



GROUND ENGINEERING

October 2023

PROPPING UP THE INDUSTRY

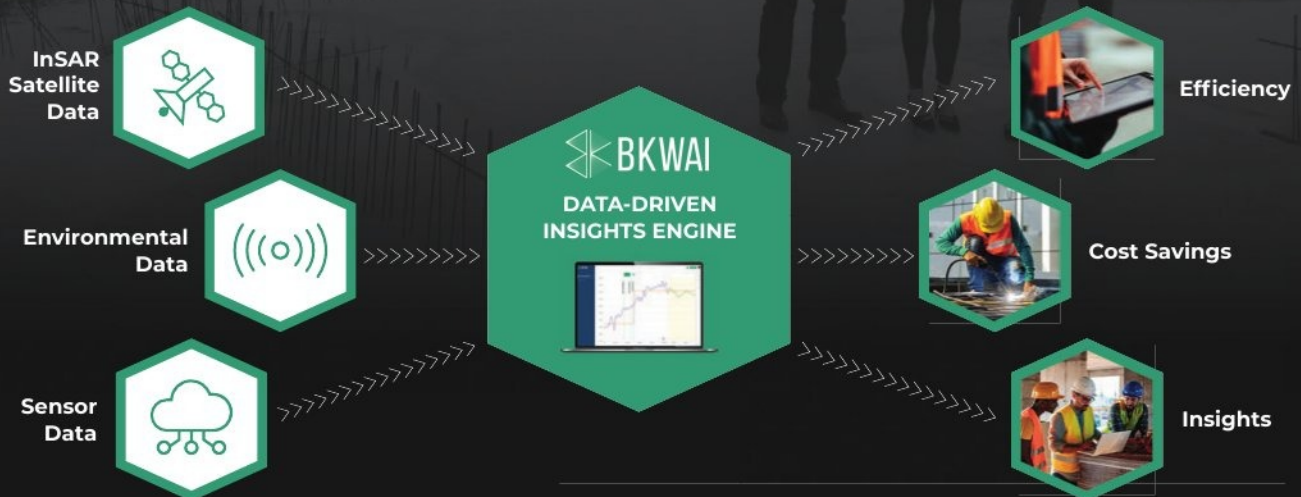
GE100: Geotechnical firms remain optimistic despite tough market conditions

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Ups and downs



“Contracts are being awarded for the lowest price to balance out the higher cost of energy and materials”

The 2023 GE100 survey results are in and, as expected, it's a mixed bag.

The combined turnover of the top 100 geotechnical contractors, consultants, manufacturers and suppliers on our list has continued to rise, since the last dips in 2019 and 2020.

Whether this will continue in 2023 and 2024 remains to be seen.

Delays to project starts, uncertainty about project funding, budget overspends and continuing inflationary pressures are all causes for concern. Even so, more than 50% of the GE100 survey respondents have predicted workload increases in the coming year.

Many are, however, expecting profit margins to be further squeezed. In some cases, in the current competitive environment, contracts are being awarded for the lowest price to balance out the higher cost of energy and materials. Megaprojects like High Speed 2, while keeping geotechnical companies busy in recent years, have also been a

drain on resources.

Based on the survey results, growth is due to slow down in a number of sectors, although ground engineering companies are expecting work on power and water schemes to come through.

But to deliver these projects, the industry needs the right technical skills and a talent pool of appropriately qualified professionals.

And the UK geotechnical sector's ability to attract new, and retain existing, talent will suffer if market uncertainty prevails and salaries remain stagnant.

The industry also needs to create more inclusive workplace cultures and emphasise the importance of sustainable practices to showcase more modern and attractive career paths. This should be done before employees start looking to other industries or seeking work abroad, where infrastructure projects continue to progress.

**Nia Kajastie, Editor,
Ground Engineering**

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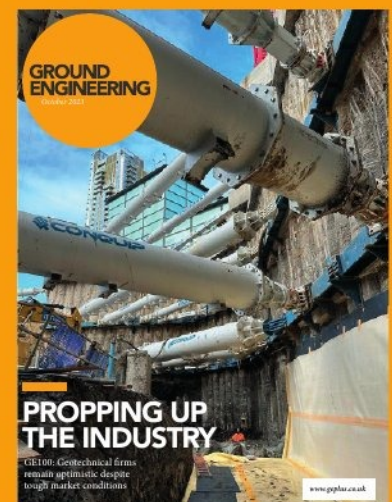
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Key consultants appointed for Dublin Metrolink project

A team led by Turner & Townsend and WSP, and supported by O'Connor Sutton Cronin, Mace and PWC, is to help Transport Infrastructure Ireland deliver Dublin's Metrolink – Ireland's first metro railway.

The multidisciplinary client partner team will support the development and construction of the proposed 18.8km long Metrolink for Dublin – much of which will be underground. The original route was to run for 26km, but was scaled back in 2019.

The metro will include 16 stations between Swords in the north of the city and Charlemont in the south.

The new network will link Dublin Airport to the city centre, stopping at key city locations including Ballymun, O'Connell Street and St Stephen's Green.

Project client Transport Infrastructure Ireland chose the delivery team. It has appointed each of the partners to a framework that runs for 13 years until 2036.

Under the framework, development and construction activities are scheduled to take 12



Metrolink for Dublin will link the airport with the city centre

years and it will take a further year to bring Metrolink into operation.

Transport Infrastructure Ireland project director for Metrolink Aidan Foley said the appointment of the client partner team was a "key milestone in the development of the Metrolink project".

"We believe the terms of engagement through the NEC4 professional services contract

represents a real opportunity to work collaboratively and productively towards achieving our shared project goals," he said.

"We are looking forward to working closely with our new colleagues to advance the project through the next stage of its development."

The recent appointment comes six months after Atkins bagged the

job to carry out the detailed design work for the project's advance works programme.

The programme consists of seven contracts, including utility diversions, archaeological and heritage works, facilitation of land access and environmental monitoring.

Ground investigations for the project got underway in 2019.

Silicon Valley's £7.3bn phase two subway extension moves forward

Early construction activities for San Francisco Bay Area's rapid transit system phase two extension are due to get underway after the City of San Jose approved a key permit for the project in August.

The latest Bay Area Rapid Transit (Bart) project will extend the subway by 9.6km from Berryessa Station through downtown San Jose to Santa Clara, with 8km constructed underground.

It is part of the wider Santa Clara Valley Transportation Authority's (VTA's) Bart Silicon Valley Extension Program, which aims to expand Bart services into Santa Clara County. Phase one has been completed and opened to the public in 2020.

The project's US\$9.3bn (£7.3bn) second phase, known as the Bart Silicon Valley II Extension Project, is now underway and is billed as

Santa Clara County's largest single public infrastructure project.

It includes four new stations and an 8km long single bore tunnel built with a tunnel boring machine.

In May 2022, Kiewit Shea Traylor joint venture won the design-build contract for the tunnel and track work.

The project is soon expected to progress to the early works construction stage after the City of

San Jose approved a final Construction Transportation Management Plan (CTMP) on 15 August.

The CTMP grants the VTA permission to bring site vehicles and plant into station areas during construction work.

Tunnelling and other construction activities are scheduled to start on site in spring 2025.

BRIEFS

Keller half year results show 50% profit jump

Keller Group has reported record performance in revenue and profit for the six months to 30 June. In its interim results Keller reported revenue of £1.47bn, up 6% on the same period last year. It said this was due to its “diverse and resilient” revenue streams. Its underlying operating profit for the period is £67M, up 50% on last year, with an increased underlying operating margin of 4.6%.

Venterra Group buys Cape Holland

Offshore wind energy services business Venterra Group has bought Dutch offshore piling equipment manufacturer Cape Holland. Beilen-headquartered Cape Holland develops unique vibro lifting tools to handle and drive piled seabed foundations.

Surplus soil guidance released

Ciria has published its *Sustainable management of surplus soil and aggregates from construction* guide for developers, contractors and consultants. It will help them ensure materials and waste management are a part of a project’s design from the start. The publication is the result of Ciria research project RP1124, which was created to provide waste soil management guidance.

SEVERN RAIL RESILIENCE JOB FINISHED



The landslide-prone Severn Estuary railway line has reopened after three weeks of upgrades, bringing the second phase of Network Rail’s £25M resilience programme on the Newport-Gloucester line to an end.

Network Rail, its contractor Amco Giffen and Amco Giffen sister company QTS carried out the work on a 1.6km long stretch of line close to Purton, north of Berkley, between 31 July and 18 August. As part of

the work, trained specialist rope access technicians abseiled down the cliff face to remove 1,000t of loose material. They then secured an “active” mesh system above the railway with 5,000 rock bolts.

Troubled Snake Pass road moves again

Derbyshire County Council has said that the troubled A57 Snake Pass road is showing signs of movement again – just three months after the route underwent extensive landslide damage repairs.

In May the road was resurfaced at Gillot Hey and Wood Cottage, where sections of the A57 suffered landslides in February last year following a period of heavy rainfall.

A third landslide also occurred along the route at Alport, where the road dropped by 2m and left major cracks to the road surface.

Since carrying out the repairs to the Gillot Hey and Wood Cottage sites, the council has noticed that the road surface “is already showing

some signs of movement” at these locations and that the movement is occurring “much more quickly than in the past”.

It will continue to monitor the sites and may need to reinstate temporary traffic lights and a reduced speed limit, it said.

Temporary traffic lights and a 20mph speed limit were put in place at Gillot Hey and Wood Cottage to protect the road from further damage following the landslide in 2022. The temporary lights were removed following the repairs in May.

The road surface at the Alport landslide site shows “no signs of any movement”, the council said.

New NEC guidance published

A new guidance note for using the New Engineering Contract (NEC) suite to procure ground investigation services has been published.

NEC contracts have been designed for use in most types of built environment work.

Developed by the NEC Contract Board, the guidance gives advice on how to deal with the specific requirements of ground investigation contracts.

Ground investigation works generally consist of two parts: drilling, boring, excavation, sampling, insitu testing and monitoring; and surveying, analysis, laboratory testing and reporting of findings.

Geotech sector reacts to loss of 'iconic' Crooked House

Demolition of the Crooked House pub in Staffordshire marks the loss of an "iconic image representing mining subsidence-related geohazards", according to an engineering geologist.

The pub was recently demolished after it was gutted by a fire.

It was famed for being Britain's wackiest pub because mining subsidence had caused one side of the building to sink to 1.2m below the other.

Built in 1765 as a farmhouse, the structure gradually began sinking in the 19th century as a result of mining activities linked with nearby Himley colliery. It later became a pub called the Glynne Arms and was renamed the Crooked House in 2002.

Despite leaning at an angle of 15°, the building remained standing for more than 250 years.

Following a fire on 5 August the whole pub was demolished on 7 August without council approval. It was recently sold by Marston's Brewery to ATE Farms.



The pub was originally built in 1765

Its destruction has been met with sadness and disappointment by the geotechnical and geological community.

Warren Geotechnical

Associates geotechnical consultant and director Colin Warren, who is local to the area and knows the pub, recalled seeing "bottles rolling up the

tables" due to the building's uneven angles.

CGL technical director David Giles called the destruction of the pub a "wanton act of criminal vandalism".

"The ironic twist to its destruction is that no other significant structure can be built at the site due to the mining subsidence," he added.

ECS geotechnical senior principal David Wilshaw said the pub's 1.2m of mining-induced differential settlement made it a favourite haunt of the West Midlands geological and geotechnical community.

"As geotechs we talk about differential settlement of buildings and how much a building can accommodate, but when you're in a building that's got four feet of differential settlement and everything's kind of wonky [...], you sit there wondering how everything could possibly be working at that angle," he said.

Atkins wins Hong Kong reservoir relocation job

Atkins has won a design and engineering services contract to relocate two reservoirs in Hong Kong.

Awarded by Chun Wo – Sinohydro JV, the contract will support the Relocation of Diamond Hill Fresh Water and Salt Water Service Reservoirs to Caverns project.

The project aims to accelerate Hong Kong's sustainable development by increasing the use of rock caverns as viable water reservoirs.

Caverns in Lion Rock, east

Kowloon have been identified by the Water Supplies Department as key water storage locations.

Using the caverns will free space occupied by fresh water and salt water service reservoirs for housing and other essential facilities.

As part of the contract, Atkins will provide detailed cost saving design consultancy services during the construction phase. This includes cavern structures layout, construction blasting assessments and internal tunnel structures.

£11M Cairngorm funicular railway settlement agreed

Development agency Highlands & Islands Enterprise (HIE) has received £11M in an out of court settlement from the team responsible for building the troubled Cairngorm funicular railway.

The payment was agreed with contractor Galliford Try Infrastructure, owner of Morrison Construction; designer AF Cruden Associates; and Natural Assets Investments, the parent company of previous funicular operator Cairn Gorm Mountain Ltd.

HIE owns Cairngorm Estate and commissioned the funicular railway. It came into service in 2001 but had to close following the discovery of faults in the structure and foundations in 2018.

HIE had taken legal action against the companies involved in its original design and construction in the 1990s and early 2000s as well as the previous operator of the railway.

The lawsuit was scheduled to begin in August.

The 2km railway was originally built for £19.5M.

HS2 Northolt tunnels pass new milestone

Skanska, Costain and Strabag Joint Venture has completed the first 1.6km of High Speed 2's (HS2's) Northolt twin bore tunnel, after overcoming challenging ground conditions.

The two 2,000t, 140m long tunnel boring machines (TBMs), *Sushila* and *Caroline*, were launched in October 2022.

The machines have each installed more than 847 tunnel lining rings, made up of 5,929 concrete segments.

The tunnel being constructed by *Sushila* is for the southbound "downline", towards London.

Caroline is constructing the northbound "upline", towards the Midlands and the North. *Sushila* is slightly ahead of its twin, having completed 2.1km of its drive.

The Herrenknecht TBMs have been designed to bore through predominantly Lambeth Group, chalk and London Clay.

Earlier this year, tunnelling operations in Ruislip caused a giant pool of foam and a bubbling puddle of muddy water. Grout was also forced upwards through an investigation hole onto a rugby pitch at the same location. HS2 Ltd said that ground conditions were especially challenging at the Ruislip site as there is a sand layer on top of the tunnel between the London Clay and ground level.



Northolt tunnel: new milestone

TALKING POINT

Natalie Wride on the engineering industry's social mobility issue.

It is important to attract talent from diverse backgrounds to address our industry's persistent skills shortage. Science, technology, engineering, and mathematics (Stem) activities, mentoring, placements and student engagement are helping to drive change. But are we doing enough to ensure that the routes into an engineering career are accessible to everyone, particularly individuals from disadvantaged backgrounds?

The UK is one of the least socially mobile societies in the developed world. Individuals born into low income families, irrespective of their inherent talent and ambition, do not have access to the same opportunities as their more privileged counterparts.

Engineering UK has reported that those from advantaged social backgrounds are nearly four times more likely to secure intermediate, managerial or professional roles compared to their less fortunate peers.

Examining education and career aspirations, the study found a mere 35% of young people aged 13 to 19 in lower income households knew what subjects would be needed to become an engineer, in contrast to 52% of those in higher income households. The divide deepens when considering young individuals whose parents had not attended university, with only 30% having a grasp of the educational prerequisites.

The government's 2021 *State of the Nation Report* stated that only 51% of households earning

between £6,000 to £10,000 had home internet access, a vital resource for learning. Coupled with the economic consequences of the cost of living crisis, the digital divide is disproportionately affecting the most vulnerable students. It is clear there is a need to maintain the in-person Stem events and mentoring sessions to actively engage with all students.

Access to Stem subjects also varies significantly among schools.

Department for Education statistics published in March 2023 reported that 47% of students eligible for free school meals achieved a "standard pass" in English and mathematics for the 2021/2022 academic year. In contrast, nearly 75% of their non-eligible peers attained the equivalent grade.

Looking ahead to university, where typically GCSE English and maths are required, A-level physics often serves as a prerequisite or differentiating factor during the application process for an engineering degree. In some deprived areas of the UK, almost half of secondary schools do not offer triple science. In more affluent regions like the South East, this subject is universally available.

Awareness of apprenticeships and vocational routes also remains alarmingly low. Given that the cost of university has been regularly cited as a primary concern for students, these statistics should raise concern within our profession. Elevating the status and visibility of apprenticeships and vocational pathways should be seen as essential to transforming

engineering into an inclusive field that mirrors the diversity and talent of our society.

There is also a regional divide in the knowledge of engineering pathways. Engineering UK's report indicates that 43% of all surveyed 11 to 19 year olds are aware of apprenticeship options, but in London, this figure stands at a more promising 63%.

Similarly, young people in London exhibit a greater understanding of the subjects required to become engineers in the future, with a striking 69% awareness compared to a mere 27% in the East Midlands.

Initiatives that engage students in hands on Stem activities, promote diversity in Stem education and provide extra curricular opportunities can help build a strong foundation for future engineers, but perhaps we need to take a deeper look at the opportunities we are offering. While charities such as the Social Mobility Foundation are striving to address this problem by selecting high performing students within this regional social-economic split, we are still leaving a much larger talent pool untapped.

● *Natalie Wride is a senior geotechnical engineer at Mott MacDonald*



New Zealand unveils £21.4bn Auckland harbour tunnels plan

A 6km long twin bore road tunnel plus a 21km light rail tunnel are part of a “bold plan for Auckland’s future”, New Zealand’s prime minister has said. Their total cost is estimated at NZ\$45bn (£21.4bn).

The twin bore road tunnel will house a six lane dual carriageway and will go under Waitemata Harbour between Wynyard in central Auckland and Akoranga on the city’s North Shore.

The light rail tunnel will also start at Wynyard and then go under the harbour east of the Auckland Harbour Bridge and on to six new stations on the North Shore. It will add new underground stations at Belmont, Takapuna, Smales Farm, Glenfield, North Harbour, Albany West and Albany Bus Station.

Dubbed the second Auckland harbour crossing, the road and rail tunnels scheme will be the biggest ever infrastructure project in New Zealand.

Proposals for the harbour



The proposed road and rail tunnels will pass under Auckland’s Waitemata Harbour

crossings were outlined by prime minister Chris Hipkins and transport minister David Parker on 6 August.

The road and rail tunnels will both be delivered in stages, with options for the road tunnels to be considered by Waka Kotahi NZ Transport Agency, including whether to build both bores at once or separately.

Construction of the light rail tunnel is not expected to begin until after at least the first of the two road tunnels is complete, the New Zealand Government said.

“A project such as this must be delivered in stages, like the Waikato Expressway [a dual carriageway south of Auckland] was, so that the cost and roll-out of each element can be managed carefully

and responsibly.

“The government has asked the New Zealand Transport Agency Waka Kotahi to accelerate work on essential first steps towards realising a transport plan of this scale,” Hipkins said.

A draft Government Policy Statement of Transport to be released in the coming weeks will set out land acquisition options.

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• THE BRITISH •
GEOTECHNICAL
ASSOCIATION

Entries sought for 2023 Fleming Award

The British Geotechnical Association has put out a call for submissions to the 2023 Fleming Award competition.

The British Geotechnical Association (BGA) is seeking entries for its annual Fleming Award Competition which commemorates the life and work of piling engineer Ken Fleming. The award recognises excellence in the practical application of geotechnics on a project or as part of a project.

Entries will be accepted from project teams whose work has been substantially completed within the two years prior to the award date of December 2023. The teams typically include representatives from clients, main contractors, consulting engineers and specialist contractors.

There will be an emphasis on teamwork across the different disciplines involved in the project. The judges will also give consideration to projects that are particularly innovative.

The competition's final will be held on 5 December at the Institution of Civil Engineers (ICE) in London.

Each team will give a short 20 minute presentation, and then take questions for five minutes. While the judges deliberate, there will be a short keynote lecture.

The judges will include BGA executive committee members, previous winners and industry leaders. The winning team will receive a prize of £1,000, donated by Cementation Skanska.

For this year's competition, the BGA is inviting submissions from mid-September onwards. The entries can be uploaded to the BGA website.



Last year's Fleming Award winners collect their prize

BGA FUND AWARD

The BGA is accepting submissions for its Fund Award. The fund allows the association to provide financial assistance of up to £1,000 to members for further study or to advance their careers.

The BGA Fund Award is open to all members. Award funds can be used to assist with education and career/professional development. This includes research activities, books, training courses, equipment and conference/field trip attendance. Priority will go to those with limited alternative funding sources.

Applications are particularly encouraged from members who are at the early stages of their careers or who want to further their basic understanding of geotechnics.

Applications are assessed twice a year. The next application deadline is 30 November, and applications will be reviewed shortly after that.

Applications must be made via the form on the prizes page of the BGA website.

BGA DINNER AND LECTURE

Tickets for the inaugural BGA Annual Dinner and Lecture are still available. It takes place at the ICE on 26 September.

The event will also include a lecture on the underpinning of Winchester Cathedral by Imperial College London emeritus professor John Burland and ground engineering professor Jamie Standing. The lecture and dinner are open to BGA members and non-members.

The lecture will only be open to those attending the dinner. Advance booking is required.

Tickets will be available from the ICE's online booking system nearer the date of the dinner.

The cost is £120 per person. The BGA will offer a number of discounted tickets (£80) to members of the BGA's Early Career Group (ECG).

BGA ECG EVENT

This year's BGA ECG Welcome and Networking Event will be held

in the Smeaton Room at the ICE on 24 October between 6pm and 9pm.

This is an opportunity for individuals from academia and industry who are at an early stage of their careers to come together and network.

Attendees can get career guidance, find out about industry and academic opportunities, and make chartership enquiries.

Among the event's sponsors are A-Squared Studio Engineers, Geokon and Geosyntec Consultants.

Companies interested in attending and sponsoring the event should contact jamie.darling@geoeng.co.uk.

Individuals should register their interest on the BGA website.

Ground Engineering is the official publication of the British Geotechnical Association (BGA), the leading association for geotechnical engineers in the UK.

The BGA performs the role of the ICE's Ground Board and is also the UK member of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) and the International Society for Rock Mechanics (ISRM).

Annual membership of the BGA costs £80 (£46 for students and retired members) and includes a subscription to GE.

www.britishgeotech.org



Optimising geotech contribution to net zero

Mott MacDonald geotechnics global practice leader Tony O'Brien recently received the British Geotechnical Association's prestigious Skempton Medal.

How do you describe your work when asked by someone outside the geotechnical sector?

I would explain that I am a chartered civil engineer involved in anything to do with the ground and the design of structures that sit within and on the ground, including foundations, tunnels and dams. I would mention projects like the Channel Tunnel, Crossrail and Wembley Stadium. I would also mention that I am involved in forensic investigations when things go wrong and I give technical advice to lawyers/barristers if disputes/litigation develop.

What do you enjoy most about your work?

First, being able to make a difference by suggesting something that enables design/construction to be completed quicker, more safely and cheaper. Second, mentoring younger geotechnics professionals. In geotechnics we have many opportunities to add value – through better characterisation of the ground, more sophisticated analysis, reuse of excavated materials, use of different ground improvement methods, and so on.

What has been the most memorable project or assignment you have worked on and why?

During the late 1990s/early 2000s, I led a series of applied research projects for London Underground, Network Rail and the Rail Safety & Standards Board on the performance of old rail embankments and the influence of climate and vegetation on delayed failure and track deformation.



At that time, there had been little study of these issues. It was very satisfying once we had integrated the full scale monitoring, numerical analyses, advanced laboratory and physical model testing into a coherent explanation for the observed behaviours.

Wembley Stadium and Crossrail were both memorable, the former for the work we did on the deformation of large pile groups under complex loading, especially while raising the Wembley Arch; the latter for deep shaft design and interaction issues between sprayed concrete tunnel linings and compensation grouting. Both projects benefited from use of the observational method (OM).

What are you currently working on?

In the UK I am advising on High Speed 2 (HS2) and the implementation

O'Brien:
Conscious
of project
management
challenges

of the OM for a large section of retained cut. To support the OM, we are using machine learning technology to facilitate back-analysis of instrumentation monitoring data, which had previously received HS2 Ltd innovation research funding. In North America, I am advising on a major metro project beneath Silicon Valley.

What challenges or opportunities should the geotechnical sector focus on today and in the future?

The combination of several technical advances – such as better instrumentation/monitoring, advanced analysis and digital technology – is creating huge opportunities to make a step change in our understanding of ground/structure interaction and ground behaviour. This has the potential to optimise our contribution to net zero and avoid overly conservative design.

However, there are major challenges in how projects are managed, including overly bureaucratic assurance processes, which stifle innovation, and the way technical specialists and geotechnics specialists are procured – considering cost not value – which means that these opportunities may be missed.

This has also filtered into how ground investigations are being managed, with too many “management” layers, so that the voice of geotechnics professionals becomes diluted. Geotechnics professionals should be directly managing investigations; ultimately clients would get better service and would get proper value from the investigation process.

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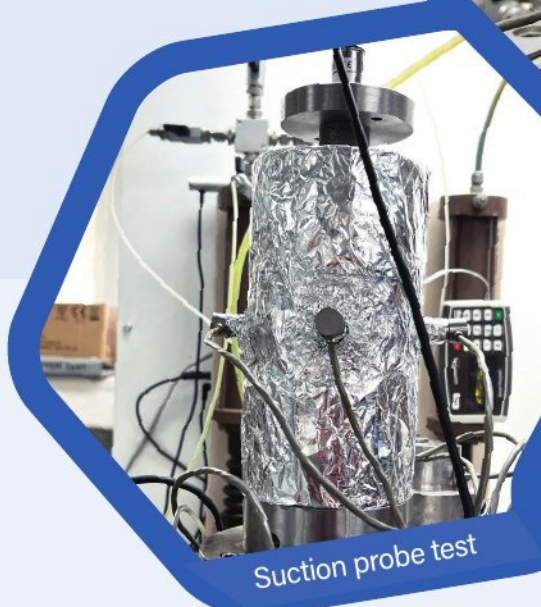
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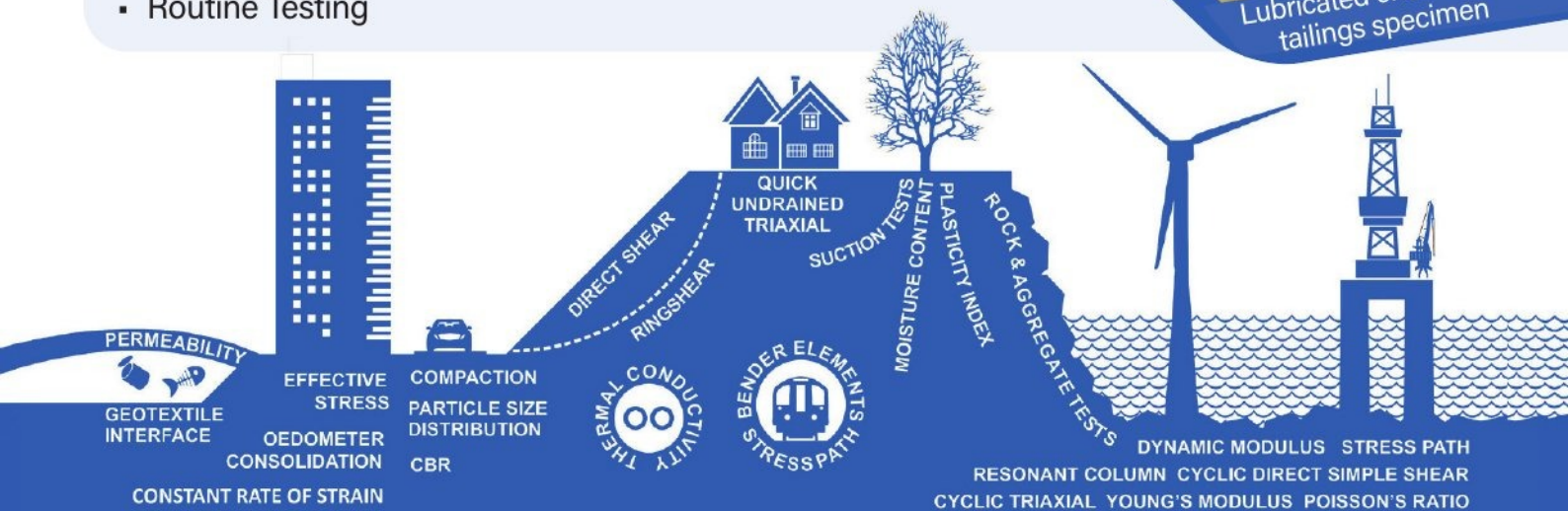
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Welcome approach

Association of Geotechnical & Geoenvironmental Specialists chair Vivien Dent wants to make the sector more inclusive. Thames Menteth reports.

Vivien Dent says she has always loved geology. When she was a child, her grandfather used to collect rocks while her aunt collected minerals, piquing her interest.

Her natural gravitation to the subject led her to a degree in geology and earth science at Royal Holloway in 1991. In her third year she took a unit in hydrogeology, which she really enjoyed.

But when Dent graduated in 1994, the UK was in the middle of a recession, so she struggled to find a job. "I tried for about six months to get a job and you couldn't get anything," she recalls.

She eventually enrolled on an MSc course in hydrogeology at the University of East Anglia and received her master's degree in 1996. Dent's first job after graduating was as a geologist at Soil Mechanics, after which she was offered a job as a hydrogeologist at Stats Geotechnical where she spent the next 10 years.

During her years at Stats, Dent was involved in various roles. "I started off doing site work for ground investigations, supervising the drilling, doing the trial pitting, gas and groundwater monitoring and other site related works. Then I progressed on to project management, and then I became a team leader," she says.

When she decided to start a family in 2005, Dent stepped back from her role as team leader and moved to part time working for three days a week.

She felt this would help her balance career and family commitments, while enabling her team to perform under a

different leadership.

Stats was bought by RSK Group at around the same time as Dent had her youngest daughter in 2008. When she came back from maternity leave, she returned to RSK.

At this time she says her work was focused on providing "generic contaminated land risk assessment of all sorts".

"Due to my background as a hydrogeologist, I was also undertaking a lot of detailed quantitative risk assessment for controlled waters.

"I worked on a variety of projects including gasworks sites, petrol filling stations, landfill sites and industrial sites. I really enjoy developing the conceptual site models, looking at the pathways, the contaminants, the receptors and then working out if there is a risk to controlled waters, such as groundwater or surface water."

Dent then became RSK Geoscience's technical lead on sustainability assessment for contaminated land, using the SuRF-UK approach.

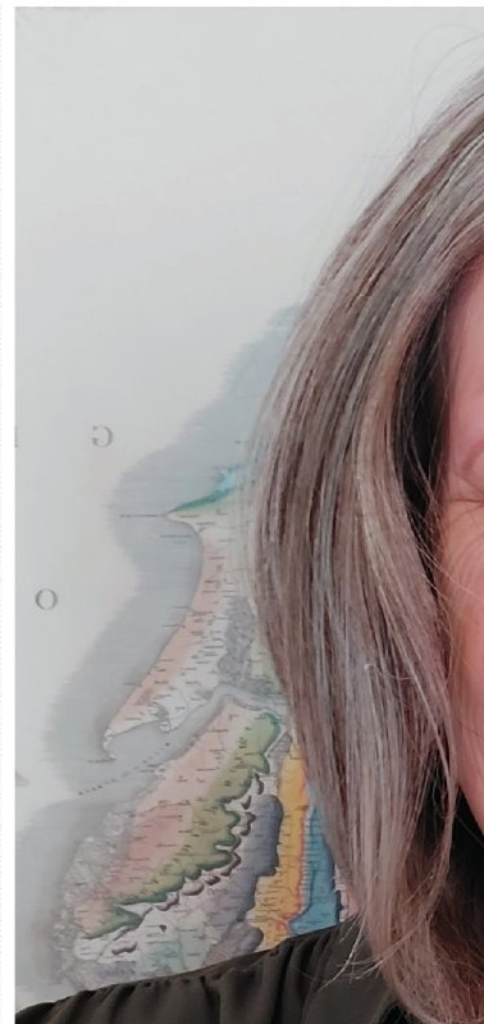
"SuRF-UK is the UK's Sustainable Remediation Forum," Dent explains.

"They've developed a framework for assessing the sustainability of your remedial options. It considers three pillars: the environment, the economics and the social aspects. And within those three pillars, there are categories and indicators."

Using the framework is a "more balanced decision-making tool to decide whether your remediation is sustainable or not", says Dent.

Towards the end of her time at RSK, Dent moved from its Hemel Hempstead office to set up a new RSK Geoscience

Dent: Passionate about sustainability and EDI



office in Cambridge and began working four days a week.

At that time, RSK had just bought environmental consultant Adas. It had a building in Cambridge, so it "seemed to make sense" to relocate some RSK staff there, says Dent.

After more than 26 years at Stats and RSK Group, Dent joined the Environment Agency as a technical specialist focusing on regulation in April last year.

As her Environment Agency role covered the same subject matter but approached it from a regulatory rather than consultancy angle, Dent says she was also interested to "see what it's like working on the other side of the table".

Throughout her career Dent has always enjoyed the variety of work in contaminated land.

"No two sites are ever the same," she says. "And that's why I like



working in contaminated land. I think my favourite part of the work is formulating a conceptual site model, working out what is going on and then testing that conceptual site model.

“That’s why each job is interesting – because the geology, the contaminants and the sites are different.”

AGS INVOLVEMENT

Dent took over as chair of the Association of Geotechnical & Geoenvironmental Specialists (AGS) from Coffey Geotechnics regional director Sally Hudson at its annual general meeting in May. She will serve a two year tenure as chair, following her previous role as the chair elect and chair of the AGS business practice working group.

Dent first became involved in the AGS around nine years ago through a colleague of hers who had been an RSK representative on the

contaminated land working group.

“He retired and asked if I would like to take his place. So, I joined the contaminated land working group,” she recalls.

Dent became the group’s chair a few years later and held the position for four years.

“I really enjoyed sitting on that working group,” she says. “It’s quite a big working group, but it shares a lot of information and it produces some really good guidance and you get some good debates.”

The AGS working groups are all slightly different in what they do, notes Dent, and they cover lots of different aspects. As well as contaminated land and business practice, there are working groups for geotechnical engineering, data management, instrumentation and monitoring, laboratories, loss prevention and safety.

“I think that’s the good thing about

the AGS,” she adds. “It looks at a wide range of elements of our industry.”

Although the groups are different, they often collaborate and share ideas.

When Dent became AGS chair elect, she asked all the groups to look at whether there was anything they could do to help address sustainability issues – an area that she is particularly passionate about.

“We’ve had quite a lot of people contacting us to ask what we’re doing on sustainability. And we’ve actually just created a single port of call by forming a sustainability working group,” she says.

Dent explains that the aim of the sustainability working group is to produce new guidance. It will also be made up of representatives from other industry bodies, with Dent representing SuRF-UK, alongside representatives from bodies such as the Federation of Piling Specialists.

“With the setting up of this sustainability working group, I’m hoping that we will be able to move the industry forward and look at ways of reducing our carbon footprint or making projects more sustainable.”

Dent is also passionate about championing issues of equality, diversity and inclusion in the geotechnical industry, particularly as someone who has lived experience of feeling out of place in the industry.

“Going back to when I started at Stats, I was the only woman in the department apart from the secretary and someone who typed up borehole logs,” she remembers.

“Things have changed a lot over those 25 years and there are now a lot more women working in the industry. But I think there’s still a long way to go especially with black, Asian and minority ethnic groups, and LGBTQIA+ groups.

“I’m keen for the AGS to welcome all. I would like to see it become more diverse. I am on the path to learn more about a wider range of diversity issues and I’m asking people for help with encouraging involvement and representation from other groups too.”

She concludes: “I’m not expecting change to occur overnight. I appreciate it may be a gradual change. I think the AGS is a welcoming organisation but acknowledge that we need to do more and I’m keen to head in the right direction.”

Pressure relief

A new ticket hall for Elephant & Castle Tube station in south London has been excavated in close proximity to live tunnels within challenging geology. Nia Kajastie reports.

A new town centre is being built in Elephant & Castle, south London, as part of an ongoing regeneration scheme. Working for client Get Living, Multiplex is overseeing the design and construction of the second phase of this project. It involves a mixed use development spread over three residential towers, an office block and a new building for the London College of Communication of the University of the Arts London (UAL). There is a two storey combined basement under the buildings.

The redevelopment scheme also includes a new Elephant & Castle Tube station entrance, as well as the integrated ticket hall (ITH) for the proposed Bakerloo line extension. The ITH will serve the Northern and Bakerloo lines, which currently have separate entrances.

The ITH will be under the 34,400m² UAL building. Bakerloo line tunnels run through the site and the 2,700m² ITH box. The transfer structure above the Tube tunnels is made up of six reinforced concrete beams. These 3.6m deep, 3.5m wide and 21.5m long beams weigh 300t each and have a bearing capacity of 6.5MN. They will transfer the load of the building above onto the piled walls on either side of the tunnels.

GEOLOGY AND GROUNDWATER

The tunnels run mainly through London Clay and the Lambeth Group

underneath, but between these there is a 500mm to 1.5m thick layer of the Harwich Formation. This geological formation in the south of the London Basin comprises a relatively thin group of clays, silts, sands, gravels and some cemented layers.

The formation is challenging to work with because of its high variability. It is also known to contain pressurised sub-artesian groundwater, which is pushing at the bottom of the London Clay layer.

The groundwater conditions have been confirmed by data from trial wells on the site, which recorded upward water pressure of 160kPa.

The ITH will be built down to basement level three (B3) at 13.65m below ground level on its eastern side and then further down to basement level five (B5) at 22.65m below ground level to the west. This means the ITH will be dug above and into the Harwich Formation.

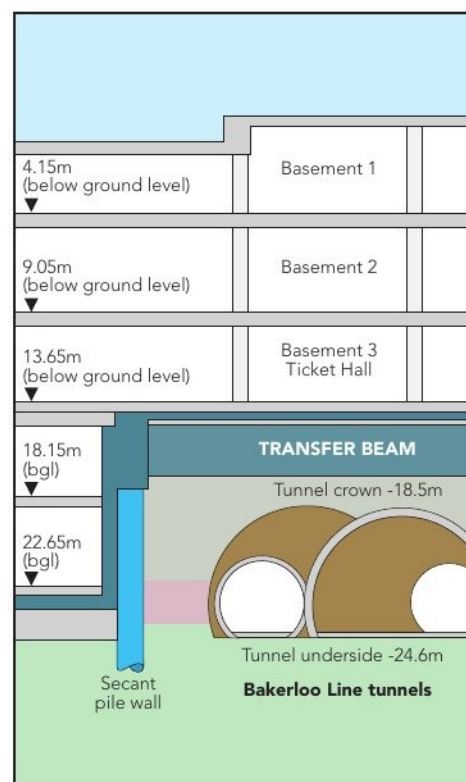
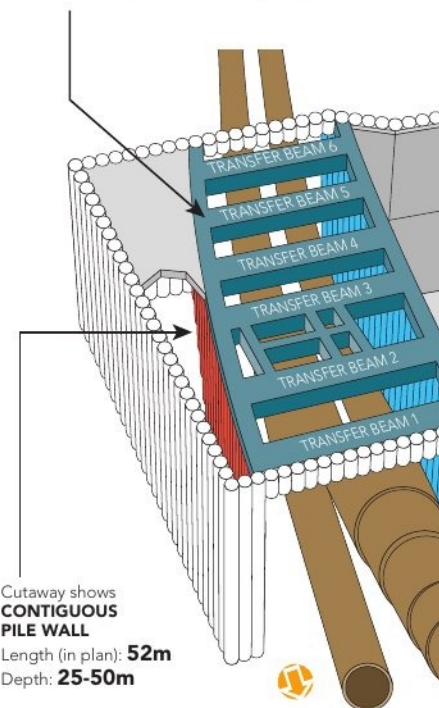
On normal excavations in London, the weight of the London Clay would be able to resist the underground hydrostatic pressure. But the ITH's depth means the clay layer within this excavation is too thin to do this.

As result of the uplift, the excavation could be destabilised, while a soil effective stress reduction within the Harwich stratum would lead to excessive movement of the Bakerloo line tunnels.

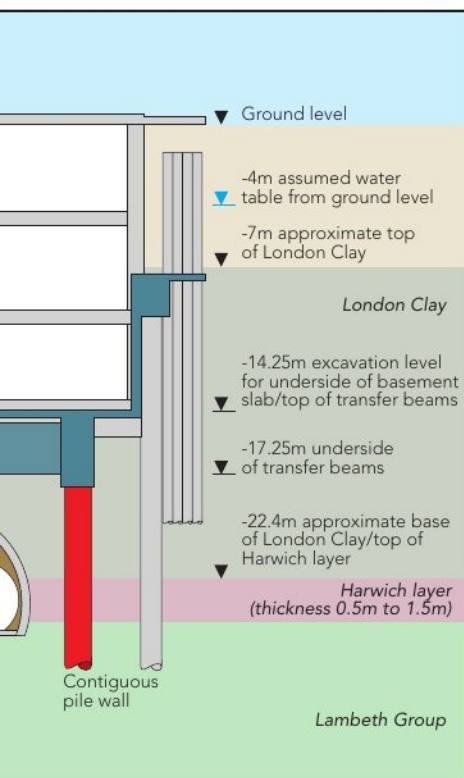
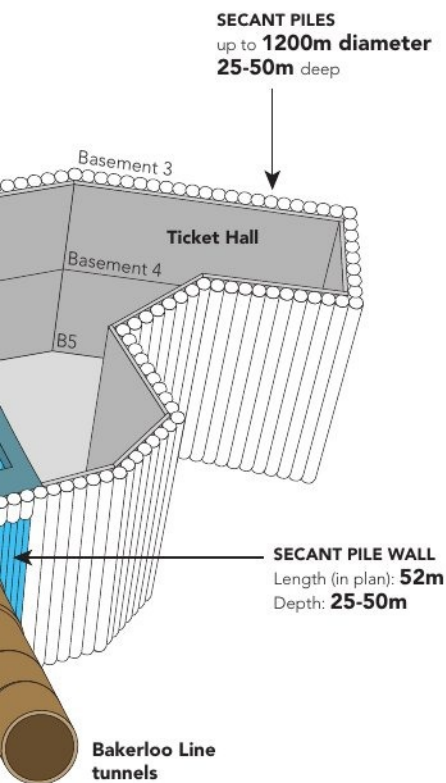
To solve this geotechnical challenge, Multiplex collaborated with the

ELEPHANT AND CASTLE

TRANSFER BEAMS
3.6m deep, 3.5m wide,
21.5m long and 6.5MN capacity



INTEGRATED TICKET HALL



project's substructure and superstructure subcontractor AJ Morrisroe, structural engineer WSP and geotechnical advisor A-Squared Studio Engineers.

The project team had to work closely together to come up with a practical solution, which involved depressurising the Harwich Formation. It also adopted a specific sequence for the excavation and construction of the transfer beams. The solution had to be approved by Transport for London (TfL) before the work could go ahead.

Morrisroe developed and supervised the complex operation, involving propping, excavating, installing wells, pumping, steel fixing and concreting.

Bulk excavation to B3 across the site was completed in April 2023, followed by the construction of the transfer beams. This involved the excavation of 3.5m deep trenches and the installation of reinforcement cages that were then backfilled with concrete.

The beams were completed in pairs and the additional weight of the concrete has contributed to the total resistance to uplift caused by the groundwater pressure. The last beam was concreted on 13 July.

WSP has been monitoring the Tube tunnels for movement during the work. It found that while there was an initial uplift of about 5mm when the transfer beams were excavated, there has been little significant movement since.

GETTING CLOSE

The walls around the Bakerloo line tunnels are made of contiguous piles to the east and secant piles to the west.

A secant pile wall is needed because on the western side of the tunnels, the ITH goes down to B5 and reaches the Harwich Formation that runs 22.4m below ground level. The wall has to confine the groundwater and ground below the transfer beams. It extends through the Harwich Formation down to the Lambeth Group to carry the vertical loading. There is also a capping beam on top of the walls on both sides of the tunnels.

The piled walls have been installed on either side of an exclusion zone around the tunnels.

The exclusion zone has been set to ensure the safe operation of the Tube lines during construction activities. As

a general London Underground requirement, the exclusion zone is 3m wide beneath and on both sides of the tunnels and 6m above them.

Foundations and temporary works are not allowed to encroach into the zone without TfL approval.

Here, TfL allowed the transfer beams to go down to 1.605m above the tunnel crowns.

"You can go into the exclusion zone, but it's by negotiation with TfL," notes A-squared Studio Engineers director Tony Suckling. "We don't think anyone has gone as close as this."

The six transfer beams, or TBs 1 to 6, run across the tunnels from north to south. The top of the one storey high beams is at B3, while their underside is at B4 at a depth of 18.15m below ground level.

Morrisroe operations director Mark Wadsworth says: "Other options discussed included a similar structure at a greater height outside the exclusion zone, but they couldn't fit that in spatially, so it had to be lower.

"There was also a steel truss solution; so instead of concrete beams, there would be a huge steel truss, but it would have taken more time to install, been more expensive and would still not have been low down enough."

The trenches in which the beams were cast were excavated and the beams were constructed in pairs, with TB1 and TB4 first, then TB2 and TB5, followed by TB3 and TB6.

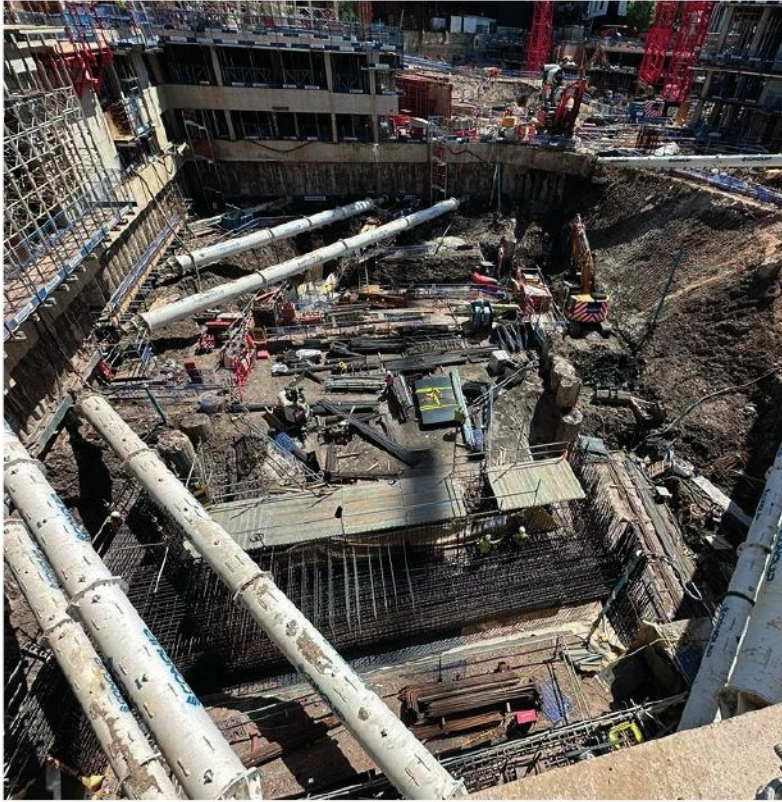
"If we dig down from ground level to the top of the tunnels and open it all up in one big excavation, the tunnel would move or pop out of the ground. So there had to be a sequence to install the beams," Wadsworth explains.

"WSP did a full ground movement assessment and, as part of that assessment, it predicated the sequence of the beams that we're digging out to prevent excessive tunnel movement."

The transfer beam installation sequence, with only two excavated at a time, was thus stipulated by WSP to even out tunnel heave.

Socotec is the monitoring contractor on the project, and the monitoring package involved weekly visual inspections and full movement monitoring, with readings taken every 10 minutes.

Morrisroe project engineer Conor Calder says that the movement



allowance is set at 30mm, but the triggers are set lower, at a maximum of 20mm. “Maximum recorded movements on the project have been only around 11mm,” he adds.

DEWATERING

In March this year, A-squared Studio Engineers associate Richard Goodey began devising the groundwater depressurisation design for the project.

He worked with Morrisroe and WSP to figure out the details of the dewatering pump setup and the number of well points.

In addition to looking at the stability of the tunnels, Goodey performed a finite element study that confirmed that the solution would be compatible with the requirements of the ground movement assessment and monitoring specification.

To keep the groundwater pressure down and eliminate the uplift, the strategy involved the installation of six dewatering wells – 150mm in diameter and 25m deep – within the ITH excavation beside the tunnels.

Pumping trials were conducted to further refine the system. “The Harwich Formation is made up of a highly variable material, and even though these wells are quite close to

each other, they all encountered different thicknesses of Harwich, different characteristics, and different permeability and water flows. But the pumping was able to take the pressure down,” Suckling notes. He adds that the final decision about how many wells would be needed had a significant effect on the logistics of installing them.

“Because trying to get the wells in while the [temporary] props are already in, you need headroom for the machine to install them. Also for the beams, there wasn’t much working space as the sides of the excavation are at a 70° angle to stabilise the London Clay,” he says.

“To limit movement as much as possible, the more soil you can leave in between the beams, the better. You can’t dig vertically, because you can’t assume it’s going to be stable, so we came up with a 70° temporary slope as a compromise for safety and to keep as much weight in as possible.”

The final dewatering strategy was then presented by Morrisroe and eventually approved by TfL.

To safeguard the excavation, beam installation and depressurisation operation, the site also had six back up pumps and a generator with a standby

The transfer beams were excavated and concreted in pairs, with the additional weight of the concrete helping resist the groundwater pressure

switch in the event of a mains failure.

Multiplex also put 24 hour site management in place and a geologist was on hand to monitor the excavation.

“When one of the pumps stopped working on the evening of the Coronation [in May],” Suckling recounts, “Morrisroe’s procedures to get the pump fixed and working then kicked in. It’s critical that the pumps keep working, so Morrisroe had put in emergency procedures, as in the case of a catastrophic failure of the pumps, there would be movement of the tunnels without immediate action.”

Wadsworth adds: “If a pump fails, it wouldn’t take too long for the wells to recharge – roughly in one and a half to two hours – and for the pressure to rise, meaning we wouldn’t be able to maintain the safety factor.”

The project team did not encounter any further faults with the dewatering pumps, however.

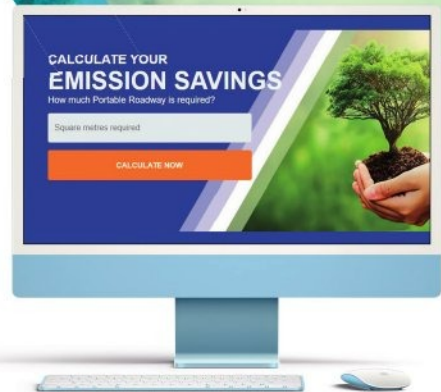
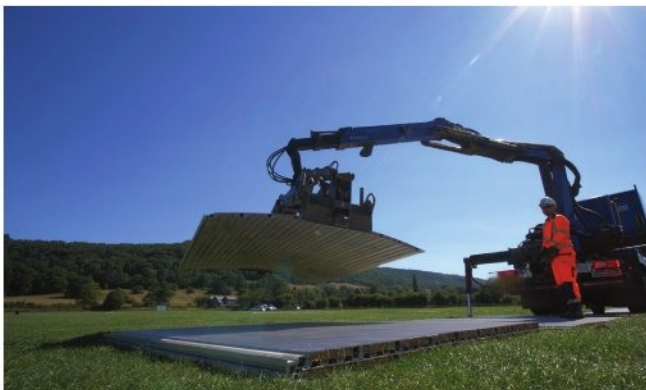
Following the completion of all transfer beams and the main structural slab at B3 over the tunnels, the depressurisation wells and pumps will be decommissioned and removed. This is scheduled to take place in September.

The next project step on the ITH involves excavating down to B5 during the remainder of 2023.

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Improving supply chain collaboration

A tendency to over-specify instrumentation and monitoring services is creating huge amounts of redundant data. Creating shorter supply chains that work better together could be a solution. Thames Menteth reports.

Geotechnical instrumentation and monitoring (I&M) services are used on construction projects ranging from tunnels to high rise buildings, deep excavations, railways, dams and bridges.

I&M can serve many different purposes, the first being to confirm that the design assumptions for an infrastructure project are correct. The second purpose is for third party asset assurance – to check that existing structures, as well as the ground around them, are responding as expected.

Clients and designers may also want to collect I&M data for research purposes and to improve future designs and decision-making. Some of the data is valuable to third parties, for example information about how a project may have impacted a utility owner's assets.

DELIVERY METHODS

I&M services form a vital part of ensuring the buildability of a project. But there is growing concern that the way in which technical specialists such as I&M contractors are procured is compromising the quality and usefulness of data they produce.

I&M supply chains typically involve five key players: the client, the designer, the principal contractor, the instrumentation and monitoring contractor and the instrument supplier.

But under some project delivery methods, the “data users”, such as the end client or project consultants, and the “data creators”, such as the I&M contractor, are “contractually disconnected”, says Geotechnical



Observations senior I&M specialist Javier Marti.

For a design-bid-build (DBB) project, for example, the client or designer does not procure it or choose the I&M contractor itself – it is instead chosen by the principal contractor.

Under certain types of contract, Marti argues, the principal contractor is constrained by cost, so will try to procure the cheapest I&M contractor that meets the project's specifications.

As the party that manages the contract, the principal contractor is the “doorman”, he says, “but they are not the one that is interested in the data”.

“They are not responsible for the

Instrumentation and monitoring services are used for asset assurance purposes

geotechnical design, or how that information is going to be achieved.

“But they do understand what is expensive and what isn't.”

As a result, the I&M contractor is often chosen by a commercial team that lacks strong technical ability. This means that the contract goes to the lowest bidder which can provide the cheapest services.

Delivery problems then arise, slowing contracts and increasing cost – mainly because I&M companies are forced to compete on cost and not quality, says Marti.

The result is the collection of “data that is not correct or meaningful”,



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and a situation where the client has “no good control” over their project, he says.

By considering costs over the value of the data delivered, Marti believes that the industry is “aiming for mediocrity” while I&M has just become about “sticking gizmos in places to tick boxes”.

OVER SPECIFICATION

Another major challenge for managing I&M on projects is the specification of overly bureaucratic assurance processes, which can lead to the collection of redundant data.

Laing O’Rourke geo-environmental engineering leader Peter Hewitt says that in recent years, there has been an increasing tendency for clients and designers to over-specify and require I&M contractors to monitor assets that are unlikely to move in the first place.

“If you’re monitoring something that doesn’t move, and it’s not supposed to move, then the thresholds that you’re monitoring become very small,” he says.

“And then you start having arguments about whether or not that 1mm of movement is real movement, or if it’s just the sensitivity of the equipment that you’re using.”

Hewitt has also worked on projects where his team has been required to monitor assets that have never been monitored before.

On Thames Tideway, for example, Hewitt’s team was measuring the river wall and finding that it moved “6mm or 7mm each time the tide came in”.

This was because of the tidal influence of the River Thames on the wall, which “has an absolutely profound impact on everything around the London Basin and for quite substantial distances away”, he says.

But this was a phenomenon that had not been measured before so nobody quite believed that the river was having such an impact on the measurements. In the end, Hewitt’s team spent three or four months proving that the movement was linked to the tide.

Because of these requirements, Hewitt says that “in comparison to where it [the I&M sector] was five or six years ago, you definitely get collection of unnecessary data”.

He puts some of these changes down to the falling cost of wireless



monitoring technology, which means that “you can monitor a lot more things for less money, so, the tendency is just to monitor everything”.

But he warns that over monitoring does not provide value for money on a project, because the data that is being collected is not being used.

He explains: “People see the standard tendering route as being the way of gaining best value out of a project. For monitoring, I don’t think that’s the case. If something’s over specified and the scope of work is much bigger than it needs to be, then saving 5% or 10% through a tendering process is a minor saving.”

ASSET OWNERS

Arup director Alison Norrish agrees that the specification, the number of instruments used and the amount of data that is generated in some major infrastructure projects can get out of hand. She says this is because of the requirements of clients – although she also points to third party asset owners as the main culprits.

“The problem in the UK at the moment is that third parties, typically utility owners, require a huge amount of instrumentation. And they also then require that instrumentation and data be used to measure predicted strains

Some monitoring instruments have become much cheaper in the last 20 years

against acceptance criteria of truly tiny magnitudes that in turn trigger significant and expensive replacement and mitigation to be implemented,” says Norrish.

Some asset owners then require “mitigation of their assets at the cost of hundreds of millions of pounds”.

In cases where strain limits are breached, third party asset owners can force the client to replace their assets. Norrish believes that asset owners do this because they do not want to pay for the replacement of their assets themselves.

Another consequence of third party asset owners requiring I&M contractors to monitor their assets is that “you just get swamped in data”, says Norrish, and then “huge amounts of money” are spent on dealing with that data.

She believes that the whole industry of utilities which can be impacted by ground movements and all the instrumentation that goes along with that “needs to be put in the bin and started again”.

In its place Norrish would like to see an I&M sector which is focused on “high quality instrumentation on real problems, at their source, and their impact, with appropriate methods and levels of instrumentation”.

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SHORTER SUPPLY CHAINS

So what can be done to tackle the challenges facing I&M supply chains? And how can clients, designers, principal contractors, and I&M contractors work better together?

According to Hewitt, a well functioning supply chain is one in which what is delivered is “actually achievable” and there is a “practical solution” for implementing the answers to clients’ questions.

Hewitt believes that instead of designers specifying what instrumentation is needed, the I&M contractor “should tell them what to monitor”.

As Laing O’Rourke self delivers a lot of contracts, it has more of an opportunity to establish a direct connection with the designer and be more engaged in the scope of works.

Indeed, the company is typically involved in the professional services contract before construction starts.

Having that early engagement in the development of the monitoring system is “always valuable because it means that you can actually figure out what it is that the client is looking for”, says Hewitt.

“And when it comes to monitoring, you can then start to suggest alternative methods and better ways of monitoring.”

Marti also believes that clients, designers and I&M contractors can have a more direct and productive relationship when there is a shorter supply chain. An example of this is London Underground, which “still has technical people in its ranks”, says Marti.

“They don’t hire consultants to design and interpret their monitoring data. They have an internal team to perform their own data analysis.

“It’s their assets and they care about them and they understand what they are doing. The supply chain is shorter because it’s client/designer – and principal contractor/I&M specialist contractor.”

The Land Transport Authority (LTA) in Singapore is another example of a client with a successful I&M supply chain.

For more than 25 years the LTA has procured its own I&M contractors, says Norrish. It sets a minimum level



of instrumentation for all types of work, including underground construction, bored tunnels, cut and cover excavations, and viaducts.

Its specifications are much more detailed, says Norrish. The LTA specifies the types of instruments to be used and specifies the quality of data that should be collected, as well as the format in which that data is supplied. It also maintains a database that uses that in the specified format.

“[In the UK] the data that comes in is such a mess because we haven’t specified,” says Norrish.

“Data is only helpful if it’s all categorised and formalised in the way it’s received and managed, which isn’t done well enough in the UK.

“[In Singapore, the LTA] has all of that under complete control.

“It has found a way of plugging the gap, which is control of works, by offering to increase the level of instrumentation and monitoring where the contractor deems it necessary to do so to control their works.”

BETTER DATA

Norrish wants to see the UK become more like Singapore, where I&M data is shared more widely between clients

Instrumentation and monitoring services are used across various civil engineering projects

and contractors. But she is sceptical that this will happen in the UK anytime soon.

She explains: “The industry is so risk averse that it would rather not share data than take appropriate caveats and warnings to share information more widely.”

Hewitt, on the other hand, says that software advances mean that I&M data could be used better.

But he adds that many I&M suppliers and contractors lack the in house expertise to meaningfully interpret complex databases.

“One of the things that has changed in the last few years is the analytics that can be associated with data sets,” he says.

“But the majority of software platforms that are available to take this data and analyse it are specific to particular suppliers. And as they are not data analytics experts, the majority of databases are timeline graphs. You lose the ability to view and compare that data.”

Hewitt believes that the I&M sector needs more data analytics specialists so that it can combine more information so the patterns that are emerging on projects can be seen.

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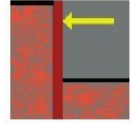
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Support for housing

A reinforced soil wall was built on challenging ground to support a brownfield housing development in London. Nia Kajastie reports.

The Barking Riverside mixed-use development is being built on a 180ha brownfield site on the north bank of the River Thames.

The regeneration project will create 10,800 new homes, which are being delivered on different developers' lots. The first residents moved in in 2012 and 2,500 homes are currently available.

The development is being led by Barking Riverside Limited, a joint venture between the Mayor of London and L&Q.

Bellway London Partnerships is building more than 1,000 homes.

Having been involved in the project from the outset, the company has secured four parcels of land to deliver its Fielders Quarter development at Barking Riverside and another, now known as Eastbrooke Village.

One of the housing plots on the western end of the site is on a sunken piece of land that had to be raised by 6m. A reinforced soil retaining wall was needed to contain the raised construction platform.

In October 2021, principal contractor Statom Group was engaged by Bellway London Partnerships to build the retaining wall. It pulled together the overall design with its supply chain, which included Andun Engineering Consultants, Geosynthetics and Geoman.

Statom began site work in May 2022 and completed the first phase of the project in January 2023. On the next phase, it will work on the infill behind the wall on which the development platform will be built.

PEAT PROBLEMS

The completed retaining wall is 6m high, 365m long and 11m wide across its base. Before construction began, a site investigation had uncovered a 2m layer of peat at the site. This had to be excavated so that a stable foundation for the wall could be built.

Statom remediation and environmental director Sean Deloughery explains that Andun was engaged to design the wall foundation.

"They ran tests to decide on the best option, which ultimately involved digging down and removing the peat layer and then re-engineering the soil back under where the wall was being constructed," he says.

According to Andun director Joshua Martin, the ground conditions on site were very challenging, including extremely low strength cohesive soils as well as the areas of peat. The groundwater levels were also high, further reducing low ground bearing capacities and making foundation construction difficult.

Statom environmental manager Michael Gillman adds: "The ground was predominantly cohesive and one of the issues was tackling the groundwater ingress when we were excavating the peat out."

The work entailed an excavation that was 365m long, 12.5m wide and 4m deep.

Andun worked closely with Statom and Geosynthetics to provide a buildable solution that supported the wall. It considered several foundation designs, including using a granular raft, stone columns, a deeper

reinforced earth wall and a piled reinforced concrete wall.

In the end, however, an Ordinary Portland Cement (OPC) chemically stabilised soil raft foundation was chosen as the most appropriate solution. "As well as being a method that sped up construction time," Martin says, "this option significantly reduced the amount of material imported onto site as a large portion of the foundation uses the already insitu soil. A stabilised platform is also stronger than a traditional imported granular foundation, which means that the amount of muck away is decreased twofold."

REINFORCED SOIL WALL

The reinforced soil wall design was undertaken by Geosynthetics and warranted by Geoman. It includes site-won materials and geosynthetics.

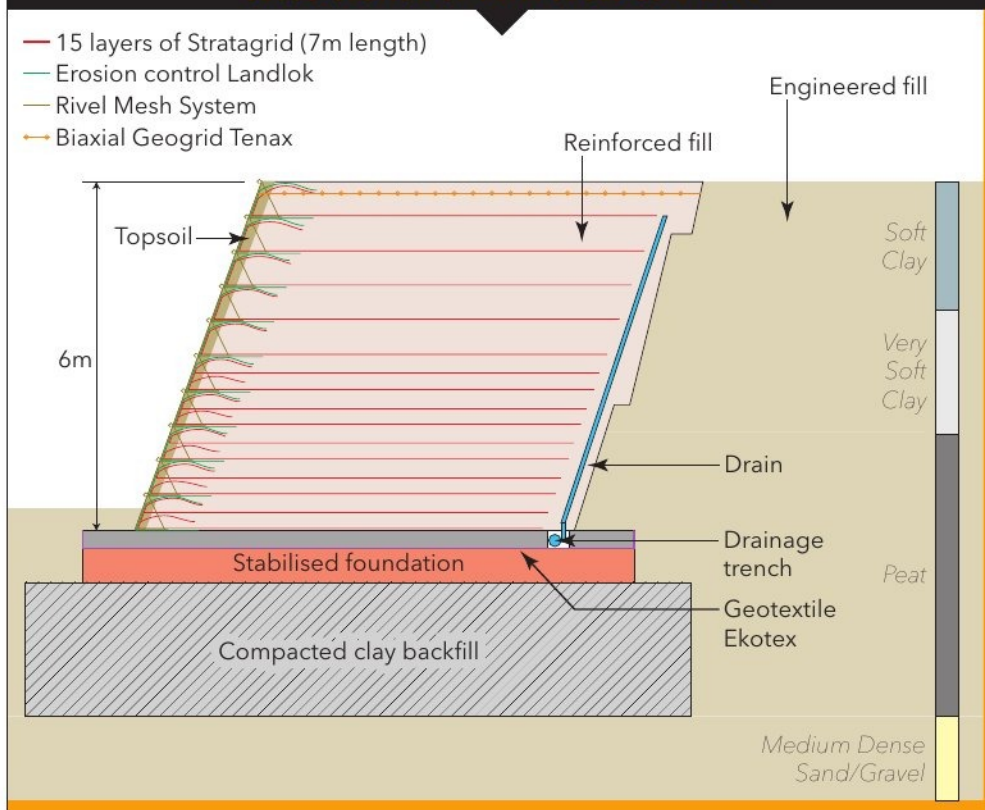
It consists of a Stratagrid SGU60 uniaxial geogrid at vertical spacings of 300mm in the lower half of the slope, increasing to 600mm in the upper half.

The slope face consists of a Geosynthetics Rivel Mesh system to



Top: The site was previously occupied by Barking Power Station which was decommissioned in 1981
Bottom: The site was underlain by a layer of peat that had to be removed before work on the wall foundation could begin

CROSS-SECTION OF REINFORCED SOIL WALL



ensure the required face geometry was achieved. Landlok erosion protection matting was installed behind the face to help with vegetation establishment.

Geosynthetics also provided Statom with some initial on site support during the reinforced wall construction to ensure the contractor was aware of the construction sequence.

The chosen soil wall material was Class 2C, or general stony cohesive fill material as specified in the *Standards for Highway Works – Series 600* document.

“The reason we chose the soil wall with the Class 2C material was for reuse purposes,” Deloughery says.

“There was approximately 70,000m² of material needed for the foundation and within the wall. So instead of sending it to landfill or trying to use it elsewhere, the design method was to use on-site reused material due to its cost and sustainability benefits.

“We spoke with Geosynthetics, and they ran two design methods for us, one using imported granular material and one for site reuse of the Class 2 material, which meant we had to do a lot more testing and compliance checks.

“We had geotechnical engineers on

site every day to do all of the testing and compliance checks, so we could adjust our working methods and compaction techniques.”

The peat that was excavated during the foundation work was included in the front face of the wall.

Geoman design engineer Andrew McKinstry adds: “For sustainability and commercial benefits we always strive, where possible, to reuse site-won fill within the reinforced soil slopes.

“On this site the biggest design challenge was understanding the geotechnical parameters of the site-won fill and looking at ways unsuitable soils could be improved to allow use within the reinforced zone of the structure. Here some initial testing of the fill, with the addition of lime in varying quantities, was carried out to determine the optimum lime to fill ratio and the most favourable geotechnical parameters.”

Geosynthetics technical manager Eddie Emblen echoes McKinstry’s comments regarding the benefits of reusing site-won fill, but also highlights the challenges this creates. “Firstly, to accurately ascertain the

design parameters of the site-won material,” he says, “then secondly, through a defined site testing regime to ensure that it is properly compacted within the correct moisture content range.”

Once the properties of the fill were established, Geoman carried out the internal stability design of the bund in accordance with BS8006-1:2010, the code of practice for strengthened and reinforced soils and other fills.

“When non-standard materials are used in designs such as this,” McKinstry notes, “the biggest design risk is often ensuring that the contractor understands the importance of properly placing and compacting the fill in optimal conditions to achieve the required properties.

“We agreed an inspection and testing plan for the scheme to ensure the material proposed for use was suitable before being used and then also post-placement testing to ensure it met the design requirements.”

Construction Testing Solutions (CTS) carried out the on site testing.

NEXT PHASE

As part of the second phase of work, Statom is due to start follow-on earthworks to build the construction platform in September.

Card Geotechnics (CGL) has conducted ground investigations on the platform site. It has provided geo-environmental recommendations for addressing soil and groundwater contamination and material management/re-use, as well as recommendations relating to condition and suitability of the existing fill for earthworks.

“It’s come to light now that when we go back in there for the second phase of works, we have to dig down again in places where there are pockets of peat and remove them, and then re-engineer all the material,” Deloughery explains.

“Overall, we’re going to be handling in excess of 100,000m³ of material. And then we’ll have to build the platform up in 275mm layers to get up to the 6m, while we’re also keying into the wall that we’ve already built.”

CGL also carried out a ground movement assessment in terms of settlements and heave for the site and supported Statom with the design and feasibility studies for this phase.

Powering through

The ground engineering sector expects power and water projects to keep companies busy for the next year and beyond, while it waits for major infrastructure schemes to pick up speed again. Nia Kajastie reports.

The UK economy has remained stagnant since the end of last year and not much growth is expected for the rest of 2023. The country continues to grapple with inflation due to the war in Ukraine and the effects of the Covid-19 pandemic.

Even though inflation has been slowly falling, it continues to be high, leading the Bank of England to raise interest rates once again in early August.

The cost of construction materials has fallen slightly, based on the latest data from the Department for Business & Trade, but it still remains higher than at the start of the year.

The UK has avoided falling into another recession post-Covid, but the threat of one is still looming.

A recent forecast from the Construction Products Association (CPA) says that the construction industry will experience an “acute recession” this year driven by poor performance in the private housing sector. This is forecast to be the worst affected sector this year, as activity has been lagging partly due to a spike in mortgage rates that has led to a fall in demand.

This is reflected in the results of GE’s 2023 GE100 industry survey, which was filled out by 151 UK geotechnical contractors, consultants, suppliers and manufacturers. While 20.5% of respondents expect to see some growth in the private housing market, 30.5% anticipate that the sector will weaken.

Van Elle pre-construction director



Main construction work for the Havant Thicket Reservoir in Hampshire is expected to start next year

Matt Love agrees that the housebuilding and large residential market has seen a sharp decline. But the ground engineering contractor remains optimistic that “market conditions will change due to the structural shortage of housing”.

Federation of Piling Specialists chair John Chick adds: “The geotechnical industry, in common with much of the construction industry, is working in a business environment where uncertainty rules.

“The war in Ukraine, inflation and approaching UK and United States elections are making investors wary in the private development market.

“Contractors have got better at protecting themselves by inserting inflation qualifications into tenders. Materials cost increases are not such

a risk now, and there is clear dialogue between contractors and suppliers.

He also mentions that “many mixed use and commercial developments are either on hold or drifting away”.

The construction industry was recently shaken by contractor Buckingham Group collapsing into administration.

Socotec UK business unit director for ground investigation Mark Toye believes the industry is likely to see “more main contractors going out of business, with Buckingham being the most recent example”. He is worried about clients going under and leaving the supply chain to pick up the pieces, “be they large or small”.

According to the CPA, infrastructure activity remains

strong due to major projects such as High Speed 2 (HS2), Hinkley Point C and the Thames Tideway Tunnel. While these schemes are late and over budget, they “continue to provide growth to a sector worth £28bn per year”, says its forecast.

Cementation Skanska business development director Chris Campbell expects to witness “intense procurement activity for major frameworks across a number of sectors” in the coming year.

The A303 Stonehenge Tunnel scheme has now been approved by the government, and National Highways is planning for a start of preparatory works in 2024.

The CPA forecast highlights the fact that infrastructure growth will be offset by delays to a number of

new road and rail projects and uncertainty about funding decisions.

Earlier this year, the Department for Transport (DfT) announced that it is delaying construction of major road schemes – including the Lower Thames Crossing – due to inflationary pressures. In addition, all new smart motorways have been removed from the government’s road building plans.

This has left “a large hole in the work bank of many geotechnical companies, particularly those who were part of National Highways frameworks”, notes Love. “Network Rail’s Control Period 6 (CP6) programme is also being delayed as planning for CP7 commences.”

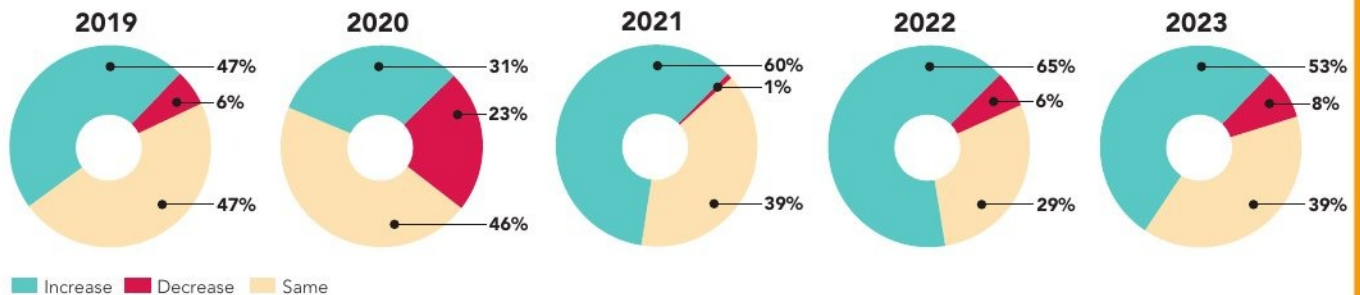
Bam Ritchies business development manager Matt Ewing adds: “With the ongoing cost

pressures, the confidence in projects starting when they should has dipped significantly. The ability to plan, invest and innovate is very much challenged by the uncertainty about much of the infrastructure spend.”

The GE100 survey results show that 25.9% of respondents expect to see growth in the road sector in the next 12 months and 23.2% forecast a decline. Confidence in the sector has clearly taken a knock, as last year 37.9% of GE100 survey respondents expected growth, and only 5% predicted a decline.

In the rail sector, it was announced that construction of HS2’s phase 2a from Birmingham to Crewe, as well as Euston station, have been delayed by at least two years. Legislation for phase 2b to take the high speed rail

WORKLOAD PREDICTIONS: 2019-2023



A new track crossing being installed as part of the Transpennine Route Upgrade

line to Manchester is still working its way through Parliament. Notice to proceed with phase one was given three years ago, and as part of it there are currently around 350 active construction sites between the West Midlands and London. The early works contractors that started work six years ago have now left the sites, with the main civils contractors entering peak construction this year.

HS2 will also continue to have a significant impact on geotechnical works over the next 12 months.

Toye is nonetheless concerned that the timings for further ground investigation work on the scheme's phase 2a and 2b remain unclear.

"There is still much uncertainty about when schemes will be in the field, so we do not know if this will be 2024 or 2025," he adds.

"This has a major effect on the whole ground investigation industry as there was a considerable expansion in capacity associated with the main HS2 scheme, and all those companies, rigs and crews need to find replacement work or we may see negative inflation in terms of market rates as we all compete in a declining market."

The DfT has implied that procurement of further ground investigation work on the East West Rail scheme, which will create a direct rail link between Oxford and Cambridge, will take place this year. The project is being built in three connection stages. Work is currently underway for connection stage one, which will allow trains to run from Oxford to Bletchley/Milton Keynes by 2025.

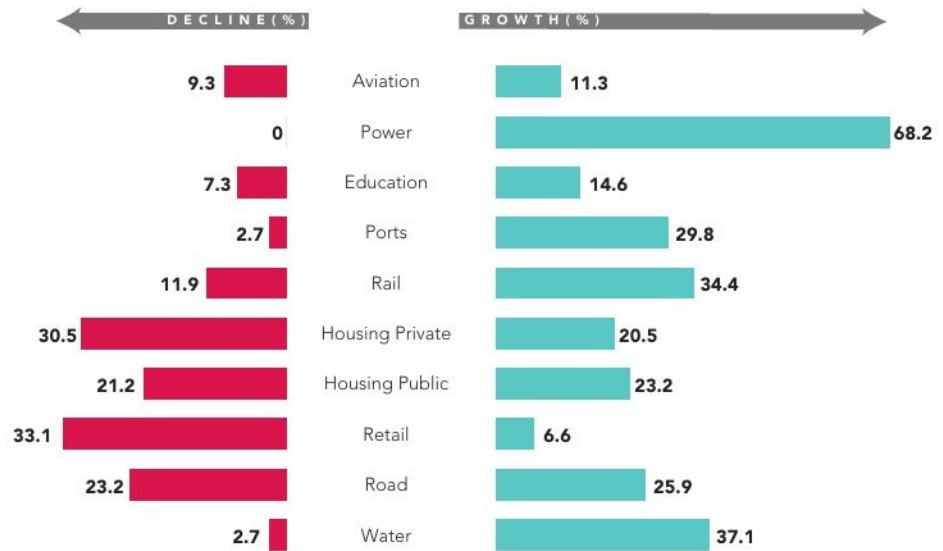
Last year, the government increased its investment in the Transpennine Route Upgrade (TRU) railway programme between Manchester and York, via Huddersfield and Leeds. In August this year, rail minister Huw Merriman said the scheme would remain within its £11.5bn budget and be completed by 2033. The TRU project aims to deliver improvements by fully electrifying the route, adding track, installing new digital signalling and carrying out station upgrades.

Transport for London (TfL) has put transport infrastructure projects



An underground pumped storage hydro plant has been given the green light at the existing Cruachan facility in Scotland

SECTORS SEEING GROWTH AND DECLINE (% OF SURVEY RESPONDENTS): NEXT 12 MONTHS



on hold due to a lack of clarity about long term government funding.

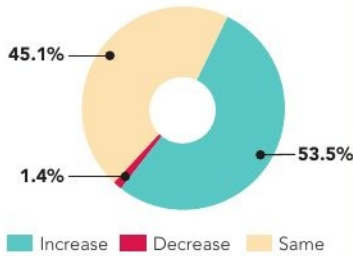
Schemes such as Crossrail 2 and the Bakerloo line extension have thus been moved from "a current to a longer term priority", according to

TfL chief finance officer Patrick Doig.

Rail was the second strongest sector in the 2022 survey, with 42.9% of respondents expecting growth, and only 8.7% anticipating a decline.

It has now dropped to third place,

STAFF PREDICTIONS: 2023



behind the power and water industries. Based on the 2023 GE100 survey results, 34.4% now expect growth and 11.9% a decline.

Once again the power sector is strongest, with 68.2% of GE100 survey respondents forecasting growth. The percentage of those predicting growth is slightly up from last year's 59%, and in 2022 and 2023 none of the respondents foresaw any decline in this sector.

"The energy sector is gaining traction with sizeable schemes coming to market from National Grid and others," says Love. "Many schemes are still struggling to get favourable planning decisions but once they do, there will be a lot of challenging work for geotechnical companies with innovative products to offer."

The optimism about the energy sector in the survey results is buoyed by the recent launch of Great British Nuclear (GBN), the government body which is expected to oversee the rapid expansion of nuclear power in the UK.

GBN will support large scale projects such as Sizewell C and Hinkley Point C, as well as emerging nuclear technologies.

Ministers also recently confirmed a £170M investment to prepare the Sizewell C site for construction; procure key components from the project's supply chain; and expand its workforce.

Advancing nuclear and offshore wind developments forms part of the the UK's plan to move away from a reliance on fossil fuels.

"The energy transition and need to shift to renewables will hopefully start to ramp up as the pumped



The government is investing £170M to prepare the Sizewell C nuclear power station site for construction

storage hydro opportunities in Scotland start to move into delivery phases as well as the associated grid improvements required to get the power to where it is needed," Ewing says. "This also includes Sizewell C and its progress to site."

Ramboll UK head of ground engineering Stephen West adds: "The rapid growth of the renewables energy market will have a huge influence on revenue generated by the geotechnical industry. This is now very much a worldwide market and is experiencing significant growth, but this can be tempered quickly by changes in the economy."

The UK is aiming to triple its offshore capacity to 50GW by 2030.

But the country's renewable energy plans suffered a setback this summer, when Vattenfall stopped work on the 1.4GW Norfolk Boreas wind farm in the southern North Sea. The energy company said this was due to "significantly deteriorating market conditions in the last year since the war in Ukraine, plus the effects of rising costs and supply chain delays". It will, however, still continue work on the

2.8GW Norfolk Vanguard project, which is part of the same offshore wind zone.

In June this year, the UK's first deep geothermal heating plant in 37 years was switched on at the Eden Project in Cornwall. On the heels of the announcement, the British Geological Survey released a government-funded white paper calling for more financial support and incentives for developing geothermal energy projects across the UK.

The high cost of drilling currently restricts geothermal energy schemes to areas with certain geologies.

British Drilling Association chair Paul McMann says: "The infrastructure necessary to support a more sustainable energy landscape is diverse and it presents varying risks throughout the UK.

"The UK's ambitious goal of achieving net zero emissions has a notable impact on the industry, particularly as the demand for geothermal energy is expected to rise significantly, putting substantial pressure on drilling resources."

The GE100 survey's second



TOP 10 GEOTECHNICAL COMPANIES

UK geotechnical turnover (£M)

Rank	Company	Turnover (£M)	Change in turnover (£M)	Change in ranking
1	Bachy Soletanche	204.1	+104.1 ↑	+4 ↑
2	RSK Group	172.6	+64.9 ↑	+1 ↑
3	Fugro	150	+20 ↑	-2 ↓
4	Van Elle	149	+24 ↑	-2 ↓
5	Balfour Beatty Ground Engineering	135	+41.1 ↑	+1 ↑
6	Keller	127.4	+27.4 ↑	-2 ↓
7	Roger Bullivant	92	+14 ↑	+1 ↑
8	Bam Ritchies	68.5	+5.5 ↑	+2 ↑
9	Socotec UK	65.6	-1.4 ↓	0 →
10	Cementation Skanska	64.94	+23.04 ↑	+5 ↑

biggest growth market is water, which was chosen as the strongest sector by 37.1% of respondents – compared with 29.2% in 2022. Only 2.7% said they expect a dip in demand.

Ramboll UK head of tunnelling Richard Miller agrees that “the growth of the renewable energy market and the investment planned in the water sector in the UK and Ireland will create exciting projects for the geotechnical industry”.

Earlier this year the UK Infrastructure Bank announced its first investment in the water sector with a £50M loan to support Portsmouth Water’s Havant Thicket Reservoir project. Further reservoir projects are also being planned across the country.

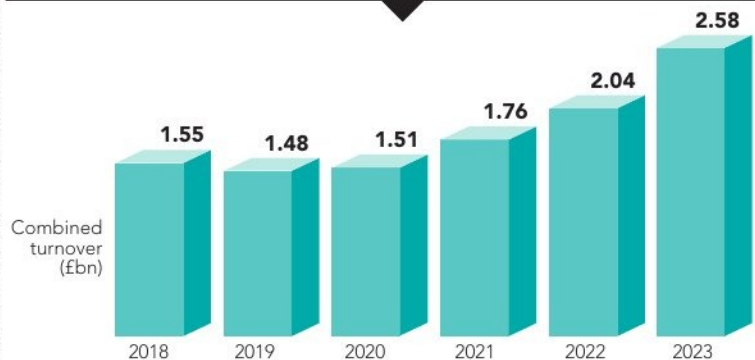
Nonetheless, the sector is facing challenges with water companies coming under fire for causing sewage spills in the sea and for causing flooding from stormwater overflow discharges.

Thames Water has also run into financial difficulties.

Ofwat recently gave the green light to water infrastructure projects worth £2.2bn to help tackle some of these issues.

Based on this year’s GE100 survey results, across the different sectors, 53% of the responding companies

COMBINED TURNOVER OF TOP 100 GEOTECHNICAL COMPANIES



still expect their workload to increase in the coming 12 months. This is a slight dip from 65% in 2022, but the ground engineering sector seems to have a generally positive outlook. Only 8% of companies expect their workload to decrease, while 39% anticipate that it will stay the same.

MOVERS AND SHAKERS

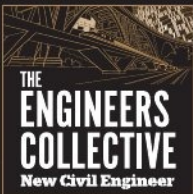
The 2023 GE100 rankings reveal that the combined UK-based geotechnical turnover of the top 100 companies has risen by 27% from last year, adding up to £2.58bn.

The turnovers of the top 10 companies also now add up to £1.23bn, a 29% jump from last year’s £951M.

Bachy Soletanche takes the top spot this year with a UK geotechnical turnover of £204.1M for the fiscal year ending in December 2022. It climbed up four spots after its turnover more than doubled from the £100M reported in last year’s GE100. Its pretax profit has risen from £1.9M to £4.4M.

Bachy Soletanche managing director Tamas Kaltenbacher says: “Our involvement in major projects, such as HS2 and Tideway, along with a robust order book across the country, has allowed Bachy Soletanche to have a strong performance and serve a wide range of customers throughout 2022.”

RSK Group has moved up to second place with a turnover of



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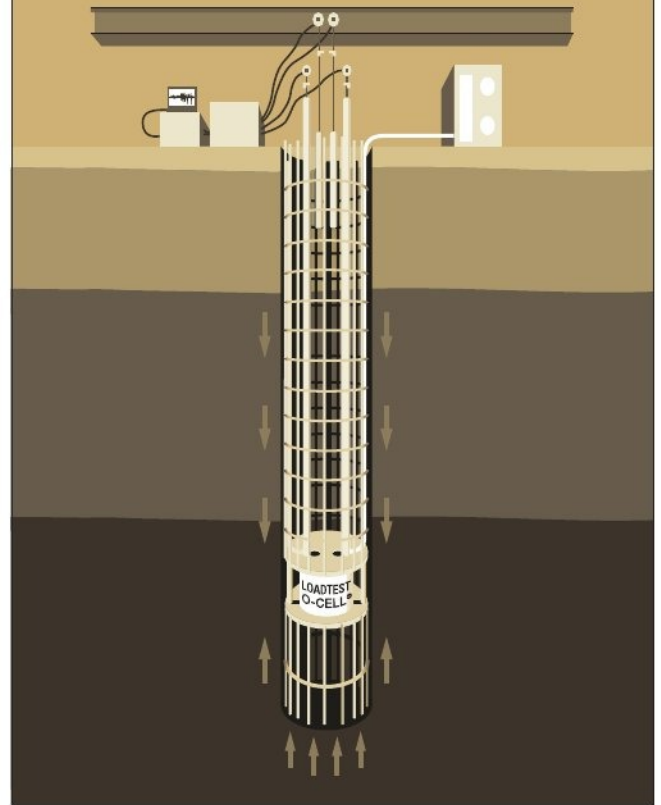
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£172.6M for the fiscal year ending April 2023, up from £107.7M. Its pretax profit was £19.1M, up from £14.65M. During the last financial year, the overall group made 27 acquisitions and established eight companies. In the UK, RSK acquired civil, structural, geo-environmental and engineering consultancy Travis Baker; land management, environmental services and geotechnical contracting group Spencer, which includes Quantum Geotechnic; and engineering consultancy Milner Associates.

The acquisitive group has made ambitious plans for the coming years. It wants to quadruple its global turnover to more than £5bn in 2030 and double its portfolio of environmental and engineering businesses from 200 to 400.

RSK founder and chief executive Alan Ryder has acknowledged that the group's strategy involves some "very big numbers and significant goals". As part of it, the company plans to focus on significant international expansion.

Fugro has moved down from last year's top spot to third place, although its UK geotechnical turnover for 2022 has actually risen by 15% to £150M and its pretax profit has gone from £16M to £21M.

A key contract award for Fugro involves ground investigation work at the Keadby 3 carbon capture power station in North Lincolnshire for SSE Thermal and Equinor.

It also signed up to a multi-year partnership with SP Energy Networks to survey and model its entire transmission network.

Van Elle has fallen two spots, but also saw its turnover rise from £125M to £149M, and its pretax profit go up from £3.5M to £5.4M for the financial year ending April 2023. The company has enhanced its resilience with a growing presence in the UK energy transmission and distribution infrastructure market.

Many of Van Elle's customers are currently developing battery plants, data centres and giga factories as well as introducing energy efficiency improvements to existing facilities.

But in its results announcement earlier this year, Van Elle non-executive



The Hinkley Point C nuclear power station project's offshore work is in its final phase

chair Frank Nelson warned that "current market uncertainty will continue over the coming year, particularly in the housebuilding sector".

And while Van Elle does not expect to see growth in the overall UK geotechnical sector over the next 12 months, it does expect housing and highways to stabilise during 2024, with the energy and water sectors presenting new opportunities.

Balfour Beatty Ground Engineering has climbed one place to fifth in the top 100 rankings, with a geotechnical turnover of £135M for the whole of 2022, up 44% from £93.9M in 2021. Its pretax profit increased from £5.2M to £11M.

When announcing Balfour Beatty's full year results, group chief executive Leo Quinn said: "The diversified portfolio, both geographically in the UK, US and Hong Kong, and operationally across construction services, support services and infrastructure investments, plus the strength of our balance sheet and cash management, have provided the resilience for the group to deliver ahead of expectations and grow our order

book through the global instability seen in 2022."

In the UK, Balfour Beatty has been involved with major project work on HS2, Hinkley Point C and Thames Tideway.

Keller (turnover £127.4M), Roger Bullivant (turnover £92M), Bam Ritchies (turnover £68.5M) and Socotec UK (turnover £65.6M) have all retained positions in the top 10.

Keller announced record revenue for the full international group of £2.9bn for the year ended December 2022. For its UK geotechnical work, its turnover increased by 27.4%, although its pretax profit dropped from £10.4M to £7.9M.

While Socotec UK remains ninth in the GE100 this year, its geotechnical turnover has dropped slightly from £67M for the previous financial year. Its pretax profit has fallen from £9M to £7.3M.

Cementation Skanska at number 10 is back among the top performers for the first time since 2019. Its turnover was £64.94M and pretax profit was £1.8M in the financial year ending January 2022. This is up from £41.9M and £1.06M the previous year.

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Skills in demand

There is no end in sight for the ever-present skills shortage in ground engineering, as the sector struggles to retain and attract more talent.

For the third year in a row, more than 70% of GE100 survey respondents have said that the skills shortage is the main concern for the geotechnical sector.

The magnitude of this problem is further highlighted by the fact that 81% of respondents said they had experienced difficulties recruiting appropriately skilled staff in the last 12 months. This is the second year in a row that this figure has been more than 80%.

It is a worrying trend as 53% of companies are predicting a workload increase, and 54% anticipate that their staff numbers will increase over the next year.

While in many ways this makes the sector a job seeker's market, respondents to this year's GE100 survey raised concerns about the lack of quality university-trained geotechnical engineers and engineering geologists.

They were also concerned about how this will impact the UK's ability to deliver projects, as experienced practitioners head towards retirement.

The cost of living crisis has driven up salary expectations, and for some companies this has impacted staff retention, which is also further exacerbated by tighter profit margins. Megaprojects such as High Speed 2 (HS2) have also contributed to wage inflation.

Nonetheless, the GE100 salary survey shows that – despite small annual fluctuations – average pay in the industry has stayed consistent



Ground engineering firms are struggling to recruit appropriately skilled staff

over the last five years. So, with higher salaries available in other industries, some are looking for alternative career options.

In response, ground engineering companies are using different methods to retain and attract more talent.

Campbell Reith partner Elizabeth Brown says the consultant works hard to create a positive work environment, build networks and raise its profile.

“As a result, we have reduced the impact of the skills shortage with three of our last four hires having been through existing contacts,” she explains. “Margins are small, but a focus on team building, training and development to enhance our effectiveness has helped us see profits increase over the last year.”

Ramboll UK head of ground engineering Stephen West says that one way to bring more people into ground engineering is by “casting a wider net for prospective colleagues with a more diverse skill set”.

Recruiting people with adaptable experience can also be beneficial as market priorities change, he says.

The skills shortage has affected Richter's ability to grow its business, says associate director David Halifax.

“We have been lucky to find a number of exceptional graduates and apprentices who have joined our team, but finding experienced professionals to help our early career team members develop has been a real challenge,” he notes.

Richter director Colin Harwood says that bridging the experience gap

in the geotechnical sector demands “education, training, and reformed procurement”. He is keen to see a more impactful and effective geotechnical sector that takes advantage of early collaboration, education, digital finesse and performance-driven design.

Mott MacDonald project principal David Harris notes that early engagement is key to addressing the skills shortage.

“Our Croydon foundations and geotechnics team has hosted nine work experience students this summer and we are in our third year of employing apprentices,” he says.

Van Elle pre-construction director Matt Love says his company has also invested in apprenticeships and development for early career professionals.

“We have supported lower earners and introduced a new suite of benefits for all grades,” he adds.

British Drilling Association chair Paul McMann explains that the drilling industry is also struggling with a skilled professionals shortage.

“The BDA is actively exploring innovative approaches to attract individuals into the industry and encourage them to pursue careers in this field,” he says.

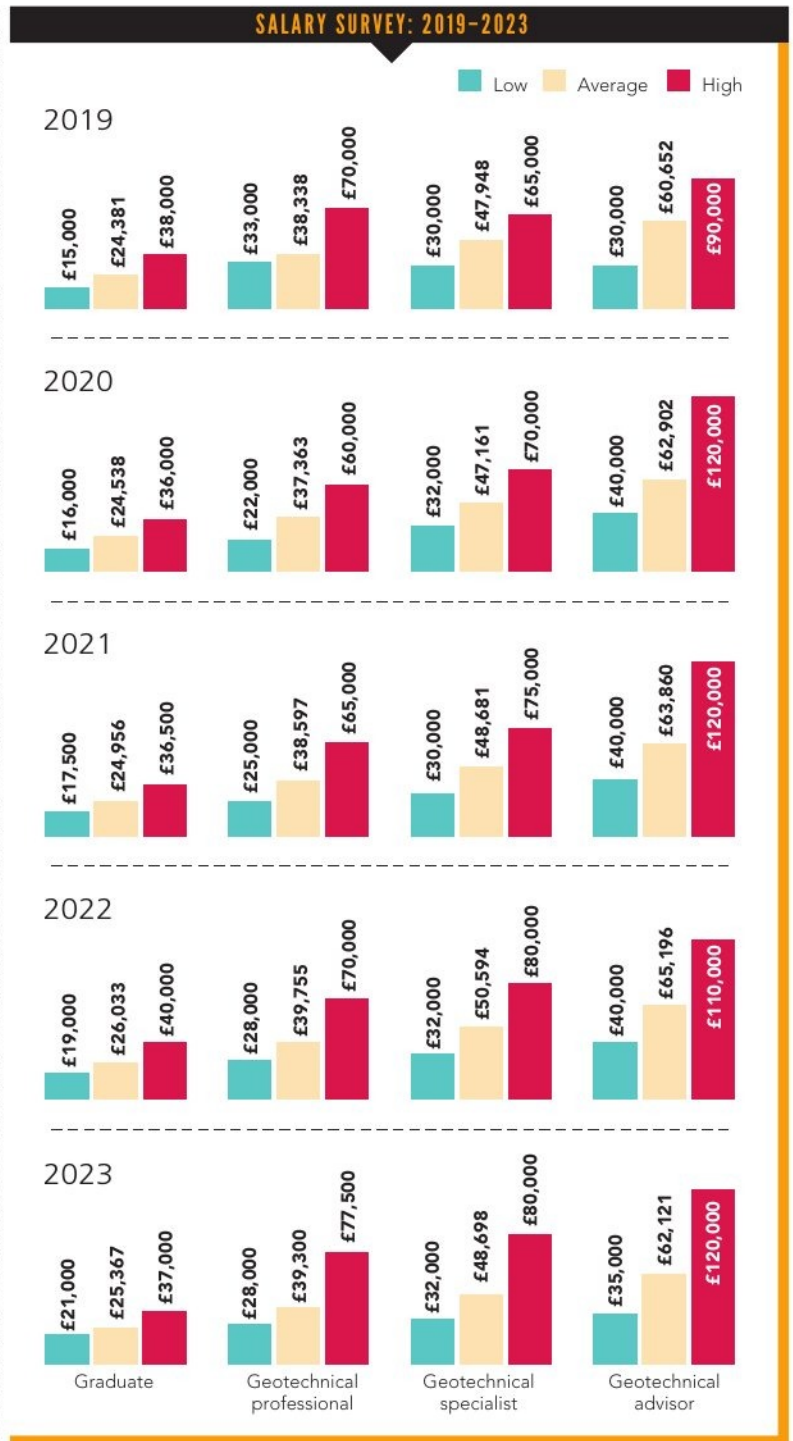
To be viewed as a desirable career option that is open to people of all backgrounds, ground engineering needs to be welcoming and inclusive as a sector.

Based on data from this year’s GE100 survey, the geotechnical and geo-environmental workforce of the responding companies comprises 23.5% women, of whom 20% are in senior positions.

Black, Asian or minority ethnic (Bame) individuals account for 9.9% of the workforce, and of this figure 9.1% are in leadership roles. There has been a small increase from last year, but the numbers are still very low and fail to reflect the diversity of wider UK society.

Ramboll principal geotechnical engineer Kalisha Sejpar says: “The industry is suffering from severe skills shortages and a fast paced demand for new approaches, technologies and skill sets.

“We can turn this challenge



into opportunity through intentional efforts towards diversity and inclusion. Diversity in all its forms is essential for boosting creativity, innovation and productivity, together with inclusive workplace cultures that lead to more engaged employees and higher

retention rates.

“However, studies show that the engineering profession is too slow in developing a true culture of inclusion, and so the ground engineering sector needs to accelerate its drive to become more inclusive to remain a key player in

the race for engineering skills. “Purposeful interventions are needed to create a cultural shift and embrace non-traditional entry routes and untapped talent pools.

“This also links to the increasing need to deliver social value outcomes in construction industry contracts.”

McMann also believes that creating a more diverse workforce should be a goal for the profession.

“Industry leaders must actively support and endorse the necessary changes and developments to meet these challenges head-on,” he says.

In addition to addressing ground engineering’s diversity issue, sector leaders also have their work cut out in trying to improve the industry’s sustainability image.

Carbon emissions were a key industry concern for 20% of the GE100 survey respondents.

Brown notes that the continued pace of climate change “impels us to address to the contribution of the construction industry to global carbon emissions”.

“Geotechnical engineers, with their early involvement in projects, can be key influencers in developing lower carbon engineering solutions,” she says.

“During the next 12 months and beyond, we need to prioritise this, for example highlighting the benefits of decent site investigations to clients to allow optimal design, and pressing colleagues to adopt realistic serviceability limit states.”

According to Cementation Skanska business development director Chris Campbell, decarbonisation is an increasing priority for its customers and stakeholders.

“We continue to see increased interest in structural and foundation reuse, as well as greener ways of delivering new infrastructure,” he says.

Mott MacDonald geotechnical lead Rob Talby says that the consultant is routinely assessing carbon as part of its design delivery process.

As McMann however notes embracing new opportunities around sustainability will require a re-evaluation of what has been considered “standard practice”.



The sector requires individuals with a wide range of skills, from construction techniques to new technologies

DIVERSITY



Percentage of female UK geotechnical staff
23.5%



Percentage of black, Asian or minority ethnic (BAME) UK geotechnical staff
9.9%

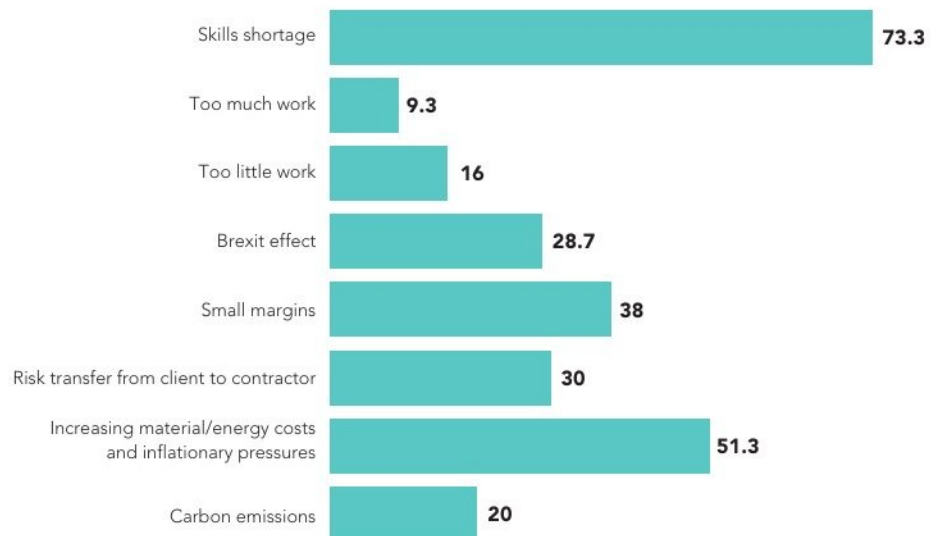


Percentage of female UK geotechnical staff in senior level positions
20%



Percentage of BAME UK geotechnical staff in senior level positions
9.1%

WHAT ARE YOUR MAIN CONCERNS ABOUT THE GEOTECHNICAL INDUSTRY AT THE MOMENT? (% OF SURVEY RESPONDENTS)



TOP 100 UK GEOTECHNICAL COMPANIES

Rank	Company	UK geotechnical turnover	Rank	Company	UK geotechnical turnover
1	Bachy Soletanche	£204.1M	51	Concept Engineering Consultants	£9.6M
2	RSK Group	£172.6M	52	Cowi	£9.35M
3	Fugro	£150M	53	Lankelma	£9M
4	Van Elle	£149M	54	PJ Edwards & Co	£8.4M
5	Balfour Beatty Ground Engineering	£135M	55	Tony Gee & Partners	£8.1M
6	Keller	£127.4M	56	WJ Groundwater	£7.97M
7	Roger Bullivant	£92M	57	Coffey Geotechnics	£7.8M
8	Bam Ritchies	£68.5M	58	A-Squared Studio Engineers / A2-Site Investigation	£7.5M
9	Socotec UK	£65.6M	59	CGL	£7.3M
10	Cementation Skanska	£64.94M	60=	SLR Consulting	£6.5M
11	Ed. Züblin UK Branch	£64.2M	60=	Sanctus	£6.5M
12	Aecom	£62M	62=	Altrad RMD Kwikform	£6M
13	Aarsleff Ground Engineering	£59.1M	62=	CC Ground Investigations	£6M
14	Jacobs	£55M	64	Ramboll	£5.75M
15	Mott MacDonald	£50M	65=	Harrison Group Environmental	£5.4M
16	Bauer Technologies	£48M	65=	Cohesion Piling Company	£5.4M
17	Dawson-Wam	£46.4M	65=	Quantum Geotechnic	£5.4M
18	Arcadis	£46.3M	68	Southern Testing Laboratories	£5.2M
19	Expanded Piling	£44M	69	GWP Consultants	£5.1M
20	Keltbray Piling	£43.1M	70	Fairhurst	£5M
21	Atkins	£39M	71	The LK Group	£4.98M
22	WSP	£38M	72	Amey Consulting	£4.9M
23	Arup	£37.6M	73	In Situ Site Investigation	£4.85M
24	Vibro Menard	£31M	74	Stuart Wells	£4.79M
25	Soil Engineering Geoservices	£29.7M	75	GRM Development Solutions	£4.56M
26	Cognition Land & Water	£28.4M	76	Solmek	£4.5M
27	Structural Soils	£28M	77	BWB Consulting	£4.44M
28	Foundation Piling	£27.4M	78	DNV	£4.41M
29	VSL Systems (UK)	£26M	79	Geobruigg	£4.4M
30	Speedeck Foundations	£21.9M	80	Geosense	£4.1M
31	Maccaferri	£21.3M	81	Geotechnical & Environmental Associates	£4.05M
32=	Systra	£20.4M	82	Marshall Drilling	£3.58M
32=	Central Piling	£20.4M	83	AF Howland Associates	£3.37M
34	Geobear	£15.9M	84	Akela Ground Engineering	£3.3M
35=	Green Piling	£15.5M	85	Waterman Infrastructure & Environment	£3.18M
35=	Newton Ground Engineering	£15.5M	86	Buro Happold	£3.1M
37	Causeway Geotech	£15.25M	87=	Saxton Drilling	£3M
38	FK Lowry	£15.13M	87=	ADP Group	£3M
39	Franki Foundations	£15M	89	Applied Geology	£2.9M
40	Geotechnical Engineering	£14.6M	90	Wentworth House Partnership	£2.8M
41	Dunelm Geotechnical & Environmental	£14M	91	South West Geotechnical	£2.65M
42	Byrne Looby, An Ayesa Company	£13.66M	92=	Earth Environmental & Geotechnical	£2.5M
43=	Sheppard Piling	£13.5M	92=	Asterra	£2.5M
43=	GDS Instruments	£13.5M	94	Norfolk Partnership Laboratory	£2.5M
45	Hydrock	£12.4M	95	Brownfield Solutions	£2.43M
46	Delta-Simons	£12.2M	96=	Campbell Reith	£2.3M
47	Geotechnics	£10.5M	96=	Geotron UK	£2.3M
48	Richter	£10.15M	98	Pell Frischmann Consultants	£2.25M
49	ABG Geosynthetics	£10M	99=	Gavin and Doherty Geosolutions (UK)	£2.2M
50	Central Alliance Preconstruction Services	£9.81M	99=	Sub Surface	£2.2M

TOP 50 UK CONTRACTORS

Rank	Company	UK geotechnical turnover	Rank	Company	UK geotechnical turnover
1	Bachy Soletanche	£204.1M	25=	Newton Ground Engineering	£15.5M
2	Fugro	£150M	27	Causeway Geotech	£15.25M
3	Van Elle	£149M	28	FK Lowry	£15.13M
4	Balfour Beatty Ground Engineering	£135M	29	Franki Foundations	£15M
5	Keller	£127.4M	30	Geotechnical Engineering	£14.6M
6	Roger Bullivant	£92M	31	Dunelm Geotechnical and Environmental	£14M
7	Bam Ritchies	£68.5M	32	Sheppard Piling	£13.5M
8	Socotec UK	£65.6M	33	Geotechnics	£10.5M
9	Cementation Skanska	£64.94M	34	Central Alliance Preconstruction Services	£9.81M
10	Ed. Züblin UK Branch	£64.2M	35	Concept Engineering Consultants	£9.6M
11	Aarsleff Ground Engineering	£59.1M	36	Lankelma	£9M
12	Bauer Technologies	£48M	37	P J Edwards & Co	£8.4M
13	Dawson-Wam	£46.4M	38	WJ Groundwater	£7.97M
14	Expanded Piling	£44M	39	Sanctus	£6.5M
15	Keltbray Piling	£43.1M	40	CC Ground Investigations	£6M
16	Vibro Menard	£31M	41=	Cohesion Piling Company	£5.4M
17	Soil Engineering Geoservices	£29.7M	41=	Quantum Geotechnic	£5.4M
18	Cognition Land and Water	£28.4M	43	In Situ Site Investigation	£4.85M
19	Structural Soils	£28M	44	Stuart Wells	£4.79M
20	Foundation Piling	£27.4M	45	Solmek	£4.5M
21	VSL Systems (UK)	£26M	46	Marshall Drilling	£3.58M
22	Speedeck Foundations	£21.9M	47	Akela Ground Engineering	£3.3M
23	Central Piling	£20.4M	48=	Saxton Drilling	£3M
24	Geobear	£15.9M	48=	ADP Group	£3M
25=	Green Piling	£15.5M	50	Geotron UK	£2.3M

TOP 50 UK CONSULTANTS

Rank	Company	UK geotechnical turnover	Rank	Company	UK geotechnical turnover
1	RSK Group	£172.6M	26	Amey Consulting	£4.9M
2	Aecom	£62M	27	GRM Development Solutions	£4.56M
3	Jacobs	£55M	28	BWB Consulting	£4.44M
4	Mott MacDonald	£50M	29	DNV	£4.41M
5	Arcadis	£46.3M	30	Geotechnical & Environmental Associates	£4.05M
6	Atkins	£39M	31	AF Howland Associates	£3.37M
7	WSP	£38M	32	Waterman Infrastructure & Environment	£3.18M
8	Arup	£37.6M	33	Buro Happold	£3.1M
9	Systra	£20.4M	34	Applied Geology	£2.9M
10	Byrne Looby, An Ayesa Company	£13.66M	35	Wentworth House Partnership	£2.8M
11	Hydrock	£12.4M	36	South West Geotechnical	£2.65M
12	Delta-Simons	£12.2M	37=	Earth Environmental & Geotechnical	£2.5M
13	Richter	£10.15M	37=	Norfolk Partnership Laboratory	£2.5M
14	Cowi	£9.35M	39	Brownfield Solutions	£2.43M
15	Tony Gee and Partners	£8.1M	40	Campbell Reith	£2.3M
16	Coffey Geotechnics	£7.8M	41	Pell Frischmann Consultants	£2.25M
17	A-Squared Studio Engineers / A2-Site Investigation	£7.5M	42	Gavin and Doherty Geosolutions (UK)	£2.2M
18	CGL	£7.3M	43	Eastwood Consulting Engineers	£2.1M
19	SLR Consulting	£6.5M	44	TRC Companies	£2.03M
20	Ramboll	£5.75M	45	Earth Science Partnership	£2M
21	Harrison Group Environmental	£5.4M	46	Patrick Parsons	£1.8M
22	Southern Testing Laboratories	£5.2M	47	Rendel	£1.76M
23	GWP Consultants	£5.1M	48	Geo Dyne	£1.68M
24	Fairhurst	£5M	49=	Haskoning DHV UK	£1.5M
25	The LK Group	£4.98M	49=	Curtins	£1.5M

TOP 50 GEOTECHNICAL FIRMS BY UK STAFF NUMBERS

Rank	Company	Staff	Geotechnical engineers	Rank	Company	Staff	Geotechnical engineers
1	RSK Group	1,505	816	26	Dawson-Wam	120	3
2	Fugro	680	250	27	Central Alliance Preconstruction Services	116	19
3	Van Elle	660	150	28=	Causeway Geotech	110	28
4	Socotec UK	648	200	28=	Hydrock	110	90
5	Aecom	610	565	30=	Foundation Piling	100	15
6	Bachy Soletanche	547	116	30=	Geotechnics	100	80
7	Roger Bullivant	518	55	30=	Concept Engineering Consultants	100	60
8	Jacobs	460	460	33	Keltbray Piling	95	20
9	Cowi	450	90	34	Delta-Simons	93	80
10	Atkins	425	400	35	CGL	86	75
11=	Keller	423	46	36=	Byrne Looby, An Ayesa Company	85	55
11=	Arcadis	423	350	36=	Franki Foundations	85	6
13	WSP	395	395	38=	WJ Groundwater	84	15
14	Balfour Beatty Ground Engineering	371	70	38=	Amey Consulting	84	84
15	Mott MacDonald	350	300	40	GDS Instruments	76	10
16	Bam Ritchies	335	120	41	Green Piling	73	3
17	Arup	311	311	42=	Fairhurst	70	65
18	Cementation Skanska	300	61	42=	VSL Systems (UK)	70	20
19	Structural Soils	260	110	44	Wentworth House Partnership	67	11
20	Aarsleff Ground Engineering	235	20	45	Tony Gee and Partners	66	66
21	Soil Engineering Geoservices	185	45	46=	Vibro Menard	65	14
22	Expanded Piling	180	38	46=	Dunelm Geotechnical & Environmental	65	40
23=	Bauer Technologies	150	35	46=	Ramboll	65	60
23=	Geotechnical Engineering	150	58	46=	Southern Testing Laboratories	65	29
25	SLR Consulting	123	103	50	Coffey Geotechnics	62	56

Leader in innovation

Geodata specialist Fugro is driving for better data access, safer operations and more sustainable practices through technological advances in geotechnics.

For the last two years, Fugro has been chosen as the Ground Investigation Specialist of the Year at the GE Awards. It has also consistently ranked highly on the GE100 list of top geotechnical firms. While the company has experienced growth in turnover and profit, it is also investing significantly in technology, both in-house and with partners, to improve its performance and to collect better geo-data from various locations, ranging from marine to onshore.

Key drivers for these innovations include:

- Increased safety – the removal of people from the field and reduced manual operation
- The energy transition – technology for renewable, carbon capture and emerging energy projects
- Improved data – better access to and understanding of data for clients.

“We develop the things our clients need,” says Fugro’s nearshore manager Paul Roach.

“We’re focused on robotics, remote operations and analytics – so improved processing of data, artificial intelligence and cloud-based geodata solutions – in order to improve the flow of data from site to the clients making decisions on that data. To do that, we invest quite heavily in web portals and making that data better presentable and easier to make decisions on.”

Fugro has the largest network of remote operations centres and remote equipment for marine applications.

“We have uncrewed remotely

operated surface vessels, a large fleet of site characterisation equipment and our seabed equipment – the Blue Snake, Blue Dragon and Deep Drive – that can get remote data from difficult to access places. We gather that data with various technologies that allow us to penetrate the subsurface deeper, more efficiently.”

The acquisition of cone penetration test (CPT) data can be automated, and the data can be accessed anywhere in the world almost instantly. This means it can be processed and made available to clients immediately. “And if agreed upfront, the clients can see that data live as well, so they can make immediate decisions on, not just the design, but the investigation itself,” Roach adds.

Fugro is also moving into remote operation for traditional onshore site investigations.

“I think we’re still at the start of the journey towards better data access,” Roach notes. “There’s lots of different methods of digital delivery that need to be rationalised across our industry. Fugro is doing that with our portals, and we’re using third party suppliers as well.

“The industry is still gathering analogue data, whether through cable percussive drilling or standard penetration tests (SPTs), and relying on these antiquated methods to deliver soil design parameters for some really significant infrastructure projects. We should take these outdated methods off the table as an industry, both client and contractor, and do better things with digital data, whether it be CPT or



just better drilling techniques such as measurement while drilling (MWD) as an example.”

Roach has worked with Fugro in operations management for more than a decade now. “My experience is firstly drilling based, and I then moved into main contractor civil engineering, working for a tunnelling contractor. I got to see the subsurface up close and see the challenges presented by poor acquisition of data.

“I came back into the site investigation industry with a real passion to make sure we’re doing the right thing, so that infrastructure projects are delivered in the correct way, uncertainty is reduced and clients have the right data to reduce risk,” he explains.

Roach wants to highlight the fact that, in addition to technological innovation, Fugro also invests in its people, creating new opportunities to develop themselves and the business.

“I didn’t stay quiet when I saw things that were screaming out for improvement, so the business invited me into the innovation team to spend a period of time developing better solutions for data acquisition.



“Off the back of that, we’ve delivered a number of innovations.”

RECENT DEVELOPMENTS

In Europe and the Middle East, Fugro has recently provided several jack-up rig solutions to clients to help reduce the work schedule and carbon footprint of projects.

“On projects where we have the choice to execute them with a dynamically positioned vessel or jack-up, we’re now highlighting to our clients the benefits of the jack-up operation, where we’re fixed, elevated on a stable platform and using less fuel and up to a sevenfold reduction in CO₂ emissions in some cases. Our clients can then see the benefit of a lower carbon footprint of the survey,” Roach says.

Fugro is also focused on improved drilling technologies, such as sonic drilling and the use of wireline CPTs in boreholes.

The Fugro Deep Line wireline system has been brought from offshore innovation development into nearshore and now onshore operations.

“That will enable us to get discrete CPT data throughout the borehole profile at any depth. The onshore aspect

Main picture: Excalibur jack-up barge with utilisation of sliding drill floor
Top right: Remote operated robotics on site
Bottom right: Fugro’s Deep Drive cone penetration test innovation

of deploying that is quite challenging logistically, but we’re looking at a target of replacing the SPT with CPT technology over the coming years,” Roach explains.

“Our nearshore team based in Falmouth has recently brought some of our most recent drilling/CPT technologies together in a sliding drill floor, on our largest in-house jack up barge *Excalibur*.

“The drill floor can slide to achieve accuracy in drilling location and drill multiple boreholes combining many downhole sampling techniques, while reducing weather downtime at each location. It can achieve higher quality data at each wind turbine foundation location, reducing ground uncertainty for our clients and enabling better engineering foundation designs.”

With its remote and autonomous solutions, Fugro has managed to remove personnel “from the line of fire” and gather data from places that were previously inaccessible. Tailings dams in the mining industry in South America are examples of these locations.

“The tailings industry has seen some quite critical and sensitive incidents there,” Roach says, “and having been

involved in that industry and knowing the pain when things go wrong, we felt it was absolutely prudent to use our technology as best as we can to solve the problems in that industry.”

While working for Fugro’s innovation team, Roach led the development of an onshore remote operation solution for tailings dams. “It is a remotely operated CPT rig, using technology that we developed for the seabed,” he explains. “We brought it onshore, created a local remote operation centre, and we then enabled our clients to look at the engineering properties of the structure that they couldn’t access with traditional technology. This enabled them to make better decisions about dam de-characterisation, which is the process of remotely excavating and removing the risk of that unstable structure.

“We’ve been working on that for a couple of years now and will continue to do so to gather data while our client goes through the process of managing the risk to people in and around and downstream of that structure.

“That’s something that we’ve heavily invested in.”

FURTHERING SUSTAINABILITY

Fugro transitioned to low sulphur fuels for marine vessels ahead of the cut-off date set by the International Maritime Organisation. It has done the same for nearshore vessels and is also developing technology to create a carbon neutral nearshore site investigation solution for clients.

Overall, the company has set itself targets for improving the sustainability of the business and its operations through new technologies. According to Roach, this approach has been driven internally rather than by clients and the market. The firm is thus keen to see clients move sustainability higher up on their agenda.

“We are seeing an increase in projects being scored on environmental sustainability and delivery, but it would be great to see higher ambitions from our clients to drive us on,” Roach notes.

“We want to do things better, and we want the industry to take that forward. In the last five years, there has been a significant increase in sustainable technology that just needs to be adapted and converged in order to deliver for our sector. Let’s not miss that opportunity.”

Welsh mine to use x-ray imaging

UK minerals development company Anglesey Mining has engaged RSK Group subsidiary Central Alliance to trial the muon tomography technique for exploration at the Parys Mountain underground project in Wales.

The Parys Mountain site on the Isle of Anglesey was once a large copper mine.

It still hosts a significant polymetallic zinc, copper, lead, silver and gold deposit.

The project already has a head frame, a 300m deep production shaft and planning permission for operations.

Ground engineering company Central Alliance will carry out a proof of concept study on the use of muon tomography as an exploratory tool.

It hopes to identify new resources and assist with the delineation of existing zones of mineralisation at Parys Mountain.

The muon sensor will be deployed in stages down the 300m deep Morris shaft, with the acquired muon data then analysed off site.

Muon tomography is a technique that measures naturally generated subatomic particles, called muons, from which it creates an image of the subsurface through density differentials. The process is often compared to medical x-ray imaging.

Anglesey Mining expects the process to enable more focused drilling programmes, which could potentially save on drilling costs and time.

Central Alliance's muon technology is designed and manufactured in the UK by its industry partner Geoptec.

Terraroc launches new S Geobor HPD system

Geotechnical drilling equipment supplier Terraroc, in collaboration with Socotec UK and Cambridge Insitu, has released the S Geobor wireline high pressure dilatometer (HPD) system.

The new system removes the need for drill rods when conducting HPD tests, reducing the need for manual handling and increasing productivity.

The HPD, which is deployed into the borehole via a wireline, is an instrumented downhole pressuremeter. It can provide measurements of rock formation properties under different loading conditions. It features a flexible cylindrical membrane that expands under pressure and also includes downhole strain gauged transducers for displacement and pressure measurement.

The system complements Terraroc's Terracore geotechnical core sampling system, extending the potential for efficient and effective insitu data acquisition during site



The S Geobor wireline high pressure dilatometer system

investigations.

Site investigations, testing, inspection and compliance services specialist Socotec UK and HPD manufacturer Cambridge Insitu worked with Terraroc to develop the new wireline HPD system.

Terraroc business line manager for Europe and Latin America Deyvi Akkris said: "The S Geobor wireline HPD system not only enhances operational efficiency, it

delivers comprehensive, high resolution data that our clients can trust."

The HPD system is designed for geotechnical engineers and drilling professionals who need to accurately assess the mechanical properties of rock formations. Positioned at the desired depth, using the S Geobor drill string, the probe expands under pneumatic pressure, delivering real-time measurements.

Australian research partnership develops rock bolt innovation

Research body Mining 3 and the University of Southern Queensland, supported by the Australian Coal Industry's Research Program, have developed a carbon fibre composite rock bolt.

The aim is to replace traditional steel and fibreglass rock bolts. The innovation is designed for improved

performance and cost effectiveness in mining and tunnel engineering.

Rock bolts are used to reinforce jointed rock masses. In 2023, the global rock bolt market was valued at £36bn.

University of Southern Queensland's Centre for Future Materials associate professor Ali Mirzaghobanali is leading

the research team in rock bolt mechanics and is supporting Mining 3 in the mechanical characterisation of the carbon fibre composite rock bolt.

"Steel rock bolts are heavy and prone to corrosion, while fibreglass composite rock bolts have limited capacity ratings and can be bulky in diameter," he said.

27 September: Woodsmith project



BGA ANNUAL DINNER AND LECTURE: THE HISTORICAL UNDERPINNING OF WINCHESTER CATHEDRAL – HEROIC OR HORRIFIC?

26 September: 6pm to 10.30pm, Great Hall, Institution of Civil Engineers, One Great George Street, London SW1P 3AA

The BGA Annual Dinner is a new addition to BGA's annual calendar of events. The inaugural BGA Annual Dinner will also include a lecture by Imperial College London professors John Burland and Jamie Standing on the underpinning of Winchester Cathedral. The lecture will only be open to those attending the dinner.

More information:
<https://bit.ly/BGADinner23>

THE WOODSMITH PROJECT: A POLYHALITE MINE

27 September: 10.30am to 2pm, Rogerthorpe Manor Hotel,

Badsworth, Pontefract WF9 1AB Anglo American lead design engineer Mark Calvert will discuss the Woodsmith project, its engineering challenges and how the team has overcome them. The project includes the mine site, as well as the processing plant and harbour facility. With the mine site located in the North Yorkshire Moors National Park, there are significant restrictions on what can be undertaken during construction and operation. These have resulted in new approaches to traditional problems. The headframes of the two deep shafts are hidden in a foreshaft, 43m below a normal looking agricultural building. The site is surrounded by earthwork bunds and once complete, motorists driving past the site will have no idea of the major feat of engineering around them. Calvert will give a full overview of the project from the continuous miners that will operate 1.6km underground, to the loading of the processed polyhalite granules onto

ships at Teesside.
More information:
<https://bit.ly/WoodsmithAnglo>

EFFC AGM

28 to 30 September, Point Barbaros Hotel, Esentepe, Yıldız Posta Cd No 29, 34394 Şişli/İstanbul, Turkey

The European Federation of Foundation Contractors (EFFC) is holding its executive and annual general meeting in Istanbul on 28 and 29 September. A special dinner has been arranged for the second evening aboard a yacht courtesy of Temel Mühendisleri Derneği and a sightseeing tour is scheduled for 30 September.

The event will be an opportunity for EFFC members to gather, network and discuss important industry topics.

More information:
<https://bit.ly/EFFCAGM>

15TH INTERNATIONAL ISRM CONGRESS

9 to 14 October, Salzburg Congress, Auerspergstraße 6, 5020 Salzburg, Austria

The Austrian Society for Geomechanics is hosting the 15th International Society for Rock Mechanics & Rock Engineering (ISRM) Congress in conjunction with the 72nd Geomechanics Colloquium in Salzburg, where the ISRM was founded in 1962. The scientific programme will focus on challenges in rock mechanics and rock engineering. In addition, site visits to tunnel and rock engineering projects will be organised.

More information:
<https://bit.ly/ISRMCongress23>

GE EVENTS

GE Basements & Underground Structures and GE Smart Geotechnics

5 October: 9am to 6.30pm, Victoria Park Plaza, 239 Vauxhall Bridge Road, London SW1V 1EQ

GE's 16th Basements and Underground Structures Conference explores the design and delivery of underground spaces. It is aimed at those working in the infrastructure, commercial or residential sectors, offering expert knowledge, best practice from major projects and networking opportunities

with clients, contractors and designers.

Co-located with the event is the second GE Smart Geotechnics conference, which builds on the popular GE Instrumentation & Monitoring conference. It is aimed at those involved in monitoring and digital solutions looking for up to date insight into projects, technologies, data management capabilities, use of the cloud and artificial intelligence.

More information:
<https://bit.ly/BasementsUG23> &
<https://bit.ly/SmartGeo23>



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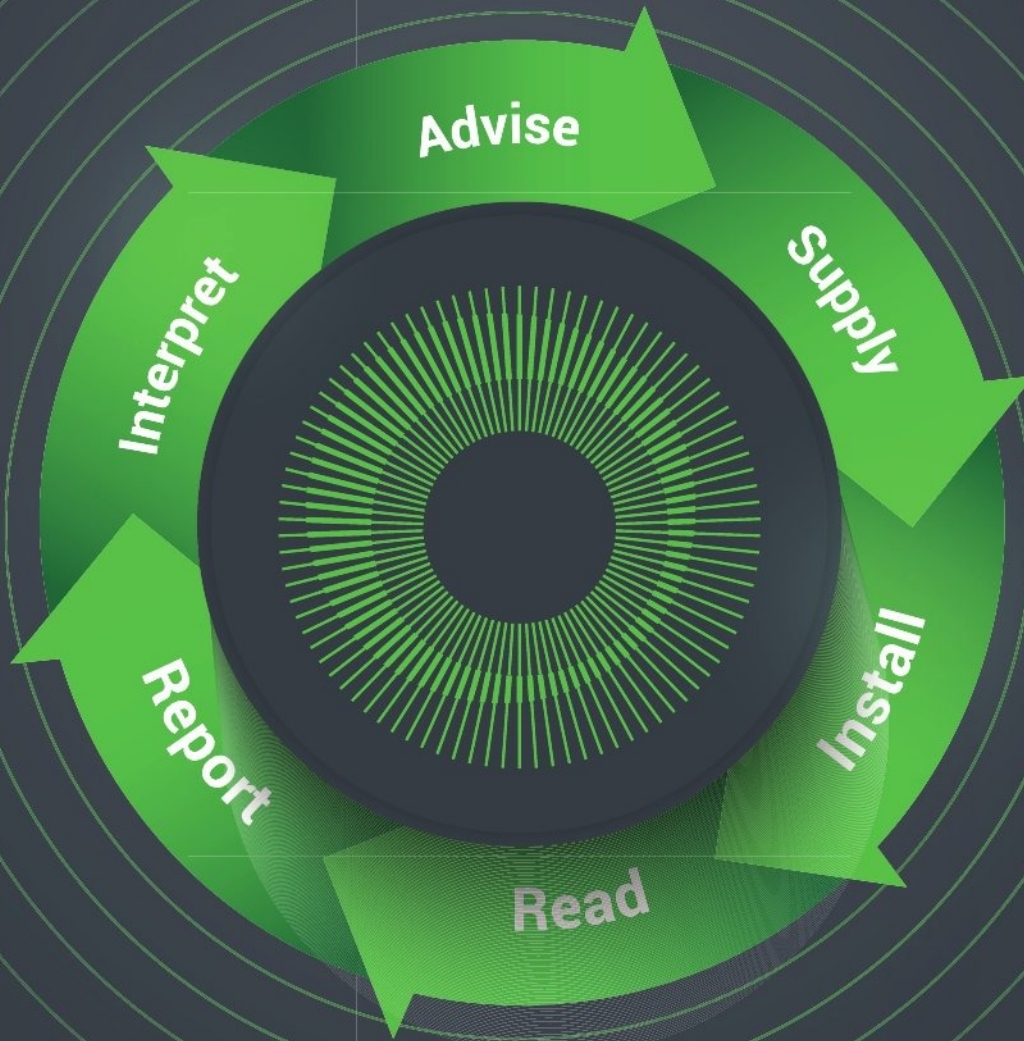


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