BAUER SPEZIALTIEFBAU
BAUER Spezialtiefbau GmbH is part of the BAUER Group, operating internationally in the Construction, Equipment and Resources segments, offering all standard foundation engineering methods. As an innovation driver, the parent company has been dominating the specialist foundation engineering sector for over 50 years.
The BAUER Group

The BAUER Group is a leading provider of services, equipment and products dealing with ground and groundwater. With over 110 subsidiaries, Bauer operates a worldwide network on all continents. The operations of the Group are divided into three future-oriented segments with a high potential for synergy: Construction, Equipment and Resources. The Construction segment offers new and innovative specialist foundation engineering services alongside the established ones, and carries out foundation and excavation work, cut-off walls and ground improvements worldwide. Bauer is a world market leader in the Equipment segment and provides a full range of equipment for specialist foundation engineering as well as for the exploration, mining and extraction of natural resources. In the Resources segment, Bauer focuses on highly innovative products and services in the areas of water, environment and natural resources. BAUER Aktiengesellschaft is the holding company of the Group and is listed on the Frankfurt Stock Exchange. BAUER AG provides central management and service functions for its affiliated companies. Among other activities, it provides personnel management, accounting, IT and facility management services.

Holding

The BAUER AG, founded in 1994, is a holding of the BAUER Group that operates as a service provider for (among others) personnel and accounting, IT, facility management, legal services and training. Bauer shares have been listed on the Stock Exchange since 2006.

TOTAL GROUP REVENUES

in EUR million (segments after deducting Other / Consolidation)

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Total 1,772
The parent company BAUER Spezialtiefbau GmbH is a globally active provider of specialist foundation engineering and specialist construction services. The focus lies on complex, international projects.

The BAUER Maschinen Group is world market leader in machines and equipment for specialist foundation engineering and develops new products for mining, deep drilling and offshore drilling. With a foreign sales portion of 80%, Bauer Maschinen has a multi-branding strategy.

The Resources segment focuses on products and services in the area of environmental technology, deep drilling, well construction and materials.
A Colorful History

**1790** Sebastian Bauer acquires a coppersmith’s shop in Schrobenhausen

**1870** Artesian well for the new Schrobenhausen railway station, start of drilling work

**1870** Artesian well for the new Schrobenhausen railway station, start of drilling work

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**1928** Dipl.-Ing. Karl Bauer builds the first central water supply for the city of Schrobenhausen

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**1948** Operations start at Wittelsbacher Strasse

**1956** Dr. Karlheinz Bauer becomes sole managing director, company specializes in specialist foundation engineering

**1958** Invention of the injection anchor on the construction site of the Bayerischer Rundfunk building in Munich

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**1971** Bauer anchors secure the tent roof on the newly built Olympia site in Munich engineering

**1975** First contracts in the Middle East (Libya, Saudi Arabia and the United Arab Emirates)

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**1976** First heavy-duty rotary drilling rig BG 7

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**1984** West works in Schrobenhausen commences operations, start of active equipment sales business

**1986** Prof. Thomas Bauer becomes sole managing director, internationalization of the BAUER Group

**1994** Foundation of BAUER Aktiengesellschaft as a holding company

**1994** Foundation of BAUER Aktiengesellschaft as a holding company
2002  Purchase of a large factory site in Aresing for equipment construction

2006  July 4: BAUER AG floated on stock exchange in Frankfurt

2007  Founding of BAUER Resources GmbH, entailing a restructuring of the three segments, Construction, Equipment and Resources

2008  Expansion of machinery manufacturing capacities in Aresing and Nordhausen as well as in Tianjin and Shanghai, China

2009  The BAUER Group completes the largest investment program in the company’s history: new administration building in Schrobenhausen, new Edelshausen plant; machinery manufacturing plant opened in Conroe, Texas, USA

2010  The 10,000 employees worldwide mark was passed for the first time

2011  Foundation works for the Lakhta Tower in St. Petersburg and the Jeddah Tower in Saudi Arabia - the future highest buildings in Europe and the world

2012  Start of large-bore drilling in the Kesslergrube landfill remediation project, the largest single project in the company’s history

2013  Foundation works for the Lakhta Tower in St. Petersburg and the Jeddah Tower in Saudi Arabia - the future highest buildings in Europe and the world

2014  Implementation of the largest special deep drilling contract in Germany – the „Schwarzkopftunnel bypass“ railway project

2015  Bauer celebrates 225th company anniversary

2016  Bauer reaches the 10,000 employees worldwide milestone for the first time
Bauer benefits greatly from synergies of the three business segments Construction, Equipment and Resources. Today, the Bauer name is associated with the most complex and largest foundation tasks in the world made with powerful, innovative and high-efficiency equipment. BAUER Group companies also successfully implement projects worldwide in environmental technology, or products and services to tap water and natural resources. Our capabilities and expertise form the basis for our success and the trust our customers show in us.

Buildings & infrastructure

From skyscrapers, industrial buildings, cultural institutions or bridges, many structures around the world stand on our foundations. BAUER Group companies also provide tailored and economical specialist foundation engineering solutions for subway and tunnel construction, from planning to implementation. Our range of services includes foundation piles, diaphragm walls, Mixed-in-Place solutions, cutter-soil mixing, anchors, ground improvement or injections. In addition, as a global market leader, the BAUER Maschinen Group offers a comprehensive range of specialist foundation engineering technology for implementing challenging projects.

Dams

Whether as water reservoirs, energy providers or for flood protection, dams perform many important functions. With over 60 years of experience in specialist foundation engineering, Bauer has already reinforced, renovated and sealed many dams around the world. One of our strengths is that as part of the BAUER Group, we not only have the specialists and expertise, we also have the machinery required to ready dams for the requirements of the future. Regional networks around the world help us to deploy equipment, teams and expertise rapidly and flexibly.

Environment

Environmental technology has been an important element in the BAUER Group’s range for more than a quarter of a century. The Environment division of BAUER Resources GmbH is among the leading contamination remediation, soil treatment and disposal companies in Germany and internationally. As an expert for removing environmental contamination, Bauer Umwelt offers a wide range of services, from operating dedicated soil remediation centers, to turnkey site recycling of contaminated land, to models for large-scale industrial customers.
Water

Water is the basis for all life, and therefore needs special protection, as less than one percent of the total water resources on earth is available to humans as fresh water. Whether exploring new water resources, building wells or treating process and industrial water and decontamination of wastewater, BAUER Resources Group is ideally positioned for all of these tasks, and offers its customers the complete range of services in the area of water and the environment.

Exploration & mining

Within the BAUER Group, a whole series of companies have specialized on products and services in the area of water, energy and natural resources. From the high north of Canada to the Australian Outback, our specialists and equipment explore deposits, tap open-cast and shaft mines, drill production wells for water, oil, gas and environment or develop special processes to exploit valuable raw materials.

Renewable energy

Harnessing renewable energy sources, like wind and hydroelectric power, biomass, solar and geothermal energy is an area people are already concerned with intensively now, not just in the future. Whether with complex foundations for tidal power stations, on-shore/off-shore wind turbines or harnessing geothermal energy; our products and experience in the areas of planning, drilling methods, expansion and connection technology make a key contribution to tapping renewable energy sources.

Oil & gas

Oil and gas are of paramount importance to the global economy as raw materials. Constantly rising demand make research and reliable exploitation of new sources essential – a challenge tackled daily by multiple companies and departments in the BAUER Group. Whether exploratory, appraisal or production wells, or development and construction of deep drilling rigs, we offer our customers expert and individual all-round solutions both as service providers and as mechanical engineers. In addition to this, the BAUER Group is also involved in several innovative research projects to explore and tap new raw material sources.
The World is our Market

EUR 1.8 BILLION TOTAL GROUP REVENUES

OVER 110 GROUP COMPANIES

IN 70 COUNTRIES

AROUND 11,000 EMPLOYEES FROM 82 NATIONS

Diavik Diamond Mine, Canada

Excavation pit Stuttgart, Germany

Cairo Metro, Egypt
OVER 40 SPECIALIST FOUNDATION ENGINEERING SUBSIDIARIES

Woodsmith Mine, UK

Dubai Creek Harbour, UAE

Jakarta Office Tower, Indonesia

- Construction
- Equipment sales business
- Resources
- Equipment production locations
Employees make the company what it is. Each individual contributes to the joint success of the BAUER Group with their work and dedication. It is thanks to our employees that we can now look back on 225 years of experience at Bauer. With their various ideologies and perspectives, experience and characteristics, they have a major influence on our corporate culture. The BAUER Group currently has a workforce of over 11,000 employees from 82 nations – people from a wide range of cultures who work for our Group around the world.

Our Values

**Personal responsibility**

Responsibility for everything we do or don’t do starts with the individual, and ends there too. Taking responsibility also means making decisions and being willing to accept the consequences. When in doubt, decisions can be discussed with managers.

**Safety and environment**

The safety and health of our employees is our priority. The standards and guidelines for HSE – Health, Safety and Environment – are core elements of our business activities and apply for the entire BAUER Group.

**Reliability**

We keep our promises. Our cooperation with business partners and colleagues is fair and trusting.

**Correct conduct**

We are open and respectful in our dealings with one another. We adhere to the laws, regulations, directives and Bauer’s internal rules and obligations.
Working for Bauer

Any company that wants to inspire customers all over the world needs employees who are satisfied and committed. The objective of our human resources activities is to create a supportive and encouraging environment for our employees’ work. We focus particularly on an environment in which all employees have the same opportunities to contribute their own ideas and perspectives to our company.

Onboarding

We ensure a rapid and uncomplicated start. Our onboarding program gives new employees an overview of the most important structures in our company and introduces them to their new working environment in a very short time. In the first weeks and months, new employees have their own personal mentor to support and advise them in all matters.

Personnel development

Our goal is for employees to quickly take on responsible tasks. The flat hierarchies in our company make it easier for you to get started. Job rotation has proven itself for many employees. Our BeMobil exchange program gives staff an opportunity to get to know one of our global branches and gain international experience. Variety at Bauer creates long-term career and development opportunities.

Diversity

Equal opportunities are a matter of course for us. We are convinced that it takes people with different ideas, strengths, interests and cultural backgrounds to be successful. In both recruitment and staff development, we place great emphasis on personality and skills-based assessment.

Training and development

Without training and development there can be no progress. Our employees’ qualification and motivation plays an important part in our company’s success. With our in-house BAUER Training Center GmbH, we promote this with a broad program of seminars which is always practically focused and tailored to individual requirements.

Health in the work place

Our work places – whether construction sites, assembly stations or offices – are equipped to the latest standards. We offer targeted wellness and preventative health programs in order to prevent risks in the work place that can lead to chronic illnesses.

Bauer is counting on you!

The BAUER Group has been driven by its passion for progress for over 225 years. Our employees’ qualification, dedication and motivation determine our success. That is why we are constantly seeking further dynamic team players for commercial, industrial and technical roles as part of our HR work. Discover the world of Bauer and take new paths with us!

Find out more at career.bauer.de
Unique Construction Projects

BAUER Spezialtiefbau GmbH, the parent company of the BAUER Group, has been a major driving force in the development of specialist foundation engineering, and carries out projects all over the world. BAUER Spezialtiefbau is organized on a regional basis in Germany, and operates on all the world’s continents with over forty subsidiaries and branch offices. Networks all around the world make it possible to utilize machinery and know-how quickly and flexibly, thus always providing an ideal technical and economic solution. In addition to the established ones, specialist foundation engineering processes developed by the company are also used.

The primary services include all types of bored piles, anchors, diaphragm and cut-off walls, injections, and vibration methods. The recognized quality of these services comes from many years’ experience, qualified employees and ongoing development activities. The main areas of application include creating complex excavation pits, foundations for large infrastructure projects and buildings, cut-off walls and ground improvements. In addition to the key specialist foundation engineering business, the company also carries out general construction work such as civil engineering, environmental projects, and project development.

< Ismailia Tunnel, Egypt
Creation of 120,000 m² of diaphragm walls to a depth of 50 m as start and target shafts for tunnel drilling under the Suez Canal

▲ Schwarzkopf Tunnel Bypass, Germany
Securing the construction pit with anchored pile walls and retaining walls, implementation of a total of 50,000 m of pile foundations using the CFA method as well as soil nailing, strutting and anchoring

< Woodsmith Mine, Whitby, UK
Construction of circular diaphragm wall shafts between 60 and 120 m deep for one of the deepest mines in Great Britain
Lakhta Center, St. Petersburg, Russia
Foundation works for the office complex in the Lakhta Center

Diavik diamond mine, Yellowknife, Canada
Creation of a 26 m deep cut-off wall for a 2.2 km long dam

Palm Jumeirah, Dubai, UAE
Ground improvement for the Palm Jumeirah artificial island in Dubai

Kirkenes, Norway
Transport of a bridge constructed by Schachtbau Nordhausen with an ocean pontoon, from Wilhelmshaven to Nordkap on the border between Norway and Russia

Thomas-Wimmer-Ring, Munich, Germany
Installation of bored pile walls to a depth of 16 m for the construction of an inner-city underground garage in Munich
Inner-city land is scarce and expensive. Clients face the major challenge of digging underground to maximize the use of space for technology and parking, utilizing the full extent of the site. Compact excavation supports make it possible to make best use of the space available. Bauer Spezialtiefbau offers individually tailored and optimized solutions for every project. We plan and implement turnkey excavation pits in accordance with the geological, local and planning conditions. Depending on the requirements, soldier piles, Mixed-in-Place, sheet pile walls, bored pile walls, diaphragm walls or cut-off walls are used. We add required support systems in the form of tie-back anchors or bracing, as well as seal system like soft gel bases/underwater concrete bases using jet stream or injection methods – with or without buoyancy safeguards – as necessary. Our range of services also includes water retention measures and earthworks. Accordingly, Bauer Spezialtiefbau offers the ideal method and the best solution for every problem and requirement in the excavation pit application.
Structural engineering for implementation and production of a complex excavation pit for the Laguna Residential Tower with up to three underground floors. Production of a secant bored pile wall as a free cantilevered temporary wall and a cut-off wall using the injection method at the intersection of two subway tunnels.

Complete planning and implementation of a turnkey excavation pit with a gravity wall tied back with anchors combined with a horizontal base seal. Production of a contiguous pile wall secured with 390 temporary anchors.

Production of a secant and double-layer piled wall tied back with anchors for an excavation pit, to a depth of 20 m in places.
The raw power of water and its ability to sicken through the most slender of fissures are well known, and again and again lead to risks for structures beside stationary or flowing waters or ground water. Cut-off walls of various types are used to seal reservoirs and dikes, or encapsulating landfill sites, tank storage or other industrial facilities. Depending on requirements, they protect the structure, entire areas or the environment on a regional basis as vertical seals. Construction in groundwater is made possible with excavation pit encapsulation using diaphragm walls, bored piles and sheet piles. Any horizontal seals required are implemented if necessary via injection or underwater concrete bases or combined solutions. For dam or dike seals, durable, proven economical system solutions are available with bored, excavated cut-off walls or cut-off walls made by cutters, also in combination with injections. Contact areas for water-based structures are also reinforced with ground improvement measures.
Diavik Diamond Mine, Yellowknife, Canada
Stabilization of the dam core area by vibro compaction and execution of a cut-off wall using CSM, high pressure and low pressure injections

Landfill seal, Bad Dürkheim, Germany
Implementation of a 35 m deep landfill seal for BASF. Production of 18,000 m² single-phase diaphragm wall in partially highly-contaminated soil

Punatsangcchu I, Bhutan
Sealing of a coffer dam by implementing a cutter excavated diaphragm wall with a depth of up to 90 m for the 70 m deep excavation pit of the main dam

Bagatelle Dam, Mauritius
Construction of a 2.4 km long cutter excavated diaphragm wall, predominantly in very hard rock
The loads of modern constructions are becoming greater and greater, and these structures are increasingly being built on foundation soil with a low weight-bearing capacity. Pile foundations down to great depths allow even high loads to be reliably absorbed by the subsoil. Bauer Spezialtiefbau constructs bored piles down to depths well over 100 m and with diameters greater than 2 m – including base and skin grouting or bell-outs if necessary. Diaphragm wall panels, Mixed-in-

Place elements or grouting underground cavities and weathering zones by injections and fillings offer further effective and economical options for dissipating structural loads. Bauer Spezialtiefbau has the ideal foundation option with grouting, foundation piles or diaphragm wall panels made of structural concrete, plastic concrete or steel in dimensions tailored for the requirements for structures of all kinds in building construction, bridge building or road construction.
Company site, Lichtenfels, Germany
Construction of 7,000 lin.m foundation piles deploying two BG 29, executed using the CFA and Kelly method incl. bell-out

One Bangkok, Thailand
Production of over 700 bored piles as foundations for a building complex and implementation of a diaphragm wall with a total length of 466 m and a depth of 35 m

Corniche Towers, Abu Dhabi, UAE
Implementation of a total of 406 bored piles with diameters of 1,000 mm, 1,200 mm and 1,500 mm as foundations for a building complex
Intensive and extensive development in conurbations of most industrial nations is causing property prices to rise continuously. This causes areas with difficult subsoil or soil conditions and low load-bearing capacities are also becoming increasingly interesting for construction use. Bauer Spezialtiefbau offers ground improvement services to develop these sites. They are implemented using vibro compaction, vibro replacement, vibro concrete columns or dry vibro concrete columns and are efficient and economical solutions, when structural loads must be dissipated over surfaces or embankments must be stabilized and secured. In addition, the load-bearing capacity of the soil can also be increased significantly the Mixed-in-Place method, injections, compacting or compaction grouting.
The Island, Dubai, UAE
Compaction of 500,000 m³ sand for an artificially raised island to a depth of 23 m via deep vibrators.

Moin Container Terminal, Puerto Limon, Costa Rica
Installation of approx. 180,000 m gravel columns using the vibro replacement method to a maximum depth of 24 m, surface compaction of approx 380,000 m² as well as ground improvement of 330,000 m³ using the Mixed-in-Place method.

Canal structure, Germany
Production of a total of approx. 300,000 m of vibro replacement columns with depths of up to 26 m for a canal structure.
Advancing urbanization, especially in the conurbations, means that more and more structures – including industry and infrastructure – must be built in areas with difficult subsoil having low load-bearing capacities. The ground improvement methods used by Bauer Spezialtiefbau are efficient and economical methods to minimize settlement and increase the load-bearing capacity of the subsoil and enhance embankment stability. By using the most appropriate method, Bauer Spezialtiefbau allows clients to realize their construction project.

**Ground Improvement**

**Methods**

**Vibro Compaction (VC)**

Non-cohesive or low-cohesion sediments – e.g. sand or gravel – often have insufficient bulk density in their natural state. The aim of VC is to increase the density of the existing soil to limit the expected subsidence. The soil is initially floated as a suspension by flushing with water or air, to facilitate penetration of the silo vibrator. The targeted compaction involves a volume reduction, which leads to forming a subsidence sinkhole. Gradually removing the silo vibrator creates a densified zone of roughly 2 to 4 m in diameter.

**Vibro Replacement (VR) / Dry Vibro Concrete Columns (DVCC)**

In cohesive soils, a sufficient re-packing of the grains cannot be implemented via VC. In VR, non-cohesive material is guided directly to the vibrator tip, where it is pressed and compacted into the soil. This creates columns of ballast, gravel or sand, which increase the load-bearing capacity of the surrounding soil due to the higher strength. DVCC columns are also produced using this method. However instead of ballast, gravel or sand, moist concrete is used, which increases strength irrespective of the surrounding soil.

**Dynamic Compaction**

Dynamic soil compaction is a method for improving the packing density of non-cohesive soils. A heavy falling weight is dropped repeatedly from a great height on the compactable soil. The kinetic energy emitted on impact compacts the soil via forced re-packing of the grains. The compression ratio depends on the soil properties, the size of the falling weight, the drop height, and the spacing between the compaction points.

**Vibro Concrete Columns (DCC)**

DCC is an efficient and economical method for largely cohesive organic soils with particularly low load-bearing capacities. Use of high-grade concrete gives the DCC column a high internal strength. DCC columns are counted as unreinforced piles for transferring structural loads into deeper subsoil and can either be produced using deep vibrators (bottom left) or with piling vibrators (bottom right).
**Construction Methods**

*Dubai Creek Harbour, Dubai, UAE*
Improvement of the subsoil on approx. 500,000 m² via vibro compaction densification and dynamic compaction

*Container Terminal, Freetown, Sierra Leone*
Compaction of a total of 543,000 m³ hydraulically deposited sand via vibro compaction to a depth of 24 m via deep vibrators to expand the Container Terminal in Sierra Leone

*Highway A 72, Leipzig, Germany*
Production of roughly 226,000 m vibro replacement columns with lengths of up to 15 m and 28,000 m replacement bores for recompaction using vibro techniques to depths of up to 26 m
Bored Piles

Bored piles are cylindrical concrete structures (with or without reinforcement) that are inserted into the ground using various methods. They transfer high structural loads into deeper load-bearing soil strata, form a supporting wall for an excavation pit or topographical change or seal off groundwater when tangential or intersected. The length, diameter, material, configuration and arrangement of the bearing piles can be modified according to the intended use.

Methods

**Kelly Pile**

The Kelly method is used to produce uncased, partially cased, fully cased or slurry-supported bored piles. The drilling tool is attached to a telescopic Kelly bar and the soil is gradually removed from the casing. The drill casing is continuously bored into the soil which is extracted until the final depth is reached.

**Continuous Flight Auger Pile (CFA Pile)**

The CFA method is a high-performance rotary drilling technique (CFA 630, 750, 880 mm). In this process, a continuous flight auger is implemented as drilling tool. Upon reaching the final depth, concrete is fed in from the bottom to the top through the core barrel of the hollow stem auger. The retaining structure is installed retrospectively, with vibration assistance if necessary.

**Twin Rotary System**

Twin rotary system is a combination of the CFA method using a continuous flight auger with the Kelly method with drill casing, resulting in a cased bore hole, produced by using a continuous flight auger (TRS 620, 880 mm). This method is particularly advantageous in the case of high groundwater and uplift-prone soil layers, which would call for drilling under water load with the Kelly method.

**Full Displacement Pile (FDP)**

Compared to the CFA method, the FDP system has the distinct advantage that hardly any cuttings are brought to the surface. This method is employed in displaceable soils. The drill string comprises an auger starter, the displacement body and an extension pipe. When drilling out and extracting, the existing soil is displaced. The concreting and reinforcing steps are performed in the same way as the CFA pile.
Production of a secant bored pile wall with a drilling depth of up to 27 m using a Cased Continuous Flight Auger CCFA system

Construction of an up to 23 m deep pile wall with the CFA method as well as fully cased foundation piles reaching up to 50 m deep using the Kelly technique

Drainage bores with drilling depths of up to 22 m
Diaphragm Walls

Diaphragm walls serve a structural and/or sealing function and can be used both as a cut-off wall for a dam or excavation pit or as foundation for or to encapsulate a building. They are constructed as concrete or reinforced concrete walls from the ground surface, are considered highly resistant to deformation and virtually impermeable to water. It is excavated in sections with duty-cycle cranes with appropriate diaphragm wall grabs or cutters using a supporting fluid between prefabricated guide walls, which serve in particular as a guide for the extraction tool, facilitate support liquid level fluctuations and absorb loads from reinforcements or joint elements. After the final depth is reached, the support liquid is recycled.

In addition, temporary or permanent joint systems can be inserted into the trench, and reinforcement cages can be installed. It is then concreted. As part of the excavation of the adjacent segment, the temporary joint systems are removed for further use. Alternatively, diaphragm walls can also be implemented using the single-phase method. In this case, a binding agent suspension that hardens over time is used as a support liquid. When this method is used, additional sheet piles, supports or prefabricated concrete components can be inserted into the fresh suspension as structural elements, so that the resulting cut-off walls can also perform structural functions.

Methods

Diaphragm Wall, grab excavated

To excavate the diaphragm, two different grab systems are available, which are suitable for regular wall thicknesses of 600 mm to 1,500 mm. The grab is lowered into the diaphragm and the soil is removed intermittently. Larger blocks or formations of rocks are broken, removed or displaced using modified grabs or heavy-duty chisels. Measuring systems can be installed to prove the verticality. With mechanical grabs a roller system drives the shovels. In order to increase the closing force, the closing cable is reeved 5 to 8 times. Hydraulic grabs work with a hydraulic cylinder. They have a very high closing force and work with less noise and vibrations than mechanical grabs.

Diaphragm Wall, cutter excavated

Cutters are used to produce diaphragm walls with thicknesses of 640 mm to 2,300 mm. As they deliver excavation continuously, they are particularly suitable for depths over 40 m. Trench cutters work with two opposing rotating cutter wheels, which, depending on the design, are suitable for a wide range of soil strata, even including the hardest of rocks. The soil material is cut, crushed, mixed with suspension by the wheel rotation, and delivered to the surface via a suction pump. Hydraulic flaps control the cutters in the x and y direction, the penetration depth and speed are regulated via the load from the cutting frame.
Woodsmith Mine, Whitby, UK
Production of circular 60 to 120 m deep diaphragm wall shafts for one of Great Britain’s deepest mines

Eidgenössische Technische Hochschule, Zurich, Switzerland
Production of an innovative embankment stabilization with 3,500 m² prestressed reinforced concrete diaphragm wall elements

Hybrid skyscraper, Frankfurt am Main, Germany
Production of 9,500 m² permanent reinforced concrete diaphragm wall for a complex excavation pit using a top-down construction method, and foundations for a skyscraper with an underground car park

CONSTRUCTION METHODS
Ground Anchors and Micropiles

Retaining systems without tie-back anchoring – almost inconceivable today. Bauer revolutionized specialist foundation engineering by inventing ground anchors in 1958. Excavation pits without cumbersome stiffeners have been taken for granted since then. Piled walls, sheet piles, Mixed-in-Place walls or diaphragm walls, or even steep embankments, support and quay walls are now secured with anchors. Installation of permanent ground anchors is a technically elegant, as well as economical solution for numerous construction measures, which is interesting from a site construction sequence. Whether temporary or permanent, single bar anchor or strand bundles, in dry soil or against pressing groundwater, the Bauer anchor can be used in all soil types and rock. Experienced drilling squads, who receive ongoing training, powerful special equipment and complete quality control guarantee rapid and technically perfect production of a Bauer anchor.

Methods

Temporary Anchors

Temporary anchors, as mini pile or strand anchors, completely or partially recyclable, serve to secure retaining walls for up to two years. They are quick to install and particularly economical. The bearing behavior of every anchor is assessed and logged as part of the acceptance process. Strand anchors are delivered to the construction site on rolls, and can therefore be used in tight conditions.

Permanent Anchors

Permanent anchors are ground anchors which can be used for over two years and therefore part of a permanent structure. Permanent anchors are available as permanent strand anchors or single rod corrugated pipe anchors. The steel tendon and anchor head are protected against corrosion with special measures. Every cavity of the anchor head is filled with permanently elastic corrosion protection compound.

Micropiles

Depending on the requirements, micro piles can be used as single piles, pile groups or walls of new buildings, remediations or modifications of structures. Bauer produces micro piles from 114 mm to 300 mm using cased or uncased drilling methods. The pile shaft consists of a cement slurry, mortar or concrete. The external load-bearing capacity can be increased via single or multiple post grouting. The internal load-bearing capacity is ensured via supporting elements made of threaded steel or reinforcement cages.
Ground Anchors and Micropiles

Excavation pit, Stuttgart, Germany
Anchoring of a secant bored pile wall using the twin rotary system. Production of over 900 anchors with a total length of 20,000 m

Leeuwarden, Netherlands
Construction of 470 GEWI bored piles with a length of 28 m from a pontoon and subsequent pile test

Zerben watergate, Elbe-Havel Canal, Germany
Production of a total of 10,500 m² diaphragm wall as a retaining wall for the excavation pit and stabilization of the horizontal underwater concrete base using over 980 uplift piles
Sheet Piles

For over 100 years, steel sheet piles have been used to stabilize topographical steps and are therefore one of the oldest specialist foundation engineering methods. While the actual sheet pile, consisting of a U- or Z-shaped rolled profile with a lock, has remained largely unchanged for many decades, the installation techniques have advanced significantly. Where sheet pile elements were previously driven or rammed into the ground, there are now far gentler methods, allowing sheet pile walls to be used without problems, even in inner-city areas.

Methods

High-frequency Vibration

Bauer develops and manufactures the equipment commonly used to adjust them for today’s installation methods (vibrators, compactors, rams). Hydraulic or diesel rams are largely used in heavy soils and ideally at great distances from sensitive developments and neighbors due to the high noise levels and potential vibrations. If particularly gentle insertion of the sheet piles is required, they can be compacted hydraulically. However, this assumes that the existing soil is not too densely packed. Bauer Spezialtiefbau is extremely rarely required to perform ramming or compacting of sheet piles. The vast majority of the sheet piles is fitted in the soil via modern high frequency vibrators. Tailored for the pile lengths and the different soils, various base carriers and vibrator types are available. Sheet piles can also be fitted at or even in bodies of water from pontoons without problems.
Regional train connection, Frankfurt am Main, Germany
Production of a sheet pile with pile lengths of up to 12 m, of which 4 m is underground and 8 m is protruding. Use of coated special piles with base grouting.

New watergate construction, Trier, Germany
Implementation of a total of 4,000 m² sheet pile walls with pile lengths of up to 16.5 m to build a new lock on the River Mosel in Trier.

Institute of Microbiology LMU, Oberschleißheim, Germany
Installation of roughly 4,500 m² sheet piles with pile lengths of up to 20.5 m via high-frequency vibration.
Soil Mixing Methods

Why excavating and disposing off soil away and bring in concrete, if the existing soil can be used? The Mixed-in-Place (MIP) and Cutter-Soil-Mixing (CSM) methods developed by Bauer avoid complex transport coordination, reduce costs, reduce emissions and relieve the stress on the area around the construction site. Both methods are efficient, economical and environmentally friendly alternatives for efficient soils. As they are developed in-house, both the base carriers and the tools and equipment can be adapted highly flexibly to the requirements of the respective construction challenge, in particular to the underground conditions. Both soil mixing methods have comprehensive patent protection.

Methods

Mixed-in-Place

The Mixed-in-Place method is particularly ideal in non-cohesive soils for producing cut-off walls as a groundwater barrier or to encapsulate inherited pollution, for repairs to dikes and dams or as structurally effective retaining walls for topographical changes and excavation pits. In the Mixed-in-Place method, the existing soil is broken with a single or triple auger, transferred and the pore spaces are filled with a binding agent slurry. The individual insertions are combined to walls using the pilgering process. The auger dimensions ultimately determine the insertion size. Reinforcements can be inserted into the fresh Mixed-in-Place mix for structural strengthening.

Cutter-Soil-Mixing

The CSM method combines properties of the diaphragm wall techniques and the Mixed-in-Place method, and also offers additional advantages: soil can also be mixed at great depths and in densely packed soils by using modified, powerful cutters. Even thicker walls and higher reinforcement levels can also be achieved. As a result, the CSM method is used in particular to stabilize particularly deep excavation pits or to reinforce high dams and dikes, in addition to the applications described for the Mixed-in-Place methods.
**Construction Methods**

**Hotel Alexanderplatz, Berlin, Germany**
Construction of 3,000 m² of Mixed-in-Place wall to a depth of 17 m

**Dam refurbishment, Ellgau, Germany**
Maintenance of dams for the Ellgau barrage at the river Lech constructing a total of 25,000 m² MIP wall to a depth of 9 m

**Agnes-Pockels Arch, Munich, Germany**
Construction of an excavation pit for a new office complex. Application of the Mixed-in-Place method to implement a total of 8,000 m² structural MIP wall with depths of up to 20 m

**Porto Novi Resort Village, Montenegro**
Execution of 200,000 m² MIP elements deploying one RG 25 and one BG 40 as soil improvement and marina stabilization
In specialist foundation engineering, grouting is used to add hardening, suspensions and solutions into cracks, cavities and gaps in the soil and rock. The selection of injection material often depends on the purpose of the measure, the geological properties of the soil and the selected injection method. The soil injections are fundamentally broken down into injections with soil displacement and injections without soil displacement.

**Methods**

**Compensation Grouting**

For compensation grouting, split bores are produced from shafts under buildings. The shafts are filled with a stabilizing mix and sleeve pipes are fitted. Targeted grouting of binding agent suspensions breaks up and braces the soil. Controlled multiple grouting compensates settlements.

**Permeation Grouting**

Permeation grouting can be used to produce deep, sealing bases in sand and gravel. In a grid, valve pipes are vibrated into the ground or fitted into bores. These valve pipes are used to grout the injected material. Grout bodies are created in the valve area, forming a gapless base.

**Compaction Grouting**

For compaction grouting, a special mortar is gradually grouted from bottom to top (upstage sequence) in generally loose subsoil, to compact it without breaking it up. This method can also be implemented using a sleeve pipe system (soil fracturing).

**Rock Grouting**

Rock grouting is used to fill gaps, cracks and cavities in the rock. In stable rock, the material is injected into the rock via an upstage sequence (from bottom to top); in unstable rock, the downstage sequence (from top to bottom) or the MPSP system is used.

**High Pressure Injection**

High pressure injection is used for reinforcing or deepening building foundations, sealing or stiffening blankets and dam sealing. After a target depth is reached, part of soil is flushed out with liquid. The binding agent suspension added at the same time strengthens the remaining soil.
**Underpass, Doha, Qatar**
Sealing- and stabilisation injection by a cement slurry and gel solutions to build an pedestrian underpass in Doha with minimal covering.

**Designer outlet, Wolfsburg, Germany**
Implementation of 7,500 m² LWS soft gel base plug by via permeation grouting and 1,000 m² Mixed-in-Place wall within existing buildings.

**Punatsangcchu II, Bhutan**
Permeability soil- and rock grouting with Tube-à-Manchette pipes in 1,126 bore holes to produce curtain sealing for a dam.

**Diavik Diamond Mine, Yellowknife, Canada**
Interconnection of a CSM cut-off wall to bedrock around a diamond mine using HPI columns.
Soil freezing is a technique for temporary ground stabilization by creating an ice-earth structure. For this purpose, pore water in the soil is frozen by circulating liquid nitrogen or a brine solution in a closed circuit to form ice. Soil freezing can also be implemented by combining the two methods.

Soil Freezing

Bauer Spezialtiefbau has global experience in the various ground freezing methods. The frozen subsoil serves as a basis for producing stable, load-bearing and waterproof structures for tunnel building, cross passages between tunnels, pit and shaft excavations, TBM and other rescue applications.

Methods

Brine Freezing

The brine used for ground freezing is an almost 30 % solution of calcium chloride in water. The cold brine circulates in low-carbon steel casings, which were previously introduced into the soil, and form a closed circuit with the freezing system. The brine circulates at a temperature of approx. -35 °C to -38 °C. Under normal conditions, it takes roughly 20 to 30 days to freeze a soil segment. A system of thermometer measuring chains ensures permanent control of the freezing process.

Nitrogen Freezing

The liquid nitrogen is stored in an insulated container. The pressure in the container is slightly higher than normal atmospheric pressure, keeping the nitrogen liquid at a temperature of -196 °C. The liquid nitrogen circulates through copper pipes, which were previously inserted into the soil, and is converted to gas. The gas consumed is discharged into the atmosphere. Under normal conditions, it takes roughly 5 to 8 days to freeze a soil segment. A nitrogen metering and thermometer measuring chain monitoring system ensures control of nitrogen consumption and the freezing process.
CONSTRUCTION METHODS

-State Opera, Berlin, Germany
Connection a bored pile wall under an existing building via brine freezing using 17 vertical freezing pipes

-Üsküdar Metro Station, Istanbul, Turkey
Construction of 33 horizontal freezing and twelve thermometer pipes via nitrogen freezing to rescue a Tunnel Boring Machine (TBM) which got stuck during the construction of a subway station in Istanbul

-Ismailia Tunnel, Egypt
Soil freezing using the brine method for the construction of four cross passages to connect two road tunnels under the Suez Canal

-State Opera, Berlin, Germany
Connection a bored pile wall under an existing building via brine freezing using 17 vertical freezing pipes
The wind, waves and tidal flows of the world’s oceans are generating enormous potential for renewable energies. Secure transfer of the loads created by rotors or turbines into the sea bed is essential. Bauer Spezialtiefbau has developed a wide range of new equipment and innovative methods that allow safe and economical foundations even for hard, rocky soils and difficult boundary conditions. They revolve in particular around drilling technologies – the BAUER Group’s core expertise.

Offshore Foundations

Methods

**BSD 3000 Underwater Drilling Unit**

In particular for rocky subsoils and high flow rates, Bauer has developed a new underwater drilling method and used this new technique successfully for the first time for foundations for a tidal turbine in the waters off Orkney, at the northern tip of Scotland. A BSD 3000 underwater drilling rig is lowered to the seabed from a working ship and operated by remote control. A rotary drilling method is used with a full-surface roller bit, heavy-duty rods and air flushing.

**Dive Drill C40**

Foundations for offshore wind turbines are usually implemented as steel pipe rammed piles. However, in unfavorable ground conditions, individual local driven piles could not reach their planned final depth, or be rammed deeper. In cases like this, relief bores are used. For this process, driven piles are drilled and then rammed further to the final depth. In order to drill rapidly and efficiently, Bauer Spezialtiefbau developed the Dive Drill. The Dive Drill drills out the partially rammed pile casing by remote control, and can also remove large blocks in front of the pile casing. The maximum bore diameter is 3 m, and the maximum drilling depth is 120 m.

**Dive Drill C40 U**

Foundations for offshore wind turbines on rocky soil require a special process, as ram technology cannot be used in such cases. The Dive Drill C40 U is an upgraded version of the conventional Dive Drill. The “U” stands for “Underreamer”, as the drill head can cut out the area under the drill casing. The Dive Drill is lifted directly into the temporary drill casing from the ship crane, whereby the Dive Drill is always at the bottom end of the drill casing and clamps itself in place there. The result is a fully cased bore, protecting the pile pipe and pile mortar when they are fitted.
Beatrice Offshore Windfarm, Scotland, UK
Application of BAUER Dive Drill C40 for relief bores to reduce the friction whilst pile driving

Tidal power station, Orkney, Scotland, UK
Foundations for a tidal turbine by using a BSD 3000 underwater drilling rig. Grouting of the 23 m long mono pile in an 11 m deep rock socket with high-strength mortar
Innovations

Innovations are created by targeted cooperation of all stakeholders and by further development of old and new ideas. Bauer Spezialtiefbau relies on its employees’ innovative capacity, as they actively facilitate the company’s development. The in-house company suggestion system enables them to contribute innovative ideas and suggest improvements, making workflows more effective, advancing existing techniques or initiating new technologies. Even minor ideas contribute to success, guaranteeing that the company continues to develop in the long term.

PASSION for PROGRESS

Intellectual property rights

Intellectual property rights protect technical advances in various markets around the world. Bauer Spezialtiefbau’s portfolio of patents currently includes roughly 60 inventions for which a patent has been granted. In turn, this results in roughly 190 legally binding patents in over 30 countries around the world. BAUER Group terms or product names – e.g. “MIP” or “LWS” – are also protected as registered trademarks. That guarantees exclusive use in the specialist foundation engineering sector. Intellectual property rights in turn protect innovations and contribute to the company’s long-term success.

Geothermal energy

Bauer Spezialtiefbau constructs bored piles down to depths well over 100 m and with diameters greater than 2 m – including base and casing grouting or bell-outs if necessary. In addition, Bauer thermally activates the foundation piles as part of its service portfolio. As the geothermal energy lines are supported in a reinforcement cage, these energy piles represent a perfect, highly economical and efficient way of tapping the Earth’s heat. This way, available geothermal resources can be used to the fullest.

▲ Energy piles
For deep foundations and thermal activation

▲ Example of an in-situ simulation
Planned operation to VDI parameters
Research and development

Innovation is an important factor for Bauer Spezialtiefbau in order to set itself apart from the competition. For this reason, we are planning a dedicated process to generate innovations and describe the path from idea through to marketing. One of the suggestions for improvement is to kick off this process. Ideas from employees are either passed on by the company suggestion scheme to Research and Development or they emerge within the product groups when working on a construction project. A promising project is then adopted and supervised by one of the seven process-related working groups. However, an invention alone is not usually enough to gain a competitive edge in the construction industry. Intellectual property rights in the form of patents, for example, ensure that other companies cannot use this innovation for a certain period of time. Innovation is a product of cooperation and coordination. All research topics are pursued with the aim of achieving a high level of efficiency. This means that complex topics are broken down into sensible modules to manage the development optimally.

GPS positioning in specialist foundation engineering

Life without the Global Positioning System (GPS) is no longer conceivable in our modern world. The navigation system guides and accompanies you to wherever you want to go, and your cell phone automatically shows a weather report for your current location.

GPS has now also found its way into specialist foundation engineering and facilitates the accurate positioning of drilling rigs in the respective drilling points. B-APS, the Assistant Positioning System uses two GPS antennas to detect the current position of the drilling rig and the display then guides the operator to the planned drilling sites. The simple and fast process increases the device’s productivity and brings additional time and cost savings. A second function documents the bearing piles that have already been drilled to substantiate the exact location of the borehole.
Digitalization has long been a driving force of progress within BAUER Group. Essential information can be reliably retrieved or easily made available via the Internet and the portals of Bauer’s intranet from anywhere in the world. Bauer Spezialtiefbau also advances the topic of digitalization with a multitude of research and development projects. Here, the main focus lies on the development of a project management tool which manages all information and data pertaining to a project centrally and pools it on a digital platform. Digitalization presents plenty of new and interesting approaches and enables us to continue to carry out future projects worldwide efficiently and in to highest quality standards.

**Digital building**

The BIM (Building Information Modeling) concept is usually defined as the digital planning process in 3D or 4D. However, until now little attention has been paid to the digital logging of quality and process data and its visualization for those involved, which is indispensable for subsequent process monitoring. As the context of BIM is therefore slightly broader, all digital processes within Bauer Spezialtiefbau are grouped under the heading „digital building“.

**Use of 4D BIM planning information on the construction site**

Additional use of data from the planning stage for the downstream production process on the construction site plays a key role in digitalization. For this purpose, Bauer Spezialtiefbau uses the REVIT construction software and MS Project to create weekly stage plans for construction site management. These plans help understand the construction procedures better in terms of time and space. This visualization greatly simplifies communication between those involved in the construction project as well as the coordination of simultaneous processes.
Tracking of Process Data – B-Tronic Activity

B-Tronic Activity is a software program that records the activity of drilling rigs and combines it with equipment data already captured. By analyzing this data, construction site delays due to workflows, for example, can be identified more accurately and rectified in a better way. B-Tronic Activity means that the entire production process no longer has to be compiled using individually recorded work steps assembled from equipment data and manual logging – a time-consuming and complex task. Once the digital information for a sufficient number of projects has been entered in a central database, it can serve as a valuable basis for costing purposes or handling follow-up work.

b-project production data management software

An integrated data management system was developed to manage the production and quality data. The production data management software b-project is its main tool. In particular in works with a high percentage of individual elements, the structural elements embedded in the ground require an enormous workload of manual verification and documentation activities. The aim is to digitalize this process throughout and create a means of automatic recording and analyzing the data. Integrated data use seems the obvious choice on the basis of this structured data. Among other things, using this information for invoicing, managing supplemental requirements or for use when costing future projects offers great potential.

Visualization of product, measurement and process data

Web-based and mobile presentation of analyses and key performance indicators (KPI) forms another essential part of the integrated approach. This allows quick access to aggregated performance and quality data even outside the construction site office. What’s more, this standardized presentation of data makes it possible to quickly identify the current status of a project so that additional, more detailed analyses or process optimizations can be carried out. Visualization of measuring equipment monitoring and building progress monitoring at any location is another potential use. Last but not least, the central availability of documents and image material helps increase effectiveness.
Good planning is the prerequisite for economically efficient building. The Design Department of BAUER Spezialtiefbau GmbH takes care of all necessary steps from drafting to the structural design of highly complex geotechnical works and provides state-of-the-art design software and useful databases. Whether at the headquarters or planning offices of subsidiaries, Structural Engineering draws on its comprehensive expertise in specialist foundation engineering and long-standing experience to create designs for foundations and excavation pits in the form of feasibility studies, preliminary drafts, pre-calculations, alternatives or even end-to-end implementation planning.
Technical Services

Passion for progress – the Technical Services Department of BAUER Spezialtiefbau GmbH gets right to the heart of Bauer’s slogan. As an internal service provider, Technical Services supports the branches and subsidiaries in all geotechnical, measurement and construction material issues, particularly when innovative solutions are called for. Highly qualified technicians and engineers analyze construction materials and carry out quality and suitability tests and inspections on concretes, slurries and other materials. Various load tests such as piling stress tests and anchor tests are also a part of the department’s repertoire along with geotechnical and geodetic measurements under extreme conditions. Intensive research and development work together with renowned universities, institutes and engineering firms actively promotes the development of new methods and products or the optimization of existing ones.

▲ Verticality measurement of a diaphragm wall
Using the Cutter Inclination Systems (CIS)

▲ Piling stress test
Construction project in Rosenheim, Germany

▲ BAUER concrete filter press
In-situ use on the construction site
The specifications and technical data are provided as indicative information only, with any errors and misprints reserved.