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EFFC

**EFFC PRESIDENT
CHRIS PRIMETT p03**



EUROPEAN FOUNDATIONS

WINTER 2013
MAGAZINE OF THE EFFC

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UP FRONT

THE INDUSTRY IS MAKING PROGRESS, BUT THERE'S STILL MUCH TO DO

Over the last two years Trevisani's Stefano Trevisani's presidency of the European Federation of Foundation Contractors (EFFC) has helped to steer us onto a new course focused on developing policy, strategy and objectives and disseminating this to our national federations. Stefano's time as president has now finished and he has handed the task of continuing this work and leading the organisation over the next two years to me.

I would like to thank Stefano for his stewardship and the efforts of our working group committees that have helped successfully deliver projects such as our carbon calculator and online accident reporting system in the last two years.

While our efforts have helped to drive up professional standards in a difficult economic climate, the challenge is not over and there are other issues to be tackled.

While the financial situation in some countries in Europe is easing, for many there is little prospect of improvement in the near future and for some further declines are forecast. Despite the economic

situation, quality remains the focus of our members and our recent AGM helped to identify some of the key areas we need to work on as an industry. News of this research and plans for these developments will be brought to you through future editions of *European Foundations*.

As president I intend to take an active role and plan to join in the working group committee meetings and to try and bring in new, young talent to these teams and the EFFC as a whole to ensure our work is representative of the whole European industry and involves the national federations we represent, as well as other stakeholders such as FIEC and the DFI.

In the meantime, I hope you enjoy this latest issue of *European Foundations* which contains news and features on some of the most innovative and challenging schemes currently underway.

CHRIS PRIMETT
PRESIDENT, EFFC



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The European Federation of Foundation Contractors aims to promote the common interests of members of the federation, to improve standards of workmanship and to maintain high standards of technical competence, safety and innovation. It is also a primary objective of the EFFC to express the point of view of members to the European Commission, national governments, consulting and civil engineers, architects, contractors, professional institutions, public authorities and other interested parties in member countries or abroad.

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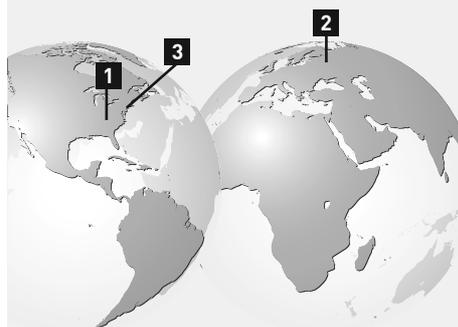
Tower cranes give Copenhagen a lift

DENMARK Construction work on building Copenhagen's Cityringen metro extension may be focused on what's going on below ground, but the project is getting some help from above in the form of a fleet of specially commissioned cranes.

Main contractor Copenhagen Metro Team (CMT), formed by Salini Costruttori, Tecnimont and Seli, is working with ground engineering specialist Trevi to deliver the new 16km metro with 17 stations by 2018. However, much of the work is being undertaken on sites with restricted access and working room so CMT has bought 18 Terex CTT 231 tower cranes to help get excavated material out and concrete into the construction sites.



IN THREE



1. TENNESSEE DAM REMEDIATION

Bauer is using specially designed cutter wheels for its diaphragm walling rig to undertake a dam rehabilitation project in Tennessee, US. The Center Hill Dam is being upgraded with a new hybrid panel and pile barrier wall that extends 60m through the existing dam and into the underlying bedrock below.

The new cutter wheels have

allowed the barrier wall to be built through the clay core of the dam and bedrock without the need to change tools.

Use of equipment weighing up to 330t called for some work to be carried out ahead of the main scheme and sequencing has been key due to limited working space.

The project is expected to be completed in March 2015.

Euroconstruct forecasts challenging times ahead, despite uplift in many economies

EUROPE Despite news that some construction economies in Europe are starting to see some growth, financial forecasting group Euroconstruct has warned that countries such as Portugal and Spain still face further declines in demand over the next few years.

“After declining for three consecutive years, total construction output growth in the 19 European countries represented under Euroconstruct remained flat in 2011, but last year output fell again by 5% to €1,323bn,” said Experian – UK Euroconstruct member – analyst Sonya Patel.

“Total output is now 20% below its 2007

peak,” added Patel. “For the 2013 to 2015 period total construction output is predicted to see annual average falls of 0.2%. The market is expected to experience further falls of 3% in 2013 before growth in 2014 and 2015. However, this increase in output is negligible as output is still expected to be far below the 2007 peak of €1,645bn.”

According to Patel, over the 2013 to 2015 forecast period, of the “big five” countries – France, Germany, Italy, Spain and the UK – the UK has the best average annual growth rate at 5%.

“By 2015, it is predicted that Spain will fall out of the big five and will instead be

replaced by the Netherlands,” added Patel. “To put this into context, if we have a look at Spain in 2007, the Spanish construction market was the biggest in Europe with Germany in second place. Over the next two years, the worst-performing country in terms of total construction output is expected to be Spain with annual average falls of 12%.”

Nonetheless, Euroconstruct forecasts faster growth in some countries, such as Norway, where annual average increases of 4.6% are expected.

Patel concluded that a return to the market peak seen in 2007 is unlikely in the short to medium term.

Deep foundations conference to deliver global perspective

STOCKHOLM The European approach on standardising and harmonising design and construction methods in the deep foundations and ground engineering industry is set to be a key focus of next year’s joint Deep Foundations Institute (DFI) and European Federation of Foundation Contractors (EFFC) conference.

The International Conference on Piling and Deep Foundations, which is scheduled to take place in Stockholm, Sweden, between

21 and 23 May 2014, will aim to look at the benefits and challenges brought by standardised design codes.

The European approach will also be compared with requirements in North America and other regions through a series of papers and video presentations throughout the three-day event.

The programme for the first day includes presentations on Eurocode 7 by Arup’s Brian Simpson and Soletanche Bachy’s Christian

Gilbert. Presenting the North American view will be FHWA’s Silas Nichols and Langan Engineering & Environmental’s Rudy Frizzi, while Tokyo Institute of Technology’s Masaki Kitazume will discuss the Asian view on standardisation.

Later papers will look more at individual projects and focus on the sustainability efforts made on these schemes.

Full details are available at www.dfi-effc2014.org

2. RUSSIAN HIGHWAY RECONSTRUCTION

Contractor SPK-Most is using a fleet of Liebherr rotary piling rigs to fast-track the foundations work on the M8 highway between Arkhangelsk and Vologda.

The route, which is being widened from two lanes to four, is located just 225km from the Arctic Circle, so conditions are harsh.

The focus of current work is on reconstruction of the interchange at Arkhangelsk where piles measuring 1.5m in diameter are being bored to 36m below ground level to support new elevated access ramps and over bridges.



3. NEW YORK'S BOXED SOLUTION

Tutor Perini has started work on construction of a concrete box cut and cover tunnel below the Eastern Rail Yard of the Hudson Yards site in New York.

The US\$133M (€96.6M) is a key part of Amtrak’s Gateway Program and is intended to preserve an underground right of way for possible future expansion of rail service via two new tunnels underneath the Hudson River between New Jersey and Penn Station, New York.

Work is expected to finish in late 2014.



Torre de Moncorvo, Portugal: Dam construction

Keller's Spanish and Portuguese businesses have joined forces to carry out ground engineering work on construction of two dams in Portugal for a new hydroelectric scheme.

The scheme involves construction of a 130m high upstream double curvature arch dam and a downstream concrete gravity dam, which is 40m high. Work started in 2009 and is expected to be finished by summer next year.

Keller's geotechnical work has included soil nailing, ground anchoring, shotcreting, superficial drain construction, drilling and grouting work for consolidation and a cut off curtain, as well as installation of instrumentation.

At the height of the work Keller had 11 rigs and 70 people on site. In total Keller has installed 180km of soil nails, undertaken 52km of roto percussion drilling and placed 2,500t of cement grout.

CLIENT EDP
MAIN CONTRACTOR ACE BAIXO SABOR (JOINT VENTURE OF ODEBRECHT AND LENA CONSTRUÇÕES)
GROUND ENGINEERING CONTRACTOR KELLER
OVERALL PROJECT COST €596M

PROJECT MAP



Marseille, France: Storm water storage

CLIENT MARSEILLE PROVENCE MÉTROPOLE DIRECTORATE FOR WATER AND SANITATION
MAIN CONTRACTOR SOLETANCHE BACHY
COMPLETION DATE FEBRUARY 2015

Below the park in Porte d'Aix in Marseilles' 3rd arrondissement Soletanche Bachy is creating a 5m diameter, 12,000m³ capacity storm water storage tank.

When the Jules Guesde retention tank and associated tunnels is completed it will help prevent flooding in periods of heavy rainfall.

Work started in April with construction

of a retaining wall using the Berlin method ahead of diaphragm walling work starting in June. Soletanche Bachy used a Hydrofraise Evolution 5 to form the wall in the hard and heterogeneous ground and create the 3,800m² wall formed of 17 primary and 17 secondary 800mm wide panels to 23.5m below ground level.

Work is now underway to excavate the shaft. The work also includes three 12m deep wells, two for a tunnel boring machine that is completing the tunnelling elements, and a third for a ventilation shaft.





Budapest, Hungary: Underground parking



CLIENT THE OFFICE OF THE HUNGARIAN NATIONAL ASSEMBLY
MAIN CONTRACTOR BOHN MÉLYÉPÍTŐ
CONTRACT VALUE €4.2M

The vision intended when Imre Steindl designed Hungary's neo-Gothic parliament buildings in the late 19th century is being restored with parking facilities being placed underground below where cars previously parked.

Main contractor Bohn Mélyépítő started work on constructing the 15.5m deep excavation pit in January 2013 using diaphragm walls, which extend to 24.5m below surface, and two levels of temporary ground anchors to provide support during the excavation.

The site is close to the Danube so high water levels were an issue for the construction process and flooding of the river resulted in Bohn needing to flood the excavation pit to provide support to the diaphragm walls until the water levels receded.

Work is now underway to construct the three-level basement parking and the site will then be covered over to restore the look of the parliament buildings.

Canton Glarus, Switzerland: hydroelectric pumping facility

CLIENT KLL KRAFTWERKE LINTH-LIMMERN
MAIN CONTRACTOR ARGE KWL
GROUND ENGINEERING CONTRACTOR KELLER-MTS
GROUND ENGINEERING CONTRACT VALUE €0.9M

Construction of a new hydroelectric pumping facility at Linthal in Switzerland will increase capacity at the plant from 480MW to 1480MW – equal to that of Switzerland's largest nuclear power plant.

As part of the project Keller was asked to seal one side of a new retaining wall using the soilcrete method. The drilling was carried out using a Wassara hammer to a depth of 20m to embed 1m or 2m into the bedrock. The triple row soilcrete columns were then jetted into the drill holes to create 1.2m to 1.8m diameter columns. Keller constructed just over 5,000m columns during the course of the project, which was completed in October 2013.

The site is located at 2,500m above sea level so completing the work before the winter was essential and Keller worked 24 hours a day between July and October to ensure this was achieved.



PRESIDENTIAL PRESSURE

In October UK-based Aarsleff managing director Chris Primett became president of the European Federation of Foundation Contractors. He tells Claire Smith about his plans for his two-year tenure.

When did you take on the role?

I took over in October at our AGM, which was held in the UK. My predecessor Stefano Trevisani from Trevi will stay on the executive committee as past president.

What are your aims for the next two years?

I want to reinvigorate the executive committee and the technical committees to generate more involvement and communication about the work that is being undertaken and take the focus away from the process itself. The committee members do lots of good work on behalf of the EFFC and a great willingness exists, but the messages about this are not being heard.

I will try to attend the technical committee meetings to try to start the communication and involvement process. I also want to bring in new people.

I also plan to promote the carbon calculator that the EFFC has jointly developed with the Deep Foundations Institute. We should be proud of the work achieved so far in pulling the industry together to create the system, but we need to ensure everyone is using it and that clients understand the benefits of it too.

How did you get into the foundations business?

I studied civil engineering at Portsmouth Polytechnic and graduated in 1982. It was a natural choice for me as working in the building industry runs in my family and with being maths and physics orientated I fell into civil engineering.

In my final year project I looked at soil retaining walls which opened my eyes up to the ground engineering industry.

When I graduated I joined Trafalgar House (now Cementation Skanska).

What is your favourite memory from your early career?

We were seconded to different areas of the business every six months and I started with



Chris Primett (left) took over from Stefano Trevisani in October

the London division and was quickly put to work on a tripod piling project on Fleet Street. From looking closely at the drawings I noticed that we were due to be working directly above a mains water pipe so I stopped the job, which was quite a daunting task at that stage of my career.

How did you get into your current role?

I joined May Gurney as a contract manager and gradually moved into a more commercial role, which led to a joint venture with Per Aarsleff in 1988. The joint venture collapsed when the market went into recession in the early 1990s but Aarsleff decided to stick with the UK market and I joined the company in 1992. Back then we imported our precast concrete piles and rigs but now we have our own facility in Newark.

How has the industry changed since your first started work?

Bureaucracy has increased, which in some cases is good but in others is bad.

I also feel that young engineers don't have hands-on or gut-feeling for the work they are carrying out that my contemporaries did due to greater use of computer technology for

design and analysis. When I started we didn't have mobile phones to check everything with the office so we had to be responsible.

The back-to-basics has gone but the techniques we use have improved dramatically.

What will bring the biggest change in the next decade?

Building Information Modelling (BIM) could be a good tool for communication between building trades but the benefits depend on how it is put into action – it could be a great change or it could bring more bureaucracy. I don't think the piling industry knows enough about the technology to fully realise the potential or see the issues it will face yet as no foundations company that I know can currently meet level 2 BIM compliance.

What issues need to be tackled?

We still face issues when trying to transfer techniques, rigs and people from one country to another. We recently brought a rig and a skilled operator to the UK from Denmark for a project but the main contractor didn't want the Danish operator working on site because he didn't have the necessary UK-industry paperwork yet he was fully qualified. This rigid application of rules is preventing people from making an informed judgement about what is safe and what isn't.

What are your thoughts for economic recovery in Europe?

I don't believe that there will be a quick recovery. The UK market appears to be ahead of the curve in terms of demand picking up and I expect that, over the next two years, the market in Scandinavia, France and Germany should start to improve. The picture is bleaker in southern and eastern Europe, though, where a significant change in the next two years is unlikely.

Given the subcontracting nature of the foundations market though, it is hard to forecast much beyond two to 12 months.

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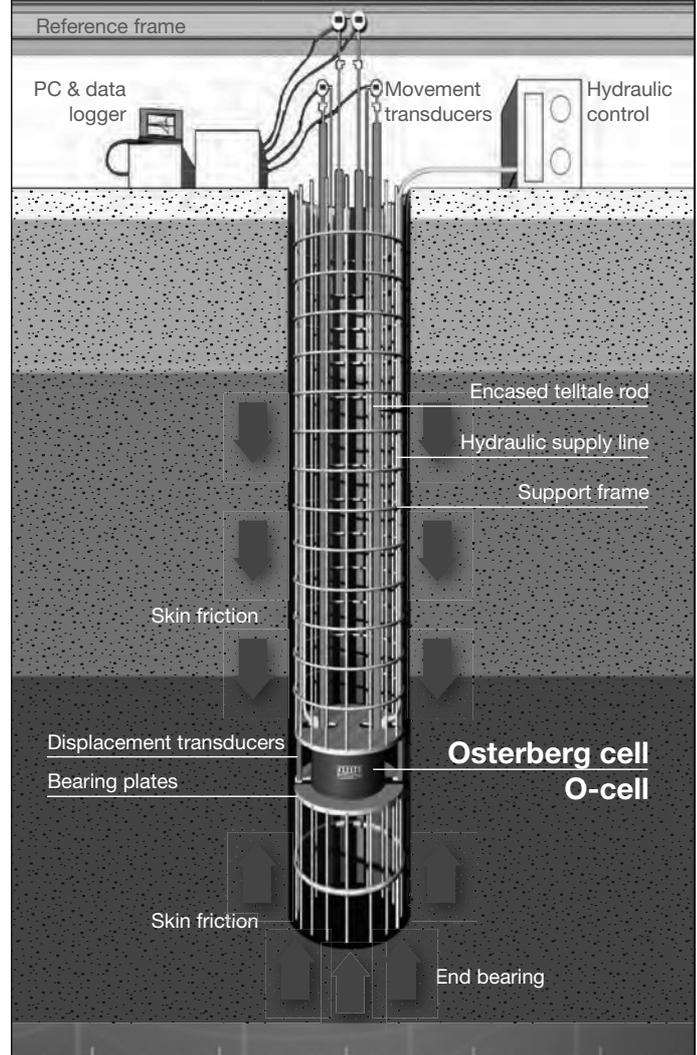
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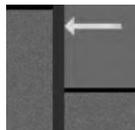
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LUXURY LIVING IN GIBRALTAR

By Claire Smith

Tax havens tend to attract the rich and famous but this type of clientele also expect to be able to live in the lap of luxury while dealing with their financial matters. While Gibraltar has long attracted people for its banking status, it hasn't had the hotel accommodation to match, but that is about to change with the arrival of the Sunborn Gibraltar.

Gibraltar's first five star hotel was set to open its doors as this issue of *EF* went to press and the opening comes less than six months since work started on the site.

The 142m long five-star standard super yacht hotel arrived in Gibraltar over the summer and was readied for business in a dry dock while construction of its permanent home in nearby Ocean Village Marina was completed by main contractor JBS. Although the footprint of the permanent dock already existed, JBS called on Roger Bullivant Spain (RBS) to undertake extensive ground engineering works to enable the £3M development to become a reality.

"There is a lot of refurbishment and redevelopment planned for Gibraltar but one thing that is missing is high quality accommodation for the wealthy visitors that this tax haven attracts," says RBS director Andy McGowan. "The colony currently has three four star hotels but they are frequently fully booked."

The 167 guest room, four executive room and 18 suite Sunborn will be Gibraltar's only five star hotel when it opens this autumn. The vessel has been provided and will be operated by the Sunborn hotel group but the location has been provided by Ocean Village and funding to enable the scheme to go ahead has been provided by the



Gibraltar government.

RBS first became involved in the scheme in April this year when the company was informed of the rough dimensions of the ship and an outline of the needs for dredging.

"Initially we were asked for the costs to carry out sheet piling for the project but that solution was not viable as the underlying geology is limestone, so we were asked to come up with an alternative design," explains McGowan.

TIGHT SCHEDULE

As well as finding an alternative foundation solution, the challenge for RBS was that the Gibraltar government wanted the work to be delivered in just 60 days, whereas McGowan says that four to five months is a more normal contract period for the scale of work.

The existing quay to the west was built 25 years ago on driven H-beam foundations, but as there were no as-built details it was assumed that they had been driven through the overlying soft sands and silts to rock head in the limestone at 10m below ground level. On the casino side to the east, the quay was



built in a similar way but records show that the construction experienced problems and piles were only driven to 8m-10m.

For the hotel to be moved into position, the area needed to be dredged by up to 2.5m which had the potential to destabilise the existing quays – and the structures on them – unless action was taken.

"The sheet piled approach would experience the same problems as the previous quay construction and also would make it difficult to predict the programme," says McGowan.

The team were under pressure as the hotel



“SHEET PILING WOULD HAVE THE SAME PROBLEMS AS THE PREVIOUS QUAY CONSTRUCTION AND ALSO MAKE IT DIFFICULT TO PREDICT THE PROGRAMME.”

Andy McGowan, RBS

from Piletec in the UK, to ensure the 7m to 9m lengths of casing were not overdriven. “We had to bring in the hammer from the UK as most in Gibraltar are in the 5t to 7t range which was too big, so we hired the 1.75t hammer from Piletec for the work,” says McGowan. “The actuator had the added benefit of being very quiet, which, given the long hours we needed to work in order to deliver the project, was important.”

McGowan’s team had to work just feet from an open air bar and cafes in Gibraltar’s Ocean Village during the work with just plastic sheeting to separate them.

REDUCING SEDIMENT

In total RBS installed 450 casings at 1.2m centres. The gaps between have been infilled with 1.15m wide sheet piles driven to just above seabed level. These piles were installed using the same actuator with a dolly formed from a section of sheet pile to avoid placing the hammer underwater. The sheet piles are not designed to be a structural element of the foundation solution, but were included in the scheme to reduce the flow of sediment into the dredged quay once the Sunborn is in place.

“The other problem that we had to overcome with the casings was driving them accurately enough for the sheet piles to fit between them,” says McGowan. “We expected some obstructions so we created a 400mm diameter mandrel using an RSJ cut to a spear point with a hardened tip to probe before driving the casings.”

To help ensure the accuracy of the spacing, RBS developed a template that could hold seven casings. “We drove the end casings ➤

“ship” had already been built in Malaysia and was already en route by barge to the site by the time RBS became involved in the project.

The solution involved piling to 12m to achieve a minimum of 1m rock socket. “The only way to achieve this and ensure we could predict the programme was to drill,” says McGowan. “But protecting the pile through the sands, silts and clays was a challenge still.”

RBS resolved the problem by vibrating the 323mm diameter, 10mm thick casing to refusal using a resonance free actuator, hired

IN SUMMARY

The project called for an existing berth at Ocean Village Marina in Gibraltar to be dredged to deepen it to become the new home of a five star floating hotel. The scheme called for the existing quay structures to be strengthened to allow the dredging to be undertaken.

WHERE?



IN FIGURES

450

Casings at 1.2m centres

142m

Length of the Sunborn super yacht

WHO?

Roger Bullivant Spain carried out the ground engineering element of the work for main contractor JBS. The vessel has been provided and will be operated by the Sunborn hotel group but the location has been provided by Ocean Village and funding to enable the scheme to has been provided by the Gibraltar government.

CHALLENGES

RBS had to develop a new ground engineering technique for the marine environment in Gibraltar that could be delivered quickly and with a predictable programme.

MORE INFORMATION

www.sunborngibraltar.com

◀ and then the middle ones before using the last casing with the template to speed up positioning of the next set of casings,” says McGowan. “We managed to drive up to 20 casings a day using this method.”

Once the casings were in place, RBS brought in a 7t piling rig to complete the work. “We were concerned about using compressed air so close to the shops and cafes so we used high pressure water as a flushing medium for the rocket sockets,” says McGowan. “We had no problem getting to 12m but it was taking time to clear the sands and silts, so we augered the first 8m to overcome the issue.”

DOWN-THE-HOLE HAMMER

Away from the shops and cafes, RBS used a Bullrock down-the-hole hammer and compressed air to increase the production rates. The piles themselves have a 190mm diameter. The outer casing is sacrificial but will be left in place to provide added corrosion protection.

Once the rock socket was formed, the

“WORKING SO CLOSE TO THE BOATS, CAFES AND SHOPS WAS A BIG DRIVER IN THE DESIGN OF THE WORK.”

Andy McGowan, RBS

circular hollow section tube was lifted and the reinforcing steel was dropped in before grouting was carried out. RBS used an obturator within the bore to allow it to achieve grout pressures of 7 bar within the rock socket, although the pile is grouted over the full length.

Most of the work for the piling was carried out from a pontoon hired by the main contractor JBS. The pontoon – named Isaac – is equipped with 1,500t and 35t capacity cranes.

According to McGowan, the limited working room at the site and proximity to neighbours meant that the pontoon was vital to keeping the work on track. As well as being used as a drilling platform, the pontoon was also used for grout batching and storing up to two weeks’ worth of steel.

Mounted on the pontoon were two rigs – a 7t multipurpose MDT MC80 and a 12t Klemm 802 adapted for augering. “We also had two Twintech restricted access piling rigs for the land-based operations close to the shops and cafes,” says McGowan.

“Logistics have been challenging – we needed to keep all three piling rigs fully occupied to meet the programme,” says McGowan. “Working so close to the boats, cafes and shops was a big driver in the design of the work.”

McGowan believes that this is the first time this piling solution has been used for marine works in Gibraltar, but it seems to have paid off as the work was completed on time and dredging of the dock is now underway.



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REACHING NEW DEPTHS IN MUNICH

By Claire Smith

High-rise developments have long been the preferred solution to maximise space on urban developments, but the trend is for ever deeper and larger basements. The basement construction for the new Schwabinger Tor complex in Munich is an example of a project that is pushing the boundaries, not just in terms of depth, but in scale too.

The site is being developed as Munich's first five-star plus rated hotel, luxury flats, a shopping centre and a theatre for Hurler and will feature two basement levels below ground and buildings of eight to 10 storeys above ground. While the height of the buildings may not sound large, the footprint of the site – and of the basement – is massive at 600m long and 60m wide and it will soon be 15m to 20m deep too.

The foundations and excavation work is being undertaken by a joint venture of Bauer and ground works specialist Trenkl on a fixed price basis of €12M, with Bauer's part of the scheme valued at €7M.

"The project is one of the most complicated underway in Germany at the moment," says

Bauer business development manager Wolfgang Harttig. The number of techniques being used on the site underlines the scale of the work – when *EF* visited Schwabinger Tor there was a BG28 undertaking CFA piling, an RG25 carrying out mixed in place walls and a low headroom rig undertaking Gewi piling.

Work started in February 2013 and is expected to finish by the end of 2015.

According to Harttig, the site is a prime location in Munich with good connections into the city centre, easy access to the motorway network, leisure facilities nearby and the site is also close to the famous English Gardens.

COMPLEX UTILITIES

The site was previously used by a number of different businesses – at the northern end was a Holiday Inn, in the central part was a multi-storey car park and at the southern end was a supermarket and petrol station.

Bauer has had previous experience of the site when it was called in to construct a cut off wall using mixed in place and high pressure



IN SUMMARY

Construction of a new basement for a development that will include Munich's first five-star plus rated hotel, luxury flats, a shopping centre and a theatre. The site is a prime location on Leopold Strasse which offers good connections into the city centre, access to motorways, and is also near the famous English Gardens.

WHERE?



IN FIGURES

600,000m³
Volume of ground to be excavated

€250,000
Cost of lowering the basement by an additional metre

“THE PROJECT IS ONE OF THE MOST COMPLICATED UNDERWAY IN GERMANY AT THE MOMENT.”

Wolfgang Harttig, Bauer



Large scale The basement is 60m wide and 600m long and will soon be 20m deep

injection grouting around the petrol station following a leak from the diesel tanks. “The system was designed to protect the groundwater when the contamination occurred in the 1990s,” says Harttig.

Because of the size of the site and range of challenges, Bauer has divided the construction into three areas to help it plan the foundation work and coordinate the mass excavation being undertaken by its joint venture partner Trenkl.

Work is already progressing well with the excavation at the northern end having reached full depth and the base slab now under construction. However, there is still a lot of work to be done.

The ground conditions at the site are peculiar to this part of Munich and meant that the planned for 20m deep, three-level basement had to be scaled back to two levels that extend 15m below ground. The geotechnical complexity meant that the deeper basement significantly affected the cost of the work.

The problem lies with there being two ➤

WHO?

Bauer is working in joint venture with Trenkl which is carrying out the mass excavation for on the project. The scheme is being delivered under a fixed price contract valued at €12M. Ground engineering work started in February 2013 and is expected to finish by the end of 2015. The Schwabinger Tor complex is being developed for Hurler.

CHALLENGES

The project calls for development of a large and deep basement in difficult ground conditions. Bauer business development manager Wolfgang Harttig describes the €7M foundations work as one of the most complicated currently underway in Germany.

MORE INFORMATION

www.jost-hurler.de/en/projects/schwabinger-tor

“WE HAVE ACHIEVED A HIGH PERFORMANCE ON THE CFA WORK WITH UP TO 300M COMPLETED IN A DAY.”

Wolfgang Harttig, Bauer

◀ groundwater levels below the site with no hydraulic connection and the lower one being under artesian pressure of 0.2 to 0.4 bar.

The ground conditions are formed of the Quaternary deposits, which are 12m to 14m thick and formed from clays, sands and gravels, and overlie the Tertiary Belt that separates the two groundwater levels and is a 4m to 6m thick layer of stiff, dry overconsolidated clay. Below the Tertiary Belt are the Tertiary deposits that are sandy clays and are firm to stiff.

In the rest of Munich the Quaternary directly overlies the Tertiary without the stiff clays of the Tertiary Belt separating them.

The challenge at the Schwabinger Tor site lies in fact that the basement is being constructed into the Tertiary Belt and the excavation will leave just a metre or two of the deposit.

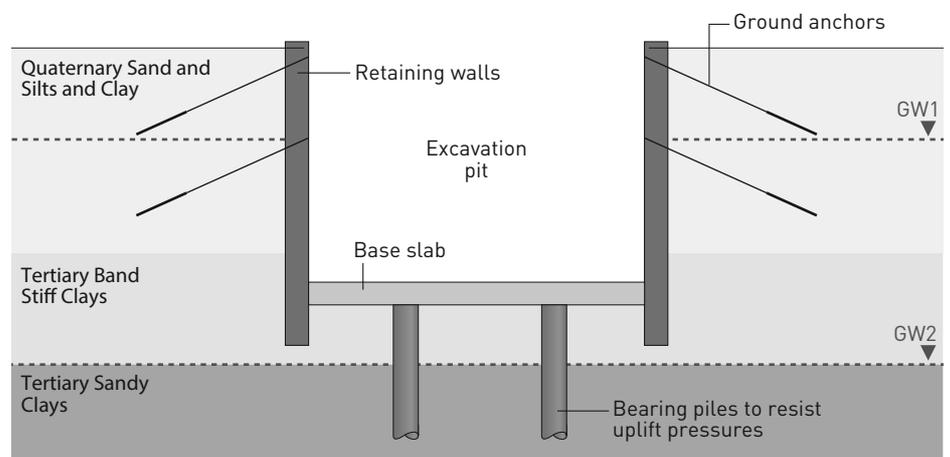
TWO-STAGE DEWATERING

To safely construct the new basements without flooding or uplift issues, a two-stage dewatering programme is being installed at the site. The first line of wells will extract the water from the Quaternary, while the second set of wells will lower the water table in the Tertiary in a bid to reduce the pressure by 0.2 to 0.3 bar.

The general groundwater flow is from south west to north east so most of the extraction wells are on the southern and western boundaries of the site and the water is being reinjected back into the ground on the eastern side.

The design also features pipes under the base slab to collect groundwater on the western side and transfer it to the eastern side to ensure the building complex has no long-

→ SCHWABINGER TOR: CROSS SECTION



Major development: The complex features eight and 10-storey buildings

term effects on groundwater levels. “The groundwater flow rate is around 0.5m/s,” says Harttig. “We are currently pumping around 58 litres per second from the northern end of the site from both water tables.”

The permanent 400mm diameter groundwater pipeline will be formed using a trenching machine before the base slab is constructed.

The constraints of the site do not end there though – the site is also crossed by a tram line, which must remain operational throughout, and the tram route also carries district heating pipes with 20°C steam that also cannot be disrupted. A bridge structure had been built below the tram route under a separate contract and is supported on 1,200mm diameter secant pile walls that extend to 30m below ground. Nonetheless, Bauer still needed to find a solution to cope with the low headroom to pile below the

structure for the new development.

As well as phasing the work into three parts, Bauer has also physically separated the areas by carrying out injection grouting along the boundaries so that Trenkl can follow on from the foundations work rather than waiting until the entire retaining wall is completed.

The original design for the works was to use a secant piled wall with multiple layers of 650kN anchors, but following the decision to reduce the depth of the basement from 20m to 12-14m, Bauer offered an alternative design that uses a mix of methods to maximise the pace of the work.

One of the biggest changes was the proposal to use fewer but stronger anchors and the company installed test anchors to prove the theory. The three test anchors delivered working loads of 900 to 1,200kN.

“The original design used 15km of anchor lengths around the site, split over three

levels,” says Harttig. “The new design mostly uses two levels, although there are a few areas where we will install three rows of anchors. The design change means that there will be a total length of 12km with most anchors measuring 12m to 16m and installed at 20 degrees from the horizontal. In general, the first layer will be 2.5m below ground level and the second will be at 5.5m.”

The other change was from the use of secant piled walls for the whole area to limited use of the technique combined with mixed in place soil walls and soil nailing of some existing retaining walls, and also a combination of techniques for the secant piling with both CFA and kelly bars used.

The whole length of the western boundary along Leopold Strasse is being formed using mixed in place technology. The panels are 12 to 15m deep and being formed using three 550mm diameter augers that are driven together to the depth required while cement – 750kg/m³ – is mixed into the natural soil to form the soilcrete wall with a compressive strength of 4MPa.

WATERTIGHT METHOD

“We form a primary and secondary panel next to each other and then form a third panel that bites into both,” says Harttig. “It is expensive to drive three panels rather than just two but it is a better method to ensure the wall is watertight and that is important here, and the technique is faster than using diaphragm walling.”

The technique produces a 550mm thick wall. The design includes a 12m steel I beam every 3m which will be used to connect the ground anchors as the excavation progresses.

At the northern end of the site the wall is formed by some mixed in place and a section of secant piled wall. Here, an existing retaining wall from the previous hotel development is being retained to form the upper part of the basement and is being soil nailed to ensure its stability.

Bauer has installed around 35 soil nails extending 6m to 7m to secure the existing concrete retaining wall and installed a secant wall to the front of it to extend the basement to the new depth.

The secant piled wall is built from 1,200mm piles placed at 950mm centres and formed using kelly bars to 15.3m depths. “This part of

RISK MANAGEMENT

“The original contract involved transferring all the ground risks to Bauer under a lump sum contract but that is not an approach that is taken by Bauer,” says Bauer estimating manager Stefan Jäger. “We worked with the client Hurler to select which risks we would take and revised the design to reduce the risks.

“We have taken the risk of the mixed-in-place solution but the client has retained the risks relating to the length of the wall as it only extends 6m below the depth of the excavation to minimise costs. Extending

the wall every 1m would cost an additional €250,000 but the client knows there is a high chance that the solution will work but the groundwater levels mean that it is not without risks.

“The tie down piles in the base slab will hold it in place when the construction is completed but if we were retaining all the risk, we would have preferred the wall to extend 10m-12m below the excavation level.”

This project has been three years and Jäger believed at one time it would not happen due to the scale of the development.

the development is close to existing buildings so the secant pile wall was chosen here to control the ground movement,” says Harttig. “The kelly bar method was used because of the potential for overbreak here as the piles only just extend into the clay layer.”

At the southern end a secant pile wall is also being constructed but the CFA technique is being used to help fast track the work. The 900mm piles are being formed at 750mm centres to a depth of 15.5m.

“We have achieved a high performance on the CFA work with up to 300m completed in a day,” says Harttig. “We have a fast turnaround between forming the primary

and secondary piles with reinforcement placed in every second, fourth and sixth pile in a sequence.”

Harttig says the work is progressing well with the northern part of the site handed over ahead of schedule to main contractor Leonard Weiss for formation of the base slab and he hopes to have the remainder of the retaining wall completed by the end of the year. “It is good to see the mixed in place wall exposed,” he says. “I am very pleased with the result – it looks very straight and is watertight too.”

At the end of the year the focus will switch to installation of piles within the basement to tie into the base slab and provide support for the new structures and to resist the uplift forces from the high groundwater levels.

Most of the bearing piles are being formed using 400mm diameter fully reinforced CFA piles to 10m to 12m depth. There will be 152 piles in the northern end, plus 52 Gewi piles installed using a low headroom rig under the tram bridge, but the final number for the central and southern areas is yet to be defined as design is still underway, but Harttig expects the numbers to be similar to the northern area.

The excavation is a major challenge – there is still 300,000m³ of soil to remove from the site and the winter months are likely to slow progress. The ground contaminated by the diesel spill in the late 1990s have been dug out and stockpiled on site while testing is carried out and a decision is made whether to remove the material in its current state or treat it on site before disposal.



In the mix: Bauer's Wolfgang Harttig says he is pleased with the soil mix wall

A SCIENTIFIC FOUNDATION APPROACH

By Claire Smith

Physicists hope that from 2018 they will start moving closer to understanding the structure of matter at the smallest scale when a new particle accelerator in Germany opens its doors. But while the research focus will be below the molecular scale, the current construction is fully focused on a somewhat larger scale with some of Europe's biggest rigs working on the foundations.

The Facility for Antiproton and Ion Research (Fair) is being developed near the city of Darmstadt and the complex structure calls for 1,400 piles up to 60m long and 1.5m in diameter to be constructed at the site.

"The development will be the largest nuclear and particle physics research centre in the world – and will be unique," says Fair managing director Boris Sharkov. "The research that we will undertake will allow us

to unravel the structure of matter at the smallest scale."

The buildings, with concrete walls up to 8m thick, will put a heavy load on the ground and settlements of between 100mm and 350mm have been predicted, which is why the decision was taken to support the structure on piled foundations.

"The development involves the construction of 3.2km of tunnels for the accelerator, which will mostly be built using cut and cover techniques," explains Fair construction director Florian Hehenberger.

"In total we will be using 600,000m³ of concrete – not all of it is structural as much of it is for radiation protection – and 35,000t of steel on the scheme."

According to Hehenberger, the geometry of the project is complex and the tolerances ➤

IN SUMMARY

The development of a new particle accelerator in Germany involves construction of buildings with concrete walls up to 8m thick, which will put a heavy load on the ground. Settlements of between 100mm and 350mm have been predicted, so the structure will be supported on piled foundations. In total 1,400 piles up to 60m long and 1.5m in diameter will be constructed at the site.

WHERE?



IN FIGURES

1,400

Number of piles being constructed

600,000m³

Volume of concrete that will be used to build the Fair facility

WHO?

The foundations element is being delivered by Züblin and Max Bögl working in joint venture and using rigs from Liebherr and Bauer to fast track the work.

CHALLENGES

The development involves the construction of 3.2km of tunnels for the accelerator, which will mostly be built using cut and cover techniques. Ground conditions and heavy point loading meant that piled foundations were needed to prevent predicted settlements of up to 350mm.

MORE INFORMATION

www.fair-centre.eu

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Major work In total, 60km of piles will be constructed

◀ tight but it is the high groundwater levels and ground conditions that are the challenge.

The work has started on the €25M pile construction, which is being undertaken by a joint venture of Züblin and Max Bögl, and the contract for creating the construction trenches will be let next year.

“The trenches will be formed using the Berlin method of steel king posts and timber infills that are secured using temporary anchors,” says Hehenberger.

In total Züblin and Max Bögl will install 60km of piles and so far they have completed 26km of the total length.

“The top 18m of the piles are unreinforced and will be exposed when the construction trench is exposed,” says Hehenberger.

REDUCING SETTLEMENT

Extensive ground investigations carried out at the site and have shown the ground conditions are formed by 20m of Quaternary sands and silts over 75m of Tertiary clays. Pile testing and surcharge analysis showed that piling could reduce predicted settlement by 50%, whereas surcharging could still result in differential settlements.

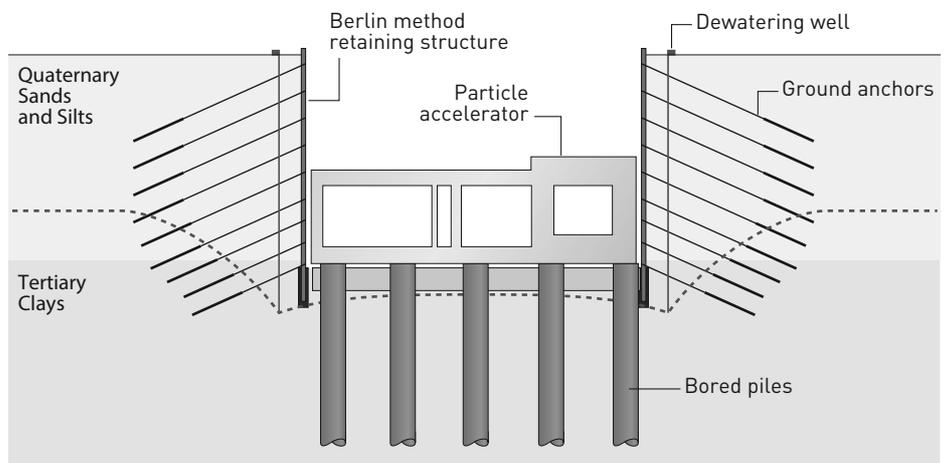
The piling work is being delivered by five rotary piling rigs fitted with Kelly bars to reach the required depth. The fleet is formed from three Bauer BG46 rigs and the first two Liebherr LB44 rigs to roll off the

➔ **FAIR: AERIAL VIEW**



Tunnelling task The facility will have 3.2km of tunnels

➔ **FAIR: CROSS SECTION**



“EACH RIG IS COMPLETING ONE TO TWO PILES A DAY WITH THE BORING TAKING FIVE TO SIX HOURS AND THE CONCRETING THREE HOURS.”

Michael Moser, Züblin and Max Bögl

production line, following its Bauma launch.

“The drilling is fully cased, which is unusual but the groundwater and ground conditions combined with the need to reach such depths has made it necessary,” says Liebherr-Werk Nenzing foundation equipment product manager Johannes Rhomberg.

Züblin and Max Bögl project manager

Michael Moser adds: “We started with one of the Bauer rigs on site in March to learn how the technique worked and learn about the soil conditions here.

“The original plan was to use a rig and crawler crane in combination with the crane used to extract the casing and install the reinforcement cages, but we soon realised ➔

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◀ that we could carry out the work with just the piling rigs.”

There are now five rigs on site with the first LB44 joining the fleet in July and the second arriving in August.

“We expect to finish the piling in May or June next year, which is faster than originally anticipated,” says Moser. “Each rig is completing one to two piles a day with the boring taking five to six hours and the concreting taking another three hours.”

The piles are being bored under water to avoid hydraulic collapse and the contractor has a desanding plant on site to enable the water to be recycled.

CONCRETE PLANT

Züblin and Max Bögl have also set up a dedicated ready mixed concrete plant on site to keep up with demand from the piling work. “It would have been impossible for a plant outside the site to have met the volume demand we have on this project,” explains Moser. “The concrete is a C35/45 mix.”

There are two types of reinforcement cage

|||||

THE ION AGE

The development is the result of a partnership of 10 countries and when the centre opens in 2018 it will be used by 2,600 researchers from 40 different countries.

Darmstadt is already home to a nuclear research centre, but the new development will be five times bigger than existing facilities. The main feature of the new facility will be a 1.1km particle accelerator ring with several extensions that will be used by four different research programmes.

“The main differences from the Cern facility in Switzerland and this new development is that we will look at all atoms

from hydrogen to uranium and Cern only focuses on hydrogen and lead,” says Fair managing director Boris Sharkov. “Here, we will be able to produce a higher quantity of ions and it will be more adjustable in terms of energy – speed – so we can carry out different research.”

The four types of research are: CBM, which will look at compressed matter which exists in neutron stars; Nustar, which will look at stellar explosions; Panda that will look at antiproton annihilation; and Appa, which will look at the atomic and plasma physics and applications for cancer treatments.

being used by each pile – one for the lower level and the other for the head of the pile – and these are brought onto site ready formed.

Hehenberger says that the piling was scheduled to take until early 2015 so it was

expected that the piling would run concurrently with the trenching work, but piling has been much quicker than anticipated. “The new rigs that Züblin and Max Bögl brought onto the scheme have really helped to fast track the work.”

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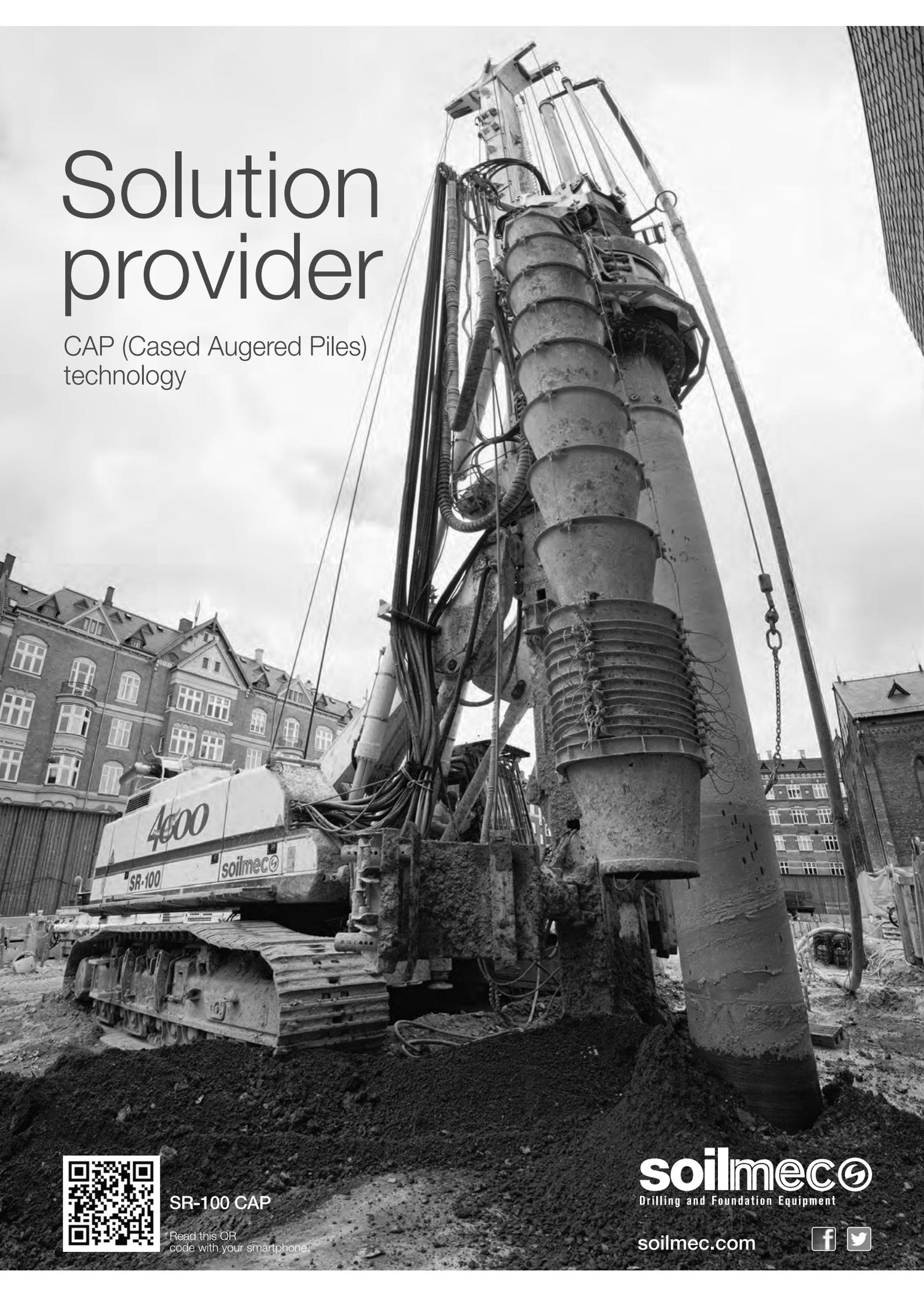
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