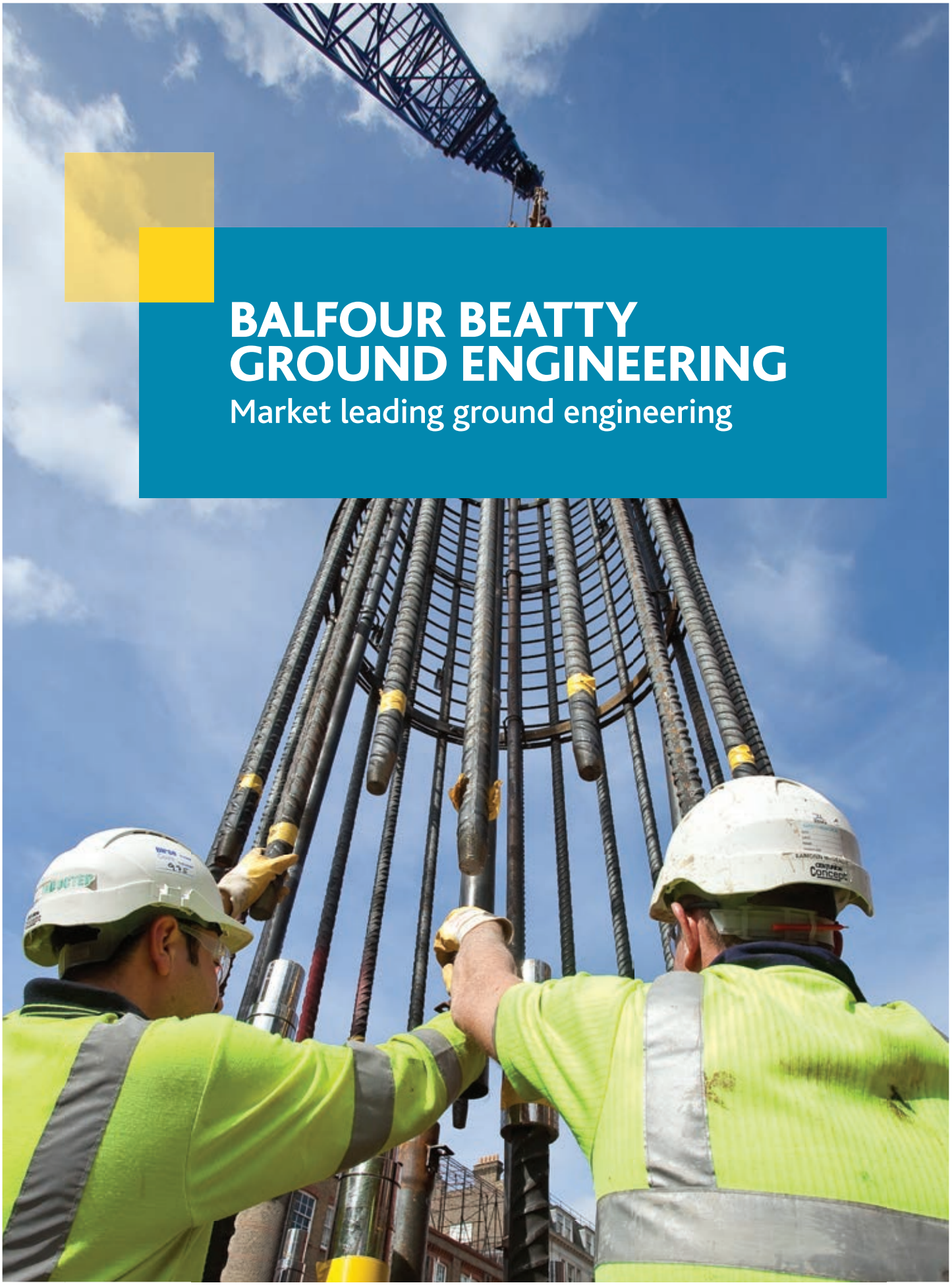


BALFOUR BEATTY GROUND ENGINEERING

Market leading ground engineering

Balfour Beatty
Ground Engineering

Balfour Beatty Ground Engineering offers a wide range of geotechnical services across the construction sector, from piled foundations to ground improvement, testing and analysis. We have established our reputation through our integrated design approach to every project, from the small to the very large. We best demonstrate our capabilities when we're consulted early on, sharing our expertise and experience to get your project off to a sure start.

CREATING THE INFRASTRUCTURE FOR EXCELLENCE

We make our processes as sustainable as possible, and are proud to have been the first ground engineering company able to evaluate our solutions for embedded carbon. Through collaboration with academic institutions, we make sure our techniques are at the forefront of innovation, so that we can offer the most effective all-round solutions for our customer's challenges.

Our ground engineering skills, equipment and experience provide a solid foundation for every project. We work across all construction sectors, helping our customers achieve cost savings by fully value-engineering projects using the latest design technology.

Balfour Beatty Ground Engineering. Success built on strong foundations.

FOCUS ON PILING AND FOUNDATIONS

Balfour Beatty Ground Engineering offer a comprehensive range of piling systems in the UK and Ireland.

- Rotary large diameter piles
- Continuous Flight Auger (CFA) piles
- Driven piles
- Mini piles

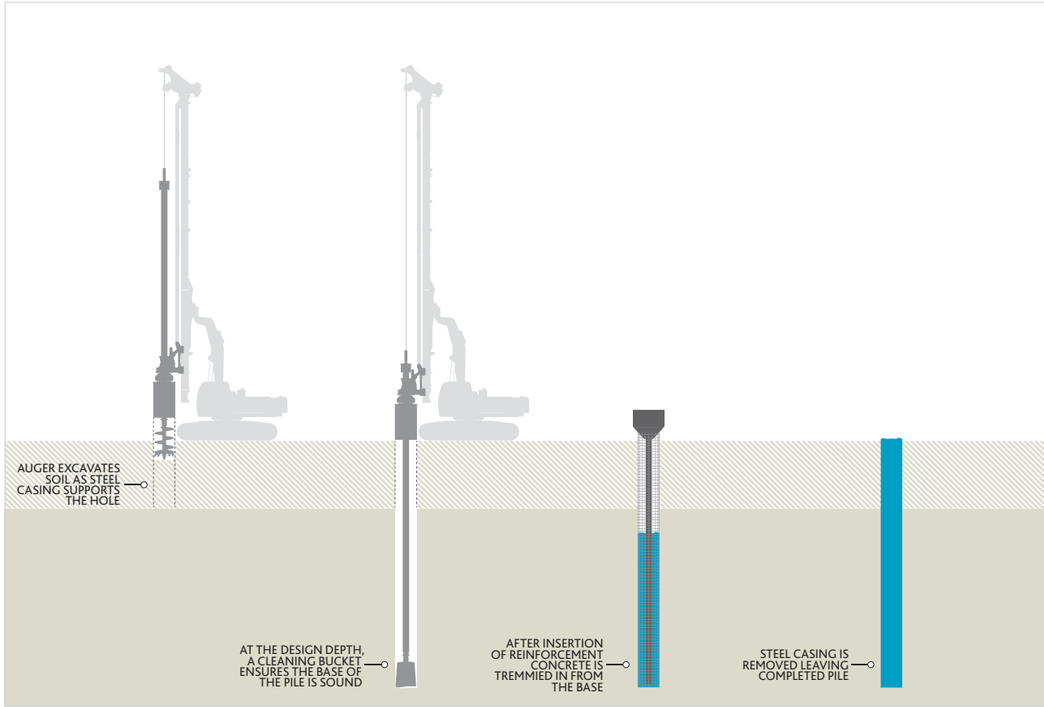
VAUXHALL SKY GARDENS, NINE ELMS, LONDON

ROTARY LARGE DIAMETER PILING

Primarily used for large public, commercial and industrial developments as well as transport infrastructure projects, we are one of the largest contractors in this field. We have particular expertise in delivering large, complex and technically challenging projects.

ROTARY BORED PILING RIG

ROTARY BORED PILING TECHNIQUE



To speed up construction of multi-storey projects with deep basements top down construction is used. This uses plunge columns within piles which enables the construction of the building above ground level to commence at the same time as excavation for the basement, saving months off the construction period.

Other developments include under reams for very high loads and drilling fluids such as bentonite and vinyl polymer, where the bore requires support during excavation.

To save on the construction of pile caps they can sometimes be removed altogether by embedding the steel structure directly into the top of large diameter piles. These are known as monopiles.

THE TECHNIQUE

An auger is used to excavate the soils, whilst a steel casing is inserted to maintain the bore through the top layers of unstable ground. A steel cage or pattern of reinforcing bars is introduced into the bore before the concrete is poured. The steel casing is later withdrawn. Where collapsible conditions are expected at depth, vinyl polymer or bentonite support fluids can be used.

This technique is suitable for all soil types and is ideal for retaining walls. The ability to deal with obstructions and the minimal disturbance created by the method are key strengths.

ROTARY BORED PILING TECHNICAL CAPABILITIES

DIMENSION	FROM	TO
PRACTICAL DEPTH	n/a	70m
DIAMETER	0.45m	3.0m
LOAD CAPABILITY	1,000kN	30,000kN (typical range)
MINIMUM WORKING HEIGHT	12.5m	Varies
TYPICAL RIG WEIGHT	37t	120t
NOISE PROFILE AT 10m	85db	90db
UNDER-REAMS	Typically 3 x shaft diameter	n/a
DRILLING FLUIDS	Bentonite, vinyl polymer	n/a
MONOPILES	From 0.75m	To 3.0m

THE SHARD IS AN 87-STOREY SKYSCRAPER IN LONDON THAT FORMS PART OF THE LONDON BRIDGE QUARTER DEVELOPMENT

Photography courtesy of www.vincewinterphotography.co.uk

CASE STUDY:
THE SHARD, LONDON

Standing at over 300m tall the tallest building in western Europe is supported on Balfour Beatty Ground Engineering Rotary Bored piles, up to 1.8m diameter and extending up to 60m in depth.

PLUNGE COLUMNS AT THE SHARD

Of the 166 load bearing piles, 67 had plunge columns installed, each inserted to an average vertical tolerance of 1 in 800 which has set new standards in the industry.

Each of the plunged column piles are designed to carry a working load of up to 24,000kN and are employed to facilitate top-down construction which saved over six months on the construction programme. The three level basement was retained using 388 no. 900mm diameter hard/firm secant piles, and these also supported the final structure.

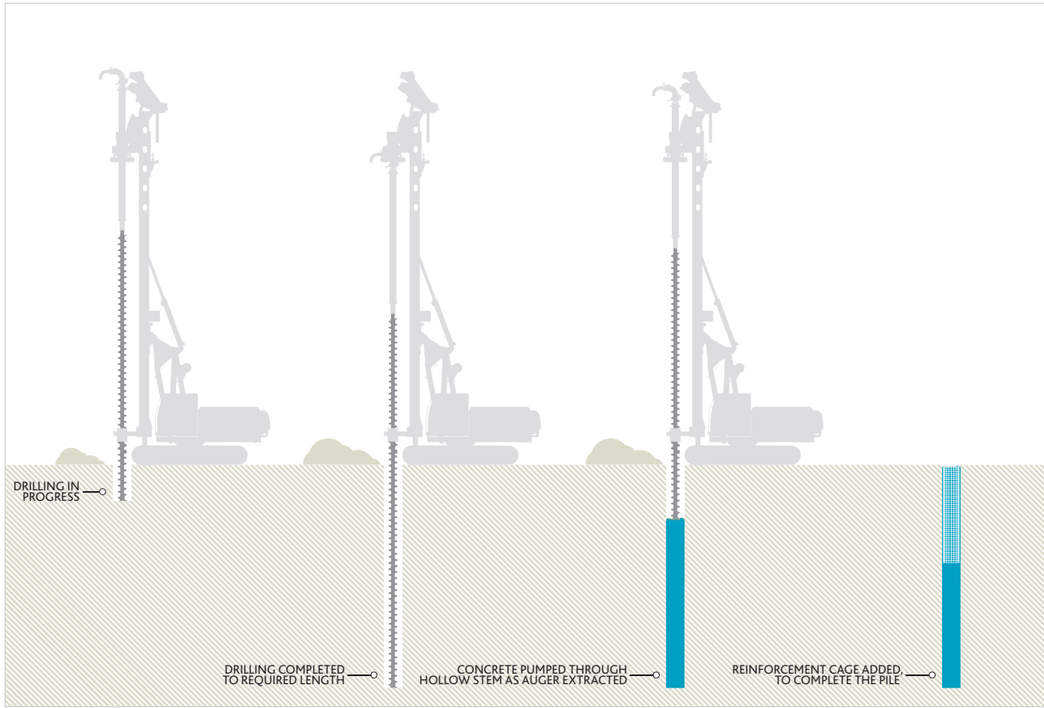
Coring of existing underreamed piles and foundations also presented challenges that were overcome using bespoke coring equipment.

CONTINUOUS FLIGHT AUGER (CFA) PILES

This solution is ideal for noise and environmentally sensitive sites for both load bearing piles and excavation support. Suitable for all soil types and fast to install, it is ideal for retaining walls as it causes minimal disturbance so posing limited risk to adjacent structures.

CFA PILING RIG

CONTINUOUS FLIGHT AUGER (CFA) PILING TECHNIQUE



Our integrated rig instrumentation system allows us to monitor installation and measure data such as depth, concrete pressure, volume and productivity. We use this data to produce graphical representations of pile conformity as a historical reference.

- CFA piling
- Auger displacement piling

THE TECHNIQUE

A hollow stemmed continuous flight auger is rotated into the ground to the required depth. As the auger is withdrawn, concrete is pumped down the hollow stem under balancing pressure forming a shaft of liquid concrete to ground level. A reinforcing cage is then inserted by hand or vibrator.

Two significant factors can influence the load bearing capacity of CFA piles – the sophistication of the equipment used and the experience of the operators on the ground. Our depth of experience and investment in R&D are both key strengths in this area.

CONTINUOUS FLIGHT AUGER (CFA) PILING TECHNICAL CAPABILITIES

DIMENSION	FROM	TO
PRACTICAL DEPTH	n/a	Max 33m
DIAMETER	0.35m	1.2m
LOAD CAPABILITY	Dependent on depth and ground conditions	
MINIMUM WORKING HEIGHT	10m	33m
TYPICAL RIG WEIGHT	38,000kg	87,000kg
NOISE PROFILE AT 10m	85db	90db

CASE STUDY: **READING VIADUCT**

The new £40 million Reading Viaduct was part of a redevelopment of the whole of Reading Station. Constructed by Balfour Beatty, it will ease congestion by taking fast mainline trains over freight and relief lines.

"Over 20,000 linear metres of piling has been completed by the Balfour Beatty Ground Engineering piling crews. The fact that all of it has been successfully completed within 15m of the operational railway, without any impact on train operations or driver concerns is a major contribution to the satisfaction of passengers on this key route."

Jim Weeden, Reading Station and Area Redevelopment Project Director, Network Rail

The £3.8 million foundations package included the installation of 980 continuous flight auger piles up to 1,050mm diameter and 24m deep through to the chalk bedrock, all required to support the viaduct structure.

The ground improvement phase required the installation of 1685 vibro concrete columns (VCCs), to support the ramps at the Eastern and Western ends.

The VCCs were up to 8m deep, toed into the terrace gravels and required a 600mm diameter enlarged head to support a geogrid load transfer platform which helped support the overlying embankment.

Working alongside the live railway, safety and logistics have been key to planning the project. One of the most critical stages was the installation of piles neighbouring the trackline on the main London to Swansea line and Reading commuter routes. These created a pinch point which required careful planning to accommodate rigs and handling cranes in such a restricted area.

"Careful planning was essential to this project, and our use of lean visual management has enabled us to closely monitor and control activities as well as provide instant updates to Network Rail."

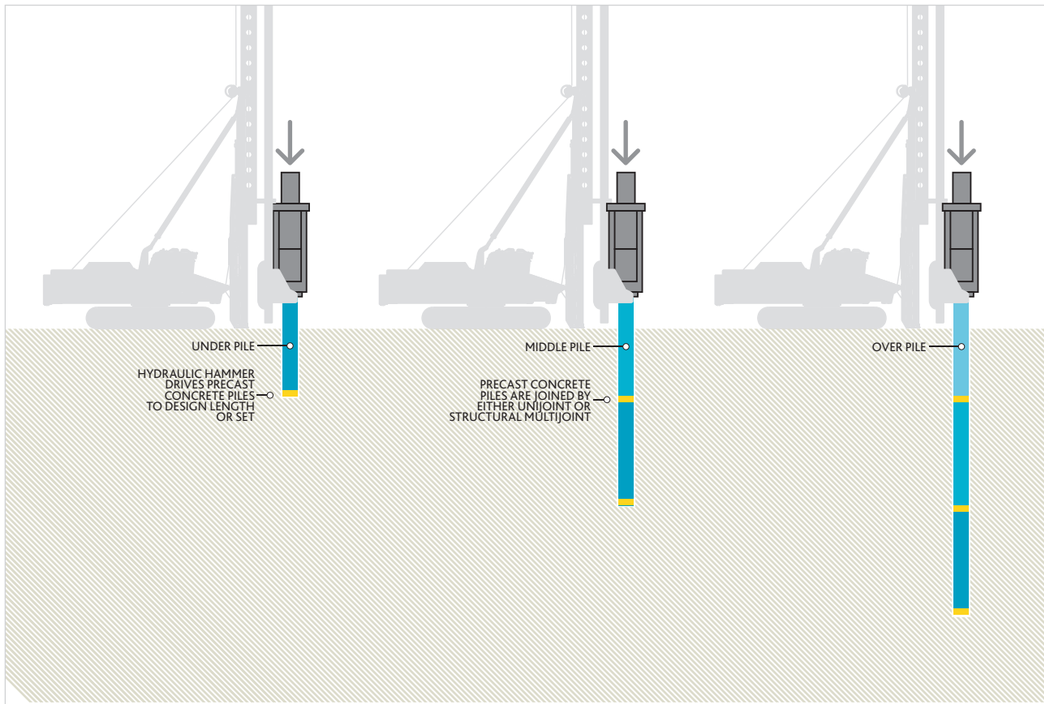
Rob Cannon, Project Manager, Balfour Beatty Ground Engineering

DRIVEN PILES

Due to their versatility, driven piles are widely used and are suited to most ground conditions. They are particularly suited where the founding strata is overlain by soft alluvial deposits or made ground. Driven piles are unaffected by ground water and don't generate spoil on site.

DRIVEN PRECAST CONCRETE PILING

PRECAST DRIVEN PILING TECHNIQUE



Adaptions that can be made to deal with contaminated land include a tapered shoe at the end of the precast pile to minimise risk of aquifer contamination in line with Environment Agency guidelines. In areas where environmental disturbance needs to be kept to a minimum we offer the most up-to-date enclosed hydraulic hammers which significantly reduce noise.

Steel tube and H-piles can be used as well, to deal with obstructive ground or where high shear loads need to be taken.

- Precast concrete piles
- Steel tube piles
- Steel H-piles

THE TECHNIQUE

Precast concrete piles are manufactured by BBGE off site in standard lengths up to 15m, and driven into the ground using a hydraulic hammer until the required depth/resistance is reached. Where a greater depth is required, the lengths are jointed together using the Multijoint or a pinned UNIjoint. In this way, piles can be as long as required to meet the load bearing specifications. Driven piles can also be raked up to 1:3 depending on hammer weight and pile size.

Enlarged heads are an add-on to precast piles that help spread the load of a building or embankment over a greater area and ensures that increased loads can be placed on the piles without the risk of the pile puncturing the slab or geo-membrane. Significant savings in slab reinforcement and thickness can be realised when using enlarged heads on piles.

PRECAST DRIVEN PILING TECHNICAL CAPABILITIES

DIMENSION	FROM		TO		
PRACTICAL DEPTH	Min 2.5m		Unlimited (72m longest to date)		
STANDARD PILE SIZES	190mm²	235mm²	275mm²	350mm²	400mm²
LOAD CAPABILITY (typically) (in the right conditions, piles would be capable of carrying loads 25% higher than the above indicated figures)	300kN	500kN	800kN	1,200kN	1,500kN
PILE SEGMENT LENGTH	Normally between 3m and 15m in one metre increments				
MINIMUM WORKING HEIGHT	12m		23m		
TYPICAL RIG WEIGHT	36,000kg		67,000kg		
NOISE PROFILE AT 10m	77-82db at rear of rig		85-90db at front of rig		

GROUND BEAMS AT BUSHBY, LEICESTERSHIRE FOR GATEWAY HOMES

BALFOUR BEATTY HOUSE FOUNDATIONS

This workstream focuses on full design and build foundation packages for housing, as well as for schools, community amenities and light commercial buildings.

DESIGNING PILE AND GROUND BEAM PACKAGES FROM ARCHITECTURAL DRAWINGS

We offer bespoke design packages from pile only schemes to full pile, ground beam and block floor solutions. For housebuilders, using a single point of service for all the foundation work saves time and money and ensures that projects can be managed effectively and safely on site.

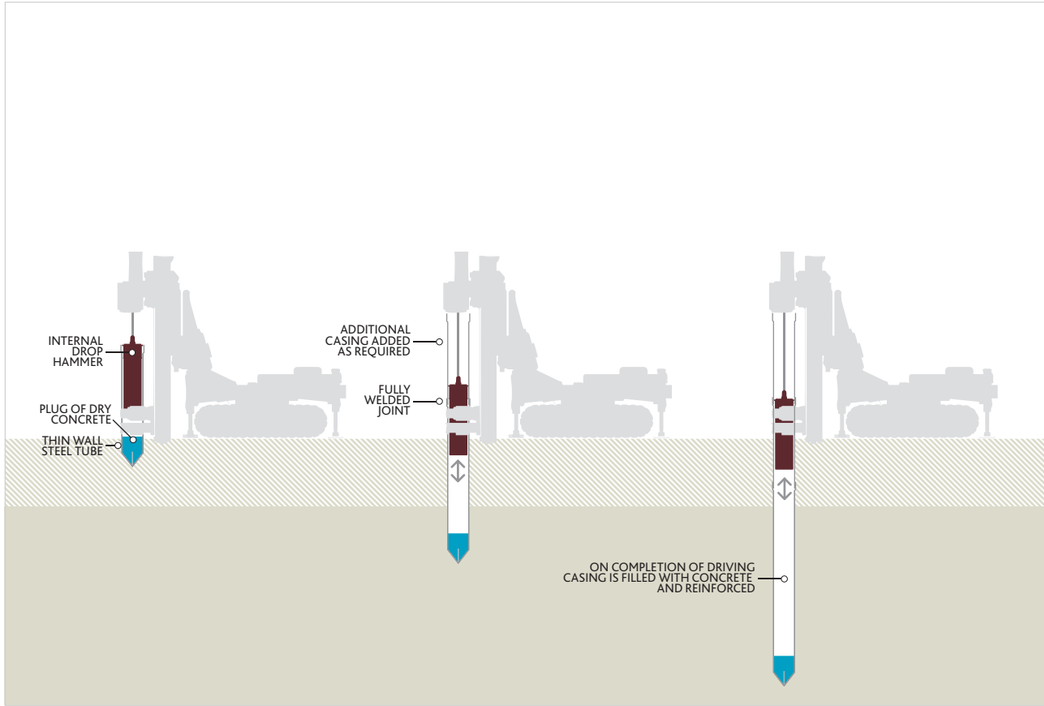
Utilising the architectural drawings with wall line loads, our team of experienced engineers can design the optimum configuration of piles and precast concrete ground beams to suit each scheme. Using quality assured factory components which are produced and installed to ISO5000 standards, our customers are assured that the system is compliant with all NHBC and LABC standards.

MINI PILES

BBGE offer a wide range of high capacity, small diameter piles which can be formed in almost any type of ground. Typically used where access or working space is restricted these rigs require minimal site preparation.

BOTTOM DRIVEN MINI PILING

BOTTOM DRIVEN MINI PILING TECHNIQUE



We offer the largest fleet of modern mini piling rigs in the UK:

- Bottom driven mini piles
- Augered mini piles
- Drilled mini piles
- Self-drilled micro-piles
- Soil nails
- Ground anchors

THE TECHNIQUE

A thin walled steel tube, closed ended, is driven in lengths of 1.5m to 6m using an internal drop hammer on to a dry concrete plug. The tubes are joined by a full fillet weld as the installation proceeds. The depth of the piles are designed using a predetermined set or length criteria.

Once the required depth is reached the tube is filled with high slump concrete or grout. A single steel reinforcing bar, cage or CHS (Circular Hollow Section) is then inserted.

BOTTOM DRIVEN MINI PILING TECHNICAL CAPABILITIES

DIMENSION	FROM	TO
DIAMETER	150mm	450mm
PILE LOADS	n/a	up to 1,500kN
HEIGHT OF RIG	2.2m	8.0m
LENGTH OF RIG	1.8m	3.3m
WIDTH OF RIG	0.7m	1.6m
OPERATING DISTANCE FROM FACE OF WALL TO CENTRE LINE OF PILE	350mm	500mm

CASE STUDY:
BEAULY-DENNY OVERHEAD LINE TOWER BASES, SCOTTISH HIGHLANDS

When complete, the Beauly-Denny Replacement Transmission Line project will have upgraded more than 220km of overhead power lines.

MINI PILING BEAULY-DENNY

The project stretches from Beauly near Inverness, to Denny, near Falkirk in often challenging terrain and includes the installation of approximately 532 new towers. Using eight of our mini piling fleet, Balfour Beatty Ground Engineering is installing a combination of drilled mini piles, top-driven steel tubes and precast concrete piles to support the foundations for over 160 of the new towers.

The geology is varied and the rocks are extremely strong. Initial progress was slow, despite using four rigs. The cage required for the horizontal loads dictated a 300mm diameter pile in the rock. By revisiting the entire design philosophy, we were able to reduce this diameter by utilising a heavy Ischebeck bar instead of the cage, at the same time as reducing pile numbers and overall drilling depth at each tower leg.

The reduction in diameter also improved the quality of positional tolerance control. The overall result of our changes has resulted in a 50% increase in pile production on the project. Where access and ground conditions permit the more cost-effective driven steel tube and precast concrete piling solutions have been used.

FOCUS ON RETAINING WALLS

Balfour Beatty Ground Engineering is able to combine a variety of piling and grab techniques for excavation support projects.

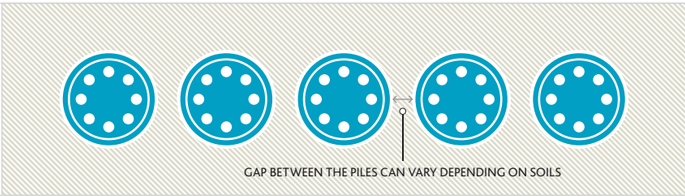
- Bored pile retaining walls:
  - Contiguous
  - Secant
- Diaphragm walls
- King post retaining walls

WEMBLEY STADIUM, LONDON – CONTIGUOUS PILE WALL

BORED PILE RETAINING WALLS

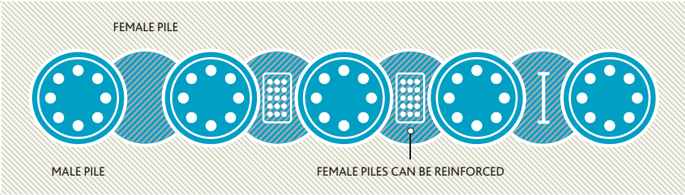
CONTIGUOUS PILE WALLS

Used in locations where water retention is not a consideration and soils are stable, contiguous bored walls dispense with interlocking piles completely. Typically a gap of 150mm to 300mm is left between the piles.



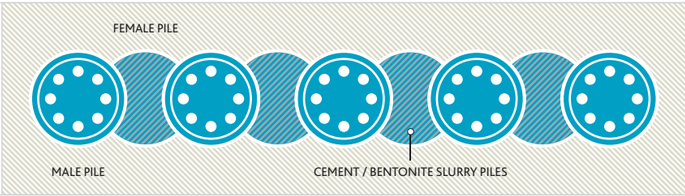
SECANT PILE WALLS (HARD / HARD AND HARD / FIRM)

Secant walls are particularly suitable where high water retention is a consideration as they have a positive interlock between adjacent concrete piles. Both male and female piles can be reinforced enabling high lateral loads to be supported.



SECANT PILE WALLS (HARD / SOFT)

This wall is used where considerations of height and lateral deflection are less critical. Female piles use self hardening slurry or unreinforced concrete to provide the seal between the reinforced concrete male piles.



SECANT PILE WALL, NARBOROUGH, LEICESTERSHIRE

Used most frequently for building basements, we can combine this technique with the installation of plunge piles to enable top down construction and thereby reduce the programme.

Either open bored or continuous flight auger techniques can be used to create retaining structures to cater for all ground and water conditions. There are three broad types of wall. Essentially primary piles are installed at suitable spacing to allow secondary piles to be installed between.

KING POST WALLS

Largely used as temporary retaining walls, this system uses a king post (open bore filled with concrete to form a base for steel H-pile). Panels of timber sleepers, precast concrete or steel sheets can then be slotted into the H-piles to form the retaining wall.

Where ground and environmental conditions permit the steel H-pile (king post) may be installed using driven techniques.

DIAPHRAGM WALLS

Diaphragm walls are underground structural elements commonly used as retention systems and permanent foundation walls. They can also be used as groundwater barriers. A reduced number of joints means that diaphragm walls have improved water tightness compared to secant walls. Diaphragm walls tend to be used for retaining deep excavations as they can be designed to take high structural loads.

Our experience in diaphragm walling is extensive with projects ranging in size from 2,000 to 50,000m^2 and from a few metres to over 50m deep. We are experienced in carrying out complex operations on restricted urban sites and have installed diaphragm walls at Heathrow Terminal 2B, Royal Arsenal Woolwich and in low headroom in the redevelopment of Westminster Station.

CASE STUDY:
HEATHROW TERMINAL 2B

This huge project required construction of a 2km diaphragm wall, over 700 piles and over 160 plunge columns for the new terminal building.

Over 43,000m³ of concrete and 7,800 tonnes of prefabricated steel cages were used to construct the piles. There were over 1,100 deliveries to the site for the cages alone!

The diaphragm wall was split into 320 panels with the length ranging from 3.1m to over 7m. All the panels were 1m wide and constructed to a maximum depth of 25m. In total over 39,00m³ of concrete was poured and 6,795 tonnes of steel, made up of 615 prefabricated reinforcement cages were installed. The cages included casting ducts for the anchor construction and couplers for up to three slab connections. The slab connection couplers were installed to a tight tolerance of +/-50mm.

The diaphragm wall was excavated using a hydraulic grab, mounted on the end of a Telescopic Kelly Bar, carried on a heavy duty base unit. Bentonite fluid was used to provide support to the sides of the excavation to prevent it from collapsing.

A total of 705 large diameter piles were installed over a period of seven months, this equates to around 35km of total bored length (roughly the distance from Dover to Calais!). The piles were 1,200mm, 1,500mm and 1,800mm in diameter with the average depth being 50m.

The piles were all constructed from the existing ground level with the pile cut-off level being between 10 and 15m below this ground level.

Over 43,000m³ of concrete and 7,800 tonnes of prefabricated steel cages were used to construct the piles. There were over 1,100 deliveries to the site for the cages alone!

We installed 163 plunge columns during the Heathrow Terminal 2B project, the largest number ever installed on a project in the UK. The columns were plunged into large diameter piles that were 1,800mm in diameter. Each column weighed approximately 15 tonnes and was up to 17m in length. The columns had to be installed to a strict vertical tolerance of 1 in 400 and with just a +/-10mm level tolerance.

Columns were installed using two plunge frames during both day and night shift leading to the completion of the plunge columns two weeks ahead of schedule.

FOCUS ON GROUND IMPROVEMENT

Balfour Beatty Ground Engineering provide a comprehensive range of ground improvement solutions using state-of-the-state equipment ideal for engineering brownfield sites and areas of weak compressible soil.

- Vibro stone columns
- Vibro compaction
- Vibro concrete columns
- Dynamic deep compaction
- Pencol™
- Marine ground improvement

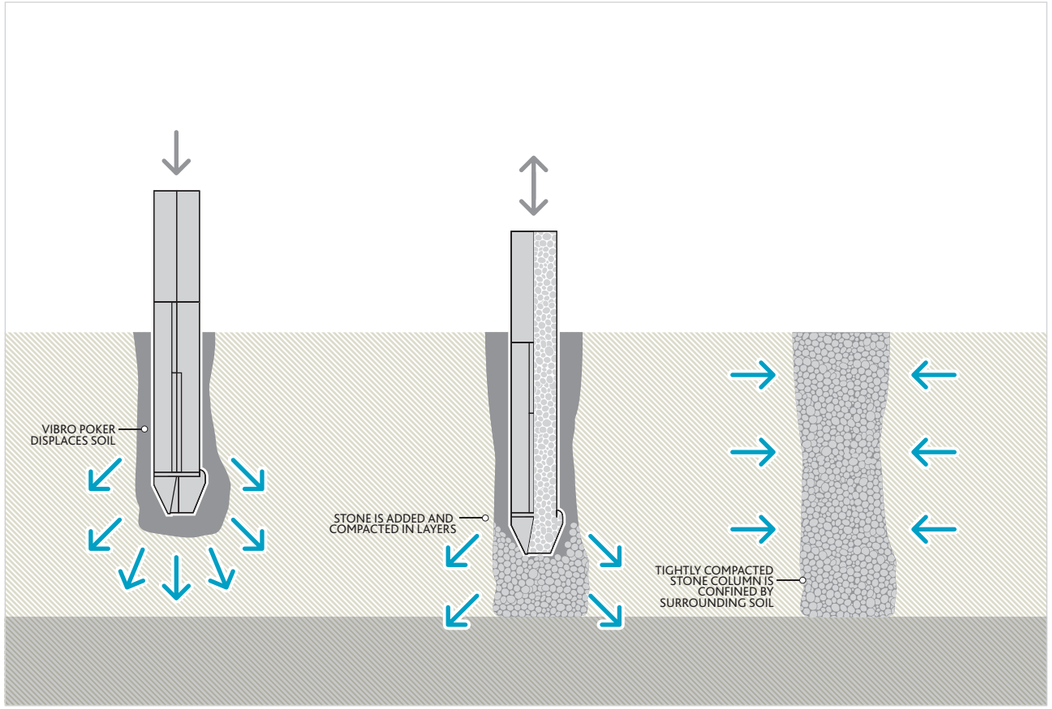
MARINE VIBRO COMPACTION – VANCOUVER DELTAPORT

VIBRO STONE COLUMNS

The Vibro stone column system is the most common ground improvement technique in the UK. Fast and efficient it can treat a wide range of weak soils and offers significant savings over piling.

VIBRO STONE COLUMNS – TOP FEED

VIBRO STONE COLUMNS BOTTOM FEED TECHNIQUE



THE TECHNIQUE

A vibrating poker attached to a purpose-built vibropiling rig is inserted into the ground using a combination of its own mass and the pull-down facility of the rig. Once refusal or design depth is achieved the vibroflot is removed and a charge of graded stone is tipped into the hole. The vibrating poker then re-enters the hole to compact the stone into the soil. The process is repeated until a very tightly compacted stone column is formed. Where collapsible soils are present, such as soft clay and sands with a high water table, then the bottom feed system is used to form the stone column.

Our ground improvement solutions offer the following benefits:

- Simplified sub structure design and construction
- Little or no spoil generated – avoiding the need for expensive disposal costs
- Reduced project time through fast design and implementation
- Around 30% of the aggregates we use come from recycled sources, contributing to the sustainability requirements of projects
- Treatment of a wide range of soil types
- Specifically developed equipment for restricted access and limited headroom situations

VIBRO STONE COLUMNS TECHNICAL CAPABILITIES

DIMENSION	FROM	TO
PRACTICAL DEPTH	1.5m	15m – rig mounted) / 30m – crane mounted
DIAMETER	0.3m	1.3m
GROUND BEARING CAPACITY	Typically up to 200kN/m² (higher in granular soils)	
MINIMUM WORKING HEIGHT	7m	Varies
TYPICAL RIG WEIGHT	22,000kg	58,000kg

CASE STUDY:

NATIONAL INDOOR SPORTS ARENA AND VELODROME, GLASGOW

The National Indoor Sports Arena and Velodrome was the main indoor sports facility at the 2014 Commonwealth Games, providing competition venues for track cycling and badminton.

GLASGOW VELODROME

ONE STOP SHOP

The £116m project was built in the east end of Glasgow, close to Celtic's Parkhead ground.

BBGE were awarded the work by main contractor Sir Robert McAlpine after a value engineered solution was proposed utilising:

- Dynamic compaction
- Vibro stone columns
- Large diameter rotary bored piles
- CFA piles
- Driven precast concrete piles

One advantage to the client was that all of the required techniques could be provided by BBGE. This meant the programming, communication and coordination required was much simpler when compared to the alternative of appointing different subcontractors for each technique.

The ground improvement works commenced first with dynamic compaction undertaken for the floor slab. The slab is lightly loaded and the granular ground conditions meant the dynamic compaction technique was suitable to achieve a bearing capacity of 15kN/m² in this area.

For the curved design of the Sir Chris Hoy Velodrome cycling track 1,287 vibro stone columns were installed using both top and bottom feed methods.

The structure was supported by a combination of Rotary Bored Piles (bores supported using Vinyl Polymer fluid), and driven precast concrete piles.

FOCUS ON SUSTAINABLE ALTERNATIVES

Balfour Beatty Ground Engineering offer a wide range of sustainable solutions and aim to ensure that the products and services we deliver help to contribute towards our customers' sustainable targets.

BBGE PRECAST PILE FACTORY – ZERO WASTE TO LANDFILL

USING ENVIRONMENTALLY FRIENDLY POLYMER SUPPORT FLUID

SUSTAINABLE SOLUTIONS

SUSTAINABILITY
a collective responsibility

OUR FACTORIES

Our two factories in Scotland and Nottinghamshire manufacture all our precast piles. This means that as well as having full quality control we are also able to ensure they are sustainable. This includes the use of 100% harvested rainwater, 99% recycled steel reinforcement and a minimum of 25% cement replacement in the production of all our precast piles. Having our own factories also means that we are able to produce non standard pile sizes and reinforcement to meet specific needs, as well as setting up modular pile production units as required.

GEOTHERMAL PILES

Providing Geothermal Piles for use in ground storage systems is one way that we can help with the provision of renewable energy and reduce carbon emissions.

Leading by example BBGE developed the first use of Geothermal precast concrete driven piles in the UK which are being used to provide energy for the BBGE office in Scotland.

GEOTHERMAL LOOPS WITHIN CFA PILES

ZERO WASTE PILING

We launched the UK's first precast concrete pile cutting system which has the potential to reduce waste to zero.

The patent pending system works by diamond-tipped twin blades neatly cutting precast concrete piles to within 100mm of ground level. If used in every BBGE project to the optimum it could save up to 2,000 tonnes of harmful CO_2 emissions per year.

RE-USE OF EXISTING PILES

In many city centre developments the sites have been previously built upon. When redeveloping these urban areas we often encounter old foundations and existing piles, which cause obstruction and are problematic.

Using a combination of rigorous integrity, materials and load testing can lead to existing piles being deemed suitable for re-use, with appropriate warranties given.

PENCOL™

Pencol™ offers a highly economical and sustainable alternative to piling. It is a new and effective ground improvement technique developed to provide enhanced bearing capacity and settlement control in very weak soils. It works in conjunction with a load transfer mattress which shares the load between the columns and soil.

FOCUS ON TESTING AND ANALYSIS

We are established providers of specialist technical services to the construction industry.

VIBRATION MONITORING

PROVIDING SURETY OF DELIVERY

PILE TESTING

Through our UKAS accredited team who have a proven track record built from over 30 years' experience, we offer:

- Static load testing
- Dynamic load testing
- Integrity testing
- Sonic logging

NOISE AND VIBRATION MONITORING

Our comprehensive range of noise and vibration monitoring capabilities includes prediction, measurement and the control of both environmental and personal exposures to noise and vibration.

DIAGNOSTIC TESTING

We undertake structural, diagnostic and geotechnical monitoring on buildings, bridges, car parks and industrial premises. We survey structures to assess the nature and extent of any defects, their probable cause and to allow development of repair strategies.

SOUND INSULATION TESTING

We are UKAS accredited for sound insulation testing for residential and commercial buildings. Testing is carried out in accordance with the Building Regulations Schedule E. We also offer an acoustic design and testing service for UK schools in accordance with Building Bulletin 93 through our partnership with Parsons Brinckerhoff.

WORKING PLATFORM ASSESSMENT

As part of the Balfour Beatty Zero Harm initiative BBGE have developed a suite of tests to assess working platforms and piling platforms constructed with unbound material. Tests include:

- Plate Load
- Clegg Hammer
- Light Weight Deflectometer (LWD)
- Ground Penetrating Radar (GPR)

STRUCTURAL AND ENVIRONMENTAL MONITORING

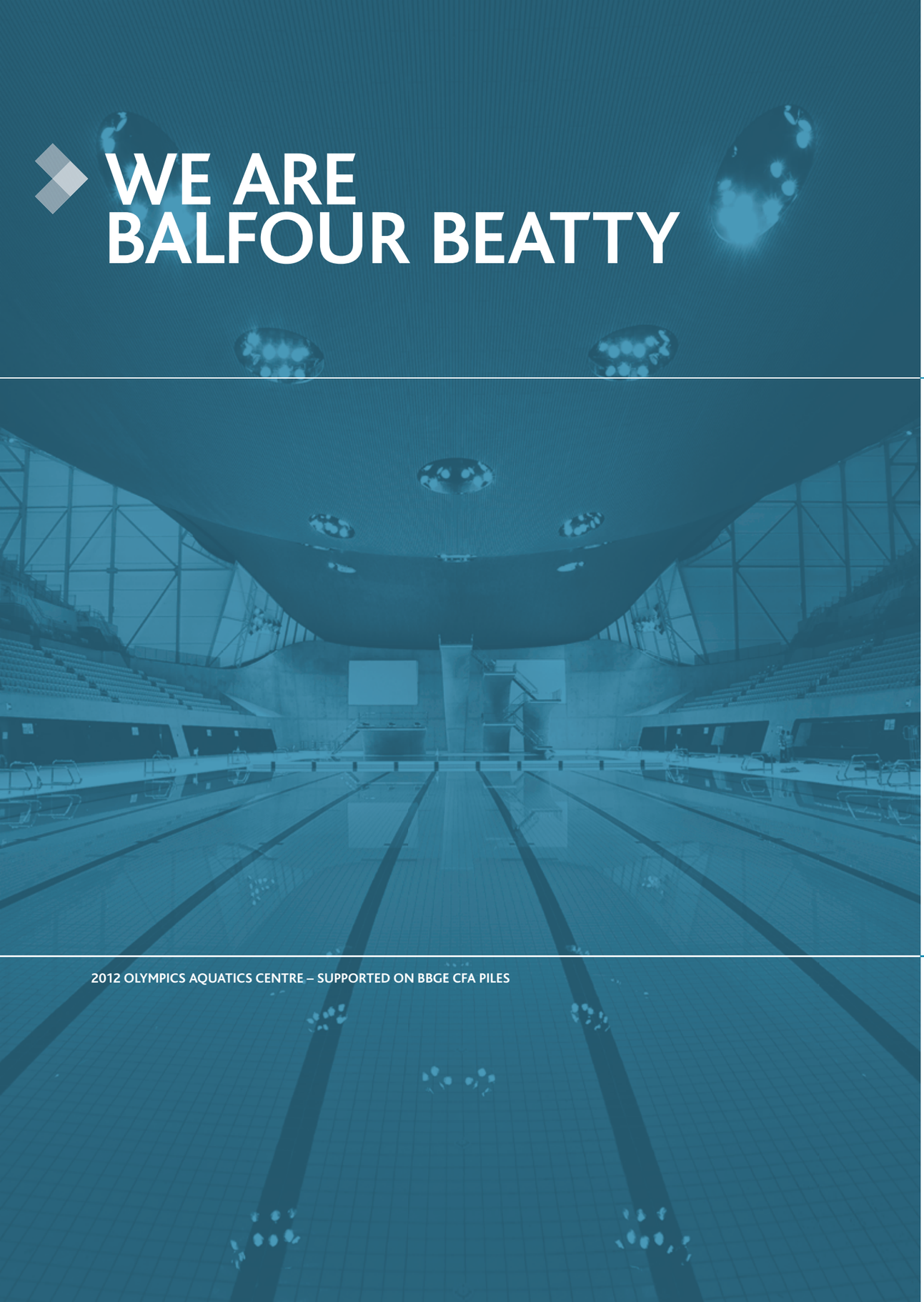
We offer a full structural monitoring service covering a wide range of structures including retaining walls, modern and historic buildings, monuments, bridges, tunnels, jetties, dams, pavements, pipelines, railways, industrial utility plants, earthworks and embankments.

Our range of environmental monitoring services include Legionella testing, air quality monitoring and gas monitoring.

THERMAL RESPONSE TESTING

BBGE can test the thermal conductivity of the ground to provide the information necessary to design Geothermal piles, Geothermal boreholes and Ground Source Heat Pumps (GSHP).

WE ARE BALFOUR BEATTY



2012 OLYMPICS AQUATICS CENTRE – SUPPORTED ON BBGE CFA PILES

Balfour Beatty is a global integrated infrastructure services group, with operations in over 80 countries.

OUR STRATEGIC PRIORITIES

ZERO HARM

Zero Harm is our commitment to eliminating any injuries or deaths as a result of our activities and aiming for an Accident Frequency Rate of zero.

Zero Harm means eliminating hazards, maintaining Zero Harm day-to-day, keeping the public safe, keeping our people healthy, working with our customers and supply chain.

We have launched a set of ten **Global Safety Principles**, which apply to all employees of Balfour Beatty and under no circumstances will any of our employees carry out a task unless they comply with them. They cover:

- Working at height
- Restricted areas
- Unsupported ground
- Mobile equipment
- Energy sources
- Equipment limits
- Work over water
- Driving
- Protective arrangements
- Lone work

BECOMING MORE SUSTAINABLE

We want and need to be a truly sustainable business. Our strategy to deliver this is called the Blueprint and is based on three central pillars:

- **Profitable Markets**
  Through close collaboration with our supply chain and the creation of unique industry partnerships, we are helping our customers to choose more sustainable solutions.
- **Healthy Communities**
  Our activities must improve the quality of people's lives while supporting the needs of future generations.
- **Environmental Limits**
  Sustainable development means using less natural resources, as well as managing our environmental risk and biodiversity.

GREAT CUSTOMER RELATIONSHIPS

We want Balfour Beatty to be recognised in all its market sectors for customer focus and collaborative working. We look to build mutual trust through listening and acting on what we are told. We use our customer experience (MAP) reporting tool to do this.

Every quarter, from the start of a project through to its completion, we invite our customers to provide feedback on how project delivery is shaping up and how it's meeting their expectations in order to help shape improvements as work progresses.

Our Perfect Landings process helps us work with our customers and stakeholders to make sure they get the best out of their newly built assets.

At its core is a progressive, collaborative approach that provides gateway reviews throughout the project lifecycle. There are clear deliverables that allow all those involved to understand the actions required in order to make the project a success. This all builds towards managing a smooth transition from construction through to handover, operations and after care.

OPERATIONAL EXCELLENCE

Jobs that deliver what we promised to the customer. Our customers get a smooth, professional service that involves good communication and regular reviews where we can see exactly how we are doing, providing additional support when it is needed to ensure that our projects succeed physically and commercially.

Every team should finish a job stronger: developing their capabilities, understanding and experience, enabling them to grow their careers and helping Balfour Beatty offer an even better service.

PEOPLE AND PERFORMANCE

Our people are accountable and professional, coming together to make high performing teams that deliver for our customers. We help them grow their careers with Balfour Beatty.

We have created Communities of Practice where people involved in the core skills of construction get together, share ideas and best practice and help the business to understand where it can provide further support to improve performance.

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