the workshop. "The awareness of wanting to improve oneself and develop further, leads to more motivation and thus to a better working atmosphere," he said. By modernisations such as remote maintenance and online review of all equipment, 70 – 80 % of the problems can be solved from the workshop and it removes the need for site visits that used to be on the agenda on a more or less daily basis. Thus, the team can concentrate on the serious problems of the machines. As a result, productive working hours are increased and unnecessary costs are reduced.

In his 23-year career at Keller, Mr. Grabler has seen some changes in his working field. Thus, he can still see many innovations in the next few years and how they will affect him. For him, the ideal would be that he and his team only have to go to the construction sites in really serious cases. The foundation for this has already been laid in recent years and Keller is doing everything in its power to ensure that it is put into practice.

For 2019, too, new ideas will be worked out concerning the workshop and the yard. Of course, we will also keep you updated on this.

1. SORT

Sort out unnecessary things and keep only important tools in your working area.

2. SET IN ORDER

Arrange a systematic order to promote an efficient workflow.

3. SHINE

Maintain a clean-working area.

Our working environment is 5S

4. STANDARDIZE

Develop standards to obtain an organized workflow. Retain them and correct them continuously.

5. SUSTAIN

Let the standards be part of your everyday work.



Andreas Kolencic

Keller Safety Week 2018



SAFETY FIRST – Keller relies on safety!

In June 2018, Keller EMEA started the Safety Week initiative with various topics and we at Keller Southeast Europe, were challenged to hold this training throughout SEE construction sites. The content was provided via a script from Keller Holding and had to be adapted for Keller SEE construction sites. The implementation was carried via a presentation in which accidents with personal injuries, correct working levels, work interruptions due to imminent dangers, shut-off of endangered construction site zones, traffic safety and near-misses were highlighted. The topic of environmental protection was also dealt with. The big challenge for site engineers was to explain the topics to the employees on site without losing too much working time. The aim of this initiative was to train all employees to ensure the safe and, above all accident-free, operation of construction sites. In conclusion, this presentation was very eagerly implemented in the course of Safety Week and interesting discussions were made during this time. This concept, which was carried out for the first time, was very well received by the blue-collar workers, as evidenced by the on-site interviews and the positive feedback from the subsequent survey. It is nice to see that further awareness-raising would be welcomed. Now it is up to us to improve it further. In this sense



Safety Week on a site in Styria



Safety Week on a site in Salzburg



Safety Week on a site in Vienna



© TU Graz

From engineers to commercial and industrial apprentices, young employees and colleagues play a crucial role within Keller. In order to successfully grow as all businesses are doing both internationally, in the Southeast Europe, and in Austria too, new staff with new ideas are very important. Young professionals with their knowledge, innovation, and affinity for new media always breathe fresh air into the company. With this in mind, EMEA President Thorsten Holl, Managing Director of the Business Unit Andreas Körbler, and Engineering Director Dr. Ing. Clemens Kummerer, took the opportunity to engage and connect with students from all over Europe at the 26th European Young Geotechnical Engineers Conference of TU Graz. "For us, events like this with students are a core element in our employer branding program," says Thorsten Holl. "The shortage of skilled workers is apparent not only in Central Europe, but globally too and "Employer Branding" is no longer just a task for HR departments. In the "War for Talent" it is something the entire top management takes very seriously". "And that applies to young academics as well as our commercial and industrial apprentices and junior staff too. At the same time, Social Media platforms like LinkedIn, YouTube, and more, continue to grow in importance every day. Keller is now using these channels quite extensively. On the Keller YouTube channel, you can now see presentations and clips on many projects and technologies", he added.

CHANGING FACE OF CONSTRUCTION

Holl also spoke about the change in the construction industry. And how the digitization of the construction site has long since begun, with BIM (Building Information Modelling) already being used in more and more projects every day. "Our Business Unit Southeast Europe is an important centre of competence within the large Keller family. We all work hard to support our colleagues all over the world however we can. And the term 'family' is an essential feature of our corporate culture," he emphasized.



EXCITING KELLER PROJECTS

In that context, a short presentation was given showcasing the worldwide presence and expertise of Keller, detailing many exciting projects. One such site was the East Port Said project, which doubled the capacity of a container terminal. In this case, Keller created 83,500 kilometres of vertical drains to consolidate the recovered land faster. The Clairwood Logistic Park project in Durban, South Africa is also quite unique. It involved Keller's Franki unit creating 46,700 columns with controlled stiffness for the foundations of seven warehouses. And from South Africa to Abu Dhabi where Keller is involved in the Zayed City development – one of the most ambitious projects in the United Arab Emirates. On an area of eight million square meters, it was shown how various methods are being deployed to improve the ground.



AFTER THE BAUKONGRESS COMES THE ÖGT / VÖBU FAIR

In the last issue of the Keller Insight magazine, we invited you to visit us at our stand during the Baukongress in the Austria Center Vienna. Thank you very much for accepting this invitation in large numbers. These two very interesting days were full of good lectures and talks with representatives of all groups from across the construction industry.

On **January 31st** and **February 1st, 2019**, the VÖBU Fair, the largest geotechnical fair in Austria, will take place in the well-known Congress Center on the Messe Wien area. Also this time, Keller will be represented with its own booth. Under the

title "Theory & Practice of Special Foundation Engineering", the 12th Austrian Geotechnical Conference will take place parallel to the fair. On both days, the participants can expect interesting lectures from the wide spectrum of geotechnical engineering.

Once again, the cooperation with the Vienna University of Technology and the ÖIAV (Austrian Engineering and Architectural Association) offers a bridge between theory and practice. For the first time, both events are being treated as one, allowing visitors to participate in both with their entrance tickets.

We look forward to meeting you on

**STAND NO.
300 & 400**

www.kellergrundbau.at



KELLER GRUNDBAU TURNS 50!

Over the last few years, **Keller Insight** and **Kellerfenster** provided the opportunity to look back on the past year. This time, we would like to seize the opportunity and take a look into the future. Both in this edition and in the previous two years, we took you to different countries throughout our business unit that celebrated their 20th and 25th anniversaries.

In 2019, Keller Grundbau Ges.mbH celebrates a milestone birthday – we will have been in the Austrian market for 50 years! We look forward to this event with great anticipation and are planning some events next year to mark this milestone. An anniversary is always a good opportunity to look back and take stock. But at the same time, it is the right time to look into the future with confidence and to make plans for the upcoming months and years.

On January, 24th 1969, Keller - at that time still under the name "Johann Keller Gesellschaft mbH" – appeared in Austria for the first time in the commercial register of the city of Vienna.

Until then, the company was managed from Munich, Germany. As a result, the first Managing Director Mr. Stockhammer gradually built up the company with his small team and laid the foundations for future success.

Over the next five decades, many interesting projects were executed, but unfortunately also some ups and downs had to be overcome. However, these have always been short-lived, so we have been able to consistently grow in recent years. The Austrian team has also grown to around 350 people and the one office in the Mariahilfer Straße 19 – 21 in Vienna has increased over the years to six throughout Austria, which support the customers locally, true to our motto "global strength and local focus".

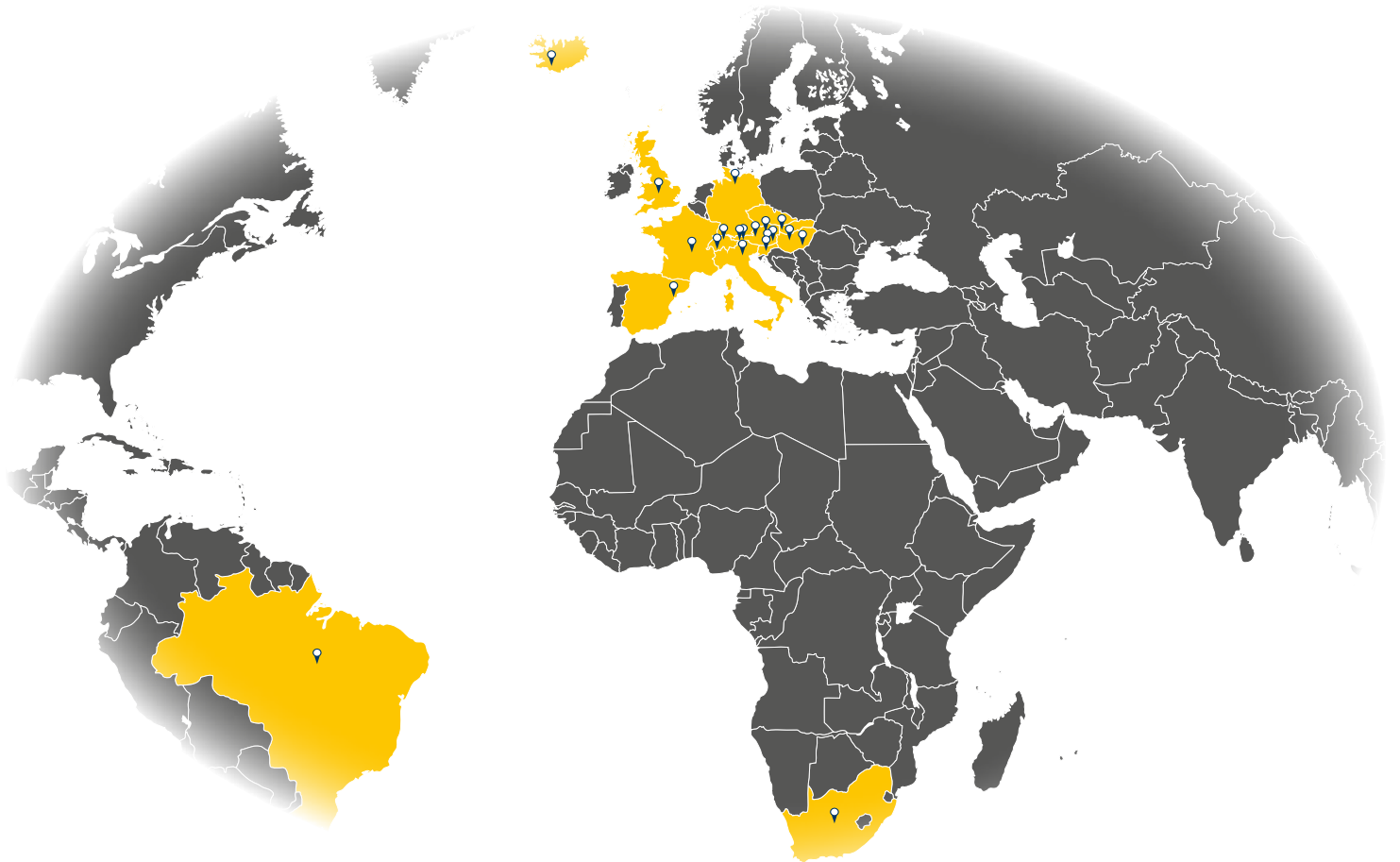
We would like to thank all the business partners, friends and families who have been with us in the past fifty years. We look forward to many more years with you and to new joint projects.



Grundbau



Global strength and local focus



Austria, Czech Republic, Greece, Hungary, Italy, Romania, Slovakia, Switzerland, Turkey

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