

BAUER

Diaphragm and cut-off walls





BAUER MC 96

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Woodsmith Mine, North Yorkshire, UK
Diaphragm walls with a depth of up to 120 m were constructed for the access shafts of Woodsmith Mine.

Applications

Diaphragm and cut-off walls are specialist foundation engineering solutions for dams, deep excavations and retaining structures. They can serve as a permanent or temporary measure, as part of a building construction, or take on a sealing and/or load-bearing function.

Dike 1, Dead Sea, Jordan

To seal off earth basins for obtaining potash at the Dead Sea, a total of 112,000 m² of cut-off wall with installed sheet piles were constructed.

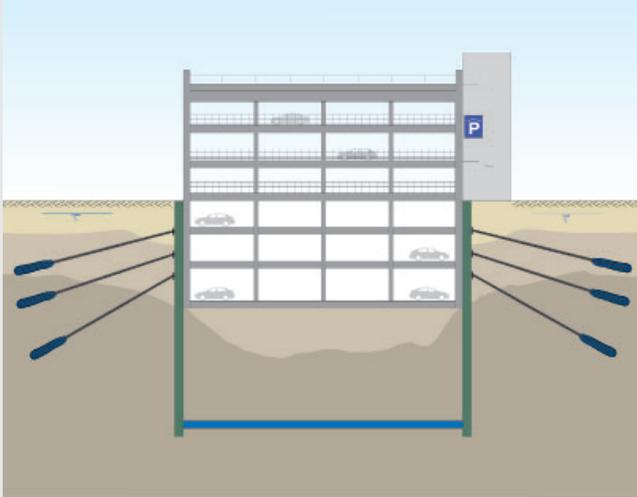




Diaphragm walls

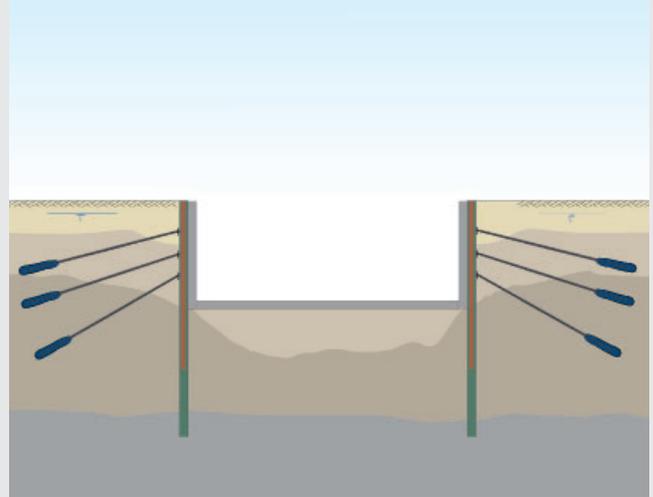
Retaining structure with horizontal seal

Excavation pits constructed in areas without impermeable ground layers often require artificial horizontal sealing blankets. For this purpose, vertical encapsulation can be combined with a high or low lying cut-off. The seal forms a full face connection with the diaphragm wall and reduces the ingress of water through the horizontal seal. After dewatering, the pit can be excavated in a dry state.



Retaining structure in impermeable ground

If a natural sealing horizon exists at a reachable depth, the enclosing diaphragm walls can be embedded in this impervious layer, thus preventing the ingress of water into the excavation pit.



Metro line 3, Cairo, Egypt

As part of the major infrastructure project for the construction of metro line 3 in Cairo, Bauer Egypt constructed circa 250,000 m² of diaphragm wall, with wall thicknesses from 800 mm to 1200 mm, for six underground stations. The excavation reached depths of up to 60 m.

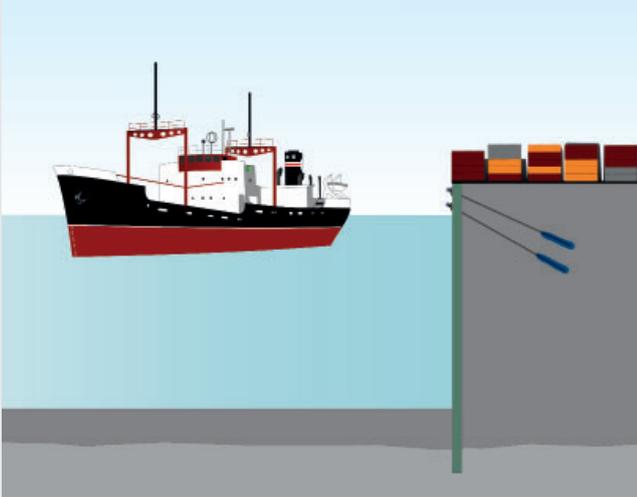


Kö-Bogen II shopping mall, Düsseldorf, Germany

For the construction of the inner city excavation pit in top down construction method, the enclosing diaphragm wall was embedded into the impermeable ground layer, to depths of up to 30 m. In addition, plunge columns were constructed as diaphragm wall barrettes with installed precast concrete units.

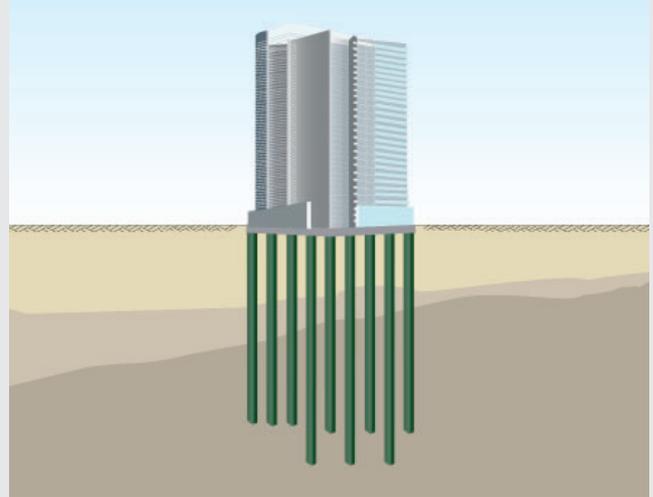
Lock construction

An expansion of the waterway infrastructure is urgently required to cater for the global rise in the exchange of goods. Diaphragm walls are an effective and economic retaining structure system, for both quay walls of jetties, as well as retaining structures for lock systems, and can also be anchored if required.



Foundations

The construction of demanding structures in unstable ground conditions require safe load transfer into deeper, more stable soil strata. Diaphragm wall barrettes provide a way of creating foundations in less stable ground. With foundation depths of over 200 m, barrettes can be created in various configuration and grid spacings to ensure optimal load transfer.



Zerben lock, Germany

As part of the expansion program of the Elbe-Havel canal, a new 265 m long lock basin was constructed at Zerben. The specialist foundation engineering works included a retaining structure with 10,500 m² of diaphragm wall, with depths up to 23 m, which was constructed using a grab.



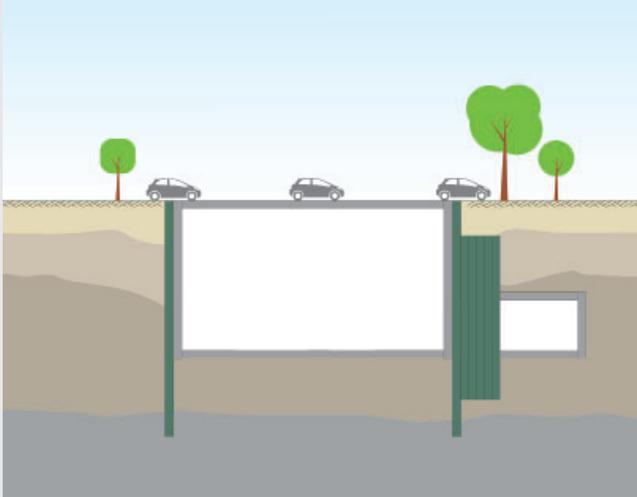
ETH, Zurich, Switzerland

An unique slope stabilization system was developed and constructed for the new research and laboratory building of the Swiss Federal Institute of Technology in Zurich. The system uses pre-stressed diaphragm wall panels, which run perpendicular to the slope and serve as a safety system. The 10 m wide panels were cut into the rock with a BC 40 cutter unit on a Bauer MC 96 up to a depth of 26 m.

Cut-off walls

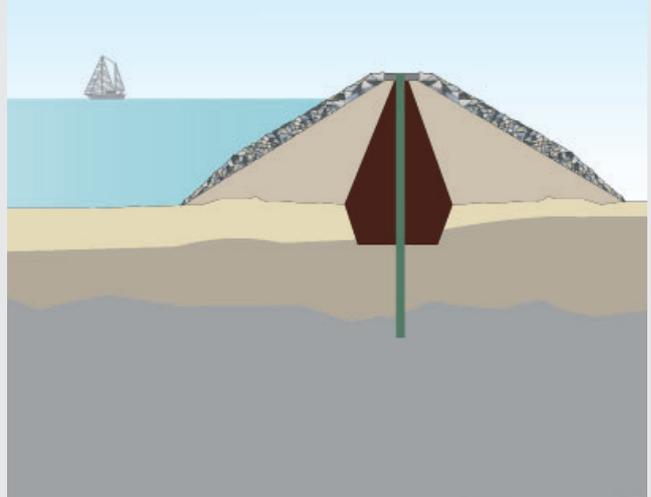
Tunneling

Cut-off walls are well suited to the encapsulation of start construction pits for tunnel boring. They can also be constructed as sealing blocks with GFR reinforcement to enable tunnel boring machines to enter and exit.



Dam sealings

The sealing of dams and dikes with cut-off walls is a proven construction method, both during construction as well as during the course of potential remediation projects. The construction of diaphragm walls as a sealing element is not only used in the dam core, but also below in possibly fragmented and highly permeable soil strata to prevent seepage and potential washout effects.



N5 bypass Biel, Switzerland

For the Biel bypass of national road N5, the appointed consortium awarded Bauer Switzerland the contract for construction of diaphragm walls and bored pile walls at the Bözigenfeld portal, the Orpund portal as well as the Brüggmoos portal.

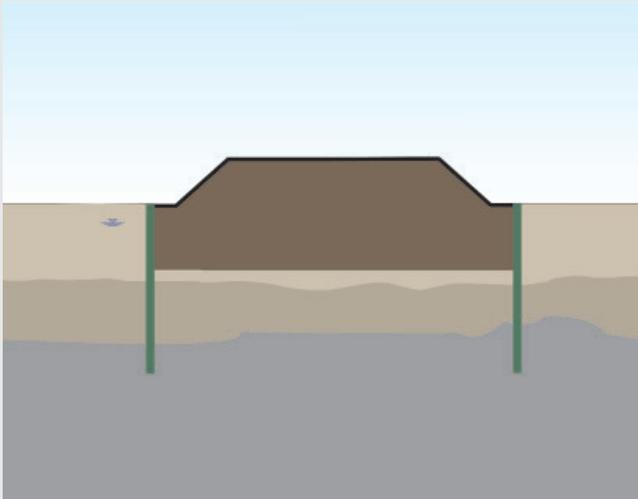


Bagatelle Dam, Mauritius

The dam is part of a reservoir used for the supply of drinking water. Close to 60,000 m² of cut-off wall was constructed over a length of 2.4 km, with cutting works carried out in partly high-strength basalt, to depths of up to 40 m.

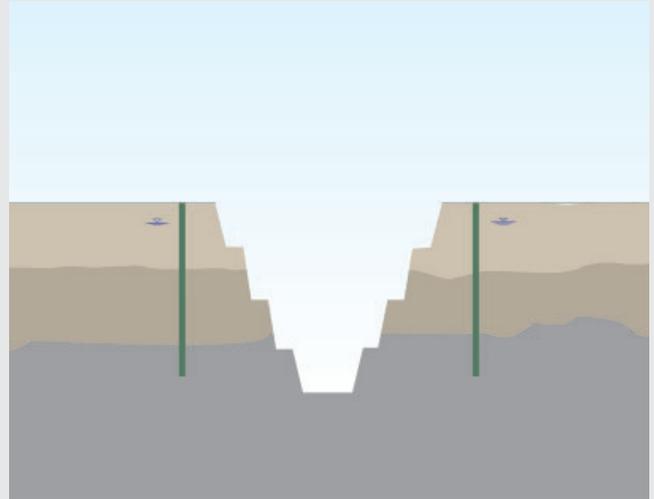
Cut-off walls for contaminated areas

In the past, industrial facilities and unsecured landfill sites have been the source of subsoil contamination in many places. To prevent ground water contamination, these areas can be enclosed with cut-off walls and the contaminated soil can either be replaced or cleaned.



Retaining walls for open-cast mines

Natural resources to be mined in open-cast mines are generally found below ground water level. Encapsulation with a cut-off wall, which can also be positioned as an artificial dike, reducing the ground water that needs to be pumped and minimizes the impact on the surroundings.



Landfill Remediation, Bad Dürkheim, Germany

To prevent the spill of further contaminants from the landfill body, the landfill site at Bad Dürkheim was secured with a cut-off wall. Excavation of the sealing wall, which was filled with concrete resistant to chemical attack, was carried out to a depth of 34 m with a grab unit.



Diamond mine, Diavik, Canada

For the recovery of diamonds from below the lake Lac de Gras near the Arctic Circle, an up to 26 m deep cut-off wall, over a length of 2.2 km was constructed in a poured dike, using the cutter-soil mixing method.

Methods

Diaphragm and cut-off walls are created by appositioning individual wall elements called panels. Specialist knowledge in the areas of calculation, construction, concrete technology and construction methods is required for the successful application of this technology.

Center Hill Dam, Tennessee, USA

A two-stage solution was used for sealing the Center Hill dam. Initially, a 2.25 m thick and 60 m deep encasement wall was constructed, which was then cut across using an 800 mm thick and up to 95 m deep cut-off wall.

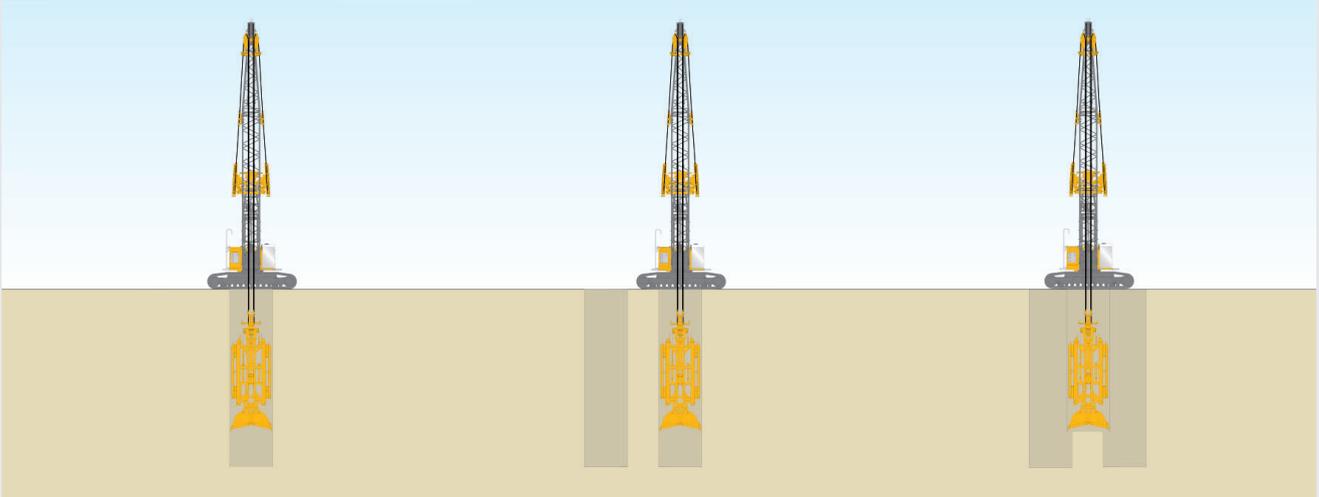




Single phase cut-off walls

Single phase cut-off walls do have a sealing function not a structural function, and are mainly used in landfill, dam, and dike construction. They are used either for encasement of contaminated sites or for the prevention of leakages in a soil mass.

The flexibility of single phase cut-off walls enables them to absorb the movements of the dam body. Single phase cut-off walls can be excavated with either a grab or a cutter.



Different construction methods allow for flexible use of diaphragm and cut-off walls to suit the demands of the project.

Alexander Metka
Head of the Product
Group Diaphragm Wall



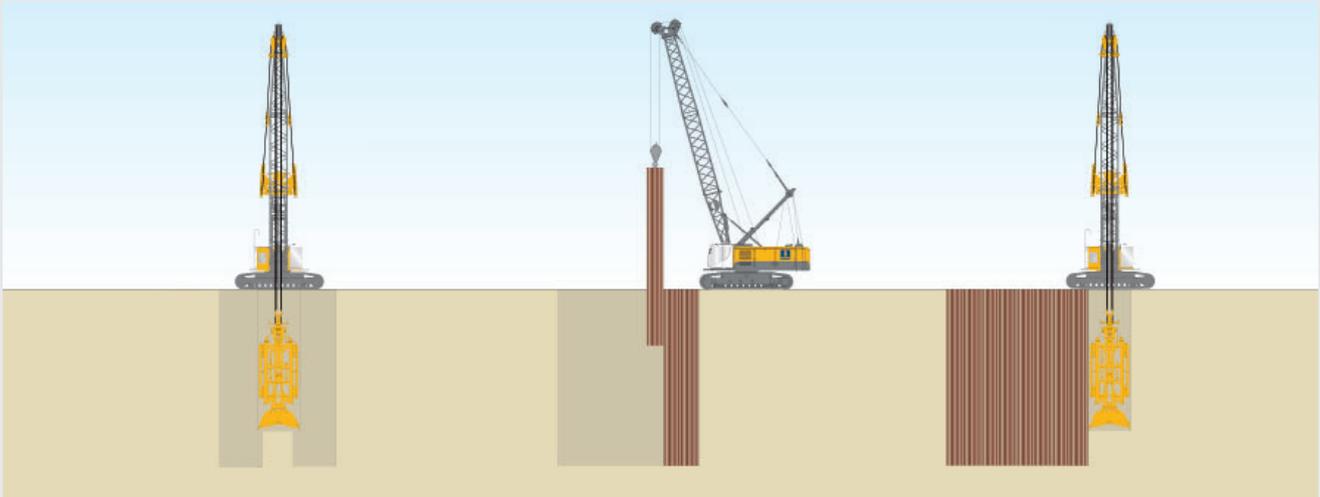
Site C, Fort St. John, Canada

For the construction of a new hydropower station 80,000 m² cut-off wall were constructed to a depth of 25 m using a grab.

Single phase cut-off walls with structural function

Apart from their sealing function, single phase cut-off walls can also take on a structural function. For this purpose, sheet piles, steel sections, or pre-fabricated elements that can be subjected to structural loads, are positioned in the unset bentonite slurry. The construction of an excavation pit in ground water is an example of how to use a single

phase cut-off wall with a structural function. The cut-off wall is embedded in the impermeable soil layer, whereby the load-bearing parts only extend as far as the structurally required depth. As an alternative to socketing in the impermeable underground, single phase cut-off walls can also be combined with an artificial horizontal sealing.



INFO

Flexibility

Diaphragm and cut-off walls can be constructed for temporary as well as permanent use. Excavation can be achieved either by grab or by cutter, depending on the geological, geometric, or other project constraints.

Pumping station in Charlottenburg, Berlin, Germany

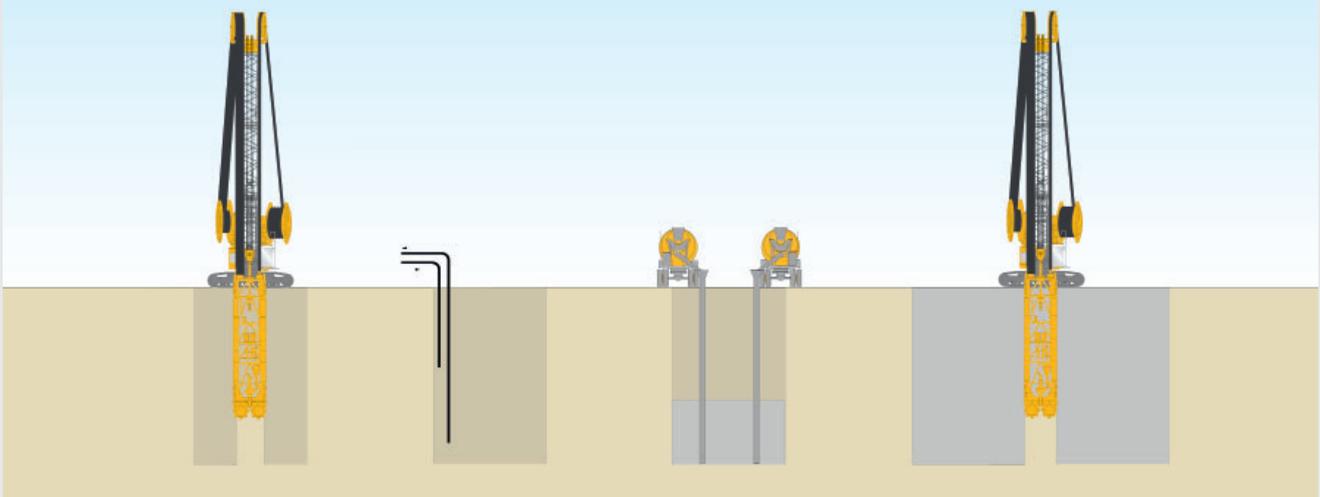
Parts of the excavation pit for the pumping station were constructed using a combination of cut-off wall and horizontal sealing. Sheet piles were installed in the self-hardening slurry, as a structural element.



Double phase cut-off walls

Double phase cut-off walls, like single phase cut-off walls, are used in landfill, dam, and dike construction. However, double phase cut-off walls have the advantage that the concrete used in the double phase process has a higher strength than the self-hardening cement

bentonite slurry used in the single phase method. The term “double phase” means that excavation is done with slurry that only has a supporting function (first phase), which is then replaced by the concrete injected using the tremie method (second phase).



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Advantages of diaphragm/cut-off wall systems

- Low noise emission
- Construction to very deep depths
- Retaining wall can double up as structural perimeter wall of the building
- Slab and wall connections possible
- Accurate installation of reinforcement and connecting components
- Excellent verticality monitoring during the excavation
- Small distance to neighboring buildings possible

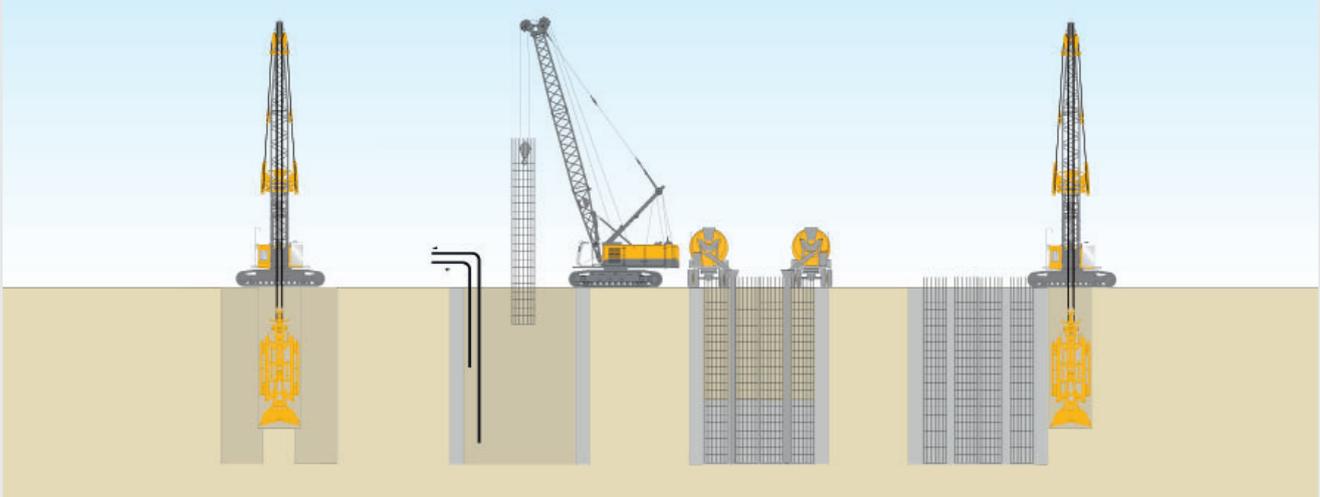
Sylvenstein Dam, Germany

To seal the dam core, around 10,000 m² of plastic concrete diaphragm wall, with a length of 170 m and depths of up to 70 m were constructed. An MC 128, with a BC 40 cutter unit, and two MC 64 rigs were used for the excavating and concreting work.

Double phase diaphragm walls

Double phase diaphragm walls can be excavated using a grab or cutter, whereby the final walls consist of reinforced or unreinforced concrete. The joints between individual sections are formed by using stop ends or over-

cutting. Double phase diaphragm walls are also used as foundation elements in the form of retaining structures or barrettes.



INFO

Underground garage systems

The increasing lack of urban space is ubiquitous and gaining growing importance worldwide in terms of urban planning. Underground garage systems maximise the parking space or limited space. For such parking systems, deep shafts are created using the diaphragm wall method.

CEVA, Geneva, Switzerland

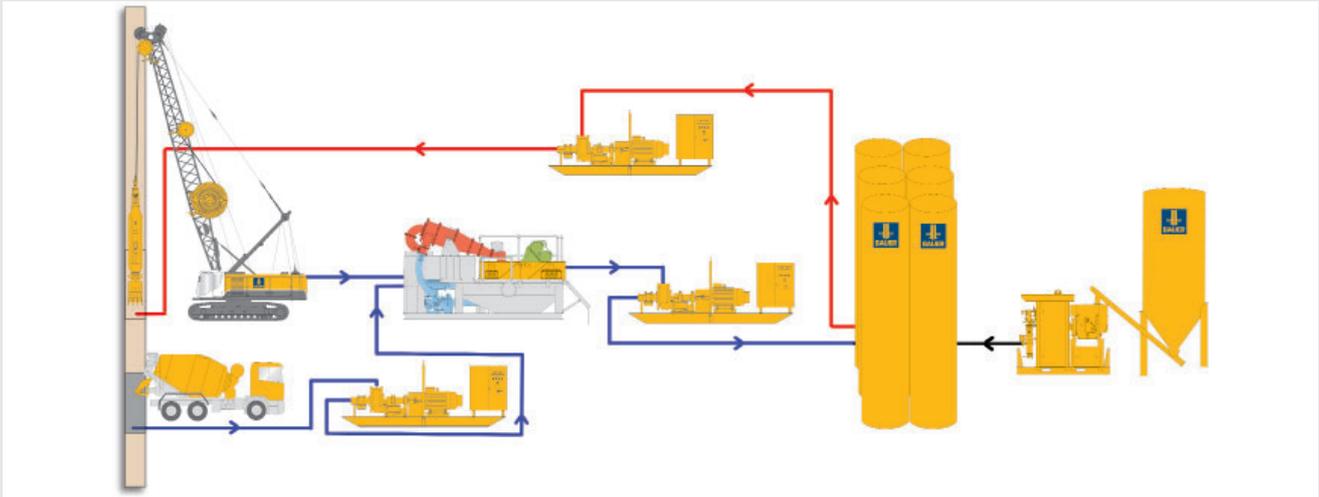
The tunnel for the underground railroad line was created using the top down method. An excavated diaphragm wall was constructed using a grab on the merely 12 m wide construction area.



Slurry handling

To ensure stability of the trench during excavation with grab or cutter, the excavated soil material is immediately replaced by a stabilizing slurry. During the cutting process, the support slurry is also re-used for transporting the excavation material to the processing plant via pipes. Solids are then separated from liquids using rocking

screens and cyclones. The cleaned slurry is then used in the excavation process and pumped back into the trench. Slurry displaced from the wall element during the concreting work is cleaned and stored for further use. Fresh, working, and concreting slurries are stored in earth basins, stack tanks, or tower silos.



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Project-specific adaptation

The processing plants are adapted to the method, ground conditions, and slurry demand by using various components.

Hinze Dam, Gold Coast, Australia

For the construction of a cut-off wall, to a depth of 55 m in karstic rock, using a trench cutter and wall grab, slurry handling had to be adapted to strongly fluctuating demands.

Hybrid tower block, Frankfurt on the Main, Germany

For the construction of four underground levels of a tower block, which were created using the top down method, a 38 m deep diaphragm wall was built as a single-leaf exterior wall.



Ismailia Tunnel, Egypt

As a result of growing demand, the capacity of the Suez Canal was adapted by widening the canal. For a new road tunnel under the widened canal, 145,000 m² of diaphragm wall was constructed for shafts to a maximum depth of 85 m.

INFO

Main areas of application

- Retaining structures
- Cut-off walls
- Foundations

US Embassy, London, UK

Two hydraulic grab units excavated 10,000 m² of diaphragm wall for the excavation pit of the New American Embassy in London.

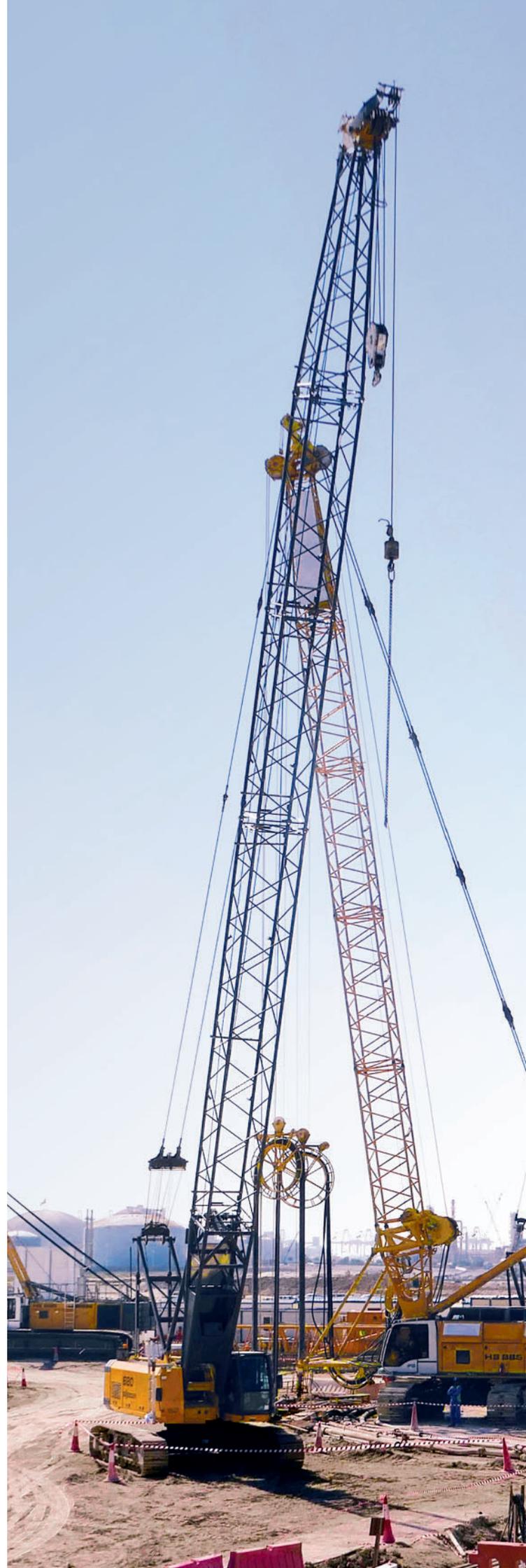


Projects

A wealth of experience, qualified employees, and a global network of branches and regional subsidiaries allow for a comprehensive package of construction services. We offer tailor-made solutions for every project and each individual project challenge.

Jebel Ali, Dubai, UAE

To prevent flooding, as a result of sudden torrential rainfall, rainwater is diverted directly into the sea, with the help of a large scale underground drainage system. As part of this system, two circular, contiguous diaphragm wall shafts were constructed with, trench thicknesses of 1,800 mm and depths of up to 80 m.





Rosshaupten Dam, Germany

Located near the idyllic Neuschwanstein Castle, the Bavarian Lake Forggensee is fed by the Lech River, and serves as both a local recreational area and a tourist destination. The fifth-largest lake in Bavaria and the largest reservoir in Germany in terms of area, it also generates electricity and provides flood control when the snow melt begins in the Alps. To prepare the power plant and flood control for the future, remedial works were carried out on the dam seal. Bauer Spezialtiefbau was tasked with the execution of the 13,500 m² of cut-off wall to seal the dam. The particular challenge was that the cut-off wall

could only be built from the narrow 11-meter-wide dam crest. Adding to the challenge, the crest was located on the side of the dam rather than in the middle. The cut-off wall, which is 1 m thick and 70 m deep, includes socketing into extremely hard rock and was executed in two steps. Firstly, the excavation of the upper 40 m of the dam body was carried out, with the help of a hydraulic grab. The remaining 30 m, beneath the actual dam body, were then excavated, using a trench cutter.



Thanks to our innovative hose drum system, widening of the dam crest could be avoided, thereby saving time and costs.

Stefan Jäger
Sales Engineer



Construction of the cut-off wall was aided by Bauer's twistable HDS-T hose reel system Bauer.

A hydraulic grab on a BAUER MC 64 duty-cycle crane and a BC 40.2 trench cutter on an MC 96 duty-cycle crane were used for the works.



Bauer carried out construction work for the cut-off wall seven days a week, operating day and night shifts (24 hours a day), even during the winter months.

INFO

After completion of the new road along the dam crest (including walking and biking paths) and other construction works, the Rosshaupten Dam was re-opened on September 12, 2019 and the occasion was marked with a ceremony.



The construction progress was monitored and documented at regular intervals, with the help of a laser scanner.



The mix of supporting slurry and excavation material was transported to the desanding facility, via pumps and installed pipes.

Dike 1 remedial works, Jordan

The Dead Sea is rich in potassium salt which, as one of the three main components of fertilizers, increases crop yields and improves plant resistance. The Arab Potash Company in Jordan utilizes the natural occurrence of salt as the basis for the production of potash. For this purpose, salt water is pumped from the Dead Sea into large earth basins, where the sought-after potash is created by means of evaporation. To prevent the salt water from seeping through one of the main dikes, BAUER International FZE was commissioned with the construction of 112,000 m² of an adjacent cut-off wall, with an embedded

sheet pile wall, over a length of 4.2 km. The cut-off wall, with a thickness of 600 mm, was installed to a depth of between 18 m and 30 m. The subsoil presented a particular challenge, as it consists primarily of salt, due to its location, directly next to the Dead Sea. Two Bauer cutters – a BC 40 and a BC 30 – and a grab were used. In addition, a total of 790,000 m³ of soil had to be moved to widen the dike.



INFO

The shore of the Dead Sea is the lowest place on earth not covered by ice or water. The works carried out by BAUER International FZE from Abu Dhabi and Bauer Lebanon were performed at 395 m below sea level, to a depth of 30 m. The finished cut-off wall reaches depths as far as 425 m below sea level.

Two Bauer cutters and a grab were used during the works in Jordan.



The completed cut-off wall extends over a length of 4.2 km.



Potassium salt is obtained by evaporation in special earth basins and then used as fertilizer.

The subsoil presented a particular challenge, both in terms of construction method as well as material difficulties, as it mostly consists of salt due to its location at the Dead Sea.



Mazin Adnan
Technical Manager



A total of 112,000 m² of cut-off wall with embedded sheet pile wall were constructed.



The cut-off wall, with a thickness of 600 mm, reaches between 18 m and 30 m into the ground.



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