BAUER REVIEW

FOR EMPLOYEES AND FRIENDS OF THE
BAUER GROUP COMPANIES

2018

48

BAUER

Contents

A former tar factory in Offenbach is being remediated in several stages, including encapsulation with Mixed-in-Place walls and closure of gaps using the HPI method and sheet piles.

Internal news

In 2018, there was a major change in the top management of the BAUER Group. Prof. Thomas Bauer, who headed the company for over 30 years, passed the baton to a new CEO who, for the first time, is not a member of the Bauer family: Michael Stomberg, who joined the company in November. Bauer Review 48 therefore starts with an interview with the departing Management Board.

The world of airports and the role of specialist foundation engineering in this field is explained in a detailed report with examples from selected projects. Mining technology from Schachtbau Nordhausen has been used successfully in Kazakhstan for ten years. The order books for projects in this exciting country are filled for the coming years.

Digitization affects everyone. BIM (Building Information Modeling), a technology being advanced and further developed by an entire team at Bauer, is now becoming increasingly important in specialist foundation engineering after being adopted in regular construction. As always, we also report on further projects and special highlights, such as the plant-based purification facility of a Bauer Resources subsidiary in Oman, as well as recent construction projects and the in-house exhibition of Bauer Maschinen.

Interview with Prof. Thomas Bauer

Prof. Bauer, after 32 years at the head of the BAUER Group you have decided transfer leadership to someone younger and, for the first time, someone outside of the family. How did you make that decision?
Thomas Bauer: There's a time for everything in life. School, college, work, the different phases of a career. But at some point you have to pass on your responsibilities. This is a natural process that you have to play an active role in. It's unaccustomed to retire after 32 years, but a company needs change, and it needs to be prepared in good time. I don't want things to reach the point where people are saying I'm done and have nothing new to offer.

So you've been planning your departure for a long time?
Thomas Bauer: Ten years ago, I told our Supervisory Board Chairman Dr. Ing. Reinhardt that I wanted to retire at 63. It's my responsibility to ensure that the transfer of leadership goes smoothly. Basically, it's a combination of many things, because it was also time for a change on the Supervisory Board. And the timing is also good. The last few years were difficult, the company was in a crisis. But now we are recovering, things are getting better. Assuming new leadership in the current situation is certainly easier than having a new team start in the middle of a crisis.

Did your career go as you imagined?
Thomas Bauer: I joined the senior management of our company very early on. When I returned to Germany from the US, I was 27. Two years later I joined the management team, and two years after that I was the sole managing director. That was in 1986, when I was 31 years old. It was due to the situation at the time. My father was in poor health. But it wasn't my plan. I would have preferred to gradually work my way into the company, starting with five years of accounting, then the whole business side of things and so on. I also wanted to spend time with my little kids. But that's not how it went.

Your son Florian has been with the company for many years and he became a member of the Management Board in early 2018. But he didn't want to replace you as chairman?
Thomas Bauer: Leadership succession isn't automatic. It was important to me to keep someone from the family in management. My son Florian has been preparing for many years, but he didn't want to do things exactly like his father did. At that time it was an insane amount of work. I've always been very relaxed, but assuming responsibility for a company like ours is an enormous burden in and of itself. You don't wish that on your son at a young age. I think it's very reasonable that he didn't want to become chairman at the age of 36. So it was only logical that we hired someone from outside the company. The new chairman has a few years more experience, but he's still young enough to get to know our company and settle in here.

The company has changed a lot under your leadership. Over the past 30 years, our workforce has grown from 1,000 to 11,000 employees worldwide.
Thomas Bauer: A company grows in stages. The DNA of our company was created mostly under my father's leadership: specialist foundation engineering, the mechanical engineering that goes along with it, and our first efforts to gain a foothold abroad. But then you always reach a point where the organization and structure of the company are no longer viable for the future. That was the case when I assumed leadership. A lot needed to be changed to make the company fit for future, at a time when the market situation was very difficult. In the mid-1980s, all large-scale construction companies in Germany were looking for a new market and believed that they would find it in specialist foundation engineering. The market share of specialist foundation engineering in the construction sector in Germany was only about two percent. At that time, our initial efforts abroad were close to failure. The oil crisis in the 1970s had been triggered by the OPEC cartel and had made the oil-exporting countries rich. In the early 1980s, the cartel collapsed for the first time, so oil-rich countries had no more money for investments. At the same time, the US dollar fell from about DM 3.00 to DM 1.60.

But Bauer has still grown despite the difficult global economic situation?
Thomas Bauer: During the first ten years, it was an immense challenge for me to keep the company on its feet during the international expansion and the start of our professional mechanical engineering operations. We didn't always do everything right, but mistakes in one country were often compensated for by good results in another. We grew out of fear of not having enough work. But in fact we always had enough orders, which led to our growth. So you could say that we've grown as a result of the crises of those years.

A important event was happening in Germany at the time: reunification. How did that historic turning point affect the company?
Thomas Bauer: It was important to us in management that Bauer, as a West German company, contribute to reunification. Unfortunately, for many West German companies, reunification led to a kind of Wild West mentality. We started by forming Spesa, a joint specialist foundation engineering company with Schachtbau Nordhausen. When we acquired Schachtbau, we were all very euphoric about what we could accomplish together. Today we know that was a huge risk. The market in the east part of Germany collapsed again in the mid-1990s. We had taken over a difficult company in what was by then a difficult market situation. Schachtbau would have never survived without Bauer. But local managers also played a significant role in the company's survival. We stood by our East German managers, unlike most other companies, which replaced East German with West German managers. We weathered every storm, through many successes and failures. The construction sector has experienced a large-scale decline in the past twenty years. But we have survived thanks to our large international presence. We can all be proud of that. Everyone helped us get here.

Aside from company growth, what do you think has changed the most over the last thirty years?
Thomas Bauer: The biggest changes I see right now are related to company culture. Even my parents organized parties and company field trips. But in today's world, diversity plays an important role. By diversity I mean the coexistence and collaboration of people of many different nationalities. I think Bauer has become a role model in this area. Company culture is one of the most important factors for success. And our company culture is down to earth, sensible and passionate about technology. The way we present ourselves in our in-house exhibition is extremely well received by customers. The same goes for the way we interact with each other, the way employees communicate within and between different departments, for example through BAUERnews. Of course you can't be great at everything, that's not possible. But overall Bauer is very special. Our employees know that.

Even with your workload, all your tasks and responsibilities, you still found time to get involved socially. Mr. Bauer, how did you manage to do that?
Thomas Bauer: I wonder myself how I managed to find the time. It takes very disciplined time management, good organization and you have to clearly separate work and family. My sons learned early on that they had to make an appointment with me if they wanted to do something with their father or go to the toy store. I took these appointments just as seriously as an appointment with the CEO of a major construction company. Organization is the key. I'm used to completing a task as soon as it's presented to me. That way you can accomplish a lot, not get stressed and enjoy your work at the same time. I enjoyed holding offices such as chairman of the wage bargaining committee, treasurer of the CSU, president of the Bavarian and German construction industry association and others. Very often, the duties of one office entail responsibilities in another office. As a result, I've chaired or at least vice-chaired almost every possible office in our industry in Germany. Here too, routine is helpful. As a businessman, I can't just blame politicians if something doesn't suit me, I have to get active myself. That's why I believe everyone has to get involved as much as possible. You can't just take, you also have to give. Everyone is responsible for the success of our society.

Mr. Bauer, thank you for this interview.

Status report

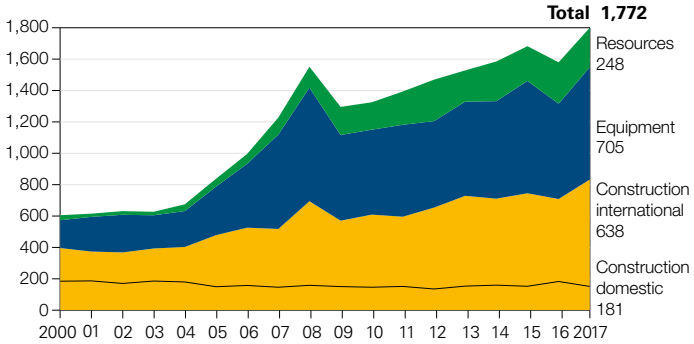
After a number of difficult years, the BAUER Group is back on a better path for the future. In 2017, we significantly increased total group revenues from 14 percent to about EUR 1.8 billion. EBIT was much more positive than in previous years. The overall picture is good except for earnings after tax, which at EUR 3.7 million were barely positive. This was influenced by the verdict in a long arbitration process, which had a negative impact of more than EUR 20 million.

In the previous year, the Construction segment posted positive results in most areas and significantly increased revenues by 17.1 percent to EUR 835 million. However, earnings were very unsatisfactory due to the verdict as well as difficult projects in Germany and Australia. Our subsidiaries in the US and the Middle East also did not have a good year.

By contrast, the Equipment segment performed much better. Revenues increased by 18.9 percent to EUR 754.5 million and earnings after tax were extremely positive at EUR 41 million. This growth was driven by the markets in Europe and Asia, very high demand for our large-scale and specialized machines as well as a renewed willingness to invest on the part of our customers. Many improvement measures also contributed to this growth.

Development of total Group revenues by segment

in millions of EUR (segments after deducting Other / Consolidation)



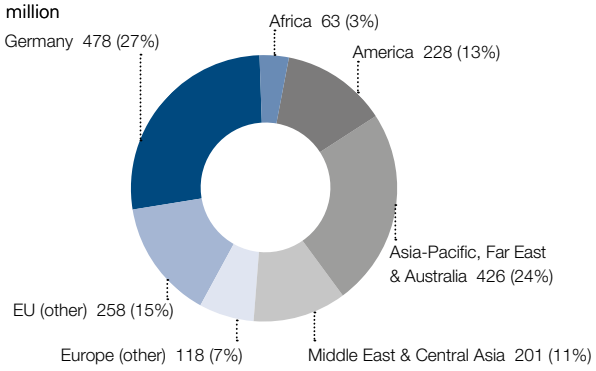
We did not meet our expectations in the Resources segment. Our reorganization measures have not yet achieved the desired results. Revenues fell by 5.4 percent to EUR 248.2 million in 2017 and earnings after tax were clearly negative at EUR 22.4 million. In Jordan in particular, we were troubled by the continued underutilization of capacity in the area of well drilling and deep drilling. We also recorded a noticeable loss in the brewery plant business. The strong environmental business could not compensate for this.

The year now coming to an end was characterized by a decline in revenues, mainly due to the construction segment. The start of 2018 was weaker compared to the previous year and there were fewer large-scale projects in progress. The Equipment segment continues to perform well, with sales revenues roughly at the same level as the previous year, and good earnings. The Resources segment is still affected by the weak order situation in some areas as well as the overall need for reorganization measures.

Thanks to the Group's order backlog, we are in a good position for the future. Construction continues to enjoy a healthy market environment and good growth. Infrastructure and urbanization are major drivers, but areas such as the environment or water require services in which our group of companies specializes. As a result, I am confident that our structure as well as our products and services are properly positioned for many years to come. At the same time, we will continue to work intensively on improvements that will enable us to achieve better overall results in the long term.

Geographical breakdown of total Group revenues

in EUR million



We can never completely free ourselves from the unpredictability of world politics. With more than 110 companies in about 70 countries, we have an excellent international presence, which is an immensely important component of our business. It is clear that changes in certain markets or political actions will always guide and influence us. Examples include the weak market in the Middle East as a result of the low oil price, or the new sanctions against Iran. This also includes issues that do not affect us directly, such as the monetary and economic crisis in Turkey, Trump's trade disputes with China and Europe, the crisis in Venezuela and the uncertain political situation in Italy. All of this has an impact on the Global economy and creates uncertainty in the stock markets and therefore among our customers in the capital goods market. The greatest difficulty and challenge is to respond to these situations and successfully maneuver through the many disruptions. It's not always easy, but I think we've been very successful so far. And we will continue to succeed in the future. With our new management team at all the major companies of the Group, we have the specialists we need to ensure our success moving forward. I am confident that everyone has the sensitivity and good instincts it will take to accomplish this goal.

I would like to thank all employees for their dedication and loyalty to the company, all customers and partners for their trust and partnership, and all friends and interested followers who have supported our company for many years. I look forward to my future role as Chairman of the Supervisory Board and to many more years of success for our company.

In Ingolstadt, an impermeable excavation pit was constructed for a hotel using a piled wall tied back with 182 double anchors and 100 foundation piles.

Changes to the Management Board of BAUER AG

Farewell to the chief: After a total of 32 years at the helm of the BAUER Group, Prof. Thomas Bauer passed on the leadership of the company to a younger pair of hands in the fall of 2018. At the same time, Prof. Thomas Bauer joined the Supervisory Board, where he is replacing Dr. Ing. Klaus Reinhardt as Chairman.

Our new Chairman of the Management Board is 48-year-old Michael Stomberg. A Hamburg native, he began his career in 1997 at global management consulting firm Booz Allen Hamilton in Munich, where he oversaw strategic and operational projects in various industries around the world. In 2006, the physics graduate joined EagleBurgmann, an international supplier of industrial sealing solutions, part of the Freudenberg family-owned group of companies. The Wolfratshausen-based company has production facilities and sales offices in many countries around the world. In his most recent role as Chief Operating Officer (COO), Michael Stomberg was in charge of production, product development and project business. Florian Bauer, member of the founding family, joined the Management Board in early 2018. As a result, it is now a four-person body.

The civil engineering graduate has been with the company since 2011. He started as a project engineer at BAUER Spezialtiefbau GmbH, where he was site manager for several major projects in Malaysia and temporarily headed the Singapore branch. Since 2015, Florian Bauer has been a Member of Bauer Spezialtiefbau's Management Board and headed the Business Division Techniques as well as the areas Digital Construction, Innovation, and Research + Development. Now, as a Member of Bauer AG's Board of Management, he takes over the areas Digitalization, R+D Coordination, Advanced Training and Company Culture. He continues to be a Member of BAUER Spezialtiefbau GmbH's Management Board, where he keeps part of his former areas of responsibility.

Specialist foundation engineering and airports

Airports are a world of their own. They have their own rules, their own traffic routes, their own infrastructure, their own supply chains, safety regulations and much more. Airports consist of terminals with gates and security checkpoints, baggage check-in and baggage claim areas with conveyor belts for baggage handling. There are also runways, huge hangars with workshops and maintenance areas as well as the control tower. Airports also include entire shopping malls with many boutiques and duty-free shops, cafes and restaurants, not to mention hotels and convention centers. They also have arrival and departure areas, access roads and parking garages, and many have rail transportation for travelers and the airport employees who commute to work every day. Large airports are like small cities. They have infrastructure, emergency services and fire departments as well as their own security personnel and regulations.

Bauer built the foundation for "The Circle," one of the largest construction projects in Switzerland.

Bauer in Dubai

"The strange thing about some airports is that they were originally built far outside the city center, and now they're suddenly inside the city," says Prof. Thomas Bauer. A recent example is Dubai Airport, which is now reaching its limits after many expansions. The airport construction site was one of his first major projects that Thomas Bauer co-managed in the Persian Gulf in 1983. At the time, a second runway was built to accommodate the increased volume of air traffic. To prepare for the runway, five-meter-thick sabkha layers and loose, silty, sandy soil had to be compacted. In just three months, Bauer Spezialtiefbau compacted a total of 1,000,000 cubic meters of soil using 15-tonne pounders. It was the first project at the Dubai International Airport for the foundation engineering specialists from Schrobenhausen, and many followed. Dubai grew and leveraged its economic strengths with tourism. "While the neighboring Emirate of Abu Dhabi had prosperous oil wells, tourism boosted the economy of Dubai in the late 1990s," says Hans-Joachim Bliss, Member of the Management Board of Bauer Spezialtiefbau.

DUBAI

For decades, Bauer has repeatedly received orders in Dubai for the gradual expansion of the International Airport.

The emirate increasingly opened up to tourists from the west. A veritable construction boom began, resulting in more projects for Bauer. Amusement parks, shopping malls, hotels and villas sprang up out of the desert floor, or as in the case of the famous Palm Islands, out of the sea. The construction boom culminated in the opening of the world's tallest building, the Burj Khalifa, in 2006.

Before long, the airport could no longer handle the rapid increase in the number of people visiting the emirate each year. Between 2001 and 2007, Bauer completed a large number of expansion projects for the airport, all of which were related to the construction of Terminal 3, which finally opened in 2008.

Tourism in the Far East also became increasingly popular in the late 1980s and 1990s. DXB, the official abbreviation for Dubai Airport, has become the hub of the major airlines connecting Europe with the Middle and Far East, most notably Gulf-based Emirates and Etihad airlines.

In 2017, DXB handled more than 85 million passengers. This makes Dubai International Airport the third busiest airport in the world, behind Atlanta, USA, and Beijing, China. Although only ten years have passed since the last expansion, it is foreseeable that the airport will reach the limits of its capacity despite the many structural modifications. Further expansion is not possible because the airport is surrounded by the city on all sides. Dubai Al Maktoum International Airport, approximately 45 kilometers from the city center, has been used as a passenger airport and steadily expanded since 2013. By 2025, it will be the largest airport in the world and be able to handle up to 160 million passengers.

Munich airport

Authorities in Munich once faced a similar situation. By the 1980s, the old Munich-Riem Airport had already reached its limits in terms of capacity. It

could barely handle the growing number of passengers. But the airport could not be expanded. An alternative site was found in Erdinger Moos in the northeast of the city. As soon as the new airport was completed, the airport company and all airport operations relocated to the new Franz Josef Strauss Airport almost overnight.

Bauer was hired for specialist foundation engineering during several stages of construction of the new airport. Construction of Terminal 1 began in 1987 and the terminal opened in 1992. Bauer Spezialtiefbau partnered with the company Boegl to construct the foundation for the central area, which includes the tower and terminals B and C. In total, over 21,000 square meters of sheet piles and 16,500 square meters of cut-off wall were installed. Draining the excavation pits proved to be a major challenge, as the groundwater in the marshy area is only two meters below ground.

Construction of Terminal 2 began in 2000. By that year, the airport was already handling twice as many passengers than originally estimated. Bauer and Walter Bau AG were contracted to construct the retaining structure and foundation for the terminal and airport apron as well as to extend the existing urban rail tunnel from the Munich Airport Center to the new buildings. In addition, Bauer built the retaining structure and floor for a baggage and supply tunnel using cut-and-cover construction methods.

Munich Airport added a new Terminal 2 after less than ten years of operation.

A third new tunnel was also built for the PTS (passenger transportation system). The PTS opened only very recently. It transports passengers from Terminal 2 to the "satellite terminal," which opened in 2016. This is where Gates K and L of Terminal 2 are located. This project is another example of how underground structures for airport projects have to be planned and executed many years in advance.

"The construction of Terminal 2 was a special challenge for us," recalls Managing Director Harald Heinzelmann, who has now managed many large-scale projects. It was the first major project involving the construction of underwater concrete columns, now a standard procedure for Bauer. The specialist foundation engineering work was done from January to December 2000. Due to the extremely challenging time constraints, up to 15 heavy-duty rotary drilling rigs were used at once on the construction site. "It was almost like a Bauer Maschinen equipment show," says Harald Heinzelmann.

Munich Airport plays a very unique but essential role for the BAUER Group. It is the home airport of the employees at the headquarters in Schrobenhausen. Bauer employees almost always fly from Munich's Franz Josef Strauss Airport, whether travelling for business or pleasure. The airport is ideally located. Travelling by car, it takes almost exactly

Airplanes transport more than just passengers. Occasionally, Bauer rigs are also shipped by air. Air freight is often preferable to ocean freight, depending on the project and the customer.

PARIS

Construction projects at airports always require consideration of space restrictions, such as here at Charles de Gaulle Airport in Paris.

45 minutes to reach the departure area of Terminal 2. That's barely more time than it takes to reach the airport from downtown Munich, especially when traffic is light.

Security regulations

In addition to HSE management, the compulsory safety system for all Bauer construction sites, the client's construction safety systems are becoming increasingly important on major construction sites. This is especially true of airport expansion projects. Airports are already sensitive to safety and security in the first place, and all the regulations that apply to passengers also apply to employees. Employees on construction sites must undergo strict security checks, especially when the airport is open, and sometimes they even have to submit to a criminal background check in advance.

Special regulations also apply to machines. Tall masts are a prominent feature of Bauer rigs. Security sensitive airspace restrictions sometimes have to be considered, depending on where the work is being done. For example, a low-headroom cutter normally used for tunneling might have to be used in an open area if such airspace restrictions apply.

ORLANDO

Foundation work for a parking garage at Orlando International Airport, USA.

Current projects

There are many other projects for specialist foundation engineering at an airport site beyond tunnels for conveyor systems, soil compaction for runways or foundations for new terminals. One showcase project currently underway at Zurich Airport is the construction of The Circle, a new commercial center with a huge business complex featuring cutting-edge architecture. When The Circle is completed, the glass facade on one side will be inclined slightly forward. The stabilizing forces must meet correctly in this structure. In 2016, Bauer was contracted to construct a piled wall up to 23 meter deep using the CFA method as well as fully cased foundation piles up to 50 meter deep using Kelly technology.

The new Gateway Gardens district currently under construction near Frankfurt Airport will be an exclusively commercial district. No residential buildings will be built at the site because of the excessive aircraft noise. For the link to the suburban train line, Bauer built 4,700 square kilometers of durable sheet piles using the RG 19 pile driver, followed by 4,500 meters of corrosion-resistant single-rod anchors.

The airport project in the Indonesian capital of Jakarta was recently completed. Soekarno-Hatta International Airport is one of the largest airports in Asia with over 60 million passengers per year. Additional runways are being added between the airport's existing runways in order to cope with the increasing number of flights, which exceed 447,000 per year, and to optimize the handling of individual aircraft.

P.T. BAUER Pratama Indonesia, the local subsidiary of BAUER Spezialtiefbau GmbH, was contracted by PT Hutama

FRANKFURT

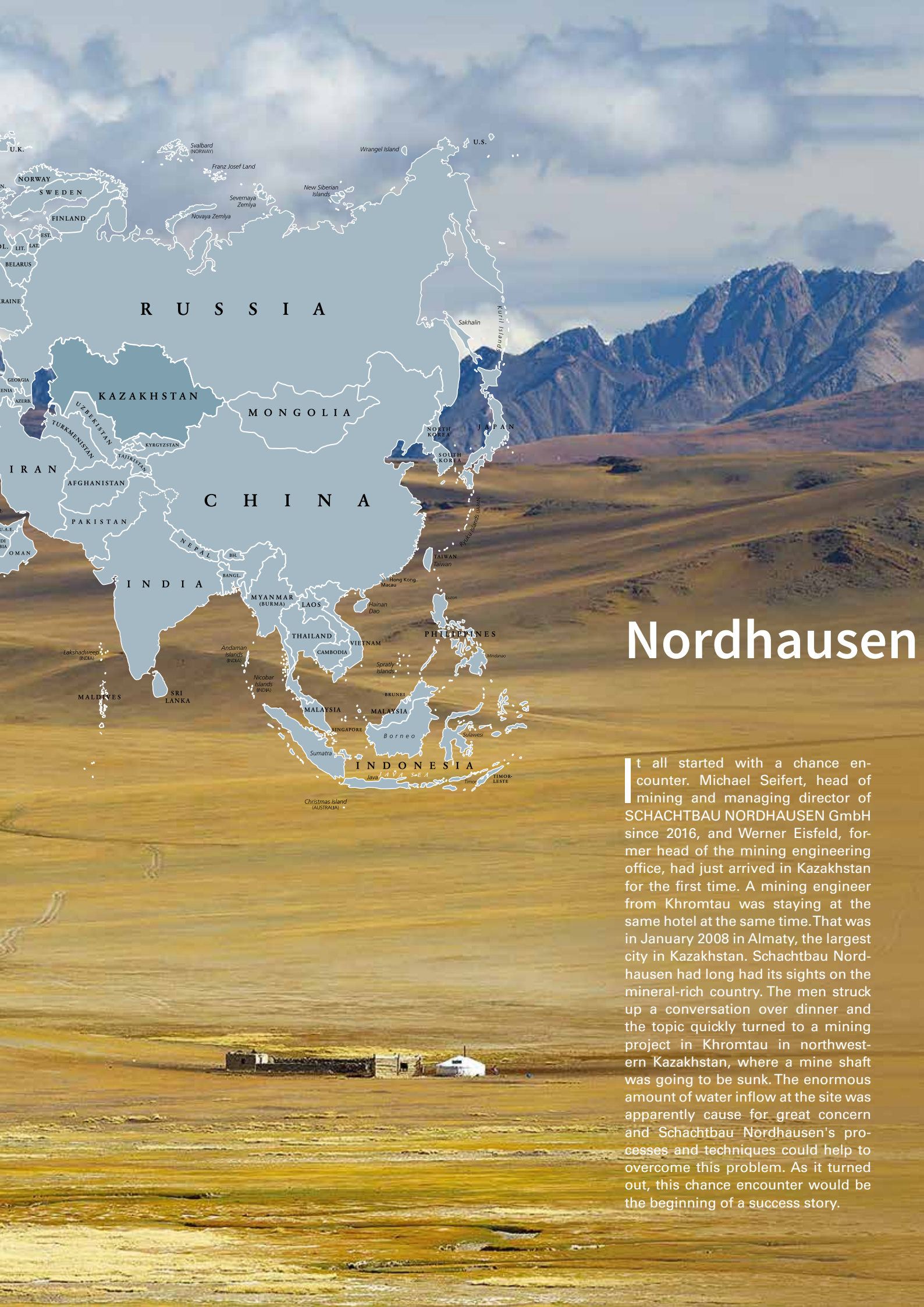
There is regular demand for Bauer's foundation services at airports such as Frankfurt am Main, where Bauer has already completed several projects.

Karya, the prime contractor of Indonesian airport authority P.T. Angkasa Pura II to conduct soil improvement work to prepare for the construction of the new runways. The "East Connection Taxiway Phase 1" focuses on two areas: foundation work for a runway bridge over the main access road of the airport as well as extensive ground improvement measures for the connection of the northern and southern runways.

A total of 1,424 bored piles with a diameter of 1.2 meters were sunk to depths of up to 37 meters for the foundation of the runway bridge. The ground improvement measures covered a total area of 196,000 square kilometers and were executed with five full displacement piles driven to depths of up to 16 meters. The equipment used in the project included three BAUER BG 14, one BG 22 and one BG 28.

JAKARTA

The local subsidiary Bauer Indonesia constructed the foundation for a new runway bridge and carried out ground improvement work at the Jakarta airport.



Nordhausen

It all started with a chance encounter. Michael Seifert, head of mining and managing director of SCHACHTBAU NORDHAUSEN GmbH since 2016, and Werner Eisfeld, former head of the mining engineering office, had just arrived in Kazakhstan for the first time. A mining engineer from Khromtau was staying at the same hotel at the same time. That was in January 2008 in Almaty, the largest city in Kazakhstan. Schachtbau Nordhausen had long had its sights on the mineral-rich country. The men struck up a conversation over dinner and the topic quickly turned to a mining project in Khromtau in northwestern Kazakhstan, where a mine shaft was going to be sunk. The enormous amount of water inflow at the site was apparently cause for great concern and Schachtbau Nordhausen's processes and techniques could help to overcome this problem. As it turned out, this chance encounter would be the beginning of a success story.

High demand for shaft construction expertise

mining project in the steppes of Kazakhstan

Many people are not very familiar with Kazakhstan. The Central Asian nation is the ninth largest country and the biggest landlocked country on earth. One possible reason for the country's obscurity is the fact that it has a population density of just under six people per square kilometer. "That's probably why they're so hospitable," says Michael Seifert.

The country is mostly desert and steppe. For centuries, the Kazakhs were nomads who moved from place to place in their vast, sparsely populated homeland. In the Soviet Union, they were forced to live in settlements. Today around 18 million people live in Kazakhstan; a multi-ethnic state, with about 120 nationalities and many different faiths. A good 60 percent of the population are Kazakhs, and just under 20 percent are Kazakh Russians. Although the country is rich in oil, natural gas and many other raw materials, nearly half of the population is still relatively poor and living in mostly very remote villages. A year and a half passed before the conversation with the German mining expert was recalled in Khromtau again. In Khromtau, on the southern edge of the Ural mountain range, the world's most chromium-rich deposits had recently been discovered in an existing mine: the chromium ore mine called "10th Anniversary of the Independence of Kazakhstan" operated by chromium producer AO TNK KAZCHROME. In planning to develop an additional district of the mine, there were concerns as to whether the previous expansion system using steel arches and stone lagging could withstand a longer-term expansion, given the difficult geological conditions and shaft depth of 1,000 meters. The rock through which the tunnels were blasted was mostly moderately to highly fractured rock mass with pronounced fault zones. It dissolves quickly and tends to crumble, especially in combination with water.

During a tour of the construction in Khromtau, which was arranged at short notice, the experts of Schachtbau Nordhausen had a decisive advantage thanks to their decades of experience in narrow-gauge tunneling. They quickly realized that the old methods would not work. Instead, Michael Seifert and his team proposed a new tunnel expansion system that had never before been used in the post-Soviet states. It consists of steel fiber shotcrete combined with support arches. There was a special strategy for each scenario, meaning the worse the rock, the more complex the tunnel expansion would be. The client was impressed with the proven tunneling technology from Germany. In the spring of 2011, SCHACHTBAU NORDHAUSEN GmbH and THYSSEN SCHACHTBAU GMBH formed the company "TOO SCHACHTBAU Kazakhstan." Following various planning projects, a 40 million euro contract was signed in October 2012 for

Nomads with their camel herds in the vast steppe of Kazakhstan.

Established in 1997, the capital city of Astana exudes

a 4,150 meter long drift that serves as the main link between two shafts. Blasting started on August 15, 2013.

The contrast between the infinite vastness of the Kazakh steppe and the bustling metropolis could not be greater. Almaty was the capital of Kazakhstan until 1997. It is located in the southeast of the country, at the foot of the Tian Shan Mountains. With almost two million inhabitants, Almaty is the largest city in the country and is influenced by Soviet traditions and architecture. Although Almaty is no longer the capital, it is still the commercial and cultural center of Kazakhstan. The city is on the foot of a mountain range with 5,000 meter peaks. The Medeu outdoor speed skating rink is located in the mountains above Almaty. May speed skating records have been broken at the rink. Today the lifestyle here is more western. Trade has brought prosperity, and traffic is increasing.

Astana is the new capital city and the symbolic heart of the up-and-coming nation. A planned city, it was built in the middle of the Kazakh steppe with the help of internationally renowned architects. The official groundbreaking ceremony was in 1997. Over one million people now live in the city, and the population is growing every day. Astana symbolizes Kazakhstan's independence, its will to modernize and the desire for international recognition. Expo 2017 in Astana brought Kazakhstan and its glittering capital to the world's attention.

Initially, up to 52 employees of Schachtbau Nordhausen were employed in Khromtau, but they were gradually replaced by the local work force over the following years. These employees were mainly recruited from other regions of Kazakhstan because the terms of the contract stipulated that the local work force could not be poached from the existing mine. Today, the tunneling operation is staffed exclusively by local employees. There are still about 15 German colleagues serving as supervisors in technical and administrative roles, but these positions cannot be filled by locals because they involve so much interfacing with the parent companies. This process has worked very well, says Michael Seifert: "The team is still highly motivated and the skills and abilities of our local colleagues are constantly improving." The project is also setting new standards in the area of safety: "Our employees are never allowed to enter an unsecured area,"

Connecting the ignition wires for blasting.

Shaft and shaft tower in Khromtau.

modern flair.

The tall peaks behind Almaty reach elevations of up to 5,000 m.

says Michael Seifert, pointing out that not a single accident has been recorded in the past two years.

Kazakh is a Turkic language and the official language of the country. But the constitution also recognizes Russian as a national language because just over half of the population in the former Soviet republic is fluent in Kazakh. Like over 85 percent of the population, many Nordhausen colleagues also speak Russian, which was a compulsory foreign language in all East German schools. This is a great advantage for communication. In addition, Germany was long considered to be the European leader in mining, and German mining expertise was in demand all over the world. As early as the late Middle Ages, German miners were able to pile-drive tunnels to a depth of 400 meters. The Russian czars began bringing these specialists to the country in the late fifteenth century. That's why the Russian word for mine tunnel ("Strecke" in German) is Штрек – *Streck*, and the German word "Schacht" (shaft) is still Шахта – *Schacht* in Russian.

The project team works on alternating schedule: seven weeks of work, four weeks off, seven weeks of work, three weeks off. Another advantage is that traveling to the site has become easier in many ways, especially for the German work force at the site. For example, in 2008, the only way to reach the site from Germany was by flying from Hanover to Almaty via Amsterdam, then taking a domestic flight to the regional capital of Aktobe, which is 80 kilometers west of Khromtau. The journey took over 12 hours at the time. Now, 10 years later, there are flights from Berlin directly to Aktobe via Moscow, with a total flying time of only five hours.

SCHACHTBAU NORDHAUSEN GmbH's work in Kazakhstan is a huge success story that is continuing. At the beginning of 2016, the company acquired a follow-up project worth over 30 million euros to build another four-kilometer tunnel at the same mine. "That will take us to a least 2020, as far as the time frame is concerned," said Michael Seifert at the time. This projection for the mine's potential is now already outdated again because the team just signed a third follow-up contract for 36 million euros. "There's a huge mine site in Khromtau. It has potential for 90 kilometers of underground tunneling," says Michael Seifert. An important milestone was reached in August 2018, when the 5,000th meter of tunneling was celebrated over a drink and a fine cigar.

Saint Barbara is the patron saint of the miners.

Large cross-section near a tunnel junction.

In-house exhibition 2018

Exciting journey into the past, present and future

Schrobenhausen – In 1976, the BAUER BG 7 rotary drilling rig was introduced, outshining many competing rigs. It was the beginning of a success story for the BG 7 and for Bauer. Technology has changed a lot since then. An array of assistance systems now reduces the work for the rig operator and increases operator comfort. But what about the digital future? And how has Bauer mechanical engineering changed in recent years? During the in-house exhibition at the end of April 2018, the BAUER Maschinen Group took nearly 1,800 visitors from all over the world on an exciting journey through time entitled "Yesterday - Today - Tomorrow: Follow the Roots." More than 35 exhibits worth over 30 million euros were on display this year, including some brand-new models as well as numerous smaller innovations. In the PremiumLine, Bauer Maschinen introduced the BG 23 H, a highly efficient, innovative base machine with a performance-enhanced diesel engine and the latest award-winning EEP energy-efficient drive technology. This impressive advancement ensures optimal efficiency and provides additional dynamics, especially when heavy-duty drilling methods are used to install piles. The latest generation of the DKS 50/140 FOW twin-head drilling drive was exhibited as an example of the PremiumLine. Compared to the previous model, the BG 33 H features much greater torque significantly increased and a further improved ratio of performance to weight. Thanks to an optimized mast design and enhanced crowd system, the BG 45 can now drill to a depth of 36 meters when continuous flight auger method is used. The giant among the rotary drilling rig exhibits towered at a height of 43.7 meters, including its single-pass attachment.

The completely redesigned ValueLine BG 15 H is specifically designed to be a highly functional and cost-effective small drilling rig with extremely compact transport dimensions. The completely revamped BT 50 base carrier offers an array of advantages: The integrated service platform enables easy access to all service points in the uppercarriage while meeting the highest standards of occupational safety. The BG 15 H also features impressively low noise emissions and outstanding fuel efficiency.

The highly functional BAUER MC 76 duty-cycle crane has been specially optimized for use with grabs, but it can also be used in dynamic compaction applications as a lifting crane or carrier for other equipment such as silo vibrators or applications with leaders. The MC 76 also features the fastest hoists in the Bauer range of duty-cycle cranes as well as a new universal mast head for grabbing and hoisting applications. The completely redesigned undercarriage is extremely rugged and compact.

In the past, our innovative free-fall technology was used primarily with duty-cycle cranes. For the first time, Bauer Maschinen showed how this innovation can be used with diaphragm wall technology. When combined with the compact GB 50 specialized rig, this advanced technology represents a milestone in the field of hydraulic grabs. Momentum is quadrupled by doubling the impact speed. This has the key advantage of enabling grab operations even in challenging soil conditions.

Actually a museum piece: The first BG 7 from 1976 was shined up for its big appearance. See the new BG 45 directly behind it to compare old and new dimensions.

Bauer Maschinen welcomed more than 1,800 visitors over three days.

Chairman of the Management Board Dieter Stetter in a TV interview in front of the first BG 7.

As always, the subsidiaries of the BAUER Maschinen Group were also represented with numerous new products and innovations. Klemm KR 801-3GK and KR 909-3G rigs were on display with a new control system and engine. BAUER MAT Slurry Handling Systems presented their new PP series of plunger pumps, which can pump up to 750 l per minute and are ideal for soil mixing and flushing in anchor drilling applications. In addition to the proven SKC-30-K continuous slurry mixer and the BD 90/75 decanter centrifuge, Bauer MAT also presented a new series of the SCA-40-K charge mixer.

As always, the subsidiaries RTG Rammtechnik, Hausherr, Prakla and ABS also had exhibits. The parts and service department, the electronics and controls Business Division of Bauer Maschinen development and the BAUER Training Center GmbH exhibited in the old welding shop. There was huge interest in the virtual reality technology that allowed BAUER Maschinen GmbH and Schlumberger and NEORig to give visitors an impressive virtual tour of an oil and gas drilling rig. The nearby machine plant in Aresing hosted live demonstrations.

This year, BAUER Maschinen GmbH offered visitors the most extensive program of activities ever, with a constant focus on the past, present and future. The program included a field trip to Munich's Olympic Stadium to commemorate the early days of Bauer specialist foundation engineering: The tent roof was anchored to the ground in 1971 using Bauer permanent anchors that are still doing their job after 47 years. The event ended with the fun Bavarian evening, where both hosts and guests wore traditional dirndls and lederhosen.

Showcased for the first time at the in-house exhibition: The NEORig TDK 80-500 E Top Drive of a deep drilling rig for oil and gas production.

Klemm, ABS and Hausherr presented a total of seven exhibits.

Egypt From September 2017 to March 2018, a BC 30 cutter and a Klemm 806 anchor drilling rig were used to construct a diaphragm wall tied back with anchors 27 meters deep and 800 mm in diameter for a 17-meter-deep excavation pit at the Cairo Cancer Hospital. **Above**

Sierra Leone From November 2017 to January 2018, a B 41 vibrator was used to improve the ground in the container terminal in the port of Freetown, which had been artificially filled with sand, through vibro compaction to depths of 24 m. **Right**

Specialist foundation engineering projects on all continents

Egypt Bauer was contracted to construct diaphragm walls in thicknesses of 80 to 150 cm for six metro stations and other structures for the extension of Metro Line 3 in Cairo. In addition, 180,000 m³ of soil injections are being executed to depths of up to 85 m. Five BC 40 and BC 30 cutters and five BG 28 cutters will be used between September 2017 and March 2019. **Below**

Angola Between December 2017 and March 2018, 4,000 m² of shotcrete and 500 m of soil nails were inserted to stabilize the slope along a road embankment. **Left**

Qatar Three BG 28 and one BG 40 were used to install 999 piles for the foundation of giant rice silos on a 5,000 square-meter site at the port of Hamad, south of the capital Doha. **Right**

Abu Dhabi In just ten months, a complex excavation pit was built for new residential and office towers. The 420 m diaphragm wall and 59 m pile wall enclosure was secured with 627 temporary anchors and 15 struts. Bauer was also contracted for 406 foundation piles as well as 155,000 m³ of excavation and groundwater control. **Below**

Dubai A gigantic shopping center is being built as part of the future Dubai II Big Box Retail Park. The excavation pit was constructed using secant and contiguous pile walls as well as soldier piles with wooden laggings over a length of 780 m. The project also included 1,754 foundation piles and 200,000 m³ of excavation. **Right**

Lebanon Bauer was contracted to reinforce the Jannah dam. Cutter excavated diaphragm wall panels were installed to depths of up to 50 m to create a bentonite concrete cut-off wall along a 123 m stretch of the dam. **Above**

Saudi Arabia In Dhahban, near Jeddah, Bauer completed three large contracts for the Security Forces Medical Center between February 2017 and June 2018. Two BG 40 and six BG 28 were used to perform eight pile tests and construct 2,000 wall piles and 4,600 foundation piles. **Above**

Indonesia Bauer built a secant pile wall and anchor piles for a port being planned on an artificial island two kilometers off the east Indonesian city of Makassar Sulawesi. **Above**

Vietnam A secant pile wall with a diameter of 900 mm and 265 foundation piles with a diameter of 1,200 mm were constructed for a retaining structure in Ho Chi Minh City. The contract also includes monitoring the neighboring buildings for settlement over a period of two years as well as further tests. **Right**

Malaysia Bauer installed bored piles with diameters of 1,350 to 3,500 mm in hard rock for an inner-city motorway bridge in Kuala Lumpur. The contract also included a test program consisting of a group of six test piles. **Above**

Philippines Sixty-five 2.8 m diameter bored piles were installed on land and seventy-four 3.4 m diameter offshore piles were installed in the San Juan Riverbed for the extension of the Metro Manila Skyway. The maximum depth of the piles is 44 m. **Below**

Panama From January 2016 to March 2018, a BG 28, BG 39 and BG 40 were used to install 783 bored piles up to 2,250 mm in diameter to depths of up to 43 m for the foundation of the continuous elevated metro line 2 in Panama City. **Left**

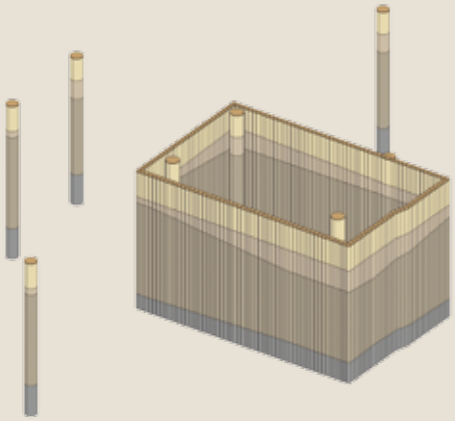
USA A total of 180 bored piles with permanent casing and a diameter of 900 mm were installed to a depth of 21 m at the decommissioned Crystal River CR3 nuclear power plant in Florida. **Below**

Canada The excavation pit for a new clinic building in Calgary was constructed using soldier piles with wooden laggings. The project required 396 piles measuring 880 mm in diameter and 20 m in length as well as 12,500 m² of timber lagging and 960 anchors in four layers. In addition, 82 permanent foundation piles with a length of 26.5 m were installed and the pile bottom was enlarged from 750 mm to 2,250 mm and from 1,500 mm to 4,500 mm. **Below**

digital@bauer

BIM – modeling a real construction site

Digitization is constantly advancing. We can now lower the blinds in our home via a smartphone app or use a domestic robot to adjust the thermostat or initiate online purchases using voice control. Today, companies must make continuous progress in digitization in order to remain competitive. It can make work and operations planning more precise, and improve calculation of costs. In specialist foundation engineering, a new development is gaining ground: BIM, which stands for Building Information Modeling.



Derivation of soil stratification and excavation quantities in the CAD system.

"BIM optimizes project planning using a 3D model, which can be augmented with the dimensions of time and costs," explains Florian Bauer, who is responsible for the area of digitization in his role on the Management Board of BAUER AG. "BIM can be used to represent the entire life cycle of construction and buildings, starting with planning, conceptual design and financing." A method that has been a standard practice in mechanical engineering for many years, namely modeling and checking components in 3D before initiating production, is now also an important method in specialist foundation engineering. A digital construction site can be planned from start to completion using BIM. All information such as geographical data or the required piles and anchors can be modeled in detail. This makes it easy to determine which solution is most economical in an individual case.

"BIM itself is not new", says Marcus Daubner, who is responsible for the further development of BIM at Bauer Spezialtiefbau. "The major construction companies have been using it for many years." BIM is now gradually spreading from structural engineering to all the adjacent trades, such as road construction, tunnel construction and of course specialist foundation engineering.

"However, there's no ready-made system for us to use," says Florian Bauer. "There are currently no drawing elements that can describe our components. That's why we're creating our own component library."

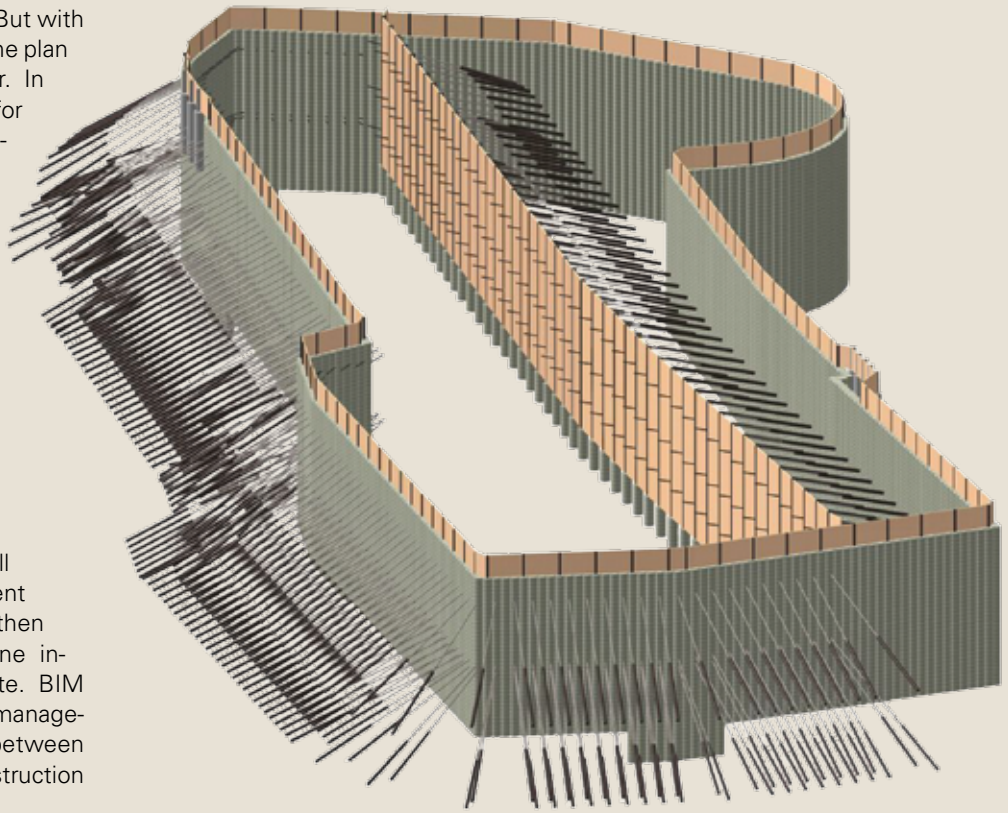
The advantages of the system are already evident even before a contract is awarded. All data of a project is stored entirely in one model and the underlying database, and the building is planned digitally in advance. This method of planning offers much more advanced capabilities than the CAD programs previously used. Instead of drawing piles individually, complete elements can be copied and fine-tuned with just a few quick keystrokes. "The whole process reminds me a little bit of building with Legos," says the member of the Management Board with a smile.

To plan the excavation pit, the results of coring and other geographic data are entered first. This data is then used to calculate soil conditions for determin-

ing the necessary diameter and depth of the piles. Of course, all this data was collected and used in the past. But with BIM, the values and therefore the plan can be illustrated much better. In the future, different solutions for process control and cost evaluation will also be modeled.
The model will be augmented with additional information, such as the methods and the type of concrete used as well as schedules and the equipment used for pile installation. "The construction site schedule can be planned much more efficiently," explains Marcus Daubner. "With BIM, we create a weekly plan that shows us when and where a pile will be drilled and the equipment that will be used. We can then discuss the plan with everyone involved on the construction site. BIM is therefore a very important management tool for coordination between the trades involved in the construction project and the client."
By visualizing the project, problems can be quickly and easily identified, resulting in new approaches. In addition to the construction workflow, collision detection is another important advantage. With thousands of anchors securing

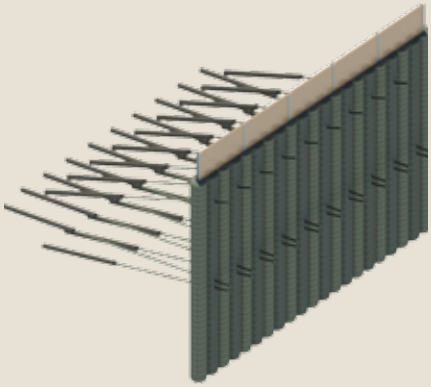
Marcus Daubner, Head of Digital Construction, and Member of the Management Board Florian Bauer.

a pile wall, BIM calculates whether there is a risk of overlap in tight spaces despite deviation tolerances.
The stated goal of BIM is to represent the complete lifecycle of a building at any time, from planning to construction to later maintenance. "From the first pile to the last window, all the information from the planning and production phases is stored in a single database instead of many individual files," says



3D model of an excavation pit with pile wall tied back with anchors.

Marcus Daubner. If you need to replace a window pane later, you can use the BIM model to determine the glass type, manufacturer and size in a matter of seconds. However, it is currently not the case that everyone involved a project is able to collaborate effortlessly in one database. Many smaller companies in downstream trades are still limited by a lack of financial resources or have not yet acquired the expertise necessary to use the system.
The German government is requiring all public sector projects to be planned in BIM by 2020. The Federal Department of Specialist Foundation Engineering of the German Construction Industry Federation has therefore established a BIM task force. Bauer Spezialtiefbau is working to further improve digital construction sites in partnership with all the other civil engineering companies in the federation.
However, Bauer Spezialtiefbau's goal in using BIM is to work more productively and efficiently across projects, not just within a project itself. In our digital building initiative, quality and production data is also collected in addition to planning data. All information is fed into the database. This results in many advantages such as effective performance evaluation, quality assurance and reporting. Cross-evaluation of different projects allows for more precise quantity surveying. For example, the quantity of overlay required for the construction of a pile in sand can be determined. Know-how is growing and being made available to employees and project managers via the database.
The first projects were planned using BIM last year. In two to three years, all major construction sites of Bauer Spezialtiefbau will be modeled in 3D prior to project launch. The two visionaries are certain that it will be a success.



Part of a model: pile wall with I-beam shoring and anchor layers.

Bauer Resources

Constructed wetlands for water treatment

Southern Oman is home to the largest commercial reed bed treatment plant in the world. In 2011, BAUER Nimr LLC, the local subsidiary of BAUER Resources GmbH completed the first phase of the multi-award winning flagship project for remediation of contaminated water from oil production at the Nimr oil field. At the end of 2017, the BAUER Group was contracted by Petroleum Development Oman (PDO), the leading oil and gas exploration and production company in Oman, to expand the plant.

The innovative reed bed treatment plant is unique in that it uses natural flow processes and treatment methods to remove large quantities of hydrocarbons from the water. The plant is also impressive for its size of 10.5 square kilometers. In addition to the excellent remediation capacity (less than 0.5 milligrams of hydrocarbons per liter remain at the end of the process), almost 95 percent of the crude oil in the water can be recovered or removed without the use of additional energy or chemicals. After an initial expansion, the facility is now treating 115,000 cubic meters per day. In addition, the former desert landscape has become a biotope for over 140 species of animals, including numerous birds, fish and reptiles. The new expansion project will now increase the capacity of the plant by 60,000 cubic meters to 175,000 cubic meters per day. BAUER Nimr LLC will be responsible for the design, construction and operation of the plant until 2044. The project is worth a total of over 160 million euros, with construction accounting for approximately one quarter of this total. Construction will be completed by the end of 2019, after which Bauer will operate the plant for 25 years.

"The reed bed treatment plant in Oman is one of our most innovative and im-

Reed has been growing in the first section of the treatment plant since 2011 (large image). Meanwhile, the plant covers a total area of 10.5 km² (small image).

portant projects in the area of Resources and in the Group as a whole," says Prof. Thomas Bauer. "Thanks to the excellent collaboration with our local partners at our subsidiary in Oman and everything we've accomplished so far, we can now continue to build on this joint success."

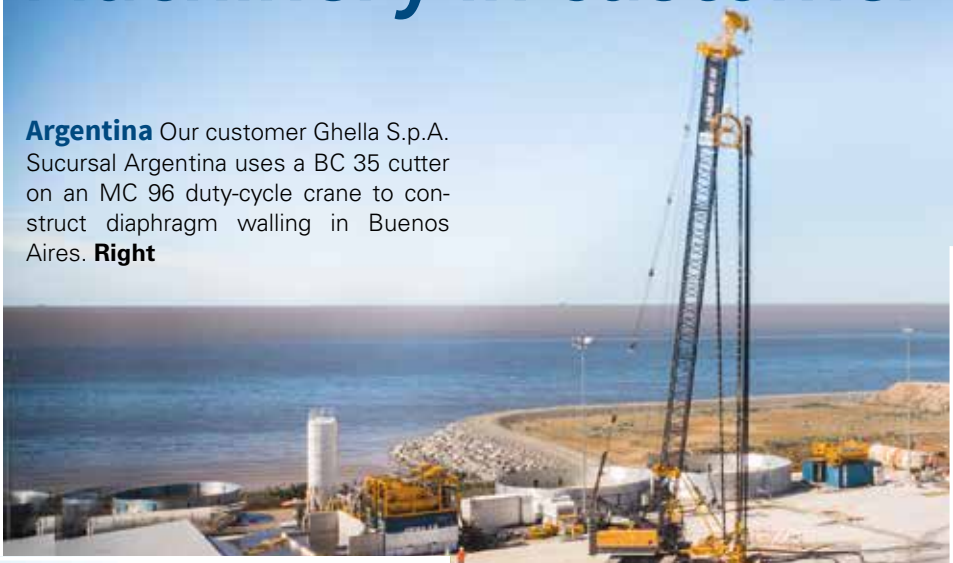
Research project

For the past two years, a research project has been underway on a 54 acre site right next to the treatment plant. The purpose of the project is to investigate innovative and ecologically sustainable alternatives for the reuse of water from the sewage treatment plant in partnership with Petroleum Development Oman, the Ministry of Agriculture and Sultan Qaboos University. Over a period of four years, salt-tolerant plants will be irrigated with the treated water to explore whether the plants can be used to produce biomass or biofuel, or whether other plants such as cotton can be grown. Initial tests have shown that cotton is a good alternative and could be a profitable new industry for the country.

Constructed wetlands to go

Bauer Resources operates one of the largest natural water purification systems in the world in Nimr, Oman. But how can this pioneering technology be used in areas with limited space, such as residential areas? Bauer Resources has developed a mobile solution called the ReedBox, a completely pre-assembled system for fully organic remediation of domestic wastewater. The 40-foot intermodal container with a simulated reed field has everything needed to remediate the wastewater generated by 60 to 80 people – anywhere and all the time.

Machinery in customer operations



Argentina Our customer Ghella S.p.A. Sucursal Argentina uses a BC 35 cutter on an MC 96 duty-cycle crane to construct diaphragm walling in Buenos Aires. **Right**

USA Our customer HB Fleming used an RG 19 T to install 2,500 six-meter-long vibro stone columns for the extension building of the middle school in Lewiston, Maine.

USA Our customer Earth Reinforcement used a Klemm KR 806-3G anchor drilling rig to install thousands of anchors to reinforce Sam Houston Lane in Pasadena, Texas.

USA Our customer Malcolm Drilling used a CBC 25 cutter and a MAT BE 550 desander for slope stabilization below the Prado dam on the Santa Ana River in Corona, California for the construction of a concrete diaphragm wall.

Norway Oslo-based YIT Norge AS used an RM 20 pile driver to install 72 piles measuring 914 mm in diameter to depths of up to 35 m for a new quay in Randaberg near Stavanger. The first piles were installed from the shore and subsequent piles were installed from a pontoon.

United Kingdom Our customer Bachy Soletanche used a BG 46 to build a pumping station on the Thames in London.

USA Schnabel Foundation Company in Texas uses a BG 20 H to install piles measuring 610 mm in diameter up to 9 m deep into the ground for an office building in San Antonio.

Sweden Our customer Skanska Sverige AB uses an RM 20 pile driver with the air hammer drilling method to drive piles measuring 406 mm in diameter to a depth of 60 to 110 m for the foundation of the new Goeta Aelvbron bridge in Gothenburg.

Sweden Our customer FBB Finspangs Brunnsborrning AB builds bridges in Stockholm with an RM 20 pile driver.

Denmark Customer Per Aarsleff A/S used a BG 55 and two MC 86 and MC 96 duty-cycle cranes for the foundation of the Karla Tower in Gothenburg, Sweden.

Germany A. Woehrl Spezialtiefbau GmbH used a BG 15 H with a BT 50 and Kelly drive for slope stabilization for a residential building in Freising.

Austria Vienna-based Porr Bau GmbH uses a BG 45 in Kelly drilling mode to construct a bridge foundation that is 24 m deep and 1,500 mm in diameter for a town bypass in Oberau, Bavaria.

Estonia Our customer Baltpile OUe used three BG 30, BG 36 V und BG 40 V specialist foundation engineering rigs and a KR 806 anchor drilling rig to construct the excavation pit for a multifunctional building complex in the Tallinn yacht harbor.

China Shenzhen Shenglong Construction Co. Ltd. uses a BCS 40 cutter to build Niuhu Station on Shenzhen Metro Line 4.

China Shanghai Foundation Engineering Group Co., Ltd. uses an MC 128 duty-cycle crane with a BC 40 cutter for an urban infrastructure expansion project in Shanghai.

China Guangdong Hualiang Construction Co. Ltd. uses a GB 50 grab during construction of Hengli Station on Guangzhou Metro Line 18.

Sri Lanka San Piling Pvt. Ltd. uses a GB 40 grab to construct diaphragm walls for a real estate project in the capital city of Colombo.

Bauer Spezialtiefbau: innovating all over Europe

Switzerland From April to October 2017, a total of 3,500 meters of drilling work was completed for the second tower of Roche Pharmaceuticals in Basel, consisting of a secant pile wall with a diameter of 1,200 mm and foundation piles measuring 1,500 mm in diameter. When the project was completed, the two BG 39 were lifted out of the excavation pit using a 500 tonne mobile crane. **Right**

England The junction of the A19/A1058 motorways at Newcastle is being converted into a new triple-decker interchange junction. The excavation pit for the underpass of the A19 and the foundations for the abutment of three bridges consists of 600 bored piles that are 1,500 mm in diameter and 31 m long. The work was carried out in two phases where there was with flows of heavy traffic ongoing. **Above**

Netherlands An RG 25 S and the Mixed-in-Place method were used to construct 1,800 m² of pile walls up to 15 m deep with installed steel sections for a residential building with a basement level in downtown Groningen. **Right**

Austria On the A10 Tauern motorway south of Salzburg, noise barriers are being built on a foundation consisting of 9,900 m of bored piles. Two BG 20 H and BG 15 drilling rigs are being used. **Above**

Slovakia In Bratislava, a BG 40 and an RG 18 were used to construct foundation piles and anchored trench support for three high-rises in the Sky Park office complex during several stages of construction between 2017 and 2018. **Right**

Russia As part of a recent series of projects, Bauer acquired yet another foundation project that involved constructing 1,413 piles measuring 35.5 m long as well as 23,600 m² of diaphragm wall for Gazprom's new Lakhta Center headquarters in St. Petersburg. **Below**

Romania A BG 28 drilling rig was used to drill a total of 3,000 bored piles to depths of up to 28 m for slope stabilization on a section of the A10 highway between Sebes and Turda. **Below**

Bulgaria Between November 2017 and March 2018, Bauer's Bulgarian team used a BG 24 to construct 700 m of partially cased piles for a bridge section on the E75 highway near the Serbian town of Predejane. **Above**

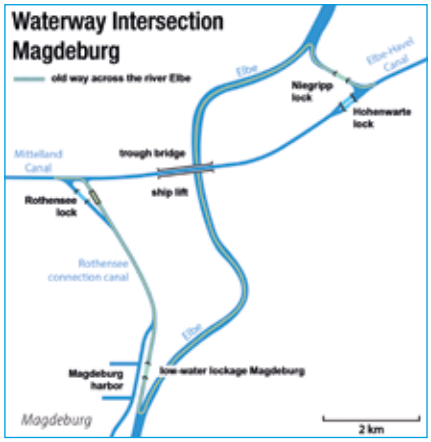
Georgia Bauer was subcontracted to install three layers of anchoring for existing pile wall for the foundation of the basement car park and casino at the Sheraton Hotel in Tbilisi. **Above**

Hungary A 16 m deep excavation pit was constructed with an 880 mm diameter secant pile wall and three anchor layers for the extension of the Buda hospital in Budapest. Two BG 28 and a UBW-08 anchor drilling rig were used. **Left**

From the Mittelland Canal to the Elbe-Havel Canal

Construction projects on German waterways

Germany – a transit country. Many routes connecting Europe from north to south and west to east pass through the Federal Republic of Germany, which is a logistics hub thanks to its geographical location. Germany connects Europe by road, rail and water. This wasn't always the case, however. For decades, the route to the east was cut off.



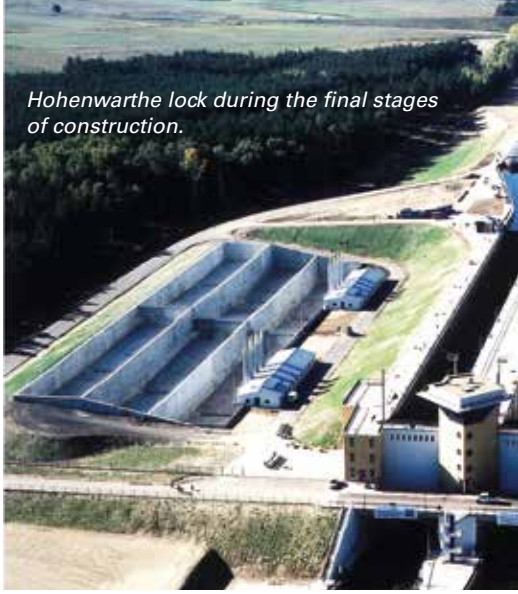
After reunification, the German Unity Transport Project (VDE) was launched, with plans for an extensive expansion and renewal of the transportation infrastructure. VDE Project 17 includes plans to expand the country's network of inland waterways. The plans mainly involved the expansion of the Mittelland Canal between Hanover and Magdeburg and the subsequent Elbe-Havel Canal toward Berlin, including the Magdeburg waterways crossing. The construction projects primarily focused on the locks along the canal, some of which were in a dilapidated state, and some of which needed to be modernized. Under the direction of Peter Asam, BAUER Spezialtiefbau GmbH helped to construct a total of five locks in partnership with other companies.

"We were the lead contractor in all five projects," says Peter Asam. "From the acquisition and bidding phase to construction management to the warranty, we worked completely independently, though always at our own risk." That's very uncommon for projects of this size, three of which were for the same client. By contrast, the consortium partners differed for each project.

All the projects involved extremely challenging excavation pits. Each was at least 15 meters deep, about 260 meters long and up to 30 meters wide. The large dimensions were required for the ships now common in inland waterways. The locks would have to accommodate modern Euro conveyor system, which measure about 185 meters in length and have a draught of 2.8 meters, or large barges.

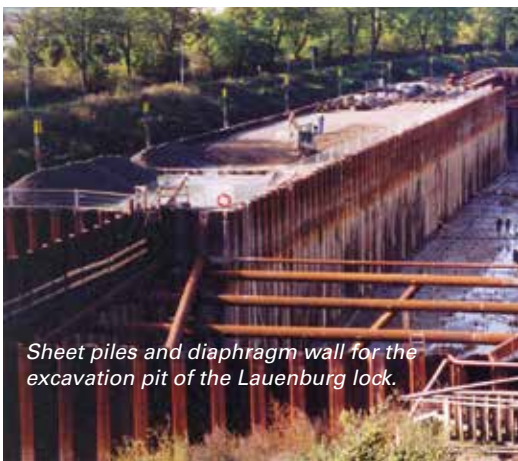
Perfect sealing was needed because the excavation pits were directly in or around water. There could be no leaky anchors, no holes in the wall. "Once we had laid the concrete base underwater, the excavation pit was pumped out over a period of two weeks," says the project manager. "That was a tense period." But he had no reason to worry. The excavation pits never leaked. All five projects were completed on time and with the best possible quality.

The first project was launched in the late 1990s: the construction of the Hohenwarthe double lock. It was part of a gigantic construction project, the Magdeburg waterways crossing. The client was the Magdeburg new waterways authority. Plans for a canal crossing over the Elbe, which would save the ships a detour of several kilometers, had already been envisaged in the 1920s. However, the construction of a lift lock was brought to a halt before the outbreak of World War II and was not resumed after the war. The project plan for the lock and canal bridge over the


Hohenwarthe lock during the final stages of construction.


The Mittelland Canal crosses the Elbe via an aqueduct near Magdeburg.


The specialist foundation engineering work for the Zerben lock began in spring 2013.


Sheet piles and diaphragm wall for the excavation pit of the Lauenburg lock.

Elbe resumed again after reunification. The Elbe and Mittelland Canal crossing required a whole array of new structures. For the lock, Bauer Spezialtiefbau first constructed a roughly 1,400 meter long cut-off wall that was up to 55 meter deep on the large site. The double lock and the recuperation basins would later be constructed on both sides of this wall. Bauer also built the foundation for the lock and basins. In addition, Bauer constructed the sheet piles tied back with anchors for the upper and lower harbor basin.

The Magdeburg waterways crossing ultimately also includes the Magdeburg Water Bridge, a massive aqueduct. The new waterway opened in 2003.

The four other locks were replaced. The old locks were narrow and in poor condition. In 2001, construction began on the Lauenburg lock. The project was contracted by the Lauenburg waterway and shipping authority. This lock southeast of Hamburg is not on the Ruhr-Berlin route, but it nevertheless deserves mention. It is an important part of the waterway network between the Elbe and the Baltic Sea. The route runs along the north-south axis between the Mittelland Canal and the Baltic Sea from the Elbe Lateral Canal close to the Suelfeld lock near Gifhorn and via Lauenburg to the Elbe-Luebeck Canal.

The project for the new Suelfeld lock west of Wolfsburg on the Mittelland Canal kicked off in 2004. The project was contracted by the Hanover new waterways authority. As in the other projects, a second lock basin was built parallel to the first. The old lock remained in operation during the entire construction period. Today, the old buildings are mainly used for inspection purposes.

In 2008, Bauer received another project from the Magdeburg new waterways authority for the construction of the second Wusterwitz lock near Brandenburg on the Havel river. The Elbe-Havel Canal officially ends at this lock near Plauer See. To the east, the lower Havel waterway and the Havel-Oder waterway continue to Poland via Berlin.

The most recent project in the series of lock structures was the construction of the second Zerben lock on the Elbe-Havel Canal. This was the third project contracted by the Magdeburg new waterways authority. The lock opened in March 2018. Its completion closed the last gap in the east-west waterway link. The construction of the Zerben lock is similar to previous projects in terms of size and execution. For the new lock, Bauer constructed a 263-meter-long excavation pit which is 23 meters wide in its narrow center section and up to 16.35 meters deep. A total of 10,500 square meters of diaphragm wall was constructed for the excavation pit retaining wall. The horizontal sealing is formed by an underwater concrete base which

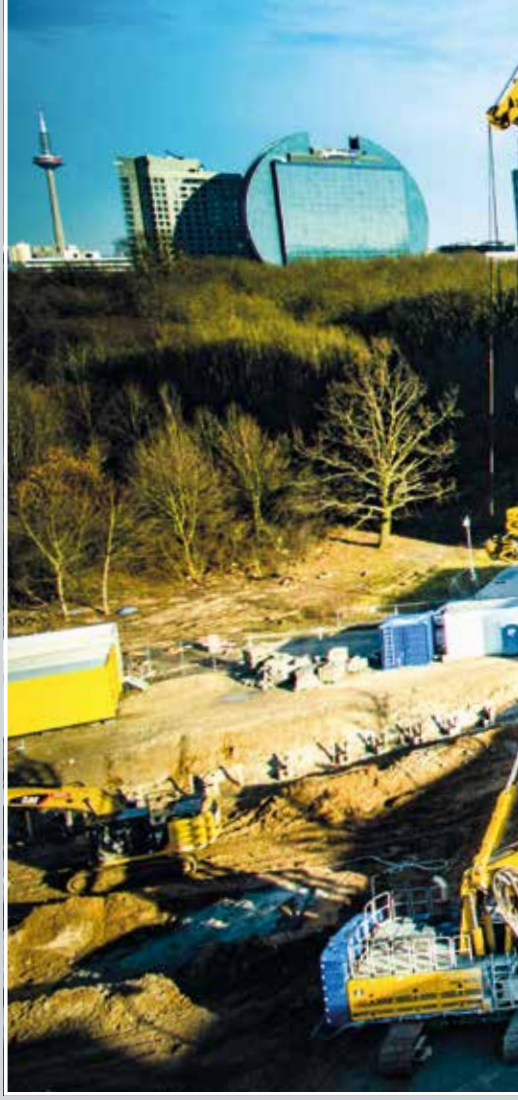
The sheet piles of the cut-off wall for the new Wusterwitz lock were covered with a material called Pecafil.

was tied back with 983 uplift piles. The drilling work for the injection-grouted piles, which extend up to 21 meters below excavation level, was carried out from the pontoon. The top area of the excavation pit was braced with 35 reinforced concrete struts measuring 1.5 meters tall and one meter wide.

The project for the new Zerben lock also included the complete expansion of the lower and upper harbor basin, including the berths and the two weirs, in addition to the lock basin. A total of 19,000 square meters of sheet piles with planks up to 17 meters deep were added to the embankment and the temporary weir pits. To anchor the embankment sheet piles, a total of 497 injection-grouted piles up to 20 meters long were constructed using a Klemm KR 806 double-headed drilling rig.

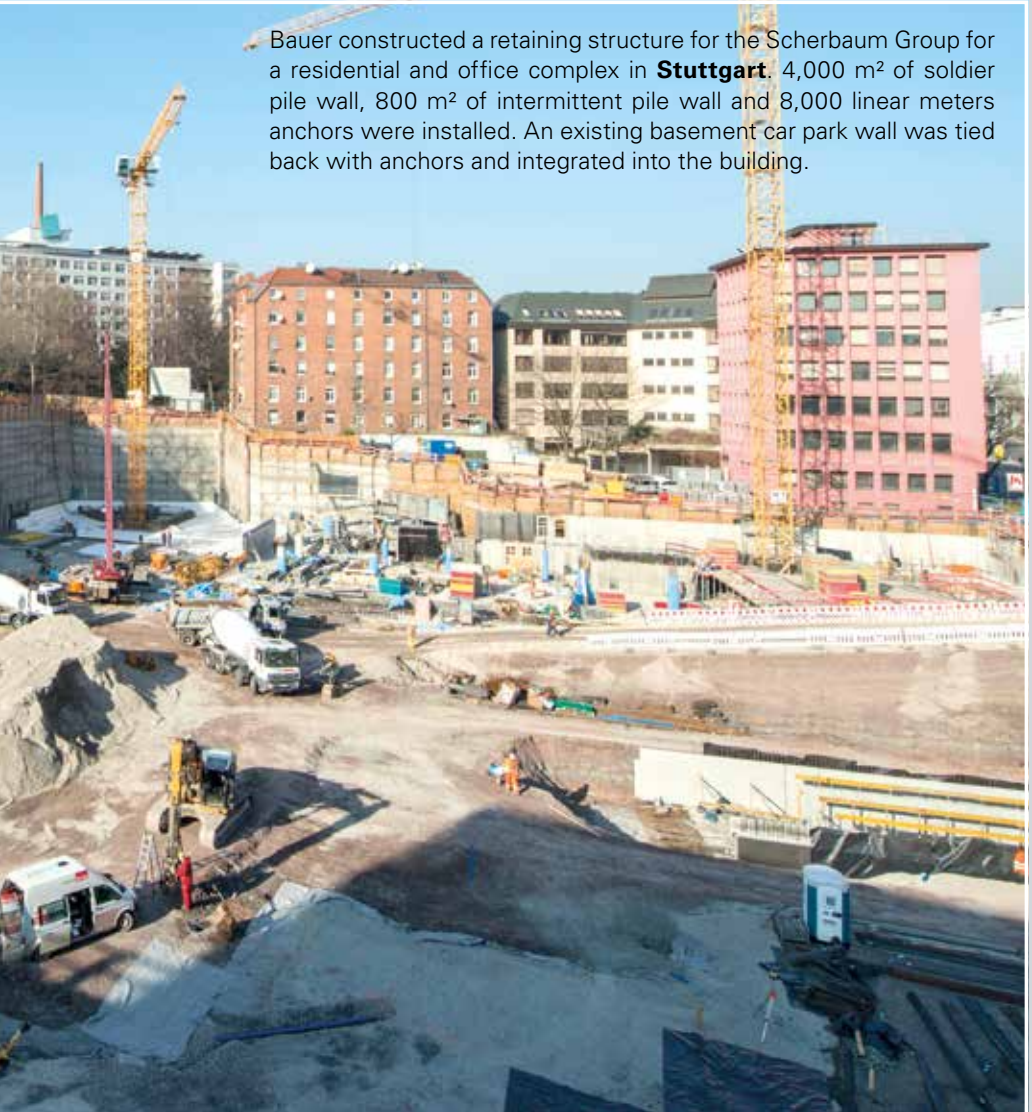
The origins of the extensive waterway network go back many years. Plans for the Mittelland Canal were made as early as the mid-19th century, and the origins of the Elbe-Havel Canal go back as far as the 18th century. With the opening of the Zerben lock, the waterway network in northern Germany is ready for the future. Together with other canals, the Mittelland Canal and the Elbe-Havel Canal connect the major Rhine, Elbe and Oder rivers. The canals have created a continuous waterway from west to east, from Belgium, the Netherlands and France to Poland and the Czech Republic.

Specialist foundation engineering all over Germany



With space extremely restricted by neighboring buildings, a BG 20 H was used to install 64 CFA piles with a diameter of 750 mm up to 15 m deep in the ground for a new office building in **Weilimdorf**. **Above**

From November 2017 to March 2018, Bauer constructed around 7,200 m² of MIP wall with a record depth of up to 23.8 m for a hotel and residential construction project in the Rebstock district of **Frankfurt** am Main. The project also included 1,300 meters of anchors meters, 20,000 m³ of excavation as well as groundwater control.



Bauer constructed a retaining structure for the Scherbaum Group for a residential and office complex in **Stuttgart**. 4,000 m² of soldier pile wall, 800 m² of intermittent pile wall and 8,000 linear meters anchors were installed. An existing basement car park wall was tied back with anchors and integrated into the building.

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